APIMONDIA

SCANDINAVIA

SWEDEN | DENMARK | NORWAY

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Bee United in Scandinavia!

ABSTRACT BOOK

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ORAL PRESENTATIONS

INVITED SPEAKER PRESENTATIONS

OP-001 [Invited Speaker]
The Treatment of Alzheimer's and Lyme Disease with API Therapy

Dietrich Klinghardt
Sophia Health Institute (USA) & Institute for Neurobiology Klinghardt (Germany)

In this presentation, I will explore an integrative, neurobiological approach to treating two complex conditions - Alzheimer's disease and Lyme disease - through the lens of API Therapy, the clinical use of bee-derived substances such as bee venom and propolis. While traditionally viewed as separate illnesses, both conditions often share similar root causes: persistent infections, immune dysregulation, and neuroinflammation.

Drawing from over 40 years of clinical experience, I will demonstrate how chronic infections, including Borrelia species and herpesviruses, can contribute to the degenerative processes seen in both diseases. Through case studies from the Sophia Health Institute and the Institute for Neurobiology, I will show how bee venom, when used in carefully titrated doses and guided by Autonomic Response Testing (A.R.T.), can stimulate the innate immune system, cross the blood–brain barrier, and target intracellular pathogens.

Propolis, royal jelly, bee venom and other hive products also play essential roles in this therapeutic framework, offering antimicrobial, antioxidant, and regenerative support. The synergy of these substances with biological medicine and individualized detoxification protocols offers new therapeutic options where conventional treatments fall short.

This lecture will include practical guidance on protocols, contraindications, and patient-specific considerations - particularly for those with neurological hypersensitivity or toxic burden.

API Therapy, when applied within a root-cause-oriented paradigm, represents a powerful, underutilized approach to restoring neurological health in patients with chronic infection-driven disease. By merging traditional apitherapy with modern diagnostics and clinical rigor, we offer renewed hope for long-term healing.

OP-002 [Invited Speaker]
The Mind of a Bee

Lars Chittka
Queen Mary University of London

Most of us are aware of the hive mind - the power of bees as an amazing collective. But do we know how uniquely intelligent bees are as individuals? I argue that they have remarkable navigational abilities, can recognize not just flowers but also human faces, exhibit basic emotions, count, use simple tools, solve problems, and learn by observing others. They may even possess consciousness. I illustrate how bee brains are unparalleled in the animal kingdom in terms of how much computing power is packed into their tiny nervous systems. I examine the psychological differences between bees and the ethical dilemmas that arise in conservation and laboratory settings because bees might feel and think.

OP-003 [Invited Speaker]
Improving honey bee resilience to varroa: what we can learn from nature to inspire beekeeping practices

Fanny Mondet
INRAE UR 406 Abeilles et Environnement, Avignon, France

Despite their high suscepDbility to invasions and disease spread, many social animals such as the honey bee have evolved mechanisms that allow effecDve defence at the group level. These collecDve strategies play a role at society level that parallels that of an immune system, and the social immunity confer provide the basis for colony resilience to pathogens and parasites, such as varroa and other diseases. Such mechanisms allow some honey bee colonies to overcome the burden caused by varroa, and to survive mite infestaDons without any treatment used by beekeepers. Understanding how these mechanisms evolved in different natural selecDon contexts can give us key insights to help honey bees cope with varroa and other beekeeping threats.

How compromised individuals are accurately diagnosed, and how the collecDve acDons of bees undertaking the immune strategies are regulated at colony level pose many unsolved challenges. It is however known that chemical communicaDon, which plays a central role in homeostasis maintenance within colonies, also plays a key role in host-parasite interacDons and in defence against pathogens in general. We will present the current knowledge on the contribuDon of chemical ecology to social immunity, as well as our latest findings on the mechanisms of hygiene against varroa parasiDsed brood. This presentaDon will highlight the input of an in-depth understanding of host defence mechanisms to provide essenDal tools not only to predict, but also to miDgate against consequences of invasive species events through naturally evolved honey bee defences.

OP-004 [Invited Speaker]
Challenges in Developing Honey Authenticity Tests

Stephan Schwarzinger
North Bavarian NMR Centre at the University of Bayreuth

Honey, unfortunately, is one of the most commonly adulterated commodities worldwide. Testing for authenticity is difficult due to the variety of adulteration methods, which range from the deliberate mislabelling of the botanical or geographical origin, to the inappropriate technical drying of unripe honey, to the addition of cheap plant-based syrups, as well as possible new and unknown methods. The additional problem with detecting adulteration with plant syrups is that there are many different types of syrup from various plant sources, which may or may not carry different markers. Furthermore, the composition of markers can change quite rapidly by adapting the production process of the syrups. Therefore, analytical laboratories face the challenge of deciding which specific markers to test for, or whether to test for everything known, which takes time and money. Consequently, an increasing number of new tests are being developed to compare the test sample against a standard for what is expected of authentic, natural honey. This presentation will address the problems associated with developing such methods and aim to provide guidelines for dealing with novel methods.

OP-005 [Invited Speaker]
Reviving Rural Economies Through Inclusive Beekeeping: Centering Women for Scalable Impact

Portia Morudi
Local Village Africa

Across Africa's rural landscapes, communities face overlapping challenges: persistent unemployment, food insecurity, climate vulnerability, and economic exclusion. In South Africa's Eastern Cape—one of the country's poorest provinces but richest in biodiversity and indigenous knowledge—these challenges are especially pronounced. In response, the Vusmzi Project (from the isiXhosa word meaning "to revive the home or village") was launched in 2024 by Local Village Africa. The initiative centers women in a scalable rural development model that combines social inclusion, ecological restoration, and circular economics.

Vusmzi supports 138 beneficiaries through a replicable value chain built around sustainable beekeeping. It begins with the training of people living with disabilities in beehive manufacturing. Participants receive tools, startup equipment, and guaranteed off-take agreements. A standout example is the Iphupholethu Hive Manufacturers Cooperative, which employs 15 women living with disabilities. Since 2024, the cooperative has generated over €22,314 in income, transforming members into household breadwinners while fostering dignity and inclusion.

The hives produced are distributed to 117 beekeepers, 61% of whom are women. These beekeepers receive technical training, protective gear, and ongoing support to establish and maintain apiaries. Each cooperative signs a secured off-take agreement to sell honey back to Local Village Africa, which aggregates, processes, and brands the product for premium and export markets. This integrated system ensures reliable income, market access, and shared value—placing women at the center of economic transformation.

This gender-inclusive model echoes successful examples across the continent. In Kenya, the Kibwezi Women Beekeepers Cooperative in Makueni County demonstrates the potential of women-led apiculture. More than 80 women have established apiaries in arid zones, regenerated degraded land, and built sustainable income through honey and beeswax production. Their success illustrates the catalytic effect of local ownership and environmental stewardship in advancing rural livelihoods.

Despite its promise, beekeeping in rural contexts faces systemic barriers. Climate change disrupts blooming cycles and forage quality; a lack of access to testing services and formal markets limits scalability; and financial exclusion restricts the growth of women-led enterprises due to limited access to credit or collateral.

To address these challenges, Vusmzi integrates ecosystem restoration and income diversification. Wildflower corridors are planted to support pollinator forage and enhance honey quality, while regenerative agriculture is introduced to strengthen household food security and climate resilience.

By centering women in the beekeeping ecosystem, Vusmzi unlocks transformative outcomes: strengthened cooperative governance, intergenerational knowledge transfer, reduced financial dependency, and increased food sovereignty. Whether in Kibwezi or Lusikisiki, women are emerging as powerful stewards of biodiversity, sustainable livelihoods, and rural resilience.
Vusmzi offers a gender-responsive, climate-smart blueprint for inclusive rural development.

OP-006 [Invited Speaker]
Honey can only be honey - a strong EU policy commitment for authenticity and traceability

Carlos Martín Óvilo
DG Agriculture and Rural Development Unit E.3 - Animal Products, European Commission.

The Animal Products Unit of the European Commission is responsible, among others, for the honey directive which defines honey, establishes composition criteria and origin labelling. The honey directive is legislation from the EP and Council, entrusting the Commission with the task of securing the authenticity of honey and enhance its traceability.

"Honey is the natural sweet substance produced by Apis mellifera bees from the nectar of plants or from secretions of living parts of plants or excretions of plant-sucking insects on the living parts of plants, which the bees collect, transform by combining with specific substances of their own, deposit, dehydrate, store and leave in honeycombs to ripen and mature." (extract of Directive 2001/110, Annex I, point 1)

The EU has put in place a series of actions to fight against honey adulteration, and more is to come:

• Member States have been invited to increase controls on the market and at EU borders.
• Import requirements have been reinforced:
o Exporting countries are responsible for attesting the authenticity of honey in the certificate that accompanies imported honey in the EU.
o Third country establishments exporting honey to the EU and other apiculture products intended for human consumption must be registered (new since 29 November 2024)

• The EU Joint Research Centre has been tasked to develop a harmonised analysis method to detect honey adulteration with sugars, that would become an agreed method at EU level.

• A Honey Platform has been set up to study in-depth honey authenticity and traceability, in particular to prevent honey overheating, to ensure that pollen is not removed from honey, and to determine the place where honey has been harvested. The ultimate goal of these actions is to ensure that only 'honey is honey' in the EU market. This is to ensure fair market conditions to EU beekeepers, and to protect consumers from being deceived.

The EU supports beekeeping by apiculture interventions in CAP Strategic Plans. With an EU budget of 60 million € (more than doubled with national cofinancing) these interventions can support investments, advisory services, laboratory analysis, bee breeding, research, promotion, among others.

All this to render the EU apiculture sector more competitive and resilient. As the EU is not self-sufficient in honey (importing 1/3 of domestic consumption), EU actions aim at ensuring that all honey placed on the market (including imported honey) is genuine, so that there is a fair competition with EU beekeepers.

OP-007 [Invited Speaker]
The landscape ecology of honeybees

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The Western honeybee, native to Europe, is a fascinating species with unique biology. Notable traits include overwintering as colony, reliance on nesting cavities, and the ability to forage for floral resources several kilometres from the colony. As pollinators, honey bees play a vital role in terrestrial ecosystems by supporting wild plant diversity and crop production. In this talk, I will explore the landscape ecology of honeybees in Europe. I will ask which habitats are suitable for wild-living honey bee colonies, how landscape composition influences the pollen and nectar resources available to honeybees and how these factors affect colony performance, including honey yields and winter survival. These questions are closely linked to major challenges in beekeeping and pollinator conservation, such as intensive agriculture and climate change.

OP-008 [Invited Speaker]
Strengthening beekeeping through bridging research and practice: Building a resilient Knowledge and Innovation System

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A skilled beekeeper understands seasonal dynamics and adapts colony management accordingly. However, many challenges in the industry, such as emerging pests, and shifting landscapes have made traditional routines less reliable. In this evolving context, beekeepers—both novice and experienced—need timely, credible, and locally relevant information. This presentation explores how programs can bridge the gap between research and practice by fostering innovation and resilience in beekeeping communities.

Despite the growing complexity of beekeeping, many support systems remain fragmented or outdated. Beekeepers often struggle to access practical, science-based guidance tailored to their specific conditions. The central question is: Are current extension and advisory services equipped to meet the changing needs of beekeepers and support innovation at the grassroots level?

This presentation draws an overview from successful and innovative beekeeping programs across diverse regions. These include participatory research initiatives, peer-to-peer learning networks, and digital advisory platforms. Each program was evaluated based on its ability to:

- Translate research into actionable practices,
- Foster collaboration among stakeholders, and
- Enhance beekeeper capacity to adapt to change.

The most impactful programs shared common features: they were locally grounded, co-designed with beekeepers, and supported by strong institutional partnerships. These programs not only improved colony health and productivity but also empowered beekeepers to become active contributors to innovation. The concept of a Beekeeping Knowledge and Innovation System (B-KIS) emerged as a framework—highlighting links between actors within the beekeeping sector such as research institutions, extension agents, beekeepers and innovation hubs. Providing a structural overview enabling a dynamic, responsive and supportive network possibility.

For beekeepers, this approach means better access to trusted information, more opportunities for hands-on learning, and stronger community support. Extension programs open for a collaborative approach embracing the B-KIS model can help beekeepers navigate uncertainty, adopt sustainable practices, and contribute to the long-term resilience of the sector.

APITERAPY

OP-009 [Apitherapy]
High concentrations of Spermidine in Drone Milk (Apilarnil)

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Spermidine is a biogenic amine. Spermidine induces autophagy and may extend life span, reduce dementia and other common diseases. Therefore, it gained popularity as a food additive derived e.g. from wheat germs. Drone milk or Apilarnil (ApiDrohn®) is a high value hive product extracted from the male larvae and conserved by lyophilisation. Apilarnil is used in traditional apitherapy for versatile applications.

In this project the presence of Spermidine in Apilarnil (fresh/different-larva-stages/dry-techniques/vehicle-solutions) was identified and quantified. A workflow was set up comprising an extraction procedure from the freeze-dried Apilarnil (supplied in high purity within Api-Zentrum Ruhr) and a liquid chromatography coupled with a high-resolution time-of-flight mass spectrometer (LC-ESI-QTOF).

Apilarnil in different stages of larva development age contains Spermidine in higher concentrations as in wheat germs. Furthermore, Apilarnil contains other bioactive amines and polyamines besides Spermidine. This is the first time that spermidine and several other biogenic amines have been definitely proven to be present in a bee product.
The spermidine content is another column for explanation the various health applications for Apilarnil in apitherapy and is most directly related to its health benefits, although further research has to be done. To understand especially the synergies in the presence of different bioactive substances like spermidine and typical hive products e.g. flavonoids will be interesting.

OP-010 [Apitherapy]
Phenolic Compounds in Propolis Collected from an African and an Asian Region and Their Impact on Antioxidant and Antibacterial Activities

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The biological activities of propolis samples are the result of many bioactive compounds present in the propolis. The aim of the present study was to determine the various chemical com- pounds of some selected propolis samples collected from Palestine and Morocco by the High-Per- formance Liquid Chromatography–Photodiode Array Detection (HPLC-PDA) method, as well as the antioxidant and antibacterial activities of this bee product. The chemical analysis of propolis samples by HPLC-PDA shows the cinnamic acid content in the Palestinian sample is higher com- pared to that in Moroccan propolis. The results of antioxidant activity demonstrated an important free radical scavenging activity (2,2-Diphenyl-1-picrylhydrazyl (DPPH); 2,2'-azino-bis 3-ethylben- zothiazoline-6-sulphonic acid (ABTS) and reducing power assays) with EC50 values ranging be- tween 0.02 ± 0.001 and 0.14 ± 0.01 mg/mL. Additionally, all tested propolis samples possessed a moderate antibacterial activity against bacterial strains. Notably, Minimum Inhibitory Concentrations (MICs) values ranged from 0.31 to 2.50 mg/mL for Gram-negative bacterial strains and from 0.09 to 0.125 mg/mL for Gram-positive bacterial strains. The S2 sample from Morocco and the S4 sample from Palestine had the highest content of polyphenol level. Thus, the strong antioxidant and antibacterial properties were apparently due to the high total phenolic and flavone/flavonol contents in the samples. As a conclusion, this study confirms the correlation between phenolic compound content and antioxidant and antibacterial activity. Moroccan samples from Sefrou and Palestinian samples from Jenin have interesting but different antibacterial and antioxidant activities. Further work involving a larger number of propolis samples is needed to judge the usefulness of cinnamic acid and pinocembrin as quality indicators for Palestinian and Moroccan propolis, respectively.

OP-011 [Apitherapy]
Results of topical application of Romanian royal jelly and bee venom combined with Api-nutrition in chronic severe skin conditions

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Bee products have been utilized by humans since ancient times, with modern science now confirming their significant role in promoting, protecting, and enhancing health. Physicians are increasingly incorporating these products into medical practice with notable success. While nutrition is crucial in maintaining health, bee-derived products as functional foods offer added benefits.

Royal jelly (RJ) has garnered substantial attention for its exceptional properties. It is highly effective in promoting health, expediting recovery from various diseases, and acting as a restorative agent. RJ's value as a natural health supplement is evident in its anti-inflammatory, antimicrobial, and antioxidant properties and its ability to strengthen immunity and improve skin health. These benefits are attributed to its rich composition, including proteins, fatty acids, phenols, minerals, and vitamins.

The quality of RJ is typically assessed by the concentration of 10-hydroxy-2-decenoic acid (10-HDA), which is expected to range from 1.4% to 1.8%. Romanian royal jelly exhibits 10-HDA levels between 2.81% and 3.80%.
Raw bee pollen and beebread are also rich in essential nutrients, including proteins, carbohydrates, lipids, probiotics, dietary fibers, and bioactive micronutrients such as vitamins, minerals, phenolics, and volatile compounds. Thanks to their comprehensive composition, these products are increasingly valued as functional foods and hold potential for medical applications.

Additionally, bee venom has demonstrated notable anti-inflammatory and anti-tumor properties, among other therapeutic benefits.

This study focuses on the therapeutic effects of select bee products, particularly Romanian royal jelly and bee venom, combined with Api-nutrition, in managing chronic and severe conditions such as diabetic foot ulcers, bedsores, and basal cell carcinoma (BCC). Topical applications of Romanian royal jelly or bee venom have produced impressive outcomes in these cases. Based on our experience, bee products, whether used as functional foods or applied topically as needed, represent a promising and effective approach for treating these conditions.

OP-012 [Apitherapy]

Assessment In-vivo effect of the binary mixture of Moroccan propolis and Olea europaea leaf extracts on type 2 diabetes induced by fructose and streptozotocin in rats: formulation by design of experiments (DOE)

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The current investigation aimed to explore the impact of combining Moroccan propolis (MPME) and Olea europaea leaf (OELME) methanolic extracts of on the dynamic changes of key biochemical markers associated with type 2 diabetes (T2D) inducted in rats with 10 % fructose supplementation combined to the intraperitoneal injection of Streptozotocin (STZ). The study focused on parameters such as fasting blood glucose (FBG), rat's plasma insulin (INS), HOMA-IR index, glycated hemoglobin (HbA1C), and body weight (BW) in a rat model. Additionally, a binary mixture design specifically, a simplex lattice design, was employed to optimize the optimal combination of these extracts, enhancing their anti-diabetic activity by achieving optimal changes in T2D markers. The preliminary phytochemical analysis revealed total phenolic content (TPC) and total flavonoids content (TFC) values of 89.53 - 35.01 mgGAE/g and 31.91- 18.99 mgQE/g for MPME and OELME, respectively. Furthermore, HPLC-DAD analysis identified and quantified 14 phenolic compounds in propolis extract, in which Apigenin (0.342 mg/g), kaempferol (0.310 mg/g) and Epicatechin (0.222 mg/g) being the major quantified compounds. While, Olea europaea leaf contained 6 phenolic compounds, with Oleuropein being the most abundant molecule with a concentration of 29.91 mg/g DW.

The application of the experimental design facilitated the optimization of change rates, resulting in improvements of 68.95%, 148.08%, 30.36%, 23.00%, and 19.24% for FBG, INS, HOMA-IR index, HbA1C, and BW, respectively under optimal mixture setting of 49% of MPME and 51% of OELME.

Using the experimental design methodology for propolis and Olea europaea leaf has proved interesting for formulating mixtures with high biological values enabling a better In-vivo anti-diabetic effect, which represents an efficient and safe alternative for the management of T2D.

OP-013 [Apitherapy]
Influence of storage conditions and preparation methods on changes in ascorbic acid, phenolic compound content, and antioxidant activity of bee pollen

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Bee pollen (BP) is widely recognized in modern phytomedicine for its rich phytochemical composition. However, its application faces challenges due to bioactive compound variability influenced by botanical and geographical origin, preparation methods, and storage conditions. Drying at high temperatures causes significant losses of biologically active compounds, particularly vitamins, while storage alters BP's phytochemical composition, emphasizing the need for strict quality control.

This study aimed to evaluate changes in ascorbic acid, polyphenols, and antioxidant activity of BP under various preparation and storage conditions. BP samples were collected from an apiary in Talkoniai, Pasvalio district, Lithuania, and prepared via drying at +28°C (first day) and +35°C (second day), or freezing at −20°C and −80°C. Ascorbic acid, total phenolic compounds (TPC), and total flavonoids were quantified using titrimetric and spectrophotometric methods, while phenolic profiles were analyzed by UPLC–MS over a 15-month storage period.

Results demonstrated significant storage-related declines in TPC. Frozen BP stored at −20°C and −80°C showed decreases after 6 months ($p<0.05$), while dried BP exhibited reductions after 3 months ($p<0.05$), with continuous decline thereafter. Total flavonoid content remained stable for 6 months in all samples, then declined gradually. Rutin was the predominant phenolic compound, comprising 29.4% of TPC. Ascorbic acid retention was highest in BP stored at −80°C, with significant loss only after 9 months ($p<0.05$), compared to 6 months storage at −20°C and 3 months in dried BP.

Antioxidant activity, assessed via FRAP and ABTS methods, declined after 6–9 months in frozen BP and after 3–6 months in dried BP. Frozen BP (−80°C) retained the highest antiradical and reducing activity, 1.8–3.4 and 2.6–3.1 times higher, respectively, than dried BP extracts during 6–15 months of storage.

Melissopalynological analysis confirmed a polyfloral pollen mixture. Pollen of Brassica napus L. and Salix spp. dominated, comprising 36.8% and 34.3%, respectively. Acer platanoides L., Malus domestica Borkh., and Taraxacum officinale L. accounted for 12.8%, 9.0%, and 5.9%, respectively, as important minor pollens.

In conclusion, freezing at −80°C ensures superior preservation of phenolic compounds, ascorbic acid, and antioxidant activity in BP compared to drying, highlighting the value of fresh frozen pollen in maintaining phytochemical quality.

OP-014 [Apitherapy]
Honey dressing on pilonidal sinus wound healing

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This study aimed to through more light on the effect of Saudi Arabia sample as a dressing on pilonidal sinus wound healing, antibacterial activity, and cytokines level. The results revealed that the pH of 3.56 of tested honey, where glucose was 378mmol/l also the specific gravity was 1.435, while total phenolic content and total flavonoid content and DPPH radical scavenging activity were (32.15 mg GAE/100 g honey), (54.27 mg RE/100 g honey) and (127.83 mg/ml) respectively.

The mean duration of pilonidal sinus wounds to be ready for surgical closure was 43.5 days in the control (standard dressing) group where the honey dressing group was 28.5 days. Patents in honey group expressed less pain, oedema and foul- smelling discharge when compared with standard dressing group.

Total bacterial count was 9 × 109 at the begging of the experiment then it reduced after the application of standard dressing traditional therapy to (9 × 105) and honey treatment group (9 × 102) after 21 days post-treatment. There was a significant ($p<0.05$) reduction in serum, TNFα (-52), IL6 - 46), and IL-17 (-60) relative to the corresponding pre-treatment values.
From the overmentioned results, it could conclude that Saudi Arabia Qatada (Acacia hamulosa) honey bioactivities had been good wound repair due to promoting the growth of tissues and reduction of total bacterial count and inflammation.

OP-016 [Apitherapy]
Proteomic Analysis of Bee Venoms From Different Honeybee Species and Their Apitherapeutic Effect on Various Cancer Cells

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Honeybees produce important bee products that are beneficial for human and animal health. One of these products is bee venom, whose effectiveness in complementary therapies has been proven by scientific studies. Bee venom is a bee product with many biological properties, produced in the venom sacs of queen and worker bees and used mainly for defense purposes. Bee venom has applications in cosmetics, pharmacology, and Apitherapy. However, it is known that the content and quality of bee venom varies depending on the bee species, collection methods, existing flora, and overall colony status. This study aims to reveal the proteomic and apitherapeutic properties of bee venoms collected from Türkiye, one of the richest countries in the world in terms of endemic plant species and honeybee biodiversity. The analysis of bee venoms obtained from different regions of the country and from different honeybee species and ecotypes shows that all collected venoms have dose-dependent cytotoxic and apoptosis-inducing effects on different cancer cells. According to the analysis results, Kırklareli (Apis mellifera carnica), Gökçeada (A.m. anatoliaca ecotype) and Efe bee (A.m. anatoliaca ecotype) venoms were the most effective on pancreas epithelioid carcinoma (PANC-1); Macahel (A.m. caucasia), Farasin (Local ecotype), Kıbrıs Mallıdağ (A.m. cypria) venoms were found to be most effective on human prostate adenocarcinoma (PC3) while Adana and Antakya (A.m. syriaca local ecotype) venoms appear to be most effective on human cervix adenocarcinoma (HELA) cells. At the same time, the genomic and proteomic sequences of the main protein melittin, which is also an indicator of the apitherapeutic properties of the venom, and the main proteins of the venom were comparatively analyzed in the bee venom and venom gland samples collected within the scope of the study. The analysis results reveal that melittin occurs in varying abundances among species. In conclusion, bee venoms collected from Türkiye, which has an important phytogeographic location, appear to have high and diverse potential for pharmaceutical or apitherapeutic use. This high effect seen in the study results, supported by detailed scientific research, may be predicted as a valuable resource for the world bee venom industry and apitherapy practices.

OP-017 [Apitherapy]
Antibacterial activity of honey in wound and oral environments: the latest in vitro findings

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BACKGROUND/PURPOSE: Antibacterial activity of honey has been considered as a major factor determining wound healing of acute and chronic wounds. Indeed, several antibacterial compounds have been identified and characterized including hydrogen peroxide (H2O2), defensin-1 and methylglyoxal (MGO). However, antibacterial efficacy of honey in wound and mouth environment remains unexplored. Therefore, the aim of the study was to characterize the in vitro antibacterial effect of different types of honey in wound-like environment (artificial wound fluid) and oral-like environment (artificial human saliva).

PROBLEM DESCRIPTION: Wound and oral environments represent favorable environments for different bacteria including pathogens producing a broad spectrum of proteolytic enzymes. Overall antibacterial efficacy of bee-derived proteinous honey components (e.g., glucose oxidase, defensin-1) in these hostile environments might be reduced due to their cleavage by bacterial/human proteolytic enzymes.

METHODOLOGY: Various types of honey including manuka honey with different MGO grading and medical-grade honeys were used in the study. Antibacterial activity of honey was determined by a broth dilution assay against selected Gram-positive and Gram-negative bacterial isolates in the absent/present of human artificial wound fluid and saliva. The GOX activity and H2O2 concentration in honey solutions were determined with a Megazyme GOX assay kit. The protein profile of honey samples was evaluated by SDS-PAGE and GOX enzyme was determined by immunoblotting.

RESULTS and CONCLUSION: The most effective honey against all tested bacteria was manuka honey and its medical product and their efficacy was enhanced with increasing amount of MGO. Artificial saliva did not affect the antibacterial activity of all honeys against oral bacteria. However, it significantly reduced the antibacterial activity of honey samples except manuka honey against non-oral pathogens. Furthermore, a significant reduction of GOX activity and a subsequent decrease in H2O2 content were observed in non-manuka honeys. The composition of the wound exudate significantly affected the antibacterial and bactericidal activity of the tested honeys, mainly against Staphylococcus aureus. Incubation of honey samples with artificial wound exudate did not cause degradation, or proteolytic cleavage of the protein content, including the GOX enzyme. In conclusion, the antibacterial effect of different honeys varied and is significantly affected by mouth and wound environments.

OP-018 [Apitherapy]
Inhibitory activities of Chinese propolis on alpha-glucosidase and ended glycosylation products

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BACKGROUND: In 2030, the number of diabetic patients in the world would amount to 366 million and death related to diabetes mellitus accounts for about 9% global mortality, particularly type 2 diabetes mellitus. In treatment of type 2 diabetes, the suppression of postprandial hyperglycemia and ended glycosylation products can decrease the risk of complications.

METHODOLOGY: This study qualitatively and quantitatively analyzed the ethanol extracts of propolis (EEP) using HPLC-PDA-QTOF. Inhibitory activities of EEP against α-glucosidase were determined by using 4-nitrophenyl-D-glucopyranoside, sucrose and maltose as substrates, and acarbose as a positive reference. The inhibitory potential of various EEP on AGEs (advanced glycation end products) and oxidative modifications were investigated in bovine serum albumin (BSA)- glucose and BSA-methylglyoxal models. RESULTS and CONCLUSIONS: Experimental results show that Chinese propolis is a poplar-type propolis, based on its chemical composition. All EEP can effectively inhibit the activity of α-glycosidase to control postprandial hyperglycemia. The 75% EEP showed the highest inhibitory effect on-glucosidase and sucrase and were a noncompetitive inhibition mode. 50% EEP, 95%, EEP and 100% EEP exhibited a mixed inhibition mode, while water extracts of propolis (WEP) and 25% EEP demonstrated a competitive inhibition mode. All propolis extracts effectively inhibited the formation of ended glycosylation products, including total AGEs, pentosidine, and Nε-carboxymethyllysine. Furthermore, all EEP can effectively inhibit protein oxidative modification. Notably, 75% EEP exhibited the highest inhibitory activity, surpassing the chemical inhibitor aminoguanidine. PRACTICAL IMPLICATIONS: These findings provide reliable evidence supporting the potential use of poplar-type propolis as novel nutraceuticals aimed at preventing and treating diabetes.

OP-019 [Apitherapy]
Nutritional Potential of Indian Bee Pollen: A Sustainable Solution for Childhood Dietary Gaps

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Bee pollen is a highly nutritious natural food packed with essential nutrients required for honey bees and supports human health. The nutritional content of bee pollen varies considerably with floral species and geographic origins. This study aimed to provide the nutritional composition of Indian bee pollen from five major pollen sources; Cocos nucifera (coconut), Helianthus annuus (sunflower), Brassica campestris (mustard), Sesamum indicum (sesame) and Zea mays (Maize). Macronutrients, such as sugars, proteins, and lipids were analyzed, which revealed that the highest sugar content (35.25g/100g) and lipids (5.9 g/100g) in sunflower, whereas Sesame has the highest protein content (38.1 g/100 g). The highest mineral content is found in coconut followed by sunflower and the lower mineral content is found in mustard and maize. Out of the 12 amino acids analysed high contents of histidine, lysine, methionine, valine, glutamic acid, and tyrosine are found in coconut pollen; proline, aspartic acid, arginine in sunflower and threonine, valine, phenyl alanine alanine in maize.

Based on the nutritional requirements of humans, the formulation of mixed pollen of all five species was done in different ratios. Bee pollen of coconut 40%, sunflower 20%, mustard 20%, sesame and maize 10% each was mixed to meet the balanced nutritional diet. The analytical report of formulated multi-floral bee pollen is as follows:
Total sugars: 21.7; Protein: 32.5 Lipids: 5.7 g/100g

Minerals: Potassium 524; Magnesium, 276; Calcium 32; Iron10.32; Copper1.4, Manganese 4.8, Zinc:3.2, mg /100g
Amino acids: Threonine 273, Valine 187, Histidine 635, Proline 2990, Methionine 92.9, Lysine 400, Phenyl alanine 105, Glutamic acid 236, Aspartic acid 879, Arginine 389, Alanine 515, Tyrosine 289 mg/100g.

The nutritional values of the formulated multi-floral bee pollen were correlated with the daily nutritional diet requirement for school-aged children. Most of the essential macro and micro nutrients of the formulated bee pollen meet the daily requirement. Therefore it is recommended as a dietary supplement (after allergy testing) to overcome nutritional deficiency in undernourished/malnourished children.

OP-020 [Apitherapy]
Use of bee products in the treatment of chronic bacterial prostatitis: results of a clinical study

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The development of apitherapy began many centuries ago. However, currently it is still not a widespread method for the treatment of various diseases. In order to strengthen the evidence base for apitherapy, Medok Company LLC (Ukraine) organized a series of clinical studies of bee products.

In 2021, at the Kharkiv National Medical University (Ukraine), at the clinical sites of the Department of Urology, Nephrology and Andrology, a clinical study was conducted on the use of bee products in the complex treatment of chronic bacterial prostatitis.

The study included 60 patients with chronic prostatitis. In the complex treatment of these patients, the following combination of bee products was used: 1) lyophilized drone larvae homogenate, 1 capsule 3 times a day (per os), 2) suppositories with drone homogenate 1 time a day (per rectum), 3) beebread, 5-7 granules per day (per os). Patients took the complex of bee products for 30 days.
As a result of the complex treatment, high and moderate effectiveness was achieved for 93.3% of patients, and low - only for 6.7%.

A significant improvement in clinical and laboratory parameters was achieved: 1) pain on palpation disappeared for 86.7% of patients, 2) the size of the prostate gland decreased and the heterogeneity of its structure disappeared (76.7%), 3) the number of leukocytes decreased (66.5%), 4) the number of erythrocytes decreased (75%), 5) testosterone levels increased (22%), etc.

Significant improvements were achieved in the international IPSS system, which is used to subjectively assess symptoms in chronic prostatitis. According to patients, the severity of symptoms of the disease decreased by 93.9%, quality of life improved by 29.3%, and the assessment of general condition changed from “severe” to “mild.”
Only 4.7% patients experienced slight itching of the skin; other patients did not experience any side effects.
A clinical study of the use of homogenate of drone larvae and beebread for patients with chronic bacterial prostatitis showed their high effectiveness and tolerability. So, these natural and safe products are very promising for further research and practical application for prevention and treatment of various diseases.

OP-021 [Apitherapy]
Diversity and Therapeutic Potential of Endogenous Peptides in Wasp Venoms

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BACKGROUND: Bee venom therapy has been officially incorporated into “TCM diagnosis and treatment system” in China since 2007. Due to its complex composition and varying toxicity, wasp venom has emerged as a promising drug resource. Therefore, it is crucial to analyze the peptide components of wasp venom and their pharmacological activities for novel drug discovery and the industrial development of bee venom. METHODOLOGY: In this study, venoms from four wasp species (Vespa mandarinia, Vespa velutina, Vespa basalis, Provespa barthelemyi) were collected using electrical stimulation, and their peptide components were analyzed by liquid chromatography-tandem mass spectrometry. BLAST searches on the UniProt protein database were performed to identify homologous proteins of endogenous peptides in wasp venom, with the closest homologous protein considered as the putative source of each peptide. Bioinformatics analysis was then conducted to identify potential bioactive peptides. Results and CONCLUSIONS: A total of 681 peptides were identified from four types of wasp venom, with nearly 90% being novel peptides. The protein sources of most peptides in wasp venom remained unidentified, likely due to the limited representation of wasp proteins and peptides in current databases. The identified protein sources of the remaining peptides primarily included Mastoparan-B, Mastoparan-X, Mastoparan-V, Phospholipase A1, Vespakinin-M, and Hyaluronidase B. Bioinformatics analysis revealed that 291 peptides exhibited high bioactivity, including ACE inhibition, DPP4 inhibition, and antioxidant properties, suggesting that wasp venom may serve as a potential resource for the development of drugs targeting hypertension and diabetes. Practical implications: This study elucidates the peptide composition of wasp venom with potential therapeutic value, providing a scientific foundation for precision medicine and novel drug development. The constructed peptide library serves as an initial screening platform for drug discovery, facilitating the efficient utilization of wasp venom resources and promoting their medical development.

OP-022 [Apitherapy]
Pine Honey As A Promising Apitherapy Product; Description Of The Linkage Between The Potential Health Benefits And Its Forefront Bioactive Substances

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Interest in natural immune boosters and traditional remedies is increasing daily. One of the bee products used for this purpose is pine honey. Pine honey, a valuable honeydew honey is produced by bees with their unique ability to use the secretion of Marchalina hellenica living in Pinus brutia and Pinus pineatrees, which are common in the Aegean and Mediterranean coasts of Türkiye. In this research, we shed light on the health-promoting effects of pine honey through its several principles and bioactive components that were analytically identified using different omic approaches. LC-MS analysis revealed that protocatechuic acid and quinic acid are the major compounds in the phenolic profile of pine honey. While protocatechuic acid shows antiapoptotic, antiulcer, anti-inflammatory, anti-hyperglycemia, antibacterial, and anti-aging effects, quinic acid stands out with its antioxidant, antiviral, analgesic, and hemostatic effects. ICP-MS analysis indicated considerably higher potassium levels in pine honey. Potassium helps reduce blood pressure, protect against stroke, and help prevent osteoporosis. Hydrogen peroxide and the peptide defensin-1 have been considered as the main contributors to the overall antibacterial activity of pine honey. It was observed that the concentration of the defensine-1 is apparently higher in pine honey as a result of bottom-up MRM-based proteomic research. Our novel findings suggested that pine honey may also be the potential for being medical-grade honey with elevated levels of defensine-1. Furthermore, HR-MS analysis brought to light that pine honey inherently provides natural oligosaccharides. Oligosaccharides' ability to act as prebiotics may offer a wide range of health benefits, including a stronger immune system, and improved gut microbiota diversity. Additionally, D-Pinitol as cyclitol was also measured in pine honey. Quantification of the purposed cyclitol was performed by utilizing HILIC-UPLC-ESI-MS/MS analysis after GC-MS annotation. Among the remarkable health benefits that D-Pinitol adds to pine honey are antidiabetic, hepatoprotective, and cardioprotective properties. The identification of this content uncovered that the source of the health benefits of pine honey is its rich bioactive components and that it can be consumed as a promising apitherapy product.

OP-023 [Apitherapy]
Bee products for fertility and perimenopausal women. Case studies

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For humankind, fertility is important for maintaining social, mental, and physical health status. However, fertility is greatly impacted by modern lifestyle. Frequently, modern women delay the moment of conception after the age of 30. The most fertile period for a woman is between the ages of 20 and 30. Fertility gradually declines at the age of 30. Every month that a healthy, fertile woman in her 30s tries to get pregnant, the chance of success is 20%. From the age of 40 and onwards, a woman's chance is less than 5%. In Romania, 23% of births are obtained with medical help. More and more people are looking for natural support in their efforts to have a child.

However, bee products have been utilized by humans since ancient times for promoting health but also fertility of men and women. Given the chemical constituents of them (specific proteins, lipids, glucides, antioxidants, vitamins, and minerals), honeybee products showed a wide range of biological effects on reproductive functions via several biological mechanisms/pathways.

Honey, royal jelly (RJ), propolis, and bee pollen were demonstrated to improve female reproductive performance.
RJ has been related to positive impacts on women's fertility, as it is effective on osteoporosis, perimenopausal symptoms, and improving the hormonal balance and the fertility by promoting folliculogenesis and increasing ovarian hormones.
Bee pollen, with a high nutrient content, can improve reproductive performance and can regulate sex steroidogenesis, specifically progesterone and estradiol.

Here we show the therapeutic effects of Romanian royal jelly and bee pollen combined with Api-nutrition for perimenopausal women aged between 38 and 44 years, with at least one pregnancy loss in their history. In these cases, 100 to 200 raw RJ grams/kg was used, 2 weeks/month, 15 to 25 grams of raw bee pollen daily, and a healthy diet, resulting in better health for women and obtaining the desired pregnancy.

In conclusion, these promising results should be beneficial for women who are infertile due to hormonal imbalances or age. Though, more studies can be done on these great natural resources.

OP-024 [Apitherapy]
Propolis as an apitherapeutic agent for use in the oral cavity

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BACKGROUND: Propolis is a good candidate for use as a cariostatic agent as it exhibits antimicrobial, anti-adherent, and anti-inflammatory activity. Furthermore, due to the strong association between periodontal disease and cardiovascular diseases, propolis, as a source of polyphenols, may have a beneficial effect not only on the oral cavity but also exhibit a cardioprotective effect.

Aim of study: The objective of the study was to demonstrate the potential of propolis as an apitherapeutic agent with cariostatic and immunomodulatory effects.

METHODOLOGY: Polish propolis's antibacterial effect was evaluated by determining cariogenic streptococci's minimum inhibitory concentration (MIC) and minimum bactericidal concentration (MBC). Moreover, ethanolic propolis extract was used to investigate the effect of cytokine secretion by human gingival fibroblasts (HGF-1). The study material consisted of supernatants from HGF-1 cultures stimulated with lipopolysaccharide (LPS), interferon alpha (IFN-α), and LPS+IFN-α. Selective interleukins and adhesion molecules were determined using xMAP technology (Bio-Plex).

RESULTS: Ethanolic extract of propolis (EEP) showed antimicrobial activity against Streptococcus mutans, Streptococcus salivarius, Streptococcus mitis and Streptococcus oralis. EEP had no cytotoxic effect against HGF-1. It also affected the release of the pro-inflammatory cytokines IL-1β, IL-6, IL-8, IL-15, and TNF-α secreted by HGF-1. There were also effects on the anti-inflammatory cytokine IL-10 and adhesion molecules: ICAM-1, E-selectin, and endothelin-1.

CONCLUSION: As an oral apitherapeutic, EEP can be an active ingredient in oral hygiene supplements. Furthermore, EEP can not only reduce plaque and thus prevent tooth decay but also its consequences. When applied to the mouth, EEP has an immunomodulatory effect, influencing the production of cytokines and adhesion molecules released by HGF-1.
Practical implication: EEP's cariostatic and immunomodulatory effects may influence propolis's potential use in dentistry.

OP-025 [Apitherapy]
From Beekeeping to Medical Certification: The Evolution of Beehive Air Therapy

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Beehive Air Therapy (BHA) is the least well-known and studied product from the beehive. While BHA as a wellness practice is accessible and unregulated, Beehive Air Therapy as a medical application (BHAT) requires adherence to high beekeeping and medical standards and the use of a certified medical system.

Despite its growing popularity, no existing BHA device is without fault or medically certified. Until now, no regulations governed their manufacturing, impact on bees, or user safety.

Jürgen Schmiedgen, Entrepreneur, Bio Beekeeper & Apitherapy Consultant, developed the beecura® SYSTEM to meet these standards, aligning with the European Medical Device Regulation (MDR 2017/745), which states that inhalation devices must be classified as medical devices.

Several studies in Germany, Brazil, Saudi Arabia, and Canada have analysed the composition of beehive air and its bioactive properties, confirming the presence of over 50 volatile organic compounds (VOCs) from propolis, beeswax, and honey. These studies support the therapeutic potential of BHAT, and advancements in air quality monitoring technology are ongoing.

In 2017, Prof. Speer and his team at the Technical University Dresden, Germany, were the first to analyse beehive air scientifically.

Clinical trials confirmed the beecura® SYSTEM's safety for respiratory patients, leading to MDR certification. Medical-grade manufacturing and beekeeping standards were implemented for safety and consistency.

Since 2019, beekeepers and medical professionals have successfully provided BHAT, following high beekeeping and medical standards. In Austria and Belgium, some health insurances have started recognising BHAT for private patients, and Turkey now recognises Apitherapy as an alternative therapy.

Beecura provides training on recommended minimum and high-standard beekeeping requirements for beehives used in BHAT. Beekeepers are encouraged to obtain the highest national beekeeping certifications to ensure quality and safety.

By adopting these standards, beekeepers can enter a professionalised apitherapy sector, enhancing safety, credibility, and economic opportunities while promoting sustainable beekeeping.

OP-026 [Apitherapy]
Exploring the Skin Rejuvenating Properties of Royal Jelly through Stem Cell Activation

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INTRODUCTION: Royal jelly has been historically utilized as a beauty ingredient and is still widely used as a cosmetic material today. However, the precise mechanisms by which royal jelly benefits skin health are not yet fully understood. It is proposed that the epidermis, dermis, and fat layers that make up the skin each contain distinct stem cells. Epidermal stem cells, located in the basal membrane of the skin, contribute to epidermal turnover and wound healing. On the other hand, mesenchymal stem cells are mainly found in the fat layer. They can differentiate into dermal fibroblasts and also secrete extracellular vesicles (EVs), which induce collagen production by dermal fibroblasts. In this study, we evaluated the effects of royal jelly on skin regeneration and rejuvenation through these stem cells.

METHODS: An epidermal three-dimensional skin model was used to assess epidermal stem cell activation. We added royal jelly during the construction of the 3D skin model and then histologically analyzed the thickness of the formed epidermis, as well as the expression of stem cell markers. To evaluate the impact on mesenchymal stem cells, we treated human adipose-derived mesenchymal stem cells with royal jelly and then investigated the number of EVs secreted into the culture supernatant. We also evaluated the collagen production activity of these vesicles when applied to dermal fibroblasts.

RESULTS: The royal jelly treatment resulted in increased thickness of the 3D skin model and enhanced expression of the epidermal stem cell marker p63 and the proliferation marker Ki67. These findings suggest that royal jelly promotes turnover by activating epidermal stem cells. Additionally, treatment of mesenchymal stem cells with royal jelly led to an increased release of EVs into the culture supernatant. When these vesicles were applied to fibroblasts, those derived from royal jelly-treated mesenchymal stem cells induced higher collagen production.

CONCLUSION: This study demonstrates the potential of royal jelly that activates skin-resident stem cells and likely contributing to anti-aging effects on the skin. Royal jelly is a promising ingredient that contributes to skin health and rejuvenation.

OP-027 [Apitherapy]
Anti-inflammatory activity of polyphenol-rich compounds from poplar-type propolis using an optimized extraction method

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Propolis is a traditional food with significant health benefits owing to its rich polyphenol content. An extraction process is essential to obtain bioactive ingredients, including flavonoids and phenolic acids. This study aimed to optimise the extraction of polyphenol-rich compounds from poplar-type propolis and evaluate their anti-inflammatory effect and underlying mechanisms in lipopolysaccharide (LPS)-induced inflammation. By employing two Box-Behnken design experiments, four key variables – extraction time, temperature, ethanol concentration, and solid-to-liquid ratio – were systematically optimised to maximise the yields of phenolic acids and flavonoids. Subsequently, a two-step extraction method was developed to maximise the recovery of phenolic acids and flavonoids via response surface optimisation. The anti-inflammatory effect of the propolis extracts was evaluated in LPS-treated bovine mammary epithelial cells and in a mouse mastitis model. The results showed that a high concentration of ethanol (85%) was optimal for extracting non-polar polyphenols, such as flavonoids, whereas a low concentration of ethanol (23%) was more effective for extracting polar polyphenols, such as phenolic acids. The two-step method combined these ethanol extracts to maximise polyphenol yield. The optimal extraction conditions were 23/25 h extraction time, 46/41 °C temperature, and 1:14/1:11 (g/mL) solid-to-liquid ratio for 85% and 23% ethanol, respectively. This approach yielded a total flavanol content of 531.6 mg rutin/g propolis extract and a total phenolic content of 214.3 mg gallic acid/g propolis extract. The anti-inflammatory potential of the combined extracts was assessed in the context of mastitis, a condition characterised by inflammation and compromised milk quality. In vitro, the propolis extract significantly increased bovine mammary epithelial cell viability and downregulated the mRNA levels of pro-inflammatory cytokines including TNF-α, IL-1β, and IL-6. In vivo, the propolis extract effectively alleviated histopathological lesions and suppressed the production of inflammatory cytokines. Furthermore, the combined extract preserved the integrity of blood-milk barrier by upregulating tight junction proteins. RNA-seq analysis revealed that the primary genes involved were enriched in the PI3K/AKT signalling pathway. In summary, optimised extraction methods can be readily translated into more efficient production processes for high-quality propolis. The anti-inflammatory properties of propolis extracts enhance their potential therapeutic applications in the treatment of inflammatory diseases.

OP-030 [Apitherapy]
Propolis Modulates Immune Responses and delays Diabetes Progression in NOD Mice: Preliminary Findings

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Background & Purpose
Propolis has immunomodulatory properties, but its effects on autoimmune Type 1 Diabetes (T1D) remain unclear.

Problem description
This study examines whether dietary propolis supplementation influences disease progression and immune responses in non-obese diabetic (NOD) mice, a well-established T1D model. By assessing early immune alterations and long-term disease outcomes, it aims to determine whether propolis has protective effects against autoimmune diabetes.

Methodology
Sixty-six female NOD mice were assigned to one of three groups: control, low-dose propolis (1.8% w/w), or high-dose propolis (3.6% w/w), with propolis incorporated into their feed. At 13 weeks of age (before diabetes onset), 18 mice underwent histological assessment of insulitis, serum cytokine analysis, and immune cell profiling of the spleen and pancreatic lymph nodes. Diabetes incidence is monitored until 30 weeks to evaluate disease progression.

Results & CONCLUSION: Propolis supplementation appears to modulate immune responses, as indicated by differences in cytokine levels and immune cell populations between treated and control groups. Preliminary findings suggest that propolis may affect diabetes progression in NOD mice and delay disease onset. This is supported by insulitis scoring, which shows a significant reduction in severe insulitis in the high-dose propolis group compared to controls. If confirmed, these results could provide insights into the immunomodulatory mechanisms of propolis in autoimmune diseases.

Practical Implications for beekeepers
These findings contribute to the understanding of the immunological effects of propolis and its potential role in autoimmune disease management. If propolis demonstrates protective effects in T1D, it could offer a natural, diet-based approach to immune modulation, complementing existing therapies. Identifying active compounds responsible for these effects may also support the development of functional foods or nutraceuticals targeting immune regulation. Further clinical studies are needed to confirm efficacy and investigate mechanisms of action. A clearer understanding of how propolis influences immune pathways could have broader implications for other autoimmune disorders.

OP-031 [Apitherapy]
Development of Nanoemulsion-Based Water-Soluble Propolis (N-WEEP) Technology for Oral Anti-Inflammation and Gum Health

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The increasing prevalence and economic burden of gingivitis and periodontal diseases highlight the urgent need for effective therapeutic strategies. Despite the rising incidence of oral health-related conditions worldwide, there remains a lack of definitive treatments for oral inflammatory diseases and gum health, underscoring the necessity for innovative solutions.

Propolis, a bioactive natural compound known for its antioxidant, anti-inflammatory, and antimicrobial properties, contains key active constituents such as Artepillin-C, CAPE (Caffeic Acid Phenethyl Ester), Pinocembrin, and Galangin. These compounds make propolis a promising candidate for oral health applications. However, its poor water solubility and low bioavailability significantly limit its therapeutic potential.

This study aims to develop and evaluate a nanoemulsion-based water-soluble propolis complex to enhance its bioactivity and therapeutic efficacy for periodontal health. A stable nanoemulsion system was formulated using natural emulsifiers and polysaccharides, significantly improving the solubility and bioavailability of propolis and other bioactive compounds. The formulation incorporated plant-derived bioactive components and underwent high-energy emulsification, producing nanoparticles smaller than 100 nm to optimize absorption and functional performance.

The therapeutic potential of the nanoemulsified propolis complex was assessed by analyzing its effects on key inflammatory mediators involved in periodontal disease pathogenesis, including pro-inflammatory cytokines and bacterial lipopolysaccharides (LPS). Additionally, its antimicrobial activity was tested against major periodontal pathogens, including Porphyromonas gingivalis, Fusobacterium nucleatum, Tannerella forsythia, Treponema denticola, Prevotella intermedia, and Aggregatibacter actinomycetemcomitans.

Experimental findings demonstrated that the nanoemulsified propolis complex effectively inhibited key periodontal pathogens and modulated host inflammatory responses, suggesting its potential as a functional ingredient for periodontal health applications.

These results underscore the potential of nanoemulsion technology in enhancing the bioactivity and therapeutic efficacy of propolis. The findings contribute to the development of innovative functional foods and oral healthcare products, leveraging targeted antimicrobial, anti-inflammatory, antioxidant, and immune-modulatory mechanisms for the prevention and management of periodontal diseases.

OP-032 [Apitherapy]
The Effect Of Royal Jelly On Female Reproductive Health In Rats

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Royal jelly (RJ) is a complementary dietary supplement widely prescribed by traditional medicine specialists for the treatment of infertility. The aim of the present study was to evaluate the effects of RJ on a set of reproductive parameters in both immature and mature female rats. Immature (30-day-old) and mature (60-day-old) Sprague-Dawley female rats were divided into four groups (n=7) and administered 200, 300, and 400 mg/kg of RJ for 75 and 45 days, respectively. During the feeding period, weight and height were measured, and cardiac blood samples were collected. At the end of the feeding period, the rats were sacrificed, and ovarian and uterine tissues were obtained for histological examination. Serum levels of ovarian hormones, nitric oxide (NO), and ferric reducing antioxidant power (FRAP) were analyzed, and the ratios of ovarian and uterine weight to body weight were calculated. A significant difference was observed in estradiol (E2) levels among the mature groups ($p < 0.05$). Additionally, a significant difference was found in anti-Müllerian hormone (AMH) levels among the immature groups (IM, IM300, and IM400). While the difference in ovarian index was statistically significant ($p < 0.05$), no significant difference was found for the uterine index ($p > 0.05$). A significant difference was noted for preantral follicle index (PF I) among the mature groups. However, no significant differences were found in primary follicle (PF), secondary follicle (SF), antral follicle (AF), and corpus luteum (CL) counts ($p > 0.05$). A significant difference was observed between the mature and immature groups for the glutathione peroxidase (GSH-Px) antioxidant parameter in both ovarian and uterine tissues ($p < 0.05$). The effectiveness of royal jelly in hormone regulation and its antioxidant effects can be attributed to its bioactive components. The findings suggest that RJ, which has a high biological value, positively influences reproductive health by promoting folliculogenesis and balancing ovarian hormones depending on the menstrual cycle. Furthermore, the antioxidant properties of RJ may help mitigate oxidative stress in women during preconception. This effect is likely due to its ability to increase glutathione levels and inhibit lipid peroxidation, a key marker of oxidative stress.

OP-033 [Apitherapy]
Antibacterial Properties of Pentacyclic Triterpenes from Melipona beecheii Propolis

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Background
The therapeutic use of bee products has gained relevance in response to the increasing development of antimicrobial-resistant strains. Propolis collected by Melipona beecheii, a stingless bee native to Central America and the southeast of Mexico, has been used in Mayan traditional medicine due to its biological properties, including its antimicrobial activity. Its chemical composition is diverse, spotlighting pentacyclic triterpenes as metabolites with potential antibacterial use. This research aims to determine which metabolites are responsible for the antibacterial activity in M. beecheii propolis.

Problem description
Antimicrobial resistance is a global problem that requires new therapeutic agents. Although propolis possesses bioactive properties, its chemical variability—shaped by environmental factors—hinders its standardization and clinical application. This study focuses on the isolation and antibacterial evaluation of pentacyclic triterpenes from M. beecheii propolis against clinically relevant pathogens.

Methodology
Propolis samples were collected in Maní, Yucatán. The hexanic fraction obtained from an ethanolic propolis extract—rich in pentacyclic triterpenes—was separated and purified by column chromatography using hexane and ethyl ether mixtures. Antibacterial activity was evaluated by Kirby-Bauer disk diffusion and microdilution methods against Escherichia coli and Staphylococcus aureus.

Results and conclusion
Successive purifications of the hexanic fraction revealed the presence of four principal bands (I-IV), observable by thin-layer chromatography. These bands were rich in pentacyclic triterpenes with a characteristic functional group at carbon 3: I acetylated (β-amyrin, germanicol, moretenol, and cycloartanol acetates), II ketone (marsformosanone, β-amyrenone, germanicone, and lupenone) and hydroxylated (III glutinol, α-amyrin and IV α-amyrin and β-amyrin).

The ethanolic extract and fractions I and IV exhibited antibacterial activity. Microdilution assays showed that 1.5 mg/ml of ethanolic extract inhibited up to 90% of S. aureus growth. These results show that M. beecheii propolis is abundant in pentacyclic triterpenes with antibacterial activity, especially against Gram-positive strains.

Practical implications for beekeepers
The findings of this study highlight the value of M. beecheii propolis, promoting its sustainable collection and commercialization. Standardizing the bioactive compounds in this propolis could enhance its potential applications in the pharmaceutical and food industries. Furthermore, promoting meliponiculture positively impacts biodiversity and the local economy, reinforcing it as a sustainable development practice.

OP-034 [Apitherapy]
Bee venom therapy for multiple sclerosis

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Multiple sclerosis (MS) is a chronic progressive disease of central nervous system, that can lead to severe physical or cognitive disability. It affects about 3 million people worldwide, with increasing annual incidence. The etiology and pathogenesis of MS remains unclear, as of most neuromuscular diseases. The present works show that different agents trigger a cascade of events in the immune system which lead to nerve demyelination and neuromuscular dysfunction. Conventional therapies for MS are based on the use of immunosupressory, immunomodulatory and anti-inflammatory drugs, but these treatments are not able to stop the destruction of nerve tissue. Thus, other strategies such as bee venom therapy have been proposed for the treatment of MS, but with very few scientific works so far, although it is indicated that bee venom is promising therapy for MS.

We have treated 26 ambulatory patients with MS with bee venom injections, during 3-year period. We used dry bee venom, dissolved it with sterile 0,9% saline solution and injected it subcutaneously over acupunctural points. Same therapy scheme was used for each patient, adapted to individual patient response. For evaluation of the results, we used Expanded Disability Status Scale (EDSS). As patients were coming from different communities, they were scored by the neurologist in their corresponding city before the treatment, and they were evaluated after 3 and 6 months from starting of the treatment by the same neurologist. Patients were scored 6,2 average (5-7,5) before treatment started. After six-month treatment, EDSS of the group was improved by 1,1 (0,5-2,5), with 3 non-responders. Patients with lower EDSS score improved more. No difference in age and sex.

There are 14 million people with some neuromuscular disease in the world, including 3 million with MS. In addition, there are 18 million people with rheumatoid arthritis. Not to mention tumors, infections, asthma. Bee venom therapy has been proven useful for these diseases. Adequate legislation, facilities, equipment and team approach would provide better conditions for patients, therapists and researchers, as well as ensure appropriate methodology and evidence based medicine. If properly proven, this medication would offer endless market for bee venom production.

OP-035 [Apitherapy]
Therapeutic Effects of Bee Venom on Hyperglycemia and Kidney Dysfunction in Alloxan-Induced Diabetic Rabbits

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Diabetes mellitus is a chronic metabolic disorder characterized by persistent hyperglycemia, which leads to complications affecting the eyes, kidneys, cardiovascular system, and peripheral nerves. Among these complications, diabetic nephropathy is a major contributor to long-term morbidity and mortality in affected individuals. Bee venom has emerged as a potential therapeutic agent in the management of diabetes, due to its potent hypoglycemic, hypolipidemic, and antioxidant properties.

The primary objective of this study is to evaluate the therapeutic potential of bee venom (Apis mellifera) in mitigating renal dysfunction in an alloxan-induced diabetic rabbit model.

Twenty-two Chinchilla rabbits were divided into three experimental groups: Group 1 served as untreated control, Group 2 was designated as the positive control and administered metformin (7.14 mg/kg) daily, and Group 3 received bee venom (0.3 mg/kg) (BVT) every other day. The duration of the experiment spanned 14 days.

RESULTS: bee venom treatment (BVT) lead to significant metabolic improvements compared to the control group, the BVT group exhibited a 26.5% reduction in blood glucose levels. Additionally, plasma creatinine and urea levels decreased by 19.8% and 14.7%, respectively. Similarly, blood urea nitrogen (BUN) levels were reduced by 14.8%. Furthermore, histological analysis showed that the kidneys of the BVT group demonstrated recovery and expansion of the glomeruli, with normal shape and size, and normal Bowman's space. Toxicity-related changes in the epithelial cells of the proximal convoluted tubules were reduced, and cellular damage was notably ameliorated.

The results indicate that bee venom exerts a renoprotective effect by reducing blood glucose levels and attenuating renal dysfunction.

OP-036 [Apitherapy]
Antibacterial efficacy of Apis honey collected from different Apiaries and its effect on Sprague Dawley rats

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With the prevalence of antibiotic-resistant bacteria, honey is increasingly valued for its antibacterial activity. Honey is a traditional topical treatment used for infected wounds and can be effective on antibiotic resistant strains of bacteria. Their antibacterial activity varies with origin and processes. Honey samples collected from local market were analyzed to test their antibacterial effect against B.subtilis and E.coli. The specific growth rate (μ) of the bacteria was reduced in the presence of honey samples. Commercial honey collected from the local supermarket showed less antibacterial activity than raw honey samples. The efficacy of honey, which showed highest antibacterial activity on the healing of wounds in Sprague Dawley rats was investigated on the basis of biophysical and biochemical changes. Equidimensional full-thickness excision wounds were created on the back of each animal and treated by topical application of honey. Thirty six rats were divided into six groups of six rats each namely, Group I(25% honey treatment), Group II(50% honey treatment), Group III(75% honey treatment), Group IV (100% honey treatment) and Group V (Saline water application). Control animals received commercial antibiotics (neomycin ointment). The rate of wound contraction was superior in animals treated with the honey along with a significant increase in the level of serum albumin as compared to the other groups. The histopathological studies revealed confirmatory evidence for improved healing activity by the honey as evidenced by improved granulation tissue formation and enhanced epithelialisation in group IV as compared to that of groups V and VI.

OP-037 [Apitherapy]
Eurasian propolis and Brazilian green propolis compared: evaluation of chemical composition and comparison of cytokine release by PBMCs

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In this work, we aimed to study and compare the differences in the chemical composition of a dry extract of Euro-Asian poplar type propolis (PEA) and a dry extract of Brazilian green propolis (PVB), evaluating how these go to affect immunomodulatory activity, through in vitro tests.

Chemical analyses carried out by means of colorimetric tests and HPLC-DAD showed that PEA is characterised by a good polyphenolic presence, flavonoids in particular, among which pinocembrin, galangin and chrysin stand out, while PVB contains a good content of cinnamic derivatives, accompanied by the presence of pinobanksin, pinocembrin and artepillin C, its main and characteristic component.

For this reason, an ex vivo cell line such as PBMC was chosen, characterized by both the innate and adaptive part of the immune system. PBMC were treated with 25 μg/mL of the two different extracts. The results showed that, although both extracts have a strong cytokine modulation activity, this appears to be different in PEA and PVB: both have determined an up-regulation of the production of TNF-α and IL-1β to a different extent but, at the same time, PEA seems to act mainly on the innate component of the immune system while PVB on the adaptive one, as demonstrated by the strong production of IL-8 induced by PEA and of IL-2 by PVB.

These results highlighted that different propolis specifically possess distinct biological activities, emphasizing that a deeper understanding of their specific properties can aid in the development of targeted products and formulations useful in the context of health-related applications.

OP-038 [Apitherapy]
WORK APPLICATION OF PROPOLIS ETHANOL EXTRACT AND OINTMENT FOR A LEG WITH GANGRENE – 5 other case reports

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The aim of this abstract is to describe the role of propolis for treatment of slow healing wounds and variety of skin disorders. To raise the popularity of propolis production from beekeepers and its application in daily life in different forms.

In the main case with a peripheral arterial disease, severe gangrene developed on the right foot. The wound was packed with a gauze soaked with 30% ethanol-based propolis extract (EEP), after evaporation of the alcohol, on a daily basis. On the surrounding area herbal propolis ointment was applied.
During the treatment the patient has taken took 30% EEP and apicocktail blend (honey, RJ, bee pollen) per os. Successful treatments were provided. I have been following this patient 15 years and he is ambulating pritty well.
Suitable dressing even for slow healing wounds with compromised circulation. Further research is needed.

Complications after an infection on a diabetic foot with partial amputation. Similar type of dressing with packing of the tunnels was provided. Complete recovery after treatment.

Chronic non-healing wound on the foot - The same treatment with complete recovery.

Venous stasis ulcer on a diabetic patient - Combination of treatment was provided, classical approach but most of the time propolis-herbal ethanol dressing and ointment.

Wound on the area of the capitis (12 years boy) – Diagnosis- Tinea capitis profunda. After treatment with fungicides and other aggresive means like iodine, dead tissue appeared. Apitherapy treatment with EEP and ointment resulted in a complete recovery.

Decubitus ulcer on both legs - Very obese patient treated for pressure ulcer on both lower legs. Daily treatment - soaked with EEP and dried, after that gauzes were utilized for packing the wound. For the peripheral part of the affected area propolis herbal ointment used to complete recovery.

In conclusion, I would say propolis can effectively stimulate the granulation tissue in slow healing wounds and speed up the recovery process.
It could be very effectively utilized for small cuts, abrasions, light contusions and wounds. It could be an effective treatment provided by medical staff for a variety of medical cases.

Sincerely yours!

OP-039 [Apitherapy]
Optimizing Bioactivity and Safety: Synergistic Effects of Green and Red Propolis Extracts for Enhanced Therapeutic Potential

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BACKGROUND: Brazilian propolis has been classified into 13 distinct types based on its chemical composition. Among them, green and red propolis are of particular importance due to their biological properties, production, and commercialization. Green propolis is derived from Baccharis dracunculifolia, while red propolis originates from Dalbergia ecastophyllum and Symphonia globulifera. Their chemical profiles differ significantly, with green propolis being more extensively studied and well-documented in terms of safety and clinical trials. Red propolis exhibits higher potency in some biological models; however, only three safety studies have been conducted to date, with one reporting an estrogenic effect in males.

PURPOSE: Given these differences, this study aimed to determine whether a 1:1 combination of green and red propolis could offer synergistic biological benefits while potentially reducing adverse effects. METHODOLOGY: Green, red, and combined propolis extracts were analyzed for total phenolic and flavonoid content (Folin-Denis and AlCl methods) and chemical profile (HPLC/DAD). Antioxidant capacity (DPPH, IC), antimicrobial activity (MIC, Staphylococcus aureus), anti-inflammatory effects (RAW264.7 cells), and cytotoxicity (MCF7, HeLa, AGS, Caco2, and HFF1 cells) were assessed. Statistical analysis was performed using one-way ANOVA followed by Tukey's multiple comparisons test ($p<0.05$). RE

SULTS: The chemical characterization of green, red, and mixed propolis extracts revealed total flavonoid contents of 65.20±0.39, 57.84±0.20, and 61.01±0.36 mg/g (as quercetin), and total phenolic contents of 152.41±1.18, 160.95±2.00, and 162.89±6.11 mg/g (as gallic acid), respectively. HPLC/DAD analysis identified key biomarkers: drupanin, artepellin C, and baccharin in green propolis, while formononetin, medicarpin, and vestitol were characteristic of red propolis, corroborating existing scientific data. Antioxidant capacity (IC) was determined as 11.28±0.44, 14.77±0.40, and 10.46±0.34 µg/mL for green, red, and mixed extracts, respectively. The MIC values against S. aureus were 1.003±0.54, 0.430±0.0, and 0.215±0.00 mg/mL. In both anti-inflammatory and cytotoxicity assays, the combined extract consistently exhibited the most potent effects, suggesting a synergistic interaction.

CONCLUSION: These findings indicate that, in the models tested, combining green and red propolis may allow for lower effective concentrations while potentially mitigating the adverse effects associated with red propolis, if any.

OP-040 [Apitherapy]
Review of therapeutic outcomes in the practice of Integrative Veterinary Medicine. Traditional Chinese Medicine and Apitherapy integrated into patient care: comparative protocols; analysis of simple data and relevant clinical cases

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The clinical management of patients in Veterinary Medicine involves acting in a systemic and interdisciplinary manner to achieve better results, from diagnosis to treatment; during the follow-up of individual patients and groups of patients; in medical centers and therapeutic, productive, and work environments of varying complexity; Providing patients with the best therapeutic combinations through medical protocols based on medicine and science.

MATERIALS-METHODS: Beehive products are part of the therapeutic arsenal in this analysis. They are included in the field medicine cabinet; in hospital medicine cabinets; at the clinical, surgical, nutritional, and physiotherapy levels; they are part of specialized medical protocols; and at the laboratory level - in quality control of therapeutic products and formulations.

This article presents an overview of the clinical outcomes of the integration of Traditional Chinese Medicine and Apitherapy in daily clinical practice in patients of different species (Canines, Felines, Equines, Bovines, Ovines/Humans).

RESULTS: The results and impact of scientifically supported Integrative Medicine are analyzed from different perspectives by medical specialty, with more than 3,000 clinical histories of patients treated with Apitherapy, accompanied by relevant clinical cases.

OP-041 [Apitherapy]
Anatolian Propolis as a Natural Remedy for Allergic Rhinitis: A Combined Turkish and European Study

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This study evaluates the efficacy of a nasal spray combining Anatolian propolis and hypertonic saline, in alleviating allergic rhinitis (AR) symptoms. By integrating findings from two prospective, multicenter studies conducted in Türkiye and Europe, we aim to assess the spray's impact on symptom relief, quality of life (QoL), and nasal health across diverse populations.
A total of 10,440 patients (10,000 from Türkiye and 440 from various European centers) diagnosed with AR were included in the study. Participants exhibited common AR symptoms such as nasal discharge, sneezing, nasal itching, and nasal obstruction. Each participant received spray (one puff per nostril, three times daily) for three weeks. Total symptom scores, QoL assessments, and otolaryngological examination results were recorded before and after treatment to evaluate clinical efficacy.

Significant improvements were observed in AR symptoms across both study populations ($P < .001$). In the Turkish cohort, the mean total symptom score decreased from 11.09 ± 3.41 to 6.23 ± 2.41 post-treatment, while in the European cohort, it dropped from 15.09 ± 3.15 to 7.42 ± 2.37. QoL scores significantly improved in both groups (Türkiye: 6.44 ± 1.55 to 7.31 ± 1.24, $P < .001$; Europe: 4.97 ± 0.72 to 8.04 ± 0.76, $P < .001$). Additionally, nasal examination results, including conchal color and edema, showed substantial enhancement after treatment ($P < .001$). These findings suggest that spray effectively reduces AR symptoms and improves nasal health across different demographic groups.

The combined data from two large-scale studies confirm that Anatolian propolis-based nasal spray, provides effective symptom relief for allergic rhinitis, enhances patients' quality of life, and reduces nasal inflammation. These findings highlight the potential of propolis-containing nasal sprays as complementary treatments for AR alongside conventional therapies.

OP-044 [Apitherapy]
Propolis: Research, Apitherapy and Clinical Applications

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Mankind has benefited from bee products for treating and preventing various illnesses. Apitherapy has been used in several countries as a complementary medicine. Scientific research based on studies carried out in vitro, using cell cultures, and in vivo, studying experimental animals, have demonstrated propolis biological properties, showing a strong relationship with apitherapy and providing support for clinical trials. In apitherapy, propolis has been used not only externally but also internally to treat a great variety of diseases due to its abundance of constituents. Propolis has been indicated for flu and cold symptoms, skin disorders (wounds, burns, and acne), psoriasis, otorhinolaryngologic, gynecologic, and proctologic diseases, preventing caries and treating gingivitis or stomatitis. Propolis has also been studied in diabetes, asthma, HIV, and others. Propolis is indicated simultaneously with other bee products to reduce chronic inflammation. Medicines containing propolis have a positive effect in treating infections caused by antibiotic-resistant pathogens. In general, propolis is safe and may be also consumed by healthy individuals or patients, without affecting the effect of medications. The standardization of propolis and its use in apitherapy are still under discussion, as apitherapy is practiced in some parts of the world, bringing benefits for healthy individuals and patients, with no clear consensus on its application according to the world regions or prevalent use of propolis and treated diseases. There are different recommendations for the use of propolis and people ingest different amounts of propolis once or several times a day. Although we have advanced in the knowledge of propolis properties, it is imperative to standardize its use, communicating the results at scientific and alternative events to strengthen the exchange of information between beekeepers, researchers, apitherapists, nutritionists, physicians, sellers and consumers of propolis. Otherwise, we will be always working separately, without complementing our expertise.

OP-045 [Apitherapy]
Functional Food Mixture Containing Green Propolis EPP-AF® Extract and Turmeric in Hemodialysis Patients: Preliminary Evidence of Uremic Toxin Modulation and Antioxidant Response

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Oxidative stress and gut microbiota–derived uremic toxins are key contributors to complications in patients with chronic kidney disease (CKD), particularly those undergoing hemodialysis (HD). Functional foods with bioactive compounds may represent a complementary strategy to mitigate these processes. This study investigated the effects of a daily mixture of turmeric, green propolis, ginger, and lemon juice on antioxidant status and microbiota-derived uremic toxins in HD patients. A total of 35 patients were enrolled and randomized into two groups: 17 received the functional food intervention (mean age 51 ± 19 years; BMI 23.7 ± 5.4 kg/m²) and 18 received placebo (mean age 51.5 ± 12.2 years; BMI 23.4 ± 3.8 kg/m²). For eight weeks, the intervention group consumed 10 mL of a compound containing Curcuma longa L. (130 mg curcuminoids/day) and standardized green propolis extract (110 mg/day, EPP-AF®), with added ginger and lemon juice, while the placebo group received a matched preparation. Curcuminoids, the main bioactive components of turmeric, present well-documented antioxidant and anti-inflammatory properties but have limited bioavailability due to poor absorption and rapid metabolism. The inclusion of green propolis extract in this mixture was designed to overcome this challenge. Propolis flavonoids enhance the solubility and intestinal absorption of curcuminoids, while turmeric improves the uptake of propolis phenolics, resulting in synergistic bioavailability and efficacy. In addition, preclinical studies demonstrated that this combination exerts immunomodulatory effects: in Nile tilapia, supplementation with turmeric and propolis improved leukocyte activity, upregulated immune-related gene expression, and increased resistance to bacterial infections. These findings reinforce the translational potential of this mixture for populations with impaired immune and redox balance, such as CKD patients. In the present clinical trial, antioxidant capacity was evaluated by oxygen radical absorbance capacity (ORAC), ferric reducing antioxidant power (FRAP), and 2,2-diphenyl-1-picrylhydrazyl (DPPH) assays. Lipid peroxidation was assessed by malondialdehyde (MDA), and high-performance liquid chromatography (HPLC) was used to quantify microbiota-derived uremic toxins. The intervention group showed a significant increase in FRAP values compared with placebo ($p < 0.01$), reflecting improved antioxidant defenses. A trend toward reduced plasma levels of indole-3-acetic acid was also observed. In conclusion, this functional food mixture not only enhanced antioxidant status in HD patients but also addressed the challenge of curcuminoid bioavailability through its synergistic formulation. These preliminary findings warrant larger studies to confirm its role as a supportive strategy in CKD management.

PP-373 [Apitherapy]
A Preliminary and Multidisciplinary Study: The Effect of "Sleeping on The Beehives" and Listening to Bees on Human Anxiety Levels

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Apihouses are specialized wooden sheds designed to promote relaxation through sensory experiences associated with beehives, such as buzzing sounds and hive air, without direct interaction with bees. While anecdotal evidence suggests calming effects of this experience, scientific validation remains limited. This preliminary study evaluates the potential anxiety-reducing effects of apihouse experiences and bee buzzing sounds. 60 participants were randomly divided into two groups: one exposed to a real apihouse environment and the other to recorded bee buzzing sounds. Anxiety levels were assessed using the State-Trait Anxiety Inventory for Adults (STAI-AD) before and after exposure.

Sound analysis from the apihouse revealed peak frequencies ranging from 237 Hz to 416 Hz, with a mean of 274 Hz, consistent with non-aggressive, normal bee activity. Both groups demonstrated significant reductions in state and trait anxiety levels ($p < 0.001$), indicating that both the apihouse environment and bee buzzing sounds lead to anxiety alleviation on their own. Within its limitations, this study highlights the therapeutic potential of apihouses and sets the stage for future research to uncover their underlying mechanisms and broader applications in promoting holistic well-being. The observed reduction in anxiety levels paves the way for new research opportunities and suggests further research with a larger sample size and in a more isolated environment is necessary.

PP-699 [Apitherapy]
The Role Of Apitherapy And Ayurvedic Integrative Approaches In The Impact Of Functional Bee Products On Chronic Health Conditions: Case Studies And Real-World Evidence

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An attempt to investigate on the role of bee products and ayurvedic herbal extracts through integrative approach has been made in human chronic diseases management. During the last five years 2020-2025 at Hi-Tech Natural Products India Ltd. (HNPL)New Delhi. Some of the bee products such as, propolis tincture, royal jelly powder, bee pollen, and honey vinegar-infused with Ayurvedic herbs were tested using standard protocols and procedures to over 200+ individuals. The outcomes, gathered from patient testimonials, medical reports, and video documentation, demonstrate significant health improvements in areas such as prostate health, diabetes, PCOS, and neurological conditions. One of the most notable cases is of a prostate cancer patient, whose prostate volume was reduced from 68cc to 10cc in just 40 days through the use of propolis tincture. Additionally, honey vinegar, formulated with Ayurvedic herbs, has helped patients with type-2 diabetes by significantly improving blood sugar and cholesterol regulation within three months of regular consumption. The paper also highlights the effectiveness of propolis tincture in regulating menstrual cycles for women with PCOS, with improvements documented over six months. Patients suffering from neurological conditions, including one with multiple sclerosis, regained mobility and significant health improvements after using royal jelly powder and bee pollen for three months. Beyond these conditions, the case studies indicate that bee products have contributed to enhanced immunity, cardiovascular health, and kidney function, with several patients reversing their dependency on dialysis. These anecdotal findings, supported by real-world evidence and personal testimonies, underscore the potential of combining apitherapy with Ayurvedic wisdom to manage chronic health conditions holistically. The evidence presented in this paper highlights the therapeutic value of bee products in addressing long-standing health issues, offering a new dimension to apitherapy's role in health and wellness. The results call for greater exploration into the potential of functional bee products, particularly in the context of Ayurvedic integration, to support holistic healing practices.

BEE BIOLOGY

OP-046 [Bee Biology]
ame-miR-5119-Eth axis modulates larval-pupal transition of western honeybee worker

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The miRNA plays a key role in the regulation of hormone signaling in insects. The pathways by which miRNAs affect hormone levels are unclear in the honeybee (Apis mellifera), an indispensable pollinator in nature. In this study, ame-miR-5119 was overexpressed and knocked down in larvae by feeding mimics and inhibitors, respectively, and we determined that ame-miR-5119 regulates hormone signaling through the target gene ecdysis triggering hormone (Eth), which affects the larval-pupal transition of workers. The results showed that ame-miR-5119 with a length of 19 nt targets six genes related to the hormone pathway. We focused on Eth and found that ame-miR-5119 and Eth exhibited reverse expression patterns during the transition from larval to pupal stages in workers. Dual luciferase assay confirmed the negative regulatory between ame-miR-5119 and Eth. Overexpression of ame-miR-5119 decreased the mRNA level of Eth, and the Eth receptor (Ethr) expression was not significantly affected, but the expression levels of juvenile hormone (JH) pathway related genes juvenile hormone acid methyltransferase (Jhamt) and Krüppel homolog 1 (Kr-h1) were significantly reduced. In contrast, knockdown of ame-miR-5119 increased the mRNA level of Eth, and the expression of Ethr, Jhamt and Kr-h1 was significantly upregulated. ame-miR-5119 did not affect larval body weight. The number of larvae overexpressing ame-miR-5119 survived in the prepupal stage was lower than that in the control group, and the number of pupations reduced at 11-day-old. The number of larvae that knocked down ame-miR-5119 survived in the prepupal stage was significantly higher than that in the control group, and the number of pupations increased at 11-day-old. These results indicated that ame-miR-5119 negatively regulates the expression of Eth, indirectly inhibits the expression of Ethr, Jhamt, and Kr-h1, and affects the JH biosynthesis, thereby preventing the metamorphic transition from larva to pupa in worker bees. These findings provide evidence that the miRNA regulation of hormone levels in honey bees.

OP-047 [Bee Biology]
Resilience and Adaptation of Wild Honeybees: A 7-Year Study at the Galbreath Wildlands Preserve (2021-2028) and Its Implications for Apiculture and Conservation

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Background/PURPOSE:
The climate emergency and accelerating species extinction rates have necessitated a reevaluation of fundamental beliefs and practices in apiculture and conservation. Apis Arborea has initiated a groundbreaking 7-year research project (2021-2028) at the Galbreath Wildlands Preserve (GWP) to investigate wild honeybee populations and their potential for sustainable pathways of apiculture and conservation. This study aims to understand the environmental and organismal characteristics impacting the fitness of free-living honey bee colonies in tree cavities within a remote California setting.

Problem Description:
The stark contrast between the ecological robustness of wild honeybee populations and the challenges faced by managed colonies highlights the need for a deeper understanding of natural honeybee ecologies. This project addresses the gap in long-term, frequent monitoring of wild honeybee populations.

METHODOLOGY:
The research is conducted at the GWP, a 3,700-acre remote wilderness owned by Sonoma State University. Since 2021, the team has been using beelining techniques to locate wild honey bee nesting sites. Monthly monitoring follows extensive protocols to collect data on colony health and survival rates.

Results/CONCLUSION: As of January 2025, nearly 60 wild honeybee nests have been identified in the preserve. Preliminary data reveals an impressive annual survival rate of approximately 80% for these wild honeybee colonies, significantly higher than the 30-50% survival rates typically observed in managed populations. Genetic analysis, conducted in collaboration with Texas A&M University and Purdue University, indicates that the GWP population possesses unique characteristics that set it apart from typical populations observed elsewhere in the country.

Practical Implications for Beekeepers:
Reevaluate current management practices in light of the stark contrast between wild and managed colony survival rates, by implementing practices that mimic wild honeybee ecologies, including log hives, natural propagation through swarming, natural nest densities or allowing bees to build natural comb.
Reduce interventions and allow colonies to develop natural resilience.
Focus on locally adapted bee populations rather than importing bees from other regions.

By bridging the gap between scientific research and practical conservation, this project aims to pave the way for a new era in apiculture that respects and learns from the resilience of wild honeybees.

OP-048 [Bee Biology]
Unraveling the modulatory manner and function of circRNAs in the Asian honey bee larval guts

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Circular RNAs (circRNAs) are a class of non-coding RNAs (ncRNAs) that can participate in biological processes such as metabolism and development. However, little has been explored about the function of circRNAs in the development of Apis cerana larval guts. By using our previously gained deep sequencing data from the guts of A. cerana worker larvae at 4-, 5-, and 6-day-old (Ac4, Ac5, and Ac6 groups), the expression pattern and regulatory role of circRNAs during the development process was comprehensively investigated, with a focus on differentially expressed circRNAs (DEcircRNAs) relevant to immunity pathways and developmental signaling pathways, followed by validation of the binding relationships among a key competing endogenous RNA (ceRNA) axis. Here, 224 (158) DEcircRNAs were detected in the Ac4 vs. Ac5 (Ac5 vs. Ac6) comparison group. It's suggested that 172 (123) parental genes of DEcircRNAs were involved in 26 (20) GO terms and 138 (136) KEGG pathways like Hippo and Wnt signaling pathways. Additionally, ceRNA network analysis indicated that 21 (11) DEcircRNAs could target seven (three) DEmiRNAs, further targeting 324 (198) DEmRNAs. These DEmRNAs can be annotated to 33 (26) GO terms and 168 (200) KEGG pathways, including 12 (16) cellular and humoral immune pathways (endocytosis, lysosome, Jak-STAT, etc.) and 10 (nine) developmental signaling pathways (Hippo, mTOR, Hedgehog, etc.). Interestingly, DEcircRNAs in these two comparison groups could target the same ace-miR-6001-y, forming complex subnetworks. The results of PCR and Sanger sequencing confirmed the back-splicing sites within four randomly selected DEcircRNAs. RT-qPCR detection verified the reliability of the used transcriptome data. The results of dual-luciferase reporter assay verified the binding relationships between novel_circ_001627 and ace-miR-6001-y and between ace-miR-6001-y and apterous-like. Our data demonstrated that DEcircRNAs were likely to modulate the developmental process of the A. cerana worker larval guts via regulation of parental gene transcription and ceRNA network, and novel_circ_001627/ace-miR-6001-y/apterous-like was a potential regulatory axis in the larval gut development. Findings from this work offer a basis and a candidate ceRNA axis for illustrating the circRNA-modulated mechanisms underlying the A. cerana larval guts.

OP-049 [Bee Biology]
Effect of vitamin A and nutraceuticals on learning, memory retention, and foraging behavior of honey bees (Apis mellifera)

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The Western honey bee is the most beneficial insect to societies and ecosystems due to their global pollination services to many flowering plant species. Unfortunately, bee colony losses have increased significantly over the past decade, particularly in North America. One of the factors associated with these losses is colony stress and malnutrition because of the intensive management to which beekeepers subject bees, including the transportation and rental of colonies for crop pollination services. Bees depend on their learning and memory abilities to efficiently collect pollen and nectar from flowers and to return to their hives after foraging trips. Additionally, bees collect pollen for brood rearing and colony growth, which is also beneficial for efficient pollination services when hives are rented for this purpose. Therefore, it would be desirable to supplement honey bee colonies with diets and additives that could improve their learning, memory retention, and foraging efficiency. Consequently, this study investigated the effects of β-carotene (pro-vitamin A) and the nutraceuticals daucosterol (a phytosterol from walnuts and other plants) and terpinen-4-ol (a terpene from tea tree oil and pine oil), incorporated into a commercial protein supplement on learning, memory retention, and foraging behavior of honey bees. These antioxidants and their doses were selected from preliminary screening experiments indicating no toxicity to the bees. Bees fed with β-carotene and/or the two nutraceuticals contained in a commercial protein supplement during seven days were compared to those fed the supplement alone. Proboscis extension reflex (PER) tests and foraging observations in hives were carried out with the experimental bees. Results showed that terpinen-4-ol, as well as the combination of daucosterol and β-carotene, significantly increased both memory retention and pollen foraging of honey bees relative to bees fed only the supplement ($P<0.01$). Therefore, these compounds have the potential to be used as additives in artificial protein supplements to feed honey bee colonies. This could bring multiple benefits to bee health such as improving learning and memory retention, as well as to increase pollen collection and crop pollination efficiency. These benefits would positively impact both beekeepers' and growers' economies, as well as potentially increase pollinated food production

OP-050 [Bee Biology]
Effects of various fall feeding sugar sources on survival, health, and performance of honey bee colonies (Apis mellifera L.)

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In Canada, beekeepers supplement their colonies with sugar in the fall to ensure survival during winter, when floral resources are absent. Sucrose syrup is the predominant choice due to its high availability, chemical stability, and ease of use. However, upcoming revisions to Canada's organic standards will prohibit the use of conventional sucrose syrup, necessitating a shift toward honey or organic sucrose syrup as overwintering resources. The implications of this transition on colony survival, development, productivity, and pathogen prevalence remain insufficiently characterized, particularly regarding economic viability. This study evaluated honey bee colonies fed with conventional sucrose syrup, organic sucrose syrup, summer honey, or fall honey. Key parameters assessed included winter survival, colony development, honey production, and pathogen prevalence (Varroa destructor, Nosema spp., and six viruses). Additionally, the economic costs of alternative feeding strategies were analyzed. Results indicate that organic sucrose syrup, summer honey, and fall honey are viable alternatives to conventional sucrose syrup for overwintering. However, precise colony weight management following fall feeding is critical to prevent starvation. In most cases, a minimum of nine honey frames per colony housed in a Langstroth single-brood chamber or four frames supplemented with 12 liters of organic sucrose syrup supported successful overwintering, although adjustments may be required depending on colony size and winter severity. No statistically significant differences were observed in brood and bee population development, honey production, or pathogen prevalence across feeding treatments. However, the cost of overwintering with nine frames of honey was $272 per colony, representing an 830% increase compared to conventional sucrose syrup. These findings suggest that while organic beekeepers can effectively overwinter colonies using alternative carbohydrate sources, the financial and logistical constraints associated with honey-based feeding warrant careful consideration. To mitigate economic risk and optimize colony survival, preliminary trials on a subset of colonies are recommended prior to full-scale implementation.

OP-051 [Bee Biology]
Enhancing Stingless Beekeeping in Thailand: Genetic Diversity, Artificial Queen Rearing, and Honey Processing

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In Thailand, stingless beekeeping (meliponiculture) of Heterotrigona itama has expanded significantly, particularly in rural southern communities, where the Ministry of Agriculture and Cooperatives promotes it as a secondary occupation. However, the increasing interest in meliponiculture has led to the relocation of colonies beyond their native ranges, disrupting local bee populations and altering gene flow across large geographic areas. Additionally, large-scale artificial propagation using a limited number of colonies has contributed to increased inbreeding within managed populations and genetic introgression into wild populations. Colony expansion is also constrained by a shortage of queens. To address these challenges, investigating local genetic variation, mass-rearing virgin queens using in vitro method, and improving honey production practices could strengthen commercial stingless beekeeping. Our findings indicate slightly lower nuclear genetic variability but higher mitochondrial genetic variability, likely due to gene flow, colony transport, and nest division. Expanding colonies through nest division does not appear to negatively impact genetic diversity, as small-scale male dispersal and human-mediated transport help maintain it. For in vitro rearing, we observed that H. itama larvae developed into queens when fed 120–150 µL of larval food, producing in vitro queens with body sizes comparable to naturally produced ones. Microscopic analysis revealed that in vitro-reared queens had well-developed ovaries and spermathecae, whereas workers had smaller ovaries and lacked spermathecae. The acceptance of in vitro-reared queens was independent of worker age, and although their mating frequency was low, it did not significantly differ from that of naturally produced queens. Regarding honey production, heat treatment at 37 °C and 45 °C had minimal effects on physicochemical properties, total phenolic and flavonoid contents, and antioxidant activity ($p > 0.05$). Since heat treatment helps preserve the physicochemical and bioactive properties of dehydrated honey, the proposed method could serve as an alternative approach for preserving stingless bee honey. These findings support sustainable stingless beekeeping, conservation efforts, and enhanced honey production for native stingless bee species.

OP-052 [Bee Biology]
The young and stressed making bad decisions: Effects of Vairimorpha ceranae on worker honey bee (Apis mellifera) foraging behaviours

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Vairimorpha ceranae is an intracellular microsporidian parasite that targets the midguts of Western honey bees (Apis mellifera); it replicates by consuming host-ingested nutrients, exerting energetic stress on its host. In the laboratory, V. ceranae-infected worker bees consume more carbohydrates and respond by extending their proboscis more to lower-quality food than non-infected workers. However, these effects on feeding behaviour have not been observed in the field. Furthermore, it is unclear how changes in worker feeding behaviours affect foraging decisions. We investigated the effects of V. ceranae infection and spore load on honey bee foraging behaviours in the field by inoculating and marking newly emerged worker bees with either high (25, 000 spores per bee), low (400 spores per bee), or control (non-infected) spore loads. Inoculated worker bees were released into experimental colonies. Foraging age was evaluated by observing each experimental colony every day when the inoculated bees were 7-27 days old. Foraging decisions were determined by collecting marked returning foragers, and subsequent laboratory analyses to determine pollen weight and crop solute concentration. Our results demonstrate that V. ceranae-infected worker honey bees start foraging at a younger age than non-infected workers, and that infected foragers forage for nectar that is significantly lower in sugar concentration than do non-infected workers. Based on these results, we predict that V. ceranae can affect colony productivity through changes in foraging age which can negatively disrupt colony temporal polyethism, potentially causing essential roles to be under-filled in the colony. Furthermore, if infected individuals are foraging for nectar of lower sugar concentration, honey production can also be affected. Decreases in colony productivity negatively affect beekeepers; therefore, V. ceranae infection levels should continue to be monitored by beekeepers.

OP-053 [Bee Biology]
Relative effects of the queen and brood on honey bee worker ovary suppression

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Western honey bees (Apis mellifera L.), are a eusocial insect species in which individual members of a colony cooperate to procure food, find and build nests, and reproduce. Typically, the sole reproductive female in a colony is the queen, with daughter workers forgoing personal reproduction in favor of rearing half and full sisters. While workers possess rudimentary ovaries and can lay eggs, they cannot mate, and are thus normally capable of producing only haploid male offspring. Egg-laying workers are uncommon, subject to aggression, and their eggs subject to policing by other workers. Worker reproduction is rare in queenright colonies, but when present it can lead to colony mortality. The presence of a queen, brood, the pheromones produced by both, and nutritional and seasonal factors can suppress worker bee ovary development. To understand the relative importance of queens and brood on worker ovary suppression, we tested their effects in a field experiment with four treatments: 1) queen and brood both present, 2) queen absent, brood present, 3) queen present, brood absent, and 4) queen and brood both absent. Worker bees from each treatment were dissected, and their ovaries were scored according to their level of development. In addition, samples were submitted for proteomics, transcriptomics and microbiome analysis. Results from an ordinal logit regression show a significant interaction between queen and brood status on the probability of observing levels of worker ovary development, whereby the effect of queen status on worker ovary development depends on the presence or absence of brood. Specifically, our results demonstrate that the presence of brood reduces the level of worker ovary development; however the presence of a queen has no impact on ovary development in the absence of brood. In contrast, in the presence of brood, the presence of a mated, laying queen further lowers the probability of observing undeveloped ovaries by 26%. These results suggest that the presence of brood is more influential on ovary development in workers than the presence of a mated queen. Beekeepers should consider adding open brood when requeening queenless colonies.

OP-054 [Bee Biology]
Genetic diversity and population structure of Apis cerana complementary sex determiner (csd) genes in China

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In honeybees, fertilized eggs with homozygous complementary sex determiner (csd) alleles develop into sterile diploid males, which are eliminated by workers during the larval stage. A decrease in csd allele diversity leads to increased inbreeding and a higher occurrence of diploid males, significantly decreasing the population growth rate and effective population size. Therefore, understanding and maintaining csd gene diversity is crucial. This study aims to analyze the genetic diversity and population structure of Apis cerana csd genes in China. We sequenced the exon 6-8 region of the csd gene in 250 workers across 13 geographical populations, identifying 234 nucleotide haplotypes and 141 unique amino acid sequences, 89 of which were newly discovered. The csd gene in these populations shows high genetic diversity comparable to that of A. mellifera, however, distribution of alleles did not show clusters based on geographic regions. Analyses of genetic differentiation showed variable genetic distance among populations. Our results demonstrate high diversity of csd genes of Apis cerana populations across China, suggesting low risk of inbreeding in the populations.

OP-055 [Bee Biology]
Honey bee selection for sustainable and high-quality royal jelly production

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Royal jelly production relies on bee colonies with specific characteristics, requiring rigorous selection to ensure a productive stock. Aware of these requirements, the members of the Royal Jelly Producers Association have implemented a breeding program to develop a bee population suited to their needs. The main objective is to improve productivity while maintaining a sustainable approach, avoiding the importation of foreign genetic material to preserve colony adaptation to local conditions. In addition to royal jelly production, beekeeping traits such as disease resistance, wintering ability and ease of colony handling are also integrated into the selection program.

We analyzed the effectiveness of this breeding program by estimating the genetic parameters of these various traits using a database of nearly 2,000 queens evaluated over several years.

The results indicate a high heritability of royal jelly production, confirming the feasibility of an efficient selection. Furthermore, the observed correlations between productivity and other traits show that colony performance can be improved without compromising their hardiness and resilience.
However, the relatively small population size selected at each generation requires close monitoring to limit increase in inbreeding, which could reduce genetic diversity. Genetic management must therefore be optimized to maintain sufficient diversity and avoid potential negative effects on colony health and vigor.

This selection program highlights the importance of a rigorous and well-thought-out approach in beekeeping. It demonstrates that performance and sustainability can be combined, ensuring the long-term sustainability and profitability of royal jelly production in France while preserving the genetic diversity of the selected bee populations.,

OP-056 [Bee Biology]
Variations in amino acid and lipid profiles of honey bee hemolymph and gut microbiome composition in response to different dietary protein sources

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Nutritional deficiencies and biotic stressors compromise honey bee health and colony resilience. While pollen substitutes like Ultra Bee or Chlorella are used by beekeepers as dietary supplements, their metabolic effects remain insufficiently characterized. This study explores the influence of dietary protein sources on hemolymph amino acid and lipid composition, and gut microbiome structure to better understand their physiological impact.

Pollen-derived protein is crucial for honey bee immunity, metabolism, and overall health, but alternative protein sources may not offer the same benefits. Beyond protein, lipids in pollen play a key role in energy storage and immune function. To gain a comprehensive understanding of how pollen substitutes affect honey bees, we examined their influence from multiple perspectives by analyzing hemolymph amino acid and lipid profiles alongside gut microbiome composition.

Honey bees were fed diets containing natural pollen, Ultra Bee pollen substitute, or Chlorella as a protein source in in vitro conditions. Targeted metabolomic analysis of hemolymph amino acids was conducted using the MetAmino® kit (Chromservis) for LC-MS. Lipidomic profiling was performed using an untargeted LC-MS approach. Additionally, gut microbiome composition was determined through sequencing to investigate potential diet-related shifts in microbial communities.

Amino acid profiling revealed distinct differences between feeding groups. Notably, bees fed Chlorella exhibited elevated levels of valine and methionine, while those receiving Ultra Bee showed higher leucine and cysteine concentrations. Lipidomic analysis demonstrated that bees consuming natural pollen had higher lipid abundance and greater lipid diversity compared to those fed pollen substitutes. These findings suggest that natural pollen provides a more complex lipid profile that may support honey bee metabolic health. Preliminary gut microbiome analyses indicate dietary-dependent differences in microbial composition, which will be further explored.

Our findings emphasize the critical role of multi-floral pollen in supporting honey bee metabolic function, particularly due to its richer lipid composition. While pollen substitutes supply key amino acids, they may not fully replicate the metabolic benefits of natural pollen. Understanding how different protein sources influence honey bee physiology can inform better supplemental feeding strategies to enhance colony resilience and health.

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OP-057 [Bee Biology]
Free-B: Studying free-living honey bee colonies to safeguard diversity, ensure resilience, and promote transformative change in beekeeping

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Whereas two decades ago the Western honey bee (Apis mellifera) was largely considered extinct in the wild, independent research since then has demonstrated the presence of free-living colonies throughout Europe. However, whether they are able to survive in the wild and form sustainable populations remains largely unknown. To solve this major scientific gap, the FREE-B project (www.free-b.eu), with funding from a Biodiversa+ grant, connects researchers in France, Ireland, Poland, Portugal, and Sweden in an effort to better understand the biological, behavioral, and environmental factors that bolster survival of free-living honey bees via natural selection.

In collaboration with Honey Bee Watch and relying on citizen scientists' contributions, FREE-B will search for nest sites in the five countries, with a special focus on forested areas; gather these colonies' metadata in a GIS-based mapping platform; and monitor their demography over two seasons. These data will be used to test environmental effects on colony fitness and behavior. Samples from select nests will be used in genomic and morphologic analyses to assess diversity and adaptations to unmanaged settings, and in parallel, pest and pathogen loads will be compared to samples taken from nearby managed colonies. Additionally, FREE-B will pilot the potential harnessing of free-living honey bees for the breeding of local resilient managed colonies by placing and monitoring captured swarms in treatment-free hives.

Results will be conveyed to beekeepers and beekeeping associations as well as any lessons that could be applied to lower mortality rates and improve the sustainability of beekeeping practices. Results will also be disseminated to key stakeholders, including bee health advisers, veterinarians, foresters, and policymakers, who may have direct or indirect influence on the well-being of these bee populations.

Although A. mellifera is universally recognized for its contribution to pollination, ensuring food security and biodiversity, free-living populations have not received the global scientific attention nor protections they deserve. FREE-B aims to fill this knowledge gap by conducting in-depth research into the survival strategies of free-living honey bees and by applying nature-based solutions to beekeeping that could serve as future models throughout Europe and beyond.

OP-058 [Bee Biology]
Genomic Analysis of Wild Bee Populations in Scandinavia Informs Biodiversity Conservation

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Recent declines in insects, particularly for anthophilous insects like bees, raise ecological concerns but remain challenging to evaluate due to scarce long-term monitoring data. Climate change and land use are considered major contributing factors that can be linked to population size changes over time. Arctic species are especially vulnerable as they approach their northern limits, making the assessment of their population viability important. Land use also strongly influences species abundance/occurrence by altering the availability of floral resources. Genome analysis provides a powerful tool to assess population declines and fragmentation. By reconstructing effective population size (Ne) trajectories over millennia, we uncover differences in evolutionary histories between common and rare/endangered species. Here, we analysed genetic variation in seven Swedish montane bumblebee species, finding that long-term Ne correlates with geographic distribution, and population fragmentation is minimal over large distances, suggesting free mating among populations. The arctic specialist species Bombus hyperboreus showed population declines since the last ice age and signs of inbreeding, potentially indicating increased genetic load. We also conducted analyses of Ne trajectories of four bee species in Denmark, which revealed contrasting patterns of demography across the last thousands of years, suggesting the influence of historical factors on the current status of species. Genetic monitoring and Ne trajectory reconstruction provide a baseline for understanding current pollinator or generally insect declines and improve conservation strategies.

OP-059 [Bee Biology]
Honeybee blood under the microscope: Characterizing hemocytes through surface protein profiling

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The global decline of honeybee populations is a pressing issue, yet their cellular immunity - specifically the blood cells, or hemocytes - remains significantly understudied. In contrast, the blood cells of other farm animals have been extensively characterized, leading to a deeper understanding of their immune systems. One of the key challenges in studying honeybee hemocytes is their morphological similarity, which makes it difficult to distinguish their functions. For instance, differentiating between plasmatocytes and prohemocytes, or oenocytoids and granulocytes, often requires advanced microscopy techniques such as interference or phase contrast microscopy. Additionally, researchers debate the existence of hemocyte subtypes like spherulocytes and coagulocytes. A standardized classification system is crucial to determine the hemocyte types present in honeybee blood and their roles in immunity.

In our study, we aim to characterize honeybee hemocytes based on the proteins present on the outer surface. This strategy, known as the Cluster of Differentiation (CD) system, has been widely applied to various cell types across different organisms. We enzymatically shaved the surface proteins from the hemocytes and identified them using mass spectrometry. Additionally, we extracted RNA to analyse gene expression, providing further insight on hemocyte function. Our combined approach revealed 1101 genes encoding surface proteins, indicating great diversity. We identified key immune pathways in insects - JAK/STAT, Imd, Toll, and JNK - and detected hemocyte markers from other invertebrates in honeybees. Notably, several of these genes encode viral receptors found in other insect species.

This knowledge opens the door for the development of monoclonal antibodies targeting potential hemocyte markers. By establishing a panel of antibodies that react with different hemocyte subtypes, researchers can investigate the impact of stress factors on honeybee blood cells. A better understanding of honeybee hemocytes could pave the way for new strategies to support colony health and resilience against environmental threats.

OP-060 [Bee Biology]
Embryogenesis of haploid honey bee (Apis mellifera L.) takes longer than diploid worker

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INTRODUCTION: During honey bee development, the embryonic stage is crucial, as it is when all the fundamental organ rudiments of adult bees are formed. There are notable physiological and social behavioral differences between worker bees and drones, primarily influenced by genetic regulation. The initial molecular basis at the proteomic level for the embryonic development of both workers and drones has been identified, but a comprehensive understanding of the significant events involved in embryonic establishment remains elusive.

OBJECTIVES: To elucidate the molecular regulatory mechanisms underlying tissue differentiation during the embryogenesis of drone and worker bees through a high-resolution investigation.

METHODS: We implemented a state-of-the-art approach that combines precise and extensive sampling with high-throughput proteomics technology and in-hive hatching observations to conduct a comprehensive comparison of male and female bee embryo development.

RESULTS: This work identified a total of 7,591 proteins, marking a 2.5-fold increase in protein coverage compared to previous investigation. Our comparative analysis reveals distinct strategies in embryonic development between worker bees and drones. Notably, proteins involved in fatty acid metabolism and the activation of biological pathways related to organ establishment, such as the hedgehog and wnt signaling pathways were initiated earlier in drones, indicating that drone development begins ahead of that of worker embryos. Furthermore, ribosomal proteins essential for material support were consistently expressed through the later stages in male bees, highlighting that drone embryogenesis lasts longer than that of workers. Specifically, the results of in-hive inspection indicate a developmental gap of approximately four hours between the two embryos. Additionally, the patterns of cytoskeletal proteins and antioxidants reflect distinct strategies employed to support the development of drone embryos.

CONCLUSION: This study offers new insights into the molecular basis of honey bee embryos and establishes a theoretical and practical foundation for further investigation into the mechanisms of embryonic development.

OP-061 [Bee Biology]
Mitochondrial DNA Variability in the Honey bee Apis mellifera L., Implications for Conservation

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The Western honey bee (Apis mellifera L.) is a keystone species that plays a vital role in maintaining environmental health and agricultural productivity. However, it faces significant threats, including indiscriminate pesticide use, parasite ecosystem expansion, climate change, and the uncontrolled importation of non-native subspecies. The PRIMA project MEDIBEES (Monitoring the Mediterranean Honey Bee Subspecies and Their Resilience to Climate Change for Sustainable Agro-Ecosystems) aims to identify the current genetic structure of native honey bee populations across the Mediterranean and neighbouring regions to help support breeding programmes and conservation efforts.

A. mellifera subspecies may be classified into four major mitochondrial DNA lineages: A (Africa), M (Western and Northern Europe), C (Eastern and Central Europe) and O (Western and Central Asia), each of which is sub-divided into a number of haplotypes. The occurrence of non-native lineages is a strong indicator of introduction of foreign subspecies.

In this study, the mtDNA tRNA-COII region of over 1,344 DNA samples was amplified using standard PCR methods, sequenced and then analysed using Geneious Prime 2024 software. These samples were collected from the Mediterranean and neighbouring regions including A.m. ligustica (Italy), A.m. siciliana (Italy, Sicily), A.m. cypria (Cyprus), A.m. syriaca (Jordan and Lebanon), A.m. ruttneri (Malta), A.m. meda (Iran), A.m. anatoliaca and A.m. caucasica (Turkey), A.m. jemenitica (UAE and Oman), A.m. sahariensis (Morocco and Algeria), A.m. macedonica (Greece) and A.m. intermissa (Algeria).

Results indicate that lineage C, typical of A.m. ligustica and A.m. carnica, was present in a number of studied samples, suggesting the introduction of non-native C lineage subspecies through the importation of commercially managed colonies. This presentation will focus on describing the current distribution of mtDNA haplotypes within these subspecies as well as evidence of non-native lineages, indicating the possible introduction of other subspecies into these regions. The implications of the data including insights into the movement and transfer of subspecies in these areas and potential impact on local beekeeping practices will be discussed.

OP-062 [Bee Biology]
Optimizing anesthetic effects of carbon dioxide to honey bee (Apis mellifera L.)

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Carbon dioxide (CO) anesthesia effects on bees have been widely utilized in colony management and instrumental insemination. However, the optimal dosage of CO and physiological impacts of CO exposure on bees remain unclear. Here we firstly inspected the emerging bees, nurse bees, forager bees exposed to CO with gradient duration, and figured out the right tolerance. Then the proteomic approaches were employed to investigate the physical changes of hemolymph and brain against CO exposure. The inspection results indicate that emerging bees exhibit the highest tolerance to CO (up to 3 hours). Furthermore, the comparative proteome reveals that hemolymph and brain adopt different strategies in response to hypoxic stress. For instance, the hemolymph of emerging bee activated P450 metabolic pathway, while brain launched mTOR and MAPK signaling pathway to resist oxidative damage induced by hypoxic environmental stimuli. Our results identified the practical threshold of worker bees' tolerance to CO anesthesia and decode the molecular mechanisms of bees' response to external hypoxia, which have significant implications for the anesthesia of experimental bees as well as for the preservation and transportation of bee populations.

OP-063 [Bee Biology]
The Development of Brain Structure in Worker Honey Bees: A Micro-CT Study of Neuropil Volume Dynamics

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Understanding brain plasticity in honey bees is crucial due to their complex social behavior and division of labor. Previous studies have shown that neuropil volume increases between nurse bees and foragers, and these changes are not only caused by the increased external stimulation from foraging. However, previous research primarily focused on comparing brain volumes between nurse bees and foragers, leaving a gap in our understanding of how brain volume changes throughout adulthood. Moreover, most studies concentrated on the mushroom body, with a lack of data on volume changes in other brain regions of honey bees.

To establish the growth pattern of brain volume, we used micro-computed tomography to measure the neuropil volume of various brain regions in worker honey bees across different ages. We also reared newly emerged worker bees without older bees, which initiated foraging precociously at seven to eight days old. We measured the neuropil volumes of these precocious foragers and compared these measurements with those of same-aged controls.

Our results revealed changes in the volume of various brain regions during the nurse bee stage, with volumes increasing and decreasing at specific age intervals. Three-day-old precocious workers exhibited brain volume differences compared to three-day-old controls. These findings demonstrate the substantial plasticity of brain volume in worker honey bees within a short period, highlighting the continuous changes in brain structure during the nurse bee stage. This study provides a more complete picture of the growth pattern of brain volume in worker honey bees. These findings contribute to our understanding of the mechanisms of division of labor and task transitions in these social insects.

OP-064 [Bee Biology]
Exploring the genetic landscape of honeybees in Ivory Coast

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A number of insect species perform vital functions, such as pollination, pest control and soil fertilization. Unfortunately, their diversity and abundance are threatened by habitat degradation or loss, pesticide use, invasive species or climate change. In the horticultural sector, poor agricultural practices, especially those based on excessive use of chemicals, have a major impact on the decline of pollinators, such as honey bees.

In Côte d'Ivoire, the MARIGO project addresses the agro-ecological transition of peri-urban horticultural practices, contributing to the sustainable and productive transformation of agriculture and food systems. Within this project, the introduction of beehives on farms undergoing agro-ecological transition is proving successful and has helped to raise public awareness of the negative impact of pesticides on bees and pollination, through its impact on the financial income from honey harvest. Despite this, the beekeeping industry is not yet optimally structured and honey is still mainly harvested through hunting wild colonies or by placing empty hives for the natural installation of swarms, which may or may not occur.

Within this project, we have started a genetic characterization of the endemic honeybee subspecies Apis mellifera adansonii. We were able to visit 63 hives in 28 sites distributed along a north-south and east-west gradient and collect 1264 bees: 294 drones and 970 workers. We are currently sequencing 96 of the drones to assess genetic structure, spatial distribution and diversity of the global population. The results will be of particular interest as they will describe the genetic structure of an unmanaged population and will allow testing eventual admixture with other subspecies we have in our current database.

Our sampling has shown the presence of the Varroa parasite in almost 70% of the colonies visited, possibly explaining a particularly high level of swarming observed, as a strategy for Varroa control.

These preliminary results will provide the basis for the genetic characterisation of honeybees in Côte d'Ivoire, a first step towards defining a local honey bee conservation strategy.

OP-065 [Bee Biology]
Influence of different diets on the growth and development of Eastern honey bee Apis cerana

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In recent years, honey bees are stressed with multiple factors, with malnutrition being a significant threat to the healthy development of honey bee colonies. To keep colony healthy and productive, the beekeepers supply their colonies with supplementary pollen or commercial pollen substitutes during periods of pollen dearth or insufficient pollen quantity or quality. Both Apis mellifera and Apis cerana are important pollinators in many natural ecosystems and agro-ecosystems. Apis cerana is an important indigenous species and is raised extensively in the mountainous regions of China. Currently, the research on effects of diets on honey bee growth and development is mainly focused on A. mellifera, with much fewer studies focused on A. cerana. In this study, we evaluated the effects of four natural pollen types (oilseed rape pollen, camellia pollen, lotus pollen and buckwheat pollen) and two pollen substitutes (Diet 1 and Diet 2) against a control group (sucrose solution) on A. cerana through cage experiments. The food consumption, live body weight, longevity, hypopharyngeal gland development and the midgut proteolytic enzyme activity of caged workers were measured. The food consumption rates of oilseed rape pollen and buckwheat pollen were greater than the other diets. Oilseed rape pollen and camellia pollen were recognized as excellent quality diet for hypopharyngeal gland development and midgut proteolytic enzyme activity. Over the entire experimental period, the caged workers fed with lotus pollen had similar diet consumption and body weight as those fed with pollen substitutes, while these bees had significant higher survival rate than those fed with other diets. The results indicated that the commercial pollen substitutes appeared to be less beneficial to caged A. cerana workers than the natural pollen resources.

OP-066 [Bee Biology]
Distribution and conservation status of *Apis mellifera* populations in Italy

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Characterization of Apis mellifera populations in Italy is important for biodiversity conservation and sustainable beekeeping. The objective of this study was conducted within the BeeNet and GENAPIS.IT projects to enhance knowledge on the distribution and genetic status of subspecies and to identify potential signs of genetic introgression. Honey bee samples were obtained from 368 colonies distributed across 20 Italian regions, and analysed using morphometric and molecular methods. For morphometric analysis, 18 right forewings per sample were dissected, and 16 wing parameters were acquired. Subspecies assignment was performed through discriminant analysis with a posterior probability threshold of ≥90%. In parallel, genetic analysis was conducted by sequencing the tRNAleu-COX2 intergenic region of the mitochondrial DNA (mtDNA), using E2 and H2 primers. The obtained sequences were analysed with the PHYLIP 3.65 software to construct phylogenetic trees based on lineages A, M, and C, using reference sequences deposited in GenBank. Morphometric analysis showed that 77% of the analysed samples were consistent with native Italian subspecies (68% to Apis mellifera ligustica and 9% to A. m. siciliana). 13% of the samples exhibited characteristics not attributable to any subspecies in the reference database, suggesting the presence of intraspecific hybrids (e.g., Buckfast) or genetic introgression. An additional 10% of samples were classified as belonging to other crosses or subspecies, including A. m. carnica(1%), A. m. carnica-A. m. ligustica hybrid (7%), and A. m. siciliana-A. m. ligustica hybrid (2%). Results of molecular analyses showed that 75% of samples carried haplotypes compatible with A. m. ligustica (C1, M7) and A. m. siciliana (A). The remaining 25% exhibited haplotypes belonging to not native subspecies, confirming the presence of genetic introgression or genetic variability. The data obtained from this study provide a detailed overview of the distribution and conservation status of Italian A. mellifera populations. The results highlight the predominance of native subspecies but also the occurrence of hybridization phenomena, emphasizing the need for targeted safeguarding strategies. The integration of morphometric and genetic analyses represents an effective approach for monitoring population status and supporting the sustainable management of Italian beekeeping.
This study was supported by the Italian Ministry of Agriculture.

OP-067 [Bee Biology]
From genomes to holobionts: can the reanalysis of large-scale bee sequencing projects open new perspectives?

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Up to now, the BeeGEES lab, based in Toulouse, France, has resequenced more than 2,700 complete honey bee genomes, including 1,200 haploid drones and 1,500 queen genomes reconstructed from sequencing pools of workers using a pool-seq strategy. With this extensive dataset, our lab has generated fundamental insights into the population genomics of honey bees, shedding light on their population structure, long-term evolutionary history, and recent demographic trajectories in the context of modern beekeeping. Additionally, we have explored the genomic architecture of key traits associated with varroa resistance, contributing to a better understanding of their genetic basis. Beyond presenting these recent advances in honey bee genomics, this talk aims to introduce a new perspective: how reanalysis of large sequencing projects can help us better describe the bee holobiont, composed by the bee and its associated microbiota.

In practice, population genomics studies rely on mapping sequencing reads to a reference genome or a pangenome. However, unmapped reads - those that do not align with the reference - are assumed to be non-bee DNA and are discarded at the very first stages of analysis. Here, we propose that these unmapped reads contain valuable information and could provide new insights into the biological communities associated with bees. The presentation will focus on an ongoing study in which these unmapped reads are meta-assembled to reconstruct genomic information about the associated communities. In the long term, this approach could pave the way for in-depth metagenomic characterization of both bees and their associated organisms, including pathogens, using already available data. This would contribute to a more integrative understanding of bee biology and health.

OP-068 [Bee Biology]
Hybridization of honey bees in southwestern Asia

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The honey bee *(Apis mellifera)* is native to Europe, Africa, and southwestern Asia. Within this large range, numerous subspecies and ecotypes have evolved, adapted to local environmental conditions. In some regions, biodiversity is threatened by the mass production of non-native queen bees and migratory beekeeping. In order to protect native subspecies and ecotypes, it is essential to discriminate them from imported bees. Discrimination can be based on wing measurements, but reference datasets are often lacking. The aim of this study is to provide a reference data set for honey bees native to southwestern Asia.

We have collated 17015 fore-wing images of honey bee workers, which represent 1535 colonies from eight countries: Azerbaijan, Cyprus, Georgia, Iran, Iraq, Saudi Arabia, Tajikistan, and Turkey. The wing images were uploaded to a publicly accessible repository. They were measured using 19 landmarks and analyzed using geometric morphometric methods. Wing shape varied significantly across southwestern Asia. Pairwise comparisons revealed that most countries were significantly different from each other. Twelve clusters were identified using Bayesian information criteria and model-based clustering. Seven of the clusters were classified as native and the remaining five clusters were classified as non-native. Six clusters from the Middle East and Central Asia belong to lineage O and one cluster from Saudi Arabia belongs to lineage A.

There is an urgent need to protect the biodiversity of honey bees in southwestern Asia. Protection can be facilitated by the large collection of wing images provided by this study. Native and non-native bees can be effectively discriminated using wing geometric morphometrics. This method is available to both scientists and beekeepers as it doesn't require expensive equipment.

OP-069 [Bee Biology]
Microbial Community Profiling of Tetragonula biroi (Friese) Hives: Insights from Pollen-Microbiome Interactions

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Pollinators play a crucial role in global biodiversity and agricultural sustainability, yet bee populations are declining due to habitat loss and environmental stressors. The microbiome is increasingly recognized as a key factor in bee health, influencing digestion, immunity, and overall colony fitness. However, the effects of temporal environmental changes on bee microbiomes remain poorly understood.

Here we show that bacterial communities in the hive of the native stingless bee Tetragonula biroi (Friese) exhibit positive correlations with pollen sources over time. Using a longitudinal approach, we sampled beehive propolis and bee bread bimonthly over three months from a meliponary in Laguna, Philippines. 16S rRNA amplicon sequencing revealed 41 bacterial genera across six major phyla, with lactic acid bacteria (Lactobacillus, Oenococcus, and Tetragenococcus) dominating the propolis microbiome. Pollen spectra analysis identified 26 plant species, with Veitchia merrillii (Becc.) H.E.Moore, Crotalaria L., and Mangifera indica L. among the most abundant, likely due to their blooming periods, hive proximity, and floral traits that enhanced bee attraction. Notably, lactic acid bacteria exhibited strong positive correlations with pollen sources, particularly resinous plants or those producing exudates used in propolis production, highlighting the intricate link between bee foraging behavior, pollen selection, and microbial community dynamics.

Overall, these findings improve our understanding of microbial-pollen interactions within stingless bee colonies and highlight the potential for strategic floral enrichment to enhance bee health and conservation efforts.

OP-070 [Bee Biology]
Mitigating the deficiency of high-quality floral pollen through a new approach to honey bee rearing with artificial pollen diet containing animal protein

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Maize pollen (Zea mays L.) serves as an essential nutritional resource for supporting honey bee populations in Thailand, primarily due to its widespread cultivation and accessibility. Its nutritional composition includes 95.68% of dry matter, 4.32% of moisture, 1.88% of ash, 0.86% of dietary fiber, 3.82% of fat, 14.56% of protein, 51.53% of carbohydrates, and an energy value of 2,987 kcal per gram. However, its relatively low protein content, compared to other floral pollens that typically range from 15% to 30%, necessitates supplementary feeding to meet the dietary needs of honey bees. Attempts to enhance protein levels using plant-based leaf protein concentrates were hindered by high fiber content, which adversely affects digestibility. To overcome this limitation, animal-derived proteins from sources such as chicken, pork, and beef were introduced to provide a more balanced amino acid profile while minimizing the inclusion of indigestible fibers. A novel strategy employing protease enzymes for pre-digestion of these animal proteins before their incorporation into artificial pollen significantly improved nutrient digestibility and absorption. Substituting 0–25% of maize pollen with these animal-derived proteins proved effective in enhancing the protein content of honey bee diets. The resulting artificial pollen formulation, containing 10–20% protein, 20–40% sugars, 1–5% fat, along with essential vitamins and minerals, was evaluated for its impact on hypopharyngeal gland size, honey bee lifespan, and gut microbiota composition. The results indicated that the optimized use of animal-derived proteins significantly promoted honey bee growth and health. Additionally, utilizing low-cost by-products from the food industry, such as livestock by-products, offers a sustainable and economical alternative for pollen substitution. This approach supports circular economic principles by promoting efficient resource use, reducing waste, and lowering production costs.

OP-071 [Bee Biology]
Vitellogenin as a Physiological Marker of Swarming in Honey Bees (Apis mellifera)

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Swarming, or colony reproduction, in honey bees (Apis mellifera) is an indicator of colony-level fitness. The drivers of swarming remain elusive to beekeepers and researchers. While floral abundance, rapid colony growth, and nest congestion are commonly associated with swarming, they are not direct causal factors. The nutritional and physiological state of individual bees within colonies preparing to swarm is understudied. We hypothesized that levels of vitellogenin (Vg), a phospholipoglycoprotein that influences the age-based division of labor in individual bees, might also mediate the cascade of physiological and behavioral processes that lead to reproductive swarming. This study aimed to determine whether Vg levels in worker bees are associated with colony swarming behavior. Over two years, we compared Vg levels in age-marked worker bees sampled at various time intervals (14, 7, 3, and 0d) before a swarm was issued (pre-swarming colonies) to samples of same-aged bees collected from non-swarming colonies at the same intervals. Samples of known-aged bees were stored in a-80°C freezer for later analysis of relative Vg levels using quantitative real-time PCR. Vg levels were significantly higher in 10 and 14 day old bees from pre-swarming colonies three days prior and within 24 hours of swarm issuance compared to same aged bees from non-swarming colonies. Vg levels normally decrease in 10-14 day old bees that are transitioning to the forager behavioral state. This finding suggests that Vg may play a role in regulating the physiological and behavioral shifts associated with colony preparations for swarming. We hypothesize that Vg modulates the swarming process by delaying the physiological transition of middle-aged worker bees, ensuring a robust population of young, nutritionally enriched bees that support both the departing swarm and the parent colony. These novel findings provide further clues to long-standing mystery about the factors that trigger swarming behavior in honey bees.

OP-072 [Bee Biology]
Dual effect of S-methyl-L-cysteine sulfoxide from rapeseed nectar on honey bee health

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Intensive agriculture affects pollinator health, including honey bees (Apis mellifera). Rapeseed (Brassica napus L.), a widely cultivated oil crop, provides abundant pollen and nectar, and its honey is valued for yield, mild taste and texture. However, rapeseed contains phytochemicals, including S-methyl-L-cysteine sulfoxide (SMCSO). This compound acts as a plant toxin in ruminants, where it is linked to kale anemia, sparking interest in its potential impact on honey bee health.

We quantified SMCSO and its metabolites across seasons, colonies, body parts, and dietary sources using nuclear magnetic resonance spectroscopy. Additionally, a cage-feeding experiment assessed SMCSO's toxicity and effects on antioxidant capacity, antimicrobial activity, proteolytic patterns, and free amino acid profiles.

SMCSO concentrations in the bee gut and body varied across colonies, likely due to dietary preferences, peaking during rapeseed flowering. The thorax showed the highest SMCSO concentration (2.5 µmol/g in foragers), while its main metabolite, 3-methylthiolactic acid sulfoxide, reached 6 µmol/g, particularly in nurses. SMCSO accumulated in tissues, indicating its presence in the body was not solely dependent on immediate gut content. Although nectar contained higher SMCSO concentrations than pollen, both served as significant sources. Short-term SMCSO exposure (1 mg SMCSO given in 1mL of sucrose solution (1:1 w/v; sucrose/water)) had no immediate toxic effects and even enhanced bees' antioxidant capacity. However, prolonged exposure (1 mg/ml SMCSO in sucrose solution (1:1 w/v; sucrose/water) ad libitum for 10 days) led to reduced body weight, particularly in the thorax and head, and altered amino acid metabolism, as reflected in the metabolomic profiles of both the body and gut. In contrast, the control group (sucrose solution (1:1 w/v; sucrose/water)), showed no such effects. This dual effect may explain why rapeseed remains a key forage source despite its phytochemical complexity. Furthermore, SMCSO accumulated in rapeseed honey at significantly higher levels than in other honey types, making it a potential botanical biomarker.

This study provides new insights into SMCSO's role in honey bee health, highlighting both benefits and risks of rapeseed forage. While beekeepers often report variable colony fitness near rapeseed fields, atrributed to pesticides, our findings suggest that SMCSO may also play a role.

OP-073 [Bee Biology]
Optimization of In-Vitro Rearing of Indo-Malaya Stingless Bee (Heterotrigona itama) Queen: A Strategy to Improve the Meliponiculture Management and Conservation of Insect Pollinator in Tropical Landscapes

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Malaysia is home to diverse species of Indo-Malaya stingless bees (Hymenoptera: Apidae: Meliponini), which consist of ~33 species. Stingless bees are known to be important pollinators in tropical rainforests and good candidates for providing pollination services in agricultural ecosystems. Due to the rapid advance of Malaysian meliponiculture in using the stingless bee as an agricultural pollinators, as well as the commercialisation of stingless bee products (pollen, honey, and propolis), the demand for colonies has considerably increased. Thus, an effort to multiply the number of stingless bee products rapidly must be developed in order to fulfill the public requirements in a short period of time. Current practice used by the stingless beekeepers is usually by cutting down the trees in the rainforest areas to obtain the bee colony brood and the queen bee. This concern has led to an alternative technique to mass-produce the queen on a large scale, particularly to our native species, Heterotrigona itama. To date, our research group has successfully developed an eco-friendly technique for rapid multiplication of the stingless bee colonies using in-vitro rearing procedure. The influence of the beneficial fungus Monascus ruber in promoting the survival of H. itama larvae was verified as 90% of larval survivorship was obtained when treated with fresh larval food compared with freeze-thawing sterilised larval food. Further experiments revealed that 150 µl and 120 µl of larval food have successfully yielded 78 % and 40 % of queen emergence, respectively. The in-vitro queens' abdominal length was significantly longer (4.24±0.01 mm) than the workers' abdominal length (1.55±0.009 mm). The validation of in-vitro queens is confirmed by the presence of huge ovariole numbers and spermatheca compared to workers that built with small ovaries and no spermatheca appearance. Outcomes obtained from this innovation enable the production of the colonies in a more sustainable and eco-friendly way, allowing for their use both ecologically and economically, and contribute to conservation efforts in Indo-Malaya stingless bees.

OP-074 [Bee Biology]
Spatio-temporal population genetics of solitary bees to investigate the impact of Osmia spp. management

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An increasing number of bee species are commercially reared to ensure pollination services. However, release of reared bees may lead to genetic admixture with wild conspecifics, thereby disrupting local adaptations. While such genetic pollution has been shown for bumble bees, respective data for solitary bees Osmia spp. are currently lacking. Here, we use population genetics to investigate whether the release of reared Osmia spp. has an effect on genetic diversity and structure of wild Osmia spp. populations. In 2022-2023, Osmia bicornis and Osmia cornuta cocoons were obtained from two commercial breeders and sampled in semi-natural, urban and rural areas of Switzerland with differences in released Osmia spp. numbers. Museum specimens of O. bicornis sampled in the same areas before Osmia spp. commercial rearing started (i.e., in the 1990s) were used as negative controls. Genetic diversity and population structure of each species across sampling areas and time periods were assessed using mitochondrial and nuclear DNA microsatellite markers to assess whether the breeding and commercialization of Osmia spp. affected the gene pools of wild populations. Microsatellites analyses revealed high levels of migration between sampling areas in both time periods. In O. cornuta no significant differences in genetic diversity levels or in the genetic structure between sampling areas were found. In O. bicornis, the same patterns were observed, but when comparing time periods observed heterozygosity declines and significant changes of genetic structure were detected. In the contemporary samples, new alleles were found in all the three sampling areas but an overall decrease of private allelic richness was found. High admixture between sampling sites suggests higher flight distances than previously expected for Osmia spp., which are considered philopatric species. Pre- and post-management comparisons indicate changes in population structure and introduction of novel alleles that may be related to management, while the overall decrease of observed heterozygosity and private alleles suggest an ongoing erosion of genetic diversity caused by other stressors. To confirm these results, ongoing mitochondrial DNA analyses will allow better tracking of management effects through the detection of non-local haplotypes into wild populations.

OP-075 [Bee Biology]
Whole genome sequencing reveals resilience of European honeybees to climate change

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Climate change is a threat to the health of honeybee (Apis mellifera) populations in Europe. Honeybees can thrive across a large range of climates, and evolution by natural selection has resulted in local populations with traits suited to local environments. Genetic adaptation of bees to their local climate is an important factor that determines how they will react to warming temperatures. However, movement of bees by humans could potentially disrupt associations between these traits and local environments. Furthermore, management and breeding practices can affect their genetic variation and their potential to adapt to a changing climate.

We have analyzed the genomes of 1096 honeybees sampled from all over Europe to understand how they are adapted to their local environments and to predict how future climate change will affect their resilience. The genomes reflect extensive translocation of C-lineage bees (mainly A. m. ligustica and A. m. carnica subspecies) from southeastern Europe, which have hybridized with and replaced M-lineage bees (A. m. mellifera subspecies) in the north and west. Our analysis uncovers the genetic basis of adaptions to different climates in Europe, and identifies genes that control these adaptations.

We combined our results on how bees are adapted to their local environment with predictions of local climate in the future throughout Europe. This allows us to predict which populations are most susceptible to climate change. We can also address two important questions: 1) in which parts of Europe are honeybees most sensitive to climate change? 2) what effect have human management and hybridization between subspecies had on honeybees' resilience to climate change? Our findings have implications for beekeeping practices in future.

OP-076 [Bee Biology]
The memory of a wild honey bee and its strength today!

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Background
Since 1987, wild colonies of Apis mellifera siciliana in Sicily have been transferred to rational hives. These naturally surviving strains, bred without beekeeper intervention, have shown superior survival and performance compared to selected lines of other subspecies, as demonstrated in several national or European projects.

Problem Description
Early on, colonies more affected by varroa were removed and not allowed to reproduce, enacting an accelerated natural selection. After over 30 years of coexistence, relict strains now show minimal varroa susceptibility, much like naturally reared strains on islands. They also exhibit low honey consumption by anticipating seasonal changes. Their total independence from human intervention reinforces their resilience in the wild.

Methodology
Relict strains were selectively bred on Sicily's smaller islands and at isolated land mating stations to ensure genetic conformity to the subspecies. Initially verified through electrophoresis in 1987 (allozyes), subsequent morphometric, mitochondrial DNA and microsatellite markers were used to discard non-compliant strains. Genetic conformity to the subspecies helped to fix adaptive traits. The goal was to restore the nearly extinct Sicilian bee population by crossing separate relict strains and reintroducing them to their original territories. Importantly, wild honey bees are not domesticated bees gone feral but rather a lineage uninterrupted since prehistoric times.

Results and CONCLUSION: For all Apis mellifera subspecies, beekeepers and researchers should focus on identifying and reproducing wild honey bee strains in areas avoided by mainstream beekeeping. Propagating these naturally adapted bees would significantly reduce management costs, which are becoming unsustainable due to climate change and declining yields. This type of breeding supports the bee's total independence from humans, and the author is deeply convinced that their ability to survive in the wild is also his as a beekeeper, and not vice versa.

Practical Implications for Beekeepers
Wild honey bee management enables production of honey free from oxidizing agents like sugary feeds and acaricides, which weaken immunity. The Sicilian bee's naturally high antioxidant and vitellogenin levels, supported by scientific research, highlight the benefits of allowing wild bees to thrive without human interference.

OP-077 [Bee Biology]
An unparalleled survey of honey bee genetic diversity in Europe – insights from wing shape, nuclear whole genome, and mitochondrial DNA data

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Europe is home to 10 subspecies of Apis mellifera, classified into four main lineages sensu Ruttner: M (western and northern European), C (southeastern European), A (African), and O (Middle Eastern). However, large-scale movements of honey bee genetic material—driven by transhumance and, more importantly, queen trading—has intensified gene flow, particularly from the C-lineage subspecies A. m. carnica and A. m. ligustica, threatening the genetic integrity of several subspecies and blurring the genetic boundaries between subspecies.

Here, we analyzed over 1,200 recently collected samples from apiaries in 33 countries using a multi-marker approach: maternally inherited mitochondrial DNA (tRNAleu-cox2 intergenic region), nuclear genome-wide single nucleotide polymorphisms (SNPs), and wing shape (DeepWings©) to provide the most updated and extensive account of honey bee genetic variation in Europe. Our results reveal a strong dominance of C-lineage ancestry across Europe, with noteworthy introgression signals in island subspecies and A. m. mellifera populations outside conservation apiaries. Notably, all three markers consistently captured these broad introgression patterns.

This unprecedented survey highlights a worrying trend of genetic homogenization in European honey bee populations. Moreover, the widespread prevalence of C-lineage genetic introgression underscores the need for conservation efforts to preserve the diversity shaped by evolution, which is crucial for adaptation to growing environmental challenges.

OP-078 [Bee Biology]
Beelining in the bush: Wild honey bee nest natural history and turnover in South Africa

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While the western honey bee (Apis mellifera) is well studied as managed livestock, relatively little is known about unmanaged populations of this important pollinator. Across Africa, the nesting ecology of wild and unmanaged honey bees remains understudied. In the Eastern Cape Province, South Africa, many agricultural lands have been converted to nature reserves, on which land management decisions are rarely made with pollinators in mind. We located wild and unmanaged honey bee colonies around the town of Makhanda using beelining techniques, with which we followed foragers from stands with sugar water to their nest entrances. Once located, we recorded nest natural history data such as cavity type and entrance orientation. Additionally, we monitored nest vacancy and damage at three time points over 12 months. We assessed seasonal changes in nest vacancy and damage by cavity type using generalized linear mixed effect models. We located 127 wild and unmanaged nests, 91 of which were located via beelining. Nests in the ground were most prevalent (69.0%), followed by nests in plants (23.8%), manmade structures (5.6%), and rock faces (1.6%). By the end of the study, over half of all nests were vacated. Nests in the ground were vacated and damaged more frequently than were nests in plants after 4-6 months of monitoring ($p < 0.05$). While the western honey bee is often described as tree-dwelling, we demonstrate that wild and unmanaged nest natural history may be regionally specific. Within our study area, wild and unmanaged colonies may rely on other animals, such as aardvarks, to create nest sites in the ground. However, nests in the ground may be more prone to flooding, predation, and other disturbances compared to plant-based nests. Secure nest sites may be a scarce resource in our study area or nest site selection may be limited by time and energy costs. High overall nest turnover may reflect harsh environmental conditions leading to colony abscondment or death. Insights from locating and monitoring wild and unmanaged populations of pollinators are essential for informing local land management decisions and conservation initiatives.

OP-079 [Bee Biology]
Alien species - European beekeeping under "siege"

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Background
Recent incidents of detection of the parasitic mite Tropilaelaps mercedesae in Georgia and the Red dwarf honey bee Apis florea in Malta alarmed the European and global beekeeping community.

Problem description
Resource competition and pathogen transmission are the keystones of the concerns related to the possible expansion, natural or anthropological, of A. floreaon the European continent. However, Malta's situation is even more dramatic since the small endemic honey bee population (Apis mellifera ruttneri), important in honey bee biodiversity, is already under enormous pressure. The arrival of Tropilaelaps in Eastern Europe may produce even worse scenarios since we understand that the mite is already moving towards the Balkans and Eastern Europe, with reports about devastating consequences in Georgia and the Black Sea region.

Methodology
The current state of the art of detection, monitoring and control methods concerning both species is presented and discussed, focusing on the efficacy, pros and cons of each known method.

Results and conclusion
We hypothesise possible invasion pathways and discuss the potential risks these species pose to European beekeeping. In addition, by publishing and sharing a multi-lingual flyer and website (see www.tropilaelaps.info) on Tropilaelaps, as part of the Horizon Europe project BeeGuards (grant 101082073; www.beeguards.eu), we hope to raise awareness of these alien species in the beekeeping community and general public.

Practical implications for beekeepers
On-time education and training of the beekeepers and authorities can slow down the invasion pace, amortise the first-wave impact and reduce losses and economic consequences. Additionally, beekeepers will benefit from the involvement of relevant authorities and the strengthening or establishment of a monitoring system for the early detection of alien species.

OP-080 [Bee Biology]
Giant Honeybees of Asia: Based on Morphological and Genetic Study

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BACKGROUND: The giant honeybees (subgenus Megapis) of Asia are important pollinators that build open nests on branches of tall trees and rocky cliffs. Two species are now generally recognised: Apis dorsata and Apis laboriosa. However, some researchers have argued that morphological variation between dorsata and laboriosa is due to their occurrence at different elevations: dorsata is widely distributed in lowlands whereas laboriosa is endemic to the higher elevations in Himalaya and neighbouring mountain ranges. Additionally, based on genetic analyses, some researchers have suggested that the three additional populations deserve species status: Sulawesi, Indonesia (A. binghami), the Philippines (A. breviligula), and South-India A. dorsata.

PROBLEM DESCRIPTION: The taxonomy and phylogeny of Megapis are controversial and unresolved. The species boundaries within this subgenus are unclear and species recognized on basis of genetic differences lack supporting morphological characters. Our goal was to (1) compare sympatric dorsata and laboriosa specimens morphologically and genetically; (2) uncover morphological differences between the populations, and (3) create a taxonomic key for identification of the species we could distinguish.

METHODOLOGY: We examined morphological characters of both drones and worker bees of all five populations. Thorax muscles from specimens from sites of sympatry were used for DNA extraction. Phylogeny reconstruction was performed using ~600bp of mtDNA COI. The specimens were deposited at the Research Collection Facility, NCBS-TIFR, Bengaluru, India.

RESULTS AND CONCLUSION: Based on numerous morphological characters, laboriosa is very distinctive from the other taxa. Mainland dorsata differed in several characters from the Philippines + Sulawesi populations based on colouration, ocellus size, and other characters. Despite its name “breviligula”, the tongue length of Philippine specimens did not differ from binghami of Sulawesi. We provided keys for identification of A. dorsata, A. laboriosa, and A. binghami.

The phylogenetic analysis of mtDNA COI from specimens from sites of sympatry perfectly matched morphological differences between A. dorsata and A. laboriosa, further confirming the species status of laboriosa.

Additional morphological and genetic analyses are required to resolve the status of A. breviligula and South-India A. dorsata.

OP-081 [Bee Biology]
Status Report on BeeGuards Innovative Breeding Strategies

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Background
The BeeGuards project (EU Horizon Europe, grant 101082073) aims to make beekeeping more resilient, by providing, among others, sustainable management practices and novel breeding strategies.

Problem description
Conventional beekeeping commonly relies on calendar-based treatment applications for Varroa control, irrespective of the actual infestation levels. Such an approach allows non-selective propagation of genotypes to the next generation, regardless of their resistance level. However, a few dedicated breeding initiatives aimed at enhancing Varroa resistance utilize natural selection strategies, particularly when performance testing colonies and drone producing colonies (DPC) are exposed to high infestation levels. Validating such concepts so far has not been done.

Methodology
The joint study is performed in 4 European countries (DE, IT, PL and MK), with 3 honey bee subspecies (A. m. carnica, A. m. ligustica & A. m. macedonica) including 150+ colonies/year (N=3). Colonies of uniform genetic background are differentially managed (conventional treatment regime vs. innovative threshold-based management) during performance testing under local conditions. Subsequently, queens are propagated from these colonies and mated with drones from their respective treatment cohort. Innovative management and breeding entails Varroa treatment based on local infestation thresholds, while controlled mating occurs in conditions of high infestation pressure of DPC. The aim is to verify the hypothesis that drones that successfully mate with queens under these circumstances carry genes for Varroa resistance. The primary decision-making framework is a field study combined with genomic breeding value estimation (EBV). While previously published gene associations are validated, additional insights will be gained.

RESULTS: Besides the opportunity to promote the pivotal role of mating stations, we will evaluate whether the approach can be adapted when using instrumental insemination. In addition, the possibility of accelerating traditional breeding cycles is tested under real-life beekeeping conditions and combined with EBV. The results of performance test in the first season will be reported.

Practical implications
Improved breeding strategies, applied within the general beekeeping community, can support sustainable and chemical-free beekeeping by using resistant stock and biotechnical methods for Varroa control. In addition, the acceleration of breeding cycles holds the potential to foster the genetic gain.

OP-082 [Bee Biology]
Dietary omega-6:3 fatty acids ratio affects honey bee (Apis mellifera) spatial cognition: maze and landmark learning

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Honey bee foragers have remarkable cognitive abilities, including associative and spatial learning. Malnutrition is a main stressor affecting honey bee health and behavior. Pollen provides many important micronutrients and macronutrients, including lipids. Of these, two essential fatty acids, omega-3 and omega-6, are abundant in pollen, and play a major role in bee health and cognition. However, pollens differ in the relative proportions of these two fatty acids, and bees must maintain a balanced omega-6:3 ratio. High omega-6:3 ratio impairs olfactory and tactile associative learning. Here we tested whether it also affects spatial cognition. Colonies were kept in netted enclosures and fed artificial diets enriched with different concentrations of corn (high in omega-6) and flaxseed (high in omega-3) oils, resulting in a balanced (omega-6:3 ratio = 1) or an unbalanced (omega-6:3 ratio = 5) diet. Newly-emerged bees were marked and tested when they were 3 weeks old. In experiment 1, bees were trained to enter the center of an 8-arm maze (25 cm diameter). Bees had to walk to the end of each arm, where they found sucrose solution reward. A trial was completed upon visiting all 8 arms, and the bee flew back to the colony. Each bee completed 8 such trials. In experiment 2, bees flew into a netted circular arena (90 cm diameter), with 8 feeders aligned on vertical stilts along the circumference. Only one of these feeders contained sucrose solution. Colored cylinder landmarks in a triangular configuration at the center of the arena guided towards the rewarding feeder. A marked bee flew into the arena and visited the feeders until finding the rewarding one, marking the end of a trial, returned to the hive and back to the arena for a total of 8 trials. In both experiments, bees were filmed from above, and detected and followed with custom-built software. In both experiments, bees fed a balanced diet solved the spatial task more quickly, with fewer errors. The implication of these results is that unbalanced forage may impair bee spatial cognition, affecting their foraging and homing abilities, and consequently colony strength.

OP-083 [Bee Biology]
Generating a comprehensive metagenome-assembled genome (MAG) catalogue of the honey bee gut

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A holistic approach to bee health is required to address global challenges. A key component of bee health is the bee's gut microbiota, which plays an essential role in digestion, defense against pathogens and regulation of the immune system, making it a key area of research to improve the sustainability of beekeeping. A balanced and healthy microbiota can enable honey bees to respond more efficiently to pathogen infections or disturbances such as exposure to agricultural pesticides. Despite recent significant advances in gut microbiome studies, a comprehensive study of honey bee gut bacterial, archaeal, and viral genomes across multiple biogeographical regions and honey bee subspecies remains unavailable.

Therefore, within the European BeeGuards project, we will leverage the consortium's large scale field study across 12 European countries to generate the first comprehensive integrated honey bee gut metagenome catalogue (MAG) (iBeeMC). To this end, we are deep sequencing >90 worker bee guts sampled across Europe capturing the bacterial strain diversity of diverse honey bees genotypes and climates. Additionally, by measuring DWV-A and B loads, we will obtain further knowledge on the abundance and distribution of this virus across Europe. Importantly, the iBeeMC and viral loads will be used to study the effect of management on the microbiome of honey bees.

Further, we will implement a hologenomic framework to honeybee research by generating hologenomic sequence data (bee genomes and transcriptomes, gut metagenomes and metatranscriptomes) from field and controlled laboratory experiments that will be linked to phenotypic colony observations such as colony development patterns, pathogen loads, and colony performance and survival, as well as environmental data collected from in-hive digital tools. From a microbial ecology perspective, we aim to identify microbial profiles associated with resilience (enrichment or depletion of certain microbial variants and/or functions).

By understanding the interactions between bees, their microbiomes, and their environment, BeeGuards will provide valuable insights for informed decision-making in resilient beekeeping.

OP-084 [Bee Biology]
Genetic Selection and Immune Mechanisms: A Scientific Approach to Enhancing Honeybee Resilience Against Viral Infections and Environmental Stressors

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Honeybees (Apis mellifera) play a critical role in global food production and biodiversity preservation. However, climate change, habitat degradation, and increasing pathogen virulence are driving unprecedented colony losses, threatening both beekeeping sustainability and agricultural stability. Traditional breeding techniques, primarily focused on single-trait selection for Varroa destructor resistance, have become insufficient in addressing modern challenges, particularly viral infections that contribute to colony immunosuppression. This study aims to develop a comprehensive genetic selection program that integrates viral resistance, immune system modulation, and colony resilience, providing beekeepers with a scientifically validated approach to improve honeybee health.

Problem Description:
Increased pathogenicity and virulence of honeybee diseases.
Reduction in plant biodiversity, limiting essential forage resources.
Unsustainable environmental and management costs for beekeepers.

Transmission pathways include queen-to-progeny vertical transmission, horizontal spread via Varroa destructor, contaminated food, and direct contact among bees. The complexity of viral co-infections, combined with the high level of social interaction within colonies, exacerbates disease spread and immunosuppression, placing extreme pressure on honeybee health.

Currently, no standardized selection criteria address viral resistance in breeding programs, making it challenging for beekeepers to choose resilient queen lines.

Methodology
An integrated breeding approach to improve honeybee resistance to viral infections through:
Selection of honeybee lines with enhanced immune responses, targeting virus-specific and broad-spectrum defense mechanisms; establishment of standardized diagnostic tools to assess queen health, reproductive viability, and colony resilience.

Data collection will involve controlled viral exposure trials, genetic and immunological profiling, and field assessments of selected colonies under diverse environmental conditions. A shared international database will be established to facilitate large-scale selection and breeding collaborations.

Results and CONCLUSION: Preliminary findings indicate that colonies selectively bred for enhanced immune function show increased tolerance to viral infections and overall improved health.By bridging scientific research and practical beekeeping needs, this program provides a transformative solution for beekeepers facing modern beekeeping challenges.
Availability of genetically resilient bee lines, reducing dependence on chemical treatments.
Development of diagnostic tools to support breeding decisions and optimize colony renewal.
Reduction in colony losses and associated economic burdens. Increased pollination efficiency and agricultural sustainability. Establishment of an international selection network to facilitate shared breeding efforts.

OP-085 [Bee Biology]
Overwintering Strategies for Honey Bees in the Yukon Subarctic: A Data-Driven Analysis

Etienne Tardif
Independent Research

The Yukon's subarctic climate imposes prolonged cold conditions that can stress honey bee colonies and threaten their survival. This research aimed to understand how honey bees manage their internal hive environment amid extreme winters, and to identify practical interventions for beekeepers in similarly harsh regions. Winter survival rates often drop when colonies fail to regulate temperature, humidity, and gas concentrations (CO). Beekeepers face decisions about hive configuration—such as entrance position, hive volume, and insulation value—that directly impact colony health. Data were collected throughout multiple winters, tracking local weather patterns, ambient hive temperatures (sensor array), relative humidity, CO , and O levels. Several hive setups were tested to evaluate how changes in entrance size, total hive volume, and insulation materials affected the colony's ability to maintain optimal conditions. Frequent hive checks and continuous sensor recordings provided insight into how bees regulate their microenvironment despite sustained sub-zero temperatures. Preliminary findings indicate that colonies adeptly adjust their clustering behaviour to maintain stable internal temperatures, even as external conditions plunged well below freezing. Optimal insulation levels reduced excessive moisture buildup, whereas properly sized entrances supported adequate gas exchange without compromising warmth. Moderate CO elevations appear to reduce bee metabolic rate, thereby lowering honey consumption and minimizing waste production (metabolic water, fecal matter) thus allowing the honey bees to go extended periods without cleansing (6-7 months). Consistently monitoring hive metrics also revealed that bees can control and manage internal conditions (temperature, humidity, CO) to optimal levels. These observations highlight the honey bees' remarkable resilience and provide evidence-based strategies for subarctic beekeeping. By refining entrance configurations, adjusting hive volume to colony size, and employing right amount of insulation, beekeepers can reduce stressors on overwintering bees. Implementing routine sensor tracking further aids in early detection of unfavorable conditions, allowing timely interventions that support healthier colonies through challenging winters.

OP-086 [Bee Biology]
Integrated Breeding Strategy for Apis mellifera: Towards Sustainable Beekeeping

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The Canadian beekeeping industry has faced major challenges, with an average colony loss of 26% since 2007, reaching a peak of 46% in 2022. This has led to increased reliance on imported honeybees and queens, which pose risks such as the introduction of new diseases, treatment-resistant pathogens, and negative impact on queen reproductive quality. Additionally, imported honeybees, which are less adapted to Canada's cold climate, have lower winter survival rates, whereas locally bred honeybees, better suited to Canadian conditions, show higher survival rates. In response to these challenges, the CRSAD/UL honeybee genetic selection program has made significant progress over the past fifteen years in improving crucial traits such as hygienic behavior (+0.30% per year), honey production (+0.63kg per year), and spring development (+164 brood cells per year). Using the BLUP-animal methodology, breeding values for all colonies were estimated and selected for reproduction, leading to notable genetic improvements.The current goal of the program is to develop a methodology that makes these improved genetics available to the entire Canadian beekeeping industry. A pyramidal selection strategy was implemented at the Deschambault Animal Sciences Research Center, where pure lines are maintained in a selection core. From this core, 180 genetically improved queens are distributed to six participating breeders for multiplication. These breeders collect as much phenotypic data on honey production as the research center, using the colonies from the selection program that form the selection core. All this data is then used to estimate the reproductive values of the distributed queens, facilitating the selection of future breeding colonies. Our results have shown significant genetic potential in several queens entrusted to breeders. These queens with superior genetics will be disseminated to beekeepers across Canada through their multiplication by the breeders, who collectively produce 28,000 queens annually. The pyramidal selection strategy aims to enhance the sustainability and self-sufficiency of the Canadian beekeeping industry. This project also seeks to evaluate the effectiveness of this strategy, particularly in honey production, to support the industry's transition to greater autonomy.

OP-087 [Bee Biology]
Impact of viruses on recapping behaviour

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Background and Purpose
The parasite Varroa destructor is a major threat to the honey bees (Apis mellifera) and to beekeeping worldwide. The pathological effect of varroa on honey bees colonies is not limited to its direct effect, but also to its capacity as a virus vector. However, specific honey bee population have developed resistance to the parasite and are able to regulate the growth of the varroa population within the colony, without the required use of mite-control pesticides. Non-reproduction of the varroa mite is a key feature of this varroa resistance. This is displayed by different behaviours or traits from both adults and brood. One of the behaviours that is gaining renewed interest is the recapping behaviour of varroa-parasitized brood cells by the adult worker bees. Little is known about the underlying triggers of this behaviour. In this study, we investigated the relationship between the viral load of the targeted pupae and the recapping behaviour.

Methodology
We studied the appearance of the cell cappings of brood cells to identify recapping behaviour and the varroa infestation and the prevalence of viruses associated with varroa were recorded for each of these brood cells.

Results and conclusions
This study revealed a link between the pupal viral load and recapping which is a behaviour of adult bees. These findings raise new questions regarding the trigger of this behaviour along with the distinction between recapping behaviour and varroa sensitive hygiene behaviour.

Practical implications for beekeepers
This study provides a deeper understanding of the recapping behaviour and how it is linked with varroa resistance and other resistance behaviours, ultimately to contribute to the development of sustainable strategies for controlling mites and viral diseases using resistant honey bees.

OP-088 [Bee Biology]
A dynamic picture of the diffusion of Apis mellifera mitochondrial DNA lineages in Italy over the last few decades utilizing honey as a source of honey bee population genetic information

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The genetic integrity of the European *Apis mellifera* subspecies in many European regions has been threatened by the human-mediated dispersion of non-native populations and lines, which has intensified over the last few years. Many studies have utilized mitochondrial DNA (mtDNA) analysis from honey bees to gather information on the diffusion of various mtDNA haplotypes and to monitor the genetic integrity of *A. mellifera* subspecies. Honey contains environmental DNA (eDNA) traces from all organisms directly or indirectly involved in its production, including the DNA of the honey bees that produced it, making it useful for indirectly monitoring the genetic integrity of honey bee populations. In this study we present a snapshot of the diffusion of the main *A. mellifera* mtDNA lineages in Italy from the last few decades using honey as a source of honey bee mtDNA sequences. DNA was extracted from over 5000 honey samples produced in all regions of the Italian peninsula, Sardinia and Sicily, from 1985 to 2024. PCR products were analyzed using a fragment size-based assay. Results confirmed that the C lineage was the most frequent mtDNA haplotype throughout Italy except in Sicily where the A lineage was highly represented. Other mtDNA haplotypes (A and M lineages) were present in almost all Italian regions. The frequency of the A mtDNA lineage has recently increased in many Italian regions, indicating an increasing level of genetic admixture within the Italian honey bee population. The results provide a time-dynamic distribution map of honey bee mtDNA lineages in Italy that can be valuable for designing and evaluating the potential effectiveness of conservation policies aimed at maintaining the integrity of honey bee genetic resources in Italy. Additionally, we also demonstrated that honey offers a simplified yet extensive population genetic picture, as each honey sample may contain the DNA of many different honey bees from different colonies or even different apiaries.

OP-089 [Bee Biology]
Implementation of an extended SNP Panel for the genetic monitoring of honeybees and its application to A. mellifera mellifera and A. mellifera carnica samples across Europe

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A number of methods have been established for the routine genetic monitoring of honeybees. These mainly focus on the estimation of hybridization between subspecies, as introgression is a major threat to the genetic integrity of native subspecies, leading to the replacement of locally adapted forms and the loss of species' genetic diversity through homogenization. Given this focus, intra-subspecies diversity of markers is limited, making them less suitable for the estimation of other measures relevant in a conservation monitoring scheme, such as genetic diversity, inbreeding and effective population size.

In this project, we evaluate a new tool for the genetic monitoring of honeybees, a 70K SNP-chip based on Jones et al. (2021). This has the advantage of including markers identified in previous studies that reflect phenotypic differences, such as variation in immune response or associations with traits such as hygienic behaviour, honey production and varroa tolerance. It also includes previously published marker sets for the estimation of introgression. The inclusion of markers that show intra-subspecies variation of functional relevance, as well as the higher marker density compared to previous honeybee SNP-chips, makes this a promising tool including a wide range of applications. These are the estimation of genetic diversity, inbreeding and effective population size, parentage analysis and possible genomic selection in breeding programs. Further, the analysis of introgression was optimized to distinguish between six clusters comprising of the A-, O- and Y-Lineages, A. mellifera mellifera, A. mellifera carnica and A. mellifera ligustica, using a comprehensive database of 1270 reference samples, built considering a total of 20 subspecies and ~4600 samples across Europe, the Middle East and Africa.

Here, we report on the optimization and validation of these applications on the basis of the 70K SNP-chip and present results on ~4200 samples targeting A. m. mellifera and A. m. carnica across 20 European countries.

OP-090 [Bee Biology]
Conservation status of the honey bee subspecies native to the Mediterranean islands

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The Mediterranean islands have been a stage for honey bee diversification, hosting four of the 31 recognized subspecies: Apis mellifera siciliana in Sicily, A. m. ruttneri in Malta, A. m. cypria in Cyprus, and A. m. adami in Crete. However, owing to small population sizes, island subspecies are particularly vulnerable to introgressive hybridization when exotic queens or colonies are introduced into their geographically isolated territories. While previous genetic surveys—typically based on mitochondrial and/or microsatellite markers—have provided valuable insights, the current conservation status of these subspecies remains uncertain.

Here, we sequenced the whole genomes of 327 samples collected from Sicily (n=97), Malta (n=79), Cyprus (n=37), and Crete (n=36), along with probable source populations (A. m. intermissa, A. m. sahariensis, A. m. media, A. m. anatoliaca, A. m. macedonica, A. m. cecropia, A. m. ligustica, A. m. carnica, A. m. caucasia), to provide a comprehensive and up-to-date assessment of the ancestry and diversity patterns of these insular subspecies. Whole-genome data were analysed using the software Admixture and additional analytical tools to explore ancestry and introgression patterns.

For A. m. siciliana, 32 out of 97 samples (32.99%) exhibited high purity levels based on a threshold of 0.9. The situation in Malta was more concerning, with only 11 out of 79 samples (13.92%) classified as pure A. m. ruttneri. The most severe admixture was observed in Crete, where just 2 out of 36 samples (5.56%) were identified as pure A. m. adami, highlighting extensive hybridization with mainland subspecies. Meanwhile, A. m. cypria appears to be the best-preserved Mediterranean subspecies, with genetic integrity largely maintained except in the northwestern population, which exhibited shared ancestry with mainland A. m. anatoliaca.

Overall, our findings highlight the urgent need for conservation efforts across these islands. While the native subspecies remain threatened by hybridization, their preservation might still be possible, provided that further importations of non-native colonies are effectively prevented.

OP-091 [Bee Biology]
Morphometric and genetic diversity of Philippine stingless bees

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There are about 550 known species of stingless bees in the world (Grüter, 2020), where 61 are from Southeast Asia (Duangphakdee et al., 2024) and 12 are from the Philippines (Baltazar, 1966). The taxonomic classification of stingless bees based on morphological characters can often lead to a synonymous species. Thus, determining discriminatory morphometric characters for each species will be of great help for correct identification by other researchers in the future and proper assessment of the stingless bee diversity and conservation. To address these knowledge gaps, taxonomic profiling of Philippine stingless bees using morphological and molecular techniques was conducted. Samples of stingless bees were collected from 170 colonies in 26 localities in the Philippines. Characters (i.e., body, wing, leg length, and/or width) were measured, and the most discriminatory characters were determined using morphometric analysis. For the molecular part, 205 individuals were subjected to RAD seq, which resulted in several genetic clusters across the islands of the Philippines. This study has led to a proper assessment of the diversity and conservation of particular species and the establishment of a standardized method in stingless bee-keeping in a specific environment.

OP-092 [Bee Biology]
The Synergy of Sustainable Selection: Interlacing Sustainable Management Practices, Epigenetics and Adaptive Bee Breeding for Changing Climes & Times

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Shifting climate and every-changing environmental circumstances are increasingly impacting the American beekeeping industry. Concerted efforts to develop mite resistant stock lines through place-based selection and adaptive rearing protocol are still needed for beekeepers and their bees to adapt to increasing challenges while also supporting livelihoods. The United States includes diverse biomes and ecoregions. Current common practices include migratory beekeeping strategies for securing forage access and mating conducive weather scenarios. For some beekeepers, the practice of moving their bees has become a strategic pattern of practice for survival of their livelihoods and for their bees. The Adaptive Bee Breeders Alliance (ABBA) is a U.S. based cross-country network of bee breeders and scientists collaborating to better support and conserve place-based and adaptive bee strains through regenerative methods. ABBA's current Western Sustainable Agriculture Research Education programs' Research to Grassroots grant funded project, "Building Comb from Castle to Castle" focuses on curating methods for bee breeding genomics analysis, cryopreservation processes, Instrumental Insemination (I.I.) training, Drone Congregation Area (DCA) assessments, Educational outreach and workshops for beekeepers to support continued professional growth, development of climate smart practices, and encourage resilience of stewards and their bees.

The Adaptive Bee Breeders Alliance has developed collaborative open-source findings and media guides to connect bee stewards with quality rearing processes and to nurture relationships between the field and the lab. In the coming years, ABBA aspires to include beekeepers of all scales across the United States with interest to connect with bee breeders across the globe. By sharing practices and resources across landscapes, together bee stewards can conserve and nurture adaptive stock lines that are healthy, productive, and enduring.

OP-093 [Bee Biology]
Genetic variation of detoxification genes: from genes to proteins

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Honey bees (Apis mellifera) are exposed to natural and synthetic xenobiotics, requiring genetic adaptations for survival. Several gene families have been implicated in insect pesticide resistance, including cytochrome P450s, glutathione-S-transferases (GSTs), esterases, and uridine diphosphate (UDP)-glycosyltransferases. This study investigates genetic variation in these detoxification gene families and predicts the structural and functional effects of non-synonymous SNPs (single nucleotide polymorphisms) on protein structure and function. We analyzed SNPs mapped to these detoxification genes extracted from over 1,500 whole genomes representing 15 subspecies and the four main honey bee lineages: M, C, A, and O. Functional annotation and variant effects were predicted using SnpEff. Allele frequencies and each SNP's fixation index (FST) were calculated per population and evolutionary lineage. Bioinformatics and molecular modeling techniques were employed to evaluate non-synonymous SNPs' structural and functional consequences. Protein structures were generated from FASTA files using AlphaFold3, converted from mmCIF to PDB format, and visualized in PyMOL. Functional site predictions were performed using Proteins Plus, and molecular dynamics simulations were conducted in YASARA to assess stability and conformational changes in proteins. Our results indicate many non-synonymous SNPs in some subspecies, such as A. m. jemenitica and A. m. intermissa. The genes with the highest number of non-synonymous mutations belong to the CYP family, particularly Probable cytochrome P450 6a14 and CYP9Q1. Conversely, genes such as Cytochrome P450 6k1 and Methyl farnesoate epoxidase exhibit no non-synonymous SNPs. By understanding intraspecific genetic variation, we move closer to reliably predicting how honey bee populations will respond to pesticide exposure.

This work was conducted in the framework of the projects MEDIBEES - Monitoring the Mediterranean Honey Bee Subspecies and their Resilience to Climate Change for the Improvement of Sustainable Agro-Ecosystems funded by PRIMA, Better-B, funded by the European Union, the Swiss State Secretariat for Education, Research and Innovation, and UK Research and Innovation, under the UK government's Horizon Europe funding guarantee (grant number 10068544) and Bee3Pomics: Omics insights into molecular effects of plant protection products in honey bees (Apis mellifera) funded by the RESTART-FCT

BEE HEALTH

OP-094 [Bee Health]
Bee Aware Science: Ten Scientific Articles Highlights Every Month

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Scientific research relating to honeybee health and hive products is abundant, but we consider that it is not sufficiently promoted or disseminated to beekeepers, technicians and players in charge of honeybee health (administrations, veterinarians, technicians, laboratories, researchers). French vets specialising in honeybee colony health wanted to improve their access to new scientific knowledge that is regularly published and relevant to their day-to-day work. With this aim of sharing and disseminating knowledge, since September 2019 we have been carrying out a daily independent and voluntary bibliographic watch. Every month, we digitally publish a collection of abstracts of the ten most interesting articles recently published. The articles selected may deal with any beekeeping theme, including apitherapy, bee biology and health, the industry's economy, beekeeping practices or pollination. This bibliographic watch is carried out using online search engines (PubMed©, GoogleScolar©, Researchgate©, etc.) and smartphone applications (Researcher©, R Discovery©, etc.). An editorial board, free of any conflict of interest and comprising several French veterinary experts in bee health, is responsible for selecting the articles chosen each month. In addition to the theme, the selection of articles is based on the quality of the publication, the independence of the authors, the reputation of the journal (Impact Factor) and the contribution of new and useful information to the beekeeping industry. This gazette is shared freely and openly with all those who request it. Its six-page format is quick and easy to read, making it easy to keep up to date. Today, the French version is distributed to all partners in the beekeeping industry in France: beekeeping unions, beekeeper groups, research organizations, analysis laboratories, pharmaceutical industries, journalists, politicians, veterinary practitioners and schools in particular. The English version is currently distributed in 31 countries on five continents, mainly to scientists. The long-term aim is to widen the circle of distribution of the English version of this gazette, to make scientific advances relating to Apis mellifera accessible to as many people as possible.

OP-095 [Bee Health]
Exploring RNA methylation as a promising biomarker for assessing risk of pesticide on honeybees

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Honeybees play a crucial role as pollinators for crops and are regarded as sensitive bioindicators of environmental health. The widespread use of pesticides poses a severe threat to honeybee survival. It is imperative to assess the toxic effects of pesticides on honeybees to facilitate informed scientific application and management of these compounds, ultimately reducing their potential ecological risks. Exposure to toxic components, even at low concentrations can induce epigenetic alterations in organisms, and various epigenetic marks are recognized as indicators of environmental disturbances. In recent years, RNA methylation has emerged as a growing field of research in toxicological studies of xenobiotic compounds. However, the study on RNA methylation in honeybees is still in its early stages, and no demonstrated examples exist thus far illustrating changes in RNA methylation levels in response to external environmental factors. Recognizing the significance of RNA methylations across diverseorganisms and the lack of relevant information regarding honeybees, our study aimed to investigate the effects of phenylimidazole pesticides on various RNA methylations in honeybee larvae and adults at environmentally relevant doses. We found the response patterns of RNA methylation upon exposure to these pesticides. Furthermore, we detected significant alterations in the expression levels of genes associated with RNA methylation in both honeybee larvae and newly emerged adults. Notably, we identified potential biomarkers derived from RNA methylation and their related genes for pesticide risk assessment purposes. This pioneering study provides valuable insights into the impact of phenylimidazole pesticides on RNA methylations within honeybees while exploring the feasibility of utilizing RNA methylation as a tool for assessing pesticide risks among this vital pollinator species. These findings offer new perspectives on strategies for protecting honeybees and advancing toxicity evaluation systems for pesticides.

OP-096 [Bee Health]
Nosema (Vairimorpha) ceranae infection alters honey bee (Apis mellifera) queen behavior and reproductive capacity

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The takeover of Nosema (Vairimorpha) ceranae over N. apis as the primary honey bee (Apis mellifera) gut pathogen in the United States has revealed a knowledge gap regarding how N. ceranae affects the reproductive health of queens and drones. While the general consequences of intense Nosemosis are well-substantiated, the long-term effects of Nosema infection, specifically on queen behavior, are understudied. In this study, we explored the effects of N. ceranae infection on queen egg-laying capacity, mobility, and retinue behavior. We hypothesized that queens would lay fewer eggs, be less mobile, and elicit a smaller worker retinue after inoculation with N. ceranae compared to the baseline values for these behaviors prior to infection. We set up observation colonies headed by sister queens and fed each a sucrose solution. We monitored the queens' egg-laying capacity, mobility, and retinue behavior in the observation colonies for six consecutive days. Then, each queen was inoculated with 200 µL of sucrose solution containing roughly 200,000 N. ceranae spores and measured the same parameters from each queen starting one day post infection, and doing so for six consecutive days. We found a significant increase in mobility and egg-laying capacity with a significant decrease in retinue size in queens post infection. Our results indicate that honey bee queens infected with N. ceranae suffer physiological consequences that is likely to be translated to an overall decline in colony productivity over time.

OP-097 [Bee Health]
Official Monitoring of American Foulbrood in Saxony 2019 - 2023

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American foulbrood (AFB) is a notifiable disease, listed in EU directive 2018/1882. Over recent years, outbreaks of AFB have been consistently recorded in Saxony, though at a low rate. In 2019, an official monitoring system was established to detect early stages of colony infections before clinical symptoms of infection are apparent and thereby reduce the costs caused by restrictions on the movement of colonies following an AFB infection.

Every year, approximately a quarter of the registered hives of Saxony was tested for AFB, including honey from the brood nest or winter hive debris. Material from up to 12 samples (colonies) was pooled. Samples were investigated for Paenibacillus larvae according to the methods published by the Federal Research Institute for Animal Health, the Friedrich-Loeffler-Institut (FLI).

In total, 8146 samples from 6373 beekeepers were examined. In the first year, 3.1% of the apiaries were positive for P. larvae. The rate dropped during the monitoring period to 1.2% in 2023. The P. larvae positive samples were classified according to colony forming units (cfu).

Across the monitoring period 2019-2023, positive samples were less frequently detected. Furthermore, the number of cfu per sample was reduced. Monitoring offers the oportunity to detect infections with P. larvae before colonies show clinical symptoms of the disease, whereupon measures can be taken to prevent the establishment of the disease.

OP-098 [Bee Health]
Presence of pesticide residues in honey-bee-collected pollen in the context of Latvian landscapes

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The widely managed pollinator honey bee (Apis mellifera) is crucial for crop fertilization. Recent studies show increased bee colony mortality rate due to anthropogenic activities (agricultural land use) and greater use for plant protection products. Our study investigated pesticide residues in pollen samples collected by honey bees, and how the landscape composition and seasonality influenced pollen contamination. In 2023, six apiaries have been selected from different Latvian landscapes (semi-natural habitats, agricultural habitats, urban environment). We carefully collected pollen samples throughout the flowering season (2023). 39 pollen samples were analyzed, of which 21 samples contained 93 pesticide residues (mainly fungicides), with values above the limit of quantification. The most frequently residues in the pollen samples were acetamiprid (28 times detected), boscalid (10), fluopyram and prothioconazole (8). The highest concentrations were detected for dimoxystrobin (44 µg kg¹), acetamiprid (37 µg kg¹), azoxystrobin (27 µg kg¹), prothioconazole (25 µg kg¹) and boscalid (15 µg kg¹). The calculation of the Pollen Hazard Quotient (PHQ) was conducted for the each pollen sample. No pollen sample tested exceeded the PHQ value of 50. Highest cumulative PHQ value of 3.621 was observed in the first half of the growing season (29.05.-11.06.), after which the PHQ value decreased significantly. To assess the effect of agricultural land cover on PHQ, a linear regression analysis was performed using agricultural land cover (%) within a three kilometer radius as a factor and PHQ values as the response variable. A significant strong positive correlation ($r = 0.67$, $p = 0.05$) was calculated between the proportion of Brassicaceae pollen and the concentration of acetamiprid in the samples, confirming that honeybees mainly collected pollen from flowering fields of oilseed rape. There was no statistically significant relationship between PHQ and landscape composition ($\beta = 0.06$; $p = 0.07$).The increase in the proportion of agricultural land within the landscape was not found to correlate with higher levels of pollen residue and increased PHQ values. The present study demonstrates that a low proportion of agricultural land in the landscape does not ensure that honey bees can avoid coming into contact with pesticides while gathering pollen and nectar.

OP-099 [Bee Health]
Tracking the evolution of viral titers in colony sub-populations throughout the season and in response to varroa treatment strategies

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Varroa destructor vectors numerous economically important honey bee viruses; however, the full details of the varroa-virus-honey bee dynamic remain to be elucidated. For example, varroa preferentially parasitize drone larvae and adults, yet the role played by the shifting production of drones across the season with respect to viral loads in the functionally crucial worker population is currently unexplored. Additionally, the consequence of varying type and timing of varroa treatments on viral titers in drones and workers, and ultimately on colony productivity, has not been determined. We received funding from the North Dakota Department of Agriculture to conduct a two-year project in southern Ontario, Canada to assess viral titers (DWV-A, DWV-B, and DWV-C) in colony sub-populations across the season and subjected to varying varroa treatment regimes. We tracked colony health, productivity, and varroa infestation parameters, and conducted operculated brood biopsies on worker and drone brood monthly. In addition to characterizing and quantifying mite levels in biopsied brood, we sampled purple-eyed worker and drone pupae from cells that were or were not infested with varroa, as well as adult workers and drones. All samples were blinded and sent to the National Agricultural Genotyping Center in Fargo, North Dakota, for high-throughput qPCR viral analysis. Our results highlight the role of drones in the varroa-virus-honey bee system, and underscore the importance of appropriate varroa treatment and timing.

OP-100 [Bee Health]
Honey bee (Apis mellifera) hygienic behavior linked to innate defenses against an adult bee pathogen, Vairimorpha (Nosema) ceranae

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The honey bee colony (Apis mellifera) as a superorganism, functions with a dual immune system operating at the individual and social level. Hygienic behavior as a social mechanism of disease resistance plays a key role in limiting the transmission of pathogens within the colony. This behavior has been linked to reduced brood diseases like chalkbrood, foulbrood, and Varroa infestations, and has been a major focus in artificial selection programs for disease resistance. Vairimorpha (Nosema) ceranae, a microsporidian parasite known to infect adult bees, is not directly targeted by the removal of diseased brood. However, using the Unhealthy Brood Odor (UBeeO) assay, we observed that hygienic colonies had lower V. ceranae loads over time compared to unhygienic colonies. We inoculated individuals from hygienic and unhygienic colonies with V. ceranae to assess their innate defenses against the pathogen. Our results suggest that individuals from hygienic colonies tend to avoid V. ceranae-contaminated food sources, exhibit upregulated vitellogenin gene expression, and have a greater probability of surviving V. ceranae infection. Using mark-recapture techniques, we also investigated the colony acceptance rate of infected individuals in hygienic and unhygienic colonies. Fewer infected individuals were recovered from hygienic colonies by day 3, suggesting that hygienic colonies may be better able to distinguish infected from non-infected individuals, and less likely to accept V. ceranae-infected individuals. Here, we present new findings that link hygienic behavior to general odor detection and individual tolerance to V. ceranae, along with co-occurring social defense mechanisms, that confer colony-level resistance to V. ceranae.

OP-101 [Bee Health]
An in vitro investigation into the survival of Tropilaelaps mercedesae on a range of matrices

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Tropilaelaps spp. are a parasitic mite that feed and reproduce within honey bee brood (Apis spp.) and cause significant damage and mortality to Apis mellifera colonies. T. mercedesae is found outside the range of its natural host A. dorsata and was recently detected in Europe for the first time in 2024 in A. mellifera colonies. It is widely believed that Tropilaelaps spp. are unable to survive without brood. However, studies have demonstrated that T. mercedesae can survive during broodless periods while parasitising A. dorsata and in overwintering colonies of A. mellifera in temperate climates which have are potentially broodless.

This study sought to examine the survival of T. mercedesae on a range of matrices and found that mites could survive for more than 96 hours on live adult A. mellifera and more than 144 hours and 168 hours on decomposing A. mellifera pupae and adults respectively. These findings could indicate one possible mechanism which allows T. mercedesae to survive without brood. These findings also have implications towards better understanding possible transmission routes for Tropilaelaps. Previously bee sales in the form of queens and packages and used beekeeping equipment were considered to be a relatively low risk for transmitting Tropilaelaps spp. due to the absence of live brood. This study demonstrates Tropilaelaps ability to survive in these scenarios and the increased potential for these mites to spread globally.

OP-102 [Bee Health]
ImBieSax – implementation and testing of a veterinary specialist counselling on bee health for beekeepers in Saxony

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The honeybee, third most important production animal in Germany due to its pollination service, is harmed by a wide range pathogens. In contrast to other livestock, the beekeepers cannot easily consult a veterinarian on bee health issues. Aim of this project was to implement a veterinary service for beekeepers to support monitoring and improving bee health. During 2023-2024, 121 apiaries throughout all regions of Saxony/Germany were advised by a veterinarian and student assistants. Site visit, examinations and sampling were adapted to every specific case. Bee samples were investigated for Acute-Bee-Paralysis-Virus(ABPV), Chronic-Bee-Paralysis-Virus(CBPV), Deformed-Wing-Virus A(DWV-A) and B(DWV-B), Black-Queen-Cell-Virus(BQCV) and Sacbrood-Virus (SBV) by RT-PCR. Additionally, they were checked for infestation with Nosema spp. by microscopic examination and Varroa destructor by washing method. Honeysamples were tested for American Foulbrood(AFB).

Furthermore, beekeepers were asked to fill in a questionnaire-based knowledge–attitude–practice–(KAP)-analysis.
After analysis of 69 fully completed surveys, participants were 90% amateur beekeepers from all experience levels. All participating beekeepers appreciated the possibility to consult a veterinarian and considered it important to gain knowledge on bee health. KAP-analysis showed AFB, Varroa and wax moth to be the most widely known bee diseases. Beekeepers in Saxony most often control the Varroa mite by measuring the natural mitefall and 55% treat their colonies in accordance with the damage threshold. Mainly, biotechnical methods, formic acid and oxalic acid are used for treatment. A total of 5.271 laboratory examinations were performed. SBV and BQCV were the most prevalent viruses with 81.7% and 93.4%, whereas ABPV was lowest (0.5%). DWV-B exhibited a prevalence of 38.7% and CBPV 19.3%. SBV, BQCV and DWV-B were distributed throughout all regions. CBPV could be found in 12/13 districts, ABPV in 2/13. Varroa mites were present in 67.6 % of the samples.

The project gave an overview of the distribution of honeybee diseases, but further investigation and support of the beekeepers over a longer period of time are needed to estimate the real value of the veterinary specialist counselling.
As veterinarians are trained in herd-health-management, multifactorial health problems and the prevention, diagnosis and therapy of diseases their involvement at apiaries can benefit bee health.

OP-103 [Bee Health]
Insights into the management of the Asian hornet in South-West Germany: nest occurrences and hurdles in control strategies

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The Asian hornet (Vespa velutina nigrithorax) is expanding its range, with south-west Germany strongly colonized. To manage the incursion of this invasive pest, a central coordination office was established at the State Institute for Bee Research (LAB) at the University of Hohenheim, Stuttgart. We validate sightings from Baden-Württemberg, coordinate nest removal, provide educational programs for beekeepers and other stakeholders, and conduct research.

In 2024, the number of verified individual Asian hornets reported rose to over 3,300; additionally 1,450 V. velutina nests were located. The proportion of false and accurate hornet sightings changed throughout the season, with substantially more sightings at the end of the year.
In order to disrupt the reproductive cycle of the Asian hornet, it is imperative to eliminate nests early, before the new queens depart. However, the majority of reported nests were found in late fall, with 311 reported in October and 506 in November. Successful nest removal was higher for primary nests, with 447 out of 468 removed, as they were more accessible. The removal of secondary nests was less successful, with less than half removed.

Despite massive efforts to destroy Asian hornet nests, the invasive species continues to spread throughout Germany. Current removal measures are neither sophisticated nor cost-effective. Consequently, we need more research to explore economically viable methods of eliminating nests. Additionally, methods for safeguarding honey bee colonies should be investigated. The utilisation of “selective traps” has been proposed; however, these devices are non-selective, capturing non-target species, including the protected European hornet (Vespa crabro) and other social wasps. Further experiments designed to capture young queens are scheduled to be conducted in spring 2025. The resulting data will be presented at the conference.

OP-104 [Bee Health]
A novel non-invasive method to characterize the gut microbiome and viral profile of honey bee queens

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The advent of next generation sequencing has paved the way to develop an extensive body of research on animal gut microbiome interactions, including their critical roles in immunity, nutrition, and reproduction. With the high mortality observed among honey bee colonies in commercial beekeeping operations globally, honey bee health, particularly queen health is at the forefront of challenges facing apicultural industries worldwide. Queen honey bees are not living as long as previously and are failing at unprecedented rates. The causes of queen failure are often unclear but can result from a combination of factors including poor mating, viruses and pathogens, temperature stress, and poor nutrition. The gut microbiome of queen honey bees may shed some light on potential environmental stressors impacting queen health, life span, immunity, and reproduction. Characterizing the gut microbiome of honey bees to date has been destructive, where evaluated queens are killed and therefore cannot be subsequently used to head colonies. In this study, we developed a non-destructive method to characterize queen honey bee gut microbiomes by sampling queen feces. In addition to presenting a detailed protocol for collecting feces from queen honey bees, we present data to demonstrate the potential use of queen feces 1) as a proxy for gut microbiome characterization, 2) to signal possible queen exposure to temperature stress, and 3) to screen for honey bee viruses. This method provides a novel opportunity to screen for viruses and gut parasites, and to begin characterizing the gut microbiome of individual queens to better understand how the queen gut microbiome responds to environmental stressors and their downstream impacts on queen health and fertility. Finally, this non-destructive method will help to evaluate queen health prior to colony installation, importation and/or exportation where international trade is limited by the risk of pathogen spread.

OP-105 [Bee Health]
A rapid diagnosis of American and European foulbrood in one test kit

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American (AFB) and European foulbrood (EFB) are devastating honey bee brood diseases that can cause high numbers of colony losses after infection. AFB is caused by the bacterial agent Paenibacillus larvae that can be categorized to different ERIC-genotypes. These ERIC-genotypes can differ in virulence. EFB is caused by Melissococcus plutonius and is considered less harmful compared to AFB. For the prevention of disease spread and the conduction of suitable and fast control measures, a rapid, reliable and affordable diagnostic tool is needed.

Therefore, we developed an antibody based lateral flow assay (LFA) for detection of EFB, AFB and the distinction of the two main occurring ERIC-genotypes of the AFB causative agent. Monoclonal antibodies were generated in mice, tested for their suitability using the target bacteria and other bee associated bacteria solutions. After testing the mAbs in a sandwich ELISA the LFAs were produced for each disease separately and tested with bacteria solutions and honey bee larvae. Certain additional features have been developed using the AFB-LFA such as an easy and save sample application tool for the LFA and a tool for objective evaluation of the result using a smartphone App. Furthermore, the tests for EFB, AFB and ERIC-genotyping have been combined on one test strip to finally have an all-in-one test kit for the main bacterial honey bee brood diseases. Here we present an affordable, rapid and reliable tool for the diagnosis of EFB, AFB and the differentiation of the two main occurring ERIC-genotypes.

OP-106 [Bee Health]
Long-term learning programs greatly improve queen production and quality

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BRAP- Bridging Research and Practice

EPIQ (Education about Production and Insemination of Queens) was a Northeastern SARE grant-funded long-term learning program for beekeepers in the northeastern United States. Participants with a range of experience used an online classroom to read scientific and popular journal articles, watch recorded presentations, listen to podcasts, and interact with each other. The group met via Zoom bi-weekly from June 2022 through September 2024 to discuss the materials that were provided and the apiary activities that were assigned. In the summer, in-person workshops were offered where queen production skills were demonstrated and practiced. Throughout the program, participants gained in-depth knowledge about queen biology, queen production, factors that influence queen and drone health, and many more topics. Surveys of participants resulted in feedback about the program. Nearly every participant reported increased knowledge about beekeeping, improved beekeeping practices, adoption of new practices, improved ability to assess colony quality, improved understanding of honey bee biology and queen production, and improved ability to understand scientific research. The variation in initial skill levels in the group led to networking and mentorship within the group. Overall, this program increased the number of queen producers in the region and greatly improved the quality of the queens that are being produced. This type of long-term learning experience is an excellent model for beekeeping education where research is disseminated in a meaningful way that changes beekeepers' practices.

OP-107 [Bee Health]
Enhanced immune response and antimicrobial activity in honey bees (Apis mellifera) following application of oxalic acid-glycerine strips

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Honey bee (Apis mellifera) health is increasingly threatened by multiple stressors, with Varroa destructor mites being one of the most significant global concerns. While oxalic acid (OA) is widely used as a natural acaricide, its effects on honey bee immunity and physiology remain insufficiently understood. This study evaluates the immunological and physiological impacts of different OA treatment methods, focusing on OA-glycerine strips (OA-G) compared to OA trickling (OA-T) and flumethrin.

Despite OA's
effectiveness in controlling Varroa, its influence on honey bee immune responses and oxidative stress remains unclear. Beekeepers require optimized treatment strategies that minimize unintended physiological stress while maximizing colony health and mite control efficacy.

A total of twelve honey bee colonies were assigned to one of three treatment groups (OA-G, OA-T, and flumethrin) with untreated colonies serving as controls. Samples were collected at five time points (0, 24, 48, 72, and 192 hours post-treatment). Immunological parameters, including antimicrobial peptide (AMP) levels (abaecin, apidaecin, defensin, hymenoptaecin), antimicrobial hemolymph activity, and oxidative stress markers, were analyzed to determine the systemic effects of each treatment.

The OA-G treatment induced a significant humoral immune response, characterized by increased antimicrobial activity in the hemolymph and elevated AMP levels between 48 and 192 hours post-treatment. In contrast, OA-T and flumethrin treatments did not elicit notable immune activation. These findings suggest that OA-G not only targets Varroa mites but also stimulates honey bee immunity, which could have both protective and potentially energy-costly effects on colony health. Further research is needed to assess the long-term implications of immune activation induced by OA-G treatment. Understanding the immunomodulatory effects of OA is essential for refining Varroa treatment protocols. While OA-G strips appear to enhance immune responses in worker bees, their potential physiological trade-offs warrant further investigation. Beekeepers should consider these findings when selecting OA application methods to balance effective mite control with colony health maintenance. This research was supported by The Ministry of Agriculture of the Czech Republic – projects NAZV QK1910286 and QL24010241.

OP-108 [Bee Health]
Crucial necessity of a revolution in bee health practices in beekeeping of Iran

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With about 10 million colonies of honey bees, beekeeping is an important industry in Iran. Diverse climate, vegetation biodiversity and traditional motivation have made beekeeping a popular activity. Among the 90 thousand apiaries across the country, only a very small portion operates through traditional hives. However, the beekeeping practices are rather misplaced in between modern and traditional perspectives. Although the native subspecies of Apis mellifera meda exists in Iran, sadly a wide combination of all varieties of subspecies is present without any regulation. Despite the popularity of beekeeping in the last few decades, since four years ago there has been a massive catastrophic honey bee colony loss all across Iran. The colony loss was reported at Apimondia 2023 Congress in Chile and still the causes are not identified through any scientific comprehensive approach. Rather an enormous amount of all types of irrelevant chemical medicines and supplements including an extensive range of antibiotics (even human antibiotics!) and an incredible long list of miticides have been prescribed and applied. Not only that the chemicals have been applied without any regulation and restriction, the most common approach has been simultaneous applications. This harmful manner, which has literally transformed each hive into a portable pharmacy, despite an incredible economic burden on beekeepers not only did not solve the loss problem but rather has turned the situation into outrageous. The only solution would be an immediate revolutionary act in the following aspects: 1) a scientific comprehensive nationwide surveillance to identify the causes of the loss, 2) a systemic factual and accurate supervision on chemical and medicine exploitation, 3) intense continuous functional education for beekeepers of Iran on honey bee health and Integrated Pest Management (IPM) principles. Through this approach of bridging research and practice, the compromised beekeeping of Iran can be rescued and although some efforts have been made a lot more is crucially demanded. The bee health situation of beekeeping in Iran could be similar to some other countries on earth and therefore sharing opinions would be internationally constructive.

OP-109 [Bee Health]
Are PFAS yet another threat to bees?

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Bees provide essential pollination services, thereby contributing to the preservation of biodiversity, ecosystem stability and food security. Bees, however, face numerous threats including loss of habitat and resources, climate change, natural disasters, predation, pests, diseases and exposure to crop protection products. Per- and polyfluoroalkyl substances (PFAS), a class of persistent organofluorine compounds, are now ubiquitous throughout the environment. Exposure to PFAS may present a particular threat to bees, but viable exposure routes and the resultant impacts of PFAS on this key pollinator species are poorly understood. In particular, plants readily take up PFAS but translocation to pollen and nectar, key components of the bee diet, is not yet confirmed. Active ingredients of numerous and commonly used pesticides such as Bifenthrin, Fipronil, and Fluvalinate include PFAS or are PFAS synergists. Bee exposure to these pesticides may occur through direct application or residue consumption. Some studies demonstrated that PFAS, in particular perfluorooctane sulfonate (PFOS), is toxic to bees and increases mortality at concentrations detected in contaminated environmental surface water. Sublethal PFOS exposure in insects (Drosophila hydei, Enallagma cyathigerum, Bombus terrestris L. and Apis mellifera) impairs developmental and reproductive function with the greatest effects observed on the larval life stage. This current work describes the first review of available literature on the risk that PFAS poses to bees, including potential exposure routes, behavioural responses, biological impacts and transfer to honey. Knowledge gaps include exposure routes in the field, the relative importance each exposure route, chronic sublethal exposure effects on bee health, and the risks to consumers of bee products. These knowledge gaps must be filled to allow development of protective reference thresholds that protect bee populations, food security and consumer safety.

OP-110 [Bee Health]
Newly isolated bacteria increase the survival of honeybee larvae infected with Paenibacillus larvae

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Honeybees are essential pollinators while contributing to agriculture. Some risk factors, including pathogens, parasites, pesticides, and a reduction in pollen availability, affect the health of honeybees. American foulbrood (AFB) is a devastating bacterial disease affecting honeybee colonies caused by Paenibacillus larvae. Honeybee gut core microorganisms were usually selected and applied to inhibit various honeybee diseases including AFB. However, there were still many honeybee gut-related non-core bacteria with probiotic properties that have not been explored, and they show great application potential in the control of honeybee diseases. In this study, two strains 74-8 and FB-1 with inhibitory effects on P. larvae were isolated from the whole gut of honeybees, and the multiple probiotic properties and safety in honeybee larvae were tested to assess their potential use in the prevention of AFB. Leuconostoc citreum 74-8 and Latilactobacillus sakei FB-1 could inhibit P. larvae by producing acid in vitro and increased the survival rates of larvae infected with P. larvae by approximate 30 % in vivo. L. citreum 74-8 and L. sakei FB-1 could colonize honeybee larvae and significantly increase the abundance of dominant microorganisms. Meanwhile, L. citreum 74-8 and L. sakei FB-1 can also modulate the transcription of antimicrobial peptides (AMPs) apidaecin, abaecin, hymenoptaecin in honeybee larvae infected with P. larvae. L. citreum 74-8 and L. sakei FB-1 from honeybee guts exhibited probiotic characteristics and effectively antagonized AFB pathogen P. larvae through multiple mechanisms. In conclusion, this study presents valuable findings that contribute to the understanding of probiotic applications in honeybee health management and highlight a new strategy for the control of AFB.

OP-111 [Bee Health]
The use of thymol as nano-emulsion in honey bee supplemental feed (Apis mellifera)

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Background and problem description: The two species of Nosema (Vairimorpha) microsporidian parasite found in honey bees are widespread, being present in Romania as well. Considering that in beekeeping the contamination of hive products with fumagillin is not allowed, the only effective and accepted antibiotic in combating the vegetative form of Nosema is thymol. There are many concerns to search for alternatives to classic antibiotics that are based on natural and effective substances, especially plant extracts. Thymol (C10H14O) is a phenolic monoterpene found in plants and especially in thyme oil (Thymus spp), known for its powerful antiseptic properties. In beekeeping, it is used both for its adjuvant role in the nosemosis control and in ecological treatments for the varroa mite control. PURPOSE: To increase the effectiveness of thymol, a new formulation approach as nano-emulsion was developed by which the natural compound extracted from the essential oil of thyme (Thymus vulgaris) is dispersed in a support substance as nanometric particles (below 200 nm) by sonication, and subsequently stabilization. METHODOLOGY: To determine the influence of energetic feed with thymol as nano-emulsion on the honeybees' lifespan, preliminary researches were conducted on honeybees kept in cages, fed with carbohydrate feed (syrup and fondant) to which thymol was added in form of nano-emulsion (experimental group 1), with syrup to which a mix of hydro-alcoholic extract of thymol was added (experimental group 2) and syrup without thymol (control group). Results and CONCLUSION: According to the Kaplan-Mayer regression curve, bees fed with syrup with thymol extract lived, on average, five days longer than bees in the control group. According to the same regression model, bees fed with thymol nano-emulsion survived, on average, one day longer than bees fed with thymol extract syrup. The results were similar when bees were fed with fondant to which thymol extract was added as per se and as nano-emulsion. The differences between the groups were statistically significant ($p<0.01$). Practical implications for beekeepers: Given the results obtained, the administration of thymol as nano-emulsion represent an improved administration method of thymol in honeybee artificial feed.

OP-112 [Bee Health]
Open source Varroa resistance through breeding selection

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Problem and goal
Even though the western subspecies of Apis mellifera originally showed little resistance to varroosis, I observed as early in as the beginning of the 1980s that different origins showed different levels of infestation. Since 1990, I have tried to integrate increased Varroa resistance into the selection of the breeding lines of our Buckfast bee using intensive breeding methods.

Methodology and technique
The only varroa-reducing measure was just one treatment per year. Without further treatments, the differences can be recognised in the following year from mid-July and conclusions can be drawn for breeding selection. Epigenetic effects are also important: even if the genetics are fully or partially present, the colony never manifests its resistance potential if intensive treatment against Varroa is carried out continuously.
The technique of sD insemination (according to John Harbo) as a filter, infections and counts in small colonies as well as the safe overwintering of the elites have been brought to practical maturity for our region with Belgian colleagues and with ARISTA.

Breeding methods
Combination breeding has proven to be an advantageous breeding method for enriching lines with resistance traits. The precise selection of haploid drones is of particular importance here.

RESULTS: We have not treated the breeding station for seven years and the production colonies for four years, and have hardly any losses due to mites. An old non-selected line with eight to ten colonies on a separate apiery serves as a comparison to all this. From this we 'harvest' around 10,000 mites a year to infect the test series at the breeding station. This old line must be treated with the AS vaporiser in August. These results were already predicted announced in 2018 in an external scientific test by the French INRA/ISTAP and have since been confirmed by many thousands of colonies in the practising beekeeping community at home and abroad. Medication and supplements are taboo.

Open source breeding
Varroa resistance genetics are made available to beekeepers in the region on 2 mating places. Beekeepers who have understood and apply the principle of inheritance, enthusiastic and rarely have to treat a colony.

OP-113 [Bee Health]
Evaluation of Aluen CAP® for Varroa destructor control during a full season in migratory beekeeping systems

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This study evaluates the efficacy of Aluen CAP®, an oxalic acid-based organic treatment, as an alternative to amitraz for controlling Varroa destructor in migratory beekeeping systems. Conducted over a full production cycle in Chajarí, Entre Ríos, Argentina, the research addresses the challenges of pest management in colonies relocated across different floral sources throughout the year, including citrus, pasture, and eucalyptus blooms. The trial involved 20 Langstroth hives, divided into two groups of 10: one treated with Aluen CAP® and the other with amitraz. Key metrics such as Varroa infestation rates, adult bee population, brood area, and honey and pollen reserves were monitored to assess the impact of both treatments. The results demonstrated that Aluen CAP® effectively maintained infestation levels below 1.1% with only three applications per year, whereas amitraz required four applications but showed inconsistent efficacy, with significant infestation peaks after some treatments. Colonies treated with Aluen CAP® exhibited better population growth, greater brood development, and improved nutritional reserves, suggesting that this organic treatment supports the long-term stability and productivity of beehives. The neurotoxic nature of amitraz may negatively impact the longevity and efficiency of adult bees, potentially reducing their ability to care for brood. In contrast, Aluen CAP® promotes a healthier environment free of chemical residues, allowing for better honey and pollen accumulation, which contributes to colony resilience and productivity. From an economic and logistical perspective, Aluen CAP® offers significant advantages by reducing the frequency of applications and the risk of resistance to acaricides. Its effectiveness aligns with the growing demand for sustainable and organic beekeeping practices, making it an environmentally friendly solution adaptable to the dynamics of migratory beekeeping. This study underscores the importance of integrating effective, eco-friendly treatments to ensure the resilience and productivity of migratory bee colonies. Aluen CAP® emerges as a reliable and sustainable alternative for Varroa control, protecting honeybee health while maintaining high-quality hive products. Its ability to control Varroa destructor without harming bees or leaving harmful residues makes it a crucial tool for sustainable beekeeping, ensuring colony vitality throughout the production season and beyond.

OP-114 [Bee Health]
Exploring the Physiological Mechanisms Underlying Sublethal Imidacloprid-Induced Early Foraging Behavior in Honey Bee Workers

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Colony collapse disorder (CCD) of the honey bee, Apis mellifera, is an abnormal phenomenon marked by the sudden loss of most worker bees, including hive bees and foragers, in a colony. Previous studies have shown that exposure to environmental stressors, such as the neonicotinoid pesticide imidacloprid, can trigger early behavioral maturation in hive bees and impair the flight and homing abilities of foragers. These symptoms are closely linked to the rapid collapse of honey bee colonies. The transition from hive tasks to foraging behavior is coordinated with the increasing level of juvenile hormone (JH) III, which plays a crucial role in age polyethism. Elevated levels of JH III in young hive bees can cause early behavioral maturation and result in precocious foraging activity. Despite these insights, the molecular and physiological mechanisms underlying stress-induced precocious forager behavior remain largely unknown, but they may be associated with the level of JH III.

To investigate the molecular and physiological mechanisms underlying sublethal imidacloprid-induced precocious foraging, we used next-generation sequencing (NGS) and gas chromatography-mass spectrometry (GC-MS) to monitor trends in transcriptome profiles and JH III titers in workers of different ages between imidacloprid-treated and control groups. Our findings indicate that JH biosynthesis-related genes were significantly upregulated in young workers exposed to sublethal doses of imidacloprid during the larval stage. Additionally, the transcriptomic profiles of imidacloprid-treated young workers closely resembled those of older control workers, suggesting accelerated behavioral maturation at the molecular level. Correspondingly, JH III titers increased earlier in imidacloprid-treated young workers, further supporting the physiological mechanism of JH III in mediating stress-induced precocious foraging behavior.

The outcome of this project provides genetic and physiological evidence that exposure to sublethal imidacloprid during the larval stage may disrupt the age polyethism in the colony; this could potentially impair individual bee development and threaten colony stability. Our results highlight the need for further research into the long-term ecological impacts of neonicotinoid exposure on honey bee populations.

OP-115 [Bee Health]
The impact of pollen diet and microbiome on honey bee health

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In the last decade, drought has been identified as one of the most relevant climate change factors affecting ecosystem integrity across countries, affecting plant growth in agroecosystems, and leading to changes in the trophic potential of nectar and pollen. As a cascade effect, a deficit in the nutritional composition and availability of pollen can weaken pollinators, triggering additional threats to ecosystem stability. In this scenario, understanding the impact of trophic sources on honey bee health remains a significant gap that needs to be addressed. Our research aims to correlate pollen of different botanical and geographical origins, and therefore of different trophic potential, with selected honey bee markers: the abundance of core gut microbial taxa and proteins involved in the immune response detectable in the haemolymph. A holistic proteomic approach based on MALDI BeeTyping® and SDS-PAGE profiles, together with qPCR for the quantification of target microorganisms, was used to elucidate these interactions in bees fed with pollen of different botanical families. Briefly, newly-emerged caged honeybees were daily fed with a fresh suspension of pollen and sugar syrup (1:1 w/v) for a total of 40 monofloral and 13 polyfloral pollens belonging to 8 botanical families (Cistaceae, Asteraceae, Cornaceae, Boraginaceae, Fagaceae, Leguminosae, Rosaceae and Salicaceae) collected in 5 Italian regions. After 5 days, haemolymph and guts were extracted for the MALDI-BeeTyping, SDS-PAGE, and qPCR analysis after DNA extraction. Our results show that different pollens significantly affect the core gut microbiome composition but do not significantly affect the concentration and the total amount of small and large haemolymph proteins. Furthermore, the effect of different diets on the microbiome suggests an indirect effect on the immune system response by modulating and influencing the synthesis of some immune-related peptides. This research confirms the importance of gut symbionts in honey bee health also in a changing diet scenario. Finally, our results represent the first step in the understanding on the honeybees response to climate changes.

OP-116 [Bee Health]
How science supports honey bees: Identification of research on best practices in beekeeping

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Science has advanced our understanding of honey bees in many areas, particularly in disease management and treatment. But what research has been published, possibly supporting beekeepers in decision-making on their own colonies? To answer this, we conducted a literature study of English language, peer-reviewed papers published since 1995. Inclusion criteria required studies to focus on honey bee colonies (excluding caged bee experiments or laboratory studies) and present field research with control and experimental groups. Out of 341 reviewed papers, 191 met these criteria, documenting 744 distinct beekeeping practices. We extracted, among others, the following information from these studies: Topic (from a pre-defined list), geographic origin of study, species and subspecies covered, and whether the respective practice had positive or negative impacts on measured parameters. The majority of identified practices (57.0%) addressed the management of Varroosis, followed by practices related to General Apiary Management (17.2%), American Foulbrood (9.7%), Tropilaelapsis (8.7%), and Aethinosis (4.6%). Geographically, most research was conducted in the USA (26.9%), followed by Italy (9.1%), Argentina (5.1%), Canada (5.1%) and Pakistan (4.6%). The primary study species was Apis mellifera and its subspecies, with only 0.1% of practices relating to Apis cerana. Among the practices with a positive impact on Varroa reduction (n = 177), oxalic acid (21.5%) was most frequently cited, followed by tau-fluvalinate (11.3%) and formic acid (10.7%). Biotechnical methods, such as drone brood removal and queen caging, were also effective. For American foulbrood, shook swarms were the primary method for spore reduction (69.2%) and colony recovery (29.1%). Additionally, General Apiary Management practices, including starting new colonies, comb management, and using domestic queens, improved colony survival and honey yields. Our findings provide an overview of key areas of honey bee health research and effective beekeeping practices, offering evidence-based insights for improving honey bee health and apiary management and supports worldwide decision-making in apiculture.

OP-117 [Bee Health]
Effective summer varroa mite control with stabilized oxalic acid (VarroxSan) and minimal honey residue

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Varroa mites remain the most critical threat to honey bee health and colony survival. Effective Varroa control during the honey flow is particularly challenging due to restrictions on many acaricides to avoid honey contamination or high summer temperatures. This study investigated the efficacy and honey residue levels of a stabilized oxalic acid formulation (VarroxSan™) for Varroa control in honey bee colonies during summer honey production. This research addresses the need for an effective treatment that can be used during honey production without risking honey contamination.

Field trials were conducted in the Pacific Northwest region of the US using 60 full-size honey bee colonies. Colonies were divided into 4 treatment groups (no treatment control, Formic-Pro, Varroxsan™ 1x, and Varroxsan™ 1.5x). Efficacy of VarroxSan™ strips were evaluated during the summer honey flow from June through August. Varroa mite levels were monitored pre- and post-treatment using the alcohol wash method and mite fall on sticky boards. Honey samples were collected and analyzed for oxalic acid residue levels using high-pressure ion chromatography-conductivity detection (HPIC-CD). VarroxSan™ resulted in significantly lower mite levels compared to the no treatment controls. During the summer honey flow, FormicPro™, VarroxSan™ 1X, VarroxSan™ 1.5X, and no treatment controls had approximately (9.34±2.48)%, (11.23±4.74)%, (14.30±2.33)%, and (3.59±0.72)% weekly varroa mortality per hive during the treatment period. The treated colonies remained below 1 mite/100 bees and significantly flattened the summer growth curve of the varroa mite populations. Equally importantly, the treatment did not result in statistically significant increases in oxalic acid residue levels in honey. Mean residue levels in hives treated with oxalic acid were 23 mg/kg (± 3.3), which were not significantly different than levels reported to be naturally found in honey.

This stabilized oxalic acid formulation offers beekeepers a safe and effective option for controlling Varroa mites during the crucial summer honey flow period, when other treatment options are limited. This allows beekeepers to maintain healthy colonies and optimize honey production. The minimal risk of honey residue contamination makes VarroxSan™ a particularly attractive option for beekeepers concerned about honey quality and marketability.

OP-118 [Bee Health]
Comparison of student learning attitudes, knowledge, and outcomes towards honey bees in online or in-person instructional environments

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BRAP. Many university instructional programs are focused on developing students into professionals within various agricultural sectors. Honey bee pollination of specialty crops is essential to agriculture and yet there are almost no university instructional programs to train the next generation of beekeepers. One reason for this lack of university investment in apiculture instruction is that there may not be enough students located at universities interested in the pursuit of beekeeping education. Teaching beekeeping as an online course can increase the number of students; however, two important questions emerge from the varying methods of teaching beekeeping: (a) Are online and in-person courses similar at teaching beekeeping principles, and (b) do the varying learning design methods change student perceptions in favor of honey bees and beekeeping? We investigated these questions with the use of an online survey for students in both the 100% online Beekeeping course and the blended Practical Beekeeping course at the University of Florida during the summer semesters of 2021 and 2022. The same survey, which was optional, anonymous, and not part of the students' grade, was completed by students in both courses. The survey included a set of ten questions, evaluated on a Likert-type scale using a single-group pre-post design and a set of eight multiple choice questions to test potential differences in knowledge gained. Our findings suggest the relevance and value of both in-person and online beekeeping educational courses for improving knowledge and changing attitudes toward honey bees and the recruitment of future contributors to the beekeeping industry. In this presentation, we suggest areas of improvement, particularly for online courses.

OP-119 [Bee Health]
Effects of conventional and sustainable beekeeping on the pathogen load of honeybees

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Varroa destructor threatens honeybee colonies by feeding primarily on developing bees, thereby depleting their nutrients and causing stress. It also leaves the bee more vulnerable to diseases. Conventional beekeeping removes drone brood in spring and treats colonies with formic acid in summer and oxalic acid in winter. However, the resulting constant low mite pressure prevents bees from adapting to Varroa mites, and climate change affects treatment efficiency. Sustainable beekeeping omits drone brood removal, resulting in a high temporary Varroa pressure, because the mites prefer drone brood over worker brood for development and reproduction. This high mite pressure supports the bees in adaptation to the mites. A brood interruption by queen caging and subsequent single oxalic acid treatment reduce Varroa infestation in summer. But some beekeepers are concerned about the high Varroa infestation in summer and the potential spread of pathogens with sustainable practices.

We compared honey bees from conventional beekeeping and sustainable beekeeping for Varroa load (using sticky bottom boards) and pathogen load (using high-throughput qPCR covering 18 pathogens) at three critical time points: mid-April, end of June and mid-October. Varroa load was significantly higher in April and June in colonies from sustainable beekeeping, while the two groups did not differ in October. Pathogen load differed significantly between foragers of the two beekeeping groups in June. Foragers from sustainable beekeeping had significantly higher loads of black queen cell virus, deformed wing virus B, lake Sinai virus and Crithidia mellificae. In October, however, foragers from sustainable beekeeping had lower levels of C. mellificae and Varroa destructor macula like virus than bees from conventional beekeeping practice but higher levels of chronic bee paralysis virus. Our findings suggest an important role of the Varroa mite in initiating a complex infection cascade through transfecting bees with deformed wing virus, thereby spreading further pathogens.
Sustainable beekeeping has no negative long-term effects on honey bees. The temporary high Varroa load leads to a higher infection rate with other pathogens in summer but queen caging and oxalic acid summer treatment suffice to reduce Varroa and pathogen loads in time for the winter break.

OP-120 [Bee Health]
The effect of oxalic acid on honey bee (Apis mellifera) physiology

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One of the main stressors to honey bee health worldwide is the Varroa destructor mite. The mites transmit viruses that can be lethal to honey bee colonies. Oxalic acid (OA) is a natural acaricide that has become widespread among beekeepers as an alternative to synthetic pesticides. However, oxalic acid with glycerol in strips also influences honey bee health. The strips activate the immune system and can be associated with high energy demands and stress, making bees more vulnerable to infections. Recent reports indicate that increased chalkbrood incidence may potentially be related to increased colony stress. Co-infection with two pathogens can increase each pathogen's virulence, increasing the risk of the host's defense being overcome.

Our research aimed to determine the effect of oxalic acid on honey bee brood with concomitant chalkbrood disease. Methods of molecular biology and proteomics were used to study protein components involved in the immune responses of honey bee brood. We used peptide sequencing and data-independent acquisition (DIA) of molecular structure determination.

Data from proteomic analysis of larvae show significant differences in proteome composition between the treated and untreated brood, identifying 1187 proteins. Due to the increase in OA concentration, there is an increase in oxalate and glyoxalate cycle proteins. Conversely, antioxidative enzymes are utilized and the detoxification system is affected. OA-G strips also affected the relative gene expression of AmPs defensin and hymenoptaecin, which was significantly increased both in clinically healthy larvae and those infected with A. apis. On the other hand, abaecin levels were decreased after OA treatment.

Our results indicate the exposure of bee larvae to the commonly used acaricide oxalic acid in concentrations used by some beekeepers can strongly affect the levels of peptides and proteins involved in immune responses. Beekeepers need to consider the possible negative implications on honey bee immunity when picking their preferred Varroa treatment and be aware of the total dosage and the timing of the treatment. This work was supported by NAZV, Czech Republic, project QL24010241.

OP-121 [Bee Health]
Toxicity tests of mosquito larvicides and adulticides on honey bee larvae (Apis mellifera) reared in vitro

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Effective mosquito control is essential to Florida residents, as the state's environment and climate are ideally suited for mosquitos. Unfortunately, some mosquito adulticides and larvicides administered by pesticide applicators could have non-target impacts, including on honey bees (Apis mellifera). Research on the effects of mosquito control insecticides on honey bees has primarily focused on the whole colonies in field settings or on adult bees, often neglecting the potential impacts on their developing brood. This study aims to address this critical knowledge gap by evaluating the differential toxicity of mosquito adulticides and larvicides on honey bee larvae reared in vitro and determine the risk posed by these public health chemicals. For that purpose, we exposed honey bee larvae to one of four mosquito adulticide active ingredients (chlorpyrifos, naled, prallethrin, sumithrin), their commercial formulations (Mosquito Mist®, Dibrom®, Duet®) or one larvicide (Bacillus thuringiensis israelensis - Bti). Honey bee larvae reared in vitro were exposed to pesticides in their diet, on day three after grafting (acute exposure) or from day two to five after grafting (chronic exposure). Our results showed a high toxicity of Dibrom® (Acute LD50 = 0.803 µg/bee, Chronic LD50 = 0.0027 µg/bee) and Duet® (Acute LD50 = 0.497 µg/bee, Chronic LD50 = 0.034 µg/bee) to honey bee larvae after both exposure ways (LD50 < 2 µg/bee). Mosquito Mist II was found moderately toxic and highly toxic respectively after acute (LD50 = 2.760 µg/bee) and chronic exposure (LD50 = 0.0059 µg/bee). The larvicide Vectobac12AS was weakly toxic to both types of exposure (LD50 > 11 µg/bee). Based on these endpoints and residues data, we observed a high risk of mosquito adulticides to honey bee larvae after chronic exposure but only a risk of Dibrom® after both exposures. The larvicide may be at risk to honey bee larvae only after acute exposure, but it is still low (RQ = 0.453 for a 0.4 threshold). The resulting data will be used to improve risk assessment for mosquito control products. help mosquito control personnel to make more informed decisions to minimize the non-target impacts of pesticide applications.

OP-122 [Bee Health]
Chemical Innovations in Varroa destructor Mite Control

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Beekeepers worldwide face unacceptable annual colony losses, largely due to the ectoparasitic mite Varroa destructor. This mite compromises individual bee health by vectoring viruses and disrupting physiology and also contributes significantly to colony winter losses. The emergence of varroacide resistance and limited efficacy of current treatments highlight the need for new control strategies that effectively target Varroa while minimizing harm to honey bees. Building on prior research assessing the impact of 26 potential miticides, we selected five promising candidates to evaluate their effects on honey bees and mites. Through a combination of laboratory and field experiments, we assessed survival of brood and diverse adult bee castes, and mite mortality. Queens generally exhibited greater tolerance to the test compounds than worker bees. Across all compounds and doses, mortality was highest in drones, followed by newly emerged workers, foragers, and nurses. This variation indicates that caste differences need to be taken into account when testing compounds for honey bee toxicity. Two pyrazole-based miticides exhibited relatively high toxicity across all age cohorts and castes, whereas the other three compounds showed little mortality at low doses no bees. Field trials of these two substances in nucleus hives demonstrated that they can effectively control Varroawithout observable negative impacts on queens or adult bee populations. Combined with their previously established efficacy against Varroa in the lab, our findings suggest that these miticides could be valuable additions to integrated pest management (IPM) strategies to control Varroa in apiculture.

OP-123 [Bee Health]
Sensitivity and Resistance to Amitraz and Amitraz-Based Products in Honey Bee Parasitic Mites

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Amitraz is one of the most widely used miticides for controlling Varroa destructor, a major honey bee parasite. However, increasing reports of amitraz resistance threaten its efficacy and colony health. This review analyzes the global status of amitraz resistance in Varroa populations, focusing on resistance mechanisms and laboratory bioassays that predict field performance.

The prolonged and widespread use of amitraz has led to the selection of resistant mite populations, raising concerns over its continued effectiveness. Beekeepers rely heavily on amitraz, and treatment failures are becoming more frequent. Understanding resistance dynamics and identifying potential alternatives are critical for sustainable mite management.
A systematic literature review was conducted following PRISMA guidelines. A total of 206 studies were screened, with 74 selected for analysis. These studies were categorized into laboratory assays (toxicological, metabolic, genetic) and field evaluations. Data from 27 laboratory studies, 42 field studies, and 12 resistance assessments were examined, focusing on resistance ratios (RR), resistance indices (RI), and mechanisms of resistance.

Amitraz resistance in V. destructor has been extensively documented worldwide. Resistance ratios (RR) and resistance indices (RI) show considerable variation across mite populations. However, the genetic mechanisms underlying resistance remain largely unknown. Laboratory bioassays have demonstrated variable toxicity responses influenced by factors such as mite strain, geographical location, and experimental conditions.

Amitraz resistance is an emerging challenge for Varroa control in beekeeping. While laboratory bioassays provide valuable insights into resistance trends, further research is needed to elucidate genetic mechanisms and improve control strategies. The findings highlight the urgent need for integrated pest management (IPM) approaches that reduce reliance on amitraz and incorporate alternative control methods.

Beekeepers should be vigilant for signs of amitraz resistance, particularly in cases of treatment failure. Regular monitoring through laboratory assays and resistance testing is recommended to assess efficacy. Implementing IPM strategies—combining pharmacological, biotechnical, and cultural practices—will be key to sustainable Varroa management and the long-term health of honey bee colonies.

OP-124 [Bee Health]
The European Union national reference laboratories are ready to diagnose diseases and protect beekeeping

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Exotic diseases affecting honeybees are a threat to beekeeping. Being able to detect and control exotic diseases is essential to protect beekeeping across the EU. American Foulbrood (AFB), the infestations with Aethina tumida, Tropilaelaps spp. and Varroa spp. are diseases subject to measures of prevention and surveillance by the European Union (EU) Animal Health Law. The Small Hive Beetle (A. tumida) was detected in 2014 in Calabria (Italy) and more recently in 2022 in Réunion Island (France). Tropilaelaps spp. mites were detected in Russian provinces (in 2021 and 2024), in Uzbekistan (2022) and Georgia (2024). This rapid spread across continents threatens European honeybee health and raises concerns. Besides exotic diseases, AFB control is also fundamental to manage outbreaks. Early detection is a key step, consequently official laboratories must be ready to rapidly perform analyses.

By law, European Union Reference Laboratories (EURLs) contribute to the improvement and harmonisation of analytical methods to be used by official laboratories. Since its designation in 2011, the EURL for Bee Health has regularly used questionnaire-based surveys to record the analytical capabilities of the national reference laboratories (NRLs) network and to follow the development of competencies.

Over the years, NRLs and the EURL organised inter-laboratory tests on various diseases at national and European levels. During these tests, laboratories perform analyses on the same or similar samples and report results which are evaluated to assess their competency. By participating in and organising tests, NRLs respectively show their capabilities to perform reliable diagnostics and to implement and harmonise diagnostic methods in their national laboratory networks. In 2023, the answers to the questionnaire on 2021-2022 activities showed the capability of all the NRLs to identify A. tumida and Tropilaelaps spp. mites, to detect and evaluate infestation level of Varroa spp. mites and to diagnose AFB on larvae in case of outbreaks (using the EURL's or the World Organisation of Animal Health methods). Since 2011 the network gained competency and is ready to diagnose diseases. Subsequent measures to prevent the spread of diseases are based on these early diagnostics to protect bees and beekeeping in Europe.

OP-125 [Bee Health]
The persistence of acaricides resistance in Varroa destructor population in Canada

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The beekeeping industry in Canada has faced significant challenges due to the ectoparasitic mite Varroa destructor, which has been a major factor in excessive winter colony losses. Control of Varroa mites has predominantly relied on a limited selection of synthetic varroacides including tau-fluvalinate, coumaphos, amitraz, and flumethrin. This dependence raises concerns about the evolution of resistance and the subsequent decline in treatment efficacy. This study assessed the phenotypic and genotypic resistance of Varroa populations in Alberta to amitraz, the most widely used varroacide. Bioassay results confirm that 86% of the samples collected exhibited varying degrees of phenotypic resistance to amitraz. Additionally, the presence of genetic mutations previously linked to varroacide resistance was investigated. The Y215H mutation in the octopamine receptor gene (Octβ2R), associated with amitraz resistance, was detected in 90% of the tested apiaries. This study also revealed widespread resistance to pyrethroids across Alberta. Mutations L925I and L925M in the voltage-gated sodium channel, which indicate pyrethroid resistance, were present in 100% of the apiaries examined. These results underscore the notion that prolonged reliance on a single treatment contributes to accelerated resistance development in Varroa populations. The implications of these findings suggest that implementing a comprehensive, nationwide monitoring program would enhance Varroa management strategies. Moreover, there is an urgent need to develop and integrate new control options to effectively combat Varroa infestations.

OP-126 [Bee Health]
Co-evolution of honey bees, varroa and beekeepers over 15 years in Hawaii

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Hawaii has long been a natural laboratory for the studies investigating the impact of the ectoparasitic mite Varroa destructor on Western honey bees. In this presentation we report on the changes that have occurred over a 15-year period between the honey bees, the mite, and the beekeeper's behaviour. The arrival of varroa in 2007 caused the collapse of both the managed and free-living honey bee colonies on the Hawaiian Islands of Oahu and Big Island. This forced almost all beekeepers to use chemical miticides to control varroa in managed colonies. From 2014 onwards, beekeepers started to notice the gradual return of free-living colonies. Investigations into these free-living colonies from 2019 onwards found that they had developed resistance to varroa by accurately detecting and removing varroa-infested worker pupae. That is 79% of infested worker pupae cells were recapped and 67% of worker sealed cells artificially infested with varroa were removed. This resistance mechanism mirrors what has been seen in other countries where varroa-resistant honey bee populations had appeared. Currently, the worker brood infestation rate in untreated colonies is 6.7% with an adult bee infestation rate of 4.3%, which equates to below 2500 mites in a typical sized colony and below the predicted number required to kill a colony. The dissemination of information about mite-resistance among the local producers, coupled with the early success of some beekeepers that stopped treating their colonies, helped convince most (>60%) beekeepers on Oahu to cease all varroa treatments, without any significant increase in colony losses. This is the first time that an entire population of honeybees and beekeepers have both adjusted their behaviours to benefit from natural selection processes that provides beekeepers world-wide with a permeant solution to the varroa problem.

OP-127 [Bee Health]
Chances and challenges in breeding for resistance to Varroa destructor – From basic principles to practical application

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Varroa destructor still reflects a major threat to honey bees and beekeeping around the globe. This key role for apiculture keeps it in focus of numerous breeding attempts aiming to select varroa-resistant stocks. However, the exact pathways of varroa-resistance are still largely unknown, which greatly hampers the selection of corresponding traits. We studied the effects of outer factors on the reproductive failure of mites ("MNR"), the recapping behaviour of bees ("REC"), the interaction of these traits and their applicability in breeding. To this end, we first investigated MNR in colonies with brood interruptions of varying durations (n= 27). In addition, we repeatedly sampled (five times per year) colonies over the course of three years (n= 20, 20 and 15, respectively) to investigate temporal variation in the accounted traits. Finally, the heritability (h^2) of both traits was calculated based on an extensive dataset of 1784 Buckfast and 2530 Carnica colonies. Colonies with interrupted brood rearing showed higher MNR (GLMM: $\chi2 = 15.2$, $p < 0.001$, $df = 1$) and REC ($\chi2 = 8.09$, $p = 0.005$, $df = 1$) values in comparison to broodright colonies. Both traits were also strongly affected by seasonal variation (MNR: $\chi2 = 152.23$; REC: $\chi2 = 335.5$; each: $p < 0.001$, $df = 14$; n= 4106 single-infested cells). In addition, REC was associated with certain forms of MNR, i.e., delayed reproduction ($\chi2 = 9.15$, $p = 0.003$, $df = 1$) and missing males ($\chi2 = 8.1$, $p = 0.004$, $df = 1$). Recapping activity was also affected by brood age ($\chi2 = 238.13$, $p < 0.001$, $df = 4$) and most frequent at day 6 post-capping, i.e., when the two eldest descendants would be expected (Tukey: $p < 0.05$; 764 recapped cells). With an accessible h^2 of 0.18 and 0.44 for MNR and 0.44 and 0.40 for REC, both traits proved promising for selection in Buckfast and Carnica stocks, respectively. A more detailed calculation including apiary factors for Carnica yielded even higher h^2 (0.51 & 0.40, n= 2233 & 2114 colonies for MNR and REC, respectively). Implications of these findings for practical breeding will be discussed.

OP-128 [Bee Health]
Rapid quantification and classification of Nosema spp. spores and M. mellificae cysts using automated microscopy and artificial intelligence

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The global decline in honeybee colonies in recent decades is generating a significant crisis in the sector. This is due to multiple factors, although pathogens are considered the major cause.

Nosemosis, caused by Nosema apis (type A) and Nosema ceranae (type C), is a key factor in colony loss, as a high rate of infection by Nosema spp.significantly weakens colonies, and exposes them to higher mortality when combined with other additional stressors. Nosemosis infection rate has been proven to be a useful parameter to monitor actual health of bee colonies.

The absence of clear clinical signs caused by Nosema type C makes diagnosis very difficult. Therefore, laboratories and veterinary technicians rely on standardized methods on honeybee samples to confirm and quantify the presence of Nosema spp.. However, methods used are PCR and/or optical microscopy, which both require expert performance and are labor and/or resource intensive.

This abstract presents a solution for autonomous full-scanning of samples with an affordable automated brightfield microscope, and subsequent detection/counting of Nosema spp. spores, with high discrimination accuracy among the other elements that appear, and species classification. Additionally, amoebiasis (Malpighamoeba mellificae) is also detected through cysts presence, which is commonly found in collaboration with nosemosis.

The device autonomously scans 20 fields (x600) of a volumetric chamber and processes the images in the cloud for rapid quantification, in 7 minutes/sample (including sedimentation).

The training dataset has been developed by Microfy, with samples provided by the Spanish Central Veterinary Laboratory. The AI pipeline developed includes: 1) autofocus, 2) MaskR-CNN detection, 3) (U-Net + OpenCV) to quantify width and length required to classify N. apis/N. ceranae, and 4) MLP, multilayer perceptron, based on color/refraction/geometry.

The achieved F1-score accuracy was 95.25% on validation dataset. The experimental validation (n = 50) was carried out by Neobéitar SL and the University of Extremadura. The validation concluded with a higher sensitivity than in the Neubauer chamber, and a high correlation with manual counting in an optical microscope. ($R2 = 0.94$, $p<0.05$, specificity >80%), which confirms the automated device as a useful, affordable and easy-to-use support tool for diagnosis, and recurrent monitoring of nosemosis/amoebiasis.

OP-129 [Bee Health]
Considering honey bee welfare to support sustainable beekeeping and honey bee protection

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BACKGROUND:
Animal welfare research is concerned with assessing the experienced quality of life of animals, and has been mostly focusing on mammals in farm contexts. The field is mainly following the paradigm of sentientism, which implies that suffering of sentient beings should be avoided and positive experience promoted. As insect farming for food production becomes more common, interest for insect welfare has intensified, while recent evidence suggests that many insects including bees are indeed sentient.

PROBLEM DESCRIPTION:
Bees fill a complex space in this landscape of insect farming: they are not equally spatially restricted or killed for harvesting as are insects kept as feed, yet they are exposed to human impact, including disease exposure, management and housing, frequent handling, and breeding. Yet, their welfare as livestock has so far been little explored. So far, bees' functions have been valued through conservation and production, usually not considering the subjective experience of individuals.

METHODOLOGY:
We conducted a literature review synthesizing existing knowledge, knowledge gaps and opportunities to advance honey bee welfare. We then utilised insights from the literature to design focus group discussions with beekeepers in order to explore values underlying different beekeeping practices related to bee health and welfare.

RESULTS AND CONCLUSION: We conclude that recent advances in animal welfare science including concepts and applied methodologies can now be expanded to all taxa including insects and that welfare concepts can advance through such expansion. Considering welfare of honey bees will strengthen conservation efforts by providing earlier indicators for declining welfare which allow the possibility for early action and more efficient and welfare-sensitive protection.

PRACTICAL IMPLICATIONS FOR BEEKEEPERS:
A lot of evidence is emerging from different fields of research regarding the sentience and cognitive abilities of bees, as well as potential for their health management. Exploring where new scientific insights meet already existing practice of beekeepers and reflect their intuitions and experiences will both, help to close the gap between stakeholders and welfare science. Honey bee welfare measures will also improve the sustainability of beekeeping and beekeeper livelihood.

OP-130 [Bee Health]
Preliminary results on the control of Vespa velutina using Beauveria bassiana in apiary environments within the GO BIOVEST Project

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The Asian hornet (Vespa velutina) is an ecologically and economically detrimental invasive species that exerts significant predatory pressure on honeybee (Apis mellifera) colonies. Beauveria bassiana is a naturally occurring fungus, widely used in biological pest control. It infects and kills insects via multiple mechanisms, including cuticle penetration, toxin production, and suppression of the host's immune response.

This study, conducted within the framework of the GO Biovesp project, investigated the efficacy of the entomopathogenic fungus Beauveria bassiana as a biological control agent against V. velutina in apiary environments. The experimental design encompassed a preliminary trial involving 21 apiaries, followed by an expanded trial with 32 apiaries. B. bassiana was administered through nebulization onto captured hornets, which were subsequently released to potentially spread the infection within the V. velutina nests.

The results indicate that B. bassiana is effective in reducing V. velutina predation pressure on managed apiaries. Furthermore, we observed honeybee tolerance to B. bassiana on direct applications with no significant impact on beehives' viability. The preliminary results suggest that a minimum threshold of 10 infected hornets per application is required to observe a reduction in V. velutina pressure. These results provide promising evidence for the use of B. bassiana as a viable, ecologically sustainable biocontrol strategy for V. velutina management.

This research contributes to the broader objectives of the GO BIOVESP project, which aims to develop and implement innovative strategies for honeybee protection and biodiversity conservation. Further investigations are underway to optimize application methods and assess the long-term impacts of B. bassiana on V. velutina populations and the broader ecosystem.

OP-131 [Bee Health]
Why are SDHI pesticides of concern to beekeepers and scientists?

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SDHI pesticides (Succinate DeHydrogenase Inhibitors) are widely used as fungicides in agriculture or as nematicides or acaricides. These substances are toxic to mitochondria by disrupting cellular respiration and energy production in the cells of all living organisms, except bacteria. However, the regulatory assessment of SDHIs suffers from shortcomings, since mitotoxicity is not considered, nor are the effects at low doses, the presence of co-formulants, long-term impacts or potential synergies and cocktail effects when combined with other biotic and abiotic stressors.

Holimitox (https://holimitox.fr/en/home/) is a research network that has tackled this interdisciplinary issue to improve protection of bees, biodiversity and public health. First, we present a comprehensive review of the scientific literature on the contamination of honeybee matrices (pollen, nectar, wax, etc.) by SDHIs. Next, we introduce 21-day bee co-exposure tests with some SDHIs and the intestinal parasite N. ceranae, conducted with both active substances and their corresponding commercial formulations. Finally, using new, highly sensitive analytical methods, we present the results of the contamination of fruits and vegetables sold in France in comparison with data found in the world academic literature. Since these fruits and vegetables came from crops often pollinated by bees, these latter results offer insights into potential risks for bees and consumers.

Results show that SDHIs pose a significant threat to pollinators, biodiversity and public health. Given that mitochondrial dysfunction at the level of succinate dehydrogenase can lead to serious diseases such as neurodevelopmental disorders and cancer, it is imperative to better assess the toxicity of SDHIs at low doses and over the long term. Our findings also show that maximum residue limits (MRLs) should be reduced to offer better protection. As SDHIs are frequently used in combination with other fungicides, such as triazoles and strobilurins (e.g., straw cereals), it is necessary to promote alternative methods to reduce the use of SDHIs.

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OP-132 [Bee Health]
Chronic exposure unravels varying susceptibility across three eusocial bee species

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Agrochemical pollution is a key driver of global insect declines, calling for increased scrutiny in regulatory assessments. Current environmental risk assessments (ERAs) for pollinating bees primarily rely on the western honeybee (Apis mellifera) as a surrogate species. However, bees can vary significantly in their sensitivity to agrochemicals due to differences in life-history, body size, feeding behavior, and detoxification capacity; this raises concerns about the extrapolation of A. mellifera data to other species. Here we show that A. mellifera-centric environmental risk assessments likely underestimate risks to other eusocial bee species. Following standard protocols (OECD 245), newly emerged workers from three eusocial bee species (two honeybee and one stingless bee species) were chronically exposed to increasing concentrations (0–1,000 ng g ¹) of a neonicotinoid for 15 days to determine median lethal daily dose (LDD) values based on sucrose consumption and mortality. Our results reveal significant time-dependent interspecies differences – A. mellifera (82 ± 25) revealed the highest and Tetragonula laeviceps (5 ± 1) the lowest LDD at day 10, whereas Apis cerana displayed the greatest tolerance (10 ± 1) compared to A. mellifera (3.8 ± 2.3) and T. laeviceps (3.3 ± 0.6) at day 15 (median LDD [ng g ¹ d]). While bee size and consumption are significant predictors of agrochemical susceptibility, they do not fully explain our findings, suggesting that other mechanisms regulate agrochemical sensitivity across species (e.g., detoxification abilities or life-history). Our findings underscore the urgent need to improve agrochemical regulatory standards to mitigate environmental risks of chemicals and thereby safeguard insect biodiversity.

OP-133 [Bee Health]
Not a numbers game – small hive beetle infestations in honeybee host colonies

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Small hive beetle, Aethina tumida (SHB), can cause more damage to honeybee, Apis mellifera, host colonies in areas with higher infestations. These higher infestation levels tend to occur in the invasive populations of SHB, but data comparing spatiotemporal variation of SHB infestations across multiple native and invasive SHB populations are scarce. Here, we measured SHB infestation levels by visually screening honeybee colonies across three native populations in South Africa, Nigeria and Kenya, and five invasive populations in Brazil, Italy, Australia and the states of Maryland and Alabama in the United States. We tested the effects of movement of new colonies to an apiary, previous use of SHB traps or other management methods and the number of colonies at an apiary on SHB infestation levels. Our data show that SHB infestation levels can be equally high in native and invasive populations, suggesting that differences between host honeybee populations, rather than the sheer number of SHBs, is the key criterion for damage caused by SHB. Our data also show spatial variation in SHB infestations within populations, but this was not explained by movement of colonies, the number of colonies at an apiary, or previous use of SHB management methods. The lowest SHB infestations were observed in Italy, possibly due to strict control management, e.g. protective zones and restricted movement of beekeeping material. It is apparent that our understanding of the drivers of variation in SHB infestations is still limited, calling for more efforts to elucidate our knowledge of this host-parasite system. Considering our results, future studies should especially address the role of quantitative behavioural differences between honeybee hosts following SHB incursion into colonies. While none of the variables we studied explained the spatial variation in SHB infestation levels, we want to highlight the importance of limiting SHB reproduction in its invasive range by maintaining strong colonies and clean facilities. Furthermore, our results indicate that new SHB introductions may be better contained by rapid implementation of strong management practices.

OP-134 [Bee Health]
The Foster AFB Method: rapid detection of clinical American Foulbrood through non-invasive hive sampling and DNA quantification via qPCR

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American Foulbrood (AFB) is a devastating bacterial disease of honeybees and subject to careful inspection measures in New Zealand. Despite a low prevalence of approximately 0.5% infection in New Zealand colonies, it has been estimated to cost New Zealand beekeepers more than 12 million euros per year, mostly in costs to inspect colonies for the disease. Diagnosis is centred on the beekeeper's skill in recognising visual symptoms – symptoms that may be confused with other brood issues such as viruses or damage from varroa.

Nearly all current AFB diagnostic testing methods rely on inspecting/sampling colonies that necessitate dismantling the colony and/or require multiple visits to retrieve passive samples. The Foster AFB method uses a novel environmental DNA (eDNA) sampling method using colony entrance swabs together with a quantitative DNA test (qPCR) for Paenibacillus larvae: the causative bacteria of AFB disease. DNA is extracted from the swabs using beadbeating and a column or precipitation extraction methods before detection and quantification is performed using a commercially available multiplex qPCR test (two targets for P. larvae plus an internal control). The quantification data generated is a critical element as it can be used to differentiate hives with clinically significant infections, even before visual symptoms are apparent (or are otherwise missed by the beekeeper). Sample pooling is used to increase testing throughput while reducing costs per colony to identify infected (and potentially infectious) colonies within an apiary, while individual affected colonies can still be identified through this strategy. Since the first report of the Foster Method in 2021, other studies have used the same sampling method for other honeybee pests and pathogens further confirming the use of the hive entrance as a rapid and non-invasive means to monitor colony health.

OP-135 [Bee Health]
Viral Exchange Between Honeybees and Greater Wax Moths: Ecological Drivers and Pathogenic Implications of Bee Densovirus 9

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Cross-species viral transmission between honeybees and their pests poses significant risks to pollinator health. However, the ecological drivers and host-pathogen interactions underlying viral spillover remain poorly characterized. The greater wax moth (Galleria mellonella), a pervasive hive pest sharing ecological niches with Eastern honeybees (Apis cerana), may facilitate virus host-shifting between phylogenetically distant species. While viral spillover from bees to non-bee hosts has been documented, the virome interface between G. mellonella and A. cerana, and its implications for disease ecology, remain largely unexplored. Here, we characterized the virome of G. mellonella and A. cerana under laboratory and field conditions to assess viral sharing dynamics and the infectivity of a novel densovirus, Bee densovirus 9 (BDV9), initially identified in Czech A. mellifera colonies in 2024.

Virome analysis demonstrated significantly higher viral diversity in G. mellonella (3.13–4.44% of reads mapping to viral genomes) versus A. cerana (0.02–0.08%), with 25–33 viral species shared between cohabiting groups. Strikingly, BDV9 exhibited 100% prevalence in G. mellonella populations across 12 Chinese regions. Experimental inoculation demonstrated BDV9-induced mortality in both A. cerana ($p < 0.001$) and A. mellifera ($p = 0.021$), though viral replication was transient, declining sharply by day 14 post-infection. Quantitative PCR confirmed shared upregulation of four antiviral peptides across both species, with species-specific statistical significance (Defensin1 and Hymenoptaecin in A. cerana; Apidaecin and Defensin2 in A. mellifera), suggesting convergent antiviral strategies limiting viral persistence.

Our findings redefine the ecological interplay between wax moths and honeybees. Beyond physical hive damage, G. mellonella may act as a viral reservoir host, leveraging its high viral diversity and colony ubiquity to facilitate cross-species transmission. The delayed pathogenicity and low replication efficiency of BDV9 imply an evolutionary trade-off favoring coexistence, yet its pervasive prevalence in G. mellonella underscores underestimated risks to apiculture. This study highlights the need to integrate pest-virus ecology into pollinator conservation strategies, emphasizing that wax moth management is critical not only for hive integrity but also for mitigating emerging viral threats.

OP-136 [Bee Health]
EurBeSt study on varroa resistance and relevant selection criteria in European honey bees

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The EU Commission assigned an international expert team (EurBeSt) to explore the level of varroa resistance in commercially available honey bees and the possibilities of increasing it through selective breeding.

As a central part of the EurBeSt study, 23 pre-selected lines from breeders throughout Europe were tested by 21 performance testers across 5 regional case studies in different countries (France, Germany + Austria + Croatia, Greece, Italy and Poland). Besides general beekeeping traits, the study assessed annual varroa infestation development, HYG (brood hygiene via pin test), SMR (suppressed mite reproduction), REC (recapping of infested cells) and VSH (varroa sensitive hygiene). The testing methodology followed standard protocols (Büchler et al 2024) and is described in detail in the study report (EU 2022).

Average adult bee infestation in summer after one year without any treatment ranged between 0.11 (+/- 1.59) and 14.63 (+/- 1.34) mites per 10g bees and showed significant differences between lines ($F = 3.75$, $p < 0.001$) and apiaries ($F = 4.55$, $p < 0.001$). Lines specifically selected for low mite population development displayed lower infestation rates than lines not selected for this trait ($F = 0.29$, $p < 0.002$). Several lines in the German and Polish case studies remained below the economical threshold of 3 mites / 10 g of bees.

The adult bee infestation at the end of the test season was significantly correlated with VSH ($r = -0.194$) and HYG ($r = -0.130$) but not with SMR and REC. However, REC showed a significant positive correlation with VSH ($r = 0.345$) and HYG ($r = 0.135$) and may thus be used as an additional trait for the selection of varroa resistance.

Beekeepers can immediately benefit from queens selected for low mite population development, VSH, HYG and REC behaviour. There is a realistic perspective of reducing high colony losses and minimizing the need for applying medication against varroosis by establishing locally adapted and mite resistant honey bee populations.

OP-137 [Bee Health]
The impact of heat stress and pesticide exposure on honeybee immune response

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The increase in honeybee colony losses is a complex problem caused by a variety of stressors, including pesticides and the growing impacts of climate change. Consequences of climate change are elevating global temperature and more frequent occurrence of heat waves, which makes heat stress an increasingly relevant concern. Additionally, bees are exposed to pesticides through contaminated nectar, pollen, and water during foraging, as well as residues in wax and bee bread. There is limited research on the effect of heat stress, and the combined impact of heat stress and pesticide exposure on honeybee immune response.

To address this gap, we simulated realistic field conditions in the laboratory. Cages were divided into 3 main groups: the control, the acute heat stress group, and the group subjected to acute heat stress while being fed with sublethal doses of acetamiprid. Heat stress was applied on three consecutive days by exposing the bees to 42°C for two hours. Before sampling, half of the cages from each group underwent an immune challenge by mechanical wounding. To evaluate the immune response, we measured total and differential hemocyte counts, quantified antimicrobial peptides (apidaecin, abaecin, hymenoptaecin, and defensin 1) in the hemolymph, and analyzed their relative gene expression in bee abdomens. Additionally, we measured total protein content in the hemolymph to evaluate overall physiological condition.

We found that wounding the cuticle of the abdomen strongly induces the gene expression of antimicrobial peptides and elevates their quantity in hemolymph across all groups. Heat stress alone did not significantly affect antimicrobial peptide expression or their quantity in hemolymph. However, the combination of heat stress and acetamiprid exposure resulted in a significant increase in antimicrobial peptide levels. Furthermore, total protein content in the hemolymph was significantly higher in both stressed groups compared to the control, which suggests an altered physiological state under stress.

Our findings suggest that heat stress alone did not significantly affect immunity, however, when bees face both heat stress and pesticide exposure, their immune response amplifies. This could lead to immune exhaustion over time and cause bees to be less capable of facing pathogens or other stressors.

OP-138 [Bee Health]
A Rapid and Early Detection Method for Paenibacillus larvae Spores: Advancing AFB Diagnosis and Hive Protection

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BACKGROUND/ PURPOSE: Honeybee populations, vital pollinators, are severely threatened by Paenibacillus larvae, the spore-forming bacteria causing American Foulbrood (AFB). Antibiotics are not a viable option, as they are either forbidden or discouraged in honey production, depending on the country, and they are ineffective against spores. This highly contagious disease spreads via resilient spores that germinate in larval midgut, degrading the host into a viscous mass. Incineration of infected colonies is mandatory, disrupting ecosystems and beekeeping economy.

PROBLEM/ OBJECTIVE: AFB clinical symptoms appear only after an outbreak, leaving beekeepers without timely intervention options, while current diagnostics are slow and labor-intensive. What solutions can enable early detection of P. larvae spores in hives, facilitating proactive disease management and reducing hive losses?

METHODOLOGY: We present a novel method for rapid and early detection and quantification of P. larvae spores in adult honeybees through light emission. This approach combines a highly efficient magnetic spore capture system—using magnetic beads coated with a keratin-binding protein D-crystallin (MB-Cryst)—with a highly specific recognition protein for P. larvae, a cell wall binding domain (PlyPl23CBD) fused to NanLuc (NLuc-CBD).

RESULTS AND CONCLUSION: We have developed a rapid method for specific detection and quantification of P. larvae spores by measuring light emission. We found that D-crystallin binds to P. larvae spores, MB-Cryst achieves over 90% spore capture efficiency from bee guts, and NLuc-CBD enables highly specific luminescence-based detection after a 3-hour germination step. This sequence of procedures forms a new protocol with a total processing time of about 4.5 hours, significantly improving existing diagnostics. Additionally, the method is designed for future adaptation into a user-friendly, on-site detection system using a portable luminometer or a mobile phone camera.

IMPLICATIONS: Timely detection of P. larvae spores in asymptomatic hives enables beekeepers to take preventive or corrective measures, preventing disease outbreaks and hive loss. This supports beekeepers through cost savings and increased honey production while enhancing agricultural pollination, boosting crop yields, and contributing to biodiversity conservation.

OP-139 [Bee Health]
Use of RNA interference to silence target genes of “Aethina tumida””, an invasive pest species of apiaries

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Background/purpose
RNA interference (RNAi) is a naturally occurring mechanism enabling eukaryotic cells to regulate gene expression; the mechanism can be reproduced by introducing in vitro synthesized double strand RNA (dsRNA) molecules into an organism to selectively block a specific messenger RNA with consequent transient stop of protein production. The goal of our study was to investigate the biological effects of dsRNA on the small hive beetle “Aethina tumida””.

Problem description
“A. tumida”” is a species native to South Africa, endemic to sub-Saharan Africa, where its populations attack African subspecies of “Apis mellifera”” without severe consequences. In newly introduced countries where the hosts are the European subspecies of honeybees, the beetle is responsible for serious damage to beekeeping by feeding on bees' eggs and larvae, wax and causing honey fermentation. Since it was detected in Italy in 2014, “A. tumida”” is considered an invasive alien species of concern in the European Union under Regulation 2016/429.

Methodology
We synthesized dsRNAs against two fundamental genes (RPS13 and V-ATPase) of “A. tumida”” and administered them to first instars via artificial diet or topical application. The measurement endpoints in the bioassays were mortality, larval growth and development, adult eclosion and fecundity. To relate the observed phenotypic effects to the treatment, Real-Time PCR were performed.

Results and conclusion
Both dsRNAs have induced negative effects on beetle development, survival rates and fecundity of emerging adults. While mortality rates were below 40%, with most fatalities occurring during adult eclosion from pupae, dsRNA caused a marked decline in all measured life parameters, sufficient to slow down the population's growth rate in natural conditions. Molecular analyses confirmed the successful silencing of both genes after 24 hours following dsRNA administration.

Practical implications for beekeepers
Pest control in beekeeping is a delicate management activity, as it needs to efficiently control pests and diseases without impairing bee health or product quality. RNAi may represent a major advance in this area, since its very specific mode of action may guarantee effective pest control in beehives, without harming honeybees, which proved to be refractory to treatments with dsRNA.

OP-140 [Bee Health]
Tebuconazole-induced oxidative stress in honeybee flight muscles: mechanisms of disruption and adaptive cellular mechanisms

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Background/Purpose
Colony collapse disorder (CCD) of honey bees is a major problem of modern agriculture, which may be caused by a number of factors including the increased use of pesticides. This is the reason why research on the impact of plant protection products on pollinator species, such as the widely used azole fungicides, is particularly importante.

Problem Description
Tebuconazole, a prominent member of the class of azole fungicides, is known to cause both redox homeostasis changes in the bee brain and altered fatty acid metabolism, which may be linked to certain cognitive changes leading to navigational as well as behavioral disturbances. However, there is lack of knowledge on how these agents act in other organs, such as the flight muscle.

Methodology
The aims of our study were to assess the effects of acute sublethal exposure to tebuconazole, with a focus on the redox homeostasis of honeybee flight muscles. Tebuconazole was applied per os mixed to saccharose containing feeding solution in lethal dose 50 (LD50)/10, LD50/20 and LD50/40 concentrations for 48 hours. Following the dissection and homogenization of flight muscles, colorimetric and fluorometric tests were performed to measure redox parameters such as malondialdehyde (MDA), hydrogen peroxide (H2O2), glutathione (GSH and GSSG) concentrations, as well as antioxidant enzyme activities.

Results and CONCLUSION: Our results showed detrimental effects considering GSH and GSSG concentrations as well as their ratio. On the other hand, flight muscles exhibited potential adaptive responses to acute oral tebuconazole exposure, contrasting with the vulnerability, previously observed in other organs, such as the brain. This was highlighted by decreased H2O2 and MDA levels together with unchanged redox enzyme activities.

Practical Implications for Beekeepers
Investigating the cellular effects of agricultural pesticides in bees is a high priority area in the context of sustainable agriculture. Our results show that although tebuconazole adversely affected defense mechanisms such as glutathione balance, negative effects for several other antioxidant parameters were not confirmed. Thus, compared to other organs such as the brain, flight muscles showed increased resistance and activation of efficient adaptive mechanisms.

OP-141 [Bee Health]
Impact of Varroa destructor infestation on the survival, quality, and performance of honeybee queens (Apis mellifera L.) overwintered in banks

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Access to high-quality queens is crucial for the beekeeping industry, as they directly influence colony health, productivity, and survival. To enhance self-sufficiency in local queen production, the Centre de recherche en sciences animales (CRSAD) and Université Laval have been developing a mass storage technique for bee queens since 2018. However, the impact of Varroa destructor parasitism on the survival and quality of overwintered queens remains unclear. Here we show that the level of Varroa destructor infestation in autumn significantly affects the survival of overwintered queens. Queens overwintered in low-infestation banks (0-1%; LIB) had a higher survival rate (76.7 ± 17.3%) compared to those in moderately infested banks (2-5%; MIB) (69.4 ± 17.8%). In this study, we also compared the fertility, morphometric characteristics, and colony performance of queens from both infestation levels with imported queens in spring. While no significant differences were observed in morphometric traits (weight, abdomen length) or fertility (sperm count and viability) between the two overwintered groups, imported queens were, on average, 1.1 mm smaller, 25 mg lighter, and had 12% lower sperm viability than banked queens. Queen introduction success was high (94.4%) across all groups. Although imported queens initially produced more eggs in the first 10 days, overall brood development during summer was comparable between groups. However, honey production was significantly lower in colonies headed by imported queens (2.6 ± 1.3 kg) than those with LIB (12.6 ± 2.5 kg) or MIB (11.7 ± 1.8 kg) queens. Regarding pathogens, no viruses were detected in overwintered queens, whereas imported queens carried BQCV, DWV-A, and DWV-B. These findings suggest that mass overwintering of local queens is a viable alternative to queen imports. By reducing dependence on foreign suppliers, this approach minimizes the introduction of pathogens, lessens the negative impacts of long-distance transport on queen quality, and promotes local adaptations in bee populations. This approach could strengthen the self-sufficiency of the Canadian beekeeping industry while supporting sustainable colony management.

OP-142 [Bee Health]
Chemical Pollution and Pollinator Health: Assessing Multi-Stressor Effects on Honeybees and Solitary Bees

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Chemical pollutants pose a significant threat to bee health, affecting their physiology, behavior, and survival. While the effects of specific insecticides on bees are well known, it is necessary to considered that bees are routinely exposed to complex mixtures of chemicals, including fungicides, herbicides, heavy metals, and veterinary drugs. The combined effects of these pollutants remain poorly understood, particularly their impacts at sublethal concentrations. Research on chemical exposure has largely been focused on honeybees, yet other pollinators, including solitary bees, also face similar risks. By integrating multiple stressors and diverse pollinator taxa, the study aims to expand our understanding of pollutant-pollinator interactions beyond the traditional honeybee model. A multidisciplinary approach has been adopted to provide valuable insights into bee survival considering and integrating information from different factors that are affected by pollutants. In particular, this research aims to evaluate effects of chronic oral exposure at sublethal concentration to different chemicals (boscalid, copper(II)chloride dihydrate; ivermectine and glyphosate) on survival of adults of the social honey bee (Apis mellifera) and the solitary red mason bee (Osmia bicornis), by integrating gut microbiome characterisation and different biomarker responses. As a result different chemicals impacted survival at different level. The gut microbial community of these pollinators was investigated by molecular analyses in terms of abundance and taxonomic composition, using quantitative PCR and high-throughput Illumina sequencing, respectively. Overall, the results indicate that all the administered chemicals, though to a different extent, affected the gut microbiome of bees in terms of community composition and diversity. As biomarkers, acetylcholinesterase, carboxylesterase, glutathione S-transferase, alkaline phosphatase, phenoloxidase and prophenoloxidase activities were evaluated, together with nuclear abnormalities assay and differential hemocytes count. In the solitary bee, detoxification processes were induced after both copper and boscalid+copper(II)chloride dihydrate treatments compared to control and boscalid ones. After ivermectine and ivermectine+glyphosate treatments, Osmia bicornis specimens showed metabolic alteration. Higher values of DNA damage were observed after all treatments, both alone and in combination. These findings will help refine environmental risk assessments and support conservation efforts to protect pollinators and their crucial ecosystem services.

OP-143 [Bee Health]
A review of bee health in Africa: From a development perspective

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The same pests and diseases, such as varroa destructor, nosema, and American Foulbrood, devastating colonies in Europe and North America are present across Africa. Despite no to minimal treatment, research and informal discussions with beekeepers have not shown high colony losses.

Most African honey bee colonies are wild or kept with minimal management. Management is often limited to monitoring colonies and preventing external pests, with no disease treatment. Despite low colony losses many development programmes, especially government and tertiary education level, focus on European and North American disease management techniques and the need for African beekeepers to adopt so called modern practices.

Research has explored the possible resistance of African honey bees and recently begun to consider how this may relate to beekeeping practices. This scoping review explores the recent research on honey bee diseases, their impact, and potential lessons for extension and development practitioners from a beekeeping development perspective. The following questions guided the review article selection: What is the spread and recorded impact of honey bee diseases across Africa? Is there a consensus on African honey bee disease resistance and its relation to beekeeping practices? Finally, what beekeeping best practices for extension and development can be drawn from the current African bee health situation? Research articles and review papers from across Africa over the last 20 years were assessed.

In general, the review demonstrates the need for a network of the network of African researchers and universities collaborating to understand the spread and impact of pests and diseases. Research should consider how an African system of beekeeping can support relevant, sustainable practices which encourage natural resistance. The review findings are applied to the development context and guide the development of specific future research questions.

OP-144 [Bee Health]
The use of "Magnetto", a tool for fast capturing of queens, dramatically improves and simplifies ecological Varroa treatment based on organic acids

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Background
Varroa destructor has been devastating honey bee colonies and held the beekeeping world in its grip ever since it spread across the globe some 40 years ago. In absence of a definite solution, organic acids, such as Formic Acid and Oxalic acid have emerged as the most promising natural treatment options. The widespread use of oxalic acid for varroa treatment is hampered by its low efficacy in presence of brood. In contrast, formic acid penetrates brood cells but the exposure to formic acid leads to increased queen losses.

Problem Description
The central hypothesis presented herein is that the ability to quickly capture queens significantly improves organic acid based Varroa treatment practices and makes them more attractive to beekeepers.

Methodology
Field tests with two experimental groups, one for oxalic acid and one for formic acid treatment were performed using Magnetto, our recently developed magnet-based tool for fast queen capturing. After queen capturing with Magnetto, the queens for the oxalic acid group were caged to induce brood free states followed by oxalic acid treatment via dribbling. In contrast, the hives in the formic acid group were subjected to a shock treatment with formic acid, immediately after removing queens with Magnetto and queens were re-introduced 24 or 48 h later.

Results and Conclusions
In a test of 60 hives, Magnetto allowed to find metal plate tagged queens in > 90% of hives in less than 4 minutes. Formic acid treatment after queen removal was well tolerated by the workers. Re-introduction of queens after 24 h did not result in increased queen losses (< 5%), as typically observed for formic acid treatment. Both methods provided treatment efficacies of 96% (oxalic acid) and 95% (formic acid).

Practical Implications for Beekeepers
Magnetto was proven to simplify and improve the treatment efficacy of organic acid based Varroa Treatment by eliminating the crucial bottle neck: the ability to quickly find and remove or cage/ring the queen as a preparation for the treatment. Magnetto reduces the hazard of formic acid treatment by allowing a temporary removal of queens before treatment.

OP-145 [Bee Health]
World Honey Bee Health – A COLOSS effort to monitor the global distribution of Apis mellifera pests and pathogens

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The health of managed colonies of western honey bees (Apis mellifera) is a topic of international concern given the importance of honey bees to crop pollination, the overall function of natural ecosystems, and the improvement of human livelihoods through the sale of bee products. Honey bees host a suite of pests and pathogens that can compromise colony health. Knowing the global distribution of these pests and pathogens is key to developing strategies for their control and limiting their spread. In 2022, a group of scientists within the COLOSS Honey Bee Research Association (https://coloss.org/) created the World Honey Bee Health (WHBH) Task Force. The purposes of this Task Force are to monitor and document the global distribution of western honey bee pests and pathogens based on specific criteria and serve as a resource for the honey bee research community and related authorities who make science-based decisions that will improve the health of honey bees and the sustainability of beekeeping globally. We developed a website (www.worldhoneybeehealth.com) where we uploaded pest/pathogen distribution maps and tables that we can modify in real time as distributions change or more information becomes available. Furthermore, anyone can download all pests/pathogen distribution tables and maps and use them as open-source material in presentations, reports, manuscripts, and other printed material. Soon, we will finish mapping the global distribution of Varroa destructor. The results allow us to link V. destructor infestation level (# mites/100 adult bees) and prevalence (% of colonies positive for the mite) to temporal and spatial data. We will upload the results to the WHBH website and publish them as an open access database and citable refereed manuscript. Following this, we will begin developing databases to map the distributions of other honey bee pests and pathogens. Our efforts will allow the honey bee community to make science-based decisions that will improve the health of honey bees and the sustainability of beekeeping globally. We believe that the resources we develop will be a valuable tool to scientists, regulators, industry officials, beekeepers, and more as we all work together to improve the health of this invaluable bee species.

OP-146 [Bee Health]
Impact of EU regulation on Honey Bee Health: the case of Aethina tumida in Italy

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Background/Purpose
Honey bee diseases and their control measures significantly impact managed colonies, beekeepers and the broader sector, with potential consequences for agriculture, food safety, and biodiversity. To ensure high animal health standards, the EU implemented Regulation (EU) 2016/429 on transmissible animal diseases ('Animal Health Law') is applied since 2021, alongside CDR (EU) 2018/1629 and CIR (EU) 2018/1882.

Problem Description
Honey bee disease are classified under EU regulations as follow: varroosis (Category C, D and E); Aethina tumida (Small hive beetle, SHB) infestation, American foulbrood, and Tropilaelaps spp. infestation (Categories D and E). While Aethina tumida is present in Calabria and Sicily, regions of southern Italy, it remains exotic to the rest of the EU.

Methodology
Historically, the approach to honey bee diseases focused on their eradication, especially for exotic pathogens. Over time, this strategy evolved into one directed at containment, management and surveillance.

RESULTS: Between 2014 and 2019, eradication measures for SHB were implemented, transitioning later to a containment approach that stabilized coexistence with the pest in two Calabria provinces. This strategy was also applied after the parasite's re-emergence in northeastern Sicily, five years after the last reported outbreak. In alignment with the Animal Health Law, Italian regulation mandates a 30 km protection zone around the SHB-infested apiaries, prohibiting honey bee movements beyond this area. Furthermore, the EU Commission has placed the entire Sicily region under emergency measures (CID 2024/3119/EU).

CONCLUSIONS: Articles 10 (Responsibilities for animal health and biosecurity), 124 (General movement requirements for kept terrestrial animals), and 125 (Disease prevention measures in transport) of Regulation (EU) 2016/429 outline beekeepers' responsibilities for safeguarding colony health and implementing biosecurity measures to ensure the safe movement of honey bees.

Practical Implications for Beekeepers
Small hive beetle infestation can be controlled and managed without the mandatory destruction of infested colonies. However, under the current emergency measures in Sicily, the export of queen bees from the region to EU and international markets is prohibited.

OP-147 [Bee Health]
Empowering beekeepers and their communities: educational strategies for mitigating pesticide risks to pollinators

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Pollinator Stewardship Council

Pollinators are essential for global food production, yet their populations are declining due to multiple stressors, including habitat loss, climate change, and pesticide exposure. Pesticides, particularly neonicotinoids, have been widely implicated in colony losses through acute and chronic exposure, negatively affecting bee navigation, reproduction, and immune function. Despite increasing awareness of pollinator decline, many stakeholders—beekeepers, farmers, and the general public—lack access to practical, science-based guidance on reducing pesticide risks. Effective outreach programs are crucial to bridging the gap between scientific research and everyday practices that protect pollinators.

Although research has demonstrated the negative effects of pesticide exposure on bee health, practical mitigation strategies and identification of critical regulatory changes may be difficult to access and understand. Many stakeholders lack the knowledge or resources needed to identify pesticide risks, implement protective measures, and engage in informed advocacy for pollinator-friendly policies.

We show that targeted educational programs on pesticide risk reduction significantly improve knowledge, increase adoption of protective management strategies, and foster collaborative advocacy for stronger pollinator protection policies at local and national levels.

Since its inception, PSC's outreach programs have reached thousands of stakeholders across diverse sectors, including commercial and hobbyist beekeepers, organic and conventional farmers, backyard gardeners, and community members. Evaluation data demonstrate a increase in participants' ability to recognize pesticide risks, understand exposure pathways in pollinator populations, understand and identify pesticide exposure in managed colonies, and adoption of practices including Integrated Pest Management, pollinator-friendly food production methods, and advocating for pollinator-friendly policies. These outcomes underscore the power of education in driving measurable improvements in pollinator stewardship and sustainable beekeeping. Moreover, they highlight the critical role of education in translating scientific findings into actionable practices across residential, agricultural, and legislative sectors.

By providing beekeepers, farmers, and community members with the knowledge and tools to mitigate pesticide risks, this program strengthens pollinator health, improves hive sustainability, and fosters long-term resilience in pollination-dependent agricultural systems. Expanding such educational initiatives will be essential for bridging the gap between research and real-world application, empowering a broader coalition of stakeholders, and ultimately fostering a more pollinator-friendly agricultural and urban landscape.

OP-148 [Bee Health]
Environmental DNA as a detection approach for Tropilaelaps mites

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Mites in the genus Tropilaelaps parasitize the western honey bee (Apis mellifera), causing severe damage. As these mites have spread far beyond their native range (especially Tropilaelaps mercedesae), they potentially threaten wild and managed Apis mellifera populations worldwide. Early detection of invasive species is key to effective management, and time-efficient and scalable techniques are needed to complement current physical monitoring methods which have limited scalability as they are time consuming and depend on trained personnel. Environmental DNA (eDNA) techniques are used for detection of other invasive species and could be applied to detect Tropilaelaps in samples from honey bee colonies. In this study we aimed to determine which sample types are appropriate for eDNA testing, and how colony infestation levels influence DNA detection. To do so, we collected samples from 106 A. melliferacolonies in Thailand and South Korea, where Tropilaelaps mercedesae mites are present. Sample types included adult bees, brood comb, bottom board debris, and honey – as well as swabs of bottom boards, individual brood cells, and brood comb surfaces. These samples were tested for Tropilaelaps DNA using a qPCR assay. We determined the Tropilaelaps infestation rate of the colonies by uncapping worker cells. For each sample type, we determined a detection threshold – the infestation of Tropilaelaps required to provide 50% probability of detection in the qPCR assay. We found that bottom board swabs collected through the entrance performed consistently well across both countries. This method detected Tropilaelaps in all tested hives in Thailand regardless of infestation levels and had a detection threshold of 2.6% Tropilaelaps brood infestation (infested cells per 100 cells) in Korea. The second-best method was samples of adult bees, with estimated detection thresholds of 0.42% and 3.9% Tropilaelaps brood infestation for Thailand and Korea, respectively. Based on these results, we conclude that eDNA methods are appropriate for Tropilaelaps detection. Bottom-board swabs and adult bee samples are simple and quick to collect. While processing costs are a consideration, the efficiency of eDNA sample collection may make it a good addition to monitoring programs in areas at risk of Tropilaelaps incursions.

OP-149 [Bee Health]
Predicting the impact of Varroa under climate change: An individual based modelling approach

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Varroa destructor continues to erode the resilience of global beekeeping, with infestation leading to an increase in the level of viruses that can ultimately lead to colony collapse. Many beekeepers utilise different interventions to maintain Varroa populations below damage thresholds. Chemical treatments, queen caging and drone brood removal are all routinely deployed by beekeepers to manage Varroa mites. Field data on treatment efficacy and long-term honey bee colony survival are difficult to obtain and highly variable. It is also not clear how Varroa build-up and treatment efficacy might alter under climate change.

Individual based models (IBMs) attempt to capture the underlying processes of animal behaviour and can be a useful tool to monitor population build-up in a changing environment. Here we report the development of a two-population IBM that includes Varroa mites and their honey bee hosts under the Horizon Europe project BeeGuards (see www.beeguards.eu). We incorporate weather as a major driver of honey bee colony development, and monitor Varroa build up over time. We also developed functions that allow management practices to be incorporated into the model, to allow us to monitor the likely impacts interventions have on Varroa populations under different climate scenarios.

OP-150 [Bee Health]
BeeGuards - an EU project for resilient beekeeping

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Background
Climate change is impacting beekeeping in many ways, Varroa is still causing colony losses, alien species are getting closer, honey bees are seen as competitors to other pollinators. On the other hand, scientific and technological advances could provide beekeeping with more efficient tools to make beekeeping more resilient.

Problem description
Warmer winters cause longer brood cycles, which mean higher chance for Varroa to reproduce and increased risk in case of arrival of the exotic mite Tropilaelaps. Thirty years after the spread of Varroa out of Asia, we do not really have strong evidence that calendar based treatments contribute to the reduction of colony losses, particularly when environmental conditions and colony development are excluded from the equation. The "Give Varroa a Chance" approach, based on threshold infestation level, can support natural selection towards varroa-resistant honey bees. But data is needed to validate the approach and to better understand the involved biological mechanisms and environmental factors. Furthermore, habitat fragmentation and reduced floral resources have highlighted potential competition between pollinators and raised the issue of optimal colony densities and tools for assessments.

Methodology
BeeGuards (EU Horizon Europe, grant 101082073; www.beeguards.eu) is a diverse consortium composed of 27 partners from 16 countries of different backgrounds (beekeeping associations, companies, research institutes, universities) bringing together expertise across multiple fields. BeeGuards aims to strengthen beekeeping resilience by providing sustainable management practices, novel breeding strategies and digital and forecasting tools that allow the sector to adapt to a changing environment.

Results and conclusion
In the field, BeeGuards is performing a comparative study in 11 countries in Europe and beyond, applying innovative threshold-based management practices and using hives equipped with digital sensors. BeeGuards is performing complementary immunological, behavioural, pathological, hologenomic and ecological studies that will serve to elucidate how management, climate and environment act on honey bees and other pollinators. Insights on preliminary results will be provided.

Practical implications for beekeepers
Beekeepers, farmers and citizens can participate via an online encyclopedia (www.WikiBeedia.eu) and by citizen-science and carbon footprint studies to ensure that research findings are directly translated into useful and good practices for end users.

OP-151 [Bee Health]
Buzzing Boundaries: Balancing Honey Bee Movement and Pathogen Risks to protect Biodiversity

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The increasing demand for food has promoted the intensive commercial use of honey bees through the transhumance of colonies to ensure crop pollination. Beekeepers are rewarded directly through hive rental payments, and indirectly through colony access to crops that provide pollen and nectar for honey bees. However, this movement of managed honey bees may have a trade-off, particularly regarding the transmission of pathogens to wild bees. Another beekeeping practice that may also impact bees, is the introduction of foreign subspecies of Apis mellifera without quarantine or prior control of their colony health in areas with local ecotypes. Both practices could potentially affect the conservation of local managed and wild bee biodiversity.

In this research we obtained information on the presence of pathogens in wild bees, and the occurrence of foreign honey bee subspecies on the Canary Island of La Palma. On this island, transhumance is concentrated on the western side and a conservation programme for the local black honey bee ecotype was established in 2001. These circumstances make La Palma an ideal natural laboratory to test our hypotheses.

Wild bee species were identified through visual examination with identification keys and confirmed by DNA barcoding. Pathogen (Trypanosomatidae and Nosematidae) presence was determined by molecular methods. Honey bees were characterized by sequencing the intergenic mitochondrial region to determine haplotypes.

Honey bee trypanosomatids (Crithidia mellificae and Lotmaria passim) were detected in wild bees albeit at low prevalence. Other pathogen species observed were host-specific (Nosema bombi and Crithidia bombi in bumblebees). Regarding the honey bee colonies sampled, all of them exhibited haplotypes characteristic of the local ecotype.

These results indicate that honey bee pathogens are present in the wild bee communities at a low frequency, but whether their presence leads to disease development remains to be studied. Finally, the conservation programme of the local black honey bee ecotype has proven effective and respected by beekeepers who are aware of the importance of working with honey bees locally adapted to the unique environment of the Canary Islands. This project receives funding from the Ministry of Science and Innovation of Spain under grant agreement TED2021-131316B-I00.

OP-152 [Bee Health]
From Screening to Mechanism: Curcumin Emerges as a Key Natural Compound Against Israeli Acute Paralysis Virus in Apis mellifera

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The honeybee (Apis mellifera), a cornerstone species in global ecosystems, sustains biodiversity and agricultural productivity through pollination and bee products generation. However, recent years have witnessed significant threats to honeybee health from diverse factors, including parasites and pathogens. Israeli acute paralysis virus (IAPV) is widely prevalent in honeybee colonies, inducing paralysis and tremors in honeybees that lead to mortality, severely compromising colony health, and is recognized as a critical factor to colony collapse disorder (CCD). Despite its devastating impact, no targeted antiviral therapies are currently available for IAPV management. Natural products, with their structural diversity, multi-target potential, and low environmental toxicity, offer a promising yet underexplored avenue for combating viral infections in honeybee.

In this study, we screened eight natural products (myrcene, citral, menthol, chlorogenic acid, resveratrol, curcumin, quercetin, and tea polyphenol) for their efficacy in reducing IAPV loads in honeybee. By administering these compounds to artificially or naturally IAPV-infected honeybees and quantifying viral titers via qRT-PCR, we identified curcumin as the most effective candidate for significantly suppressing IAPV replication. After 7 days of feeding with a 50% sucrose solution containing 10 μM curcumin, artificially and naturally IAPV-infected honeybees exhibited significant reductions in viral titers by 46.2% and 84.0%, respectively. Transcriptomic analysis revealed that curcumin upregulated genes associated with nutrient metabolism (Vg, Hex110, Hex70a, Vhdl), suggesting improved physiological resilience, alongside antiviral genes such as Dicer and Argonaute-2 (core RNA interference pathway components) and Tep7 (a gene implicated in pathogen defense). Concurrently, curcumin downregulated antimicrobial peptide genes (Hymenoptaecin, Abaecin, Defensin), indicating a strategic shift in immune resource allocation. These findings indicate that curcumin combats IAPV by enhancing honeybee health and reallocating physiological resources to prioritize the RNAi pathway and other antiviral mechanisms, thereby amplifying targeted viral suppression.

This study identifies curcumin as a novel, eco-friendly candidate for IAPV mitigation. By suppressing viral replication without compromising the safety of bee products, it resolves existing deficiencies in apicultural viral management and provides a sustainable solution to enhance healthy beekeeping practices and ensure the production of safe bee products.

OP-153 [Bee Health]
High plasticity for many of the Bond bee population's varroa, colony development, foraging, and virus traits, in relation to year, season and varroa treatment

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BACKGROUND:
The Bond Project is a research programme based on a small honeybee population on Gotland that has survived without varroa control for 20+ years. The Bond Project has been hugely successful and influential world-wide, by identifying numerous adaptive traits that permit this population to persist long-term with varroa.

PROBLEM:
We wanted to know how these traits would behave under normal, productive beekeeping conditions, i.e. including varroa treatment. Stable traits are suitable for breeding programmes, while variable 'plastic' traits are less suitable. Both are important for adaptation and survival.

METHODOLOGY:
The entire experiment took place on the Gotland peninsula where the Bond population survived for 20+ years. Nine Bond colonies were split evenly, with each split producing a new locally mated queen. One colony in each pair was assigned to the varroa-treated group; the other to the untreated group. Both the genetic and environmental backgrounds of the two groups are therefore essentially identical. The treated group was given a single oxalic acid treatment early December each year. The colonies were monitored over two years for survival, swarming, colony development, varroa infestation and fertility and several virus infections.

RESULTS: The oxalic acid treatment was very effective. Varroa fertility was constant at around 55%, irrespective of treatment, season or year. Swarming and survival were higher in the treated group. Bee strength (adults, open and closed brood) was variable across the season and between years, and slightly higher for the treated group. Treated colonies collected much more pollen and nectar, particularly during June. Brood rearing ceased completely by August each year, coinciding with a lack of stored pollen. DWV was lower in treated colonies, while SBV, BQCV and LSV were higher. All viruses were variable across season and between years.

PRACTICAL IMPLICATIONS:
Most of the traits were highly plastic, varying by season and year as well as treatment. The only constant trait was reduced mite fertility. The treated colonies were much more productive for similar bee strength. Their higher SBV, BQCV and LSV levels were clearly not detrimental. Finally, consider that your colony's traits may be largely plastic, rather than primarily genetic.

OP-154 [Bee Health]
Viral Infections: When and How Do Honey Bee Queens Become Infected

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Viruses constitute a major class of honey bee pathogens, with most being +ssRNA and posing significant health concern. They employ various transmission routes and infect queens at different developmental stages. Therefore, understanding transmission pathways and identifying the most vulnerable stages of queen development to viral infections are essential for reducing or preventing viral infections. To address this, we conducted a series of controlled experiments and surveys in commercial queen-producing operations, covering the entire queen-production process. Using the RT-qPCR approach, we tested seven honey bee viruses including DWV type A and B, BQCV, LSV, CBPV, SBV, and IAPV. Our findings highlight the critical role of vertical and venereal transmission in queen infections, regardless of virus type. Queens are highly vulnerable in their early development, highlighting the importance of selecting healthy breeder queens. Although we detected high virus loads in nurse bees, virus levels in royal jelly were very low or undetectable, suggesting that the vertical transmission from infected breeder queens is the primary pathway for viral spread. Additionally, we found that mated queens carried significantly higher virus loads than virgin queens, highlighting mating as another critical transmission point. This finding emphasizes the need to produce healthy mature drones during queen mating period. Furthermore, virus loads in queens were consistently higher in banked colonies compared to mating nucs, suggesting that the practice of queen banking may contribute to increased virus levels in honey bee queens.

OP-155 [Bee Health]
Be-eRNA: Using next-generation sequencing to characterize the community of honey bee viruses from hive environmental samples

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The western honey bee (Apis mellifera L.) plays a critical role in agricultural pollination services globally, yet is threatened by many pests and pathogens, particularly RNA viruses. Monitoring for viruses is challenging as diagnosis relies on destructively sampling adult bees and screening for a standard virus panel, thus overlooking novel, uncommon, or emerging viral pathogens. Here, we investigated the utility of next-generation sequencing of environmental RNA (eRNA) samples collected from hive substrates to characterize the virus communities of honey bee colonies. We swabbed the following substrates from test hives: hive entrances, hive bottom boards, frame top bars, sugar feeders, honey, and hive tools. RNA was extracted from all swabs and screened for seven viruses using conventional PCR techniques. For two additional samples (swabs of a hive tool and hive entrance), libraries were prepared with and without viral enrichment, and RNA-seq was subsequently performed on an Illumina NovaSeq instrument. Overall, we found that over 85% of eRNA samples were positive for at least one virus. From NGS data, we found the enrichment step nearly doubled the viral transcripts detected in our samples. Shotgun sequencing results from our hive tool eRNA sample detected viruses present in conventional PCRs as well as less common viruses not included in standard viral panels. We were able to characterize the virus community within honey bee colonies from eRNA samples, but there was great variation in viruses detected among hive sampling locations. Thus, our next step will be to determine the hive substrates that will give us the most informative results for characterizing known and emerging viruses. We show that non-destructive environmental sampling combined with high-throughput sequencing can be used to monitor emergent viral threats to honey bee health. This study demonstrates the untapped potential of eRNA as a tool for global viral monitoring in honey bee colonies.

OP-156 [Bee Health]
Varroa destructor infestation levels can be predicted by brood cell recapping rate and mite non-reproduction in honeybee colonies (Apis mellifera)

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The genetic selection of honeybees (Apis mellifera) offers the beekeeping industry the possibility of combating the Varroa destructor parasite and thus reducing its dependence on acaricides. Indeed, some bee populations have heritable hygienic behavioural traits that allow them to resist Varroa infestation. However, the links between these different behavioural traits are not yet well defined, which limits genetic progress. In this context, we measured the following behavioural Varroa resistance traits: freeze-kill brood assay (FKB) and pin-kill brood assay (PKB), varroa-sensitive hygiene (VSH), pupae removal, mite non-reproduction (MNR) and recapping activity. Correlations between these measures show that two are negative and significant: (1) between the recapping of cells infested with Varroa and the total number of recapped cells and (2) between the recapping of cells infested with Varroa and varroa-sensitive hygiene (VSH). We also selected the best predictive model of varroa infestation levels using the "step-wise" approach based on the AIC criterion. Our model revealed that MNR and FKB were significantly related to the varroa population levels with a negative relationship, while recapping was significantly related to mite infestation levels with a positive relationship. Thus, a higher MNR or FKB score is significantly related to low levels of mite infestation in colonies at the end of August, while a higher recapping activity is significantly related to a high level of mite infestation. Our work indicates that recapping behavior could be a useful trait to aid the selection of Varroa-resistant bee lines but that further work needs to be done to better understand its significance.

OP-157 [Bee Health]
Will my colony survive this season? A benchmark analysis of statistical and computational models to predict honey bee mortality

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For the past decade, managed honey bee populations have experienced substantial yearly mortality worldwide (~40%). While scientists have identified a series of potential causes underlying these declines, predicting how and when bee mortality should occur remains a challenge. This is in part due to the difficulty of collecting data over a colony's lifetime, the complex nature of longitudinal datasets collected in the field, and a lack of standardized protocols and guidelines for analyzing such data. As a result, beekeepers face considerable uncertainty, as they cannot reliably anticipate when and how many of their colonies will perish. To address these problems, we built a longitudinal dataset using the Nectar application, a data platform working with beekeeping operations across Canada and the U.S. Nectar allows us to monitor a colony's lifespan from its creation to its potential death, and assess how beekeeping practices and environmental features influence survival. Our objectives were 1) to test the performance of models tailored for survival analysis on a field honey bee dataset, 2) to provide a clear protocol for the analysis of honey bee colony survival, and 3) to provide guidelines for beekeepers to maximize colony survival. Preliminary results indicate that computational models outperform traditional statistical models (Cox proportional hazards) at predicting hive survival. Models using extreme gradient boosting (XGBoost) displayed the best performance, achieving high predictive accuracy (~0.90 Concordance Index) over independent test data. On average, the chances of survival declined to 50% when colonies reached approximately 325 days of age. The most important features for predicting colony survival were air quality, precipitation, and the rate of kilometers travelled for crop pollination. This suggests that beekeepers should closely monitor colonies older than one year and aim to mitigate the impacts of practices that may compromise honey bee health. Hence, our analyses reveal that monitoring hive level data is essential to obtain accurate predictions of honey bee survival.

OP-158 [Bee Health]
Small hive beetle reproduction in association with honeybee colonies

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Small hive beetles (SHB), Aethina tumida, are parasites of honeybee, Apis mellifera, host colonies. SHB are known to display destructive mass reproduction on combs or cryptic low-level reproduction in debris. However, field observations indicate that SHB reproduction may not always fit these categories. Here, we show that reproduction in debris can be common and equal in numbers of larvae those on combs calling for a redefinition of SHB reproduction and respective field mitigation.

Numbers of SHB adults and larvae were measured in non-managed honeybee nests in Italy (Calabria) (n=9), as well as in managed Langstroth hives in Italy (Calabria) (n=50), the United States (Maryland) (n=30) and in Australia (New South Wales) (n=30). The data were combined with published data from traditional African bark hives from Benin (n=20). All data were gathered by visually screening the entire nest/hive for SHB adults and larvae. We tested whether the occurrence of debris reproduction (i.e. the presence of SHB larvae in the hive debris) or the number of SHB adults and larvae differed between the three types of honeybee colonies. Additionally, we tested whether the number of SHB larvae correlated with the number of SHB adults. The results show that debris reproduction occurs more rarely in Langstroth hives and when it does occur the Langstroth hives also have less SHB larvae. The data also show a positive correlation between the number of SHB adults and SHB larvae.

Since SHB infestation levels in Africa can match those in Australia or the US despite the apparent absence of destructive mass reproduction it seems apparent that the importance of debris reproduction has been severely underestimated. Indeed, thousands of larvae were found in the debris of a single feral colony in Italy. Further reproduction on combs is not necessarily destructive to the colony. In conclusion, it seems overdue to change terminology into comb and debris reproduction of SHB respectively. Further, beekeepers are kindly advised to limit debris or to use mashed bottom boards to limit SHB numbers.

OP-159 [Bee Health]
Lysozyme, an powerful protein supplement for prevention of brood diseases and stimulation of colony development: a report from large scale laboratory-to-field trials on the Canary Islands and Spain

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Background
Honeybee diseases, are a constant threat to the fitness of colonies. While the extensive study of Varroa has yielded many treatments, the damage to colony development from subclinical brood diseases has long been underestimated. Long before outbreaks are visible, the presence of various pathogens is inhibiting the development and reducing the performance of honeybee colonies. Yet, aside from largely prohibited antibiotics, there are no effective solutions available for protecting colonies from common brood diseases, such as Chalkbrood, American- and European foulbrood.
Problem Description

Here we present data from laboratory and in large field trials on the use of egg lysozyme, a natural antibacterial and anti-fungal enzyme, which improves the hygiene around the brood nest and stimulates colony development.

Methodology
Lysozyme has been previously reported by Van Haga et al. (J. Economic Entomol. 2012) for its effectiveness in the treatment of chalkbrood in field trials in Canada. We have undertaken extensive artificial larval rearing experiments to study the effects of Lysozyme in larval food for the treatment of common brood diseases (Chalkbrood, American- and European Foulbrood. Field trials for colony development were conducted in Spain, Romania and Italy, using a commercially available liquid formulation “ApiForte”. Currently a large multi-year field trial is ongoing in apiaries, where there have been recent foulbrood outbreaks, on the Canary Islands. Honey samples of nearly two hundred colonies located in these apiaries were taken to quantify the presence of foulbrood spores and disease incidence. Thereafter, a one-year treatment regime consisting in three applications of ApiForte was initiated and spore counts, disease incidence and colony development measured for one year.

Results and Conclusions
Lysozyme has emerged as a natural, effective and powerful tool to prevent and treat chalkbrood and foulbrood infections under field conditions. The product stimulates colony development with visible effects after 4 weeks and reduces disease incidence.

Practical Implications for Beekeepers
Systematic field trials in several countries have shown the positive effect of supplementation with this protein ingredient and confirm prior studies from North America.
Lysozyme provides the beekeepers with a real tool to increase the fitness and resilience of their colonies.

OP-160 [Bee Health]
Remote detection and monitoring of invasive species of hornets (Vespa velutina and Vespa mandarinia) using acoustic tools

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Beekeeping in Europe has faced significant challenges from Vespa velutina since its introduction in France in 2004, with the species now widespread across the continent. Similarly, the arrival of Vespa mandarinia (Asian Giant Hornet) in 2019 and V. velutina in 2024 threaten North American beekeeping. These invasive wasps prey on honey bees and other pollinators, potentially causing ecological, economic, and public health impacts if established. The ability to detect their presence as well as monitor their spread is fundamental to any measures aimed at eradication or control. This paper describes how acoustic based tools were used to remotely detect the unique flight signature of V. velutina and V. mandarinia. Over the past 8 years, working in apiaries across Europe, a device was trained for the detection of V. velutina near beehives, sending alerts to beekeepers. The equipment was tested in a number of environments including the apiaries hosting V. crabro, a protected species of honey bee predator.

Following the introduction of V. mandarinia into Washington state, working in collaboration with the USDA the device was used to monitor the entrance of an established V. mandarinia nest. This generated large quantities of high-resolution audio recordings of V. madarinia flight activity; these recordings were used to produce robust detection algorithms. From the data we were able to profile the daily nest activity, such as as commencement and cessation of daily flight and overall traffic, which correlated well with the nest's population and manual observation. The differences in acoustic signatures of hornets of known sizes and weights, constrained within a flight tent, were extrapolated to profile the nest demographic. The system has since been adopted by the department of agriculture in Georgia (US) for used on mainland and remote islands following the introduction of V. velutina.

Practical application of this technology provides early detection of hornet presence in apiaries and potential entry points, while tracking activity at established sites. Additionally, it could inform longer term strategies for eradication and containment, by improving knowledge of hornets' behaviour while identifying areas of activity, better define how and where resources should be focused for maximum effect.

OP-161 [Bee Health]
Assessing pesticide impact on honeybee gut microbiota: a call for microbial diversity as an environmental risk assessment endpoint

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A recent roadmap for integrating environmental microbiota into risk assessments under the European Food Safety Authority (EFSA) remit has been published. The honeybee gut microbiota has emerged as a promising avenue to protect bees against stressors. Honeybees exhibit a stable core microbiota, and dysbiosis may serve as an indicator of adverse conditions.

We investigated the gut microbiota of newly emerged “Apis mellifera iberiensis” workers exposed to a single concentration of the insecticide flupyradifurone (FPF, 36 ppm). The control groups included pure syrup (negative control, NC) and syrup supplemented with 1% acetone (acetone control, AC). Laboratory trials followed official guidelines (OECD No. 245). The abdomen of each bee was separated from the thorax, and DNA extraction was performed individually. Full-length 16s rRNA amplicon metagenomic was sequenced through PacBio sequel II (HiFi/CCS mode).

The Shannon diversity index was used to analyze honeybee gut microbiota composition across experimental groups. Our results revealed a significant increase in bacterial community diversity (Shannon index, $P = 0.003$) after ten days of chronic exposure to FPF. This effect was more pronounced when compared to the AC group ($P = 0.003$) than to the NC group ($P = 0.03$). These findings demonstrate that FPF disrupts the honeybee gut microbiota.
This study represents the first characterization of honeybee gut microbiota strictly adhering to OECD guidelines without modifications or adaptations. Furthermore, we have provided new insights into pesticide risk assessment, highlighting an overlooked aspect of bee health assessment. We propose integrating this approach into pesticide risk assessments by using diversity indices as comparative parameters. Specifically, we advocate for the inclusion of honeybee gut microbiota dysbiosis as a sublethal effect in the initial screening phase of risk assessments (laboratory-based assays) and as a key parameter for evaluating pollinator health.

OP-162 [Bee Health]
"NestSweeper" - An AI based method to track the yellow legged Asian hornet Vespa velutina in the UK

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The yellow legged Asian hornet Vespa velutina was first found in the UK in 2016, in Tetbury, Gloucestershire, and over the next few years was found sporadically each year in various places in England, with a maximum of four nests found and destroyed in 2018. In 2023, however, there was a vast increase in sightings, and the evidence shows sadly that the hornet is now reproducing in the south east of the UK. Following trials of a fixed AI based Hornet Camera system (Hornet AITM) in 2022 and 2023 on Jersey and the Scilly Isles, the concept of the NestSweeper was developed. This consists of the NestSweeper device, a hornet attractant vaporiser which lures V. velutina in to feed, providing the opportunity for users to capture a photograph of the hornet. The NestSweeper app, designed for use with the vaporiser using any smartphone, is then used to identify V. velutina in real time, and then upload sightings on to an interactive map. The AI model was trained using 40,000 images of verified V. velutina collected on the island of Jersey during the summer of 2023. The limited field trials that were possible in 2024 clearly showed that: 1. The vaporisers were effective at attracting V. velutina; 2. The app is effective at identifying V. velutina and distinguishing them from other insects in the field; 3. The app can successfully identify marked hornets on sequential visits; and 3. Analysis of time differences of sequential visits can accurately estimate the distance of the hornet nest from the bait station. By setting up a triangle of bait stations and NestSweeper app smartphones, and noting the flight bearing and direction of V. velutina flights, it should be possible to rapidly and accurately pinpoint the position of unknown nests. Further field trials are planned to fully demonstrate the potential of the NestSweeper.

OP-163 [Bee Health]
Exploring environmental influences on honey bee gut microbiota: a comparative analysis of Apis mellifera ruttneri and Apis mellifera ligustica across two climates

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The gut microbiota of honey bees plays a crucial role in their health, immunity, and adaptation to environmental conditions. Previous research suggests that Apis mellifera ruttneri, the endemic Maltese honey bee, harbours a higher proportion of environmental microbiota than other subspecies, such as A. m. ligustica. However, whether this difference is driven by genetic factors or environmental exposure remains unclear.

To investigate this, experimental apiaries were established in Malta (Mediterranean climate) and Italy (continental climate), each housing colonies of A. m. ruttneri and A. m. ligustica under identical environmental conditions. Worker bees were collected monthly for over a year, and their gut microbiota was analysed using Oxford Nanopore long-read 16S rRNA sequencing, alongside pollen samples to assess environmental microbial influences. Bioinformatics pipelines classified microbial taxa, and statistical analyses determined subspecies-specific microbiota differences.

Findings show that A. m. ruttneri harbours a higher prevalence of environment-associated bacteria, often found in soil, including Bartonellaceae, Apilactobacillus, Arsenophonus, Bombella, Commensalibacter, and Pseudomonas, whereas A. m. ligustica has a microbiota dominated by Lactobacillaceae (Lactobacillus and Bombilactobacillus). Despite sharing core microbial taxa, their relative abundances differed markedly. These preliminary results suggest that environmental factors play a dominant role in shaping honey bee gut microbiota, with A. m. ruttneri exhibiting microbial adaptations potentially linked to the harsh Maltese climate.

By incorporating multi-season sampling and genomic analyses, this study provides deeper insights into the interplay between genetic and environmental factors in shaping honey bee microbiota. Understanding these dynamics is crucial for honey bee conservation and subspecies management, as microbiota composition may influence resilience to pathogens, pesticides, and climate stressors.

For beekeepers, these findings highlight the importance of subspecies-specific microbiota dynamics in colony health and management. If A. m. ruttnerinaturally integrates more environmental microbiota, this may enhance its resilience to local stressors, reinforcing the need to preserve locally adapted honey bee populations.

This research was carried out in the European Union Next-Generation Framework (PNRR – mission 4, component 2, investment 1.4 – D.D. 1032 17/06/2022, CN00000022).

OP-164 [Bee Health]
Taking the sting out of honey bee medicine: training and tools for veterinarians

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BRAP - Bridging research and practice

In 2017, federal policy changes in the United States required that beekeepers work with a veterinarian to access needed honey bee medications - treatments that used to be directly available. Honey bees, like other animals, can be affected by viral, fungal, and bacterial diseases, but finding good care can often be difficult, as honey bee medicine is not covered by most standard veterinary schools. Trained veterinarians are needed to provide access to needed antibiotics, but in time can also help to address other issues with the bee crises, including optimizing nutrition, and managing parasites.

In 2022, four universities began working together on developing training materials for veterinary professionals. We first administered a survey to determine the level of interest, confidence, and ability of veterinarians to take on beekeeping clients. This survey also highlighted training gaps and needs to focus our materials. In the second objective we provided hands-on training for over 100 veterinarians in four states, and we developed and disseminated over a hundred honey bee veterinary medicine kits. In the third objective we developed online training materials to address gaps from the survey including a diagnostic training module and financial guidance to help veterinarians set up a honey bee medicine side business. Finally, we increased our work with veterinary students, developing rotations and special problem courses at veterinary schools and two traveling externships for students to work in the industry.

We have had positive results from our work and are developing materials that can be shared with other extension educators and specialists to help train veterinarians in other states.

OP-165 [Bee Health]
Paenibacillus melissococcoides: the discovery of a new bacterium associated with a honey bee brood disease

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Because honey bee colonies contain many individuals in close physical contact, they constitute fertile grounds for numerous pathogens to multiply and spread. Among these, the brood bacteria Paenibacillus larvae and Melissococcus plutonius, the causative agents of American (AFB) and European foulbrood (EFB) diseases, respectively, are both globally distributed. By affecting larvae, these bacteria can lead to colony weakness and possibly to death. In Switzerland, high numbers of EFB cases were reported each year, leading to increased research efforts into the epidemiology of EFB. During such research, an atypical bacterium was found in addition to M. plutonius in an apiary affected by EFB. To identify it, we sequenced De Novo the full genome and described its genome features as well as its physiology and chemotaxonomy. We thus discovered it was a new species, which we named Paenibacillus melissococcoides. In this presentation, we will retrace the steps required to identify and name a new bacterium species. Using the genomic information generated, we screened EFB affected colonies in Switzerland and searched genome databases for misidentified matches. We indeed found the possible presence of this bacterium outside Switzerland, suggesting that this species can be found worldwide. The discovery of this new species brings new insights into EFB epidemiology and the suite of bacteria associated with it, as well as a better understanding of the ecology of Paenibacillus species when they encounter honey bees. With this information available, it will be possible to study the role of this bacteria in honeybee health and particularly in idiopathic cases, for which brood diseases are suspected, but M. plutonius and P. larvae are not found.

OP-166 [Bee Health]
Safeguarding agroecosystems resilience under climate change through efficient pollination and sustainable beekeeping

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The Mediterranean Basin is an area characterised by diverse agricultural management systems due to the combination of African and European culture, high floral biodiversity, as well as climate differences from very dry and hot to very humid and cold areas.
Climate change threatens pollinators, and it is unclear how climatic conditions as well as farming practices can affect pollination provisions, honey bee survival and productivity. SafeAgroBee was a PRIMA project funded by National Funding Agencies aiming to address the above topic.

In SafeAgroBee project we focused on pollination provided by both wild and managed bees in a climatic gradient, as well as on practices improving the resilience of beekeeping on such a diverse geomorphological area. We addressed the resilience of bee pollinators on a changing environment, determined the carrying capacity of particular crops, investigate the adaptability of local bee populations, compared organic versus conventional beekeeping, tested the local populations on their resistance to varroa, investigated the use of local strains of beneficial bacteria against foulbrood, tested and validated monitoring tools and precision apiculture systems and developed novel models for predicting the health (e.g. Health Status Index) and productivity of the bees.

We have demonstrated a) that pollination efficiency and fruit yields can be increase by 20-30% with increased bee diversity; b) that honey bees perform, develop and survive significantly better under organic treatments and bee friendly agricultural practices; c) that local populations of honey bees show better adaptation ability, to be used under the pressure from climate changes; d) that beneficial bacteria of local populations of bees could be used to minimize effects of other bacterial diseases of honey bees; e) that innovative censoring systems can be beneficial reducing working load and predicting losses and f) that prediction models for pollination services, beekeeping production as well as Health Status Index of honey bees, now exist, for the benefit of the farmers and beekeepers.

The main outcomes of our project will be used to draw strategic plans and guidance for farmers and beekeepers. Mediterranean countries collaboration is essential to drive green solutions under climate change.

OP-167 [Bee Health]
The Good, the Bad and the Ugly: Insights and trends from a 20-year natural selection experiment on disease resistance in Gotland, Sweden

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Background and Purpose
Disease susceptibility has caused a significant decline in honeybee populations thriving outside of human management, as honeybees rely on disease interventions for their health and survival. This is especially true in the context of Varroa destructor mites and their associated viruses. Chemical-based treatments are effective, but can harm bees, leave residues in products, and are increasingly ineffective as mites develop resistance. New approaches are required to ensure the sustainability of beekeeping.

A long-term natural selection experiment on the island of Gotland Sweden consists of a honeybee population that has survived without mite control, showing evidence of adapted resistance to Varroa and tolerance to viral infections. This population is a valuable model for understanding how these species interact and exploit each other and could inform more refined and effective mite control strategies but does not advocate for removing control strategies in beekeeping. The growing trend of “natural” or treatment-free beekeeping, which advocates minimal intervention to reduce stress and improve bee health, relies on adaptations of resistance to Varroa mites but is based on an oversimplification of natural selection processes, at the cost of high mortality rates. This highlights the need for clearer definitions of “stress” and “better health” in the context of honey bee management.

Results and CONCLUSION: This presentation will provide an overview of the key insights gained from studying the Gotland population, highlighting the positive outcomes (the good), assessing its current health and productivity status (the bad), and examining the trends it has sparked in "natural" beekeeping (the ugly).

Practical Implications for Beekeepers
The promising results of the long-term treatment-free study on Gotland do not suggest that treatment should be removed within the beekeeping industry. For adaptations and evolutionary rescue to succeed, a sufficiently large population with adequate genetic diversity is essential. Moreover, evolution through natural selection does not always guarantee improved prospects for long-term survival. While treatment-free beekeeping is feasible, it requires careful management and is not a low-intervention alternative if the goal is a healthy honey bee climate. Success in this approach demands thoughtful consideration of ethical values and responsible practices.

OP-168 [Bee Health]
Brazilian Bee Observatory: Hive Monitoring as an Indicator of the Sustainability of Brazilian Agriculture

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Designed in response to the demands of various sectors of society, the Brazilian Bee Observatory aims to implement and support actions to mitigate bee mortality in the country, aligning with the United Nations' efforts to achieve the Sustainable Development Goals of the 2030 Agenda. The program is based at EMBRAPA Environment in Jaguariúna (SP) and operates in partnership with the Ministry of Agriculture and Livestock, collaborating institutions, and state agricultural defense agencies. Given the lack of standardized and reliable data on bee-related incidents, the Observatory has developed an information system for the systematic recording of occurrences, identification of possible causes of bee deaths, and consolidation of this data into an official national platform. The systematization of reports and the regional and temporal analysis of occurrences enable a technical and scientific interpretation of causal factors, providing public agents and other sectors of society with the necessary data to implement effective measures to reduce pollinator losses. One of the Observatory's main objectives is to establish a national database on bee mortality through the AgroTag System, which consists of an application and a WebGIS interface. AgroTag Bees is a tool designed for state agricultural technicians, facilitating the recording and monitoring of occurrences. Using tablets or mobile phones, incidents are identified, photographed, and georeferenced directly in the field. In areas without internet access, the data is stored on the device and transmitted to the database once the connection is restored. The information collected and verified by the Observatory team is made available to users through the WebGIS interface, ensuring transparency and accessibility to bee mortality records. The expectation is that hive monitoring will serve as an indicator of the sustainability of Brazilian agriculture.

OP-169 [Bee Health]
Influence of heat and humidity on the survival of the honey bees: A study within five Apis mellifera subspecies from the Mediterranean basin

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Heat is a very damaging environmental stress factor for living organisms and is the most direct effect of climate change. Only organisms that are able to cope with environmental changes will undergo a process of adaptation that will allow them to survive and reproduce under the new conditions. On bees, the adverse effects of heat stress include multiple aspects such affecting their growth, development, task-related physiology, immunocompetence, foraging activity, and reproduction. Hence, it is expected that the new and increasingly hot environments coming from climate change affect to the life expectancy of the honey bees. On the other hand, humidity as single possible stressor seems to have lowest impact on bees, but it acts synergist when both variables get combined. The MEDIBEES Project seeks to study different subspecies of Apis mellifera living in Mediterranean basin, their adaptation, resistance and resilience to climate change. In order to understand the influence of the hotter and drier environments, six different conditions have been studied: 35ºC, 40ºC and 45ºC at 75% of relative humidity (RH), and 35ºC combining 15%, 30% and 50% of RH. This study presents the survival results of 5 subspecies: A.m. iberiensis in Spain, A.m. ligustica in Italy, A.m. anatoliaca in Turkey, A.m. syriaca in Jordan and A.m. ruttneri in Malta. During the study, the different groups of bees were fed ad libitum under each condition and food intake was monitored. Our results showed important differences according to the subspecies and a clear negative influence of heat on the survival rate of the bees, as in all cases the bees survived less than half of the days at 40ºC compared to 35ºC, and in no case they were able to survive 24 hours at 45ºC. With regard to humidity, the effect seemed to be less relevant along each subspecies, although differences in food intake should be thoroughly analysed. This study supports the importance of local breeds and warns of the problem of heat stress in hives.
These results are under the project 2011-MEDIBEES, which is part of the PRIMA programme supported by the European Union.

OP-170 [Bee Health]
Pros and Cons of Diagnostic Tests Used for Early Detection and Risk Assessment of American Foulbrood in Small and Large Beekeeping Operations

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American foulbrood (AFB), caused by Paenibacillus larvae, is a devastating contagious disease that is often controlled by antimicrobials in North America. Destruction of affected colonies is mandatory in many jurisdictions. Therefore, early detection of AFB is crucial. However, the efficacy of diagnostic tests and risk assessment strategies for a beekeeping operation is influenced by sample types, timing of sample collection and size of operation.

We conducted multiple clinical investigations of AFB outbreaks and assessed levels of P. larvae spores (hereafter, AFB spores) in various sample types using quantitative bacterial culture. The number of AFB spores in bees, bottom board debris, brood-chamber honey, and extracted honey was comparatively analyzed to evaluate their suitability for AFB risk assessment.

A series of case studies involving AFB outbreaks will be presented, and the validity and feasibility of various sample types for risk assessment will be discussed based on the results of our ongoing clinical investigations. In general, for both small and large beekeeping operations, the most feasible AFB risk assessment method is based on the number of AFB spores in extracted honey at the end of the honey harvesting season (late summer). Additionally, the number of AFB spores in nurse bees during the brood-rearing season, and potentially in bottom board debris during early spring, may also be useful for AFB risk assessment in small beekeeping operations. The number of AFB spores in brood chamber honey could be used for surveillance of colony exposure to AFB over time, similar to the use of serology tests in “herd health” management.

The selection of an appropriate AFB risk assessment strategy depends on the size of the beekeeping operation, the season, and the availability and accuracy of diagnostic thresholds. Future research should focus on refining these diagnostic thresholds to enhance evidence-based AFB control, ultimately reducing reliance on antimicrobials and mitigating the development of antimicrobial resistance.

OP-171 [Bee Health]
Disinfection and antimicrobial management of European foulbrood disease reservoirs

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Background
Clinical outbreaks of European foulbrood (EFB), a stress-associated, bacterial disease of honey bee larvae, continue to be unpredictable and costly for Canadian beekeepers. The natural reservoir for the causative bacterium, Melissococcus plutonius, is poorly understood, with adult bees and hive equipment potential candidates. Accordingly, investigation of the persistence of M. plutonius in adult bees and beekeeping equipment, as well as appropriate decontamination and antimicrobial management strategies, are urgently needed to decrease EFB risk and reoccurrence.

Methodology
To investigate adult bees as a reservoir for M. plutonius, we inoculated both honey bee worker larvae and adult bees in vitro with incremental doses of M. plutonius and monitored their survival and bacterial load over time as adult bees, as well as the impact of antimicrobial treatment on bacterial load. Additionally, we determined the bacterial load of larvae and adult bees sampled from colonies with clinical EFB, before and after antimicrobial or sham treatment. To investigate hive equipment as a reservoir for M. plutonius, hive matrices, including metal, wood, and comb, were inoculated with incremental doses of M. plutonius and bacterial recovery was evaluated over time. In parallel, we determined the efficacy of decontamination, including soap, bleach, alcohol, and radiation, on bacterial recovery from inoculated hive material.

RESULTS: We found that adult bees remained persistently colonized with M. plutonius, which significantly decreased their lifespan in vitro. Antimicrobial treatment improved adult bee survival after M. plutonius inoculation; however, treated adult bees still remained persistently colonized. Moreover, antimicrobial treatment of colonies with clinical EFB did not decrease bacterial load of adult bees and larvae. Evaluation of M. plutonius persistence and decontamination from hive equipment is in progress.

Significance
Adult bees and larvae remain persistently colonized with M. plutonius, in spite of antimicrobial treatment and clinical resolution of EFB, emphasizing their role as a reservoir for this disease. Adoption of decontamination methods for M. plutonius in hive equipment may be an effective strategy to reduce the M. plutonius reservoir within colonies, and thereby decrease the incidence of EFB, as well as decrease the reliance on antimicrobials for EFB treatment in Canada.

OP-172 [Bee Health]
Using Hyperthermia against the Varroa mite - 15 years of successfully working with the Varroa Controller

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Varroa destructor remains a major entomological and ecological threat to Apis mellifera colonies worldwide. As an obligate ectoparasite, it compromises bee health directly through feeding and indirectly by vectoring viral pathogens. Climate change, particularly warmer winters, is exacerbating the issue by promoting continuous brood cycles in many regions. This shift undermines the timing and efficacy of traditional chemical treatments, which rely on brood less periods and are increasingly associated with resistance development, hive contamination, and collateral harm to bees and beneficial microorganisms.

To address these challenges, sustainable, non-chemical alternatives that can be applied year- round are urgently needed. One such strategy is hyperthermia, which exploits the differential heat tolerance between bee pupae's and mites. This method was first explored in the early 1990s by Prof. Engels and his team at the University of Tübingen, who demonstrated that controlled thermal treatment could effectively reduce mite loads without damaging bee brood.

Building on this concept, we developed the Varroa Controller, a device introduced to the market in 2010. Over the past 15 years, thousands of beekeepers worldwide have successfully implemented hyperthermia, confirming its viability across diverse climatic and management conditions. In this paper, we present a systematic approach for integrating hyperthermia into the beekeeping season, tailored to regional brood cycles and environmental factors. A proposed annual treatment plan is outlined, and practical guidance is offered for optimizing effectiveness and minimizing colony stress.

We also summarize beekeepers' experiences collected over more than a decade, demonstrating the method's consistency, safety, and utility as part of integrated pest management (IPM) strategies. Our findings support hyperthermia as a robust, residue-free tool for Varroa control, with the potential to reduce reliance on chemical interventions and enhance colony resilience in the face of evolving environmental pressures.

OP-173 [Bee Health]
B-THENET: Advancing Sustainable Beekeeping through Knowledge Exchange and BestPractices

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"B-THENET" (Best practices and innovations for a sustainable beekeeping) is a four-year project funded by Horizon EU, aimed at modernizing the beekeeping sector by sharing practical knowledge and fostering the exchange of best practices. The project's objectives include establishing a multi-actor network connecting beekeepers, researchers, advisors, and other actors in the apiculture sector; collecting, categorizing, and selecting best practices and new research findings using a bottom-up approach; and creating digital platforms for discussing, developing, and storing best practices. The "Exchange Platform" (https://www.bthenet.eu/platform/) is where best practices are developed, while the "Repository Platform" (https://www.bthenet.eu/repository-platform/) stores completed co-created practices.

The B-THENET consortium consists of 18 partners from 15 EU countries, including research institutions, universities, national and international beekeeping associations, and communication agencies. This diverse consortium works to uncover and share knowledge, ensuring it successfully reaches end users. Researchers collaborate with beekeeping associations to bridge the gap between science and practice. Scientists, beekeepers, and advisors collectively prioritize and develop beekeeping practices and innovations at the EU level. Beekeepers and advisors contribute their practical expertise, while researchers guide the development of sustainable practices and assess their value. Social science centres and communication agencies ensure that practices are presented in a way that maximizes knowledge uptake. Thirteen National B-THENET Centres in partner countries facilitate knowledge exchange through targeted training and events, while three International B-THENET Centres support training at the international level—one for beekeepers, one for advisors, and one for all other stakeholders of the apiculture sector.

After three years, B-THENET has successfully collected, developed, and disseminated 75 best beekeeping practices across various themes, including varroosis, American foulbrood, European foulbrood, apiary and colony management, bee feeding and watering, and record keeping. In the project's final year, additional practices on routine preventive hygiene, nosemosis, small hive beetle, and invasive vespid management will be developed. These practices are available on the B-THENET repository platform in 12 languages: Croatian, Danish, Flemish, German, Greek, Hungarian, Italian, Polish, Slovak, Slovenian, Spanish, and Swedish. They will also be compiled into two comprehensive manuals, one for beekeepers, available in all 12 languages, and another for advisors, published in English. Digital resources for beekeepers include two booklets on proper hive management, 20 infographics, and two factsheets outlining the project methodology. The National and International B-THENET Centres organized 147 training sessions, reaching 5,805 beekeepers, and promoted B-THENET through 171 dissemination events at both the national and international levels. Future prospects include expanding best practice development to more countries and featuring them on the platforms, enabling a broader community of beekeepers and advisors to benefit from B-THENET's results.

OP-174 [Bee Health]
Sustainable strategy of control for the hornet, Vespa velutina

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Since it first appeared in France in 2004, the Vespa velutina hornet has gradually and rapidly colonised Western Europe (Belgium, France, Germany, Italy, Portugal, Spain, and Switzerland). Numerous measures are being taken in the countries concerned to curb its spread and limit its impact on honeybee colonies, as well as on entomophilous fauna. To date, these efforts have met with little success. In this paper, I outline the main control measures that could be taken to achieve an integrated and effective control strategy. These elements are based on the hornet's biology and the risks it poses to beekeeping, biodiversity and humans, with particular emphasis on the cost-effectiveness of control methods. Based on this approach, the paper analyses and identifies the research needs and the control methods that are most likely to produce economically reasonable results. The choice of control methods must in particular raise the question of the scientific demonstration of their effectiveness. For example, is it possible to scientifically demonstrate the effectiveness of spring trapping or the destruction of secondary nests in autumn? Are these two approaches economically sustainable? The answer is "yes" in both cases for spring trapping and probably "no" for the destruction of secondary nests. This counterintuitive result deeply questions the latter approach which is usually recommended as the most efficient approach. All measures of control options are examined from this angle. Consequences are then drawn and recommendations for reasonable and economically sustainable control methods proposed. Knowledge gaps are also identified as new research objectives.

OP-175 [Bee Health]
Microscopic Insights into Overwintering Disease Dynamics in Yukon's Subarctic

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Independent Research

Honey bee colonies in the Yukon endure extreme winters, where prolonged cold and limited cleansing flights intensify disease pressures. This study examines the impact of Nosema and Malpighamoeba mellificae (Amoeba disease) infections on colony survival, emphasizing the role of late-season nutrition and hive management in reducing winter losses. Despite strong populations entering winter, subtle late-summer nutritional deficiencies often go unnoticed. In resource-scarce conditions, bees may forage on honeydew, fungal spores, and rust, compromising digestive health. These indigestible materials, combined with restricted winter flight opportunities, contribute to increased Nosema and Amoeba infections through fecal-oral transmission. Colonies that appear healthy in fall may collapse due to cumulative disease burdens in late winter and spring. Over multiple seasons, hive inspections and microscopic analyses tracked Nosema and Amoeba infection rates. Gut dissections and spore counts assessed disease progression. To analyze honey composition, samples were collected from Yukon's boreal regions and underwent Nuclear Magnetic Resonance (NMR) analysis to determine sugar composition and chemical profiles. Additionally, 10g of each honey sample was examined microscopically for pollen sources and honeydew elements. Data on hive management, forage availability, and honey production history were assessed for correlations with overwintering viability. Findings confirm that Nosema and Amoeba co-infections significantly increase winter mortality. Monthly monitoring of live bees and freshly dead bees at hive entrances revealed infection rates rising as winter progressed, with mortality notably higher in front of infected colonies. In spring, infected colonies failed to rear brood beyond early-stage larvae, collapsing within 2–4 weeks. However, when an infected colony's queen was introduced to a healthy queenless hive, she resumed laying, and new bees successfully emerged, demonstrating that colony failure stems from infected winter nurse bees' inability to raise brood rather than queen viability. Microscopy revealed substantial ingestion of non-pollen debris—especially rust and fungal spores—during late-summer/fall periods. Honey analysis indicated that certain honey types contribute to winter dysentery. Routine microscopic monitoring, evaluating honey stores, and supplementing late-summer and fall feeds can mitigate infection risks. Best practices—such as frame sterilization, strategic feeding, and optimized insulation—help subarctic beekeepers reduce winter stressors and improve colony resilience.

BEEKEEPING ECONOMY

OP-176 [Beekeeping Economy]
Decoding Honey: A Comprehensive Melissopalynological Analysis of Georgian Honey and Consumer Preferences

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Georgia's rich floral biodiversity supports a diverse honey industry; however, the identification, classification, authenticity verification, and market positioning of Georgian honey remain underdeveloped. Despite its diversity, limited research on regional composition and consumer behavior constrains its market potential and the growth of beekeeping entrepreneurship. Here, we present a nationwide melissopalynological analysis of 123 honey samples from 62 municipalities, covering the entire country. For the first time, we identified 18 distinct honey types, with 11 classified as common (represented by multiple samples) and 7 as rare (represented by a single sample). Based on these findings, the common varieties were selected for a blind tasting experiment involving 152 consumers, which highlighted chestnut and acacia honey as the most preferred types, with taste, color, and consistency emerging as key purchasing factors.

This study aims to bridge research and practice by enhancing the understanding of Georgian honey's geographical distribution and floral sources while aligning production strategies with consumer behavior insights. Our findings highlight the need for improved sales marketing approaches, including targeted branding, sensory-driven promotion, and diversified product positioning to increase consumer engagement. Strengthening rural economies will not only enhance the credibility but also improve the global competitiveness of Georgian honey.

OP-177 [Beekeeping Economy]
Working with small-scale beekeepers to develop successful honey bee businesses

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Professional beekeeping operations of all sizes must employ effective business practices to maximize the income that their bees can provide. While educational programs aimed at honey bee management are widespread, training related to beekeeping business development is significantly lacking. Many beekeeping businesses struggle to maintain effective marketing, financial, and production strategies. To help address this educational gap, members of the University of Florida, Institute of Food and Agricultural Sciences (Florida, United States) established "Leveling Up", a two-year beekeeping business program. This work was supported by the National Institute of Food and Agriculture, United States Department of Agriculture, under the Beginning Farmer and Rancher Development Program.

The goals of this program were to 1) train beekeepers in business planning; 2) assist beekeepers with value-added product development; 3) help beekeepers develop digital marketing competence; 4) train beekeepers in workplace safety; and 5) increase revenue for small-scale beekeepers. To reach these goals, program leaders developed online modules, videos, and documents and hosted four in-person workshops related to business planning, value-added hive product development, marketing, and safety. Program members and leaders met virtually each month and participants received individualized feedback through peer reviews and one-on-one consultations with experts. Upon program initiation, the participants were overwhelmed with how to get started and how to make their beekeeping operations profitable. At the end of the Leveling Up program, 100% of participants have written a business plan and increased their ability to complete key business practices. At least 72% developed a new digital marketing product and 95% increased their knowledge of employee hiring practices and apiary workplace safety. In addition, participants have completed budget spreadsheets, developed new products, set appropriate prices for their products and services, and established legal businesses. This program provided participants with business resources specific to beekeepers and accountability for their new businesses. We present an overview of the Leveling Up program, how the program was adapted to the participants' needs, and a report of participant outcomes at the end of the two-year program.

OP-178 [Beekeeping Economy]
Honey cost: determination of sustainability and efficiency in honey production

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The lack of accurate and reliable information in the beekeeping supply chain allowing for estimation of production costs has gained considerable attention. The Honey Cost project realized by CREA-PB seeks to fill this gap, developing methodology and tools for data collection and evaluation for the Bees and Honey sector and set up a sample survey on it. The Honey Cost statistical survey aims to deepen knowledge on the economic and production dynamics and responds to the cognitive needs of the institutional, scientific and economic system.

The determination of the costs is carried out through a questionnaire submitted to a sample of 434 farms with an economic size of at least 8,000 euros of Standard Output and represent a population of about 6,000 professional beekeepers. In the methodology adopted, 3 cost levels are envisaged, a first level referring only to current expenses, a second level, in which other general expenses are added, and finally, a third level which contains also the cost of family labor.
The first experimental survey was carried out in 2023 and referred to 2021 and 2022. Following this pilot period, the yearly survey was carried out again. It emerges that in 2023 about 2/3 of the farms practice nomadism while the rest are permanent and the value of the three cost levels analyzed can vary greatly depending on farm type and economic size. On average, first-level costs are around 3 euros per kilogram and rise to about 6 euros if second-level costs are added. Depending on farms type, the costs of transport, packaging or emergency nutrition can vary remarkably. Finally, the strong presence of family work has a great impact on the formation of the productions cost and can lead to situations in which the farm produces at costs above the price recognized by the market for their product.

This work is useful for the beekeeping sector: for farms to better define their strategies, for political decision makers to better design support tools, for researchers to have the correct information to determine the consistency and trend of the sector and to build analyses of evolutions and scenarios.

OP-179 [Beekeeping Economy]
Forecasting SROI of APIVITA Billion Bees Program for the years 2023-2027 through the 1% for the Planet Coalition

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INTRODUCTION: APIVITA, a Greek natural cosmetics company, member of the PUIG group, demonstrates a strong commitment to sustainability. Through the participation to 1% for the Planet Coalition, APIVITA is committed to donate 1% of annual sales to partnered non-profit organizations addressing environmental issues. In this context, APIVITA launched the “Billion Bees Program”, an initiative based on the regeneration of honeybee populations worldwide, providing 1 billion bees annually, and education on the importance of bees for life and biodiversity.

METHODOLOGY: The analysis utilizes Theory of Change, involving comprehensive stakeholder engagement, data collection, systematic outcome mapping, and precise valuation techniques to identify tangible and intangible impacts. Stakeholder involvement was crucial, with input from employees, beekeepers, beekeeping trainers contributing to the program, B2B customers/ pharmacies, and collaborating institutions and NGOs. Adjustments for deadweight, attribution, displacement, and drop-off are meticulously applied to ensure the accuracy of the net impact calculations. The final SROI ratio was calculated by dividing the total value of benefits by the total investment, confirming the project's efficiency and effectiveness in generating positive social outcomes. A sensitivity analysis was conducted to assess the validity and robustness of the findings under different assumptions, such as changes in discount rates, stakeholder attribution levels, and the duration impacts.

RESULTS: The SROI analysis for the “Billion Bees Program” through “1% for the Planet Coalition” for the years 2023-2027 demonstrates a significant social impact with a forecasted SROI ratio of 4.17:1, meaning that €4.17 of social value is generated for every euro invested.

CONCLUSION: Key social and environmental impacts include the support of beekeeping entrepreneurship, protection of biodiversity, enhancement of ecosystem services, improved livelihoods for beekeepers, increased awareness of the importance of pollinators among various stakeholders, and the fostering of a more sustainable and resilient agricultural sector, potentially stimulating demand for locally sourced honey products. This study provides valuable insights for businesses seeking to maximize their social and environmental footprint through strategic sustainability initiatives. It demonstrates the potential of the “Billion Bees Program” as a powerful platform for driving positive social change and underscores the importance of integrating social and environmental considerations into core business strategies.

OP-180 [Beekeeping Economy]
Impacts of climate change on the beekeeping supply chain; a system dynamics modeling approach

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Background/PURPOSE: Climate change is one of the most significant challenges facing businesses and supply chains today. However, the impacts of this phenomenon on some supply chains are more significant, tangible and immediate. Beekeeping is one of these chains due to its direct interaction with nature and reliance on natural living resources such as bees, flowers and plants. On the other hand, the role of honeybees in pollination and providing healthy food for communities is vital, and disruption in its function has devastating effects on life and the economy. As a result, it is essential to recognize and predict the effects of climate change on the performance of beekeeping supply chain and adopt strategies to reduce risk, increase resilience, and maintain performance.

Problem description: In this study, the effects of two factors, "rainfall rate" and "dust rate" on the performance of the beekeeping supply chain were investigated. The research question is: What effect do "reduced rainfall" and "increased dusty days" have on beekeeping performance? And what are the appropriate strategies to prevent a possible drop in performance?

METHODOLOGY: We have used system dynamics modeling to answer the research questions. For this purpose, a number of performance variables were first identified using the research literature, and then the list of variables was modified and finalized with the opinions of experts. Then, through interviews with experts and receiving their mind maps, an initial framework of relationships and dynamics was prepared. After that, the relationships between the variables were formulated using appropriate functions and the model was run under different scenarios using vensim software.
Results and CONCLUSION: The results show that a decrease in rainfall and increase in the number of dusty days leads to a significant decline in production performance and a decrease in the number of forager bees during the simulation period. However, investment in new technologies can compensate for this decrease and improve performance even compared to current conditions.

Practical implications for beekeepers: Training and application of new methods and technologies, increasing production efficiency, using modern equipment, and using hybrid queens can help beekeepers overcome the challenges posed by climate change.

OP-181 [Beekeeping Economy]
Sustainable beekeeping and market development in western Uganda achieved through a social enterprise and micro financing

David Howard Holloway
Bees Abroad

The development of a large-scale sustainable honey production, processing and marketing organisation is challenging in rural locations with limited infrastructure. A social enterprise utilising microfinance has the potential to become a sustainable business, while enhancing valuable habitats and biodiversity.

The lack of basic infrastructure (roads, education, electricity, etc) in Western Uganda makes the development of sustainable businesses challenging due to the difficulty in accessing materials and markets. Beekeepers often sell to middlemen who offer low prices and pay late, if at all. Despite being a high value product, income from honey is not maximised and does not provide the full potential to lift rural beekeepers out of poverty and pay for their children's education and skills needed to survive in a very challenging location.

The establishment of Social Enterprises, bringing beekeepers together, provides an opportunity for improved skills and centralised processing and marketing. Establishing the enterprise as a Savings and Credit Cooperative Organisation (SACCO) provides credit and banking services that further allow individuals to build their own businesses in a secure environment. The formal structure required by a SACCO provides oversight and can facilitate training and technical support with centralised processing and marketing.

Since the establishment of the Bulhalho Foundation as a Social Enterprise and its registration as a SACCO, the group has grown rapidly and now supports beekeepers from 19 Districts in Western Uganda. Over 500 beekeepers supply honey and wax through their central processing facility near Fort Portal. Over the last 3 years, sales have increased from 5 tons to 20 tons per year, and the group is investing to increase production to 100 tons.

Members of the Social Enterprise are small scale subsistence farmers, typically with 1 hectare providing all their basic needs. There are limited opportunities for additional income for non-essential items such as healthcare or education. Membership provides huge benefits including guaranteed payment at high rates, and access to training funded through profits and the support of Bees Abroad. Access to loans and saving schemes at favourable rates help lift members out of poverty and encourage group cohesion, building sustainable communities through beekeeping.

OP-182 [Beekeeping Economy]
Building Economic and Social Resilience Through Community-Supported Beekeeping

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Community-Supported Agriculture (CSA) is a pre-paid, subscription-based model that creates a direct connection between food producers and consumers. It serves as a form of social entrepreneurship, fostering learning, community engagement, and environmental stewardship while addressing environmental distancing and the need for reskilling in sustainable food systems. Founded in 2020 in Oslo, Local Buzz Andelsbirøkterlag has adapted the CSA framework to small-scale beekeeping through a Community-Supported Beekeeping (CSB) program. This presentation will use Local Buzz as a case study to elaborate on its economically resilient business model and approach to social entrepreneurship. Through subscription, consumers purchase shares in community beehives, in early season, becoming shareholders that share the risks and rewards of honey production. This prepayment provides a predictable and early operating budget for the beekeeper. This principle of sharing of risks (as well as abundance) distributes economical risks across the beekeeper and shareholders against environmental uncertainties that threaten the honey yield. Shareholders participate in hive management, harvests, and other activities, which translate into an experience economy, while the main responsibility remains by the beekeeper, and hive products are shared equally across shareholders. Shortly, these elements contribute to income security, risk mitigation and market autonomy, building an economically resilient practice compared to traditional beekeeping. For shareholders, starting beekeeping is often a significant decision, requiring financial investment, technical knowledge, and full responsibility. In urban environments, additional challenges include limited space for hives and storage. Local Buzz addresses these obstacles by offering a partnership in practice and lowering the threshold for participation. This approach demystifies beekeeping, inspiring new beekeepers to enter the profession. Involvement of shareholders powers transparent operations and cultivates trust in the model. This agreement of trust functions in both directions, creating an engaged community of learning, caring and contributing.

We propose that CSB can be a solution for community-oriented beekeepers who seek to increase profitability without scaling while generating social benefits, and, for citizens who seek to learn more about beekeeping as a hobby or profession. This case study showcases how reconfiguring organizational structure and sales strategy contributes to a financially and socially sustainable model.

OP-183 [Beekeeping Economy]
COLOSS results on the Wellbeing of beekeepers in 17 European and 3 African countries

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Beekeeping is troubled and threatened by many issues, such as honey bee diseases, colony losses, poor forage and harvest, honey price and sales, climate change, invasive species, pesticide applications, lack of flowers. Whereas the health of honey bee colonies, and the causes of colony losses have been increasingly investigated in the last decades, the wellbeing of the beekeeping sector has not been thoroughly investigated. We therefore conducted the first multi-country survey on beekeeper wellbeing using the Cantril ladder. This is a widely used self-assessment tool for measuring subjective life satisfaction. It involves individuals imagining a ladder with steps numbered from 0 to 10 and placing themselves at a point that reflects their current and future life satisfaction. This tool provides insights into individuals' perceptions of their own wellbeing and has been utilized in cross-cultural studies, policy evaluations, and public health research. The study aimed to investigate the impact of operation type (operation size) on life satisfaction and explore how different beekeeping-related factors influence life satisfaction. The survey questions were distributed alongside the COLOSS questionnaire on honey bee colony losses and management practices. The Cantril ladder results were compared among beekeepers in different countries and to the general population of each country using data from the World Happiness Report. We collected more than 8000 answers from beekeepers from 17 European and 3 African countries. The highest Cantril ladder result among beekeepers for the time of the survey (2024) was found for the Netherlands, followed by Finland and Denmark, whereas it was lowest for Bulgaria, Portugal and Greece. The life satisfaction of beekeepers significantly correlated with the World Happiness Report data for the countries. In Europe, 'Financial aspects of beekeeping' and 'Technical and financial support for beekeepers' were found to contribute most negatively to life satisfaction, whereas in Africa it was 'Weather and working outdoors' and 'Technical and financial support for beekeepers'. This is the first multi-country study on beekeeper life satisfaction. We hypothesize that wellbeing of large-scale beekeepers might be affected stronger by the problems of the sector.

OP-184 [Beekeeping Economy]
Assessment of exporting experience of Ukrainian honey in the context of modern challenges and changes of international legislation

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Confirming of honey authenticity is increasingly relevant in the context of global problem of food adulteration. The requirements of EU legislation on honey largely comply with the Codex Alimentarius, but the approaches to control quality indicators are still not harmonized and diverge in different countries, causing assessment discrepancies of the commercial quality of exported honey.

Adulteration of large honey batches using sophisticated but accessible modern fraud technologies often results in the products indistinguishable from natural honey using classical methods, necessitating costly advanced analyses. Addition of hydrolyzed sugar syrups from certain plants remains common method of fraud, being difficult to detect even with isotope ratio methods. The analysis of market prices, the balance of supply and demand, which are economic motives for fraud, also should be considered. In late 2024 and early 2025, it was reported that from 80 to over 90% of honey samples purchased from large retailers in Germany, the UK and other European countries failed new authenticity tests, which raises concerns about the spread of honey adulteration. Significant part of samples were marked as suspicious due to presupposed dilution of honey with cheap sugar syrup. This highlights an increase of honey adulteration cases and imperfections in current control approaches, reducing consumers' trust and affecting the global honey market.

According to new EU Honey Directive, coming into force in mid-2026, the European Commission will have the right to introduce harmonized analytical methods for detecting honey adulteration with sugar for 4 years. Assessing the importance of honey authenticity for combating the threats of honey adulteration from the point of view of importing countries, we have concluded that the first priority measures aimed at detecting possible honey falsification are attention to basic indicators of honey quality. In particular, metrics of diastase activity and GMF content regarding the levels established in the national legislation of Ukraine on honey, which was in force before its repeal in 2019. The second important task is the selection of fast, cost-effective and reliable screening methods to control honey adulteration with hydrolyzed sugar syrups at various stages of the formation of large honey batches for export.

OP-185 [Beekeeping Economy]
Strengthening Rural Development through Sustainable Beekeeping: The Case of Miski Miel de Campo

Mauricio José Rosales Durán
Miski Miel de Campo

Background/Purpose
Beekeeping is a key driver of biodiversity conservation and food security, but it also holds significant potential for rural economic development. However, small-scale beekeepers in developing regions face substantial barriers to accessing competitive markets and integrating into sustainable value chains. This study examines the case of Miski Miel de Campo, an Ecuadorian beekeeping enterprise that has successfully addressed these challenges by implementing sustainable practices, international certifications, and fair trade strategies to empower rural communities and strengthen their market position.

Problem Description
Despite the increasing global demand for honey and other bee-derived products, small-scale beekeepers face critical obstacles that hinder their economic viability. These challenges include:
• Limited infrastructure and distribution networks, restricting their access to high-value markets.
• Lack of certifications, reducing competitiveness against industrial producers.
• Honey adulteration, which distorts prices, erodes consumer trust, and undermines producers committed to pure, high-quality honey.
• Fragmented markets and unfair pricing, limiting the ability of small-scale beekeepers to negotiate favorable conditions.

Methodology
This study evaluates Miski Miel de Campo's business model as a case study in sustainable beekeeping. Data collection involved interviews with rural beekeepers, financial records analysis, and an assessment of key market access strategies. Results and CONCLUSION: Findings indicate that quality certifications, fair trade models, and value-added processing strategies have enabled Miski Miel de Campo to successfully access high-value markets while ensuring fair compensation for beekeepers. Furthermore, the company has played a leading role in combating honey adulteration by positioning product traceability and quality as key differentiators in the industry.

Practical Implications for Beekeepers
The Miski Miel de Campo model serves as a real-world example of how alliances can be successfully implemented, scaled, and adapted to different regional contexts, paving the way for a more equitable, resilient, and sustainable global beekeeping industry. Key recommendations include:
- Cooperative business models to strengthen the capacity of the industry.
- Adoption of certifications to incorporate good practices.
- Sustainable production practices and product diversification to enhance resilience and economic stability.

BEEKEEPING FOR RURAL DEVELOPMENT

OP-186 [Beekeeping for Rural Development]
Prison beekeeping programs in the state of Georgia, USA

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Background/Purpose
Prisons in the United States offer vocational education in hopes of reducing recidivism. In the state of Georgia in the Southeastern United States, beekeeping classes have been offered in some prison facilities since 2015.

Problem/description
Repeated incarceration is linked to poverty, lack of job training, and mental illness in the United States.

Methodology
Prison beekeeping classes give participants the opportunity to learn the craft of beekeeping. At the end of each year students are tested using the Certified, Journeyman and Master beekeeper protocols outlined in the University of Georgia Master Beekeeper Program. Using on-site hives, the students care for 4-14 hives, harvest honey, wax, and propolis and raise queens.

Results and conclusion
Since 2015, 235 incarcerated individuals have passed the test for the Certified level, 19 passed the Journeyman level and 7 have achieved the Master Beekeeper level. Since 2022, students have been asked to fill out a survey regarding the beekeeping programs. Participants responses are overwhelmingly positive. They reported increased awareness of the importance of caring for the environment, increased ability to work collectively as a community, gratitude for forming relationships with others from different backgrounds that they would otherwise not have sought out, the value of being able to act as a teacher and mentor for those who continue to the Journeyman and Master levels, an appreciation for having something interesting to talk to their loved ones about, and hopes that they will be able to continue keeping bees upon release.

Practical implications for beekeepers
While there is known value in providing vocational training for incarcerated individuals to reduce recidivism, the therapeutic benefits of beekeeping could be considered even more valuable. The opportunity to work together to care for living beings, the intellectual stimulation of learning beekeeping, and the rewards of passing tests are all opportunities for these mostly disadvantaged populations to heal, for them to be positive community member while incarcerated, and to return to their communities better equipped for success. More broadly, prison beekeeping programs increase awareness of the importance of honey bees among staff and the general incarcerated populations.

OP-187 [Beekeeping for Rural Development]
Meliponiculture- An Additional Income in South India

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Meliponculture, the rearing of Stingless bees for honey harvesting, is an eco-friendly and sustainable practice that has gained traction nowadays. Many beekeepers have turned to this practice, in addition to their conventional cerana beekeeping in South India. Stingless bees, belonging to the order Hymenoptera, of the family Apidae, classified further into 58 genera and 550 species, is widely distributed in the tropical and subtropical regions of Africa, Asia, Australia and America (Crane,1992). In India, the three species commonly found are Tetragonula, Lisotrigona, Lepidotrigona. The most widespread species in peninsular India is Tetragonula travancorica. Shanas and Faseeh, 2024. Since many centuries, traditional stingless beekeeping with indigenous bees, ie Tetragonula sp, has been the norm in South India and other parts of the country. Amongst the many shortcomings of this method, a few to be noted are its poor honey yield, with each colony contributing to just 100 to 300 grams and the unhygienic honey collection methods. The introduction of scientific management, with standardized beehives and accessories, raising awareness through workshops and trainings,stingless bee flora identification, establishment of bee gardens, and yield increase through pollination studies on vegetable and fruit crops has been undertaken to overcome such limitations. Additionally, other features that have facilitated the popularity of Meliponiculture amongst hobbyists and beekeepers are the abundance of its wild colonies in nature, easier management and its pathogen resistance. Moreover, it is easier to establish the hives in residential areas. Presently, beekeepers manage thousands of stingless bee colonies with each colony providing a yield of 500 grams to 1 kilogram of honey. We have observed that Kasargodu and Kannur in Kerala are the leading districts in Meliponiculture. With income generation through the sales of honey, bee colonies, pollen, value added products like Propolis cream, one can generate Rs 25000 to 30000/ from 10 Stingless bee colonies /year which serves as a sustainable income to the humble beekeeper. Key words: Stingless bees, Meliponicultutre, Tetragonula, Lisotrigona, Lepidotrigona

OP-188 [Beekeeping for Rural Development]
Beekeeping and Forest Conservation

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Globally honeybees are found to be associated with forests. Various tree species found in the forests provide bee forage and physically provide shelter for bee colonies and beehives. Forest conservation and beekeeping has a long-lasting relationship globally. The combination of beekeeping and forest conservation provides annual bee products to supplement income for communities. Tree growing and beekeeping can easily be combined since they are activities that enhance ecosystem restoration and community livelihoods. High rate of deforestation, veldt fires, land degradation and poaching threaten the forest landscape. Makoni is a representative district for this study, and this is one of the biggest tobacco growers in the country with sources of fuel for its curing coming from the indigenous woodlands within the district. This has reduced the forage base for bees and has affected honey production as most of the bee friendly species such as the Brachystegia and Julbernardia which are indiscriminately cut for fuel. It is from this background that a study was conducted. Through random selection a total of 50 respondents were picked, 25 from each of the two purposively selected localities where the size of area under tobacco, beekeeping activities and other livelihood options were considered. Semi-structured questionnaire, field observation and interviews with key informants were used to generate data. Presentation of data was done using tables. Different categories and themes were used to analyse the data. The study revealed that most respondents, 80% cut down trees for various uses and aim at clearing those that are bee friendly. Lack of forest protection, control of resource movement, proper forest management practices, access and ownership of resources remained poorly administered at local level where chiefs and other local leaders are in control. In conclusion, to reduce the identified threats interventions that promote sustainable livelihoods through beekeeping and tree growing be done under a community-led approach. This can provide an economic, social and environmental incentives that encourage communities to protect the forest and manage it sustainably. Beekeeping and forest conservation resonates well with Nature-based Beekeeping that embraces bee ecology and sustainable use of local resources to construct low cost-hives.

OP-189 [Beekeeping for Rural Development]
The International Meeting of Young Beekeepers (IMYB)

Jiri Piza
Icyb - International Centre For Young Beekeepers

The International Meeting of Young Beekeepers (IMYB) is the world's largest gathering of young beekeepers. IMYB serves as a unique platform for the best young beekeepers in the world to meet and compete.

The competition, which takes place annually, invites three team members (aged 12-18) guided by two mentors from each participating country to participate in five days of theoretical and practical beekeeping competitions, complimented by a rich social and cultural program.

IMYB is held every year in a different country. Over 1,000 young beekeepers from 48 different countries have participated at IMYB events till date. So far, it has taken place in the Czech Republic, Slovakia, Poland, Germany, Austria, France, England and Slovenia, with the most recent, 13th annual competition organized by Beekeepers Foundation from Dubai in the UAE in December 2024.

The next IMYB will be organized by Ulster Beekeepers Association in Belfast, Northern Ireland in 2026. We invite representatives from other countries, who are interested in becoming members of our IMYB family and participate in future international conferences, to get in touch.

IMYB is organized by the International Centre for Young Beekeepers (ICYB), in coordination with local partners. ICYB is a non-profit organization headquartered in Prague, Czech Republic.

ICYB is an association whose main mission is international support and coordination of young beekeepers. The association provides the IMYB project with full coordination service, which consists, among others also, of the promotion of IMYB, the search for new organisers and participants from different countries, communication with the organisers and participants, making them familiar with the project and international coordination of all activities connected with the IMYB project.

Since its founding in 2010, ICYB has organized thirteen annual meetings of young beekeepers around the world. As of January 2025, the organization has official representatives in over fifty countries.

Vision of ICYB is to have more countries included in IMYB and for each country to run their own national-level competitions. The organization achieves this by operating a global platform for young beekeepers, and creating a community of mentors.

The Future of Beekeeping is in Hands of the Young Generation!

OP-190 [Beekeeping for Rural Development]
The accompanying fauna in honeybee colonies in tree-beehives and logs in Poland

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Background/PURPOSE: In managed apiaries, beekeepers protect hives from predators and maintain hygiene, minimizing pest intrusion. In contrast, tree beehives lack such protection, making the presence of other organisms in these nests inevitable. The study aimed to investigate the diversity of species cohabiting with honeybees in tree beehives and beehive logs, as well as their impact on the bee colonies.

Problem Description: The interactions between honeybees and other organisms in tree beehives are poorly understood, particularly regarding their role in forest ecosystems and potential competition with other pollinators.

METHODOLOGY: Between 2018 and 2024, samples were collected from approximately 50 honeybee nests in central and northern Poland. Material was gathered from the bottoms of tree beehives (nest debris and remains), as well as from the walls and covers of the exit holes. Insects and arachnids were identified to the order, family, or species level using identification keys for Polish arthropods. The organisms were categorized as “accompanying fauna” and grouped into parasites, predators, nest destroyers, cleptobionts, and accidental nest residents.

Results and CONCLUSION: The study identified parasites such as Varroa destructor and Phora incrassate, predators like wasps (Vespa crabro, Vespula vulgaris) and spiders (Anyphaena accentuate, Steatoda bipunctata, Araneus diadematus), and nest destroyers including the lesser wax moth (Achroia grisella). Kleptobionts such as ants (Formicidae) were also present. Accidental nest residents included saprophytic organisms like beetles (Tenebrionidae, Latridiidae), Dendrophilus punctatus, Dermestes Lardarius, springtails (Collembola), moths (Pheosia tremula), millipedes (Julus sp.), bristly millipedes (Polyxenus lagurus) and Oribatida mites. In total, the accompanying fauna included 22 species, 7 families, 1 genus, 1 order, and 2 classes. The findings indicate that some organisms traditionally seen as pests act as a “clean-up crew” in tree beehives. Moreover, wild beehives often serve as habitats for birds and small mammals, suggesting a demand for nesting sites in forests. While tree beehives contribute to forest biodiversity, potential food competition with other pollinators must be considered. Practical Implications for Beekeepers: Understanding the role of accompanying fauna can help forest managers foster biodiversity while mitigating potential conflicts between beekeepers and tree beekeepers.

OP-191 [Beekeeping for Rural Development]
Beekeepers Restore the Forests of Kwahu Afram Plains of Ghana

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The forests of Kwahu Afram Plains in Ghana's Eastern Region are under severe threat due to inadequate management personnel, unsustainable exploitation, and destructive perennial dry-season bushfires. Valuable tree species such as Ceiba pentandra, Khaya ivorensis, and Milicia excelsa have become scarce, while rural communities, facing limited economic opportunities, rely heavily on natural resources for survival. Recognising the urgency of reversing forest loss while improving livelihoods, Bees for Development Ghana (BfDG) launched the Beekeepers Restore Forests initiative - an innovative community-driven approach that links nature-based beekeeping with forest conservation while improving their economic well-being.

By transforming honey hunters into trained nature-based beekeepers, the initiative creates economic incentives for communities to protect trees and restore degraded landscapes. Beekeepers understand that thriving forests provide essential bee forage, leading to higher honey yields and increased incomes. To strengthen this connection, BfDG has established a Honey and Beeswax Processing Centre in Donkorkrom, ensuring a reliable market for honey, which in turn motivates beekeepers to safeguard their apiaries and surrounding ecosystems.

Key project components include bushfire prevention training, tree planting to enhance floral diversity, and social enterprise development to improve market access. In 2024, beekeepers earned over £16,000 from selling about 12 tons of honeycombs, with many experiencing unprecedented financial stability. Beekeepers are shifting their perception of trees from charcoal sources to vital resources for honey production, reinforcing conservation efforts. The project promotes agroforestry systems where farmers plant nectar-rich trees alongside food crops, creating a win-win for biodiversity and livelihoods.

This intervention highlights how beekeeping serves as a powerful nature-based solution for both poverty alleviation and environmental restoration. By aligning economic benefits with conservation goals, the project is fostering a sustainable and resilient economy in Afram Plains, demonstrating the potential for replication across similar ecosystems. This presentation shares successes achieved and the transformative impact of beekeeping on rural livelihoods and biodiversity conservation. Key lessons learned include that access to a ready market is the strongest driver, and planting trees in a forested landscape is problematic when the drivers of forest loss are still active. Again, poor people need cash but also need financial literacy to achieve transformational change.

OP-192 [Beekeeping for Rural Development]
Biodiversity of Apis dorsata and its conservation strategies in India

Muniswamyreddy Shankar Reddy
MUNISWAMYREDDY SHANKAR REDDY

The Wild honey bees are distributed throughout the Asia including the Indian sub-continent. In India has eleven honey bee species have been identified, the domesticated are three species (Apis cerana cerana, Apis cerana indica, Apis cerana himalaya), Amongst the wild bees two little bees(Apis florea, Apis andreniformis) and there are four wild and giant honey bees (Apis dorsata dorsata, Apis dorsata bingami, Apis dorsata breviligula, Apis laboriosa), introduced European honey bee species Apis mellifera and Stingless bee Trigona species are well distributed in plains, forest and hill areas of India. The study on the Biodiversity of Apis dorsata, distribution, honey production, people involved in honey harvesting/hunting and its economics has been undertaken. The nest population ranges from solitary both in terrestrial and arboreal habitats to as many as 610 in a single Banyan tree Ficus bengalensis. As these bees are migratory in nature move from one region/area to other region/area by leaving remnants on rock cliffs, tree branches, buildings due to change in the cropping pattern and environmental condition. These remnants act as attractants to bees to construct nests for the next season. There is manifold increase in crop yield of Agriculture, horticulture and forest produce.
The details of sustainable honey harvesting from these giant bees and the conservation strategies are documented. The production of the honey ranges from 25 to 60 kgs and beeswax from 5-8 kgs per year per colony. As these A. dorsata nests on man-made structures such as tall buildings, underneath bridges, these bees are the excellent pollinators, the pollination efficiency was also documented. Three fourth of the honey produced in India is from these wild bees. Many people particularly tribal communities are largely dependent upon for their livelihood and sustain the nests through scientific honey harvesting and colony management for pollination service and ultimately for the conservation. Different regions and geographical areas have adopted different methods of conservation strategies. The details will be discussed.

Keywords: Apis dorsata wild bees, rock bees, biodiversity, conservation

OP-193 [Beekeeping for Rural Development]
Prevention of rock bee, "Apis dorsata" colonies from nesting in vulnerable sites

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Rock bee, Apis dorsata, is one of the effective pollinators of several agricultural, horticultural crops and forest trees. Their natural nesting places are branches of larger trees, rock cliffs and high raised buildings. Usually under urban ecosystem they choose high raised buildings as their nesting places. The urban dwellers get afraid of the presence of rock bee colonies due to the incidence of rock bees attacking them. The people feel the presence of rock bees in their buildings as dangerous. Often this leads to a conflict between rock bees and urban dwellers, which results in elimination of rock bee colonies by application of insecticides. Thus several numbers of colonies are destroyed every year just by the fear of possible attack to the people in urban and semi-urban areas. One of the measures to protect the A. dorsata colonies is prevention of their nesting in vulnerable places and safely shifting them to other places. The present investigation was carried out during 2020-24 with an objective of finding out measure to prevent their colonization at undesired places and to work out the possibility of relocating them from such places.

The different measures imposed to prevent their colonisation at undesired places were scraping and painting the previously colonized places, application of glue to the nesting places, fixing some fumigants to the nesting places, fixing fluttering materials and fixing netting material to the nesting places. Among these scraping, painting and application of glue were not effective. The colonization was observed after a month and even within a month also. Fixing of fumigant was effective only temporarily and was effective immediately after removal of the comb in an attempt to relocating the colony. Fixing of fluttering material to the possible nesting sites was very effective in preventing the colonization for the entire season. Similarly, fixing of netting material also gave encouraging results in preventing the colonies throughout the season. The paper gives a detailed account of the measures and also the results of efforts made to safely relocate the colonies from vulnerable places to other safer places for their conservation.

OP-194 [Beekeeping for Rural Development]
Temporal Trends in the Brazilian State of São Paulo Meliponiculture: Woman participation, Shifting Geographies, and the Decline of Non-Native Species

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Background/Purpose
Meliponiculture (stingless beekeeping) in São Paulo, Brazil, is a critical practice for biodiversity conservation and sustainable livelihoods. This study analyzes its evolution from 2016 to 2022, focusing on shifts in beekeeper demographics, spatial expansion, and management practices to identify trends, challenges, and opportunities for growth.

Problem Description
Despite increased participation, meliponiculture faces challenges: lack of knowledge about the activity's regulation, limited market, and tensions between conservation goals and the use of non-native species. Additionally, spatial imbalances persist, with uneven activity distribution across mesoregions, and novice beekeepers lack long-term engagement strategies.

Methodology
Surveys were conducted with 255 (2016) and 330 (2022) meliponists across São Paulo's 15 mesoregions. Data included demographic profiles, colony numbers, species preferences, motivations, knowledge sources, and economic outcomes.

Results and CONCLUSION: Male dominance persisted (78.48% in 2022), but female participation rose by 8.58%. Practitioners aged significantly (average age: 41 to 51), with a 9% increase in those aged 60+. Education levels remained high (50% undergraduates; 10.62% postgraduates by 2022). Geographically, Vale do Paraíba doubled participation (15.76% in 2022), surpassing Ribeirão Preto, while rural meliponaries increased by 4.6%. Colony numbers grew from 5,185 to 7,419, though 60% kept ≤10 colonies. Native species predominated: Tetragonisca angustula (41.41%) and Melipona quadrifasciata (21.88%) thrived, while allochthonous M. scutellaris fell to <1%. M. mondury rose 9.29%, reflecting preference for productive natives. Conservation remained the primary motivation (90.3%), but commercial interests grew to 22.12%. Over 36% were beginners in 2022, with women disproportionately represented among novices (49.3% had ≤1 year experience). Knowledge acquisition shifted toward supervised learning (e.g., courses), matching self-guided methods (70% combined). Profitability stagnated: 70.61% reported no profit, despite modest commercial growth (<10%).

Practical Implications for Beekeepers
Despite increased participation, meliponiculture faces challenges such as limited market reach, and tensions between conservation goals and the use of non-native species. To address these issues, actionable strategies include prioritizing native species like M. mondury for their ecological compatibility and productivity. Concurrently, advocating for policy incentives to support native species conservation and equitable value chains is essential.

OP-195 [Beekeeping for Rural Development]
Empowering Indigenous Peoples Communities through Sustainable Beekeeping and Native Bee Honey Harvesting

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Beekeeping with stingless bees (Tetragonula biroi) was introduced to an Indigenous Peoples Community in Barangay Loyal, Victoria, Oriental Mindoro, Luzon Island, Philippines. The project aimed to commercially propagate stingless bees for the production of honey, pollen, and propolis as part of a sustainable enterprise. The specific objectives were to establish a meliponary enterprise in Barangay Loyal, standardize and package bee products for local and international markets, and provide capacity-building in both technical and management aspects. The training program spanned the bees' active season, covering processes from handling starter colonies to expansion and colony division or splitting. This comprehensive approach led to activities culminating in harvesting, processing of bee products, and marketing. A modest bee facility was built for processing. After two years, the community generated additional income from the sale of honey and propolis. This paper highlights the training strategy and community-driven approaches used to create a sustainable bee extension program.

OP-196 [Beekeeping for Rural Development]
Beekeeping awareness, training of youth and rural women for income and employment generation in Telangana, India

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Beekeeping activity has dawned a new hope for the distressed lot of farmers, unemployed youth and mainly rural woman in Telangana state of India. With a mandate in empowering rural women, youth and children to achieve self-reliance by organizing training programs, conducted webinars to create awareness in over 100 Government schemes. Keeping in view the importance and the role of bees in income and employment generation, an attempt has been made to identify rural youth, women and jobless people to create awareness and conducted training programmes utilising the government schemes like kisan organisations, horticulture and agriculture university facilities and infrastructure conducted more than 45 Beekeeping Training and Awareness programmes during the last 4 years. Training ranging from 3-4 days, hands-on-training on handling of bees, honey extraction, beeswax candle making, crack cream making etc., and identifying different species such as Indian hive bee, Apis cerana, European bee, Apis mellifera and stingless bees, Trigona species were organised during 2020-24. Also farmers associations and tribal people were involved in the training programmes on scientific beekeeping for maximum production of honey and other products. The income generated has been documented.

The farmers were given bee boxes and other beekeeping equipment's after the training and created awareness on the importance of bees in crop yield in sweet lime, watermelon, sesame, safflower, sunflower etc., The farmers have reported that, more than 40-80 % increase in the yield and helps in pollination of crops to maximum fruition for bounty yields. As the said bees are sensitive, to some of the pesticides and insecticides and farmers were educated to use the safe methods of practices and conservation of bees. As the Hon'ble Prime Minsters National mission on sweet revolution ie increase in crop productivity, of agriculture, horticulture and edible oil seeds production to cut the burden on import of edible oils through indigenous productivity have been advocated amongst the farmers. The details of the achievements made in training, awareness and conservation of bees will be discussed.

OP-197 [Beekeeping for Rural Development]
Taking an industry approach to beekeeping development

William Van Blyderveen
Bees for Development

Development organisations often claim beekeeping projects have a high impact, with significant financial benefits, within a short period of time. However, beekeeping development is plagued by challenges-failed projects, abandoned hives, and limited financial returns for participants. Projects often focus on short-term, localised beekeeping training with selected participants. Development work and livelihood research fail to consider the industry as a whole, especially the differences between beekeeping operational levels – for example small-holder beekeepers versus commercial beekeeping businesses and the interactions between levels.

In 2021, the author used focus group discussions, key informant interviews, and household surveys to examine beekeeping operational levels across Malawi from a Sustainable Livelihoods Approach (SLA). SLA characterises livelihoods using five capitals: human, social, financial, natural, and physical. The research found clear differences in SLA capitals and beekeeping constraints between beekeeping operational levels of small-holder, NGO recruited, commercial, and association/cooperative beekeepers. There were also important connections between small-holder and commercial beekeepers, supporting long-term sustainability in the beekeeping industry.

With respect to enabling beekeeping livelihoods in Malawi, non-governmental organizations need to use an industry driven and participatory approach rather than be oriented only to poverty relief. Applying this in practical development work has demonstrated the importance of considering beekeeping operational levels and focusing on the industry, not one-off beekeeping projects. Working with the industry includes partnering with and building the capacity of national associations, supporting university and colleges to build extension capacity, and working with the private sector to expand bee product markets.

OP-198 [Beekeeping for Rural Development]
Engaging youth and children in beekeeping through the honeyway.by initiative: a model for education, sustainability and community empowerment

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1. Introduction
Pollinators are vital to global biodiversity and food systems, yet their populations are declining due to habitat destruction, climate change, and chemical overuse. Engaging youth in apiculture presents a strategic opportunity to reverse this trend while fostering sustainable development.

2. Problem/Objective
However, existing educational programs often fail to integrate hands-on practice, community engagement, and digital tools, limiting their ability to inspire long-term youth participation in environmental stewardship.

3. Here We Show
Here we demonstrate that the Honeyway.by initiative, a six-year Belarusian program combining school-based education, apiary training, and public events, significantly enhances ecological literacy and empowers youth to drive pollinator conservation.

4. Main Results & Conclusions
From 2018–2024, the program engaged 2000 children (8–16 years) and 400 adolescents through three pillars:
1. Curriculum-aligned workshops using films and online classes improved understanding of bee ecology (78% proficiency gain).
2. Hands-on apiary training with mentors enabled 45% of teens to launch advocacy projects or micro-apiaries.
3. Annual World Bee Day festivals strengthened community ties, with 32% of families adopting pollinator-friendly practices like planting bee friendly gardens.

The hybrid model—blending education, mentorship, and public outreach—proved critical in sustaining engagement across age groups.
5. Implications
This framework offers a scalable solution for regions facing pollinator decline and rural depopulation, directly supporting SDGs 4 (education), 13 (climate action), and 15 (life on land). By transforming youth into ambassadors for bees, Honeyway.by provides a replicable blueprint to cultivate ecologically literate, proactive communities worldwide.

OP-199 [Beekeeping for Rural Development]
Beyond educational benefits, integrating stingless beekeeping into school activities generated additional income for the institution through honey and hive sales

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Problem-solving skills are essential 21st-century competencies, particularly in the digital era characterized by complexity and uncertainty. Developing these skills requires structured, analytical thinking and adaptability to overcome challenges sustainably. This study explores the integration of stingless beekeeping into school curricula as an experiential learning approach to enhance youth problem-solving abilities while fostering engagement in sustainable apiculture.

In collaboration with 25 teachers, the research team designed an interdisciplinary learning model incorporating stingless beekeeping into subjects such as mathematics, science, and Thai language from early childhood to secondary school levels. The approach emphasized experience-based learning, transformative learning curves, and real-world problem-solving. Teachers received training on stingless bee management, its ecological and economic benefits, and pedagogical techniques for integrating beekeeping into classroom instruction. They subsequently developed and implemented learning activities for over 200 students. For instance, in mathematics, students applied measurement concepts to construct stingless bee hives.

The program consists of seven subjects and two rally activities, which have been implemented in a total of seven schools. These include three primary schools in rural areas, one primary school for indigenous students, and four secondary schools in area of Ratchaburi Province, Thailand. The learning outcomes have been assessed through researcher observations, student interviews, and teacher questionnaire responses. The study assessed students' academic knowledge and problem-solving skills using various methods such as tests, observations, interviews, and reflection. Significant transformations were observed in both teachers and students. Teachers demonstrated increased competence in designing lessons based on real-world scenarios and improved interactions with students. Meanwhile, students exhibited greater enthusiasm for learning, enhanced analytical and systematic thinking, decision-making, and problem-solving skills across all grade levels. Beyond educational benefits, integrating stingless beekeeping into school activities generated an additional income of 5,000 Thai Baht per year, accounting for 15% of the family's income for the institution through honey and hive sales. This initiative not only reinforced students' engagement but also inspired entrepreneurial thinking, enabling them to explore beekeeping as a potential livelihood for their families. The findings highlight the potential of stingless beekeeping as a transformative educational tool that cultivates essential problem-solving skills while promoting environmental sustainability and economic empowerment.

OP-200 [Beekeeping for Rural Development]
Safeguarding Amazonian Stingless Bees for Conservation and Rural Development

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Amazon Research Internacional

Stingless bees (Meliponini), found in tropical regions worldwide, are critical pollinators essential for biodiversity, forest regeneration, and the cultural and social structures of indigenous communities. In the Amazon Rainforest, indigenous people have safeguarded and cultivated stingless bees for generations through deep ecological knowledge and stewardship. However, climate change, deforestation, habitat loss, and pesticide exposure are driving population declines, threatening these keystone species and the livelihoods of those who rely on them. Despite their ecological and cultural significance, stingless bees remain largely absent from conservation policies, leaving their populations vulnerable. Here we show that integrating sustainable stingless beekeeping with scientific research, conservation policy, and community-led initiatives enhances biodiversity protection, strengthens rural economies, and contributes to environmental stewardship. Working alongside indigenous Kukama and Ashaninka communities, we established seven community-led beekeeping sanctuaries to safeguard bee populations and mapped stingless bee species and their host trees, providing the first data-driven evidence that deforestation increases the risk of stingless bee decline in the Peruvian Amazon. Through Las Meliponicultoras, the first indigenous women-led stingless beekeeping program in the Amazon, we trained over 350 beekeepers (70% women, 15% youth) in sustainable hive management, pollination-based reforestation, and economic resilience through bee-based tourism and the sale of honey, pollen, and propolis, Additionally, our research led to the first scientific publication documenting traditional ecological knowledge of stingless bees, co-authored with an Ashaninka indigenous leader, setting a precedent for integrating indigenous knowledge into conservation science. This research underpins an ongoing Rights of Nature declaration, advocating for legal recognition of stingless bees as vital ecological and cultural entities. Our findings also informed discussions leading to the modification of Peru's Law 32235 in December 2024, granting legal recognition to native stingless bees for the first time. Our results show that sustainable stingless beekeeping is a replicable model for biodiversity conservation and rural development in the Amazon and beyond. By integrating indigenous-led conservation strategies into policy frameworks, beekeepers can restore ecosystems while securing sustainable, nature-positive livelihoods, setting a precedent for scalable rural development in tropical regions worldwide.

OP-201 [Beekeeping for Rural Development]
Beekeeping in Challenging Environments: Case Studies from Kenya and Ethiopia with a Focus on Women Beekeepers

Marta Panco
Marta Panco, MSc

Women play a crucial role in beekeeping. Beekeeping in challenging environments presents unique obstacles that can hinder colony health, honey production, and the overall sustainability of beekeeping operations. These challenges include aridity, human-wildlife conflict, socioeconomic barriers, and cultural norms that limit women's participation. This study aims to examine case studies from Kenya and Ethiopia, highlighting the diverse challenges faced by women beekeepers and the innovative solutions implemented to overcome them. Arid regions in Kenya experience limited water sources and sparse flowering vegetation, impacting colony health and honey production. Human-wildlife conflict, particularly with elephants, poses a significant threat to beekeeping operations. Socioeconomic barriers, including limited access to markets, low honey prices, and lack of access to modern beekeeping equipment, hinder the economic viability of beekeeping. Cultural norms, gender roles also limit women's participation in beekeeping. This study employs a case study approach, examining beekeeping projects in Kenya and Ethiopia that address specific challenges in their respective environments. Data was collected through literature reviews, project reports, and online interviews. The analysis focuses on the effectiveness of various interventions in promoting sustainable beekeeping practices, enhancing livelihoods, and conserving the environment. The case studies reveal the positive impact of innovative solutions and adaptive strategies in overcoming beekeeping challenges. Beehive fences have been successful in deterring elephants and protecting crops in Kenya. Drought-resistant beekeeping practices have enhanced the resilience of beekeepers in arid regions of Ethiopia. Women's empowerment programs, such as Women for Bees, have increased the participation of women in beekeeping, contributing to their economic empowerment and community development. Beekeeping in challenging environments requires a comprehensive approach that addresses the diverse obstacles faced by beekeepers. The case studies demonstrate the effectiveness of interventions that promote sustainable practices, enhance resilience, and empower marginalized groups. By learning from these experiences, beekeepers can adapt their strategies, improve their livelihoods, and ensure the viability of beekeeping in challenging environments. Beekeepers can adopt beehive fences to deter elephants, implement drought-resistant practices in arid regions, and empower women through targeted programs. Collaborative research and knowledge sharing are crucial for promoting innovation and ensuring the sustainability of beekeeping in challenging environments.

OP-202 [Beekeeping for Rural Development]
BeeAutism: Individuals with autism spectrum disorder have been trained to become professional beekeepers in Greece

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Despite the desire of individuals with autism spectrum disorder (ASD) to work, there are still several obstructions limiting their professional opportunities. The majority in Greece (and other countries) remain unemployed or underemployment. Beekeeping, in combination with supported employment, could provide an alternative and beneficial training and professional field for people with ASD. Furthermore, supported employment is a method that supports the employment integration of people who, due to their disability, are unable to work. Therefore, a common action between the Laboratory of Applied Apiculture at the University of Thessaly, Greece and the Autism Association of Larissa, is taking place in Greece, aiming to turn five young persons with ASD to professional beekeepers. The trainees, never involved with apiculture before the BeeAutism project, received theoretical and practical training from the scientific personnel of ApisLab on observing and maintaining bee colonies, under the supervision and support of their assistants. After the first observations the group was enriched with students without ASD aiming in the interaction of all trainees under a common environment. The new beekeepers with ASD, received their first colonies and gradually reached the number of 20 for each one. They developed high interest for bees and beekeeping, and they are about to extract and bottle their first quantities of honey in early summer. The APIVITA SA company, supporting this project, provided all the necessary material for the project has prepurchase the quantities of honey at a high price. During the project, trainees' progress is monitored by the research assistants regarding their ability to complete tasks as observing both sides of 10 frames, identifying the presence of the queen, eggs, brood, food supplies and pathogens. Furthermore, the “level of satisfaction” (Minnesota Satisfaction Questionnaire) and the “autonomy and level of functionality” (Vineland Adaptive Behavior Scales) are used to assess the impact of this project on the individuals with ASD. Results will be carried out in late summer.

OP-203 [Beekeeping for Rural Development]
Using non-traditional means of value addition to support rural honey and beeswax supply chains

Chris Keywood
Bees for Development

Beekeeping is a critical economic activity in many rural localities around the world. With few barriers to entry, rural beekeeping is accessible to almost anyone, regardless of wealth, age or gender. Rural landscapes are also regularly some of the best habitats for honey bees to thrive in. Where barriers do arise for rural beekeepers is in getting the honey and beeswax to market. Market access in rural conditions is always a challenging endeavour. The local markets are often small and can only support a small quantity of bee products. The high logistics costs involved in moving honey and beeswax to larger markets usually further away are prohibitive and can make these supply chains unsustainable. In order for rural beekeepers to combat this, methods need to be found to attract buyers to take on the logistics costs without lowering the price they will pay for the products. To incentivise buyers to do this the beekeepers have to have add value to their products but without expensive processing facilities and equipment traditional value addition is not feasible. Here we show other solutions to value addition. We have had success using in adding value to the beekeepers offering to buyers by helping the beekeepers take away some of the risk and logistic costs. Using freeware, we have developed a traceability and quality assurance system in order to prove the provenance and quality of the honey and beeswax before it is purchased, thus limiting the risk to the buyer.

Having organised beekeeper groups that have a central collection site, dramatically reduces the logistic burden on buyers, and working together small-scale beekeepers can offer large volumes of honey and beeswax from a central location.

These combined with evidence we have collected to support that beekeeping promotes forest protection and helps maintain biodiversity, beekeepers have a robust offering to buyers that helps to create a stable supply chain even in rural conditions.

OP-204 [Beekeeping for Rural Development]
Forest conservation through beekeeping: using satellite imagery to demonstrate the role of beekeeping in protecting natural forests

Chris Keywood
Bees for Development

Natural forests are known to be some of the most florally diverse landscapes on earth, providing exceptional habitats for bees and therefore are productive areas for beekeepers. They are also some of the most biodiverse areas, containing many of the world's unique fauna and flora. Around the world however, these habitats are shrinking. As human settlements expand into the forests and economic pressures push for deforestation, in order to create landscapes with greater income generating capacity, these forests are at risk of disappearing. One of the main activities causing this deforestation is the clearing of the forest landscapes to create traditional agricultural cropland. Beekeepers can play an important role in combatting this trend. By using the forests for their income generation there is less pressure on the beekeepers to clear the forested land and as they depend on the forests for their income, they are incentivised to prevent others from clearing the land as well. Using satellite imagery we are providing evidence that forests well used by beekeepers are less prone to deforestation than those where little to no beekeeping is taking place. Comparing on the ground studies with Sentinel satellite data and vegetation indices we are creating a collection of evidence to demonstrate the extent of beekeepers ability to preserve their habitats and livelihoods. This evidence can then be used to inform land use policy, assist with development programs and add additional value to the products supplied by these forest beekeepers, allowing them to reach new markets and generate more income.

OP-205 [Beekeeping for Rural Development]
Unlocking opportunities for sustainable beekeeping in project-affected communities by large economic growth & development projects in Africa

Kai Hichert
Independent bee project consultant specializing in Africa

BACKGROUND:
As global industries expand, rural communities often find themselves at the crossroads of economic development and environmental disruption. Large-scale projects, such as a 1,500-kilometer pipeline from Uganda to Tanzania and 200-hectare solar farms in Malawi, bring economic growth but also significantly impact thousands of Project-Affected Persons (PAPs) and Project-Affected Households (PAHs). Many of these communities depend on agriculture and traditional beekeeping for their livelihoods. Our work highlights how sustainable, modernized beekeeping can serve as a vital Livelihood Restoration Activity, ensuring that affected communities not only adapt but thrive.

Problem Description:
This session will explore the realities of beekeeping in challenging environments, where limited resources, lack of training, and environmental pressures threaten honey production and bee health. We will share first-hand insights from Tanzania and Malawi, where traditional beekeeping practices persist but often result in low honey yields, poor-quality honey, and colony losses.

METHODOLOGY:
By implementing proper hive selection, training, and access to modern beekeeping equipment, we can create sustainable beekeeping enterprises that empower local communities, preserve bee populations, and enhance economic resilience. Integrating PAPs and PAHs into economic development projects through sustainable agriculture ensures mutual benefits for all stakeholders.

Results and CONCLUSIONS:
Join us as we discuss practical solutions to the challenges faced by rural beekeepers, including hive design, “bee space” principles, mitigating theft, honey badger threats, and the need for quality protective gear. A structured training and support program has the potential to transform beekeeping into a sustainable, profitable industry for PAPs and PAHs affected by industrial development in rural Africa.

Practical Implications for Beekeepers:
Livelihood Restoration Activities not only support PAPs and PAHs in affected areas but also offer a global model for utilizing bees in sustainable agriculture. Innovations such as Agri-Voltaic Farming—where solar farms incorporate sheep, cover crops, vegetables, and bees—demonstrate how beekeeping can be integrated into future energy projects.

Join us in Copenhagen at Apimondia 2025 to explore how beekeeping in challenging conditions can become a cornerstone of sustainable development and community empowerment!

OP-206 [Beekeeping for Rural Development]
Improved harvesting of wild Honey from tree hives without burning the bees and nest to produce quality honey and to preserve the bees – the case of adopting Incubator Bee Tent to preserve the bees and to produce quality honey

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MARKETING. GHANA BEEKEEPERS ASSOCIATION

Background /PURPOSE:
Wild honey harvesting kills bees and contaminates the honey which could have been harvested as a prime organic honey at a premium price to protect the forests and woodlands.

Problem Description
About 60% of the honey on the African market is harvested from the wild through application of intense smoke and fire which either drives away the bees or kills them. The bee population of the world is declining and must be preserved

OBJECTIVE: To develop an Incubator Bee Tent that will enable honey in the wild of tree hives to be harvested without burning the bees.
Methodology
Materials
Incubator Bee Tent
15cm pipe fixed on woollen carpet
Methods

An Incubator Bee Tent is an untreated 'mosquito' net made as with various width of sleeves attached to the tent to enable you to work with your hands in the tent whilst your body is outside the tent. It has length 300cm width 210cm with various numbers of sleeves at the length and width sides respectively.All the sleeves are 90cm long and width either 15 or 30 cm with 30 cm in the tent and 60cm outside the tent with elastic bands at the mid portions and both ends of the sleeves.

Usage of the Bee Incubator Tent for wild honey harvesting on tree
The woollen carpet with the fixed pipes is placed at the entrance of the tree hive holes at night when all bee are in the nest such that any bee movement in and out from the tree nest is through the pipe.
Harvesting starts by smoking the nest and by-passing hands through any of the 15 cm wide sleeves near the entrance of the tree hive to get access to the nest combs which are removed into a bucket whilst the bees charge and cluster out into the net. to be transferred into a hive later

Results and Conclusion
The bees and combs are harvested and secured for use in colonized a hive and a premier honey to be marketed as an organic honey is obtained

OP-207 [Beekeeping for Rural Development]
Engaging rural youth in beekeeping: a pathway to sustainable livelihoods and biodiversity conservation among indigenous communities in India

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86% of India's farmers are small and marginal farmers, with the average operational holding size declining from 1.15 ha in 2010-11 to 1.08 ha. In this context, it is crucial to highlight beekeeping as a tool to make smallholder agriculture more remunerative. Smallholders in India are characterized by- a) fragmented small land holdings with fewer livestock, b) limited capital and assets, c) susceptibility to migration, d) vulnerability to natural hazards and climate change, e) monsoon dependent agriculture, f) degrading soil health.

The Bees for Poverty Reduction programme by Under The Mango Tree Society (UTMT Society) India offers a promising solution to address fragmented livelihoods among rural youth (68% of India's youth reside in rural areas). It provides sustainable livelihood opportunities and fosters local economic development through beekeeping. This initiative creates an entrepreneurial pathway for rural youth, offering dignity and better working conditions while reducing the need for migration by promoting community-based livelihoods.

Beekeeping value chains are green and sustainable, minimizing natural resource destruction. UTMT Society supports micro-entrepreneurship by providing hands-on skill-building at the village level through fortnightly visits. Additionally, the intervention raises awareness about the significance of bees in agriculture and improves access to beekeeping training and resources, ensuring long-term sustainability.

So far, the intervention has impacted 1,69,000 people across India, of whom 35% are rural youth. Reported benefits include- a) 50% increase in savings, and b) 60% improvement in social status and respect. The various income streams developed include - a) Income from the sale of increased agricultural produce post-beekeeping (87%), b) Income from the sale of honey and beehives, c) Incentives earned through engagement as Master Trainers, Apiarists, Carpenters producing bee boxes, Women Self-Help Groups stitching inputs and maintaining bee-flora nurseries, etc.— while contributing to pollinator conservation.

By involving rural youth in sustainable beekeeping ecosystem, communities can empower them as valuable contributors to local development. This approach fosters social equity by keeping youth engaged in meaningful work within their communities, integrating traditional knowledge with sustainable techniques. It nurtures a new generation of beekeepers, strengthens rural economies, and ensures ecological sustainability, making it a viable strategy for rural development.

OP-208 [Beekeeping for Rural Development]
Beekeeping development in Ethiopia; a twelve year review of practice and impact

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Bees for Development Ethiopia, based in Amhara, Ethiopia, is a specialist beekeeping NGO. Founded in 2012 our mission is to support beekeepers, conserve the environment and support sustainable rural livelihoods. Since 2012 we have delivered a wide range of projects. Amongst our core values is a determination to continuously learn and improve. We strive to be accountable to the donors who give us funds and to the communities we are working with. It is against this background that in 2025 we reflected on our achievements to date and asked ourselves some questions? What have we learned about project implementation and beekeeping development? How do we most wisely spend money to achieve the greatest impact?

We designed an internal framework of analysis. This combined a review of documents and achievements, followed by an internal reflection process whereby key staff presented project results to other team members and sought feedback and questions. This was then followed by an external community-based impact assessment.

A number of learning points emerged. We struggled to evaluate one of our earliest projects because we did not have a good beneficiary list and data was not curated in one central database – instead project results were scattered in different formats. On the plus side we reflected that we had refined our indicators of achievement over the years and we felt more confident in measuring beekeeping progress based on skills and scale of beekeeping enterprise. In terms of approaches to development we are convinced that in-depth training, and longer projects are necessary to achieve transformational change. We implemented a mentoring approach to beekeeping learning – whereby beginner beekeepers are assigned mentors within their own communities. This proved successful and has been scaled up. Although no beekeeping system is ideal for every context we are confident that top-bar beekeeping is accessible and suitable for many. Yet replacing tried and tested indigenous beekeeping systems with new approaches is rarely necessary or successful.

This review process has given us confidence to deliver excellent work going forwards. We resolved to develop standard indicators our work and establish stronger data collection and evaluation protocols.

OP-209 [Beekeeping for Rural Development]
Inclusive Beekeeping for Persons with Disabilities and women in Uganda

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Uganda National Apiculture Development Organisation

Beekeeping is considered to be an appropriate poverty reduction intervention for the vulnerable and resource poor people including persons with disability (PwDs) because of its relatively low starter-up costs and labour requirements (Amulen et al., 2019). However, worldwide, persons with disabilities and women face significant barriers to participation, including limited access to training, information and land, lack of adaptive beekeeping approaches and technologies, socio-economic exclusion. To bridge this gap, Bees for Development (BfD) and The Uganda National Apiculture Development Organisation (TUNADO) piloted 2- year projects on beekeeping, for persons with disabilities and women. The lessons learnt provided invaluable insights on the strategies and adaptations needed before and during implementation of beekeeping programs aimed at empowering PwDs and women.

This paper shares the adaptations in training approaches and practical steps that have led to an increase in the number of persons with disability and women interested and economically, socially benefiting from the apiculture value chain. Key strategies include; disability and gender inclusion trainings and awareness among the stakeholders on the unique needs of the participants, application of Gender Action Learning Systems (GALS) methodologies, tailored and accessible materials and disability-friendly training approaches. Findings indicate that these deliberate efforts are enhancing economic independence, improving family and community dynamics, and promoting sustainable development.

The paper also highlights what is working, challenges, and recommendations to scale up inclusion along the value chain in Uganda and elsewhere. There is need to heighten our advocacy for an inclusive apiculture sector, we can set a precedent for disability-friendly and gender sensitive agribusiness models aligning with global sustainability and social equity goals.

OP-210 [Beekeeping for Rural Development]
Honey forest restoration as a conservation strategy for bee habitat in Santa Rita-Chone-Ecuador

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Honeybee forest restoration is essential for the conservation of bees and biodiversity, especially in areas where deforestation threatens their habitats. This study focused on the rural parish of Santa Rita, Chone canton, Ecuador, with the objective of implementing a reforestation plan on three farms, using native species to strengthen tree diversity and conserve stingless bees, thus contributing to ecological sustainability. The study identified a lack of effective conservation strategies and local knowledge about the proper management of honey-producing species. To address this issue, forest inventories, interviews, and direct observation were conducted. Community trainings on reforestation and sustainable environmental management were also implemented. The reforestation plan included native species such as carob (Ceratonia siliqua L.), pechiche (Vitex cymosa), guasmo (Guazuma ulmifolia), and annatto (Bixa Orellana), among others. Results showed a high prevalence of Rutaceae species (Citrus reticulata, C. sinensis, C. paradisi) in the region, despite limited knowledge about their conservation. The plan achieved an 85% survival rate in the first eight weeks, indicating good adaptation to the environment and community commitment. Additionally, an increase in floral diversity and pollinator presence was observed, suggesting an improvement in the honey-producing ecosystem.
In conclusion, this honeybee forest restoration project has proven to be an effective strategy for strengthening biodiversity, promoting environmental education, and ensuring the long-term conservation of bees and their habitat. Reforestation with native species has not only enriched the ecosystem but has also fostered greater commitment from the local community toward ecological sustainability.

OP-211 [Beekeeping for Rural Development]
From Forest Flowers to Honey: Synergies Between Beekeeping and Forest Conservation in Nepal

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Beekeeping plays a crucial role in Nepal's agriculture, supporting sustainable rural livelihoods through its economic benefits and contributions to pollination. Due to the country's diverse flora, fauna, and favorable climatic conditions, beekeeping has experienced substantial growth over the past decade. It is a high-value enterprise, engaging over 16,000 households and managing 248,995 beehives, which collectively produce 5,168 metric tonnes of honey annually, valued at $15 million. Beyond honey production, Nepal's beekeeping industry has significant untapped potential. It is estimated that pollen production could generate $40 million, while propolis and wild honey exports could contribute $1.3 million and $1 million, respectively. Commercial beekeeping in Nepal primarily involves two species: Apis cerana, a native honey bee, and Apis mellifera, an introduced species. A recent study identified several key factors influencing the productivity and profitability of beekeeping in Nepal. These include the number of beehives, colony multiplication, supplementary feeding, honey harvesting periods, and marketing strategies. In addition to honey production, beekeeping plays a vital role in crop pollination, facilitating the production of 75% of Nepal's cultivated crops. This pollination service contributes approximately $477 million annually, accounting for 10% of the country's Agricultural Gross Domestic Product (AGDP). Furthermore, research on pollinator diversity in Nepal indicates that Apis species constitute over 60% of the pollinators for major cultivated crops. Given its economic and ecological significance, beekeeping is essential for agricultural success, substantially enhancing household income while promoting food security and long-term economic stability in the region.

OP-212 [Beekeeping for Rural Development]
Land use and climate change analysis as tools of conservation and policy activities for an endangered Brazilian stingless bee species, Melipona scutellaris

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Melipona (Michmelia) scutellaris Latreille, is a stingless bee species endemic to the Atlantic Forest of northeastern Brazil. This species is often cultivated for honey production and colony trade, sometimes even beyond its natural habitat. In recent years, the debate over the risks associated with translocating stingless bees to non-endemic regions have intensified among researchers, meliponiculturists, and policymakers. The Atlantic Forest is a biodiversity hotspot with high species richness and endemism, making it one of the most threatened ecosystems on the planet. Robust scientific support is necessary to generate effective public policies, enhancing conservation efforts for the remaining forest, including its flora and fauna, to maintain essential ecosystem services. Our analyses focused on the state of Bahia, home to the largest stretch of the Atlantic Forest biome in the Brazilian Northeast and most of the occurrence area for the species. Determining priority conservation areas is crucial for its long-term preservation. To map the current climate suitability area of the species and to assess the impacts of estimated climate changes in these areas, we developed a species distribution modeling framework using multiple models and algorithms. We incorporated Mapbiomas soil coverage data into the models to identify resource-providing typologies for the species. Thus, the combined effects of land cover and climate were considered together in identifying priority conservation areas. Our results enabled the zoning of habitat suitability for the species (2040;2060), with classes indicating potential sanctuaries, refugees, threatened areas, and areas of suitability loss where populations will disappear. Additionally, we spatially determined priority zones at different levels (Maximum, High, and Medium) for conservation investment. The findings indicate that the species will lose about 47% of its original habitat, with 16% of the area threatened and 20% vulnerable, needing restoration actions. However, approximately 20% of its original area will remain suitable and can serve as sanctuaries, with conservation as the utmost priority. These results provide support for monitoring and planning actions for conservation and restoration, as well as recommendations for prioritizing the allocation of financial resources. Thus, these spatially explicit and long-term recommendations can provide scientific subsides to the political decision-making process in conservation.

OP-284 [Beekeeping for Rural Development]
Natural beekeeping in an industrial environment

Tucka Saville
Tucka Bee LLC

Buzz buzz! I'm Tucka. I run 300-500 Comfort Hive nucleus colonies for queen production in Central Florida, USA. It's a small business, dedicated to the welfare of bees and humans alike. In my 12 years keeping bees, I have noticed a great deal of controversy regarding the prioritization of bees vs people. We want to build our developments, grow our engineered food, control agriculture with pesticides, and eat our pure, natural honey too. But where do the bees end up in all of this? What is the long term plan when medications stop working? How can we band together and move beyond the feeble bandaids holding together the practice of apiculture? My entire operation is dedicated to these impossible questions. Set against the industrial nature of agriculture in my country, I seek a collaborative solution involving education, genetic resilience and open conversation across boundaries and borders. I look forward to exploring these questions in a European context, and I hope to meet more bright and brilliant minds in the melting pot that is Apimondia.

BEEKEEPING TECHNOLOGY AND QUALITY

OP-213 [Beekeeping Technology and Quality]
The effects of supplementary diets on Thai commercial stingless bee (Tetragonula pagdeni)

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The nutritional needs of stingless bees (Meliponini) are critical for their health, productivity, and overall colony success. However, the development of artificial diets for stingless bees is a complex area of research that has garnered attention due to the challenges faced by these bees in natural foraging conditions. This study was conduct to determine the effect of artificial diets on stingless bee (Tetragonula pagdeni) in both laboratory and meliponary. For the laboratory experiment, 270 newly emerged T. pagdeni were divided into three replicated feeding groups (30 bees/cage). Each feeding group received artificial diets containing probiotics (A3), a commercial diet for honey bees (A2), or negative control (A1), and each group was fed with 50% sucrose solution (w/v) for 30 days. The effect of diets on survival, fat body content, and HPG acini width were measured. The most effective diet will be selected for the field experiment. In the field experiment, 60 stingless bee (T. pagdeni) colonies were divided into two feeding groups replicated at three apiary sites. Feeding groups received diets or negative control. Diets were analyzed for macronutrient content and then evaluated concerning life span, hypopharyngeal gland size, fat body content, colony population size, and honey production. The results demonstrated that an artificial diet A3 containing probiotics increases the protein content, which benefits stingless bee workers by increasing lifespan, fat body content, and HPG size. In the field test, diet A3 successfully increased the colony size, including eggs, pollen pot, and honey production, about 3 times compared to the control without the colony's collapse. Our findings highlight the important and beneficial effects of an artificial diet for physiological development and health in stingless bees and reveal that probiotics are the key factor governing HPG size and lifespan in worker bees. Besides, the artificial diets were also effective in increasing honey production and improving colony fitness. The data provide a foundation for future studies to investigate the impact of supplements for meliponiculture to mitigate the impacts of food shortages due to climate change, which will help farmers reduce losses and generate income without compromising the quality and safety of honey.

OP-214 [Beekeeping Technology and Quality]
Determination of dynamic variation characteristics of flavor and aroma volatiles of chaste honey during natural ripening process using electronic nose, electronic tongue and GC-O-MS

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The natural ripening process of honey is accompanied by the generation and transformation of volatile compounds, which affect the sensory quality of honey. It is generally believed that the honey aroma is one of the important factors determining the characteristics and quality of honey. However, there is limited research on the dynamic changes of aroma volatile compounds in honey. In this study, gas chromatography-olfactometry-mass spectrometry (GC-O-MS) combined with electronic nose and electronic tongue technology was used to investigate the evolution of flavor characteristics and aroma volatile profiles in chaste honey at different ripening stages. The results showed that electronic nose and electronic tongue could be used to distinguish chaste honey at different stages of maturity. We identified 206 volatile compounds in chaste honey at different ripening stages using GC-O-MS. Among these, 59 annotated compounds were recognized as aroma-active compounds, with benzeneacetaldehyde, benzaldehyde and benzeneethanol emerging as the three most aromatic compounds throughout all stages. Quantitative analysis of the top 20 compounds revealed that benzeneacetaldehyde was the primary aromatic compound that increased, potentially due to the high phenylalanine content in chaste honey. Although common aromatic compounds in honey, such as linalool, isophorone and 4-oxoisophorone, showed significant increases during ripening, their odor activity values remained below the threshold for aroma activity. Our highlight the aroma characteristics of chaste honey during ripening and offer new insights into honey quality control.

OP-215 [Beekeeping Technology and Quality]
Starch and non-starch hydrocolloids synergy in honey fillings: Techno-functional, rheological, textural, and sensory properties

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This study focused on developing honey-based fillings using native corn starch (NCS) combined with various non-starch hydrocolloids, including xanthan gum, guar gum, carboxymethyl cellulose (CMC), and locust bean gum, as an alternative to conventional fat-based filling materials in bakery products. The research evaluated the techno-functional properties (baking stability and syneresis), rheological characteristics (steady and dynamic), textural profile, and sensory attributes of the formulated honey fillings. The addition of non-starch hydrocolloids with NCS in honey fillings significantly enhanced the baking stability index (from 80.15% to 85.21–89.61%), however, NCS-xanthan gum combination achieved the highest baking stability (89.61%), followed by CMC (88.14%), locust bean gum (86.17%), and guar gum (85.21%). All formulations exhibited negligible syneresis (<0.5%). The incorporation of hydrocolloids with NCS improved the viscoelastic behavior of the honey fillings compared to NCS alone, while NCS-xanthan gum combination showed superior viscoelasticity, higher shears thinning, better consistency, and improved gelling strength. The Herschel-Bulkley model was identified as the best fit for describing the rheological behavior of all formulations. Sensory evaluation indicated that the highest overall sensory score was achieved by NCS based honey fillings, followed by fillings prepared with NCS combined with xanthan gum, locust bean gum, CMC, and guar gum, respectively. The formulated honey fillings demonstrated excellent consistency, sensory appeal, and baking stability, making them a promising alternative for bakery applications. These findings provide a foundation for the development of innovative, high-quality baking products with improved stability and nutritional value, contributing to advancements in the food industry.

OP-216 [Beekeeping Technology and Quality]
Forensic melissopalynology: is pollen in honey fit for court?

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We trace the origin of the need for forensic melissopalynology, evaluate its ability to meet that need, and identify future opportunities to enhance the evidentiary value of the science. Melissopalynology, the study of pollen and spores in honey, can provide scientific evidence about the authenticity of honey, which is becoming a medical, economic and legal problem globally. The pollen spectrum of a honey can be used to investigate whether the botanical and/or geographical origin alleged on the product's labeling is consistent with its palynological, and so chemical and physical properties. By requiring explicit indication of origins on the labeling of honey, legislation can counteract honey fraud, protect producers and consumers, and create premium economic products for small-scale honey production. Germany, Croatia, Greece, and other countries have used melissopalynological information to legislate benchmarks to authenticate selected monofloral honeys. If a legal challenge arises, the widely used techniques of melissopalynology must be able to provide admissible forensic evidence but are currently under-evaluated as a forensic science. Many jurisdictions have explicit tests for the admissibility of scientific findings as forensic evidence, including considerations of the accuracy, repeatability, reproducibility, error rates, peer review, and general professional acceptance of the methods and techniques of the science. For instance, the United States' Supreme Court's so-called Daubert criteria provide an adjudicatory framework that is explicit, reasoned, and extensively discussed in forensic literature. Forensic melissopalynology overwhelmingly satisfies the Daubert criteria and, by implication, the evidentiary requirements of many other jurisdictions. There remain opportunities for further development, especially in calibrating the limitations and risks of error of melissopalynology, and in calibrating legislative benchmarks. If benchmarks are vague or unduly permissive, fraudulent and adulterated honeys may remain in the market; if they are too strict and unaccommodating of natural variation of authentic specialist products, sellers may be unfairly accused of criminal fraud or unnecessarily excluded from global marketplaces. International standards exist that will help forensic melissopalynology to meet these goals.

OP-217 [Beekeeping Technology and Quality]
Physicochemical properties of different honeys from Reunion Island

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Reunion Island is a French overseas territory located in the Indian ocean. It owns a rich indigenous and endemic biodiversity that grows in tropical weather. While the local beekeeping industry has been flourishing for decades, Reunionese honeys have never been described in the scientific state of the art. For the first time, a European project was launched to check the quality and beneficial aspects of Reunionese honeys. The Reunionese beekeeping industry gathered around this project with 100 beekeepers that provided 304 samples of monofloral and polyfloral honeys. Among those samples we can noticed some honeys from exotic plants: Pink pepper (Schinus terebinthifolius), Litchi (Litchi chinensis Sonn.), and endemic plant: Tan Rouge (Weinmannia tinctoria). Firstly, we determined their physicochemical parameters (% humidity, free acidity, hydroxymethylfurfural, pH, conductivity, mineral, sugar…) based on official methods and compared them to standard criteria specified by The International Honey Commission (IHC). Secondly, we evaluated the antioxidant capacity of the different honeys using spectrophotometric analysis: Folin-Ciocalteau for phenol content (PC) and 1,1-diphenyl-2-picrylhydrazyl (DPPH) for antiradical activity. Finally, a preliminary in vivo study was carried out on Witsar rats to assess the potential for wound healing. Our analysis revealed that more than 80% of our samples meet the quality standard requirements. It highlights the serious skills of Reunionese beekeepers, who can produce fine honeys despite the tropical weather and high humidity. Furthermore, our results processed with chemometric techniques demonstrated a clear distinction between honeys from several floral sources. Preliminary in vivo results have shown that Reunionese honey appears to accelerate wound healing. The biological and dermatological characterization of the Reunionese honeys samples showed their high potential for human health.

OP-218 [Beekeeping Technology and Quality]
Toward the development of an easy, fast and reliable screening method for the detection of adulterated honeys: first results of a European study

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The honey market is currently facing a major crisis mainly due to the strong presence in commercial circuits of products that do not comply with European directives. A recent investigation sponsored by the European Commission revealed that more than half of the operators had exported honey consignments suspicious of being adulterated with extraneous sugars. The practice of adulteration negatively impacts the beekeeping sector, as the efforts of beekeepers to provide the consumer with genuine honeys are countered by the presence in the market of adulterated honeys, sometimes completely counterfeit, sold at derisory prices against which beekeeping companies cannot compete. Some high-performance analytical techniques, also used in the aforementioned investigation, can reveal with a high degree of accuracy the presence of adulterants in honeys. However, such techniques are expensive, time-consuming and require the intervention of experienced and highly skilled personnel. The fight against the illicit practice of adulteration must come through the application of fast, practical, and on-site screening approaches, which allow for the early determination of which honeys are suspect and which do not require further investigation. Near-infrared spectroscopy is a simple and practical analytical technique that has proved to be useful for the individuation of adulterated honeys. Nevertheless, the studies proposed by scientific literature are focused on a too limited number of samples coming from delimited areas and deriving from a few botanical sources. To explore the possibility of implementing this type of strategy at a European level, as part of the activities of Cost Action CA22105, a collection of nearly 1.000 honey samples coming from 19 different countries and belonging to a wide variety of floral sources, was performed. Samples were randomly adulterated with three different syrups, each characterized by different sugar compositions, applying adulteration levels ranging from 0 to 60 percent. NIR spectra were acquired using a portable device, and various classification models able to correctly discriminate among the different adulteration levels were developed. Prediction accuracies varied between 85 and 97%, revealing the great potential of this type of approach also on a large scale.

OP-219 [Beekeeping Technology and Quality]
The Effect of Honeybee Genotype on the Quality and Protein Content of Bee Venom Collected From Different Geographical Regions of Türkiye

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Honeybee venom is a valuable bee product that has a wide range of uses in health, pharmacology, cosmetics and Apitherapy due to its unique biological properties. It has been reported that there are various factors affecting the quality of bee venom and one of them is the species of bees. Turkey has an important place in the world in terms of beekeeping and the production of bee products due to its phytogeographic location, plant and honeybee biodiversity. In this study, bee venom samples were collected by electroshock method from 57 apiaries representing seven different regions of Turkey to examine phenotypic and genotypic effects on bee venom quality and worker bee samples were collected to determine the species. In order to determine the relationship between bee venom and genotype, the amount of bee venom and total protein contents were analyzed, and honeybee species and ecotypes were compared using geometric morphometry method. According to the results of the study, when the quality of honey bee venom was evaluated in terms of both geographical differences and honey bee species, it was found that the most prominent venoms in terms of quantity and quality were those collected from local and protected species and ecotypes located in isolated areas with rich and diverse pollen-nectar resources, away from environmental pollution, and collected under appropriate seasonal and temperature conditions. Our results show that genotype is an important parameter in bee venom production, although it cannot be evaluated alone. Environmental factors should also be taken into consideration in high quality bee venom production.

OP-220 [Beekeeping Technology and Quality]
Honey Fraud: What Should We Know?

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BACKGROUND: Globally, the Food Fraud Database ranks honey as the third most counterfeit food. While some perceive this issue merely as a matter of consumer rights and trade, the profound implications on human health and beekeeping sustainability are often overlooked. Our study investigates the complex impacts of honey's authenticity beyond consumer rights and market dynamics using several research models. METHODOLOGY: We collected honey samples from wild bees in the jungle and local apiary farms and purchased honey from the local market. These samples underwent authenticity analyses encompassing physicochemical and antioxidant assessments and metabolomic analysis prior to conducting cell culture and animal study. RESULTS: All jungle and farm-sourced honey (pure honey) met international standards from the Honey Commission and Codex. In contrast, 90% of honey from the market failed to meet these standards, indicating widespread counterfeit honey. Pure honey exhibited significant benefits in cellular and animal models, including inhibiting cancer cell growth, stimulating normal cell viability, controlling adipocyte size and lipid volume and reducing blood sugar, cholesterol, and triglyceride levels. Conversely, fake honey stimulated cancer cell growth, decreased the viability of the normal cells, increased glucose and lipid levels and induced toxicity in rat livers and kidneys over four weeks of consumption. Data from metabolomics also supported the discrepancy effects of pure and fake honey samples. CONCLUSION: The medicinal benefits of honey are solely derived from pure sources, while fake honey leads to numerous health risks. Intriguingly, data from our study has been used as one of the guidelines for the authority's enforcement in preventing fake honey trading and systematically increasing pure honey production. However, more advanced methods and prompt actions are required to combat the honey fraud issue worldwide. IMPLICATION: The authenticity of honey not only affects consumer health and rights but also reverberates through food security and environmental sustainability. Preserving bee populations and ensuring the authenticity of honey is imperative for safeguarding our future well-being and ecological balance. Thus, prompt actions need to be taken to overcome the honey fraud throughout the world for the sake of all life on this planet!

OP-221 [Beekeeping Technology and Quality]
Title: Advancing Bee Product Quality and Authenticity Assessment with NMR Technology

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Background/PURPOSE:
Ensuring the quality and authenticity of bee products is essential for consumer trust and market value. This presentation aims to showcase the advancements in Nuclear Magnetic Resonance (NMR) technology, specifically the FoodScreener with Honey-Profiling and Advanced Chemical Profiling, as a reliable method for assessing these parameters.

Problem Description:
Bee products, particularly honey, face challenges related to adulteration and quality assurance. Traditional methods may not detect all forms of adulteration, and there is a need for a more comprehensive and validated approach to ensure product integrity.

METHODOLOGY:
The FoodScreener employs NMR technology to analyze the chemical composition of bee products. This method involves preparing samples by adding a buffer and adjusting their pH. Samples are placed on a sample changer, and acquisition is started. A report is then generated with the results. The process is non-destructive and provides a detailed chemical fingerprint of the product. Additionally, NMR combined with Advanced Chemical Profiling offers a simple workflow for quickly measuring quantitative parameters in bee products, enhancing its efficiency and practicality.

Results and CONCLUSION: Recent advancements in NMR have significantly improved its efficiency in assessing the quality of bee products. The results demonstrate the potential to detect dilution with syrups, which are designed to mimic authentic honey. Furthermore, NMR is the only method capable of detecting adulteration even without having measured the syrup or adulterant before, as it is not targeted to a specific adulterant. These findings support the use of NMR as a robust tool for quality control in the bee product industry.

Practical Implications for Beekeepers:
For beekeepers, adopting advanced NMR technology means enhanced product credibility and marketability. By ensuring the authenticity and quality of their products, beekeepers can build consumer trust and potentially command higher prices. Additionally, the rapid and accurate assessment of quantitative parameters can help beekeepers make informed decisions about their production processes and product offerings.

OP-222 [Beekeeping Technology and Quality]

Evaluation of total phenolic compounds profile and antioxidant activity of propolis extracts: effect of extraction solvent

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Propolis is valuable beehive product with profits expectation of approximately 850 million US dollars by 2030. Regarding composition, propolis is a resinous material created by honeybees by processing the versatile plant exudates with their enzymes and some other beehive constituents such as wax to act as a colony homeostasis. Above 500 chemical substances such as phenolic acids and flavonoids have been identified in raw propolis which are commonly associated with its reported biological activity. Extraction solvent is a crucial determinant of propolis quality as it affects the quantity of phenolic compounds which further influence extract's important activity such as antioxidant potential. The current study aimed to determine the phenolic profile and antioxidant activity of raw propolis sample extracted using 6 organic solvents. Extracts prepared from raw propolis sample (provided by Nature's laboratory Ltd., Whitby, UK) using 70% ethanol, Propylene glycol, lactic acid, acetone, olive oil and water were studied for total phenolics and flavonoids contents by Folin-Ciocalteau method and Jurd and Geissmann Calorimetric method, respectively. Antioxidant potential was determined by 2,2-Diphenyl-1-picrylhydrazyl (DPPH) assay method. Olive oil-based extract showed the highest flavonoid content (18794.33± 0.03 mg QE/L) while sample extracted in acetone appeared to have the maximum phenolic content (511.32 ± 0.04 mg GAE/L). Minimum phenolic and flavonoids contents were observed for water-based and lactic acid-based extracts. For antioxidant potential assay, propylene glycol extract showed the highest antioxidant activity (EC50 (mg/ml) 0.0727±0.003) followed by acetone and ethanolic extracts (EC50 (mg/ml): 0.0854±0.001 and 0.0964±0.001 respectively) which could be attributed to their higher phenolic and flavonoids compounds contents. Despite of having richer phenolic profile, olive oil extract demonstrated lower antioxidant activity than lactic acid-based extract. The lowest antioxidant potential was observed for water extract (EC50 (mg/ml): 4.4965±0.4).The results of the current investigation highlighted the effect of extraction solvent on chemical profile and activity of raw propolis which might help beekeepers to optimize quality, efficacy and processing methods of raw propolis extracts

OP-223 [Beekeeping Technology and Quality]
Analysis of aroma-active compounds in propolis from different climate regions in Croatia and Bavaria

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Propolis, a complex resinous material produced by honeybees (Apis mellifera), has attracted considerable attention due to its various bioactive properties and potential applications. This study represents a novel investigation of the aroma-active compounds in propolis samples from two distinct geographical and climatic regions: Croatia and Bavaria. The samples were collected in the summers of 2023 and 2024 in four climatic zones: Alpine Bavaria, Continental Croatia, Alpine Croatia and Mediterranean Croatia.

The aroma-active compounds were identified using gas chromatography-olfactometry (GC-O), gas chromatography-mass spectrometry (GC-MS) and two-dimensional gas chromatography-mass spectrometry/olfactometry (2D-GC-MS/O). The advanced analytical techniques were complemented by reference standards to ensure accurate identification of the compounds. To further define the sensory profile of propolis, a trained panel from the Friedrich-Alexander-Universität Erlangen-Nürnberg (FAU), Faculty of Sciences, Department of Chemistry and Pharmacy, Chair of Aroma and Smell Research, conducted sensory evaluations using an in-house flavour language.

Samples were pulverised using liquid nitrogen, then 0.5 g was extracted in 100 ml dichloromethane (DCM). The extracts were filtered, prepared for solvent assisted flavour evaporation (SAFE) apparatus and concentrated to 100 µl for analysis. An odour extract dilution analysis (OEDA) was conducted using the DB-FFAP column to determine the potential impact of individual odour-active compounds on the overall aroma of propolis samples. The flavour dilution factors (FD) were determined through stepwise dilution of the undiluted distillate with DCM at a ratio of 1:5 (v/v). In the proposed presentation, we will highlight the main substances and sensory impressions that were found to be characteristic to all propolis samples, such as the vanilla-like attribute that correlates with the substance vanillin, but will also aim at elaborating sensory differences between samples and the respective causative substances.

To the best of our knowledge, this study is the first comparison of aroma-active compounds in propolis samples from Croatia and Bavaria. By examining the impact of climatic and geographical factors on the chemical and sensory properties of propolis, it provides valuable insights into a potential regional divergence in this bee product and on how different plant sources may be shaped by environmental conditions, potentially influencing its chemical composition and thus aroma profile.

OP-224 [Beekeeping Technology and Quality]
Determining the Geographic Origin of American Honeys: An Analytical Method through Multivariate Analyses

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Honey's geographic origin significantly impacts its economic value and consumer trust. However, honey adulteration, including geographic mislabeling, remains a widespread issue. This study employs environmental DNA (eDNA) analysis combined with multivariate statistical methods to discriminate the geographic origins of honeys from Guadeloupe, Saint-Lucia, and the United States of America. DNA traces of plant species in honey samples were analyzed using trnL primer and the Illumina MiSeq platform, and processed with the FROGS pipeline. Three statistical approaches were applied: Principal Component Analysis followed by Linear Discriminant Analysis (PCA-LDA), Discriminant Correspondence Analysis (DiCA), and Nonmetric Multi-Dimensional Scaling (NMDS). Our findings demonstrate that the presence-absence data of plant DNA reads achieves higher classification accuracy than abundance data. PCA-LDA models yielded an average accuracy of 90.74%, with robust regional discrimination. DiCA provided complete separation of samples by region when using abundance data. NMDS revealed distinct floral compositions across regions when using presence-absence data, particularly between Caribbean islands and the USA. This study underscores the effectiveness of eDNA in honey for detecting subtle floral and geographic differences. The results advocate for eDNA-based techniques as a complementary or alternative method to conventional approaches like mellissopalinology or spectrometry. Furthermore, the application of multivariate analyses amplifies the discriminatory power of eDNA data, offering a robust tool for honey authentication. These findings hold significant implications for combating honey fraud, supporting local producers, and enhancing consumer confidence in labeled products.

OP-225 [Beekeeping Technology and Quality]
Detection of Economically Motivated Adulteration in Honey Using Untargeted Liquid Chromatography-Mass Spectrometry and Chemometrics

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The addition of sugar syrups in honey are currently detected by approaches based on stable isotopes and the specific detection of targeted marker compunds or foreign enzymes. Recently, we have developed a new data processing strategy that allows us to transfer the advantages of the robust method Proton Nuclear Magnetic Resonance (1H-NMR) to the highly sensitive method untargeted Liquid Chromatography–High Resolution Mass Spectrometry (LC-HRMS) [1]. The detection of foreign sugars requires a sufficient sensitivity, and we can show that the distinction between pure and economically motivated adulteration in honey is possible. The classification accuracies range from 98 to 100%, while the accuracy of the quantitative syrup content estimation using regression models depends on the respective syrup. For rice and beet syrup, the deviations from the true proportion were in the lower percentage range, while for high-fructose corn syrup they were much higher, in some cases exceeding 20% [2]. The method we present here shows great promise for the reliable and sensitive detection of syrups in honey, making it suitable for routine laboratory applications.

[1] Hansen, J.; Kunert, C.; Münstermann, H.; Raezke, K.-P.; Seifert, S. Application of Untargeted Liquid Chromatography-Mass Spectrometry to Routine Analysis of Food Using Three-Dimensional Bucketing and Machine Learning. Sci. Rep. 2024, 14, 16594.

[2] Hansen, J.; Kunert, C.; Raezke, K.-P.; Seifert, S. Detection of Sugar Syrups in Honey Using Untargeted Liquid Chromatography–Mass Spectrometry and Chemometrics. Metabolites 2024, 14, 633.

OP-226 [Beekeeping Technology and Quality]
RNAi As a Next Generation Varroa Mite Control

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Beekeepers worldwide understand the challenges the varroa mite Varroa destructor present within their hives. Colony losses due to this parasite are increasing in many countries around the globe, highlighting the need for new, safe methods of mite control. One of the most promising next generation technologies is RNA interference (RNAi), which uses double stranded RNA (dsRNA) to control varroa populations without having any negative impact on honey bee populations or in-hive dynamics.

Vadescana is a new RNA based active ingredient in NorroaTM, which is currently under review by multiple regulatory authorities. By targeting the gene that regulates the production of calmodulin protein, the foundress mite is unable to lay viable eggs, therefore maintaining low varroa populations within a colony. Years of scientific research by both GreenLight Biosciences and Victoria University of Wellington has supported both the effectiveness and safety of Norroa, showing significant reduction in mite fertility with no impact on pupal survival.

Laboratory mini-hive experiments demonstrated that Norroa induces a near-complete knockdown of mite reproduction. While female Varroa mites are not killed, their gene expression is substantially altered immediately following dsRNA exposure. By monitoring bees using Radio Frequency Identification (RFID) tags, we found that bees from hives treated with Norroa survive significantly better and forage more during their lifetime compared to bees from hives without mite control.

Non-target effects were evaluated both bioinformatically and experimentally with multiple generations of wax moths, with results suggesting that the only likely non-target species affected by Norroa would be mites related to varroa. Field trial data with commercial beekeepers in the US supports these results, showing the ability to keep varroa population under 3 mites per 100 bees for up to 18 weeks.

Given the supporting data, Norroa appears to offer a highly targeted and much needed tool in the beekeeper's toolkit for varroa control.

OP-227 [Beekeeping Technology and Quality]
Evaluating Precision Varroa destructor Treatments with the HiveMaster applicator: Field Trials in the USA and Israel

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The control of Varroa destructor remains a critical challenge in modern beekeeping, with conventional treatments facing issues such as uneven distribution, resistance development, and labor-intensive application. This study evaluates an automated precision treatment system using gas micropulse technology at the University of Florida. Our experiment in Florida involved 96 colonies divided into three treatment groups (32 colonies per group): an automated system (ToBe LTD HiveMaster), Apivar®, and an untreated control. Colonies were equalized prior to treatment application to ensure they were of similar size and strength. Alcohol washes were used to determine V. destructor populations prior to treatment application and two weeks after application. We observed a significant difference in treatment efficacy, with the automated HiveMaster device achieving 95% mite reduction, Apivar® 41%, and the control group 11%. Additionally, separate field trials conducted in Israel tested the automated application of Oxalic acid in over 20 hives. After two weeks, this method resulted in more than 90% mite reduction measured by alcohol washes and fallen mites on sticky bottom board, without observing any bee mortality nor queen loss. These results further highlight the potential for effective V. destructor control with additional compounds and in different environmental conditions. Beyond efficacy of V. destructor treatments, the integration of Internet of Things (IoT) sensors in hive management presents new possibilities for precision beekeeping. By continuous monitoring of colony conditions and comparing results to a standard hive assessment of counting occupied frames and number of bees, the HiveMaster can assess colony strength while enabling tailored treatment strategies (e.g, 5frame hives will receive lower dosage in comparison to a 10frame hive). This approach has the potential to optimize V. destructor treatment application, reducing chemical exposure while improving colony resilience.

These findings suggest that automated and sensor-driven treatment methods may offer a more effective and sustainable approach to V. destructor management, addressing key challenges associated with traditional chemical treatments. Further research will explore long-term colony health outcomes and the broader applicability of precision treatments in diverse beekeeping operations.

OP-228 [Beekeeping Technology and Quality]
HoneyTrace - Using Blockchain Technology to trace Honey from the Jar back to the Hive

Klaus Beckmann
Dr. Klaus Beckmann, Intertek Food Services GmbH

This presentation examines how blockchain technology can be applied to fight fraud and increase traceability of bee products.

Problem description
Concerns over honey authenticity often receive mainstream news coverage, impacting consumer trust and not only putting profits at risk, but also bee-keeping practices, and therefore the bees themselves. To help address this, the Honey EU "Breakfast Directive" EU 2024/1438, will require specification of the exact countries where honey was harvested for honey labelling. However, to achieve this highly detailed level of traceability requires a new approach and the application of innovative technology.

Methodology
Intertek has applied its global honey testing expertise to address this global issue, developing a technology platform that enables honey traders, producers, exporters, importers and packers, to trace each batch of honey as it moves through the supply chain. The platform uses blockchain technology to securely verify the identity and location of beekeepers, store laboratory test results, and track batches from hive to jar. Blockchain is a decentralised, distributed ledger technology that records transactions securely and transparently across a network of computers. It enables trustless peer-to-peer transactions without the need for intermediaries, using cryptographic hashing.
By tracking the product's journey step by step, HoneyTrace minimises the opportunities for adulteration and helps ensure the integrity of honey products worldwide, protecting both consumers and producers of honey products.

Results and conclusion
This presentation will discuss how HoneyTrace will set a new standard in honey traceability, helping businesses throughout the supply chain meet regulatory requirements and safeguard their reputation. It will be explained how global expertise in honey testing and compliance has been applied to build the platform, as well as how it ensures privacy of results and commercial confidentiality. Furthermore, it will be shown how this technology can be applied to all hive-based products, impacting not just the food industry, but other industries that use honey, bees wax and Royal Jelly.

Practical implications for beekeepers
As the foundation of the honey supply chain, it's valuable for beekeepers to understand how technology is protecting the integrity of the honey they produce and the industry as a whole.

OP-229 [Beekeeping Technology and Quality]
Colony Disorders revealed by automated monitoring of hive weight changes

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Honeybee colonies presently face numerous challenges, including pests, diseases, and environmental stresses, which threaten their survival and productivity. This study explores the use of unsupervised machine learning, specifically Principal Component Analysis (PCA), to analyse hive weight data and detect colonies underperforming within a mini-apiary.
Data from eight colonies from the same apiary was collected continuously over a year, using BEEP (BEEP, NL) mass sensors. The "feature", a seven-day long dataset comprising 15-minute interval mass measurements, was extracted, zeroed every 24 hours, and further analysed to identify deviations from the collective weight-change patterns of healthy colonies. The same protocol was applied in the UK, Belgium and Germany. The algorithm successfully flagged colonies suffering from disorders such as queenlessness, Nosema, and Varroa mite infestation, which were all corroborated by physical inspections. The method is most effective during nectar flows, where weight-change patterns provides rich information on foraging behaviour and the strength of the colony. However, it is less effective in winter, where minimal weight changes and external weather influences influences the data collected from the colonies.

Our work demonstrates the remarkable uniformity of daily weight changes in healthy colonies in the same apiary and the use of machine learning in identifying outliers. The results suggest that detection of anomalies by PCA can serve as a non-invasive monitoring method for hives within the same apiary. By eliminating the need for frequent physical inspections, this method saves beekeepers time and resources while enabling early intervention to prevent colony collapse. Future improvements, such as enhancing winter analysis by optimising the sensitivity of the algorithm in extreme weather, will further refine this promising tool for precision beekeeping.

We are presently extending the method in applying supervised machine learning to the same "feature", in order to discriminate survivor from failing colonies, in apiaries where honeybees are not treated for varroa infestation.
When the method's specific diagnostic strengths are fully clarified, it will provide beekeepers with a quantitative mass measurement tool, providing colony status assessment without having to open the hive.

OP-230 [Beekeeping Technology and Quality]
Beeswax quality: the entry root of pesticides trough pollen

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Pesticide residues originating from beekeeping and/or agriculture can affect beeswax quality. Here, we investigated the entry root of pesticides trough pollen, their subsequent accumulation in beeswax as well as their possible fate during wax purification for the production of new foundation sheets. For our study, we chose an apiary in a typical agricultural environment for Switzerland. Pollen was collected from traps on ten sampling days from April to October 2022 from five colonies. At the same time, two comb pieces of beeswax containing freshly stored pollen were collected from each colony. Out of the 50 pesticides analyzed, 23 pesticides were quantified in pollen, including 13 fungicides, 5 insecticides/acaricides, 4 herbicides and a synergist. Eighteen of these pesticides were also quantifiable in beeswax. Among these were 17 lipophilic pesticides with logarithmic octanol water coefficients (log Kow) above 2.5. These pesticides appeared at the same time in beeswax as in pollen. For example, peak levels of the fungicide cyprodinil were observed in April in pollen and simultaneously in beeswax. As determined by pollen analysis, the presence of cyprodinil was related to pollen from fruit orchards. However, the temporal profiles differed for hydrophilic pesticides, such as the neonicotinoid insecticide acetamiprid (log Kow of 0.8). Acetamiprid was present in pollen from April to August up a maximal level of 48 µg/kg, but was absent in beeswax.

We also investigated whether lipophilic pesticides have the potential to remain in beeswax during recycling. We placed wax samples containing the above-mentioned pesticides for 1h in a baker containing water at 80°C and subsequently determined pesticide levels in wax and water. Lipophilic pesticides with log Kow above 2.5 remained in the beeswax (>85%), while the hydrophilic insecticides acetamiprid and thiacloprid were mainly found in the water (>64%).
In conclusion, pesticides from agricultural use may be brought into the hive through pollen and subsequently accumulate in beeswax. When beekeepers recuperate the beeswax from old brood combs, a large variety of these lipophilic pesticides stay in the wax during recycling and are also present in the new foundation sheets.

OP-231 [Beekeeping Technology and Quality]
Hydrolysis for Drone pupa (Apis mellifera L.) Utilization

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The drone pupa (Apis mellifera L.) was approved as an edible insect and food ingredient in South Korea in 2020, allowing it to be used in a variety of foods. Drone pupae are an edible insect resource rich in protein (approximately 42% dry matter) and unsaturated fatty acids. However, drone pupae have not been studied or manufactured into food compared to other edible insects. Hydrolysis is one of the effective methods to enhance the bioactivity of proteins. The present study was conducted to prepare drone pupa hydrolysate and analyze its antioxidant activity and effects on muscle cells. The drone pupae were freeze-dried and powdered, and the enzymes were hydrolyzed by mixing flavorzyme (FZ) and nutrase (NT) in proportion. The enzyme ratios were CON (no hydrolysis), T1 (FZ, 100), T2 (NT, 100), T3 (FZ:NT, 30:70), T4 (FZ:NT, 50:50), and T5 (FZ:NT, 30:70). The experiments were performed by SDS-page, hydrolysis, ABTS and DPPH radical scavenging activity, and added to muscle cells (C2C12) to determine the effects on differentiation and gene expression. The hydrolysis treatment increased the hydrolysis degree, as measured by the formation of more small molecular peptides on SDS-page. Both ABTS and DPPH radical scavenging activity indicated lower antioxidation in CON. leucine was significantly higher in the hydrolyzed treatment compared to CON, with the highest values in T3 and T4. The fusion index and myotube area, which are indicators of muscle maturity, were significantly higher in the drone pupa extract and hydrolysate. Also, gene expression levels showed a similar trend. Based on the above results, drone pupae promote myotube formation, and hydrolyzing drone pupae enhances their antioxidant activity. Drone pupa is being discarded as a byproduct of the beekeeping industry. Therefore, the results of this study are expected to be used as basic data to create a new source of income for the beekeeping industry.

OP-232 [Beekeeping Technology and Quality]
Adulterated honey: fake or real news?

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Honey (Apis mellifera) adulteration is a worldwide problem because of its economic, commercial and sanitary implications. The main world beekeeping organization, APIMONDIA, considers that the detection of adulteration in honey is still an unresolved problem. This highlights the importance of the development of analytical techniques that allow the unequivocal detection of adulterants in honey, especially those emerging adulterants whose use has recently emerged. The aim of this work was to develop a rapid, easy to perform, low-cost analytical method for the qualitative and quantitative determination of different syrups and mixtures of them by using the Fourier transform infrared spectroscopy (FTIR) technique with the attenuated total reflectance (ATR) module, without complex mathematical procedures or sophisticated sample preparation. In this study, 426 adulterated samples of 92 pure samples of multifloral bee honey from Spain were analyzed. The method, strictly based on the determination of absorbance directly at the appropriate wavelength, allows the unequivocal detection of syrup or its mixture in adulterated honey containing 3% (m/m) or more of these adulterants. The use of the model for quantification shows high accuracy and precision, in terms of relative error (0.32%, m/m) and coefficient of variation (1.4%).

OP-233 [Beekeeping Technology and Quality]
An AI chatbot as a dependable and trustworthy beekeeping advisor: present-day reality or still wishful thinking?

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Recent development in widely accessible and ready-to-use AI chatbots from various companies has provided exciting new tools for information gathering, as the complexity level of the AI-generated answers is high and the interaction mode allows follow-up questions. Especially in countries with no or few beekeeping advisors, such chatbots could provide beekeepers with advice tailored to their needs and regional conditions. However, the quality of such AI-generated answers is greatly debated, and it is questionable whether they could adequately replace advice from human experts. Thus, the COLOSS core group B-RAP tested a well-known chatbot (ChatGPT; several versions) by asking two practically relevant beekeeping questions and rated the ChatGPT-given answers for correctness and usability. The rating committee (=author list) comprised beekeeping researchers, beekeeping advisors and veterinarians, most with practical beekeeping experience. Each question defined an acute problem in beekeeping for a specific geographical location and asked how to address the problem (American foulbrood in Norway, and problems with the queen excluder in Germany). All rated chatbot answers gave a broad overview of possible solutions to the presented problem, similar to the quality found in general beekeeping books. However, ChatGPT's answers consistently contained misleading information. Answers were either entirely incorrect or lacked crucially important details. Following the misleading advice would result in visibly negative results, such as (1) decreasing the probability of colony survival, (2) leading to the spread of notifiable diseases (including conflict with local law), or (3) decreasing honey quality. Furthermore, a considerable amount of information was useless for the given case, containing general advice for how to increase bee health or suggesting preventive measures of no use in the given acute situations. The results show impressively that the use of chatbots of their current quality must be critically questioned for beekeeping advice, especially when used by inexperienced beekeepers and in legally-relevant situations (e.g. notifiable diseases). To fulfil their desired potential as easy-to-access dependable advisory tools, serious improvements are necessary. For example, chatbots need to be trained with high-quality information sources that are also sensitive to the local context of beekeeping techniques and legal requirements.

OP-234 [Beekeeping Technology and Quality]
Methods for Authenticity Verification of Chilean Honey: Stable Isotopic Techniques and Their Connection to Botanical Origin and Bioactive Compounds

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In recent years, honey production has been optimized, and the characterization of honey and its natural attributes has enhanced its value and differentiation. However, at the same time, the counterfeiting of bee products has increased, severely impacting the beekeeping industry and causing significant economic losses for beekeepers. Additionally, the health of consumers who ingest adulterated products is at risk, as fake products often lack a defined origin and may contain harmful residues or undesirable elements. In Chile, counterfeit honey is present and sold in informal markets, raising concerns within the beekeeping sector. Addressing this issue requires scientific tools and methodologies to certify the authenticity of Chilean honey. Moreover, exported honey must comply with strict regulatory standards imposed by destination countries.

This study provides an overview of the methodology used for processing and analyzing the 13C/12C isotopic ratios of 30 Chilean honeys from different botanical origins, assessed using IRMS-EA. Additionally, the results were correlated with the natural biological attributes of the samples to develop a comprehensive database on the authenticity, geographical origin, and bioactive molecule pattern of Chilean honey.

OP-235 [Beekeeping Technology and Quality]
Mannose in Eucalyptus honey from Uruguay: should it be considered as an indicator of possible adulteration?

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Eucalyptus honey is a type of monofloral honey characterized by its nutraceutical and organoleptic properties. In Uruguay, this type of honey represents about 30% of the national production, 90% of which is exported.
In recent years, the quality and authenticity of honey has become more relevant, leading to the development of new methodologies for the detection of possible adulterations. One of the parameters in current controversy is the presence of mannose which is related to the addition of exogenous sugars or treatment with ion exchange resins. However, there are reports of the presence of mannose in honey from different countries and it can even be a marker of geographical or botanical origin.
The possible presence of mannose of natural origin can lead to unadulterated honeys to be considered suspicious of adulteration, making their exportation difficult.

The aim of this work is to study and quantify the presence of mannose and other minority sugars that appear naturally in Eucalyptus honeys from Uruguay.

A study was carried out on 45 samples of Eucalyptus honey harvested in 3 consecutive years in Uruguay. Samples were supplied directly from the apiaries, minimizing the chances of adulteration and were physico-chemically characterized. Also, their botanical origin was confirmed by melissopalynological analysis. Samples with a percentage of Eucalyptus pollen higher than 70% were considered monofloral honeys and the mannose content of these samples was quantified. To achieve this, sample preparation methodology was developed, and all samples were analyzed using different Nuclear Magnetic Resonance techniques on a Bruker Avance Neo 400 MHz spectrometer equipped with a 5mm PABBO probe.

This study presents the first advances in the development of a methodology for the identification and quantification of mannose in honeys from Uruguay. Mannose was found in the samples in concentrations between 0.01 and 0.05g mannose/100g of honey, with 0.02g/100g being the limit at which honey is suspicious of adulteration.

These results could be of relevance for beekeepers as this could lead to a reconsideration of whether this sugar can be used as a marker of adulteration in honeys of this botanical origin as it can to be found naturally.

OP-236 [Beekeeping Technology and Quality]
Ultrasound-Augmented Conjugation of Whey Protein Isolate and Propolis: Structural Insights and Functional Enhancements

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Propolis has been extensively utilized as a traditional food and medicinal source owing to its potent antioxidant activity. Polyphenols, including total phenolic and total flavonoid, are acknowledged as the primary antioxidant components in propolis. However, propolis exhibits inherent limitations including low water solubility, restricted oral bioavailability, and unfavorable taste and odour profiles during processing and storage, which limit its application. To enhance these functional properties of propolis, this study aimed to develop a conjugation between whey protein isolate (WPI) and propolis through free radical reactions, both with and without ultrasound treatment. Notably, subjecting the reaction to ultrasound at a power of 270 W for 20 minutes accelerated the conjugation process, leading to significantly elevated levels of total phenolic and total flavonoid contents. This enhancement may be attributed to the favorable structural modifications induced by ultrasound treatment. To better understand the conjugation mechanisms under the influence of ultrasonic waves, the structural properties of various WPI-propolis conjugates were investigated with the aid of Fourier transform infrared spectroscopy, circular dichroism and fluorescence spectrometry. Comparative analysis revealed distinct structural differences between conjugates prepared via ultrasound and the traditional free radical method. Specifically, the ultrasound-treated conjugates exhibited reduced α-helix structures but showcased higher contents of β-turn and random coil. Additionally, these conjugates displayed enhanced fluorescence intensity and surface hydrophobicity. Furthermore, the integration of ultrasound exhibited a multifaceted impact on the bioactivity and functionality of the conjugates. It significantly improved antioxidant activity, thermostability, water solubility and emulsifying stability. These results highlight the potential of WPI-propolis conjugates, formed through ultrasound-assisted free radical reactions, providing new insights into broader applications in the food industry.

OP-237 [Beekeeping Technology and Quality]
Development of an economically resilient and climate-friendly beekeeping practice

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The honey bee Apis mellifera is a key pollinator, but climate change, inflation, and rising energy costs threaten beekeeping. We developed a more resilient management approach and compared it to standard practices, focusing on colony health, energy use, labor, material costs, and climate impact. In 2023 and 2024, a total of 34 colonies were divided into a 'standard' and a 'resilience' treatment group. The standard group underwent regular drone brood removal and weekly swarm control. Normal sized split colonies were formed with two brood combs and transported to a new apiary in 3 km distance. Varroa destructor was controlled in summer with two formic acid (60%) evaporation treatments and in winter with an oxalic acid treatment. In the resilient group, drone brood remained, and 5–8 capped brood combs were removed in early summer (end of April/beginning of May) to build strong split colonies which remained at the same apiary. This suppressed swarming and relieved the colonies of a considerable proportion of varroa mites, which are mainly found in the capped brood cells. Queens were caged for 25 days in summer, followed by oxalic acid trickling; winter treatment was only applied if varroa mite fall exceeded two per day. Colony development was tracked using the Liebefeld method and we recorded weight change, honey yield, bee longevity, fat body reserves, mite infestation, management time and energy and resource consumption.
Honey yield and overall colony strength did not differ significantly between treatment groups. However, splits from resilient colonies developed stronger and required less feed. Management time per colony averaged 53 minutes in the resilient group vs. 2 hours 10 minutes in the standard group. Fewer apiary visits also reduced climate impact. Interestingly, the total weight lifted by the beekeeper throughout the year decreased from 1059.7 kg per standard colony to 605.4 kg per resilient colony.

OP-238 [Beekeeping Technology and Quality]
Near-infrared spectroscopy and isotope ratio mass spectrometry for Honey authenticity

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Food authenticity and high levels of food safety are challenging goals to achieve today, due to the complexity of globalized supply chains and the multiplicity of stakeholders and participants in the food trade. Honey is a natural food product much appreciated by consumers, as confirmed by the high market demand. However, reduced production and rising costs raise numerous concerns about honey authenticity regarding its botanical or geographical origin, as well as adulteration through sugar addition. Here we present the results of honey authenticity verification through isotope ratio mass spectrometry (IRMS), in order to detect the addition of exogenous sugar. Moreover, we developed a model for the botanical origin characterization using near-Infrared Spectroscopy (NIR) coupled with chemometric approach. 40 honey samples were collected and analyzed, both multifloral and monofloral including chestnut, eucalyptus, rhododendron, cherry and acacia. The IRMS DELTA V hyphenate EA IsoLink system (ThermoFisher) was used for the analysis of carbon isotope ratios δ13C. The samples were analyzed according to the Association of Analytical Communities (AOAC) method 998.12. Approximately 1.0-1.4 mg of honey and extracted proteins were loaded into a tin capsule, which was dropped via an autosampler into the reactor where it was burned in the presence of pure oxygen to form CO2 for isotope analysis. The NIR acquisitions were performed in triplicate in reflectance and transmittance mode. The spectra were acquired with the MicroNIR (Viavi) in a wavelength of 908-1676 nm spectral range and processed with the Unscrambler X. Linear discriminant analysis was used to create a sample classification model.

The results obtained from IRMS revealed a difference between the δ13C values of proteins and honey lower than 1‰, suggesting the absence of adulteration and confirming the authenticity of the samples. Regarding NIR results, a good classification model was developed to discriminate between monofloral and multifloral honey with an accuracy around 80%. Honey adulteration can negatively affect both consumers and honest producers. By using IRMS and NIR spectroscopy it is possible to evaluate the incidence of commercial frauds. Furthermore, these two methods can be used both in the context of real markets and in official control plans.

OP-239 [Beekeeping Technology and Quality]
Chemical Fingerprinting of Honey - Quality, Origin and Authenticity control

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Background/Purpose
The global honey market is increasingly affected by fraud, with adulteration, dilution, and overheating compromising both consumer trust and the livelihoods of genuine beekeepers. Fraudulent honey is often sold at lower prices, making it difficult for local producers to compete. In recent years, significant advancements have been made in developing techniques and methods to detect adulterated honey, playing a crucial role in cleaning up the market. However, the goal is not only to identify fraud but also to highlight and support those who uphold honesty and integrity in honey production.

Problem Description
To protect authentic honey producers, it is essential to emphasise the superior quality of locally produced honey and showcase its remarkable natural diversity to consumers. Over the years, e-Sense Sweden has developed methodologies to visualise this diversity, highlight unique properties, and optimise honey handling and storage. The development of these analytical tools provides beekeepers with valuable insights, enabling them to assess and communicate the high quality of their honey.

Methodology
We have build a big database of multiple chemical fingerprinting techniques, including HPLC, GC, and FTIR, to build a reference database of honey samples from around the world. This database serves multiple purposes: detecting adulteration, determining geographical origin, and identifying quality deterioration. Furthermore, it provides a scientific basis for demonstrating the natural diversity of locally produced honey and its biological origin.

Results and CONCLUSION: Our results demonstrate that the reference database detects deviations from the typical chemical fingerprint of authentic honey. These deviations may indicate adulteration, improper handling, or mislabelled geographical origin. However, they can also highlight a unique nectar source or an unusual but natural sensory profile.

Practical Implications for Beekeepers
This methodology provides beekeepers with a valuable tool for enhancing honey quality. It can help identify unique batches, optimisation of production processes, and support transparent communication with consumers. By offering scientific validation of honey authenticity and quality, beekeepers can differentiate their products, strengthen market confidence, and sustain fair pricing for genuine, high-quality honey.

OP-240 [Beekeeping Technology and Quality]
Genetic parameters for honey production in a small size and recently created bee breeding nucleus in France

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BACKGROUND/PURPOSE
They are still limited reports of selective breeding programs for honey production operated by professional beekeepers controlling the male pathway in optimized BLUP based breeding designs of small size. We report estimations of genetic parameters and breeding values (EBVs) for honey production in such small-sized breeding program recently established by professional beekeepers (L'Abeille Ligérienne, Lagord, France).

METHODOLOGY
Virgin queens were mated naturally, in island mating station or inseminated with drone-producing colonies with queens from selected dams. 1 234 queens were phenotyped from 2017 to 2024 in 29 apiaries by 12 beekeepers. Genetic parameters were estimated with BLUP methodology and software previously adapted to bee biology. The pedigree relationship matrix was calculated using an R program (Brascamp and Bijma, 2019). Genetic parameters and EBVs were estimated using AIREMLF90 of BLUPf90 software package, applying a linear mixed model with a single direct genetic effect considered, either the queen effect (Queen Model: QM) or workers' one (Workers Model: WM).

RESULTS
Significant year, apiary, beekeeper effects and pedigree structure indicated the opportunity to limit these effects, increase genetic ties between apiaries and improve contributions of parents across apiaries. Heritability (standard error) for Workers (WM) and Queen (QM) Models were 0.53 (0.11) and 0.37 (0.10). The colony ranking did not change according to the model used (Pearson correlations 0.94 to 0.96). The colony rankings between EBVs and colony performances corrected for year and apiary were consistent (correlations of 0.80 with WM and 0.88 with QM). Selection the 10% best queens on pedigree-BLUP EBVs by the two models led to increases in selection response of 6% and 22.5% when compared to mass selection on phenotypes corrected for environmental effects (with QM and WM respectively).

CONCLUSIONS
The breeding design, even for a small size breeding nucleus, was able to capture additive genetic variance. Heritability were in the higher range reported by previous authors. An improvement of the genetic evaluation is expected with the next 2025 year-classes for which apiaries will be genetically better connected. Selection pressure applied in managing inbreeding is expected to increase EBVs.

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OP-241 [Beekeeping Technology and Quality]
Wilder, Wetter, and Warmer: Leveraging Extended-Range Forecasts for Climate Adaptation Among Beekeepers in Western Norway

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BACKGROUND: Climate change is increasingly recognized as a significant threat to agriculture and food security due to the strong dependence on weather conditions. In this context, apiculture plays a vital role via pollination services, making it essential to understand how climate impacts could affect both beekeeping operations and agricultural productivity. The effects of climate change are most pronounced in northern regions like Norway, where beekeepers already face difficult weather patterns that are expected to become even wilder, wetter, and warmer.

PROBLEM DESCRIPTION: Adaptation is crucial for managing increasing climate risk. Extended-range weather forecasts, which extend several weeks beyond traditional weather forecasts, have emerged as promising tools for improving agricultural planning and supporting decision making under uncertainty. Despite their potential, these forecasts have however not been systematically utilized in the apiculture sector.

METHODOLOGY: This study applies long-term climate predictions and qualitative social science methodologies to investigate how beekeepers in Western Norway can integrate extended-range forecasts into their decision-making processes. Prior to the season, beekeepers were interviewed about the challenges and opportunities posed by the expected climate change and the potential benefit of applying long-term forecasts. Then, in monthly focus groups throughout the season, participants were provided tailored extended-range forecasts to explore how they can benefit their management practices in real time. Their experiences were finally discussed in a common workshop after the season.

RESULTS: Our findings reveal a strong demand for reliable extended-range forecasts among beekeepers to adapt to an increasingly variable climate. The study participants successfully used the information provided to plan operations, such as pollination preparation, choice of foraging areas, treatments, or the timing of winter preparations, highlighting the practical value of the forecasts.

PRACTICAL IMPLICATIONSs: By integrating extended-range forecasts into their decision-making processes, beekeepers are better equipped to optimize their strategies in accordance with seasonal weather variations, maximise their outcomes and enhance their resilience to climate variability and extreme events. Furthermore, the knowledge generated in this case study could be transferred to other settings and regions by applying similar forecasting tools tailored to local conditions, fostering a broader framework for resilience and sustainability in global beekeeping initiatives.

OP-242 [Beekeeping Technology and Quality]
INSIGNIA-EU. A pan-EU biomonitoring citizen science study to detect environmental pollution

Jozef Van Der Steen
INSIGNIA consortium

The INSIGNIA-EU study is a citizen science pan-EU biomonitoring study with honey bee colonies, using a range of in-hive passive samplers; the APIStrip for pesticides, the APITrap for microplastics, silicone bands for VOCs and PAHs, propolis for heavy metals, honey for a selection of 8 polar pesticides, and trapped pollen. The target compounds were 450 pesticide residues, microplastics, eleven heavy metals, 35 PAHs, and 19 VOCs known to be hazardous to humans. Pollen is also sampled to determine pollen diversity. The protocol of the study is available on the EU pollinator information hive (EU pollinator information hive). The study was carried out in 315 apiaries selected by dominant land-use: agriculture, artificial, or forest/nature. In the 5,525 APIStrips, 202 pesticide residues were detected. There was no apiary in the EU where no pesticide was detected. In the 2,390 APITraps, 52,099 synthetic polymer fibres and 7,244 synthetic polymer fragments plus films, mainly polyester, polypropylene, and polyethylene were detected. The target VOC and PAH were found, and appeared to be omnipresent as were the heavy metals. Both metals and PAH/VOC results indicated emission sources. In 6% of the honey, the polar pesticides glyphosate and AMPA were found. In the trapped pollen 501 plant genera were identified, the most frequently recorded genera being Trifolium, Plantago, Brassica, Rubus, and Castanea. Brassica was mostly in the northern and Plantago in the central and eastern European sampling sites) The bee-collected pollen mean diversity was higher in artificial (mean number of genera = 9.1) than in agricultural (mean number of genera = 8.5) or forest/natural (mean number of genera = 8) land-use types. The predictive models show the changes in the risk of pesticide exposure and pollen diversity available for honey bees. Up to now, the study has generated fourteen peer-reviewed scientific publications, and more will follow. More information about INSIGNIA-EU is available on our website www.insignia-eu

OP-243 [Beekeeping Technology and Quality]
Veterinary practice, antimicrobial resistance, and food safety in beekeeping

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Honey bees, like all food-producing animals, require proper veterinary supervision to ensure health food safety and welfare. Modern beekeeping often lacks professional veterinary engagement, leading to gaps in disease control and antimicrobial stewardship. Increasing presence of paramedical approaches instead than veterinary-led health management raises concerns about regulatory compliance and oversight. Despite international efforts, honey bee health remains a neglected aspect of veterinary medicine. Food safety risks arise from improper use of antimicrobials, particularly in controlling American foulbrood (AFB), where antibiotics are misused to mask symptoms more than eliminate infections. This contributes to antimicrobial resistance (AMR) and challenges global honey quality control measures. Absence of systematic honey surveillance for AFB spores highlights a critical regulatory gap because they enter in human food chains. This communication is based on a synthesis of literature, regulatory reports, and observations from international beekeeping and veterinary meetings. It identifies key weaknesses in veterinary services, knowledge dissemination, and disease monitoring in apicultural sector. Veterinary services for pollinators and food-producing animals often fail to integrate disease monitoring, toxicological assessment, and AMR surveillance, primarily due to financial and logistical limits. Lack of transparency and education cause honey bee losses, food fraud, and pest and pathogens spread. Use of antibiotics as a prophylactic or therapeutic measure maintains endemic bacterial infections, transforming infected apiaries into disease reservoirs. American foulbrood illustrates how fragile and uncoordinated current veterinary and regulatory framework is in addressing honey bee health globally. Absence of harmonized control measures across countries highlights urgent need for stronger surveillance, regulatory enforcement, and global coordination. Effective AMR stewardship in beekeeping should follow principles of Responsibility, Reduction, Refinement, Replacement, and Review to mitigate risks.

Beekeepers rely on metaphylactic antibiotic treatments for spore-forming bacteria create persistent sources of infection, threatening both their own colonies and those in surrounding areas. Sustainable disease management requires respecting biological and evolutionary mechanisms more than relying on antibiotic interventions. Strengthening veterinary involvement, regulatory management, and beekeeper education is essential for protecting bee health, ensuring honey quality, and preventing AMR in apiculture products.

OP-244 [Beekeeping Technology and Quality]

From Hive to Biomedical Application: Bee Pollen-Derived Biocompatible Sporopollenin Microcapsules for Gastrointestinal Drug Targeting

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Bee pollen is a valuable nutritional and functional food with various health benefits. It also serves as a resource for fabricating pollen-based microcapsules, fostering innovations in biomedical applications, food technology, and environmental sustainability. However, the transformation of bee pollen into a drug mini-cargo carrier remains insufficiently described. Herein, we outline this process, demonstrating its potential for drug delivery systems. Bee pollen pellets were collected and sorted by color, with palynological analysis confirming up to 97% purity for species including Echium sp., Jasione sp., Papaver sp., Amaranthaceae, and Helianthemum sp. A chemical treatment removed the pollen's inner content and intine layer, yielding sporopollenin microcapsules (SMCs) composed solely of the exine shell. Protein analysis revealed a reduction in potential allergenic proteins from 14–33% to 2–7%. Advanced microscopic and particle size analyses confirmed the hollow, uniform structure (15–24 µm) of the SMCs. Fourier-transform infrared analysis showed a structural model in which SMCs consist of aliphatic chains cross-linked with phenylpropanoid derivatives via ester and acetal bonds while thermal analysis showed thermal decomposition up to 457°C. Given their inherent hydrophobicity, The surface chemistry of SMCs was treated using UV-irradiation, rendering them super hydrophilic. Cell adhesion assays revealed increased adherence of UV-modified SMCs to Caco-2 cell lines, with no cytotoxicity in normal Vero cells. As a proof of concept for site-specific drug delivery, Helianthemum sp. type SMCs were loaded with 5-Fluorouracil (5-FU) and coated with 5% and 15% Eudragit to prevent premature release. A 76% encapsulation efficiency was achieved via vacuum-loading. Different coating concentrations were adjusted for controlled and sustained release of the 5-FU in specific environments in the gastrointestinal tract.

These findings highlight the potential of SMCs derived from bee pollen as a safe, efficient, and tunable platform for targeted drug delivery in biomedical applications, enhancing the value of bee pollen beyond its nutritional recognition, and therefore add a source of additional income for beekeepers.

OP-245 [Beekeeping Technology and Quality]
Orbitrap HR-MS Based Metabolomic Strategies For Seamless Determination of Honey Fraud

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Fraudulent techniques for honey adulteration are constantly evolving and the fact that QC activities have become the center of attention has necessitated the development of novel methods using modern instrumentation. This work aimed to generate a non-sophisticated, qualitative screening method to confirm honey authenticity by exploiting a simple dilute & shoot preparation linked to an LC-SIM-HRMS acquisition. We developed an analytical workflow starting with non-targeted metabolomic screening to underscore potential markers of honey adulteration. Foreign polysaccharides in honey with an extended degree of polymerization (DP) were assumed as the accurate indicators of starch-based syrup usage. Fructooligosaccharides or maltooligosaccharide-type liquefied starch syrups were distinguished efficiently in our method by analyzing the retention time indexes. Hence, starch-based syrups derived from different origins like agave, corn, rice, wheat, and cassava were able to be reported by novel methods. For corn syrups, other than polysaccharide residues, 9 additional markers covering all corn syrup types were selected. Again, other than polysaccharide residues, 6 discriminant markers for brown and rice syrups respectively suggested by the novel method. We defined 10 common markers for 7 different E150d dyes and included 6 honey dilution markers for the confirmation of fake honey. Psicose and mannose were found as rare monosaccharides and assumed as certain markers of beet and corn syrups. These monosaccharides were also monitored in our method with improved resolution. The presented method in this study described 12 common markers for enabling the detection of thin juice or thick juice syrups obtained from beetroots. In total, 13 molecules were tentatively annotated and assessed as botanical origin markers for pine, manuka, chestnut, sunflower, and citrus honeys respectively. In the real sample analysis, it was determined that most of the honey in the market contained adulteration and this situation constituted a major problem concerning food safety. The use of beet syrup was found to be the dominant type of adulteration. The described SIM-HRMS method using targeted multimarker detection represented a remarkable improvement over past analytical methods and reshaped the demonstrated approaches by providing a high degree of certainty in terms of adulteration identification.

OP-246 [Beekeeping Technology and Quality]
Absolute Quantification of Major Royal Jelly Protein Variants and Simultaneous Adulterant Identification to Assess Royal Jelly Product Quality and Authenticity

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Polymorphism-derived proteotypes named MRJPs are predominant in Royal Jelly (RJ). Each MRJP variant has distinguished health benefits. They may undergo a rapid structural change depending on storage conditions, and efficacies may be modified. Therefore, measuring the individual levels of each MRJP separately instead of the total protein concentration is crucial. In this study, it was aimed to develop an analytical method for the absolute quantification of MRJP variants. A novel MRJP purification workflow was also presented to obtain authentic standards for Native-LC-SEC-UV method development. Firstly, RJ proteome extract was subjected to tandem purification at FPLC. Purities were confirmed by SDS-PAGE. Protein annotation of each purified MRJP was accomplished by in-gel digestion followed by Orbitrap HRMS bottom-up proteomic strategy. Data was processed at Thermo PD software, sequences were retrieved from UniProtKB. Sample analysis was performed using the developed Native-SEC-UV method. In order to observe the effect of storage conditions samples stored at different temperatures were also analysed. Egg white powder, skimmed milk powder, and melamine as potential adulterants were also simultaneously screened. In real samples, MRJP-2 and MRJP-3 results were between 1.1-29.5 mg, and 0.6-22.8 mg respectively. Royalactin was quantified between 0.4-10.4 mg while Apisin was found between 1.2-78.2 mg. It was determined that storage conditions dramatically affect the protein composition and Apisin was the most fragile variant. Elevated temperatures or improper packaging promote protein loss induced by Maillard reaction. Furthermore, it was observed that the lyophilization process can induce MRJP3 to be fragmented and Royalactin to be oligomerized. The total protein amounts of these samples were also analyzed by Bradford, BCA, and Khejdahl assays. It has been observed that these methods have significant disadvantages. The non-protein components could potentially interfere with the accuracy of the measurements resulting in false positives with the BCA and Khejdahl assays. All these total protein assays cannot reflect the protein degradation and not indicate whether proteins are fragmented, denaturated, or native form. So, they could not pinpoint improper storage induced protein loss. These results proved that adapting the novel LC-SEC-UV method into the QC workflows can reliably indicate the quality of the RJ products.

OP-247 [Beekeeping Technology and Quality]
Volatiles for the characterization of monofloral honeys

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In addition to the pollen analysis, chemical-analytical methods are needed to characterize different kinds of monofloral honeys. Especially phytochemicals, such as phenolic compounds (Speer et al.) or the aroma compounds – the volatiles - show great potential (Oelschlägel et al.). Headspace in combination with a fiber, coated with a special solid phase (HS-SPME), enables a simple and solvent-free accumulation of honey volatiles as a prior step to GC/MS analysis. were recorded for many honeys. A database with characteristic chromatograms for more than 300 honey samples was built, regarding 250 volatiles. However, this inexpensive technique has some drawbacks. These include the low capacity of the fibers and the low comparability of chromatograms delivered by fibers even out of the same batch. Although the same substances were detected, the intensity of the signals is completely different under otherwise identical analysis conditions. Therefore, the micro-chamber from Markes was tested. A stream of nitrogen is passed through the honey solution and the volatiles were collected onto a tube filled with Tenax®. After optimizing the adsorption, the desorption and the gas chromatographic conditions, a number of monofloral honeys were analyzed. The system generated highly reproducible data so that the ChromCompare® software from Markes could be used for automatic evaluation. With its help, the three honeydew honeys spruce, fir and pine could clearly be separated from each other for the first time. Furthermore, monofloral linden, acacia, and rapeseed honeys could be separated as well. In addition to assigning different monofloral honeys, the analysis of volatiles can also provide evidence of immature harvested honey. This is shown for acacia honey.

OP-248 [Beekeeping Technology and Quality]
The utmost importance of removing interferences for the proper analysis of glucose oxidase and catalase in honey

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BACKGROUND: Honey enzymes play an important role as authenticity, quality and potentially functional parameters. Glucose oxidase and catalase are related to antibacterial and antioxidant properties of honey. The former releases hydrogen peroxide, whereas the later breaks it down. Both enzymes are particularly sensitive to heat and storage time and conditions.

Problem description: Despite being of paramount importance, analyses of honey glucose oxidase and catalase are not common, because a tedious and time-consuming dialysis step that guarantees interferences removal is required before determination.

PURPOSE: The purpose of this research was to compare the activities of glucose oxidase and catalase of six honeys, carrying out the assays without interferences' removal, as well as after removing interferences with the conventional dialysis procedure and with a film-shaped polymer designed to selectively and quickly extract catechol derivatives that had proven to be the main interferents.

METHODOLOGY: With and without interferences' removal, enzymatic activities of both glucose oxidase and catalase were measured at 400 nm, quantifying the product formed by the reaction of hydrogen peroxide with o-dianisidine and peroxidase.

Results and CONCLUSION: Activities of glucose oxidase and catalase were significantly higher in purified samples. As for glucose oxidase activity [µg H2O2 h−1 g(honey)−1], values ranged between 364.4 and 998.7 (average: 569.4) without interferences' removal, between 530.4 and 1181.7 (average: 871.0) after removing interferences by dialysis, and between 523.7 and 1219.0 (average: 854.9) after removing interferences with the film-shaped polymer. With regard to catalase activity [g(honey)−1 10−3 min−1], the difference between the data of non-purified and purified samples was much more noticeable. Results ranged between 2.2 and 14.4 (average: 7.1) without interferences' removal, between 14.4 and 82.0 (average 29.9) after removing interferences by dialysis, and between 12.9 and 81.3 (average: 28.8) after removing interferences with the film-shaped polymer. No significant differences were found between the enzymatic activities in samples purified by dialysis and using the film-shaped polymer. In conclusion, for the proper analysis of honey glucose oxidase and catalase a purification step is absolutely compulsory. Practical implications for beekeepers: Undoubtedly, having the accurate values of the activities of glucose oxidase and catalase will help improve honey commercialization.

OP-249 [Beekeeping Technology and Quality]
Honey composition 2.0 – comparison between traditional pollen analysis and modern DNA analyses

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Background
Honey is a highly regulated natural sweet substance, valued for its regional and floral origin, both of which influence its characteristics. The traditional accredited method to determine floral origin—and indirectly the region—is light microscopy pollen analysis.

Problem description
Traditional pollen analysis requires specialized expertise and extensive reference collections. Advances in DNA sequencing now offer a high-throughput, sensitive alternative. Even though the methodology to extract and sequence DNA from honey now exists, little is known of how the results of pollen analysis and DNA analysis correspond with each other.

Methodology
We compared pollen identification from light microscopy and DNA sequencing (ITS2, rbcL, trnL) of 65 honey samples collected in Finland (2022–2023).

Results and conclusion
Most plant families detected by microscopy were also found via DNA analysis. DNA analysis identified significantly more genera (218) than microscopy (82). Both methods consistently detected high proportions of Brassicaceae, Fabaceae, Rosaceae, and Salicaceae. However, microscopy showed higher proportions of Rosaceae, Trifolium sp., and Salix, while DNA analysis detected more Brassicaceae. Taxa abundance patterns differed between methods, but both approaches correlated significantly at the genus (Spearman's $r = 0.373$, $P = 0.001$) and family ($r = 0.406$, $P = 0.001$) levels. Given the substantial overlap in commonly detected taxa, DNA analysis provides a more comprehensive view of plant composition and is recommended for routine honey origin identification.

Practical implications for beekeepers
Beekeepers and the honey market now have a new option to choose when determining the floral origin of honey, in other words, the plant usage of honeybees. Moreover, DNA analysis is more sensitive and more precise than pollen microscopy, as any DNA from plant tissue in honey, not only pollen, can be identified. Through DNA analysis plants can be identified to genus or species level, while with pollen the plant origin can often only be distinguished at coarser level. Besides honey plant contents, DNA analysis may reveal many other factors, such as beneficial microbes or bee-related pathogens, which can tell about the regional origin of the honey, as well as the well-being of the bees.

OP-250 [Beekeeping Technology and Quality]
What's the best queen ? It depends ! A fitness based hybrid recommendation system for beekeepers

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Nectar Technologies

Commercial beekeepers have access to a variety of queen providers and genetics. Performance of a genetic is highly dependent on its context making the performance of queens highly variable for beekeepers. Indeed, in evolutionary ecology, the performance of different genotypes and/or phenotypes is often defined in terms of fitness. Fitness can be described as the survival of the form that will leave the most copies of itself over successive generations. To address this issue, we've built a queen recommendation system from the Nectar database In this dataset, over 132 000 colonies are tracked on a daily basis by commercial beekeepers and present at least one queen type during its lifetime. Additionally, beekeepers will annotate the state of the colony and most beekeeping practices. The survival of the colony and the queen is also tracked and allows us to build performance metrics for each queen. We've built a fitness score based on the hive survival and the number of days spent in each location. We parametrized the location data using weather, air quality and landscape features. In the context of an hybrid model, these features will be used as input features for a deep learning model to parametrize the content. The target variable for the collaborative filtering side was built using a simple approach where we sum the days of each hive that pass by a yard and survive while we reduce the days spent at the yards when the hive ends up dying. The model then outputs the expected best match between location and queen type. For the baseline retrieval model, the true positive is in the top 5 retrieved items 35% of the time. This approach allows us to parametrize queen types to provide recommendations based on their provenance, the introduction period, the dominant genetics of the queen, and the type of yard in which we can expect these queens to perform better. This system can guide beekeepers to select queens that will perform well for their needs and context rather than trying to find a queen that works for all.

OP-251 [Beekeeping Technology and Quality]
Physico-chemical characteristics of honey powder: Impact of the botanical origin and the drying procedure

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Background/purpose and problem description: Honey is appreciated for its sweet flavor and their potential health benefits. The main drawback of honey is their high viscosity and stickiness. Honey powder is a good alternative. Due to the high amount of fructose and glucose it is necessary to add carriers in order to obtain the powder. However, large amount of carriers increases the costs and can alter the original flavor. The aim of this study was to characterize honey powder obtained by freeze (FZ) and vacuum drying (VC), using maltodextrin (MD) as carrier, from honeys of different botanical origin, using the most appropriate honey-maltodextrin ratio for each technique.

METHODOLOGY: 12 honeys [ling heater (LH), thyme (TH), lavender (LV), vetch (V) and multifloral (M)] collected by beekeepers from Spain were used. Honey was mixed with MD and powder was obtained by VC (60% honey) and FZ (75% honey). Moisture, water activity, color, hygroscopic rate, tapped density and solubility were determined.

RESULTS: Powder showed recoveries between 86 and 99%, obtaining FZ the highest recoveries, regardless of the botanical origin. Moisture was lower in VC than in FZ powders, showing LV, TH1 and M1 powders the lowest moisture. Aw, in general was higher in VC. The LV1 sample showed the lightest color intensity. In general VC samples exhibited higher a* values (red). Botanical origin influence in all color parameters, while drying procedure-honey concentration affect only to a*. FZ showed higher solubility (5-41 s) than VC (18-92 s), being the samples of LH the least soluble. The tapped density was higher in VC than in FZ and VC showed higher hygroscopic index (7.90-13.81%) than FZ (2.92-13.14%).

CONCLUSION: FZ provided the highest recovery, with a higher final honey concentration (75%), showing higher moisture and solubility and lower density and hygroscopicity than VC powders. Moisture, hygroscopicity, solubility and density depended on the drying procedure (using the most appropriate honey-MD ratio). Moisture, color, solubility and density depended on honey's botanical origin. Practical implications for beekeepers: Honey powder is a promising substitute for honey in food, cosmetic and pharmaceutic industries, being labeling as “Real Food”, helping to promote the beekeeping.

OP-252 [Beekeeping Technology and Quality]
SHARP-FB:Short Hive Audio Recording Predictor of Frames of Bees

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Over the past decade, researchers and practitioners have explored the potential of audio recording for precision beekeeping. Most of the research focused on in-hive sensors and real-time detection of critical events, such as swarming, queen state or hive strength. However, adoption of such sensors is difficult in a low margin industry such as beekeeping. On the other hand, most, if not all, beekeepers have a smartphone. As such, in this work we explore the potential of using short audio segments recorded from beehives. Such non-invasive assessment has been gaining interest mainly to allow beekeepers to lower the number of interventions they make on a hive. To train our model, we used a combination of recordings captured by Nectar beekeepers using their mobile phone (N: 536) and a subset of recordings from an in-hive microphone from the recently open-sourced URBAN dataset (N: 5000). First, we split each signal into 15 one-second frames, which were then transformed to the mel-spectrogram. Domain adaptation was used to ensure that both data sources, which were recorded under different conditions, could be used to train our models. In our work, we utilize a two-stage approach, where the first stage relies on an AutoEncoder as a feature extractor, which is then input to the second model which predicts the number of frames of bees with an uncertainty estimate. Experimental results with unseen mobile data resulted in a mean absolute error (MAE) of 3.71frames. This was significantly better than a random model which achieved a MAE of 5.23 on an independent test set. This study demonstrates the potential of short mobile recording to augment the intelligence of beekeepers and promote low touch beekeeping. Additionally, this model is deployed on devices promoting sustainable use of AI. By doing the inference and the fine-tuning of the model directly on the user's device, we can lower the carbon emission associated with our model training and serving. In addition, our model is deployed in a continuous training loop leading to performance increase and refinement on a daily basis.

OP-253 [Beekeeping Technology and Quality]
Establishment and Evaluation of Cooling Shelter for Protecting Honeybee Colonies During Summer Season Under Abu Dhabi Emirate Conditions

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Maintaining honeybee colonies in arid area poses significant challenges due to harsh weather condition and limited floral resources. To address these challenges, Abu Dhabi Agriculture and Food safety Authority (ADAFSA) had developed and evaluated a cooling shelter constructed using date palm fronds, recycling irrigation system materials, and shade nets, integrated with a cooling system that operated for 30 minutes every two hours from 9:00 am to 5:00 pm. This study assessed the shelter's efficacy in mitigating UAE summer condition in two periods, June - September 2020 and 2021. The assessment was conducting by monitoring 69 colonies distributed in three groups (five-frame, three-frame, and control) in agricultural cropland. Each beehives group were approximately the same workers population, and each colony had a new mated queen. The control colonies were divided in two groups; three colonies with five-frames and three colonies with three-frames kept under trees shadow. All the colonies were fed weekly sugar syrup and pollen powder. Temperature differential, brood development, queen egg-laying efficiency, and honey production were recorded. The result demonstrated that the cooling shelter aided in 4-5oC in temperature reduction. Colony strength were improved dramatically in 2020, as five-frame colonies showed an increase in the number of brood as they expanded from two to six broods' frames, while three-frames colonies reached four frames. However, the colonies performance in 2021 experienced a decline due to the bee eater attacks which also increased the colony loss from 7.1% in 2020 to 17.2%. Lastly, Sider honey production yield varied by location, in 2020, 24 colonies across three sites in dry area (Al Ain area) yielded in average of 3.37 kg/site, whereas nine colonies in one site in wet area (Al Wathbah area) averaged 6.1 kg in 2021. In conclusion, the performance of the cooling shelter had enhanced the queen activity, colony survival and honey yield production achieving the primary goal of protecting bees from high temperatures conditions in arid area.

OP-254 [Beekeeping Technology and Quality]
Toward the ultimate assay for honey authentication: combining multi-dimensional DNA sequencing data with multi-platform physical-chemical and isotopic d13C analyses

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One of the most pressing issues facing the global apicultural sector is the frequent presence of honey on the market that does not meet regulatory requirements. This is evidenced by the numerous notifications of adulterated honey. The most common form of adulteration involves extending honey with sugar syrups. This malpractice presents enticing opportunities for fraudulent business operators due to the low cost of sugar syrup and the challenges associated with current analytical approaches in detecting them in honey. Other frauds include mislabeling the geographic, botanical and entomological origins of honey. Given the complexity of the issue and the extensive information required to detect adulterated honey and frauds in this production system, it is necessary to utilise a combination of analytical approaches and methodologies capable of examining different components and chemical-physical parameters of honey and foreign substances. In this study, we utilised a combination of various methodologies to analyse authentic, suspected and adulterated honey samples from different countries with various declared botanical origins. These methodologies included: 1) next-generation DNA sequencing techniques involving five plant and entomological metabarcoding analyses and whole DNA shot-gun sequencing, with advanced bioinformatic approaches for interpreting sequencing data and identifying multiple environmental DNA fingerprints in honey; 2) melissopalynological analysis to identify the pollen spectrum present in the samples; 3) standard chemical-physical parameters, such as humidity, acidity, hydroxymethylfurfural, diastase and pH; 4) standardized isotopic-based methods, including Elemental Analyzer (EA) for determining C-4 plant sugar in honey and Liquid Chromatography (LC) Coupled to Isotope Ratio Mass Spectrometry (LC-IRMS) method for determining the δ13C ratios of mono-, di-, and trisaccharides in honey; 5) Liquid Chromatography High Resolution MS (LC-HRMS) in target mode to detect markers of the sugar syrups. The combination of results from these different methodologies provided a wealth of information that allowed us to effectively group honey samples in authentic or adulterated. Our pilot test suggests that using multiple methods is necessary to identify adulterated honey samples. We are working on constructing a reference database with multiple analytical information to further enhance our ability to identify counterfeit honey.

OP-255 [Beekeeping Technology and Quality]
Entomological signatures in honey: combining metabarcoding approaches to provide insights into plant-sucking insects that populate agricultural and forest landscapes

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Honeydew, primarily produced by plant-sucking insects of the order Hemiptera, is an important source of carbohydrates that complement the honey bee diet, especially when nectar is unavailable or does not fully meet the bees' dietary needs. Honeydew honey is a unique type of honey that comes from this prevalent source of sugar components. Honeydew contains valuable environmental DNA (eDNA) signatures that provide insights into the plant-sucking insect communities living in agricultural and forest landscapes. The presence and composition of these insect communities can indirectly indicate the botanical and geographical origin of honey, as many plant-sucking insects have host-plant specialization linked to specific ecosystems. In this study, we used DNA extracted from honey as a source of eDNA to determine its entomological fingerprinting, focusing specifically on honeydew-producing Hemiptera. We designed two primer pairs targeting mitochondrial DNA (mtDNA) genes (cytochrome b and COXI) of Hemiptera species to amplify the DNA extracted from 70 honey samples of various geographic and botanical origins, including several honeydew honey samples. We utilized a next-generation sequencing (NGS) metabarcoding approach, along with specially designed bioinformatics pipelines and a reference sequence database to analyse the amplicons obtained for the two targeted mtDNA regions. On average, 47 and 16.5 taxa per honey sample were identified with the cytochrome b and COXI primer pairs, respectively, demonstrating the high informativeness of this multiple metabarcoding approach. Metcalfa pruinosa was one of the most common hemipters identified, along with several other specialised aphids that provide an indirect signature of the botanical origin based on the specific insect community. Our results emphasize the potential of entomological metabarcoding as a robust tool for honey authentication and landscape characterization. This approach could provide new possibilities for verifying honey authenticity and analyzing the intricate entomological ecosystems of agricultural and forest landscapes, including the geographical identity and origin of honey.

OP-256 [Beekeeping Technology and Quality]
Quercus pyrenaica honeydew honey: production and characterization towards botanical origin assessment and valorization

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Honeydew honey from Quercus sp. is increasingly regarded as one of the most valuable honey varieties within the beekeeping industry, and consumers highly accept it. This honey is characterized by a unique botanical origin, as it can derived from extrafloral secretions exuded by the acorns of Quercus pyrenaica or/and by exudates of phloem-feeding insects that extract sap from living plant tissues. Recent climatic trends, particularly the prevalence of prolonged and arid summers, have created an impact on honeydew production. To prevent adulteration and fraudulent practices and to enhance market value, it is crucial to establish reliable authentication parameters and correlate them with botanical sources. This work aimed to monitor the production of honeydew honey from black oak and to assess its specificities, thereby enhancing its commercial value. For the study, four experimental apiaries were established, each consisting of 10 colonies, located in black oak forest areas within the Montesinho Natural Park, in the northern of Portugal. Honey production was monitored over three consecutive years, from 2021 to 2023, with samples harvested in September and characterized through melissopalynology, physicochemical parameters, sugars, minerals, phenolic compounds, and volatile profile. The melissopalynological analysis revealed a high diversity of pollen, identifying a total of 53 pollen types belonging to 33 families, with Castanea sativa and Rubus sp. being the most predominant. The physicochemical parameters aligned with those characteristic of honeydew honeys. Regarding sugar composition, the detection of erlose and melezitose confirmed the presence of honeydew components. The phenolic profile characterization identified 17 compounds, with flavonoids being the most prevalent, followed by phenolic acids. The most abundant volatiles were 1-nonanol, phenyl-acetaldehyde, and benzaldehyde. The characterization of Quercus pyrenaica honeydew honey was essential for its market valorization, as it highlights its unique properties and quality, increasing consumer demand and product differentiation. This, in turn, will provide a new source of income for beekeepers in black oak forest areas, promoting sustainable apiculture and supporting local economies.

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OP-257 [Beekeeping Technology and Quality]
A Multicriteria Spatial Framework for Assessing Beekeeping Suitability: Application to a Portuguese Honey PDO Region

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Nowadays, beekeeping is widely recognised for its importance in supporting the environmental sustainability and the socioeconomic development of rural territories. However, it faces multiple challenges, such as climate change, habitat loss and diseases affecting bee populations, along with the occasionally inappropriate management of beekeeping practices. To overcome these tricky issues, the first step should be focused on identifying the most suitable areas for beekeeping, thus contributing for more informed decisions regarding the selection of the best locations for apiaries, and the prioritisation of interventions in more vulnerable areas. For that purpose, the present study shows a high-resolution multicriteria approach for mapping beekeeping suitability, which was applied to a Portuguese region renowned for its honey Protected Designation of Origin (PDO). The methodology integrates topographic, environmental and climatic criteria, prioritised by category through expert judgments and the Analytic Hierarchy Process (AHP). By using high-resolution spatial data processed from Geographic Information Systems (GIS), it enables a comprehensive assessment of landscape key features (e.g., availability of melliferous flora, proximity to water and rural roads) and potential limitations (e.g., hilly terrain, climate extremes) that can impact the honey production and bee health. Findings reveal that environmental and climatic criteria (43% each) have a greater contribution for the beekeeping suitability than topographic ones (14%). Within these categories, hillside exposure (63%), land use (53%), and annual precipitation (50%) were particularly influential. When overlapping the final suitability map with the apiary influence range, most apiaries were found in locations classified as very-high suitability. This evidence demonstrates that the beekeepers, especially those managing many beehives, have a deep knowledge of both the activity and the territory where they operate. These valuable insights for beekeepers and policymakers are very useful for optimising the beekeeping management and preserving the honey quality, primarily in PDO areas. Furthermore, the proposed approach offers a flexible and scalable framework that can be applied to other regions with beekeeping potential.

OP-258 [Beekeeping Technology and Quality]
Exploring Bee Pollen Microencapsulation as a Strategy for Food Preservation: Extending Shelf Life and Mitigating Food Waste

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Apis mellifera collect pollen, mix with saliva and/or nectar, transport it to hive, which later feeds larvae and young bees. Structure of pollen grains consists of two layers: inner layer (intine), composed of cellulose and pectin, outer layer (exine), primarily made of sporopollenin, which offers durability/protection. These properties render pollen promising natural alternative for microencapsulation technologies. Although pollen microcapsules have been used in pharmaceutical applications for drug loadings, their use in food technology remains to be explored. This gap in research was chosen for this study, aiming to extend shelf life of food products by including preservative-loaded microcapsules, contributing simultaneously to reducing food waste. Valorisation of bee pollen using innovative applications could enhance profitability of beekeeping activity. To develop pollen microcapsules, multifloral bee pollen samples from Northern Portugal were collected, separated by colour, subjected to purity assessment by microscopy analysis before several cleaning steps to extract internal biomaterial. Those pollen-empty shells were then loaded with potentially usable food preservatives. The emptied shells were loaded with food preservatives. The study examined microencapsulation potential of monofloral pollen from Castanea sativa, Erica sp., Rubus sp., Cistus sp., Olea europaea, using phenolic propolis extracts and preservatives (sorbic acid, lecithin, nisin) with passive and vacuum loading techniques. Passive loading efficiency of propolis ranged between 4% and 6%, depending on pollen type, whereas vacuum loading increased 29%-35%. After loading, biocapsules evaluated for their antioxidant activity using DPPH methodology. Results indicated various IC50 values across all pollens that propolis loaded, ranging from 0,057 µg/ml to 0,048 µg/mL.

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OP-259 [Beekeeping Technology and Quality]
Field experiment to test food supplements for honey bee colonies. Can we expect significant results at a reasonable cost?

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More and more nutritional supplements appear in the market, with various allegations poorly supported by scientific studies. In the frame of the Coloss NutriTask Force, the BeeQualiFeed project is working on methodologies to evaluate the quality of food supplements for bees. A specific challenge is related to field experiments in testing the supplements, which often show poor results as numerous factors interfere with nutritional quality. In this study, we aim to evaluate how to approach such an experiment to come to a result, at a reasonable cost. We compared a commercial product BeeElixir, to sugar syrup and honey as controls in order to understand the impact of feeding on overwintering success in the conditions of temperate climate in Center-East of France. We observed slight differences among the experimental conditions in each of the studied variables (e.g. survival, consumption, strength of the colonies post wintering), but the overall overwintering success shows a significant result in favor of the commercial product. We discuss several points: (1) the specific case of honey, that came at the lowest rank, (2) the management of a large number of automatic scales, (3) the cost of that kind of study,and (4) the strong impact of the specific climatic conditions of the experiment. We conclude on the challenges of experimenting in the field with food supplements for bees, and open new ideas on the way to improve the knowledge on the aliments for bees, in relation to the quality of the bee products.

OP-260 [Beekeeping Technology and Quality]
Integrating IoT, AI, and Satellite Data for Predicting the Spread of Bee Diseases and Enhancing Apiary Biosecurity

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Honeybee colonies are vital to ecosystems and agriculture, pollinating over 75% of food crops. However, environmental pressures, pathogens, and climate change pose serious threats to their survival. Early disease detection is essential to preventing colony losses and limiting pathogen spread. An ideal solution would forecast pathogen risks before an outbreak, allowing beekeepers to proactively protect their colonies through targeted supplementation or increased vigilance, especially for diseases with no available treatments or with treatments of limited efficiency.

Apisense has developed an innovative system integrating IoT sensors, artificial intelligence (AI), and satellite data to predict disease outbreaks and enhance apiary biosecurity. In-hive IoT sensors analyze volatile organic compounds (VOCs) and other environmental parameters, providing real-time insights into colony health. The collected data is transmitted to a cloud-based platform, where AI-driven algorithms detect patterns linked to key bee diseases, including Varroosis, Nosemosis, and American and European Foulbrood. At the same time, satellite imagery and meteorological data help assess environmental risk factors such as vegetation phenology, nectar availability, and climate conditions. Machine learning models process these multi-source datasets to predict outbreaks and map disease spread, providing early warnings for beekeepers and regulatory agencies. Field tests confirmed the system's effectiveness, achieving 86% accuracy in Varroa detection and 88% accuracy for Nosema identification.

Early warnings enable beekeepers to take preventive action, particularly against highly contagious diseases such as foulbrood, where timely intervention is critical. By enhancing early detection and leveraging predictive analytics, the solution supports sustainable beekeeping, by reducing chemical treatments and strengthening hive biosecurity across large areas. Since a single set of devices can cover up to 30 km², a country the size of Denmark would need only 1,500 sets to monitor and control the spread of diseases effectively.

OP-261 [Beekeeping Technology and Quality]
Austrian beekeepers' current attitudes, utilization, and feedback on digital tools for beekeeping and ongoing digital transformation opportunities

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When we talk about digital tools for beekeeping (DTB), most publications focus on technological opportunities, novelties, and theoretical frameworks that may be applied to bee research, bee health, or beekeeping. There is a regrettable gap in knowledge, however, when it comes to the actual use by common beekeepers and their own attitudes, needs, and real-world experiences, including financial investment payoffs. We utilized multidirectional information/communication flow (AGES to beekeepers, beekeepers among beekeepers, beekeepers to AGES), encouraging beekeepers to define for themselves which DTB and information are useful, from their practical point of view and in light of their own reflections. To share and discuss information and thoughts regarding available or potential DTB, beekeepers were encouraged to participate in a) workshops, b) online questionnaires, c) personal discussions, as well as d) information/opinion-sharing via conventional mail or e-mail.

The Austrian beekeepers' current attitude and interest towards DTB were on average positive but varied considerably. It was influenced by age, sex, and professionalism. While conventional digital tools (e.g., software or devices used also by non-beekeepers) are used on a regular basis, beekeeping-specific tools are far less common among Austrian beekeepers. Online sharing of monitoring data for the common interest of beekeepers in a region is even less common, despite an outspoken willingness to share data for such purposes.

1. From what beekeepers say themselves, DTB can indeed notably support virtually everyone who wishes to use them.

2. Since every apiary and beekeeper is quite unique, the recommendable digital toolbox will be equally unique.

3. From 2) it follows that every beekeeper will substantially profit from information and advice coming from colleagues from the same region and with similar needs.

4. Beekeepers who try out DTB are notably more likely to find something with practical use and therefore correspondingly are also more positively inclined towards DTB in general.

5. Overviews on the topic and real-world solutions, coming from beekeeper-trusted organizations, will likely not only provide substantial support for beekeepers but also accelerate the positive aspects of digital transformation for beekeeping in general.

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OP-262 [Beekeeping Technology and Quality]
Chemical profiling of South African honey: establishment of a regional reference dataset for origin determination and adulteration identification

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Due to the diverse and unique properties of honey, numerous markers qualifying a honey as authentic have been identified. Technologies required to analyse these markers has become more accessible and there are local facilities that offer screening tests. However, these services are limited by outdated South African legislation, which does not take into consideration significant advancements in honey adulteration. This legislation does not provide benchmarks for verifying the botanical and geographical origin of honey leaving the local industry vulnerable to honey fraud. The most common form of which occurs when authentic local honeys are blended with sugar syrups or cheaper, imported honeys, yet sold under the pretence of being a pure South African product.

Proton Nuclear Magnetic Resonance (^{1}H NMR) is a fast, reproducible method of sugar profiling, needing small quantities and little to no sample pretreatment. The various chemical shifts of unique compounds in different honey types can be used for the botanical and geographical origin identification as well as detection of adulterants and quality control.

Using ^{1}H-NMR over 150 unique honeys collected from various South African regions, with a focus on the Western Cape - a region with unique flora, have been profiled. Chemical profiles of the local honeys identified key sugars and trace chemical compounds that allow for origin checking and validation. This has resulted in the development of a reference data set that will aid in the identification and differentiation of honey by origin at a local and national level.

This reference set was used to evaluate commercially available honeys. Fermentation and processing indicators were detected and the key identifying sugars revealed a number of mislabelled and incorrectly classified honeys.

These sugar profiles combined with melissopalynological and physicochemical analyses, will result in greater quality control of the honey on South African shelves and gives consumers confidence in the product they are purchasing as well as providing the much-needed origin validation opening the door for the exploration of the export market.

OP-263 [Beekeeping Technology and Quality]
Characterization of Slovenian royal jelly

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Background/purpose
Royal jelly (RJ) is known for its diverse biological activities and complex chemical composition. Due to its significant nutritional value and health benefits, the characterization of its main biological properties is of great importance. This multi-year study aims to characterise the Slovenian RJ in order to define a standard composition, assess antioxidant activity, evaluate the sensory properties and establish a comprehensive database.

Problem description
Despite well-established physico-chemical and bioactive profiles of RJ, limited data is available regarding its sensory properties. This research focuses on the full characterization of Slovenian RJ, including defining its sensory profile and standard composition.

Methodology
Between 2017 and 2024, 135 RJ samples were collected from beekeepers from various regions of Slovenia. The colour of RJ was qualitatively described, while a professional sensory panel assessed the odour and aroma using quantitative descriptive analysis. Physico-chemical and bioactive parameters were determined according to ISO standard for royal jelly and AOAC methods.

Results and conclusions
The colour of RJ was light, mostly ivory or various shades of yellow. The overall odour and aroma intensity were moderate to strong. The chemical aroma was most pronounced. Warm and animal aromas were mostly weak, while the floral aroma was very weak. The taste of RJ was very weak to slightly sweet and moderately to strongly acidic. A characteristic feature of RJ is also a moderate to strong astringency. The Slovenian RJ samples correspond to the values specified in the ISO standard in terms of total acidity and the contents of water, sugars, total lipids, proteins and 10-HDA. All RJ samples were able to scavenge free radicals and the correlation between antioxidant activity and total phenolic content was significant.

Practical implications for beekeepers
The identification of natural compositional ranges for Slovenian RJ and the establishment of criteria for authenticity control will help protect local RJ producers. This study contributes to a better understanding of RJ by defining its standard composition and sensory characteristics, fostering better communication between producers and consumers and promoting the consumption of this functional bee product.

OP-264 [Beekeeping Technology and Quality]
Integrated Palynological and Physicochemical Characterization of Tilia Honey

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Monofloral honey is a particular kind of honey that is made mostly from the nectar of a single plant species by honeybees, giving it a unique flavor, color, and scent. The purpose of this research was to determine the melissopalynological and physicochemical characteristics of monofloral linden honey produced in Yenice-Karabük, which has economic potential in both the Turkish and EU markets. For those objectives, 54 honey samples that were produced in 13 distinct areas throughout the Yenice region in 2018 and 2019 were analyzed. A total of 87 species from 37 families were identified in the honey samples gathered from the area as a result of the melissopalynological study. Out of 54 honeys produced in the region, 8 of them are dominant, 7 of them are secondary, 24 of them are minor, and 8 of them consist of a trace amount of Tilia pollen. However, none of the Tilia pollens were found in the other seven samples. It was found that 10 g of honey had an average of 22.174 ±27.024 total pollen. In honey samples, the following parameters were evaluated: proline 665.955 ±210.527 mg/kg, free acidity 37.57 ±11.74, water-insoluble substance 0.0344 ±0.038 g/100 g, G + F 68.45 ±4.90 g/100 g, sucrose 1.70 ±0.53 g/100 g, humidity 17.60 ±1.24%, pH 4.08 ±0.254, electrical conductivity 0.873 ±0.169 mS/cm, HMF 4,409±2,020 mg/kg, and ash 0.288 ±0.068%. The elements that were identified in the honey samples were K> Mg> Na> Ca> Fe> Zn> Mn> Ni> Ba. The electrical conductivity, pH, proline, and free acidity values could potentially be utilized as determining factors at a rate of 86.893% in the differentiation of honeys according to Tilia pollen rates, according to the results of the assessment of the physicochemical analysis parameters using PCA. Na, Mg, and Mn element quantities have been determined to account for 85.6% of determining characters.

POLLINATION AND BEE FLORA

OP-043 [Pollination and Bee Flora]
Comparison of Honey's Botanical and Geographical Origin Determination Using Melissopalynology and DNA Analysis Methods

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Background/PURPOSE: Pollen, which is in the content of honey, helps identify the bee that makes the honey from which flowers and, therefore, will help detect the origin of honey. Plant families can be detected by the microscopic analysis of pollen in honey (Melissopalynological analysis). But, in recent years DNA isolation method for the determination of the origin of honey are regarded as faster and more reliable. So microscopic method and DNA Analysis method compared in this study.

METHODOLOGY: Honey samples were collected from various regions of Turkiye. The number of pollen analysis and botanical origin were determined by microscopically. DNA were isolated from these honey samples by Eurofin Genespin DNA extration kit. After DNA isolation, spectrophotometric and electrophoretic method were used to determine DNA quality. 18S rRNA gene amplification was performed to show also quality of DNA isolated from honey samples. The Next Generation Sequencing (NGS) device was used to create DNA barcodes. rbcL and psbA-trnH genetic regions were selected for NGS analyses.

Results and CONCLUSION: In the conclusion of this study, for the first time, honey samples collected from different geographical regions in Turkiye were barcoded using rbcL and trnH-psbA loci and compared using melissopalynology and NGS. Although there are some differences in the plants determined by both techniques, identified dominant floral components were shown high similarity. When the melissopalynological analysis and NGS analysis were compared in the study, it was shown that there were similar families according to the regions, and a higher number of families (%48) were determined in the NGS analysis. Results show that 53 families have an abundance of >20% when comparing the two methods. Of these, 29 taxa are found using both methods, giving 55% correspondence between DNA and microscopy. However, NGS analysis is disadvantageous compared to melissopalynological analysis, which is a cheaper and faster method, since plant reference information is scarce and it is an expensive method. So, more studies and comparisons between the two methods are needed.

OP-265 [Pollination and Bee Flora]
Harmonious integration of bees and soybean cultivation

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Brazilian agriculture (pastures and crops) occupies 30.2% of the country´s land, while 66.3% is preserved as native vegetation. Brazil is responsible for 42% of the global soybean production, cultivated in 46 Mha. Both government and private sector are deeply compromised with the sustainability of the agricultural production systems, avoiding or minimizing environmental impacts. During the last two decades, soybean cultivation approached both honeybee colonies as well as wild bees nesting and foraging sites. Beekeepers have increasingly placed their beehives near soybean fields, because of the large quantities of high-quality nectar produced by soybean flowers. Bee visits provide supplemental pollination, leading to a 10-20% increment in soybean yield, but control of soybean pests may pose a threat to bees. We conducted a series of observational studies and interviews with growers, beekeepers, and pesticide application experts, to identify the best agricultural, apicultural, and communication practices (BPs) to avoid impacts of soybean cultivation on managed or feral bees. Along the 2022/23 and 2023/24 seasons, we followed 17 clusters of farmers and beekeepers, located in different Brazilian soybean regions, to test and validate the BPs, using Apis mellifera apiaries near soybean fields as indicators, but also observing impacts on native bees. We scouted soybeans fields twice a week, during blooming, to evaluate the visitation of bees to soybean flowers. Beehives were weekly examined for the sanitary conditions and the strengthness of colonies. Results showed that by strictly following the BPs, no adverse effects on the bee colonies were observed. Improved honey production of up to 50kg/hive was collected, as well as 10-15% increase on soybean yield was achieved. A definitive set of detailed instructions are now available for soybean growers and beekeepers, along with an internet-based course, to enable the harmonious integration of soybean cultivation and bees. By following these instructions - which can be adapted to other crops and implemented in any country – we expect to avoid bee mortality or sub lethal effects, leading to an increase in honey production and crop yield, further reducing the impact on native vegetation and greenhouse gas emissions.

OP-266 [Pollination and Bee Flora]
Honey bees are generalist pollinators, but the bulk of pollen supply was from less than 20 plants in rural-urban mosaic landscapes in Denmark

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Background/purpose
Pollen is an important source of protein, lipids and micro-nutrients for insects. The composition of pollen diet, specifically pollen diversity, has been documented to impact honey bee health. Honey bees forage within flight distance of their hive, in Northern Europe typically in rural-urban mosaic landscapes.

Problem description
We investigated how pollen diversity and proportional abundance of key pollen types was influenced by season, study year, and landscape composition.

Methodology
Using pollen traps, pollen samples were collected every three weeks during the flowering season in two years from 25 apiaries. Study sites were rural-urban landscapes in Denmark with different proportions of agriculture, urban and nature areas. Botanical composition of pollen samples was determined by palynological analysis (morphological determination by microscopy). For each sample, pollen diversity and relative abundance of all pollen types found in >1% of a sample was calculated. Effects of study year, season and landscape parameters were tested using GLMMs.

Results and conclusion
A total of 211 different pollen types belonging to 85 plant families were detected in a total of 300 pollen samples. Pollen diversity varied seasonally and annually, and pollen diversity was positively related the area of green urban spaces in the surrounding landscape. Only 17 pollen types were found in at least 15 samples. These were found in both study years, and were strongly influenced by season, but mostly not by landscape parameters.

Practical implications for beekeepers
Diversity of pollen varied seasonally, with a higher diversity in late season, and higher pollen diversity in landscapes with urban green areas. However, the bulk of pollen collected by honey bees belonged to less than 20 pollen types, which were mostly present in all study landscapes, regardless of composition. These key pollen plants were mass-flowering crops as well as wild flowers.

OP-267 [Pollination and Bee Flora]
Honey efficiency of currently cultivated winter oilseed rape cultivars in Poland

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Beekeepers in the case of poor rapeseed honey harvests, most often give the reasons as the poor nectar production of currently rapeseed cultivars. There is an urgent need to provide reliable information on currently cultivated oilseed rape cultivars, based on detailed studies of the intensity of nectar production.

The research was carried out in 2024 in the winter rapeseed collection maintained at the central Poland. The research material consisted of 46 cultivars and 10 breeding lines included in national comparative studies. The observations concerned the plant population density, and the beginning and the end of flowering. The amount of nectar per 10 flowers using the pipette method, the concentration of sugars in the nectar and the number of flowers per plant and unit area were measured. Nectar was collected six times between April 30 and May 8. Collecting nectar from 56 varieties took the whole day from 8:00 to 19:00, therefore, the order analyzed cultivars was changed each day. After weighing the amount of nectar/10 flowers and determining the concentration of sugars, the mass of sugars/10 flowers was calculated. Knowing the number of flowers/m² and the mass of sugars/10 flowers, the amount of sugars secreted by flowers of each cultivar was calculated.

It was found that flowering length average of all varieties was 28 days. There were no varieties with flowers without nectar. Ten flowers secreted an average for all varieties of 32.64 mg of nectar, with sugar concentration of 27.49%, and the calculated mass of sugars/10 flowers was 8.62 mg. The lowest result was obtained for the Scorpion cultivar - 5.85 mg of sugars/10 flowers, while the highest for the Debussy - 12.48 mg. The Ilona had the fewest flowers per plant - 307, while the Armada had 927. The tested cultivars produced an average of 620 flowers/plant. With an average number of plants in the maturity phase of 21/m², an average of 12,849 flowers/m² were obtained. The lowest sugars yield, approximately 50 kg/ha, were obtained for the Ilona and Scorpion, while the highest, over 150 kg/ha for the Temptation, Typos, Debussy, Azzurite, Aviron and Dominator.

OP-268 [Pollination and Bee Flora]
Are Latvian apple orchards a good habitat for wild bee species?

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Wild bees (Hymenoptera: Anthophila) are important pollinators of apple trees. Previous studies have shown that a rich species community of bees can be found in flowering apple orchards in Latvia. However, it was unclear whether the bees inhabit these biotopes permanently or only visit them when flowering apple trees provide abundant foraging resources. Therefore, we set the goal of studying the phenology of bee species communities. The study was conducted in 2023 in eight orchards. Bees were sampled in April (before apple flowering), May (during the flowering), June and July (after the flowering) using yellow, white and blue pan traps and Malaise traps. The total number of observed species increased from 69 in April to 80 in July. On average, 32 species were found in each apple orchard in April and 25...26 species in the other months. Species diversity (Hill number corresponding to Shannon-Wiener index) was 9.41 in April, but in the other months it varied in the interval 12.6...13.7. According to ANOVA, neither species richness nor diversity differed significantly between months. Throughout the season, small-sized species (e.g. Lasioglossum pauxillum, L. morio etc.) with a small dispersal radius had a relatively large proportion in the species community. Kleptoparasites also were abundant; in April, Nomada and Sphecodes individuals accounted for 4% of all bees we observed. We also analysed the dependence of bee species community on landscape diversity and evenness within 1km and 3km radius around the orchards. The bee abundance and species richness was not significantly related to landscape parameters in any month. Species diversity strongly positively correlated with landscape evenness within a 1km radius in May ($r=0.753$; $p=0.031$) and landscape evenness within a 3km radius in May ($r=0.720$; $p=0.044$) and June ($r=0.875$; $p=0.004$). We conclude that bee species communities in apple orchards depend on the resources and the processes occurring within them, but not on the surrounding landscape. Latvian apple orchards are good habitats for wild bees, as they contain a relatively rich and diverse species community both during apple flowering and the rest of the vegetation period.

OP-269 [Pollination and Bee Flora]
Managed pollinators essential for offsetting the declining contribution of native pollinators to fruit yield stability due to changes in breeding-mediated flower traits

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The global population and food supply requirements are increasing, and the acreage of insect-pollinated plants that serve human well-being has expanded. Pollinators considerably contribute to the current plant yield, which underpins global food security. Breeding aimed at improving fruit traits substantially alters flower traits such as flower anthesis and size. However, the effects of breeding-mediated changes in flower traits on sustainable agroecosystem production via the plant–pollinator relationship remain unclear. As sustainable agroecosystem production directly impacts the United Nations Sustainable Development Goals (SDGs), an economically important oilseed tree (Camellia oleifera) was considered in this study to address the above-mentioned gap in literature, with a focus on the implications for pollinator management and sustainable agroecosystem production. The pollination system of C. oleifera used in this study includes native pollinators (Andrena camellia) and managed pollinators (Apis cerana and Bombus spp.). In this study, we evaluated floral traits, observed pollinator (including native and managed pollinators) preferences, assessed pollinator pollen transfer efficiency, and recorded fruit set data. The results showed that breeding based on fruit traits induced substantial changes in flower anthesis and size, which subsequently affected plant–native pollinator relationships and even pollinator specialization of plants. The changes in anthesis resulted in decreased interactions between plants and pollinators; smaller flowers diminished the attraction of pollinators to plants, whereas larger flowers resulted in a reduction in the pollen transfer efficiency of pollinators. Additionally, the pollen transfer efficiency of pollinators contributed more to plant fruit sets than plant attractiveness to pollinators. Thus, breeding may reduce the contribution of pollinators to plant fruit yield, particularly in large-flowered varieties, which would increase the reliance on managed pollinators for plant yield in future agroecosystems. Overall, breeding-mediated flower trait changes will diminish the contribution of pollinators to sustainable production in agroecosystems, highlighting the importance of managed pollinators in future agroecosystem production. These findings call for knowledge exchange between beekeepers and plant growers to promote the integration of pollination and domestication syndromes in breeding to safeguard future global food security. There also is a need for beekeepers to carefully reconcile the conflicts between native and managed pollinators in future.

OP-270 [Pollination and Bee Flora]
Reconsidering beekeeping practices: Better-B explores how to restore harmony and balance in the bee colony and with its environment

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The post-war intensification of beekeeping has improved productivity enormously, but this has come at a cost, in particular bee colonies have become vulnerable and require frequent interventions from the beekeeper to survive. In parallel, honeybees are increasingly exposed to various forms of stress. All this leads to a devastating mix of vulnerable bees in a threatening environment, leading to colony losses and economic damage. There are, however, enough known cases where an alternative beekeeping management has helped to get honey bees back on track. A striking example is that of apiculture in Africa, which is based on natural selection and swarm catching. This way of beekeeping ensures that the harmony and balance that naturally arises is not disturbed. Major disadvantage, however, is that productivity is particularly low here. How can we get the honey bees from the intensive beekeeping of the west back out of this devastating mix? How do we combine more resilience with high productivity?

We believe that the current beekeeping practices have to be reconsidered. One way forward is to harness the power of nature to restore harmony and balance inside the honey bee colony and between the colony and the environment. This is where the Horizon Better-B project stands for. The project aims to predict the landscape pollinator capacity and the competition with wild pollinators. We want to understand the basis of resilience against different sorts of stresses like exposure to chemicals, climate change and heat stress. Do they have a molecular, ecological and/or genetic ground, or can we mitigate by changing the beekeeping practices, like improving the thermoregulation of the hive or choosing for Darwinian selection? This presentation will frame the research lines of the project and explain our approaches.

OP-271 [Pollination and Bee Flora]
Historical and seasonal changes in the flowering plants used by honeybees

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Background/PURPOSE: Honeybees use a wide range of flowering plants through the year for nectar and pollen. Agricultural intensification and other land use changes have substantially reduced the amount of flower-rich habitat available for foraging.

Problem description:
• How have the flowering plants used by honeybees changed over historical time?
• How do the plants used by honeybees change through the season?
• Which times of year are most likely to lead to food shortages?

METHODOLOGY: We find out which plants honeybees use by identifying the pollen within honey samples using DNA metabarcoding. For the historical investigation, we analysed 441 honey samples collected throughout the UK in 2017 and compared these to 855 honey samples analysed in 1952. For the seasonal investigation, we sampled honey from six colonies within a botanic garden and nature reserve every month from April to September 2016 – 2019. We extracted plant DNA from the honey, amplified and sequenced DNA barcodes (rbcL and ITS2) and compared these to a reference library of DNA barcodes for the UK flora to identify the plants.

Results and CONCLUSION: From 1952 to 2017 changes in agricultural practices have altered the nectar and pollen sources available in the UK. We show a decrease in the use of white clover (Trifolium repens) and increase in bramble (Rubus fruticosus) as the major forage source for UK honeybees. We show an increase in use of the crop plant, oil seed rape (Brassica napus) and the invasive species Himalayan balsam (Impatiens glandulifera) as these plants have become abundant in the UK landscape.

By analysing honey samples each month, we show that spring-flowering trees and shrubs are important at the beginning of the season and that when these finish flowering there is a resource gap until bramble and white clover become available. During this, 'June gap' honeybees use a wide variety of different plants in small amounts since none of their preferred resources are available.

Practical implications for beekeepers: We provide a detailed overview of the different plants used by honeybees through the year and make recommendations on the best plants for honeybees.

OP-272 [Pollination and Bee Flora]
Smaller Bees in the City? Understanding the Influence of Urbanization in an orchid bee species

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Euglossini is a tribe of neotropical bees commonly associated with orchid flowers. Some species are found in urban areas and serve as bioindicators of environmental health. However, one of the consequences of urbanization is the fragmentation of habitats and a reduction in floral resources, which can lead to smaller body sizes in these bees. In particular, the species Euglossa cordata, which have been reported to show changes in body size based on the level of urbanization. This study evaluated body size changes in E. cordata collected from 11 urban parks in São Paulo, the largest metropolis in South America. Bees were sampled using eucalyptol. Intertegular distance was used as a measure of body size, while the degree of urbanization was estimated by assessing the proportion of impermeable surfaces in 2 km radius buffers around the urban parks. Here we show a negative correlation between the collection period and intertegular distance, suggesting that smaller bees were collected closer to winter. The proximity to winter appears to play a significant role in determining the body size of E. cordata, likely due to the lower availability of floral resources during this season. While there were statistically significant differences in the body size of bees collected from various parks, no correlation was found between their intertegular distance and the proportion of impermeable surfaces in the parks. One possible explanation for this result is that local factors may be more influential in altering the functional traits of these bees. Overall, urbanization likely impacts the development of bees through the uneven distribution of floral resources in urban green areas. The limited availability of food, especially close to winter, can hinder larval development, resulting in smaller adult bees. The reduced body size of adults can impair their reproduction and movement, leading to decreased species distribution, gene flow and pollination. To address these issues, it would be recommended to ensure winter floral resources, improve local habitat quality, and promote green corridors for better connectivity.

OP-273 [Pollination and Bee Flora]
Evaluating the Impact of Honeybee Colonies on Insect Biodiversity and Ecosystem Restoration in Mount Parnitha Post-Fire Forests

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Wildfires increase by climate change and have devastating effects on ecosystems, destroying forests, protected areas and cultivated lands. This destruction leads to a significant loss of biodiversity, affecting not only plant communities but also the arthropods that depend on them. Honey Bees, as generalist pollinators, are crucial for post-fire ecosystem recovery by facilitating plant regeneration and supporting habitat restoration for other species. This study aims to assess the impact of honeybee colonies' presence on insect biodiversity in fire-affected forests at the foothills of mountain Parnitha, Greece. The role of honeybee colonies in fire damaged ecosystems remains understudied. Specifically, it is unclear whether the presence of honeybee colonies affect the diversity and therefore insect populations in such areas. Understanding this relationship is essential for evaluating the ecological benefits of apiculture in post fire landscapes. To assess biodiversity in post-fire areas in relation to honeybee presence, thirty beehives were strategically placed in a burnt forest in mountain Parnitha. In the surrounding area, four seasonal samplings were undertaken, with entomological sweep-net from 10 random spots. Also, another fire affected area was selected for sampling, using the same protocol, which was far away more than 3 km for every known bee keeping area. Simpson Index of Biodiversity was calculated to assess the differences in insect communities.

In the summer samplings, the area with honey bee colonies exhibited higher biodiversity, with a Simpson index of 0.960 compared to 0.726 in the area without honeybees. The samplings of autumn exhibited almost similar results. These findings suggest that honeybee presence may enhance insect biodiversity in fire affected areas, by supporting plant regeneration and creating more diverse habitats.

Beekeepers can play a vital role in post fire ecosystems recovery by strategically placing their beehives in fire affected areas. The presence of honeybee colonies not only supports plant regeneration but may also promote insect biodiversity, contributing to overall ecosystem restoration. This highlights the ecological value of beekeeping beyond honey or other bee products production, emphasizing its potential as a tool for environmental restoration. Further monitoring is needed to confirm these trends and assess long term impacts.

OP-274 [Pollination and Bee Flora]
CODABEILLES: A CO1 barcode reference library for monitoring wild bees of France (Apoidea: Anthophila)

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Currently, inventories and monitoring of wild bees in France face significant methodological obstacles linked to a lack of entomologists and reliable, standardized methods allowing identifications down to the specific level. DNA barcoding and metabarcoding open new perspectives to study wild bee populations at large scales. However, such studies require reliable and complete reference databases. During the course of the CODABEILLES project, we collected samples from 2260 specimens representing approximately 650 species and processed them through DNA barcoding, targeting the standard COI-5P fragment. Our results produced DNA sequences for 1477 (65% success rate) specimens belonging to 561 French wild bee taxa. The specimens come from 16 academic or private collections; all of them were identified, photographed, and the associated metadata were integrated into the Barcode of Life Datasystems (BOLD). All sequences went through a curation and validation process including: the removal of contaminations, the correction of sequencing errors, the computation of genetic distances and the inference of distance trees. In cases of inconsistencies between the sequence and the initial identification, the specimens were re-examined by entomologists. Thanks to CODABEILLES and projects occurring in parallel, the proportion of French wild bee species with reference DNA barcodes increased from 63% to around 86% since 2021, and may even increase to 95%, depending on the sequencing success of additional samples currently in progress. This work contributed to expanding DNA barcode data for many species of the Mediterranean Basin that previously lacked references. Additionally, it highlights the high level of cryptic diversity that still exists among diversified groups in southern Europe, notably within the Andrena genus, underscoring the need for further extensive taxonomic investigations.

OP-275 [Pollination and Bee Flora]
Bees' Eating Habits and Competition Uncovered using Cameras and DNA

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Wild bees are in decline, primarily attributed to loss of habitat. Fragmented habitats persist in an agricultural landscape, vulnerable to surrounding stressors. Among stressors, concerns have been raised that managed honeybees may competitively displace wild bees in protected areas.

The objective of this phd-work was to investigate whether beekeeping pose a risk to wild bee communities in protected areas of Denmark, specifically semi-natural grasslands and heathlands. Furthermore, studies of plant-pollinator interactions are crucial for our understanding of pollinator health and decline, but traditional methods, such as direct observations and manual pollen analyses, are very time-consuming and limit the quality of data. Thus, modern methodology such as metabarcoding and computer vision was applied.

Presented studies span across the season and 50 grassland-heathland sites of which 42 were sampled in May and July using pan traps to assess wild bee communities and proportion of honeybees. Competition was assessed through experimental introduction of beehives to one of two species rich calcareous grasslands during June and diet overlap was investigated using DNA-metabarcoding. On eight heathlands with varying densities of apiaries, 40 time-lapse cameras recorded heather (Calluna vulgaris) for 30 days during August and machine learning was used to assess visitation frequency of wild pollinators and honeybees.

Honeybees were generally low in abundance on studied sites, even when placed in a species rich grassland, but metabarcoding of the few individuals revealed diet overlap with bumblebees. However, honeybees were highly abundant on heathlands during the late-summer flowering of heather. Only few common species were detected and the effect of honeybees depended on time of the month, where negative effects were found early August.

Honeybees generally do not seem attracted to fragments of grasslands and heathlands in a Danish agricultural matrix, except in August, but may vary from country to country. Seasonal phenology is highly important to consider when assessing the effect of honeybees on wild bees. It is suggested that beekeepers investigate plant species are utilized during the season and when they may visit areas of conservation concern. For migratory beekeepers, it is stressed that hives are not mass-introduced prior to flowering.

OP-276 [Pollination and Bee Flora]
Monitoring Bumblebee Queens through Citizen Science in Slovenia

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Bumblebees are important pollinators. However, their populations have been declining over recent decades, a trend that remains poorly documented. Additionally, little is known about the activity of bumblebee queens in spring and the impact of climate change on their emergence from hibernation. To address this, we launched a citizen science initiative in Slovenia in 2024, collecting data on bumblebee queen activity until the end of April. We collect this data annually. Participants photograph bumblebees and enter observation data directly at the sighting location using a mobile application, recording species, activity, a photograph, and location. The initiative focuses on gathering data for the ten most common color variations of bumblebees. Experts review and, if necessary, correct the collected data. In the first year, we gathered 1479 data entries contributed by at least 75 participants. Photos were included in 80% of entries, with 92% of these being suitable for analysis. Among entries with suitable photos, the color group was correctly identified in 89% of cases. The majority of queens were observed feeding on flowers (79%), using 70 different plant genera as food sources. More than half of the recorded observations were on Lamium, a known crucial food source. Other commonly recorded plants included Symphytum, Vaccinium, Pulmonaria, Ajuga, and Prunus spp. Crocus, an important early food source for bumblebee queens, accounted for a quarter of February observations. The citizen science approach has proven to be a suitable method for monitoring bumblebee queens, particularly for tracking their activity, though it is less effective in assessing bumblebee community structure. Ensuring data quality is crucial, and participant-provided photographs allow for accurate verification of identification. Beyond its scientific value, the initiative also plays an important role in raising awareness among participants about bumblebees, their dietary needs, and the effects of climate change on their activity.

OP-277 [Pollination and Bee Flora]
Enhancing agricultural productivity through applied pollination: a large-scale study in tropical crops

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Pollination is a fundamental ecosystem service that underpins global food production and biodiversity. More than 75% of the world's major crops depend, at least partially, on pollinators, yet their populations are declining due to habitat loss, pesticide exposure, and climate change. This decline poses a direct threat to agricultural productivity, making pollination management a key strategy for sustainable food systems. Despite this urgency, Applied Pollination (AP) remains underutilized in large-scale tropical agriculture. This study evaluates the impact of AP on three major tropical crops, Arabica coffee (Coffea arabica), soybean (Glycine max), and orange (Citrus sinensis), through an extensive and multi-season field experiment. Between 2018/19 and 2023/24, we conducted 149 experimental trials across major Brazilian agricultural regions, introducing managed honeybee (Apis mellifera) colonies into selected field plots during flowering, while control plots remained unmanaged. Productivity was assessed based on fruit set, revealing significant yield increases, 20.1% in Arabica coffee ($n = 121$; $t = 8.56$, $df = 120$, $p < 0.001$), 13.0% in soybean ($n = 23$; $t = 5.05$, $df = 22$, $p < 0.001$), and 28.2% in orange ($n = 5$; $t = 3.72$, $df = 4$, $p < 0.05$). The economic impact of AP is substantial, with a projected annual revenue increase of US$ 12 billion for the Brazilian agribusiness sector. Additionally, this study highlights the synergy between AP and biological pest control, demonstrating that integrating pollinator-friendly practices can enhance productivity while reducing reliance on chemical pesticides. These findings provide strong evidence supporting the widespread adoption of AP as a sustainable, high-impact agricultural practice. Expanding AP in tropical crops could play a crucial role in mitigating pollinator decline, promoting biodiversity, and ensuring food security for a growing global population.

OP-278 [Pollination and Bee Flora]

Melissopalinology applied to the study of the botanical characterisation and geographical traceability of Apis mellifera, Linnaeus 1758 and Meliponini honeys produced in certain areas of Bolivia

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Melissopalynological analysis is a useful tool not only for identifying the botanical composition of honey, but also used to trace its geographical origin, thus highlighting the relationship between the bee and the territory. Honey is a product that is closely linked to the area of production, since its characteristics depend largely on the plants foraged by the bees. By analysing the pollen elements in honey, it is possible to identify relatively constant differences that distinguish products of different origins. This type of analysis is widely used in Europe to characterise Apis mellifera's honeys and to identify the area of production of a given honey, but it is also applicable to other types of honeys, such as those produced by some stingless bee species belonging to the tribe Meliponini, which are widely reared for their products in some regions of South America. However, in many Latin American countries, especially in Bolivia, studies based on this technique are not widespread and research is few. The aim of this work is to valorise, through botanical characterisation, the typical bee products of some areas of Bolivia and to increase the knowledge of the botanical context in those regions where beekeeping practices are more widespread; areas for which there is a lack of detailed information on the diversity and availability of melliferous plants. More than 60 honey samples of A. mellifera and the other half of different Meliponini species from different areas of the country, were subjected by melissopalinological analysis. The analysis of the pollen spectrum of the samples made it possible to highlight the close relationship between the bees and the territory, the apicultural suitability of the areas of origin of the samples and the possibility of producing monofloral honeys in some places. In Bolivia there is no tradition of monofloral honeys, but this study could provide the basis for consolidating production practices aimed at defining and preserving monofloral honeys.

OP-279 [Pollination and Bee Flora]
Mass flowering tree crops and the overwhelming efficiency of honey bee pollen exploration – what remains for native bees?

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Honey bees are known to be highly efficient at exploiting the best available resource plants that bloom within their flight radius due to their excellent recruitment. This is particularly true for mass flowering trees in the tropics. How does this efficient foraging performance of honey bees that were introduced to the neotropics affect native bees, especially the stingless bees (Meliponini)? How much of the available pollen resources are allocated to honey bees and how much to native bees?

To answer these questions, we studied the mass-flowering native Myrtaceae fruit crops gabiroba (Campomanesia pubescens), cagaita (Eugenia dysenterica) and jaboticaba (Plinia jaboticaba) in Brazil. We determined the visitor spectrum, the sequence and frequency of flower-visiting bee species during the day, determined the amount of pollen per flower, of pollen collected by individual bee groups and the uncollected pollen at the end of anthesis. In a honey bee exclusion experiment, we measured how much pollen was collected by meliponines in the absence of Apis mellifera.

The studied species had pollen-only flowers, synchronized flower opening and pollen presentation at dawn (~04:30 am) and showed “big-bang” flowering. One flower contained on average 180,000 (Cagaita), 270,000 (Jaboticaba) and 920,000 (Gabiroba) pollen grains. The consistent order of daily bee visits to flowers on the three species started with crepuscular bees at dawn, followed by honeybees from about sunrise, then stingless bees and solitary bees. Honey bees were by far the most frequent visitors, while crepuscular and diurnal solitary bees were rare. The honey bee visits declined rapidly after about two hours, and overall bee visits ceased around noon. After just one hour of visits, the honeybees alone had removed an average of 82% to 86.6% of the pollen from the three species. Three to 10% of the grains were left in the wilting flowers.

After experimental exclusion of honey bees, native stingless bees collected 76% of the pollen, while their pollen extraction in the presence of honey bees was only 3.7%. This indicates that the overwhelming pollen exploration by honey bees leads to a displacement of native bees by exploitative competition in mass flowering Myrtaceae.

OP-280 [Pollination and Bee Flora]
Increased pollination activity by honey bee colonies managed in thermodynamic hives

Eitan Nir, Gianmario Riganti, Jason Graham, Tomer Moldovan, Yotam Melman, Alex Gamberoni, Assaf Shachar
Primal Bee

Pollination is a critical environmental service provided by bees that helps to insure food security by increasing the bounty and genetic diversity of plants that we and our livestock depend upon. Many beekeeping operations rely on income generated from locating hives of bees onto farmland in order to pollinate crops. Unfortunately, beekeepers also need to manage increased operational costs, and contend with high colony mortality. The decreased profitability and unpredictable high risks has become a barrier to beekeepers, leading to a potential shortage in agriculture pollination services and threat to food security.

This presentation explores the use of innovative methodology to increase pollination capability while reducing operational costs. Honey bee colonies (50) were installed in both thermodynamic Primal Bee hives (25) and standard, wooden, Langstroth hives (25) in a commercial operation in Israel. The two groups of colonies were managed in the same way, overwintered and were then used to measure and compare survivability and Spring pollination activity through the metrics of brood area and forager timing and frequency of bee flights.

The colonies managed in thermodynamic Primal Bee hives resulted in larger brood areas, larger forager populations which began foraging flights earlier and ended foraging later in the day, resulting in increased flight activity compared to colonies managed in standard Langstroth hives. The increase in population dynamics resulted in increased pollination services. The data collected were used in a comparative analysis of the economics of pollination services. The results demonstrated a margin within which commercial beekeeping operations can reduce the risk of high colony mortality, and increase profitability while providing pollination services to insure our food supply.

OP-281 [Pollination and Bee Flora]
Divergent pollen collection by honey bees and bumble bees: Evidence from Calgary, Canada

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ABC&C Ltd, Calgary, Canada

Understanding how different pollinators utilize floral resources is critical for assessing interspecific competition and ecosystem functioning. Honey bees (Apis mellifera) and bumble bees (Bombus spp.) are both major pollinators, yet their foraging behaviours differ significantly. This University of Calgary study aimed to quantify floral resource partitioning between these species in Calgary, Alberta, Canada, and to evaluate whether they exploit the same floral resources or demonstrate niche differentiation.

Resource overlap among pollinators can lead to competition, particularly in urban and fragmented landscapes where floral resources may be limited. Given that honey bees have extensive foraging ranges spanning kilometres, whereas bumble bees typically forage within 500 meters of their nests, it is hypothesized that these differences in foraging distances drive pollen resource partitioning.

Nine study sites were established within Calgary, each containing one honey bee colony and two bumble bee colonies. Pollen samples were collected simultaneously from returning foragers at each nest site over multiple sampling periods. Pollen was identified and quantified using microscopic analysis to compare floral resource use between species. Statistical analyses were conducted to determine the extent of pollen overlap.

The results revealed a striking divergence in pollen collection between honey bees and bumble bees, with no significant overlap in floral resources ($p < 0.0001$). Honey bee pollen originated from distant agricultural floral species; bumble bee pollen was from urban ornamental species. This suggests that the two groups largely avoid direct competition through differences in their foraging strategies. Honey bees likely access more distant floral sources, while bumble bees exploit nearby resources, resulting in distinct pollen compositions.

Beekeepers and conservationists should consider these findings when managing colonies in shared landscapes. Since bumble bees and honey bees may utilize different floral resources, their coexistence may not necessarily lead to competition for pollen. However, maintaining diverse floral plantings within 500 meters of bumble bee nests and ensuring adequate forage availability for honey bees beyond this range can support both species.

OP-282 [Pollination and Bee Flora]
Large-scale flowering initiatives (>1000 ha) have a significant impact on pollinator diversity and abundance

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The loss of biodiversity, including the decline of pollinators, poses significant challenges to both ecosystems and agricultural systems. It undermines their stability and productivity. This presentation explores the essential role of floral resource enhancement in strengthening functional biodiversity based on the results of a study investigating the impact of large-scale floral plantings on pollinator communities and ecosystem services. By selecting a diverse range of native, melliferous plant species with extended flowering periods, we aimed to maximise pollinator attraction and support their life cycle. Our experimental design compared pollinator diversity, abundance, and pollination rates between control and flower-rich plots. Two main experiments had a very high impact. The Apiluz programme asks the farmers to leave part of their Alfalfa to flower, rather than cutting it before flowering for desiccation. This programme involves hundreds of farmers cultivating more than 50,000 ha of lucerne in France. The Coup d'Pouce programme aims to help the farmer to establish more biodiversity-oriented areas, by seeking funding to reduce the cost of these measures. More than 1000 farmers have been helped for more than 1500 hectares involved. Statistical analyses showed a significant increase in pollinator diversity and abundance in the flower-rich areas, together with improved pollination success and seed production. In the case of lucerne, highest honey crop was observed, adding further value to these measures. Our results highlight the effectiveness of targeted provision of floral resource in enhancing functional biodiversity and ecosystem resilience. In conclusion, this research provides further evidence that the implementation of strategic flower planting initiatives for pollinator conservation and ecosystem restoration must be supported. Indeed, these strategies play a key role in redefining ecological corridors and providing diverse food resources, that ensure both the health and sustainability of pollinator populations.

OP-283 [Pollination and Bee Flora]
Flowers for bees

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Forage sources for honey bees are a crucial consideration for beekeepers, influencing brood development, bee health, honey production, and even the flavor of the honey harvested. Despite their importance, reliable and comprehensive information about bee forage plants remains limited. To address this gap, I have gathered data on plant attractiveness for honey bees and compiled it into a comprehensive catalogue featuring over 881 species of herbs, shrubs, and trees.

The goal of this work is to enhance the understanding of flowers that benefit bees by providing detailed information on their value as sources of nectar and pollen. This compilation, aimed for Northern Europe, can serve as a useful tool for beekeepers in selecting optimal locations for their apiaries.

The plants are categorized and graded based on their nectar and pollen production, indicating their attractiveness to honey bees. The gradiation extends from 0 to 4. Additionally, the catalogue includes data on the suitability of certain species for long-tongued and short-tongued bumble bees, as well as solitary bees. Information on pollen color, protein content, nectar secretion and sugar concentration, and potential honey and pollen yield per hectare is also presented in tables. Moreover, some species that tend to be alien invasive for Scandinavian conditions are marked.

The sources for this compilation primarily consist of European articles and books, with additional insights drawn from my own observations. The work is published in Swedish and is available for free download as a PDF on the website of the Swedish Board of Agriculture.
https://webbutiken/jordbruksverket.se/sv/artiklar/

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POSTER PRESENTATIONS

APITHERAPY

PP-318 [Apitherapy]
Enzymatic hydrolysis of bee pollen cell wall and extraction of protein isolates to enhance the structural, functional, and nutritional profile

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Background
Bee pollen is a nutrient-dense natural product, rich in proteins, vitamins, and bioactive compounds, but its rigid structural layers (exine and intine) limit nutrient release and functional application. Enhancing protein extraction and functionality from bee pollen could improve its value as a food ingredient and dietary supplement.

Problem Description
The tough cell wall of bee pollen reduces protein availability, making it a challenge to extract high-quality protein isolates with desirable functional properties. Enzymatic hydrolysis with protease provides a promising solution, but optimized conditions are needed to achieve efficient cell wall disruption and enhance protein yield.

Methodology
Response Surface Methodology (RSM) was used to determine optimal enzymatic hydrolysis conditions for bee pollen. The study identified the ideal parameters as 0.25% enzyme concentration, 49°C temperature, pH 7.3, and 12 hours of hydrolysis. Protein extraction was performed at an extraction pH of 10 and precipitation pH of 4.5, yielding 19% protein with 85% purity. Key response variables included wall-breaking rate, protein dispersibility, antioxidant activity (DPPH), and total phenolic content.

Results and CONCLUSION: Protein isolates from enzymatic pre-treatment (PA-BPPI) showed superior functional and nutritional properties compared to untreated isolates (BPPI). PA-BPPI exhibited 80% solubility, water-holding capacity of 234%, oil-holding capacity of 198%, emulsifying activity index of 190.25 m^2/g, and emulsifying stability index of 22 minutes. Nutritional improvements included higher levels of essential amino acids (lysine, leucine, and isoleucine), with an Essential Amino Acid Index (EAAI) of 80.29, Biological Value (BV) of 75.81, and Nutritional Index (NI) of 66.81. Thermal and FTIR analyses confirmed structural modifications enhancing functionality.

Practical Implications for Beekeepers
Enzymatic pre-treatment adds value to bee pollen, enabling its use in functional foods such as protein-enriched snacks, beverages, and emulsions. Improved amino acid profiles make bee pollen protein isolates ideal for dietary supplements targeting muscle growth and recovery. Beekeepers can benefit from diversified income streams and meet the rising demand for plant-based functional ingredients.

PP-319 [Apitherapy]
A comparative study of bee pollen, Aloe vera and commercially available ointment on the treatment of freckles

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Freckles are hyper-pigmented skin lesions, presenting a common cosmetic concern and affecting the beauty and confidence of a person. Several commercial products are available to treat freckles but due to their chemical nature, they affect the skin adversely. For centuries, Bee pollen and Aloe Vera have been used as natural antioxidants. This study hypothesizes that bee pollen and Aloe vera have ameliorative effects and may help in the removal of these skin lesions. To test this hypothesis, the current study aimed to design and formulate Aloe Vera gel and bee pollen to investigate their ameliorative effect on freckles. The samples of Bee pollens were collected from the KUST apiary and Aloe Vera from the local garden. An ointment of bee pollen and Aloe Vera was prepared by using the Vaseline base (paraffin), 2% Aloe vera gel, 1% pollen grain tincture, and vitamin E as a preservative. Overall four diverse formulations A1, A2, A3, and A4 were prepared using different concentrations of pollen grains, Aloe vera gel, and Vaseline base. Thirty patients (30 females) were divided into two experimental groups; Group A was treated with ointment prepared, and Group B was treated with commercial ointment having formula magnesium ascorbyl phosphate 5% for four weeks. Five patients out of each group were controls and received only a cream base. Physical characteristics of herbal ointments, such as color, odor, smoothness, and grittiness, were recorded. It was observed that herbal ointment showed compliance with the parameters of acceptable ointment. The formulation A4 presented significantly ($p<0.05$) better results compared to the standard drug and a marked decrease in dark spots was observed compared to the standard drug. Moreover, the formulations didn't show any allergic reaction, itching, or redness on the skin of patients. These findings highlight the potential of bee pollen and Aloe Vera as effective and safe alternatives for freckle treatment.

PP-320 [Apitherapy]
Improving the nutritional and functional profile of coconut bee pollen through supercritical fluid extraction-based cell wall disruption

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Background: Bee pollen is recognized as a nutrient-rich super food with bioactive compounds. However, its robust cell wall limits the bioavailability of these compounds, reducing its potential benefits. Elevating the degree of cell wall disruption can unlock bioactive compounds, improving the nutritional and functional properties of bee pollen.

Problem Description : The cell wall of bee pollen presents a challenge for bioavailability, restricting its use in functional food and nutraceutical formulations. Conventional methods of cell wall disruption often fall short of optimizing the release of bioactive compounds while maintaining nutritional integrity. Therefore, an efficient and eco-friendly method is needed to improve nutrient accessibility and techno-functional properties.

Methodology: Supercritical fluid extraction (SFE), a green and efficient cell wall disruption technique, was employed in this study. Response Surface Methodology (RSM) was used to optimize SFE parameters—pressure (400 bar), temperature (40°C), and time (40 min)—to achieve maximum wall disruption and enhanced functional properties. The optimized bee pollen samples (SCOP) were analyzed for compositional, thermal, and functional properties, as well as amino acid profiling and in vitro digestibility.

Results and CONCLUSION: The optimized SFE process significantly enhanced the nutritional composition of bee pollen, increasing crude protein (29.36%), lipids (11.43%), and carbohydrates (42.85%) compared to untreated bee pollen (UTP). Techno-functional properties such as solubility (43.69%), water-holding capacity (1.65g/g), oil-holding capacity (2.25g/g), emulsifying activity (62.58%), and emulsion stability (47.56%) improved substantially. Mineral analysis revealed elevated levels of essential macro and trace minerals, while amino acid profiling showed enrichment in essential (4.57mg/g) and non-essential amino acids (5.51mg/g). In vitro digestibility increased from 60.68% to 81.81%, confirming enhanced nutrient accessibility. The findings demonstrate the effectiveness of SFE in improving bee pollen's nutritional, functionality, and digestibility

Practical Application for Beekeepers: Beekeepers can leverage the findings of this study to increase the commercial value of bee pollen. By adopting supercritical fluid extraction technology, they can produce high-quality bee pollen with enhanced nutritional and functional properties. This optimized product can be marketed to functional food and nutraceutical industries. Additionally, the improved digestibility and versatility in food formulations make it more appealing to health-conscious consumers, creating opportunities for premium product offerings.

PP-321 [Apitherapy]

LITHUANIAN UNIVERSITY OF HEALTH SCIENCES
FACULTY OF VETERINARY MEDICINE

Preserving Boar Semen Quality Parameters with Propolis Extracts During Long-term Storage

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INTRODUCTION

Propolis is a natural resinous mixture used by honeybees with a variety of biological effects, including antioxidant and anti-inflammatory properties. In animal reproduction studies, propolis has exhibited the potential to protect spermatozoa during storage. The aim of this study was to evaluate the effects of aqueous and ethanolic propolis extracts on boar semen quality parameters during 72-hour liquid storage at 17°C.

METHODOLOGY

Eleven semen samples were collected from boars at an artificial insemination (AI) station and subsequently diluted with a long-term extender. The samples were then divided into separate parts and supplemented with 5% and 10% aqueous (5AP, 10AP) or ethanolic (5EP, 10EP) propolis extracts (Figure 1). For extract preparation, crude propolis was ground into powder and macerated in water or 70% ethanol at room temperature (5 h, occasional shaking). Extracts were prepared at concentrations of 5% and 10% (w/v), filtered, and stored at 4°C until use. One part of each semen sample was designated as the control group, receiving no addition of propolis extracts. Assessment of sperm viability and motility was conducted prior to dilution and after a 72-hour storage period using a sperm class analyzer (SCA). A total of 66 sperm motility and viability tests were performed.

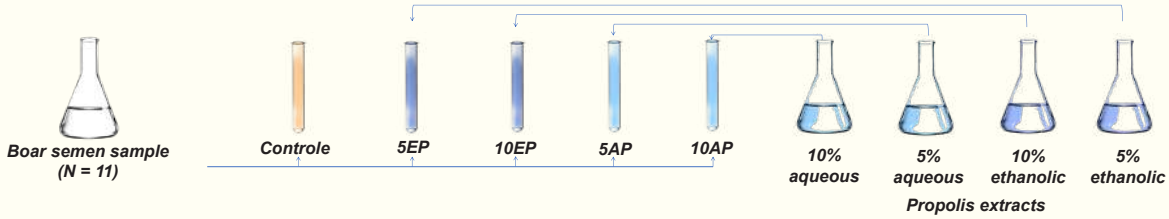

Figure 1. *Schematic overview of semen sample dilution with propolis extracts.*

RESULTS

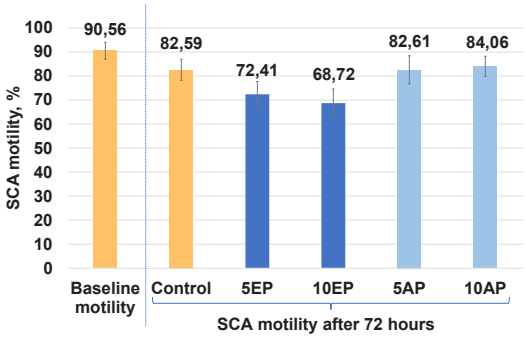

Figure 2. *Sperm motility assessed by SCA before and after 72 h storage with different propolis extracts.*

At the beginning of the experiment, the mean motility of the semen samples measured by SCA was 90.56 (SD (standard deviation) = 6.990) %. After 72 hours, the results demonstrated that aqueous propolis extracts (5AP, 10AP) in boar semen helped to maintain sperm motility in comparison with control group and ethanolic propolis dilution ($P < 0.05$). In aqueous groups, SCA motility was reduced by 7.95 (SD = 13.142) % in 5AP and 6.50 (SD = 8.302) % in 10AP, while in control group it was reduced by 7.97 (SD = 10.435) % (Figure 2). Conversely, ethanolic propolis extracts (5EP, 10EP) had a detrimental effect on semen SCA motility. Furthermore, the viability of semen samples diluted with aqueous propolis extracts was more than 10% higher compared to the control group ($P < 0.05$), further supporting the beneficial effects of propolis.

CONCLUSION

In conclusion, the present study indicates that aqueous propolis extracts provide protective benefits for boar sperm during storage, while ethanolic extracts may have a cytotoxic effect. Further research is necessary to understand the mechanisms underlying these effects.

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Spotted Lanternfly (SLF) Honeydew Honey: A New Frontier in Medicinal Honey Research from the US

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HONEY PATHWAY UTSA The University of Texas at San Antonio College of Sciences
USDA nextgen

Abstract

The spotted lanternfly (Lycorma delicatula) has contributed to the emergence of a distinctive, dark honey produced by managed honeybees *(Apis mellifera)* using honeydew as a nectar source. Beekeepers in Pennsylvania and New Jersey have reported the production of this unique honey, characterized by remarkable aromas, flavors, and potentially valuable bioactive properties.

To explore the medicinal potential of this honey, samples were collected and analyzed for physicochemical characteristics, antibacterial activity, antioxidant capacity, phenolic content, sugar, and metabolomic profiles. Results were compared to manuka honey, widely recognized as the gold standard for medical-grade honey. The findings revealed that this honey exhibits high antimicrobial, antioxidant, and anti-inflammatory properties, suggesting its strong potential for applications in wound healing and other medicinal uses.

This study highlights a promising new variety of honey with exceptional bioactivity, underscoring its value for both the apicultural industry and medical research. The emergence of this honey offers an exciting avenue for innovative honey products that contribute to health and wellness.

Introduction

The spotted lanternfly (SLF), *Lycorma delicatula*, is an invasive insect species first detected in Pennsylvania in 2014 and now widespread across several U.S. states. SLFs feed by piercing plant tissues and extracting phloem sap, particularly from the tree of heaven (*Ailanthus altissima*) and grapevines, leading to plant stress, reduced productivity, and even death. As they feed, SLFs excrete large volumes of honeydew, which promotes the growth of sooty mold and disrupts photosynthesis, posing a major threat to both agriculture and natural ecosystems.

During periods of nectar scarcity, honeybees may forage on honeydew excreted by SLFs. Beekeepers in SLF-infested regions have observed unusually dark honey in their hives—suspected to result from bees collecting SLF honeydew. Given the SLF's preference for chemically rich host plants like Ailanthus altissima, their honeydew may carry secondary metabolites that influence the resulting honey's flavor, composition, and potential therapeutic properties.

Our study presents the first scientific evaluation of SLF honey, investigating its antimicrobial and antioxidant properties. We hypothesize that SLF honey, due to its unique origin and dark color, may exhibit potent biological activity, potentially comparable to or exceeding that of well-known medical-grade honeys such as Manuka. This research aims to explore SLF honey as a novel U.S.-based candidate for medicinal applications.

Figure 1. Spotted Lanternfly (*Lycorma delicatula*) insect

Materials and Methods

Color Detection

Honey color was measured using the Pfund scale based on absorbance at 560 nm. A 50% (w/v) honey solution was prepared, vortexed, centrifuged, and transferred into 96-well plates. Pfund values were calculated by multiplying Abs560 by 3.15 and USDA color grades were assigned accordingly.

pH and Moisture Content

pH was measured using a calibrated pH meter in a 40% honey solution prepared with deionized water. Moisture content was determined using a handheld honey refractometer.

Antibacterial Activity – Zone of Inhibition

Antibacterial activity was assessed using the agar well diffusion method against *Staphylococcus aureus* (ATCC 25923). Honey samples (~100 µg) were added to 8 mm wells in Mueller Hinton Agar plates seeded with bacteria. Plates were incubated at 37°C for 18 hours, and zones of inhibition were measured in millimeters.

DPPH Radical Scavenging Assay

Antioxidant activity was evaluated by DPPH assay. A 10% honey solution was mixed with DPPH (17 mM in methanol) in a 96-well plate and incubated for 30 minutes in the dark. Absorbance was measured at 517 nm, and radical scavenging activity (%RSA) was calculated relative to the control.

Total Phenolic Content (TPC)

TPC was determined using the Folin–Ciocalteu method. A 10% honey solution and gallic acid standards were reacted with FC reagent and sodium carbonate. After 2 hours incubation in the dark, absorbance was measured at 765 nm. Results were expressed as mg gallic acid equivalents (GAE) per kg of honey.

Results

Antibacterial Activity – Zone of Inhibition SLF and Manuka honey samples were tested against *Staphylococcus aureus* using the agar well diffusion method (Figures 3 & 4). Most samples demonstrated notable antibacterial effects. Sample NJ-15 showed the strongest activity with a 26.0 mm zone of inhibition. In contrast, minimal inhibition (9.0 mm) was seen in AB-32, AR-37, AR-42, C1, and C2. Among the Manuka samples, 7 of 11 samples had high antimicrobial activity (ZOI > 16mm)

Antioxidant Activity – DPPH Radical Scavenging Assay

The antioxidant potential of SLF and Manuka honeys was evaluated using the DPPH radical scavenging assay. Percent radical scavenging activity (%RSA) was calculated based on absorbance at 517 nm. SLF honey samples demonstrated a wide range of antioxidant activity (Figure 5), with sample PA3 showing the highest %RSA at 92.8%, while Wiles 224 exhibited the lowest at 11.7%.

Total Phenolic Content (TPC) A key indicator of antioxidant capacity, TPC, varied across SLF honey samples (Figure 6). The highest TPC was observed in NJ-14 with 211.1 mg GAE/100 g honey, indicating high phenolic concentration. The lowest was

Results – con't

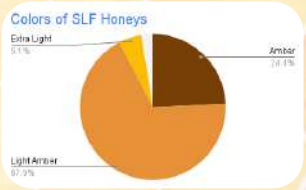

Figure 2. Distribution of SLF samples based on their colors. Each segment represents the number of SLF samples falling within specific range. **67.9% of the samples were light amber.**

Figure 3. Distribution of SLF honey samples' ZOI against *S.aureus*, grouped into defined ranges; each slice indicates the count of samples in that range. **74 % of the SLF samples were above 16 mm ZOI**

Figure 4. Distribution of Manuka honey samples' ZOI against *S. aureus*, grouped into defined ranges; each slice indicates the number of samples in that range. **63 % of the Manuka samples were above 16 mm ZOI**

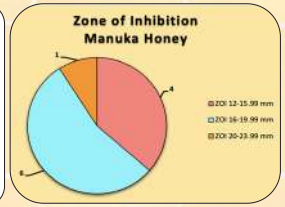

Figure 5. Distribution of SLF samples based on their radical scavenging activity (%RSA). Each segment represents the number of SLF samples. **85% of the samples were**

Results – con't

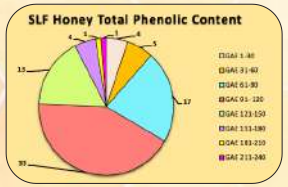

Figure 6. Distribution of SLF honey samples by total phenolic content expressed as gallic acid equivalents (GAE), with each slice representing the number of samples within a defined GAE range. **66% of the samples were above 90 GAE**

Conclusions

- This is the first study to scientifically evaluate the medicinal potential of Spotted Lanternfly (SLF) honeydew honey, a newly identified honey in the U.S.
- 67.9% of SLF honey samples were classified as light amber, aligning with common medicinal honey color profiles.
- 56.6% of SLF samples (43/76) exhibited zones of inhibition >16 mm against *S. aureus*, indicating strong antibacterial activity comparable to or exceeding that of Manuka honey.
- 85% of SLF samples (67/78) showed %RSA > 40%, and 66.7% (52/78) had TPC > 91 mg GAE/100 g, demonstrating robust antioxidant potential.
- These findings highlight SLF honey as a high-bioactivity, U.S.-based honey with strong therapeutic potential.
- Its antibacterial and antioxidant properties make it a promising candidate for future classification as medical-grade honey, particularly for the prevention and treatment of Staphylococcus aureus infections and oxidative stress-related diseases.

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PP-323 [Apitherapy]

Moroccan Propolis' potential as a multitarget therapeutic product

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ABSTRACT

Morocco, as a north-African and Mediterranean country, is characterized by its floral biodiversity. In fact, our research revealed the variability of Moroccan propolis and its richness in flavonoids as well as its important antioxidant power.

The present in vitro study investigated the potential use of propolis as a multitarget therapeutic product and the physicochemical properties, chemical composition, and immunomodulatory, antioxidant, antibacterial, and anticancer properties of a propolis extract from the northern Morocco region (PNM). Within the Moroccan propolis, there are valuable molecules whose mechanisms of action and clinical interest need to be further investigated, to enable the transfer of experimental results from the laboratory to the patient's bedside.

INTRODUCTION

Many studies have been conducted on the propolis of Morocco and have shown the importance of some of its biological activity.

However, there are no detailed studies on the action mechanisms of these activities, especially anticancer and anti-inflammation activities.

Therefore, we investigated here the anti-inflammatory, antioxidant, antibacterial, and cytostatic effects on cancer cell lines of a propolis extract from the northern Morocco region.

→ In order to analyze its **multi-target therapeutic potential**

MATERIALS & METHODS

70% ethanolic extract of Moroccan propolis was prepared and evaluated for their:

→ **Physicochemical characteristics:** resin, wax, balsam, ash, pH, humidity

→ **Total antioxidant capacity, phenol and flavone/flavonol** content

→ **Antioxidant activity:** DPPH, ABTS, FRAP **and Phenolic compounds**/ RP- HPLC analysis

→ *In vitro* **antimicrobial activity** *(MIC/MBC):*

- ***GNB:*** *E. coli BLSE (ATB : 87) BGN, E. coli (ATB : 57) B6N, E. coli (ATB : 97) BGM, Pseudomonas aeruginosa*
- ***GPB:*** *Streptococcus faecalis, Staphylococcus aureus*

→ *In vitro* **cytotoxic and cytostatic activity:** ***THP-1:*** human monocytic cell line, ***HCT-116:*** human colorectal carcinoma cell line, **MCF-7**: breast cancer cell line

→ *In vitro* **anti-inflammatory activity:** assessed by investigating propolis ability to alter cytokines production (TNF-α, IL-6, IL-10) in human peripheral blood mononuclear cells (PBMNCs) stimulated with lipopolysaccharide (5µgLPS/mL).

RESULTS

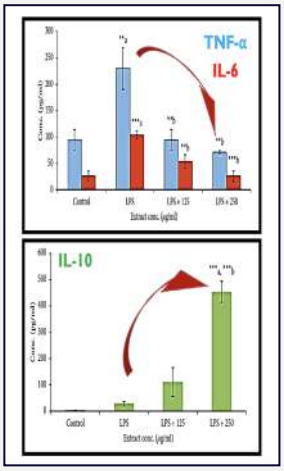
PHYSICO-CHEMICAL PROPERTIES

Resin : 59.01 ± 0.12%
Wax : 20.31 ± 1.03%
Balsam : 1.11 ± 0.01%.
Moisture : 1.01 ± 0.01%
pH : 5.1 ± 0.11
Ash : 4.87 ± 0.01%

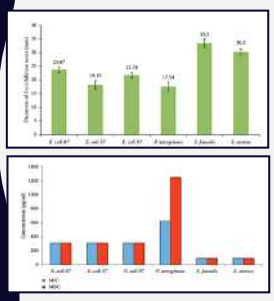
ANTIOXIDANT ACTIVITY

Sample	Phenols (mg GAE/g)	Flavone/ Flavonol (mg QE/g)	TAA (mg AAE/g)	DPPH IC_{50} (mg/ml)	ABTS IC_{50} (mg/ml)	FRAP IC_{50} (mg/ml)
Moroccan Propolis	141.46 ± 1.67	98.33 ± 1.19	94.76 ± 1.91	0.02 ± 0.002	0.04 ± 0.001	0.04 ± 0.001

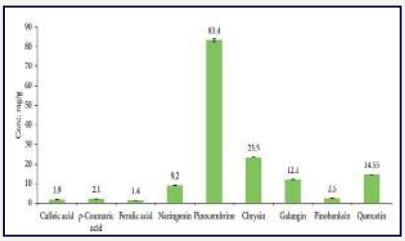
ANTI-INFLAMMATORY ACTIVITY



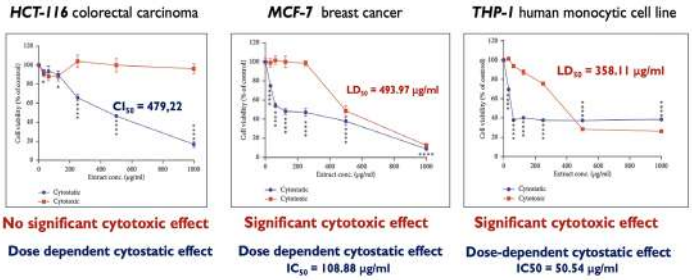
ANTIBACTERIAL ACTIVITY



PHENOLIC COMPOUNDS



CYTOTOXIC AND CYTOSTATIC ACTIVITIES



Taken collectively, our results show that traditionally known anticancer effects of the PNM seem to be mediated in part through cytostatic effects and immunomodulatory effects. These include the inhibition of proinflammatory cytokines and stimulation of the anti-inflammatory cytokine in LPS-activated PBMNCs.

The results of this study show that propolis from Morocco has important therapeutic activities especially in suppressing the TNF-α and IL-6 production and increasing the production of the anti-inflammatory IL-10.

CONCLUSIONS

The multitarget actions including antibacterial, anti-oxidant, cytostatic, and immunomodulatory actions of the Moroccan propolis seem to be as a result of the presence of several active compounds which may act in a synergistic pathway.

Our findings suggest the potential application of PNM in the pharmaceutical industry as well as in health foods and nutritional supplements. Still, propolis is yet or hardly considered in health systems, the main obstacles being lack of standardization and data from well-conducted clinical trials related to safety (allergy, toxicity) and therapeutic efficacy.

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PP-324 [Apitherapy]

The effect of dehydrated honey as an energy source on boar sperm quality parameters

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Introduction

The semen used in artificial insemination (AI) procedure is diluted with various types of extenders that act as an energy source, provide temperature protection, facilitate membrane stabilization, pH buffering, antibiotic action, and generally extend sperm storage time. Dehydrated honey (DH) is a more convenient liquid honey alternative consisting of various types of carbohydrates that can act as an additional energy source for spermatozoa. The objective of this study was to evaluate the effect of storage at 17 °C for 96 hours on the motility and viability of boar spermatozoa when different concentrations of DH were added to semen samples.

Methods

Twelve semen samples were collected from 12 breeding boars, diluted with long term extenders, divided into separate parts and supplemented with 0 % (DH0), 0.1 % (DH0.1), 0.5 % (DH0.5), 1 % (DH1) and 2 % (DH2) dehydrated honey (Fig. 1).

Fig. 1. Dehydrated honey.

All samples were stored in a refrigerator at 17 °C for a period of 96 hours. Total sperm motility and sperm viability (HOST test and eosin/nigrosin staining (Fig. 2)) were determined before (0 H) and after 96 hours (96 H) of storage.

Fig. 2. Sperm cells stained with eosin/nigrosin: 2 viable (white), 1 non-viable (pink).

Results

Following the designated storage period, the eosin/nigrosin staining method showed the greatest reduction in sperm viability in the DH0 control group, with a percentage of non-viable spermatozoa of 45.92% (SD (standard deviation) = 16.262). In DH1, the percentage of non-viable spermatozoa was 40.33% (SD = 13.330), which was 5.59% lower (Fig. 3). No significant effect was observed in other DH concentrations compared to the control.

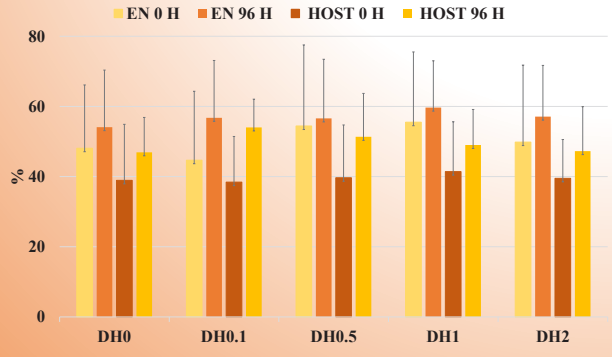

Fig. 3. Effect of dehydrated honey on sperm viability (eosin/nigrosin staining (EN) and HOST).

Furthermore, the hypo-osmotic swelling test (HOST) revealed the lowest viability in the DH0 control group (46.92% (SD = 9.931)), while in the DH1 group it was 49.00% (SD = 10.126). The DH1 group exhibited the highest total sperm motility and the lowest percentage of non-motile spermatozoa (11.66% (SD = 9.324)). In contrast, the DH2 group had the highest percentage of non-motile spermatozoa (27.44% (SD = 16.138)) ($P < 0.05$) (Fig. 4).

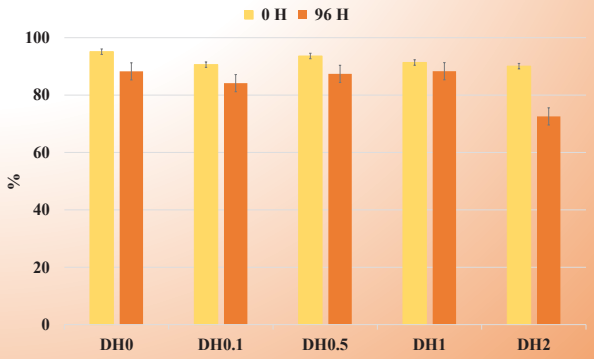

Fig. 4. Effect of dehydrated honey on sperm motility.

Discussion and conclusion

In conclusion, after 96 hours of storage at 17 °C, semen samples with a 1% dehydrated honey concentration had the highest levels of motility and viability across multiple assessments. In comparison, the control group had the greatest reduction in viability, highlighting the potential benefits of using appropriate concentrations of dehydrated honey to maintain semen quality during storage.

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PP-326 [Apitherapy]

Identification from a Rwandan propolis of 2,4-Di-*tert*-butyl phenol as an antimicrobial agent against *Cutibacteriumacnes*

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OFA OBSERVATOIRE FRANÇAIS D'APIDOLOGIE — Bee for life

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- **Propolis**, a resinous substance crafted by honeybees, boasts a rich history in traditional medicine spanning millennia. Derived from tree buds and bark, propolis, with its sticky and gummy consistency, results from the collection of resins by foraging bees, creating a blend with pollen, waxes, and enzymes. Literature sources reveal that propolis is primarily composed of key constituents: plant resins (constituting 50–70%), beeswax (making up 30–50%), essential and aromatic oils (comprising 5–10%), and pollen (contributing 5–10%), in addition to trace quantities of organic compounds and minerals. The exact composition varies based on plant source, bee species, harvesting seasons, and climate changes. This versatile apiary product has demonstrated a spectrum of clinical applications, including antioxidant, anti-cancer, anti-inflammatory, and antimicrobial effects. It is crucial to recognize that propolis is not a singular entity; its composition varies depending on the local environement, and not all types will demonstrate the same effectiveness in treating a specific condition
- **Acne** stands out as the prevailing dermatological condition among humans, primarily affecting approximately 80% of adolescents during the onset of puberty, a period marked by hormonal fluctuations that are uniform across genders. The anaerobic bacillus *Cutibacterium acnes*, recognized as a primary contributor to acne vulgaris, colonizes pilosebaceous follicles, deriving energy from sebum triglyceride hydrolysis and secreting predominantly propionic acid. These by-products can irritate the follicular wall, inducing inflammation that attracts neutrophils to infection or inflammation sites.
- **Antibiotics** play a pivotal role in restraining bacterial growth, with oral antibiotics serving as the primary treatment for moderate acne. Notably, systemic erythromycin and various generations of tetracyclines have demonstrated efficacy in addressing inflammatory acne. However, the prolonged use of topical and oral antibiotics against *C. acnes* has led to a prevalent emergence of resistance, particularly in European Union countries (91% and 92.4% for both antibiotics in Spain, Greece 75.3% and Italy 59.5%)

1 Harvesting Propolis from various collection sites in Rwanda

2 Identification of propolis with best antibacterial properties

Hydroalcoholic Propolis extracts

Sample	MIC (µg/mL)					
	E. coli ATCC 25922	*S. aureus* ATCC 25923	*S. epidermidis* CIP 81.55	*B. cereus* ATCC 11778	*C. acnes* DSM 1897	*C. acnes* DSM 39753	*C. acnes* DSM 110516
OFAP 2	>256	>256	256	16	8	16	32
OFAP 6	>256	>256	>256	125	125	64	256
OFAP 7	>256	>256	>256	64	64	32	32
OFAP 9	>256	>256	256	32	32	16	ND
OFAP 10	>256	>256	32	64	16	32	ND
OFAP 11	>256	>256	>256	64	64	64	ND
OFAP 15	>256	64	32	16	16	ND	ND
OFAP 16	>256	>256	>256	32	32	ND	ND
OFAP 18	>256	64	16	16	16	16	16
OFAP 20	>256	>256	>256	64	16	32	>256
OFAP 21	>256	64	64	32	32	32	>256

Antimicrobial activities of various Rwandan propolis extracts

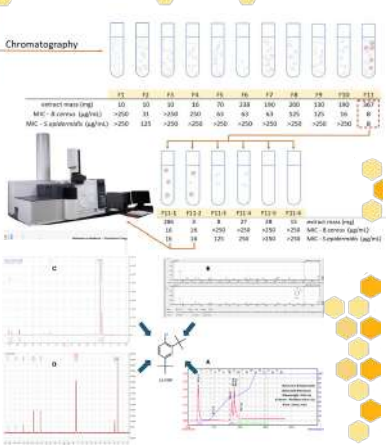
3 Identification of the antibacterial molecule from OFAP 18, the 2,4-Di-tert-butylphenol

Method :

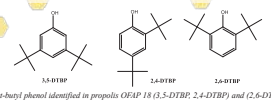
- Submission to flash chromatography of crude 1,8 g powder of OFAP 18
- Antimicrobial activities test of all the fractions
- Determination of the nature of the molecule present in fraction F11.1 by GC-MS

The structure of the molecule was clearly determined as 2,4-di-*tert*-butylphenol (2,4-DTBP) and ^{1}H and ^{13}C NMR spectrometry.

Notably, we also detected the presence of 3,5-Di-*tert*-butylphenol (3,5-DTBP) an isomer of 2,4-DTPB in a 1:10 ratio relative to 2,4-di-*tert*-butylphenol in the analyzed propolis sample.



4 Antimicrobial activities of OFAP18, 2,4-DTBP, 3,5-DTBP and 2,6-DTBP



Structure of Di-tert-butyl phenol identified in propolis OFAP 18 (3,5-DTBP, 2,4-DTBP) and (2,6-DTBP)

Sample	CMI (µg/mL)				
	E. coli 25922	*S. aureus* 25923	*S. epidermidis* 81.55	*B. cereus* 11778	*C. acnes* 1897
OFAP18	>256	64	16	16	16
2,4-DTBP	>256	16	16	8	16
2,6-DTBP	>256	>256	128	256	>256
3,5-DTBP	>256	32	32	16	64

Antimicrobial activities of OFAP18, 2,4-DTBP, 3,5-DTBP and 2,6-DTBP against a wide range of bacterial strains

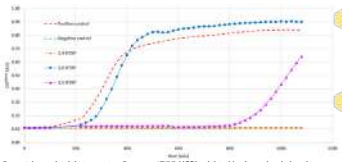
Sample	CMI (µg/mL)					
	C. acnes DSM1897	*C. acnes* DSM110512	*C. acnes* 110516/GRV-IR	*C. acnes* DSM110517	*C. acnes* DSM110518	*C. acnes* DSM A179
2,4-DTBP	16	16	16	16-32	16	16

Antimicrobial activities of 2,4-DTBP against a large panel of C. acnes bacterial strains

The antimicrobial activity tests of the commercial molecules 2,4-DTBP, 3,5-DTBP demonstrated strong antimicrobial activity against *B. cereus* and *C. acnes*, particularly for 2,4-DTBP whereas no activity was encountered by using isomer 2,6-DTBP.

We extend the spectrum of action of 2,4-DTBP on a larger panel of *C. acnes* strains confirming the great activity towards this pathogen with a MIC of 16 µg/mL even against an erythromycin resistant strain.

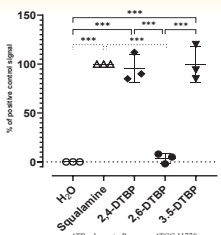
No inhibition of bacterial growth was observed in the presence of 2,6-DTBP at a concentration of 16 µg/mL. In contrast, the growth response to 2,5-DTBP was more nuanced; inhibition was observed during the first 13 hours, followed by a subsequent escape from the action of the compound. Finally, significant growth inhibition was only observed with the 2,4-DTBP isomer used at 16 µg/mL concentration.



Bacterial growth inhibition against B. cereus ATCC 11778 exhibited by di-tert-butyl phenol isomers (2,4-DTBP, 3,5-DTBP and 2,6-DTBP) used at a 16 µg/mL concentration.

5 Mechanism of action 2,4-DTBP: Permeabilizing and disrupting behavior of the outer membrane of Gram-positive B. cereus

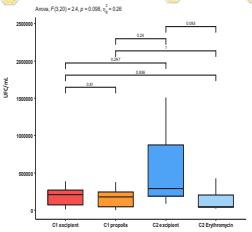
A bioluminescence method was developed involving the detection of the external concentration of ATP which was used as a reporter reflecting the permeabilizing effect of 2,4-DTBP and 3,5-DTBP.



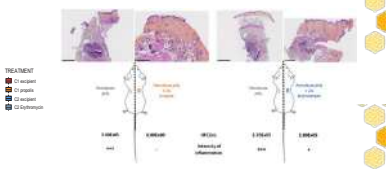
ATP release in B. cereus ATCC 11778

6 Application: Propolis anti-acne ointment

We formulated an ointment using OFAP18 and petroleum jelly (1% propolis or erythromycin) for the treatment of acne in a mouse model. We applied propolis and erythromycin ointments daily for 8 days before injecting the bacterial suspension. We then evaluated the efficacy of propolis and erythromycin ointments against *C. acnes* colonization over the course of 2 days.



Representation of bacterial counts of C. acnes based on the treatments performed on the two cohorts of mice.



**propolis and erythromycin treated mice exhibited lower epidermal inflammation than control ones treated with excipient 2 days after injection with 10^8 CFU/mL of C. acnes DSM1897 suspension.*

These data support the effectiveness of the propolis-based cream OFAP18 and, more broadly, the molecule 2,4-DTPB responsible for its antibacterial activity.

ROUVIER *et al*, *Antibiotics* **2024**

PP-327 [Apitherapy]
Impact of bee products in managing pathologies

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Bee products are inexhaustible sources of bioactive molecules. There are extensively used in folk medicine for the prevention and self-treatment of several diseases and has become actually the objective of many scientific investigations. Different biological and pharmacological effects of honey, propolis and bee pollen have been referred to their antioxidant, antibacterial, antitumoral, anti-inflammatory agents, antihyperglycemic effect and renal disease protection. Oxidative stress is believed to be responsible for the occurrence of several pathologies. We have shown that honey, propolis, bee pollen and royal jelly have antioxidant and anti-inflammatory properties.

Phytochemical analysis of propolis, honey and pollen extracts showed the presence of several natural antioxidants belonging to different chemical groups: flavonoids, phenolic acids and stilbens. These may be responsible for the documented efficacy of several extracts in protecting biochemical characteristics and enzymatic activities of kidneys and liver tissues from alterations induced by xenobiotics. Overall, daily intake of propolis and/or honey or bee pollen could offer promising protective effects on hepatic and renal functions, as well as maintaining the redox homeostasis. Scientific reports from our laboratory have shown that bee products have a wide chemical composition and multi-functional properties. In this context, and in order to understand the relationship between biomolecules from beehive products and their functional potential, we investigated the antioxidant properties of these bee products, their capacities for preventing lipid peroxidation and scavenging free radicals was generally correlated with their phytochemical screening. It was also shown that simultaneous treatment with honey, propolis or bee pollen extract alone or in association prevented changes caused by gentamicin administration and improved hepatic and renal functions. Changes caused by gentamicin administration, observed by in vivo experiments, include significant elevation of uric acid, urea, creatinine, and hepatic enzyme levels (ALT, AST, and ALP) and kidney biochemical changes (an increase of urea, uric acid, and creatinine and a decrease of albumin and total protein) as well as remarkable changes of renal and liver oxidative stress markers (CAT, GPx, and GSH) and elevation of MDA levels.

Bee products might be useful in the management of several diseases. These results pave the way for controlled clinical studies.

PP-328 [Apitherapy]

Abs Ref: 0176

ANALYSIS OF BEE PROPOLIS AS A HYPOGLYCEMIC AGENT AND DIABETES CONTROL

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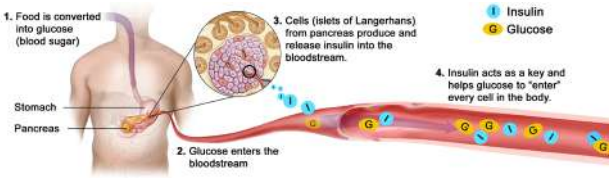
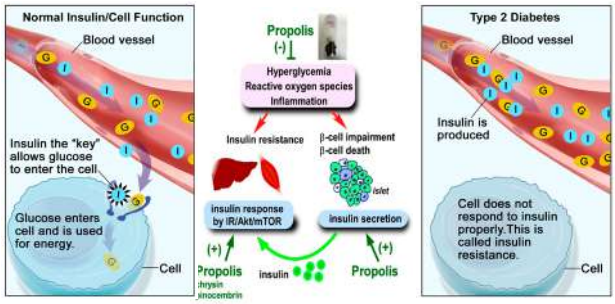
REMARKS

The main mechanism for controlling blood glucose levels in type I and II diabetes is insulin therapy. In type I diabetes, the pancreas stops producing insulin. Therefore, glucose control is entirely dependent on external administration of this hormone. In type II, the body develops insulin resistance or the pancreas doesn't produce enough.



Propolis, a resinous substance collected by bees, has been studied for its potential benefits in managing diabetes, particularly Type II diabetes.

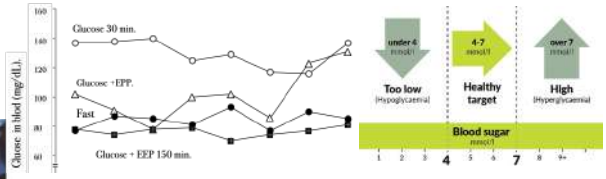
Research suggests that it may help control blood glucose levels through several mechanisms. The key compounds in propolis, especially flavonoids and other polyphenols, are believed to be responsible for its effects. Here's a breakdown of how propolis may help with diabetes control. In the pancreas, GLUT2 detects the blood glucose level and triggers the release of insulin.



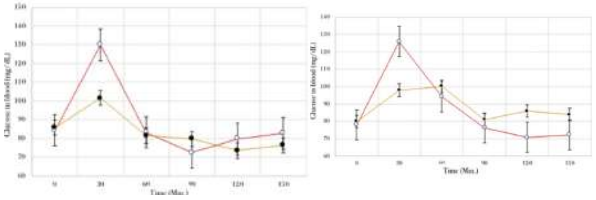
- Propolis can increase the activity of glucose transporter 4 (GLUT4), a protein responsible for moving glucose from the bloodstream into muscle cells. This improves the body's ability to use glucose, lowering blood sugar levels.
- It has powerful antioxidant and anti-inflammatory properties. In animal models, it has been shown to protect the insulin-producing beta cells in the pancreas from damage caused by oxidative stress. This can help preserve their function and improve insulin secretion.
- Chronic low-grade inflammation is a hallmark of insulin resistance and Type II diabetes. Propolis can suppress the production of pro-inflammatory cytokines, which may help to reduce inflammation and improve overall metabolic health.

MATERIALS AND METHODS

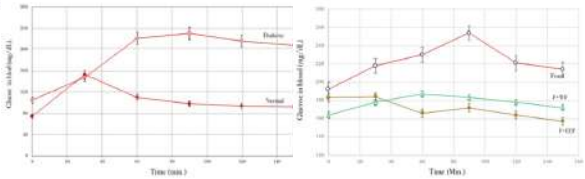
The hypoglycemic effect of propolis was evaluated in healthy young adults of both sexes, aged 17–24 years. A preliminary pilot study was conducted to determine baseline blood glucose levels in 45 volunteers who fasted for 11 hours prior to testing. After a 15-day interval, glycemic curves were obtained by administering 300 mL of a glucose solution (0.25 g·mL^{-1}) and recording blood glucose at 30-minute intervals over 2.5 hours. In a subsequent trial under the same conditions, participants received 300 mL of a glucose solution (0.25 g·mL^{-1} in water) supplemented with an ethanolic propolis fraction identified as having the highest total flavonoid content. Blood glucose was again measured every 30 minutes over 2.5 hours. Each propolis dose contained 6.1 mg of flavones plus flavonols and 119 mg of total flavanones.



In the studied population, fasting glucose averaged 82.3 ± 7.10 mg/dL, increased to 127.1 ± 9.65 mg/dL after glucose ingestion, and then declined to 83.3 ± 11.7 mg/dL at 60 min and 72.4 ± 12.3 mg/dL at 90 min. When comparing these results with those obtained under glucose + EEP treatment, a regulatory effect of propolis components was evident: glucose levels decreased from 127.1 ± 9.65 mg/dL to 99.8 ± 21.9 mg/dL in men (≈ 21% reduction) and from 121.5 ± 7.90 mg/dL to 117.3 ± 0.50 mg/dL in women at 30 min. The mean difference of 27.3 mg/dL was statistically significant. Overall, EEP tended to regulate glucose levels over time, contributing to the maintenance of basal levels as glucose naturally declined.



In diabetic adults, averages of 115 to 205 mg dL^{-1} were observed for pre and postprandial conditions. In the phases after evaluating the glycemic curves for each of the observation groups, administration of a standard dose of solution (EEP) demonstrated a substantial effect on blood glucose levels. This condition suggests that the solutions (EEP) can contribute to the control and modulation of the metabolic rate of blood glucose in humans, with possible modulations on the lipid profiles of patients with diabetes problems.



Propolis may inhibit the activity of enzymes like alpha-glucosidase and alpha-amylase, which break down carbohydrates in the gut. Bee propolis extracts led to decreased levels of blood glucose (FBG), fructosamine (FRU), malonaldehyde (MDA), nitric oxide (NO), nitric oxide synthetase (NOS), total colesterol (TC), triglyceride (TG), low-density lipoprotein cholesterol (LDL-C), very low-density lipoprotein cholesterol (VLDL-C) in serum.

PP-330 [Apitherapy]
Protective Effect of jujube Honey Against Ovalbumin-Induced Asthma in Albino Wistar Rats

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OBJECTIVE: This study aimed to evaluate the protective effect of Moroccan jujube honey against ovalbumin (OVA)-induced asthma in Albino Wistar rats.

METHODOLOGY: Rats were divided into three groups: a normal group (non-asthmatic, treated with distilled water), a control group (asthmatic, treated with distilled water), and a honey-treated group (asthmatic, treated with an aqueous solution of honey at 1 g/kg of BW). Asthma was induced using OVA sensitization and challenge, where rats received intraperitoneal injections of 1 ml of a sensitizing preparation containing 200 µg OVA and 10 mg Al(OH)per ml of saline on days 1, 2, 3, and 11 of the experiment. At day 5, rats were daily gavaged by selective interventions for a total period of 21 days. From day 19 of gavage, they were exposed to 300 µl of saline containing 1.5 mg OVA via intranasal instillation for three consecutive days. Blood, bronchoalveolar lavage fluid (BALF), and lung tissues were collected at the end of the experiment for immunological and histopathological analysis, including total white blood cell count, monocytes, lymphocytes, neutrophils, basophils, eosinophils, and IgE levels.

RESULTS: The control group exhibited a significant increase in white blood cell count, monocytes, lymphocytes, neutrophils, basophils, eosinophils, and IgE levels compared to the normal group, whereas the honey-treated group showed a preventive effect by attenuating these increases. Besides, histological analysis revealed alveolar condensation, bronchial dilation, pneumocyte hyperplasia, and peripheral nodular inflammatory infiltration in the control group. However, treatment with jujube honey mitigated these pathological changes.

CONCLUSION: These findings suggest that jujube honey may have a protective role against OVA-induced asthma by modulating inflammatory and immune responses.

PP-331 [Apitherapy]

Royal jelly as a natural supplement for improving semen quality and blood parameters in breeding dogs

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Introduction

Royal jelly, a secretion from worker honeybees, is known for its antioxidant and reproductive benefits. While its effects on various species are studied, its role in canine fertility remains unclear. Enhancing semen quality is crucial for breeding success, and natural alternatives to synthetic supplements are gaining interest. This study aims to assess the impact of Royal jelly on semen quality and blood parameters in breeding dogs, providing insights into its potential as a natural reproductive health supplement.

Methods

Fig. 1. Study dog and supplements.

The study was conducted in a kennel with six German Dwarf Spitz dogs (2.5–3 years old), divided into two groups: a control group (n=3) receiving glucose tablets (100 mg/day) and an experimental group (n=3) receiving Royal jelly tablets (100 mg/day) for ten days.

Semen and blood samples were collected at three time points: before supplementation (T1), 10 days after supplementation (T2), and two months post-supplementation (T3).

Fig. 2. Semen collection, semen samples.

Fig. 3. Sperm motility testing program.

Semen was analyzed for volume, motility, concentration, and morphology, while blood samples were examined for biochemical and morphological parameters.

Results

Royal jelly supplementation significantly improved sperm subjective motility (MOT) and volume in the experimental group compared to the control group ($P<0.05$). The sperm motility in the Royal jelly group increased from 65.0% (SD=13.2) at T1 to 85.0% (SD=5.0) at T2 and remained elevated at T3 (86.7% (SD=2.9)). The control group did not show a statistically significant difference ($P>0.05$). Semen volume also increased in the Royal jelly group (T1: 1.6 (SD=0.06) mL; T2: 2.0 (SD=0.46) mL; T3: 2.0 (SD=0.44) mL), while the control group showed a decreasing trend (T1: 1.43 (SD=0.49) mL; T2: 1.27 (SD=0.20) mL; T3: 1.33 (SD=0.40) mL.

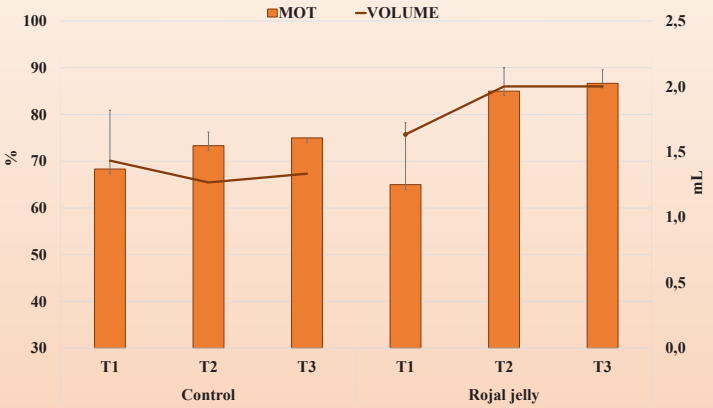

Fig. 4. Effect of Royal jelly on sperm motility and volume.

Blood morphology remained within the normal range across all time points in both groups, and blood biochemistry showed no significant differences but indicated improvements in some parameters. These findings suggest that Royal jelly supplementation can enhance semen quality without negatively affecting overall health.

Discussion and conclusion

The study highlights the potential of Royal jelly as a valuable supplement for improving fertility in breeding dogs, offering a new market opportunity for beekeepers. With increased awareness of natural reproductive enhancers, Royal jelly could gain broader recognition in veterinary applications, encouraging sustainable and profitable beekeeping practices.

PP-332 [Apitherapy]

Bee Air Therapy:

A Natural Approach to Human Well-Being

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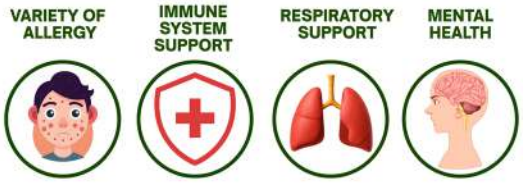
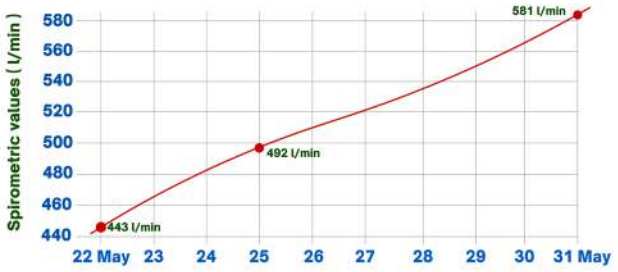
BEE CLINIC
KLINIKË BLETE

BEST APITERAPI BATLLAVË

CLINICAL CASE:
Asthma
Nasal Mucus
Oral/airway Mucus
Male, 45 years of age



SPIROMETRIC RESULT



SPIROMETRY

BEE AIR THERAPY

PROPOLIS STEAM THERAPY

SUMMARY OF RESULTS

Spirometer assessments demonstrated a clear upward trend across the monitoring period. Measurements increased from 443 on the 22nd to 492 on the 25th, and further to 581 on the 31st. A linear regression line of best fit indicates a consistent positive trajectory, suggesting progressive improvement in respiratory function over time.

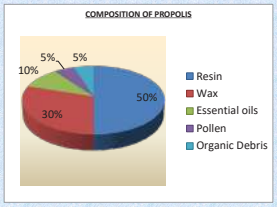
CONCLUSION

These findings confirm a novel and holistic method in treating asthmatic patients. The increase in expiratory time with the forgone removal of the asthmatic pump suggest a successful conclusion.

PP-333 [Apitherapy]

TO STUDY THE EFFECT OF BEE PROPOLIS ON GINGIVITIS AND PLAQUE CONTROL

INTRODUCTION :- Propolis or `bee glue' is the generic name for the resinous substance collected by honeybees from various plant sources. The word propolis is derived from the Greek pro-, for or in defense, and polis-, the city, that is, defense of the city (or the hive). Propolis is a strongly adhesive, resinous substance collected, transformed and used by bees to seal holes in their honeycombs, smooth out the internal walls and protect the entrance against intruders.

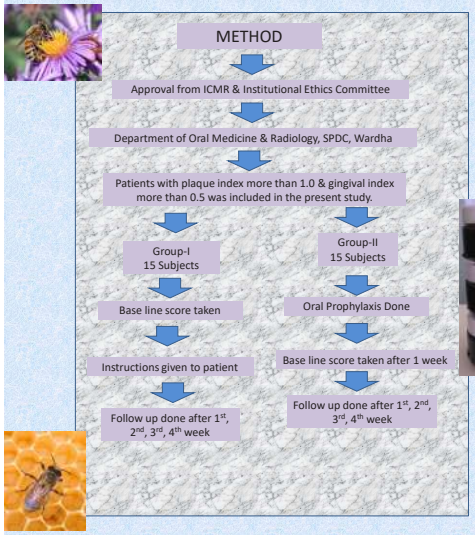


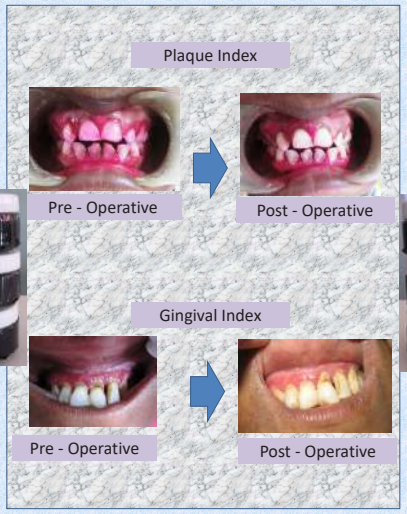
AIMS AND OBJECTIVES :-

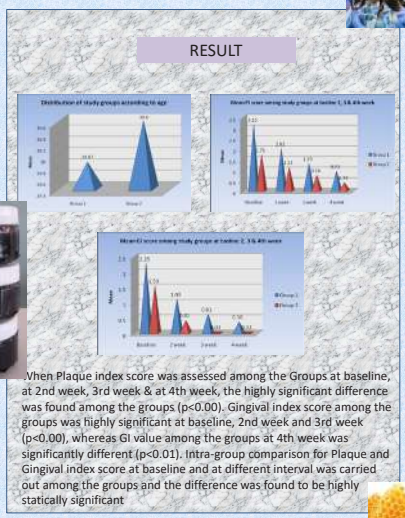
- To study effect of bee propolis in plaque control & gingivitis by using ethanolic extract of bee propolis in Gel form . To compare pretreatment plaque & gingival index at the base-line with at the end of two weeks, three weeks & fourth weeks in patients without oral prophylaxis **(Group-I).**
- To compare pretreatment plaque & gingival index at the base-line with at the end of two weeks, three weeks & fourth weeks in patients with oral prophylaxis **(Group-II).** To correlate pretreatment & post-treatment plaque & gingival index in group I & group II .

MATERIALS AND METHOD:-

3000 Grams raw propolis was obtained from Central Bee Research & Training Institute, Pune & 3.5% ethanol extract was prepared in gel form. For dispensing 30 gram light protective plastic container was used. Before, dispensing the drug all information regarding the source of drug & its action was provided to the patients then after obtaining write consent patient was included in study group.







DISCUSSION:-

"Apitherapy" is a distinguished method of treatment based on the use of products which are collected, processed or produced by bees. Such products include the following: pollen – as a product collected by bees, propolis, nectar honey, and bee bread – products collected and processed by bees, royal jelly, bee venom and beeswax – products secreted by bees. The therapeutic properties of propolis have been used in dentistry for many years, focusing on the four most well-known properties of that substance: regenerative, anti-bacterial, anesthetic and stimulation of the immune system. The therapeutic properties of propolis can be confirmed with its effectiveness in periodontal diseases, as it mitigates the course of alveolar osteitis. Its anesthetic properties are used in dentin hypersensitivity, electro-coagulation of hypertrophic inter-dental papillae and minor surgical procedures. There are also reports on research tests with the use of propolis in the treatment of pulp and caries . Propolis is also used in the form of gel and rubbing ointments, a 10-percent ethanol solution for brushing and a 0.2-percent ethanol-water solution for mouth-washing used three times a day in the treatment of periodontal diseases, ulcerative gingivitis, chronic and recurrent aphthous ulcers, desquamative cheilitis and bullous and ulcerative forms of lichen planus. Propolis, to produce the anti-inflammatory effect, acts in the modulation of cytokines and inflammatory enzymes, such as the suppression of the production of prostaglandins, leukotrienes, histamine, and TGF-β1.There are some studies *in vitro* and *in vivo* where propolis, in several formulations, has demonstrated activity against periodontal pathogens. Synergistic effects of different compounds seem to be the most important process to explain the antibacterial activity of propolis, since it is well established that a single propolis component does not have an activity greater than the other components of propolis isolated.Reducing, the number of microorganisms in dental plaque results in the reduction of products released by them, which act as trigger of gingival inflammation. In the present study, 3.5% ethanolic extract of Indian propolis were effective in controlling the plaque & gingivitis. It produced significant reductions in supra-gingival plaque and gingivitis, in both groups when compared to baseline scores index with second, third and fourth week. These findings are probably justified by the antibacterial and anti-inflammatory effects of propolis.

CONCLUSION:-

Current opinion is that the use of standardized preparations of propolis is safe and less toxic than many other synthetic medicines. Since the anaerobic microflora associated with aggressive periodontitis may be resistant to several antibiotics, the reported antimicrobial activity is of relevance. The results of this study indicate the antimicrobial activity of ethanolic extract of **Indian** propolis. The present study showed evidence of the efficacy of 3.5% ethanolic extract of Indian propolis for the control of plaque and gingivitis, suggesting that it can be used as a therapeutic and preventive use for the control of periodontal diseases.

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PP-334 [Apitherapy]
Propolins content in the different parts of Macaranga tanarius trees—a source plant of the Pacific type propolis

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Taiwanese Green Propolis (TGP) is a Pacific type of propolis, which is derived from the fruit surface materials of Macaranga tanarius trees, a propolis source plant collected by honey bees. The ethanol extract of TGP contains the unique active chemical ingredients - propolins, with the highest content of propolin C, D, F, G, and H, which has been proven to have antibacterial, anticancer, antioxidant, anti-inflammatory and other biological activities. Due to the small production of TGP, it can only be produced and harvested during a specific fruiting period (approximately May-July). Macaranga tanarius is a masculine pioneer tree, which is widely distributed throughout the island of Taiwan, and the plant itself has the characteristics of easy collection, easy planting and year-round picking. Therefore, in this study, different parts (leaves, petioles, flowers, fruits) of the plants were collected in different seasons, dried and extracted with 80% ethanol, and the propolins content of the extract was analyzed. The results showed that, in addition to the petioles, the leaves, flowers and fruits of Macaranga tanarius tree contained propolins. Among them, the total content of propolins in fruit extract (5.03 mg/ml) was the highest, and the content of C, D, F, G, and H of propolins was similar to that of TGP, but the total content of propolins was still lower than that of TGP (89.9 mg/ml). Although the propolins content (1.79 mg/ml) in the leaf extract was not high, the content of propolin G could reach 1.57 mg/ml. In addition, the DPPH free radical scavenging ability was tested with the same concentration (10 mg/ml) of TGP extract and Macaranga tanarius leaf extract, and the scavenging ability of the latter was about 30% of that of the former. In summary, the fruits, flowers, and leaves parts of the Macaranga tanarius plant contain vary propolins, which has the potential to become a substitute raw material for TGP, especially the leaves of the plant can be extracted as an important source of propolis G.

PP-335 [Apitherapy]

USE OF BEE ROYAL JELLY IN THE THERAPY OF GYNECOLOGICAL PATHOLOGIES

RESULTS OF A CLINICAL STUDY

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knizhenko.medok@gmail.com / iolkin.medok@gmail.com / www.medok.com

RELEVANCE OF THE CLINICAL STUDY TOPIC

In order to strengthen the evidence base for apitherapy, Medok Company LLC (Ukraine) organized a series of clinical studies of beekeeping products. In 2019, at the Kharkiv National Medical University (Ukraine), at the clinical sites of the Department of Obstetrics, Gynecology and Pediatric Gynecology, a clinical study was conducted on the effect of royal jelly on the state of the reproductive system and the course of gynecological diseases in women.

STUDY GROUP

110 female patients ages from 6 to 46 years were observed for a year. Based on a comprehensive examination, the following patholog ical conditions were verified for these patients: menstrual dysfunction, disorders of sexual development, tumors, inflammatory diseases of the female reproductive system, genital injuries, etc .

APITHERAPY COURSE

In addition to standard treatment regimens, all patients were prescribed a course of apitherapy. Capsules with royal jelly (per os), suppositories with royal jelly (per vaginam), and suppositories with drone homogenate (per rectum) were used.

RESULTS OF THE APITHERAPY COURSE

After the treatment, the examined patients showed a statistically significant decrease in the pathological clinical manifestations of gynecological diseases.

CLINICAL STUDY FINDINGS

Based on the results of this clinical study, strong conclusions were drawn that the use of products with royal jelly contributes to pronounced immunostimulating, antiseptic and anti-inflammatory effects. The products used during the therapy also demonstrated high effectiveness with no complications or adverse reactions, which demonstrates the high potential of their usage to improve people's health.

1) normalization of hormonal levels;
2) rapid hemostasis in case of abnormal uterine bleeding;
3) restoration of menstrual f unction;
4) positive dynamics in the development of secondary sexual characteristics in case of delayed sexual development;
5) reduction in the severity of pain syndrome in dysmenorrhea and regression of ovarian retention formations;
6) reduced recovery time in the postoperative period;
7) relief of swelling and discomfort in the mammary glands;
8) elimination of pathological discharge due to external genital inflammation;
9) decrease in menopausal symptoms, etc.

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PP-336 [Apitherapy]
Effects of royal jelly and its extracts on endometrial receptivity and MCF-7 cell growth in rats with thin endometrium

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Background/PURPOSE: Royal jelly (RJ), a nutrient-rich secretion from honeybees, has potential health benefits, including hormone-like effects that may improve reproductive health. Thin endometrium, a condition where the endometrial thickness is insufficient for embryonic development, poses a significant challenge to female fertility. Current treatments often involve hormone therapy, which can have adverse side effects. This study explores the therapeutic potential of RJ and its extracts in improving endometrial receptivity and their effects on MCF-7 breast cancer cells.

Problem Description: Thin endometrium affects fertility and pregnancy outcomes. Hormone therapies, while effective, can impose a burden on the liver and have other side effects. Safer, natural alternatives are needed to enhance endometrial thickness and receptivity without adverse effects.

METHODOLOGY: A rat model of thin endometrium was established and treated with RJ, RJ protein extract (RJ-Pr), RJ fatty acid extract (RJ-FA), and estradiol valerate (E2) as a positive control. Endometrial thickness, gland number, and blood vessel count were measured. Serum estrogen and progesterone levels were assessed, and VEGF expression was analyzed. In vitro experiments on MCF-7 cells evaluated cell proliferation, apoptosis, and estrogen receptor (ER) expression.

Results and CONCLUSION: RJ and its extracts significantly improved endometrial thickness and vascularization in rats with thin endometrium. RJ-FA showed the most pronounced effects, increasing VEGF and AKT expression while decreasing PI3K expression. In MCF-7 cells, RJ and RJ-Pr promoted apoptosis and increased ERβ expression, while RJ-FA enhanced cell proliferation and ERα expression. These findings suggest that RJ and its extracts can improve endometrial receptivity through estrogen-like effects, with RJ-FA being particularly effective. However, high doses of RJ-FA may promote cancer cell growth, indicating a need for careful dosage consideration.

Practical Implications for Beekeepers: The study highlights the potential of RJ as a natural alternative for improving reproductive health. Beekeepers can explore the production and marketing of RJ and its extracts for therapeutic applications. However, the dual effects of RJ on endometrial health and cancer cell growth suggest that further research is needed to optimize dosages and ensure safety. Beekeepers should collaborate with researchers to develop standardized RJ-based products that maximize health benefits while minimizing risks.

PP-337 [Apitherapy]
Comparative Study Of Wound Healing Properties Of Apis Totale In Rats

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Honeybees produce important bee products that are beneficial for human and animal health. In addition to these products that can be consumed for human and animal health, it is also possible to utilize them after the natural death of the honeybee. This product, called “apis totale” (podmore), is prepared with dead bees collected in hives in the fall or spring. Podmore contains bee venom, pollen, nectar, bee bread, royal jelly and chitin, naturally. Podmore extract traditionally uses apitherapy for wound treatment, radiation protection, nerve healing, obesity and general support. This study aimed to compare podmore extract with propolis extract and silver sulfadiazine in the treatment of surgically sterilized wounds on the back skin of rats. Within the scope of the study, the healing level of the back skin was followed and histological analysis was performed. In the study, chemical analysis, amino acid analysis, wound healing and antioxidant activity level of podmore extract and phenolic compound analysis of propolis extract were performed. As a result, it was revealed that podmore extract had positive effects on wound healing in rat back skin. When histopathologic findings were examined, it was observed that podmore and propolis groups were more effective than silver sulfadiazine and had similar histopathologic appearance. It was found that epithelial integrity was successfully completed in the podmore group, however, in the propolis group, protection in terms of hair follicles and sebaceous glands was at the highest level. Among the experimental groups, the lowest healing was found in the control group and the epidermis thickness was thinner than all groups. Our study is a pioneering study for content analysis of podmore extract and investigation of its activity in biological processes besides of using facilities this up-cycle bee product.

PP-338 [Apitherapy]
Does Apis Totale Have A Protective Effect On The Harms Of Radiation In Rats?

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Honeybees produce important bee products that are beneficial for human and animal health. In addition to these products that can be consumed for human and animal health, it is also possible to utilize them after the natural death of the honeybee. This product, called “Apis totale" Apis totale is produced by completely grinding dead drones and worker bees. It is obtained by extracting the biological contents of glands, internal organs and body parts. It contains chitin, heparin, heparinoid, glucosamine, melanin, acetic acid, honey, bee bread, propolis, pollen, royal jelly, apilarnil, bee venom, wax, melanin oil (Omega 3-6-9 and Q-10), proteins, carbohydrates, essential amino acids, polypeptides, flavonoids, proteins, enzymes, hormonal, vitamins, fiber, sterin, multiple Contains unsaturated fatty acids, hemolymph, peptides (adolapin, melitin, MCD-peptide, apamin and protease inhibitors). Apis totale extract form traditionally uses apitherapy for wound treatment, radiation protection, nerve healing, obesity and general support. This study aimed to investigate that Apis totale extract have a protective effect on the harms of radiotherapy. In experimental design of the study, radiotherapy applied to the left abdominal skin of the rats. The left abdominal region of the rats skin was shaved under proper anesthesia dosage and radiotherapy was applied. After formation of radiation-induced dermatitis Apis totale exract and sulfadiazine treatment compared each other. In the study the healing level of the abdominal skin was followed and histological analysis was performed. In the study, chemical analysis, amino acid analysis, dermatitis healing levels, ALT, AST, BUN levels in blood were performed. In radiation-induced dermatitis groups; one group Apis totale exract applied to the abdominal skin which radiotherapy apply, in the second group Apis totale excract applied with oral gavage before radiotherapy apply, after that radiotherapy applied than Apis totale excract applied to skin as a result of these we compared Apis totale excract protective effect on the harms of radiation. And all of the Apis totale excract groups compared to sulfadiazine treatment group and control groups. Our study is the pioneering study for investigation of Apis totale extract protective effects to the harms of radiotherapy and content analysis of it.

PP-339 [Apitherapy]

The Role of Apitherapy in Integrative Medicine: A Comprehensive Approach to Healing with the Hive

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Background & Purpose

Apitherapy—the medicinal use of bee-derived products—has been practiced for centuries across cultures. Today, as chronic illness, pain, and autoimmune conditions rise, more people are turning to integrative care.
This study explores how apitherapy—including honey, propolis, bee venom, bee pollen, oxymels, jun, bee bread, hive air, and beekeeping itself—can be used as a primary treatment modality in modern health care [3], particularly for inflammation, pain, and neurological conditions. Medicinal beekeeping supports both therapeutic efficacy and the economic sustainability of apiaries by producing high-value, health-supportive products.

Problem Description

Despite growing interest in natural and integrative medicine, hive products remain under-recognized in the U.S. for their full therapeutic potential. Many healthcare providers are unaware of their efficacy, while beekeepers often struggle to convey the medicinal value of what they produce.
This disconnect limits patient access to time-honored, effective treatments—and hinders beekeepers from building sustainable livelihoods rooted in wellness.
Medicinal beekeeping offers a way forward: by centering hive health, ecological integrity, and product potency, it creates new market pathways grounded in health, education, and intentional production. A shift toward this approach could strengthen small farm economies and enhance outcomes for both patients and practitioners.

Results & Conclusion

Clients receiving apitherapy report decreased inflammation and pain, improved cognitive clarity and energy, better digestion, and stronger immune resilience.
BVT is especially effective in conditions like MS, Lyme, RA, and chronic pain. Fermented products and hive air therapies enhance gut healing and nervous system balance.
Apitherapy reconnects us with the healing intelligence of bees and offers a regenerative model of care grounded in relationship, rhythm, and reciprocity. When beekeepers grow medicine, they not only nourish their communities but also transform their livelihood through deeper connection, purpose, and regenerative income streams.

Methodology

This work draws from over a decade of direct practice with clients using apitherapy as a primary treatment modality. It integrates ancient hive medicine with modern clinical intuition, drawing from case studies, client outcomes, and the lived feedback of hundreds of individuals over time.
Apitherapy includes both topical and internal use of hive products, as well as fermented and herb-infused preparations created for systemic support. Each therapy is chosen and adapted based on the unique needs and constitution of the individual.

Bee venom therapy (BVT):

Used to treat Lyme disease, chronic pain, multiple sclerosis, arthritis, and a wide range of stagnation-based conditions. BVT supports circulation, detoxification, and cortisol modulation, while stimulating nerve regeneration and immune resilience.

Propolis:

A resinous hive compound with powerful antiviral, antibacterial, and antifungal properties. Supports immune modulation, oral health, skin repair, and chronic infection recovery. Also beneficial in cases of microbial resistance.[2]

Honey:

Enzymatic and antimicrobial, honey aids in wound healing, microbiome restoration, and metabolic support. Internally, it soothes the digestive tract and supports immune response; externally, it speeds tissue repair. [1]

Bee Pollen:

A highly nutrient-dense adaptogen rich in protein, enzymes, vitamins, and bioflavonoids. Supports immune health, hormone balance, and stamina; often used in rebuilding protocols.

Bee bread:

A fermented form of pollen containing lactic acid bacteria and bioavailable nutrients. Especially helpful for gut flora diversity, nutrient absorption, and post-illness recovery.

Oxymels:

Traditional herbal preparations preserved in honey and apple cider vinegar. Support digestion, lymphatic flow, seasonal immunity, and serve as gentle carriers for deeper plant medicines.

Jun (fermented honey beverage):

A honey-based probiotic beverage traditionally fermented with green tea. Jun supports microbiome balance, liver function, detoxification, and sustained energy. Often called the "champagne of kombucha," it's lighter, smoother, and naturally sweet — made with honey instead of sugar.

Hive air inhalation:

Therapeutic inhalation of hive atmosphere, rich in volatile oils and aerosols. Helps support respiratory conditions, calm the nervous system, and restore parasympathetic tone.

Beekeeping as medicine:

Working closely with the hive invites mindfulness, somatic awareness, and heart-centered healing. Beekeeping becomes an embodied practice that strengthens mental clarity, nervous system regulation, and connection to nature.

Tenets of Medicinal Beekeeping

A Framework Rooted in Ecological Integrity, Hive Health, and Healing Potential

These tenets are adapted from the authors' practical experience, formalized in the 10 Medicinal Beekeeping Guidelines for the International Federation of Apitherapy (IFA) and reflected throughout *Raising Resilient Bees*

1. Hive Stewardship – Center hive management on mutualism, seasonality, and non-chemical care rooted in observation and presence.
2. Hive Product Integrity – Prioritize purity and potency through clean harvesting, organic inputs, minimal processing, and natural materials.
3. Bee-Plant Relationship – Site hives near diverse medicinal flora; collaborate with herbalists and land stewards to align blooms with colony cycles.
4. Queen Longevity & Genetic Diversity – Support naturally mated, long-lived queens and diverse drone populations to build resilient genetics.
5. Monofloral Medicinal Products – Harvest single-source honeys with specific therapeutic profiles (e.g., thyme for antimicrobial action, linden for calming).
6. Bee Health Strengthening – Use placement, forage diversity, thermal regulation, and immune-supportive inputs (e.g., propolis, honey-fed, biodiverse bee forage) over artificial feeding or chemicals.
7. Relationship-Centered Management – Build trust and innerstanding through consistent, informed, attuned hive visits. Prevent illness proactively.
8. Medicinal Harvest Practices – Harvest respectfully and only in times of abundance. Use ethical materials like stainless steel, glass, and food-grade tools.
9. Ecosystem & Ethics – Ensure clean forage zones and support long-term ecosystem health. Medicinal hives rely on thriving landscapes.
10. Power to the Producer – Medicinal bee products must remain traceable to the beekeepers who made them. No white-labeling or anonymous distribution.

Practical Implications for Beekeepers

Reimagining Hive Products as Regenerative Medicine

Medicinal beekeeping transforms hive products from low-value commodities into high-potency healing agents.[4] When beekeepers adopt methods that prioritize purity, potency, and ecological responsibility, they open the door to regenerative income streams and deeper land connection.[5]
Integration of apitherapy into mainstream and integrative care systems could:

- Create viable markets for small and mid-scale beekeepers.
- Foster local health sovereignty by offering accessible, potent, bee-based remedies.
- Shift apiculture from industrial extraction toward ecological stewardship and relationship-based healing.

This model honors the intelligence of bees, the power of nature, and the role of the beekeeper as both medicine maker and land steward.

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1. Silva, B., et al. (2017). Antioxidant and anti-inflammatory activities of honey: A review. Food Chemistry, 210, 293–301.
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PP-340 [Apitherapy]

Physico-Chemical and Antibacterial Properties of Herbal-Infused Honey

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Introduction

Honey is known for its antibacterial, antifungal, and antioxidant properties, primarily due to its high sugar content, low water activity, and presence of hydrogen peroxide and other bioactive compounds. Additionally, when infused with medicinal herbs, the bioactive properties of the honey can be significantly enhanced. Herbs contribute additional phytochemicals, including flavonoids, polyphenols, and essential oils, which further boost the mixture's ability to combat harmful microorganisms. Thust honey-herb infusions may be effective against a range of pathogens, including antibiotic-resistant bacteria.

Problem description

The growing interest in natural antimicrobials necessitates the exploration of novel honey products formulation with enhanced multifunctional properties. However, limited research exists on the combined effects of herbal infusion on honey's antibacterial activity and quality parameters. This study investigates the effects of *Thymus vulgaris* L. infusion on the physico-chemical properties and antibacterial efficacy of multifloral honey.

Methodology

Two groups of samples were prepared and analysed: (1) raw multifloral honey and (2) raw multifloral honey infused with *Thymus vulgaris* L. Summer honey was collected in Lithuania in 2024. Herb enriched honey was prepared by addition of 5% (by mass) of dried herb (all parts of the plant without roots). Physico-chemical parameters, including pH, moisture content and electrical conductivity were analyzed. Antibacterial activity was assessed against 10 pathogenic and opportunistic bacterial strains using the agar well diffusion method.

Results and Conclusions

Herbal infusion altered honey's physico-chemical properties, increasing electrical conductivity and pH, but the moisture content was found to be the same in both samples. The raw honey sample demonstrated increased antibacterial activity against *Staphylococcus aureus, Salmonella enterica, Pseudomonas aeruginosa,* and *Enterobacter cloacae,* whereas the infused honey sample was effective only against *Salmonella enterica.*

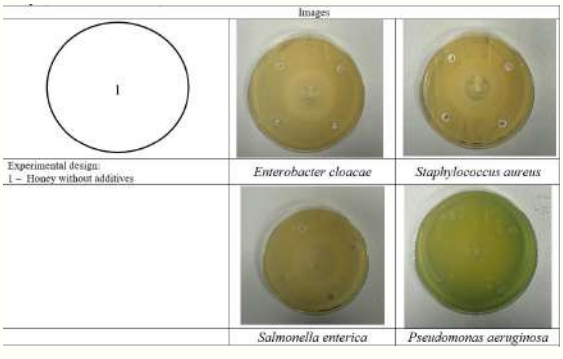

Fig. 1. Honey (without additives)

Fig. 2. 1, 2, 3, 4 – empty; 5 – *honey with 5% Thymus vulgaris* L.

Practical Implications

Herbal-infused honey offers an exciting innovation for beekeepers, combining medicinal plant infusions to enhance its antibacterial properties and mineral content. This high-value product meets consumer demand for natural remedies, boosting both economic returns and the sustainability of apiculture, as well as promoting non-traditional agriculture - cultivation of medicinal herbs.

The authors acknowledge the apiary "Biciuliukai" (Lithuania) and COST action CA22105.

PP-341 [Apitherapy]
From rapeseed to honeydew: comparative analysis of antimicrobial, antioxidant, and bioactive properties of different honey types

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BACKGROUND
Honey is a product with antibacterial, antioxidant, and wound-healing properties. Its biological activity varies depending on botanical origin. This study integrates two independent research projects evaluating the antibacterial, antioxidant, and bioactive properties of different Polish honey varieties. The first study assessed antimicrobial and antioxidant activity of buckwheat, rapeseed, linden, and honeydew honey collected from the IMMUNO University of Szczecin's apiary. The second study analyzed heather, buckwheat, rapeseed, and linden certified honey "Miód Drahimski", focusing on phenolic acid composition, skin penetration, and formulation stability. By combining these studies, we provide a broader understanding of honey's therapeutic potential.

Problem Description:
Despite increasing interest in honey's pharmacological applications, beekeepers and consumers lack detailed comparative data on its bioactivity. Moreover, while honey-based formulations are gaining popularity in dermatology, little is known about their effectiveness in delivering bioactive compounds through the skin. This study aims to address these gaps by evaluating honey's antimicrobial properties, polyphenol content, and its ability to enhance skin permeation of phenolic acids.

METHODOLOGY:
Honey samples were tested for antibacterial activity using spectrophotometric determination of Minimum Inhibitory Concentration (MIC) and Minimum Bactericidal Concentration (MBC) against Staphylococcus aureus, Bacillus subtilis, and Escherichia coli. Antioxidant potential was assessed using the Folin–Ciocalteu method and Ferric Reducing Antioxidant Power (FRAP) assay. Vitamin C content was determined spectrophotometrically. In "Miód Drahimski" we also analyzed phenolic acid composition using HPLC and examined skin permeation with Franz diffusion cells. Biodegradability of honey-based hydrogels and emulsions was also tested.

Results and CONCLUSION: Buckwheat and honeydew honey exhibited the highest antibacterial activity. Heather honey showed the highest antioxidant potential and polyphenol content. Phenolic acids, especially gallic acid and 3,4-dihydroxybenzoic acid, penetrated the skin more effectively when incorporated into hydrogel formulations. Biodegradability tests classified honey-based formulations as partially biodegradable, supporting their use in eco-friendly cosmetics. These findings suggest that different honey types may be optimized for medical, pharmaceutical, and cosmetic applications.

Practical Implications for Beekeepers:
Beekeepers can utilize these findings to promote honey's value beyond nutrition. The demonstrated antimicrobial and antioxidant effects support honey's application in apitherapy and dermatology. Proper harvesting and storage can preserve its bioactive properties, enhancing product quality.

APIMONDIA SCANDINAVIA 2025
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PP-342 [Apitherapy]

Apimondia 2025, Copenhague, 23- 27 septembre 2025

Exploring the nutritional value of fresh bee pollen from different Belgian areas

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Introduction

Despite its potential as a promising area of growth for beekeepers, the valorisation of bee products other than honey is limited in Belgium. Bee pollen is widely available in this country, is easy to collect and could contribute to the local economy. However, the nutritional value and safety of Belgian bee pollen must be investigated, as well as its stability despite geographical and seasonal variables.

For two years, the main objective of this research was to characterise fresh bee pollen samples (*i.e.* not dried) collected monthly from three Belgian apiaries located in distinct geographical areas, regarding nutritional quality, but also safety aspects, botanical origin and sensory properties.

Materiel & Methods

3 apiaries / 3 geographical areas:
- Rural area (Doische)
- Urban area (CERIA – Brussels)
- Suburban area (Louvain-la-Neuve)

Pesticide residues
Trace elements
Gross composition
Antioxidant capacity
Total polyphenols
Minerals
Amino acids profile
Palynology

Results

1. Contaminants & Toxicity

Screening of > 300 pesticide residues (GC-MS & LC-MS/MS)
- **2023** → 1 herbicide in the suburban sample (< MRL)
- **2024** → 2 fungicides and 1 herbicide in the rural sample (< MRL), but presence of 1 fungicide (Fluopyram) > MRL (0.057 mg/kg) !

Trace elements (ICP-AES)
- Higher Pb concentrations in urban area ; < LOQ in rural area;
- As, Pd, Sb and Sn always < LOQ ;
- Presence of Al, Co and Ni but no norms available for bee pollen.

2. Gross composition

The gross composition reported to dry weight did not differ significantly between geographical areas (**Fig. 1**) or between years and seasons. However, variable moisture contents were observed, probably associated to the different types of pollen traps used during the study (Romanian *vs*. RG trap).

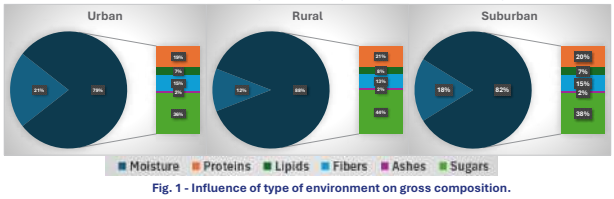

Fig. 1 - Influence of type of environment on gross composition.

3. Focus on specific nutritional properties

The nutritional properties of bee pollen were also investigated, including its antioxidant capacity and polyphenols content, amino acids profile and minerals concentration. High antioxidant capacity was observed, associated with polyphenols content of around 4 mg of gallic acid equivalent per g of pollen. No significant influence of localisation was observed (**Fig. 2A**), but polyphenols levels tended to decrease during the year (**Fig. 2B**).

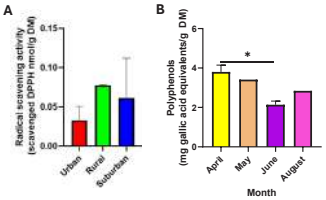

Fig. 2 – Study of antioxidants. (A) Radical scavenging activity determined using DPPH method according to the type of environment; (B) Total polyphenols concentrations determined by Folin-Ciocalteu method, depending on the month of collection.

On average, all the samples were a good source of all the essential amino acids, with profiles that remained almost constant throughout the year and between apiaries (**Fig. 3A**). Daily consumption of 10 g of pollen could significantly contribute to dietary requirements for essential amino acids (**Fig. 3B**).

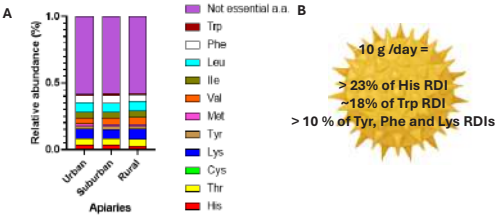

Fig. 3 – Amino acids composition of Belgian bee pollen. (A) Amino acids profiles by geographical area, determined by HPL-UV after protein hydrolysis and amino acids derivatization ; (B) Part of the recommended dietary intake (RDI) potentially supplied by the consumption of 10 g of pollen per day.

4. Palynology and Sensory analysis

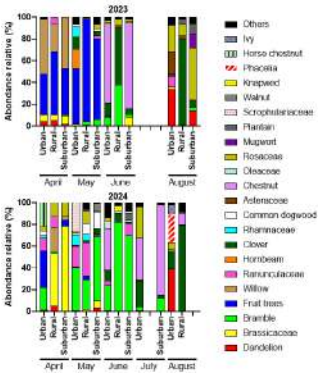

Fig. 4 – Botanical origins of all bee pollen samples determined by optical microscopy.

Palynological analyses (**Fig. 4**) revealed significant differences between geographical areas, especially during the summer months, and between seasons, with a more diverse range of botanical origins from June. There were also notable differences between years, such as dry (2023) versus rainy (2024) years and the presence or absence of canola fields close to apiaries. Notably, fruit trees pollens dominated all samples in April–May 2023 but were barely observed in 2024.

A quantitative sensory analysis was performed by 15 judges. During pre-sessions, more than 20 attributes were identified, focusing on colour, taste, aromas, texture and aftertaste. Interestingly, data analysis highlighted three groups of correlated attributes (**Fig. 5**): (a) Colourful, sweet and acidic pollens with a fruity aroma, (b) Green bitter pollens with chemical and plant aromas, and (c) Yellow pollens with intense floral and honey aromas.

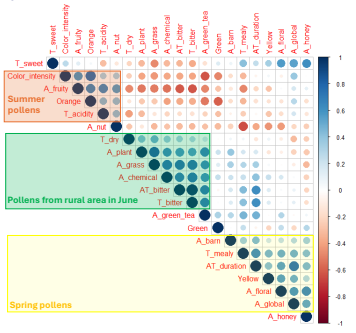

Fig. 5 - Correlation between sensory attributes. Blue and red bullets indicate positive and negative correlations between two descriptors, respectively ; T, A and AT are attributes related to texture, aromas and aftertaste, respectively.

Conclusions & Perspectives

This study confirmed the nutritional interest of Belgian bee pollen, which is a good source of proteins with a high-quality amino acids profile. It is also rich in polyphenols, which confer antioxidant properties. Furthermore, while most samples are free from major contamination, monitoring the presence of pesticide residues remains important.

In the next years, it would be interesting to continue this work in order to confirm the trends observed during this two-year study, particularly the progressive decrease in polyphenols concentrations over the course of a year, and to attempt to link sensory attributes to the botanical origins of pollens. The actual bioavailability of nutrients also remains to be investigated, as does the absence of any cytotoxic effect on human intestinal cells.

Acknowledgements. The author would like to thank technical staff of CARI for performing palynological analysis, all people who took part to tasting sessions, and Meurice R&D asbl for the funding of this research.

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PP-343 [Apitherapy]

Identification of Cough Suppressant Components in Honey: Flazin and a New Compound, Melpyrrole

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Objectives To evaluate the cough suppressant effect of honey in a controlled experimental setting and identify its active components

Background

Honey as cough suppressant

Honey has long been used as a folk remedy for cough, and numerous studies have demonstrated its ability to improve both the frequency and severity of cough compared to usual care.

2007	The first report: honey can soothe nighttime cough in children [1]
2010	Cochrane review: Honey probably relieves cough symptoms in children better than no treatment (updated: 2012, 2014, 2018; headquarters: London)
2011	A study shows honey or honey with coffee is effective to adult cough [2]
2015	Codeine was contraindicated in children under 12 in EU (US: 2017, Japan: 2019)

Some of the earliest records of using honey as a remedy for cough can be traced back to ancient Egypt.

What's the active component(s) in honey?

Honey contains about 80% sugar and about 20% water with minor and trace elements. Those composition depends on source plant, harvest season, and so on.

Polysaccharides, flavonoids and/or phenolic compounds have been reported to suppress inflammation in upper respiratory tract infection [3,4]. However, the active components and mechanisms of the cough-suppressing effect of honey have not yet been clarified.

○ Other
proteins, lipids, minerals, vitamins, other organic compounds (phenolic acids, flavonoids, melanoidin).

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[3] Šutovská M, *et al. Int J Biol Macromol.* 2009;44:236–9.
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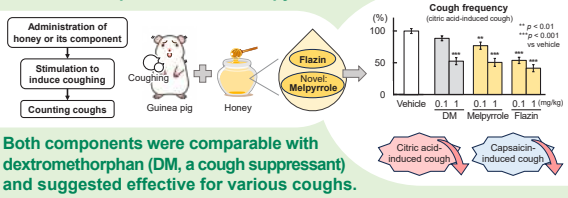
Key Findings

1 In this study, we developed a system to evaluate the cough suppressant effects of honey and its components in guinea pigs.

2 Two active components were discovered for the first time, one of which is a novel compound named "melpyrrole."



3 Both components were comparable with dextromethorphan (DM, a cough suppressant) and suggested effective for various coughs.

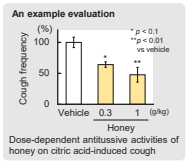
These findings provide aspects for evidence-based standardization of honey products and future development of a new type of cough medicine.

Tani H, *et al. J Agric Food Chem.* 2023;71:13805-13.

System Setup for Cough-Suppressant Evaluation

Method: Thirty minutes after intragastric administration of test samples, guinea pigs inhaled 100 mM citric acid or 10 μM capsaicin aerosol (5 min, ultrasonic nebulizer). Coughs were counted for 30 min from inhalation onset.

Figure 1. Citric acid- or capsaicin-induced guinea pig cough model



Dose-dependent antitussive activities of honey on citric acid-induced cough

Evaluation Cough Suppressant Activity of Honey

Method: DM (positive control) and honey were tested using the evaluation system.

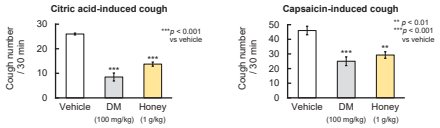


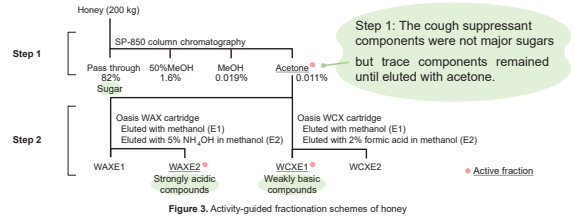
Figure 2. Antitussive activity of DM and honey in citric acid- and capsaicin-induced guinea pig cough models

DM and honey significantly reduced the cough number induced by citric acid (stimulates Aδ-fibers) and capsaicin (stimulates C-fibers).

Screening, Identification and Evaluation of Active Components

Screening 1 Search for Active Fractions of Honey

Method: Honey was separated on Sepabeads SP-850 column chromatography and two types of ion-exchange cartridges, WAX and WCX. Cough suppressant activity of each fraction was evaluated.



Step 1: The cough suppressant components were not major sugars but trace components remained until eluted with acetone.

Figure 3. Activity-guided fractionation schemes of honey

Step 2: Amphoteric compounds (possessing both acidic and basic functional groups) have been suggested as active components.

Screening 2 Search for Active Components

Method: Candidate active components were identified by LC/MS/MS-based multivariate analysis. Peaks common to active fractions with ≥2-fold change ($\log_2$ FC > 1) and $p < 0.01$ ($-\log_{10} p > 2$) were selected and shown in orange (○).

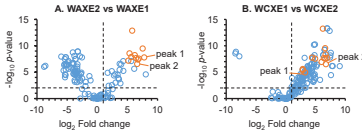


Figure 4. Volcano plot of the comparison for active fractions vs inactive fractions

Table 1. Candidate active components

	m/z	Estimated formula
peak 1	308.10	$C_{17}H_{13}O_3N_2$
peak 2	309.09	$C_{17}H_{12}O_4N_2$

Peak 2 (*m/z* 309.09), the most intense peak in the active fractions, was selected. Peak 1 (*m/z* 308.10), with a lower MS signal, differed from peak 2 by approximately one mass unit and had a formula in which one O atom replaced by an N atom.

Identification Structural Determination of Active Components

Method: Structures were predicted based on the fragmentation patterns observed in LC-MS/MS and confirmed either by direct comparison with an authentic standard or by chemical synthesis.

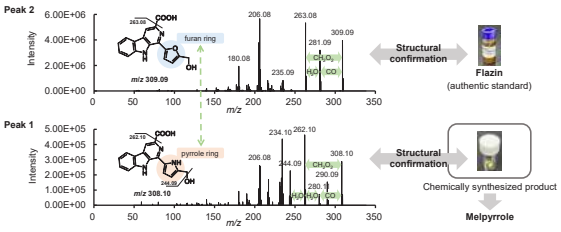


Figure 5. Positive ESI MS/MS spectra of candidate antitussive components in honey

Peak 2 was identified as flazin. Peak 1 was a novel compound in which the furan ring of flazin was replaced with a pyrrole ring, and named "melpyrrole."

Evaluation Cough Suppressant Activity of Melpyrrole and Flazin

Method: DM, melpyrrole and flazin were tested using the evaluation system.

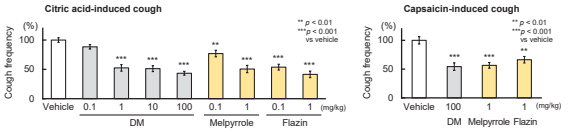


Figure 6. Antitussive activity of melpyrrole and flazin in citric acid- and capsaicin-induced guinea pig cough models

Melpyrrole and flazin suppressed cough in the citric acid-induced cough model, with results comparable to or even better than DM. They also significantly reduced cough in the capsaicin-induced cough model, suggesting broad-spectrum cough suppressant effects.

PP-344 [Apitherapy]

Effects of different multifloral pollen extracts on the vital parameters of human epithelial cell lines

Cristina Rossetti[1], Paola Zinno[1], Barbara Guantario[2], Viviana Valenzano[3], Gennaro Di Prisco[3]
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[3]Institute for Sustainable Plant Protection, National Research Council, Piazzale Enrico Fermi 1, 80055 Portici, Italy.

Nutrition is a factor that plays a significant role in the resilience of honeybees to biotic and abiotic environmental stresses, particularly through pollen, a primary source of proteins and bioactive compounds. In this study, the impact of multifloral pollen-derived polyphenolic extracts on the vital parameters of human epithelial cell lines was investigated to assess their protective potential against microbial pathogens.
Pollen extracts were obtained from colonies of Apis mellifera ligustica, located at the CNR-IPSP experimental apiary. Pollen was collected with specific traps installed at the entrance of the hives for three consecutive days, then stored at low temperatures for subsequent analysis. The effect of these extracts was evaluated on HCT 116 and Caco-2 cell lines by means of MTT (3-[4,5-dimethylthiazol-2-yl]-2,5 diphenyl tetrazolium bromide) assay, Trans-Epithelial Electrical Resistance (TEER) and bacterial adhesion assays.
Preliminary findings indicate that pollen extracts, particularly at high concentrations, demonstrate a dose-dependent cytotoxic effect on HCT 116 cell lines and a positive influence on epithelial barrier integrity, as measured by TEER. Additionally, the extracts exhibited a capacity to inhibit bacterial adhesion of Salmonella Typhimurium, with variations in efficacy depending on the type of extracts and concentrations examined.
Although the potential antimicrobial and protective properties of these extracts have been observed, further studies are needed to clarify the molecular mechanisms behind these effects and to optimise the application of these extracts.

PP-345 [Apitherapy]

Evaluation of therapeutic properties of *Apis florea* honey against *Helicobacter pylori*

Shabnam Parichehreh[1], Gholamhosein Tahmasbi[2], Mohammad Babaei[1], Mohammad Eslampanah[2]
[1]Honey bee Research Department, Animal Science Research Institute of Iran, Agricultural Research Education and Extension Organization (AREEO), Karaj, Iran
[2]Department of Microbiology, Razi Vaccine and Serum Research Institute, Agricultural Research, Education and Extension Organization (AREEO), Karaj, Iran

Abstract
Honey is not only considered as a fabulous food product, but also it has healing properties. Iranian men are susceptible to gastrointestinal cancer caused by *Helicobacter pylori*. It is very imperative to find effective methods to control this bacterium without side effects. In this study *Apis florea* honey samples from 7 various floral and geographical origins of Iran and 5 samples from each region were analyzed in terms of acidity, pH, moisture, sucrose, fructose, glucose, proline, diastase, Ash and HMF. Also, honey samples were analyzed for antioxidant activity using the FRAP, DPPH and ABTS methods. Using atomic absorption measurements, the honey samples were also tested for their phenolic and flavonoid content, protein concentration, and mineral content. Furthermore, antibacterial activity of honey samples against *H. pylori* was assessed in mice's gastrointestinal tracts both in vitro and in vivo. In-vitro antibacterial activities of different honey samples was performed using the agar well diffusion method and In-vivo antibacterial activities of them was analyzed by introducing *H. pylori* into the gastrointestinal tract of mice, feeding them with the honey samples for 75 days and dissecting their stomachs. The Sydney system was also used to assess the degree of inflammation in addition to detecting *H. pylori* contamination. The results showed that the highest and lowest phenol contents were observed in Bushehr (755.83 g/g) and Iranshahr (348.83 g/g), respectively. According to the results, the highest and lowest levels of antioxidant activity with ABTS method, were found in Bushehr (786.40 ± 29.73 µg/g) and Iranshahr (324.90 ± 4.90 µg/g) honey samples. The DPPH and FRAP methods confirmed the results of the ABTS method for honey antioxidant activity. A statistical analysis of the honey samples revealed significant positive correlations between antioxidant and antimicrobial activity. According to the results of antibacterial activity test, in the Bushehr honey sample, gastric mucosa showed mild inflammation and mild degeneration, along with severe eosinophilia. Based on these results, Jujube (*Zizyphus spina Christi*) honey from Bushehr could prevent and cure infections and inflammation caused by the bacteria H. pylori in the gastrointestinal tract.

Materials and methods

Fig 1. Investigation of the physicochemical properties of *A. florea* honey

Fig 2. Evaluation of antibacterial properties of *A. florea* honey against *Helicobacter pylori* in vitro

Fig 3. Evaluation of antibacterial properties of *A. florea* honey against *Helicobacter pylori* in vivo

Results

Table 1 - Antioxidant power of honey samples collected from different areas

Sample	Antioxidant capacity (µgr /gr)		
	ABTS (Mean±SE)	FRAP (Mean±SE)	DPPH (Mean±SE)
Dezful	533.44±19.9 ^{c}	23.28±0.80 ^{ab}	424.64±4.63 ^{d}
Iranshahr	324.90±4.90 ^{d}	14.41±0.95 ^{d}	393.03±11.98 ^{d}
Bushehr	786.40±29.73 ^{a}	26.98±0.92 ^{a}	625.20±26.17 ^{a}
Jahrom	691.96±32.38 ^{b}	23.37±1.81 ^{ab}	570.62±16.58 ^{b}
Jiroft	626.19±6.84 ^{b}	19.97±1.45 ^{c}	472.73±5.59 ^{c}

Table 2 - Diameter of growth inhibition zone of *H. pylori* in different concentrations of different honey samples

Sample	Diameter of growth inhibition zone (mm)	
	100% solution	50% solution
Dezful	14.83±0.15 ^{c}	12.74±0.05 ^{c}
Iranshahr	13.09±0.04 ^{d}	11.32±0.07 ^{D}
Bushehr	19.17±0.12 ^{a}	17.53±0.13 ^{A}
Jahrom	18.83±0.06 ^{ab}	11.65±0.13 ^{D}
Jiroft	18.36±0.15 ^{b}	14.22±0.07 ^{B}

Table 3 – Presence of *H. pylori*, inflammation, degeneration, and eosinophil in the gastrointestinal tract of mice, according to the Sydney System classification scale (0 = Absent, + = Mild, ++ = Moderate, +++ = Severe)

Sample	Inflammation	Degeneration	Eosinophil
Dezful	1	3	1.5
Iranshahr	0.5	2	1.5
Bushehr	0.5	1	3
Jahrom			
Jiroft	1.5	1	1.5
Negative control			
Positive control			

Table 4- Correlation between antioxidant and antibacterial activities of honey samples against *H. pylori*

Antibacterial properties		ABTS	DPPH	FRAP
	Pearson correlation	0.929	0.851	0.672
	Sig	0.000	0.000	0.000
	N	15	15	15

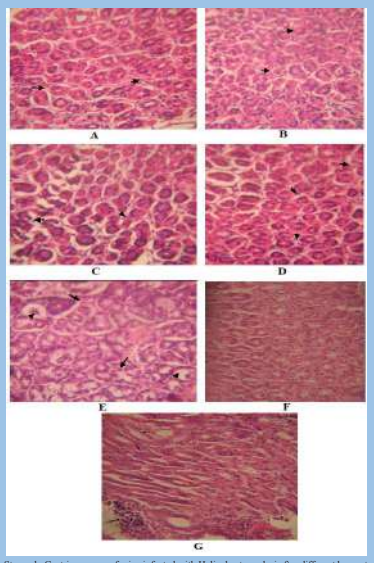

Fig4- (a-g). Stomach. Gastric mucosa of mice infected with Helicobacter pylori after different honey treatment groups
Stomach. Dezful. Mild inflammatory process and severe degeneration in the gastric mucosa were observed. Haematoxylin and eosin× 400.
Stomach. Bushehr. Mild inflammatory process, mild degeneration and severe presence of eosinophils in the gastric mucosa were observed. Haematoxylin and eosin× 400.
Stomach. Jahrom. Mild inflammatory process, relative degeneration and moderate to severe presence of eosinophils in gastric mucosa were observed. Haematoxylin and eosin× 400.
Stomach. Positive control. Moderate inflammatory process, mild degeneration was observed. Haematoxylin and eosin× 400.
Stomach. Jiroft. Mild inflammatory process, moderate to severe degeneration and severe presence of eosinophils in gastric mucosa were observed. Haematoxylin and eosin× 400.
Stomach. Negative control. Haematoxylin and eosin× 400.
Stomach. Iranshahr. Mild inflammatory process, moderate to severe degeneration and moderate presence of eosinophils in gastric mucosa were observed. Haematoxylin and eosin× 400.

Acknowledgement
Razi Vaccine and Serum Research Institute
Tehran University

PP-347 [Apitherapy]
Propolis: Ecological Medicine
James Fearnley
Research Dept: Apiceutical Research Centre Whitby United Kingdom

Propolis fulfils a threefold immune defence role for the superorganism that is the honeybee colony providing physical structural defence for the hive, social hygiene within the hive and internal pharmacological protection for the individual honeybee.

The honeybee collects resins from local plants and trees,adding wax to it from its own body and in so doing transforms the whole into the highly complex substance we know as propolis.
Global research into the relationship between the geographic origin of propolis and its chemical and biological properties illustrates how honeybees are effectively collecting a 'fingerprint' of the local plant populations' immune defence response and converting it into its own unique and individual immune defence system protecting the colony against its local ecological challenges.

Research into the use of propolis as a medicine for human beings is illustrating how propolis from specific geographical locations may also be of particular benefit in treating the diseases in humans within the same local ecology e.g. our analysis of propolis from South Cameroon from an area where sleeping sickness was prevalent in the human population showed the presence of the anti-trypanosome chemicals. This discovery has stimulated the creation of a Global Propolis Survey which we hope will be able to link the effectiveness of local propolis to disease patterns within human beings in those areas.

Ancient concepts of medicines which believed that locally available plants and bee products where most appropriate for the treatment of local diseases in human beings are emerging again as evidence based front runners in the battle against the pandemic of auto immune disease.
These developments have the capacity to revolutionize our concepts of medicine. However we must be aware that should these new natural medicines come from the living world. Without strong measures to ensure a sustainable relationship between human beings and the honeybee both may end up without benefit.

www.apiceuticalresearchcentre.org james.fearnley@beearc.com

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PP-348 [Apitherapy]

InHort INSTYTUT OGRODNICTWA

Katarzyna Jaskiewicz, Teresa Szczesna
The National Institute of Horticultural Research, Apiculture Division
Bee Products Quality Testing Laboratory
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ANTIOXIDANT ACTIVITY AND TOTAL PHENOLIC CONTENT IN POLLEN LOADS AND BEE BREAD COLLECTED FROM ECOLOGICAL APIARY

INTRODUCTION

In recent years, there has been an intensive search for neuroprotective substances, i.e. those that are intended to protect neuronal cells from damage leading to their death. Due to their multidirectional mechanism of action, phenolic compounds of plant origin exhibit good neuroprotective properties. Bee products, such as pollen collected by bees and bee bread, play an important role in the human diet due to their nutritional and health-promoting properties. Phenolic compounds present in these products exhibit strong antioxidant effects, which can contribute to protecting the body from oxidative stress.

The aim of the study was to investigate the antioxidant properties and total phenolic content of pollen and bee bread collected from an ecological apiary.

MATERIAL AND METHODS

Material

The pollen loads and bee bread samples were collected in 2024 beekeeping seasons in an ecological apiary of the National Research Institute of Horticulture, Apiculture Division in Pulawy, located in the Poleski National Park.

Methods

Palynological analysis were conducted by microscopic analysis according Pokajewicz et al. (2024).

The radical scavenging activity of the extract of pollen loads and bee bread samples was assessed by using 2,2-Diphenyl-1-picrylhydrazyl assay according to the method reported by Kahraman et al. (2022). The principle of the method is based on the measurement of the reducing ability of antioxidant components toward DPPH radical.

TPC was determined in aqueous extracts of pollen loads and bee bread samples by using the Folin–Ciocalteu method which was described by Pelka et al. (2021). The principle of the method is to use the ability of phenols to form a colored blue complex with the reactants of the Folin-Ciocalteu reagent and a saturated solution of sodium carbonate (Na_2CO_3).

CONCLUSIONS

1. Bee bread obtained from an ecological apiary compared to pollen loads is characterized by higher biological value determined by antioxidant activity and total phenolic content.
2. The results obtained in this work constitute the basis for continuing research into the use of bee bread in human nutrition and the treatment of civilization diseases.

RESULTS

The results showed that bee bread samples from ecological apiaries contained a higher total phenolic content (mean 1439.7 mg GAE/100 g) compared to pollen loads (mean 304.8 mg GAE/100 g) collected from the same apiary. Antioxidant activity expressed as the percentage of DPPH reduction, was also higher in bee bread samples (mean reduction 94.4%) compared to samples of pollen loads (mean reduction 87.9%).

Fig.1. Standard curve of galic acid (0 – 200 µg/L)

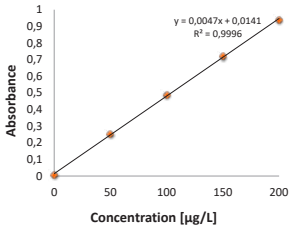

Table 1. Total phenolic content (mg GAE/100 g) and antioxidant activity (DPPH %) of pollen loads and bee bread samples from ecological apiary

	Total phenolic content (mgGAE/100 g)		Antioxidant activity (DPPH %)	
	Bee Bread	Pollen	Bee Bread	Pollen
Mean	1439,7	304,8	94,4	87,9
SD	259,8	73,0	1,8	0,5
Min	1053,9	216,2	91,3	87,1
Max	1728,3	381,4	96,5	88,5
CV	18,0	23,9	1,9	0,5

Fig. 2. Pollen spectrum of pollen loads samples from ecological apiary (%)

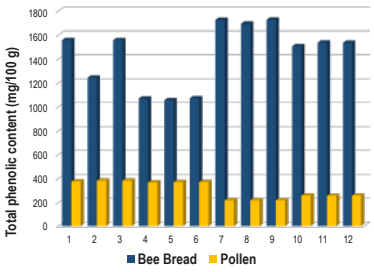

Fig. 3. Total phenolic content (mg GAE/100 g) in pollen loads and bee bread samples from an ecological apiary

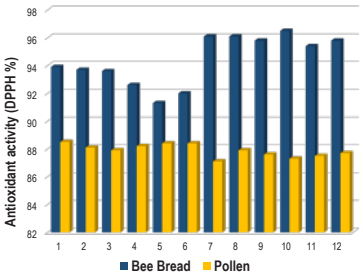

Fig. 4. Antioxidant activity (DPPH %) in pollen loads and bee bread samples from an ecological apiary

Fig. 5. Pollen spectrum of bee bread samples from ecological apiary (%)

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PP-349 [Apitherapy]

Rigshospitalet

UNIVERSITY OF COPENHAGEN

Spectroscopic and Chemometric Profiling of Propolis and Cerumen Across Species and Regions.

Key differences identified using rPLS and STOCSY.

Jonas Vind[1], Søren Balling Engelsen[2], Henrik Munch Jørgensen[1], Julie Christine Antvorskov[3], Knud Josefsen[1], Violetta Aru[2].

Affiliations: [1]Department of Pathology, The Bartholin Institute, Copenhagen University Hospital, Copenhagen, Denmark, [2]Department of Food Science, University of Copenhagen, Rolighedsvej 26, 1958 Frederiksberg C, Denmark, [3]Department of Clinical Research, Steno Diabetes Center Copenhagen, Translational Type 1 Diabetes Research, Herlev, Denmark

Background

Propolis and cerumen are complex mixtures of beeswax, plant resins, and secretions, with composition influenced by geography and bee species. Understanding these differences is key to identifying antioxidant compounds.

Aim

To compare the composition and antioxidant-related compounds in Scandinavian (SC) and Australian (AU) *Apis mellifera* propolis and Australian *Tetragonula carbonaria* cerumen using phase-resolved ^{1}H NMR and recursive weighting partial least squares regression (rPLS).

Experimental

Samples were extracted using a modified Folch method to yield hydrophilic and hydrophobic phases for ^{1}H NMR analysis. Composition was assessed by PCA and wax structure by signal ratios. RSA data were modeled using full PLS and rPLS, and key signals were validated by standard addition.

Results

Scandinavian propolis had more aromatic compounds; Australian propolis had more carbohydrates; cerumen was rich in terpenoids. Wax content was highest in Australian propolis, but only *T. carbonaria* wax differed structurally. rPLS identified ferulic acid and p-coumaric acid as RSA-linked, with higher levels in Scandinavian samples.

Conclusion

^{1}H NMR combined with rPLS effectively revealed species- and region-specific differences in propolis and cerumen. Ferulic acid was identified as a key antioxidant in the aqueous phase, reflecting both compositional and RSA variation.

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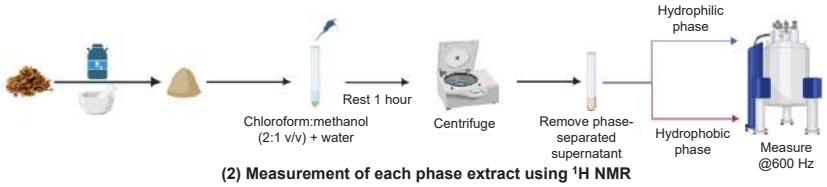
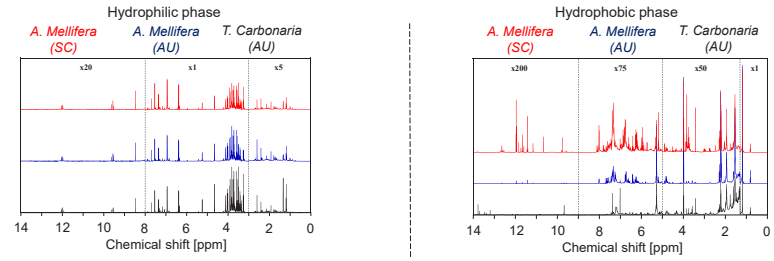
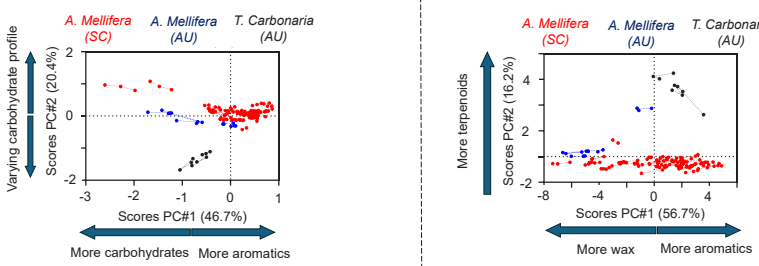
(1) Two phase (hydrophilic and hydrophobic) extraction protocol for propolis samples



(2) Measurement of each phase extract using ^{1}H NMR

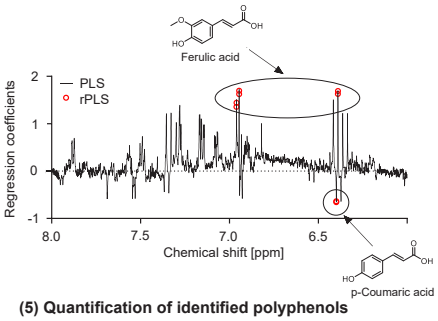


(3) Comparison of chemical composition using PCA

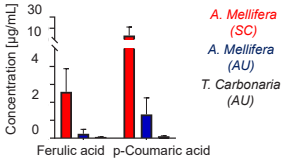


(4) Performance of rPLS to find most important anti-oxidative compounds in hydrophilic phase

A Full PLS and an rPLS model was created and compared. They performed similarly (**PLS: RMSE$_{CV}$ = 8.26%; rPLS: RMSE$_{CV}$ = 7.99 %**), and the selected signals in rPLS thus is indicative of important compounds for anti-oxidative effect of propolis.

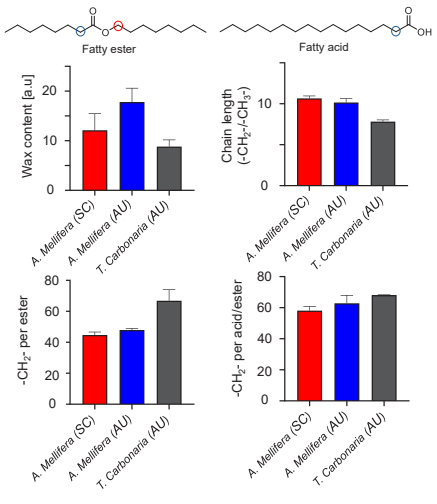


(5) Quantification of identified polyphenols



(4) Comparison of beeswax in propolis and cerumen samples

Wax analysis of propolis and cerumen samples. Wax content was defined by CH_2 signal intensity in ^{1}H NMR; chain length as the CH_2/CH_3 ratio; chain length per fatty ester as the CH_2 to red-circled protons ratio; and chain length per fatty ester and acid as the CH_2 to blue-circled protons ratio.



PP-350 [Apitherapy]

Rigshospitalet

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Comparative Spectroscopic Analysis of Bee Propolis: NIR, FT-IR, FT-Raman and ^{1}H NMR.

Focus on Provenance and Antioxidative Correlation

Jonas Vind[1], Violetta Aru[2], Henrik Munch Jørgensen[1], Julie Christine Antvorskov[3], Hasim Tekin[1], Knud Josefsen[1], Søren Balling Engelsen[2].

Affiliations: [1]Department of Pathology, The Bartholin Institute, Copenhagen University Hospital, Copenhagen, Denmark, [2]Department of Food Science, University of Copenhagen, Rolighedsvej 26, 1958 Frederiksberg C, Denmark, [3]Department of Clinical Research, Steno Diabetes Center Copenhagen, Translational Type 1 Diabetes Research, Herlev, Denmark

Background

Propolis is a polyphenol-rich, resinous substance produced by honey bees. It is widely recognized for its antioxidative activity, mainly attributed to its high content of aromatic polyphenols.

Aim

To compare the chemical composition and antioxidative activity of propolis from Australia, Denmark, and Norway using untargeted spectroscopic methods, and to predict radical scavenging activity (RSA) using multivariate models.

Experimental

Propolis samples (N = 53) from Australia (8), Denmark (38), and Norway (7) were analyzed using IR, Raman, and NIR spectroscopy on raw material, and ^{1}H NMR on chloroform extracts. The latter is not shown in this poster. Radical scavenging activity (RSA) was measured using a colorimetric assay. Data were evaluated by Principal Component Analysis (PCA), correlation analysis, and Partial Least Squares (PLS) regression to explore composition and predict RSA.

Results

PCA showed Danish and Norwegian samples contained more aromatic compounds, while Australian samples had higher levels of carbohydrates and terpenoids. RSA was significantly lower in Australian samples ($p < 0.001$). NIR-based PLS models predicted RSA with the highest accuracy ($R^2 = 0.75$, RMSECV = 6.66%).

Conclusion

Untargeted spectroscopic methods effectively profiled propolis composition and predicted antioxidative activity. Scandinavian propolis showed higher RSA, likely due to increased aromatic polyphenol content. NIR spectroscopy proved most accurate for RSA prediction.

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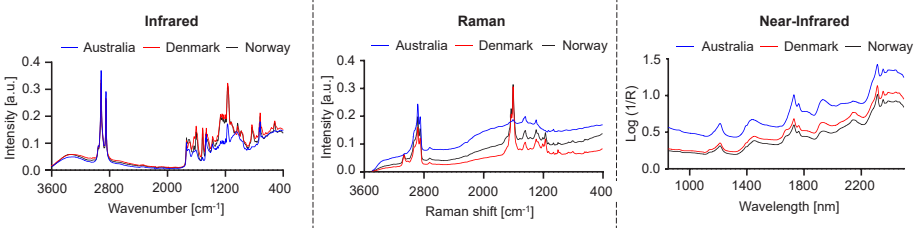
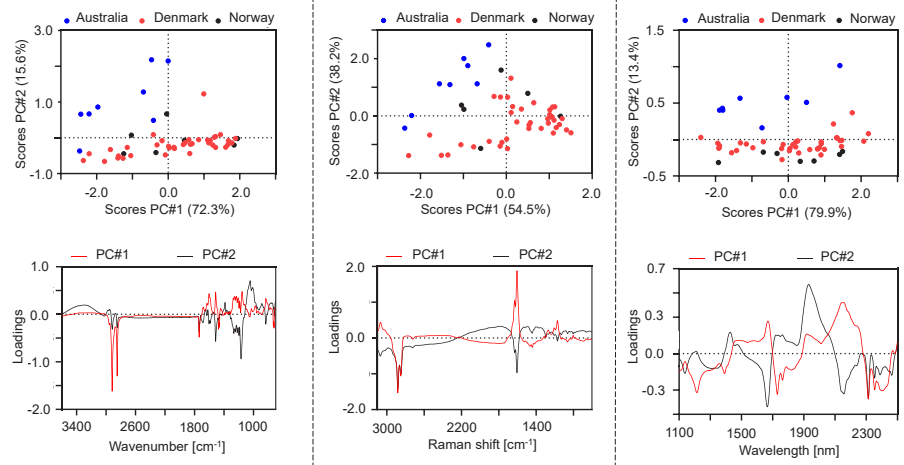
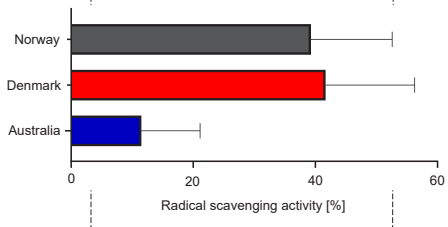
Step 1: Analyse propolis samples using spectroscopy



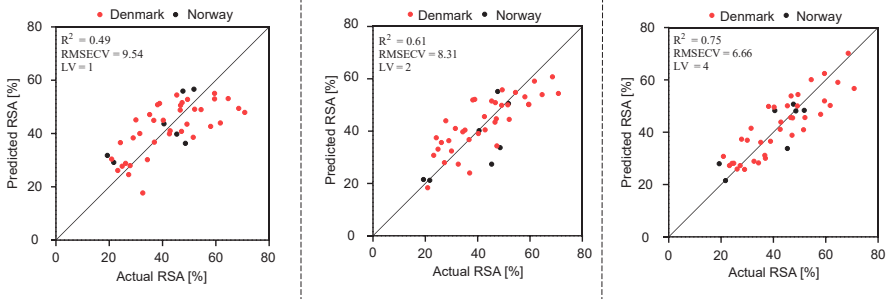
Step 2: Compare chemical composition using PCA



Step 3: Measure radical scavenging activity of propolis samples



Step 4: Predict radical scavenging activity based on spectroscopic data



PP-351 [Apitherapy]

Rigshospitalet

UNIVERSITY OF COPENHAGEN

Uncovering the Most Active Anti-Inflammatory Compound **Propolis.** A Combined Chemical and Immunological Approac

Jonas Pordel Vind[1*], Magni Steintún[1*], Camilla Hartmann Friis Hansen[2], Jesper Larsen[3], Lars Duelund[4], Rime Bahij[4], Henrik Jørgensen[1], J Christine Antvorskov[5], Violetta Aru[6], Søren Balling Engelsen[6], Knud Josefsen[1]

Affiliations: [1]Bartholin Institute, Rigshospitalet Copenhagen Biocenter, Ole Maaløes Vej 5, Copenhagen N, Denmark, [2]Department of Veterinary and Animal Sciences, University of Copenhag Ridebanevej 9, 1870 Frederiksberg C, Denmark, [3]Bioneer A/S, Kogle Alle 2, Hørsholm, Denmark, [4]Department of Green Technology, University of Southern Denmark, Campusvej 55, Odens [5]Steno Diabetes Center, Herlev Hospital, Borgmester Ib Juuls Vej 1, Herlev, Denmark, [6]Department of Food Science, University of Copenhagen, Rolighedsvej 26, 1958 Frederiksberg C, Den

Background

Propolis is a resinous bee product traditionally used for its anti-inflammatory effects. Its complex and variable composition, however, poses challenges for developing standardized therapies.

Aim

To identify the most potent anti-inflammatory compounds in propolis by combining HPLC-based chemical profiling with functional immune assays.

Experimental

Ethanolic extracts of 52 propolis samples from Australia, Denmark, and Norway were analyzed by HPLC. 8 polyphenol standards were used as benchmark compounds. PBMCs were stimulated with LPS, and IL-1β levels were measured by ELISA. PLS regression linked HPLC signals to IL-1β concentrations, followed by in vitro confirmation of predicted compounds.

Results

Scandinavian propolis reduced IL-1β more effectively than Australian samples. PLS analysis highlighted four signals linked to IL-1β inhibition, with caffeic acid and chrysin emerging as the strongest contributors. In vitro tests confirmed their effects.

Conclusion

Caffeic acid and chrysin are key anti-inflammatory compounds in propolis. Integrating chemical and functional data enables the identification of bioactive constituents and supports propolis as a source of immunomodulatory agents.

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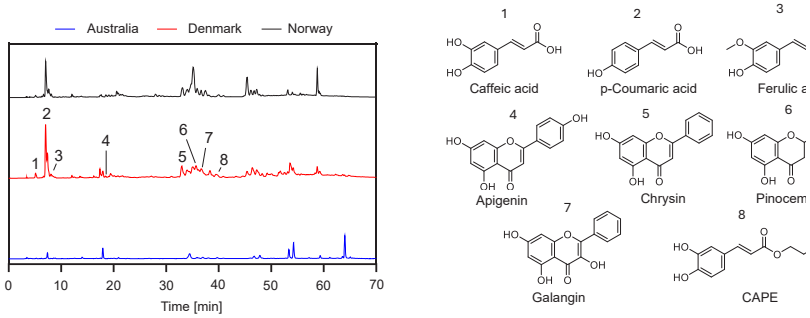
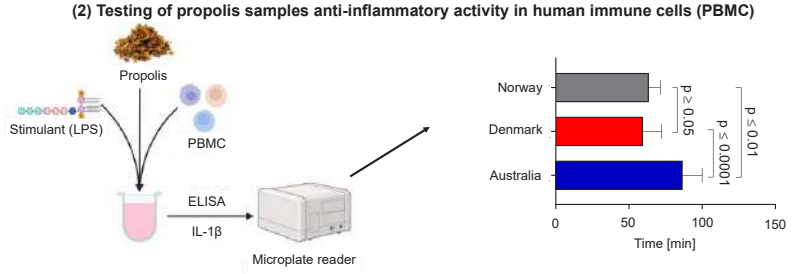
(1) HPLC chromatograms of propolis samples and identified polyphenols

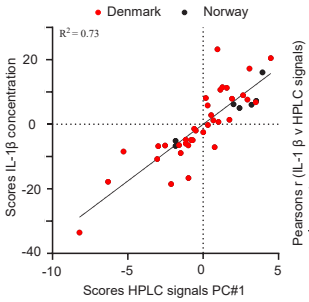


(2) Testing of propolis samples anti-inflammatory activity in human immune cells (PBMC)

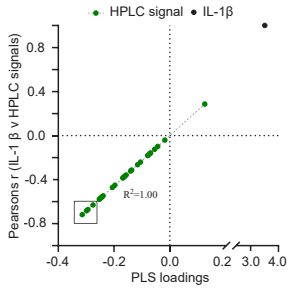


(3) Correlate HPLC data with anti-inflammatory activity

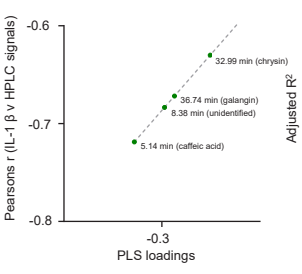
Step 1: HPLC data (X) v IL-1β concentration (Y)



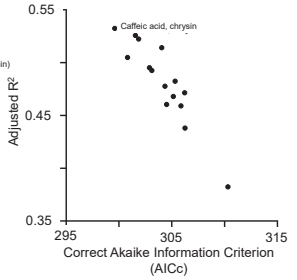
Step 2: Loadings plot and each loadings correlation to IL-1β concentration



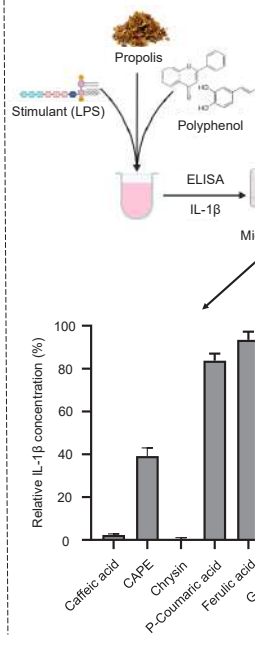
Step 3: Zoomed in loadings/correlations plot



Step 4: Comparison of models using combinations of the 4 identified signals



(4) Test polyphenols anti-infla effect to confirm caffeic acid a are most potent of all comp



APIMONDIA SCANDINAVIA 2025
SWEDEN | DENMARK | NORWAY

PP-352 [Apitherapy]

Antimicrobial Potential of Stingless Bee Honey: Physicochemical Characterization and ActivityAgainst Pathogenic Bacteria

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LABBEES

APIMONDIA SCANDINAVIA 2025 23-27 SEPTEMBER

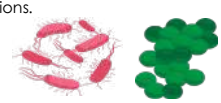
Background/Purpose

Stingless bee honey is a complex natural product composed of sugars, organic acids, proteins, minerals, vitamins, phenoliccompounds, and flavonoids. Due to its bioactive properties, it has been traditionally used in phytotherapy and homemade remedies. The growing demand for natural therapeutic alternatives is driven by concerns over the side effects of syntheticdrugs and the rise in antibiotic resistance.

This study aimed to characterize the physicochemical properties and antimicrobialactivity of stingless bee honey from different species and assess its effectiveness against pathogenic bacteria.

Problem Description

Escherichia coli and *Staphylococcus aureus* are major bacterial pathogens responsible for various infections. Their increasing resistance to conventional antibiotics highlights the urgent need for alternative antimicrobial agents. Stingless bee honey hasdemonstrated antibacterial potential, but its variability among species remains poorly understood. This study sought to evaluatehoney samples from multiple stingless bee species to determine their antimicrobial properties and potential therapeutic applications.



Methodology

Honey samples from 15 stingless bee species across different Brazilian regions were analyzed. Physico-chemical characterization was conducted, and antimicrobial activity was assessed using the broth microdilution method. The Minimum Inhibitory Concentration (MIC) and Minimum Bactericidal Concentration (MBC) were determined for each sample to evaluatetheir effectiveness against *E. coli* and *S. aureus*.

Table 1. List of 14 Analyzed Samples with Species, Popular Name, Origin, and Geographical Position

Scientific name	*Popular name*	*Origin*	*Geographical position*
Melipona bicolor	Guaraipo	Guaraqueçaba-PR	25° 18′ 24″ S, 48° 19′ 44″ W
Melipona interrupta	Jupura	Paritis-AM	2° 37′ 42″ S, 56° 44′ 11″ W
Melipona mondury	Uruçu amarela	Aracruz-ES	19° 49′ 11″ S, 40° 16′ 27″ W
Melipona obscurior	Manduri	Seara-SC	27° 08′ 58″ S, 52° 18′ 38″ W
Melipona quadrifasciata	Mandaçaia	Irecê - BA	11° 17′ 60″ S, 41° 51′ 24″ W
Melipona rufiventris	Tiúba	Goiás-GO	15° 55′ 21″ S, 50° 8′ 16″ W
Melipona seminigra	Uruçu boca-de-renda	Belém-PA	1° 27′ 18″ S, 48° 30′ 9″ W
Melipona subnitida	Jandaíra	Jandaíra-BA	1° 33′ 32″ S, 37° 47′ 7″ W
Plebeia emerina	Emerina	Seara-SC	27° 08′ 58″ S, 52° 18′ 38″ W
Scaptotrigona tubiba	Tubi	Barra do Corda-MA	5° 30′ 2″ S, 45° 14′ 34″ W
Tetragona elongata	Borá	Seara-SC	27° 08′ 58″ S, 52° 18′ 38″ W
Tetragona elongata	Borá	Atibaia-SP	23° 7′ 2″ S, 46° 33′ 1″ W
Tetragonisca angustula	Jataí	Jundiaí - SP	23° 11′ 11″ S, 46° 53′ 03″ W
Tetragonisca angustula	Jataí	Seara-SC	27° 08′ 58″ S, 52° 18′ 38″ W

Results and Conclusion

A high variability in physicochemical properties was observed among honey samples, but no directcorrelation with antimicrobial activity was found. However, honey from *Melipona rufiventris* and *Scaptotrigona tubiba* exhibitedthe highest antibacterial activity, comparable to propolis. These findings reinforce the potential of stingless bee honey as anatural antimicrobial agent and suggest its application in developing alternative treatments for bacterial infections.

Table 2. Relationship of Minimum Inhibitory Concentration and Minimum Bactericidal Concentration for the Strains of Staphylococcus aureus ATCC 6538 and Escherichia coli ATCC 8739 in the 15 Analyzed Samples of Stingless Bee Honey

Scientific name	*MIC S. aureus (µL/well)*	*MIC E. coli (µL/well)*	*MBC S. aureus (µL/well)*	*MBC E. coli (µL/well)*
Duckeola ghiliani	125	125	X	X
Melipona bicolor	X	X	X	X
Melipona interrupta	125	125	500	X
Melipona mondury	250	250	X	X
Melipona obscurior	X	X	X	X
Melipona quadrifasciata	250	250	250	500
Melipona rufiventris	15.62	62.5	31.25	62.50
Melipona seminigra	125	250	X	X
Melipona subnitida	62.50	125	250	125
Plebeia emerina	62.50	62.50	500	500
Scaptotrigona tubiba	62.50	62.50	31.25	62.50
Tetragona elongata SC	31.25	62.50	125	62.50
Tetragona elongata SP	62.5	125	125	125
Tetragonisca angustula SP	125	125	125	125
Tetragonisca angustula SC	125	125	125	125

X means that the honey had no antimicrobial activity.
MBC, minimum inhibitory concentration; MIC, minimum bactericidal concentration.

Table 3. Relationship of pH, Acidity, and Moisture in the 15 Analyzed Samples of Stingless Bee Honey

Scientific name	*Density (g/mL)*	*Moisture*	*Acidity (mEq/kg)*	*Reducer sugar (g/100g)*	*HMF (mg/kg)*	*pH*
Duckeola ghiliani	1.36	>25	117.09	49.40	40.77	3.1
Melipona bicolor	1.30	>25	33.75	57.60	114.06	3.2
Melipona interrupta	1.36	>25	83.06	47.70	54.95	3.1
Melipona mondury	1.36	>25	45.20	46.21	22.40	3.9
Melipona obscurior	1.35	>25	58.87	37.79	0.50	3.8
Melipona quadrifasciata	1.30	>25	101.50	37.34	0.89	3.1
Melipona rufiventris	1.37	23.60	41.64	72.88	0.80	3.4
Melipona seminigra	1.37	24	22.55	64.39	9.69	3.3
Melipona subnitida	1.35	>25	78.39	33.37	12.86	3.1
Plebeia emerina	1.37	25	79.32	44.26	28.61	3.6
Scaptotrigona tubiba	1.35	>25	67.21	39.37	191	3.2
Tetragona elongata SC	1.36	>25	49.12	35.86	15.71	3.7
Tetragona elongata SP	1.35	22.60	40.58	72.81	0.40	4.5
Tetragonisca angustula SP	1.37	23.40	48.25	56.77	0.88	3.7
Tetragonisca angustula SC	1.37	>25	72.81	38.24	4.71	3.5

HMF, hydroxymethylfurfural.

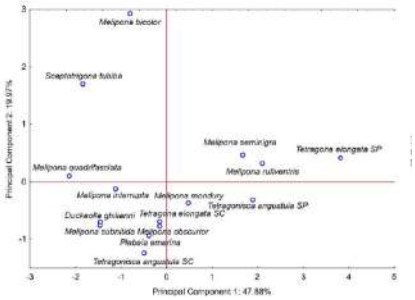


FIG. 1. Principal components analysis scatterplot showing the distribution of honey samples based on their physicochemical features.

Practical Implications

The identification of highly bioactive honeys provides an opportunity for beekeepers to promote specific species for medicinaluse, increasing the market value of their products. Understanding the antibacterial potential of different honey types may alsoencourage sustainable beekeeping practices and the development of functional honey-based products with health benefits.

KEYWORDS Apitherapy, stingless bees honey, physicochemical properties, antimicrobial activity

More about LABBEES

EACH USP

PP-355 [Apitherapy]

"Anticancer potential of bee venom for head and neck squamous cell cancers – the preliminary results"

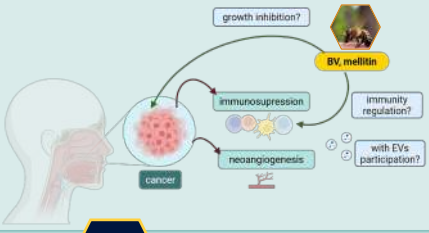
Katarzyna Piszczatowska [1,2], Mirosław J. Szczepański [1,2,3]

[1] Polish Apitherapy Society, [2] Department of Biochemistry, Medical University of Warsaw, 02-097, Warsaw, Poland

1 Introduction

The **anticancer activity** of **bee venom (BV)** and **melittin** have been shown in various cancers, as well as their beneficial effect on immune system. However, the BV activity in regard to **head and neck squamous cell cancer (HNSCC) remains almost unexplored.**

HNSCC relates to **poor survival outcomes**, unsuccessful treatment in many cases or serious disability. Therefore, new effective therapies are urgently needed. Currently, **immunotherapy** occurs as the novel, promising anticancer strategy. In this aspect a role might play **extracellular vesicles (EVs)** that regulate the activity of cells, including immune cells populations. Cancer induces immunosuppression that favors its growth and metastasis. The solutions that **boost the immune system may improve effective tumor inhibition and drop out in the end.**



2 Aim of the study

The aim of this preliminary study was to evaluate the anticancer potential of BV for pharyngeal carcinoma and healthy human keratinocytes cell lines (HaCat), as well as BV's effect on EVs secretion.

3 Methodology

- **Bee venom** was obtained from honeybees using **low-voltage electrical stimulation**.
- The **melittin** concentration was estimated with **UHPLC-ESI-MS**.
- **Cell lines:** The BV activity was determined in the in vitro studies with **FaDu (squamous cell carcinoma), A549 (lung cancer) and HaCat (keratinocytes) cell lines.**
- After BV treatment:
  - the viability with **MTT assay**,
  - staining with **crystal violet**,
  - **scratch assay**
  - and apoptosis analysis with flow cytometry were performed.
- **EVs** were isolated from cell culture supernatant using pre-clearing with differential centrifugation and **Size Exclusion Chromatography (SEC)** and characterized by **Nanoparticle Tracking Analysis (NTA).**

4 Results

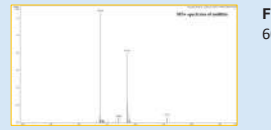


Fig. 1 UHPLC-ESI-MS analysis – the 60,82% of BV was the mellitin.

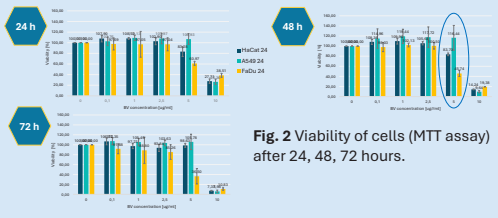


Fig. 2 Viability of cells (MTT assay) after 24, 48, 72 hours.

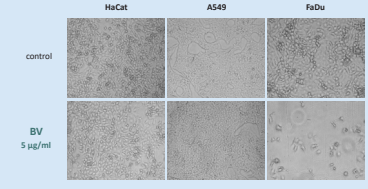


Fig. 3 Cells morphological changes after BV treatment.

Results

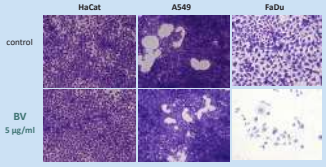


Fig. 4 Cells morphological changes after BV treatment (crystal violet staining)

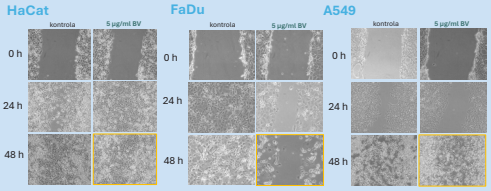


Fig. 5 Scratch assay.

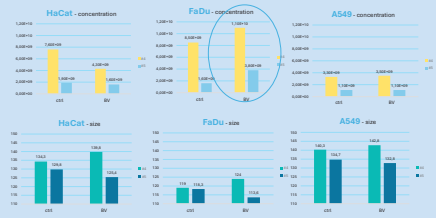


Fig. 6 EVs size and concentration evaluation with NTA measurments.

5 Conclusions

The BV treatment results in case of:

1. FaDu: inhibited growth, inhibited wound healing, visible morphological changes, proapoptotic effect and increased level of EVs in the supernatant.

2. HaCat: no effect on cell viability, no visible morphological changes and no/ slightly anti-apoptotic effect.

In summary, those preliminary studies revealed no toxic effect of BV for HaCat and potential anticancer activity in case of FaDu in which might take part EVs, however, further investigation with the use of other methodologies is urgently needed.

APIMONDIA SCANDINAVIA 2025
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PP-356 [Apitherapy]

Rural Development Administration
National Institute of Agricultural Sciences

Antiviral Effects of Chestnut Honey Against Influenza A Virus Through Innate Immune Modulation

Hongmin Choi, Soonok Woo, Hyoyoung Kim, Segun Kim

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Abstract

The continuous emergence and spread of viral infectious diseases, such as influenza, pose significant public health and economic challenges. Current antiviral treatments and vaccines have limitations due to viral mutations and drug resistance, necessitating the development of alternative therapeutic agents. Natural products have gained increasing attention for their potential antiviral properties. In this study, we investigated the antiviral effects of chestnut (Castanea crenata) honey against influenza A virus infection. Using an in vitro model with Raw 264.7 macrophage cells, chestnut honey treatment activated key innate immune signaling pathways, including TBK/IKK, IRF, and RIG-MAVS, leading to enhanced immune responses. In an in vivo mouse model, oral administration of chestnut honey prior to viral infection increased survival rates by 60% and reduced virus-induced weight loss by 20.9%, while also mitigating lung inflammation. These findings suggest that chestnut honey exhibits strong antiviral activity by modulating innate immunity and inhibiting viral replication. Therefore, chestnut honey has the potential to be developed as a functional natural remedy for the prevention and treatment of influenza and other viral infections.

Introduction

Influenza & Immunity

Influenza is one of the most significant respiratory diseases, affecting nearly 1 billion people each year and causing up to 650,000 deaths globally. Current prevention and treatment strategies, including vaccines and antiviral drugs, face limitations due to rapid viral mutation and drug resistance. As a result, there is a strong need for novel approaches that can enhance host defense. The innate immune system, the first line of defense, plays a central role by producing interferons and proinflammatory cytokines that restrict viral replication.

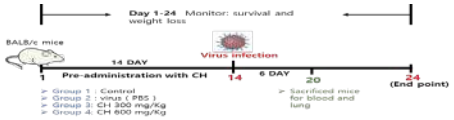
Materials & Methods

Sample: Castanea crenata honey (2020).

➢ In vitro assays:
- Murine macrophages (Raw264.7 cells) pretreated with CH.
- Infection with influenza A/PR8/34-GFP strain.
- Viral protein expression (M2, PB1, PA) measured by
- immunofluorescence, Western blotting, and plaque assays.

Cytokine secretion and signaling pathway activation analyzed by ELISA, RT-PCR, and EMSA.

➢ In vivo assays:
- BALB/c mice orally administered CH (300 or 600 mg/kg/day) for 14 days before IAV infection.
- Body weight, survival rate, lung pathology, cytokine levels, and NK cell activity assessed.



Results

Antiviral effect of CH on IAV-infected Raw264.7 cells

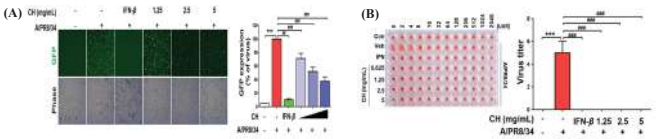


Fig. 1. Antiviral effect of CH on IAV-infected Raw264.7 cells. The cells were pretreated with CH (1.25, 2.5, and 5 mg/mL) or 1,000 units of IFN-b as a positive control for 24 h before infection with IAV-GFP. Detection of GFP using (A) fluorescence microscopy (10×) and flow cytometry. (B) Infected supernatant was added to round plates and then diluted with PBS. Finally, 0.5% cRBC in PBS was added to each well and incubated for 1 h at 25°C before imaging.

CH activates the RIG-1-mediated MAVS pathway

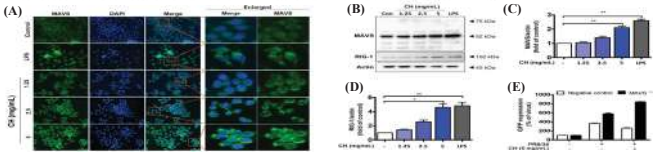


Fig. 2. CH activates the RIG-1-mediated MAVS pathway. The cells were pretreated with CH (1.25, 2.5, and 5 mg/mL) or 100 ng/mL LPS as a positive control for 24 h. (A) Expression of MAVS was detected via immunofluorescence. (B) Western blot analysis of RIG-1 and MAVS using whole-cell lysates and (C, D) quantitative analysis of protein bands (MAVS and RIG-1) was performed via ImageJ software. (E) Cells were transfected with siRNA against MAVS and then infected with GFP-IAV, followed by detection of viral GFP via flow cytometry. Bar graph (mean ± standard error of mean) statistical data were determined using one-way analysis of variance with Tukey's post hoc test. **P < 0.01 and *P < 0.05 compared with the untreated group (Con).

Antiviral effect of CH on IAV-infected BALB/c mice

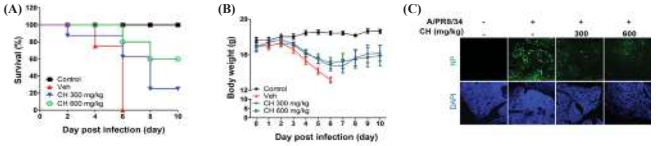


Fig. 3. Antiviral effect of CH on IAV-infected BALB/c mice. (A) Survival rate and (B) body weight was monitored daily until 10 dpi. (C) Immunofluorescence analysis revealed the levels of IAV NP in virus-infected mouse lungs. Scale bar = 100 mm.

Conclusion

Castanea crenata honey (CH) activated innate antiviral signaling by enhancing RIG-I/MAVS-mediated TBK/IKK phosphorylation and promoting IRF3/7 nuclear translocation, which stimulated type-I interferon production and IFN-stimulated genes (e.g., IFITM3). In vivo, CH pretreatment in mice significantly increased survival (up to 60%), reduced body weight loss (~20.9%), and alleviated lung inflammation and histopathological damage. Moreover, CH elevated serum cytokine levels and enhanced natural killer cell activity, suggesting a strengthened systemic immune response. Collectively, these findings demonstrate that CH enhances host immunity through the RIG-I/MAVS–TBK/IKK–IRF axis and provides effective protection against influenza infection, supporting its potential as a natural immunomodulatory agent.

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PP-357 [Apitherapy]

Stability and permeability studies on canine skin of two liquid formulations based on apitoxin

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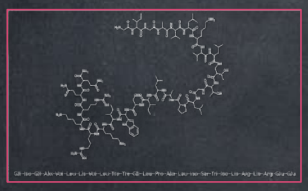
Introduction



Bee venom, a complex peptide mixture secreted by female bees of the *Apis mellifera* genus, is highly valued and recognized. This product is a solid composed primarily of peptides responsible for its biological activities, such as its major component, melittin.
It has demonstrated anti-inflammatory, antinociceptive, immunomodulatory, and antimicrobial properties, among others. *In vitro* and *in vivo* studies have demonstrated melittin's ability to inhibit the production of inflammatory mediators such as prostaglandins and cytokines, as well as to modulate the activity of immune cells such as macrophages and neutrophils. Despite these benefits, there are no commercial veterinary products on the market containing this active ingredient. In this context and considering the significant shortcomings of current anti-inflammatory treatments for chronic diseases, we set out to develop a liquid formulation for topical use in canines.

In this study, we present the results obtained from the stability analysis of apitoxin in aqueous solution and in two developed topical formulations. In addition, we present permeability studies performed on canine skin using Franz diffusion cells.

Results and discussion

Ingredient	Form 1	Form 2
Water	68.6 g	68.6 g
Glycerin	15 g	15 g
Tween 20	1.5 g	1.5 g
Propylenglycol	15 g	- g
Methylparaben	0.1 g	0.1 g
DMSO	-	15 g
Citric acid anhydride	0.5 g	0.5 g
Apitoxin	0.5 g	0.5 g

Table 1. Composition of 2 formulations developed for possible topical use in canines.

This work involved the development of a formulation for topical use in canines, using different excipients as previously presented, resulting in the formulations presented in Table 1. An HPLC method developed by the group was used to analyze the concentration of melittin in the different samples.Based on these formulations, the corresponding stability and permeability tests were performed. Some of these results are showed in this poster.

In this study, the stability of different aqueous solutions of purified bee venom was determined under different storage conditions. Melittin was used as a control because it is the majority compound and the one that has been shown to have greater lability to storage conditions. Distilled water and the mixture developed for a topical formulation 1 (Table 1) were used as solvents. Storage conditions were refrigerated (2-8°C), ambient conditions (room temperature approximately 20°C), and accelerated stability conditions according to Zone II (42°C and 75% humidity). In all cases, the product was stored in amber containers and protected from light (Figure 1 and 2).

In both solutions, melittin degrades rapidly in accelerated stability tests and ambient storage conditions. However, under refrigeration, it can maintain its potency relatively stable. For the topical solution, which contains an antioxidant agent in its formula, it remained highly potent for several months under refrigerated conditions.

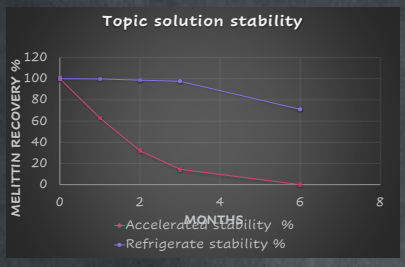


Figure 1. Graphic of melittin recovery vs storage time in different conditions.
Accelerated stability conditions according to Zone II: 42°C and 75% humidity. Refrigerated stability conditions: 2-8°C.

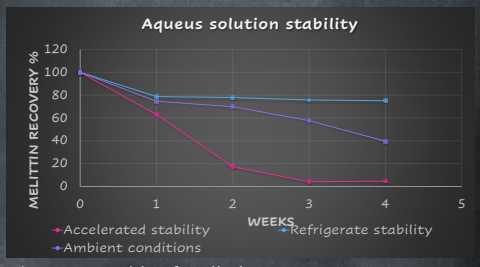


Figure 2. Graphic of melittin recovery vs storage time in different conditions.
Accelerated stability conditions according to Zone II: 42°C and 75% humidity. Refrigerated stability conditions: 2-8°C. Ambient stability conditions: room temperature approximately 20°C.

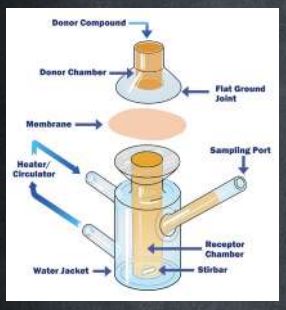


Figure 3. Franz cell diagram.
Image obtained from permgear.com, supplier of the cells used in this test.

Transepithelial permeation of apitoxin was determined using the Franz cell methodology, which consists of determining the amount of analyte that crosses a membrane (in this case, canine skin) from the donor chamber to the recipient chamber. The test was performed with two sections of canine skin: skin with abundant hair and skin with little hair. Melittin was used as a marker as the majority component. The test conditions were chosen to simulate canine physiology; this implies a temperature between 38.5-38.9 ° C ± 0.05 ° C and a pH of 5.5. Once the test began, samples were removed over time to determine if melittin passed through after a few hours. In this experiment, permeation through the canine skin was not observed for either of the 2 formulations (Form 1 and Form 2) in either of the barriers used, but absorption of the marker in the skin was observed.

Conclusions

By studying the stability of bee venom in aqueous solution and in a topical formulation developed for use in canines, it can be concluded that the latter maintains its potency in melittin after 3 months of refrigerated storage. Furthermore, no passage of melittin was observed through two canine skin sections for two topical formulations, but this compound was absorbed into the skin. For these reasons, we can conclude that the developed formulation would be adequate for preserving bee venom, but there is no evidence that it is effective for treatments that require the action of bee venom on deeper layers of the skin.

Fundin and Acknowledments

PEDECIBA Química, by the Despeue Científico tool.

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APIMONDIA SCANDINAVIA 2025
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PP-358 [Apitherapy]

APIMONDIA SCANDINAVIA 2025
23-27 SEPTEMBER
COPENHAGEN

TRANSCRIPTOMIC ANALYSIS OF THE *Pseudomonas aeruginosa* BIOFILM EXPOSED TO ConA-UNBOUND PROTEIN FRACTION OF *Melipona beecheii* HONEY

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Introduction

Honey produced by the stingless bee *Melipona beecheii* is highly valued in Mayan communities for its medicinal properties [1]. It is traditionally used to treat respiratory diseases, strengthen the immune system, and manage eye infections and wounds. Recently, it has been reported that ConA-unbound protein fraction in this honey exhibit antimicrobial activity and inhibit biofilm formation by *Pseudomonas aeruginosa*, affecting its cell integrity, flagellar gene expression, and reducing exopolysaccharide matrix formation [2]. In this study, the transcriptomic response of *P. aeruginosa* ATCC 27853 biofilms exposed to ConA-unbound protein fraction from *M. beecheii* honey was analyzed using RNA-seq.

Methodology

1. Honey Sampling

Meliponary: Maní, Yucatán, México

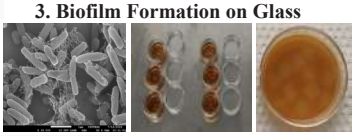
Honey of *M. beecheii*

2. Honey Protein Extraction & Fractionation

Ultrafiltration Amicon ultra 3K

Affinity Chromatography Con-A Sepharose 4B

3. Biofilm Formation on Glass

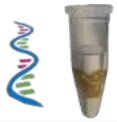


Model Organism: *P. aeruginosa* ATCC 27853

Treatment: 2.0 µg/mL ConA-unbound protein fraction

48 h Incubation

4. RNA Extraction



RNA Isolation & Purification:
- RNeasy Mini Kit (Qiagen)
- RiboZero Plus rRNA Depletion Kit, Illumina

5. RNA-seq library prep

Kit: KAPA RNA HyperPrep

6. Sequencing

Sequence Libraries: Illumina NovaSeq 6000, 150 PE (Paired-End)

7. Data analysis

Quality Control: NGS QC Toolkit v2.3.3
Mapping: HISAT2
Assembly & Expression: StringTie2 v2.2.0

Results

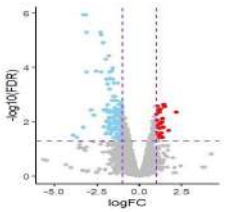


Figure 1. Volcano plot of differentially expressed genes (DEGs) of untreated and ConA-unbound protein fraction-treated *P. aeruginosa* ATCC 27853 biofilm.

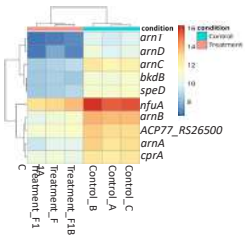


Figure 2. Heat map of the 10 most affected genes differentially expressed between the three replicates of untreated (control) and ConA-unbound protein fraction-treated *P. aeruginosa* ATCC 27853 biofilm.

Table 1. Differentially expressed genes in *P. aeruginosa* ATCC 27853 biofilm with the ConA-unbound protein fraction-treated.

Gene ID	Gene name	log2 *FC	p-value	Up/Down Regulated	Description
ACP77 RS31925	*rnpB*	1.70309859	9.96594E-09	Up	RNase P RNA component class A
ACP77 RS06765	*CAZ10_20305*	1.470209761	0.000957126	Up	Antibiotic biosynthesis monooxygenase
ACP77 RS30940	*olsA*	1.392081536	5.34314E-08	Up	Lyso-ornithine lipid O-acyltransferase
ACP77 RS01535	*hflC*	1.292586537	2.83312E-06	Up	Protease modulator HflC
ACP77 RS20750	*tagT*	1.187694779	0.000484114	Up	Type IV secretion associated ABC transporter ATP-binding protein TagT
ACP77_RS06270	*arnD*	-3.10600235	1.58433E-26	Down	4-deoxy-4-formamido-L-arabinose-phosphoundecaprenol deformylase
ACP77 RS28020	*oprH*	-2.563437398	5.90758E-24	Down	Outer membrane beta-barrel protein
ACP77 RS06250	*PA2022*	-1.79431309	8.42135E-13	Down	UDP-glucose 6-dehydrogenase
ACP77 RS16275	*PA4781*	-1.553378506	7.13933E-19	Down	Cyclic di-GMP phosphodiesterase
ACP77 RS21195	*oprD_10*	-1.551257856	1.98314E-07	Down	OprD family porin
ACP77 RS28470	*fliC*	-1.072595423	3.96393E-05	Down	Flagellin

RNA-seq analysis revealed that treatment with ConA-unbound protein fraction from *M. beecheii* honey altered the transcriptomic profile of *P. aeruginosa* ATCC 2785 biofilms. Of the 6,423 genes analyzed, 27 were upregulated and 143 were downregulated (|log2FC| > 1.0 and FDR < 0.05) (Figure 1). A set of 10 genes showed significant expression changes between the Control and Treatment groups, including a reduction in *arn* genes, which impacts the Cationic Antimicrobial Peptide (CAMP) resistance pathway (Figure 2). Upregulated genes may be associated with adaptive or defensive strategies during biofilm formation, whereas downregulated genes included those encoding enzymes involved in the regulation of the second messenger c-di-GMP (cyclic di-guanosine monophosphate) and in the biosynthesis of exopolysaccharides (Table 1).

Conclusions

ConA-unbound protein fraction from *Melipona beecheii* honey predominantly negatively affected the regulation of genes that are key to *Pseudomonas aeruginosa* biofilm formation. These findings provide key insights into the mechanism of action of these honey-derived proteins and highlight their potential as natural antibiofilm agents, particularly against antibiotic-resistant pathogens.

Acknowledgments

I would like to thank UNAM for the use of its servers for RNA-seq analysis, Mérida Institute of Technology where all the experiments in this project were conducted, and SECIHTI for providing a financial grant during my doctoral studies. I would like to thank my entire doctoral committee for their contributions to improving this work.

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[2] Pool-Yam, L., Ramón-Sierra, J., *et al*., (2024). Effect of conA-unbound proteins from *M. beecheii* honey on the formation of *P. aeruginosa* ATCC 27853 biofilm. *Arch. Microbiol*, *206* (1), 54.

PP-359 [Apitherapy]

"Inhibitory effect of *Melipona beecheii* honey on the morphological transition of *Candida albicans*"

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Keywords: Candida albicans, Stingless bees, honey, morphological transition

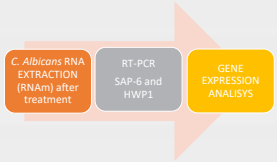
INTRODUCTION

Candida albicans is a polymorphic commensal fungus that is part of the microbiota in humans, as well as in other mammals and birds. Under certain conditions where the host's immune system fails, it becomes pathogenic. One of its main virulence factors is its morphological transition from yeast to hyphae. Recently, *C. albicans* has been classified as a critical priority fungus on the WHO's priority fungal pathogen list due to its high mortality rates, the severity of the disease in immunocompromised patients, and the development of antifungal resistance. The honey of *Melipona beecheii* has been reported to have inhibitory effects on the growth of *C. albicans* yeasts. The objective of this study was to evaluate the effect of *M. beecheii* honey on the morphological transition of *C. albicans*, specifically its transition from yeast to hyphae.

METHODOLOGY

Samples were collected in Maní, Yucatán, Mexico, and processed in the laboratory to evaluate antifungal activity. The minimum inhibitory concentration (MIC) was determined using both the agar dilution method and broth microdilution assay. To assess inhibition of morphological transition, *C. albicans* cells were incubated in RPMI medium buffered with MOPS and supplemented with 10% fetal bovine serum, in the presence of honey at 5, 10, 15, and 20% (w/v). After 3 hours of incubation, morphological changes were examined by light microscopy.

Figure 1. From left to right: (1) Meliponary, (2) *Melipona* honey extraction, (3) antimicrobial assay, and (4) microscopy observation and quantification of morphological changes.



Additionally, assays were performed to determine the expression of two genes involved in *C. albicans* virulence: *SAP6* and *HWP1*. mRNA was extracted, followed by RT-PCR, and gene expression was analyzed.

RESULTS

Figure 2. Antifungal activity of *M. beecheii* honey. Agar dilution assay at 5, 10, and 15% (w/v) and negative control (without honey).

The antifungal activity of the honey of *M. beecheii* was assessed by agar dilution (5, 10, 15% w/v), with complete inhibition observed at 10% w/v. Broth microdilution confirmed the MIC between 10-12% W/V.

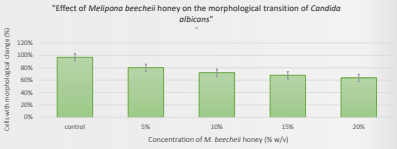


Figure 3. Evaluation of the inhibition of morphological transition in *C. albicans* with treatments corresponding to 5, 10, 15, and 20% of honey.

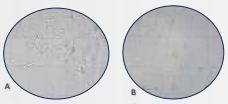


Figure 4. Representative images obtained by light microscopy. A. Control without honey shows all cells in hyphal morphology. B. Treatment with 20% of *M. beecheii* honey shows fewer hyphae and higher proportion of yeast cells.

The effect of *M. beecheii* honey on the inhibition of morphological transition in *C. albicans* was evaluated. Significant differences were observed among treatments ($p < 0.05$), with higher honey concentrations resulting in greater inhibition. In the 20% honey treatment, hyphal cells were reduced by 33.64% compared to the control (figure 4).

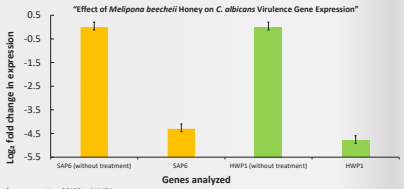


Figure 5. Evaluation of gene expression of *SAP6* and *HWP1*.

SAP6 expression decreased up to –4.5 and *HWP1* up to –4 relative to the control, showing strong inhibition of key virulence genes by *Melipona beecheii* honey.

CONCLUSIONS

M. beecheii honey exhibited effects on the morphological transition of *C. albicans* as well as on the expression of two key genes involved in adhesion, proteolytic activity, and biofilm formation. This study highlights the importance of these findings, as morphological transition represents one of the earliest stages of *C. albicans* virulence. The results demonstrate the potential of this honey as an alternative therapeutic agent.

PP-360 [Apitherapy]

Heavy Metals in Honey and Pollen Collected in Different Ecological Areas

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INTRODUCTION AND AIM

Honey and pollen are natural products valued for their nutritional and medicinal properties, but environmental contamination can affect their quality and safety. Urban areas, with higher industrial and vehicular emissions, may contribute to increased heavy metal deposition, potentially leading to unsafe honey products or pollen. Heavy metal accumulation in honey and pollen raises concerns regarding consumer health and apiculture sustainability. This study aims to assess and compare the levels of heavy metals in honey and pollen samples collected from forest, agriculture field and urban areas, providing insights into potential contamination sources and risks.

METHODS

Honey and pollen samples were collected during flowering season from urban apiaries, representing pollution sources, along with control samples from an agriculture field and forest (Fig. 1 - 2). Cd, Cr, Cu, Ni, Pb, Mn, Fe, Zn were analyzed in the collected samples. Inductively Coupled Plasma Mass Spectrometry with optical emission spectrometer (ICP-OES) was used to quantify heavy metal concentrations (Fig. 3).

Figure 1. Pollen samples.

Figure 2. Honey samples.

Figure 3. ICP-OES Avio 220 max, PerkinElmer, USA.

RESULTS AND CONCLUSION

All heavy metals tested were detected in the honey and pollen samples, except Cd which was not detected in samples (LOD = 0.01 mg/kg). The concentrations of heavy metal in honey and pollen (Fig. 4 - 5) differed significantly, with higher concentrations of heavy metals detected in pollen than in honey.

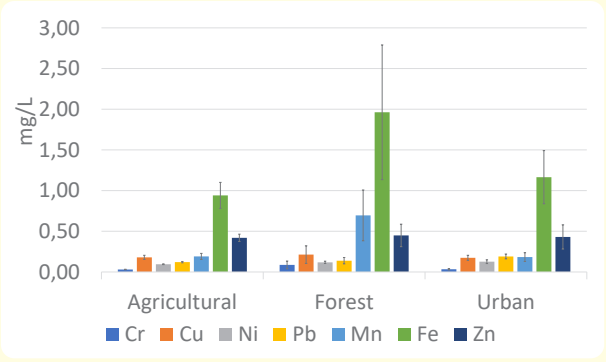

Figure 4. Concentrations of heavy metals in honey collected from three different agricultural areas.

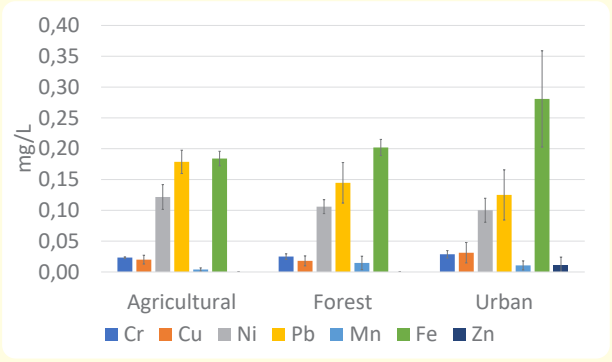

Figure 5. Concentrations of heavy metals in pollen collected from three different agricultural areas.

The largest differences in honey samples were found for Cr, with 47% lower concentration in honey collected in the city center compared to the agriculture field site. Cu and Ni concentrations were also lower in the urban honey samples. Although Pb is usually considered to be a major source of urban pollution due to heavy traffic, its concentration was lower in urban honey samples compared to the agriculture honey samples. The most significant variation in pollen samples was observed for Mn, with its concentration being 51% lower in pollen collected from the city center compared to that from the forest. However, one pollen sample from an urbanized area contained significantly higher amounts of Fe, as well as increased levels of Zn and Pb. Analysis revealed that pollen always contains higher concentrations of heavy metals than honey.

PP-361 [Apitherapy]
Proteomic study of the Bioactive molecules of bee venom of Apis cerana and Apis mellifera and its health implications

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The word "proteome" represents the complete protein pool of an organism encoded by the genome. Proteomics helps in understanding the alteration in protein expression during different stages of life cycle or under stress condition. It helps in understanding the structure and function of different proteins as well as protein-protein interactions. Bee venom contains many proteins such as melittin (major protein), enzymes such as phospholipaseA2, hyaluronidase and other various proteins that has many medicinal efficacies. These proteins vary in their concentration and composition between different Apis species and with respect to season, so it is analyzed with the help of proteomics. Amino acid variation in the proteins can also 11make profound changes in the action of proteins. This is done by Two-Dimensional Gel Electrophoresis technique. Proteins are first separated based on their individual charges in 1D. The gel is then turned 90 degrees from its initial position to separate proteins based on the difference in their size. This separation occurs in 2 dimensions hence the name 2D. The spots obtained in 2D electrophoresis are excised and further subjected to mass spectrometric analysis of each protein present in the mixture. Once the sequence of the proteins is obtained, it can be used for drug development by screening for suitable targets using online tools. It can also be used for finding out the genetic background of the proteins; the switching mechanism of genes involved which will be helpful in rDNA studies.

PP-362 [Apitherapy]
"In vitro" investigation on anti influenza A H1N1 and SARS-CoV-2 var. delta of a chemically characterized poplar-type propolis

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[2]National Institute for Infectious Diseases INMI "Lazzaro Spallanzani" IRCCS, Laboratory of Virology, Rome, Italy
[3]University of Siena, Department of Physical Sciences, Earth and Environment, Siena, Italy
[4]University of Siena, Department of Biotechnology, Chemistry and Pharmacy, Siena, Italy
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Effective prophylactic and therapeutic options for severe viral infections, such as influenza and COVID-19, are currently limited. This study investigates the antiviral and anti-inflammatory properties of a chemically characterized Euro-Asian poplar-type propolis extract.

The same propolis sample (a hydro-ethanolic dry extract obtained from a commercial poplar-type propolis authorized for use in food supplements and cosmetics within the EU) was used in three independent studies, ensuring quality control and a clear relationship between chemical composition and biological effects.

Propolis was analyzed using validated UV and HPLC methods. In vitro antiviral tests were performed against the influenza A (H1N1) virus in MDCK cells and SARS-CoV-2 (delta variant) in VERO E6 and CALU3 cells. Peripheral blood mononuclear cells (PBMC) were used to test anti-inflammatory activity. Cell-free enzymatic assays and cell-based molecular investigations completed the experimental protocol.

Chemical analysis confirmed a high flavonoid content (>15%) and total polyphenols (>18%), with major compounds including galangin, chrysin, pinocembrin, and caffeic acid phenethyl ester (CAPE).

In antiviral assays, the propolis extract did not show a significant effect against H1N1. However, it demonstrated strong anti-neuraminidase activity. More promising results were obtained against SARS-CoV-2 (delta variant) in VERO E6 and CALU3 cell cultures, where the extract protected cells from cytopathic effects in a concentration-dependent manner. Ultrastructural analysis revealed a decrease in viral particles, and viral titration confirmed a significant decrease in infectivity. Gene expression analysis revealed downregulation of viral N and E transcripts, suggesting inhibition of viral replication. The antiviral effect was due to a synergistic action of CAPE, galangin, and pinocembrin. Furthermore, propolis exhibited potent anti-inflammatory activity in LPS-stimulated PBMC, significantly reducing IL-1β, IL-6, and TNF-α, with an efficacy comparable to that of flurbiprofen.

These findings highlight the potential of poplar-type propolis for future experimental and clinical research in viral infections and inflammation management.

PP-364 [Apitherapy]

APIMONDIA SCANDINAVIA 2025
SWEDEN | DENMARK | NORWAY
23-27 SEPTEMBER
COPENHAGEN

BEE PRODUCTS
AS NUTRITION AND NATURAL THERAPY

1. MALE, 11 years old – child growth and development

PITUITARY HYPOPLASIA – E23.6/251
THYMOID DEFICIENCY – E34.3/251
WEIGHT DEFICIENCY – E44.1/263

RECOMMENDED TREATMENT:

INGREDIENTS FOR MIXTURE: 3 teaspoons/day

500 g. raw honey
300 g. fresh bee bread
100 g. lyophilized Apilarnil/
100 g. Queen larvae
100 ml brown propolis aqueous extract
50 ml soft brown propolis extract (70%)
10 drops lemon essential oil

RECOMANDED DIET:

Replacing dairy products with plant-based alternatives and also excluding any red meat (according to the food intolerance test)

Consume 1 tablespoon of pollen/day

PROGRESS:

21.05.2024 – started at 11 and a half years old
T= 134,3 cm G= 28,4 kg

13.12.2024 – 12 years old
T= 137.8 cm (gained 3,5 cm height) G= 31 kg

16.08.2025 – 12 years and 9 months
T=148.2 cm (gained 10,4 cm height) G=34,3 kg

The improvement was achieved without the use of synthetic hormonal treatment. Now he even got to play sports (football) professionally.

2. FEMALE, 37 years old – Escara open for almost 3 months

Patient in wheelchair following a spinal cord injury at T7 and L1-L2, underwent surgical intervention on 20.11.2024.

On 10.01.2025 the patient recieved debridement, lavage, secondary suturing and vacuum therapy. Postoperatively, the patient was treated with Ciprofloxacin for 1 month, followed by 2 weeks of intravenous Oxacillin.

The wound remained unhealed due to E. coli infection, and closure was incomplete, necessitating a second surgical procedure on 1 August 2025 at the femoral head. Following this intervention, the wound became fully closed and infection-free within 7 days.

RECOMMENDED TREATMENT:

Take 10 g of Romanian royal jelly daily for 4 days

Apply honey enriched with green propolis directly onto the wound, cover with a sterile dressing, and change the dressing 2–3 times/day

Use 1 propolis suppository in the evening for 10 days to support elimination

RECOMANDED DIET:

Replacing dairy products with plant-based alternatives (according to the food intolerance test)

Take 4 teaspoons of honey blended with green propolis (57% extract, 2% concentration) daily

Consume 1 tablespoon of bee bread/day

MIXTURES OF BEE PRODUCTS CAN HELP WITH VARIOUS HEALTH PROBLEMS AND FASTER HEALTH RECOVERY

Benefits:

Supports healthy immune function

Promotes rapid recovery

Enhances overall mental and physical well-being

1 kg raw honey
500 g. fresh bee pollen or 300 g fresh bee bread
20 ml green propolis extract (minimum 50%)
50 ml soft brown propolis extract (70%)
40 g. royal jelly or 40 g fresh queen larvae or 50 g lyophilized Apilarnil
10 drops lemon essential oil

Recommended Dose:
1 tablespoon per 30 kg of body weight/day

casa BIO

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PP-366 [Apitherapy]
The Seven Gifts of Bees – The Bridge Between Apitherapy and Mythology

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[1]Petra Bole: Living Together: About Bees and Mankind (book)
[2]Petra Bole, Ivan Esenko, Andrej Šalehar: World of Pollinators (book)
[3]Petra Bole: Mythology and Symbolism of Bees (book)

For millennia, bees and their products have been an essential part of human culture, healing traditions, and spirituality. The concept of the Seven Gifts of the Bee has been revered in both ancient wisdom and modern apitherapy. Across civilizations, these natural substances were considered sacred, possessing both medicinal and mystical properties.
This study explores how traditional beliefs, myths, and symbolism surrounding these gifts provide a deeper understanding of their medicinal applications today. It builds on research from Mythology and Symbolism of Bees, which examines how mythological narratives shape our perception of bees and their healing power. Drawing from historical texts, ethnographic sources, and scientific research, this study examines how different cultures—from the temples of ancient Egypt and the healing sanctuaries of Greece to the principles of Ayurveda and Traditional Chinese Medicine—perceived and utilized bee products.

Ancient traditions emphasized the holistic power of these substances, mirroring modern integrative medicine's approach. Honey, often referred to as the "nectar of the gods," has long been used in wound healing and as an antimicrobial agent. Pollen, rich in nutrients, is valued for its immune-boosting and anti-inflammatory properties. Royal jelly, the food of queen bees, has been associated with vitality, longevity, and hormonal balance. Propolis, known as nature's antibiotic, has been widely used for treating infections and strengthening immunity, while bee venom therapy is gaining recognition in rheumatology, neurology, and pain management. Beeswax, beyond its dermatological applications, has held deep spiritual significance.

Beyond biochemical healing, the Seven Gifts of the Bee hold deeper esoteric meanings. Ancient shamans, priests, and healers viewed bee products as a conduit for spiritual transformation, energy purification, and enhanced consciousness. Modern complementary practices such as energy healing, homeopathy, acupuncture, bioresonance therapy, and vibrational medicine integrate bee products for amplified therapeutic effects.

Understanding the symbolic roots of these substances enriches our appreciation of apitherapy and highlights the interconnectedness of cultural wisdom and scientific discovery. By revisiting their historical and symbolic significance, we can deepen our understanding of apitherapy and rediscover the ancient knowledge that continues to guide healing practices today.

APIMONDIA SCANDINAVIA 2025
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PP-367 [Apitherapy]

Chemical Profiling of Beehive Air (Apiair) and its Biochemical Effects on an Asthmatic Rat Model

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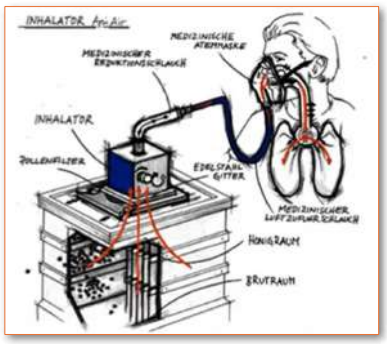
ıtroduction

ıe use of products such as honey, propolis, royal jelly, pollen, bee ead, bee venom and beeswax for health is called apitherapy, which eans treatment with bee products. It is defined in the Ministry of ealth's Regulation on Traditional and Complementary Medicine ractices as "the use of bees and bee products as a preventive measure ıd as a support in the treatment of certain diseases".



ıim of the Study

ıe **biochemical effects** of Apiair and its combination with chestnut ɔney on rats, particularly in an asthma model.
ıe **chemical composition** of beehive air using **GC-MS analysis**, to ıaracterize its active volatile components.
ıe variability of hive air components among different colonies, to ghlight the need for **standardization** in Apiair applications

Materials and Methods

ıemical Composition Analysis:GC-MS used to identify volatile ɯponents in hive air Each colony analyzed
ıbjects: 64 female Wistar Albino rats (250–300 g)

xperimental Groups *(n = 8 per group)*:
ontrol
eehive air (Apiair)
hestnut honey (200 mg/kg/day)
hestnut honey + Beehive air

Experimental Groups *(n = 8 per group)*:
Asthmatic rats
Asthmatic + Beehive air
Asthmatic + Chestnut honey
Asthmatic + Beehive air + Chestnut honey

Sample Collection and **Biochemical Analysis**:
Oxidative stress biomarkers: MDA, SOD, CAT, GPx, GSH
Methods: Standard spectrophotometric protocols

Oxidative Stress Findings:
Group 2 (Apiair) and **Group 3 (Honey)** showed moderate improvements in oxidati stress parameters compared to the healthy control (Group 1).
Group 4 (Apiair + Honey) had better antioxidant outcomes than Apiair or hon alone.
Asthmatic control group (Group 5) showed the **highest MDA levels** and reduc antioxidant enzyme activity.
Group 6 (Asthma + Apiair) and **Group 7 (Asthma + Apiair + Honey)** exhibit significantly **lower MDA** and **improved antioxidant defense** (↑ SOD, CAT, GI GSH).
Group 7 demonstrated the most pronounced protective effect.
22+ 24 volatile compounds were identified in hive air, including:
Aldehydes (nonanal, decanal)
Terpenes (limonene, α-pinene)
Acids (butyric, caprylic acids)
Phenolics (eugenol, methyl salicylate)
Composition **varied significantly between colonies**, even in close proximity.

Table 1. List of volatile components

	Chemical Compound Name	Retention Time (minutes)		Chemical Compound Name	Retenti Time (minut
1	1,4-Pentadiene	5,752	1	1,3-Dioxolane, 2-methyl-	9,192
2	1,3-Dioxolane, 2-methyl-	9,195	2	Heptane	11,20
3	1-Pentene, 2-methyl-	10,13	3	Furfural	14,71
4	Hexane, 2,4-dimethyl-	14,578	4	2-Heptanone, 3-methyl-	15,00
5	Cyclopentanone, 2-methyl-	17,004	5	Pentanoic acid	16,15
6	α-Pinene	19,236	6	Cyclopentanone, 2-methyl-	17,00
7	Benzene, 1-ethyl-2-methyl-	19,66	7	Heptanal	17,25
8	Camphene	19,744	8	Decane	17,86
9	Benzene, 1-ethyl-3-methyl-	20,271	9	2-Furancarboxaldehyde, 5-methyl-	18,99
10	Octanal	20,461	10	Camphene	19,74
11	β-Pinene	20,558	11	Trimethylsilyl methyl sulfide	20,26
12	D-Limonene	21,902	12	β-Pinene	20,56
13	Undecane, 3,7-dimethyl-	22,703	13	Bicyclo[3.1.1]hept-2-ene-2-methanol, 6,6-dimethyl-	21,45
14	Nonanal	23,374	14	Benzene, 1-ethenyl-4-ethyl-	23,22
15	Decane, 4-methyl-	23,711	15	Octanoic acid	24,72
16	Undecane, 5,7-dimethyl-	23,878	16	Benzaldehyde, 3-ethyl-	25,10
17	Cyclodecanol	25,139	17	Octane, 1-chloro-	25,22
18	Pinocarvone	25,383	18	Pinocarvone	25,39
19	Decanal	26,027	19	Benzaldehyde, 2,5-dimethyl-	25,54
20	Dodecane	26,22	20	Bicyclo[3.1.1]hept-3-en-2-one, 4,6,6-trimethyl-	26,47
21	Bicyclo[3.1.1]hept-3-en-2-one, 4,6,6-trimethyl-, (1S)- (2-Pinen-4-one)	26,477	21	Citral	27,55
22	Benzothiazole	26,884	22	Benzaldehyde, 4-(1-methylethyl)- (cuminaldehyde)	28,85
23	Hexadecane	28,599	23	1,3-Dioxolane, 2-methyl-	9,192
24	5,9-Undecadien-2-one, 6,10-dimethyl-, (E)-	31,566	24	Heptane	11,20

Table 2. Serum Antioxidant Levels in Control and Treatment Groups (Mean±SE).

Grups Parameters	1.Control (n=7)	2. Apiair (15 min.) 2 times (n=8)	3.Apiair (30 min.) 1 times (n=8)	4. Honey (n=8)	5. Apiair + Ho (n=7)
MDA (nmol/mL)	0,63±0,06a	0,58±0,04	0,50±0,04	0,51±0,06	0,43±0,07
CAT (ng/mL)	9,10±1,35	8,48±0,80	9,94±0,45	9,97±1,22	10,95±0,88
SOD (U/mL)	16,85±1,17^{ab}	16,91±0,95^{ab}	14,41±1,50^{b}	20,01±2,04^{a}	21,24±1,11^{a}
GSH (mg/dL)	402,14±10,50	409,17±15,13	387,50±11,66	428,33±21,35	413,33±12,29
GPx (ng/mL)	21,41±2,86	21,87±1,52	23,23±2,20	24,55±1,71	24,73±2,74

Conclusion

Apiair, especially in combination with chestnut honey, reduc oxidative stress markers in both healthy and asthmatic rats. The findings suggest its potential as a complementary therapy f respiratory conditions. However, variability in hive a composition underscores the need for standardization befo clinical use.

Discussion

Hive air contains a complex mix of volatiles from honey, propolis, wax, and bee brea
Composition varies between colonies, even in the same apiary (Bengsh, 2016).
In this study, 30 min/day Apiair exposure showed positive effects, especially wh combined with honey.
For therapeutic use, application frequency and duration should match disease sever (Guardia, 2020).
Colony health matters: Air from unhealthy hives may cause harm (Balas, 2000).
Standardization and safety control are essential before clinical use.

References & Acknowledgments

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The authors would like to thank the GC-MS analysis team and laboratory staff for their valuable contributions.
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PP-368 [Apitherapy]
Screening of antibacterial properties and antibiotic resistance in honey

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The therapeutical properties of honey have been known since the early history of beekeeping. The various mechanisms for the therapeutical properties of honey are far from well known, however one suggested trait has been linked to the presence of antibacterial microorganisms in honey. However, the mechanisms of antibacterial activities are far from well explored. Further, considering the increasing global spread of antibiotic resistance, it is also necessary to explore if antibiotic resistance can be detected in honey and/or its microbes. So far, few studies have been performed to explore antibiotic resistance in honey.

In this study, we have screened a large amount of honey samples from different parts of Sweden, and a selected amount of honey samples from other countries in Fennoscandinavia, EU and outside EU. We employed a three step strategy: i) screening of lytic properties of honey on prokaryotic and eukaryotic cells embedded in solid agar media; ii) screening of inhibition on agar media with different types of antibiotics (natural compounds, anthropogenic compounds) at different concentrations; iii) isolation and identification of microbes from a selected amount of honey samples. Different kinds of controls were used, such as heat treated honey, artificial sugar solutions, “fake honey” and maple syrup. A selection of these honey samples were characterized further with regard to chemical composition, floral origin (pollen analyses), and molecular biology.

In summary, antibacterial properties could be observed in a relatively large proportion of the studied honey samples. Further, antibiotic resistance could also be observed in a smaller amount of the studied honey samples. These differences may be attributed to the geographical origin and the environmental conditions of the honey. However, the mechanisms for these differences need to be explored further by systems biological based methods.

APIMONDIA SCANDINAVIA 2025
SWEDEN | DENMARK | NORWAY

PP-369 [Apitherapy]

PHILIPPINE STINGLESS BEES PROPOLIS:

MEDICINAL PROPERTIES AND PROSPECTS FOR ANIMAL & HUMAN HEALTH

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ABSTRACT

The Philippine stingless bee (*Tetragonula biroi* Friese) propolis contains different bioactive compounds that are responsible for its medicinal properties to address various disease condition. Utilizing different models of wounds like full thickness incisional, sutured, surgical, and burn wounds and bed sores, treatment with our locally developed sterile propolis wound dressing significantly hastened the healing rate of these wounds through significant reduction of inflammation, exudation, faster wound apposition, and prevented the development of pus formation and necrosis. The potent anti-inflammatory activity is attributed to propolis capacity to down regulate the the pro-inflammatory cytokines TNFα, IL1β and IL6. Furthermore, propolis exhibit remarkable anti-pain activity against somatic and cutaneous pain associated with the occurrence of wounds. Histopathologic examination of wound sites showed re-epithelialization and intact dermal matrix with fast growth of hair follicles and sebaceous glands with propolis wound dressing treatment. The hair growth promoting effect of propolis is through stimulation of hair follicles development by activating the Wnt/β-catenin signaling pathway. Cost benefit analysis shows huge savings with treatment of propolis wound dressing. Collectively, these information infer the uniqueness and high potential of the Philippine stingless bee propolis for development of high value biomedical products such as the propolis wound dressing for the management of different types of wounds in animals and humans.

INTRODUCTION

Philippine stingless bee propolis has demonstrated promise as a therapeutic agent, driving investigations into its wound-healing and medicinal properties. Preliminary studies in murine models revealed its ability to accelerate wound closure and modulate key inflammatory pathways. Building on this foundation, subsequent research explored propolis-based treatments in feline surgical and wound management, offering insights into the translational potential of this natural product for both animal and human health applications.

MATERIALS & METHODS

One hundred six (106) male ICR mice underwent dorsal skin preparation followed by the creation of a 1-cm incisional wound and left as is or sutured using non-absorbable material. Standardized treatments (propolis-alginate, povidone-iodine, fusidate sodium) were applied topically, and progress was monitored over 14 or 21 days.

Subsequent studies used 15 male and 15 female domestic shorthaired cats. They were evaluated in studies involving either a dorsal 3-cm incisional wound and left as is or sutured with non-absorbable material, and surgical wounds from ovariohysterectomies, respectively. Treatments were the same as in the mouse models. Histo-morphometric analysis was performed on biopsy samples to assess collagen formation, epidermal thickness, angiogenesis, and cellular characteristics within the healing tissue. Statistical analysis of total wound scores and healing times was performed, and the cost effectiveness of each treatment was evaluated to provide a holistic view of the interventions.

RESULTS

Table 1. Comparison of mean total wound scores (MTWS), mean duration of wound healing (MDWH) and incidence of wound closure in **incisional and sutured wound mice models** treated with H2O2 + povidone iodine (n=17), fusidate sodium (n=20), and propolis-alginate (n=16).

	INCISIONAL			SUTURED		
Treatment groups	H_2O_2 + Povidone Iodine	Fusidate sodium	Propolis-alginate	H_2O_2+ Povidone Iodine	Fusidate sodium	Propolis-alginate
MTWS at Day 1	7.00 ± 1.46^a	4.85 ± 0.88^a	5.88 ± 1.3^a	2.60 ± 0.60^a	2.50 ± 0.71^a	2.39 ± 0.71^a
MTWS at Day 14	2.82 ± 2.07^{b*}	1.80 ± 1.94^{b*}	1.13 ± 1.67^{b*}	1.65 ±1.39^{a*}	0.89 ±1.32^{a*+}	0.39 ±0.92^{b*+}
MDWH (days)	13.71 ± 0.49^a	13.17 ± 1.03^a	12.42 ± 1.38^a	10.71 ± 1.98^a	10.33 ± 1.67^a	9.00 ± 1.65^a
% of mice with healed/closed wounds	41.00%	60.00%	75.00%	35.00%	66.67%	83.33%

Table 2. Comparison of mean total wound scores (MTWS) and mean duration of wound healing (MDWH) in **incisional and sutured wound feline models** treated with H2O2 + povidone iodine (n=5), fusidate sodium (n=5), and propolis-alginate (n=5).

	INCISIONAL			SUTURED		
Treatment groups	H_2O_2 + Povidone Iodine	Fusidate sodium	Propolis-alginate	H_2O_2+ Povidone Iodine	Fusidate sodium	Propolis-alginate
MTWS at Day 1	4.80±0.84^a	4.80±0.84^a	3.80±0.45^a	0.16±0.97^a	0.20±0.40^a	0.08±0.27^a
MTWS at Day 7	5.60±1.95^a	4.00±1.58^a	1.80±0.45^{b*}	0.24±0.59^a	0.08±0.27^a	0.04±0.20^a
MTWS at Day 14	3.40±1.52^a	2.20±1.30^{a*}	0.20±0.45^{b*}	0.00±0.00^a	0.00±0.00^a	0.00±0.00^a
MTWS at Day 21	0.80±0.45^{a*}	1.00±0.00^{a*}	0.00±0.00^{b*}	0.00±0.00^a	0.00±0.00^a	0.00±0.00^a
MDWH (days)	18.00±4.00^a	13.00±4.18^{ab}	9.00±2.45^b	11.20 ±3.70^b	7.40 ±2.5^{ab}	5.00 ±3.08a^a

Table 3. Mean total wound scores (MTWS) and mean duration of wound healing (MDWH) in **surgical wound feline models** treated with H2O2 + povidone iodine (n=5), fusidate sodium (n=5), and propolis-alginate (n=5).

Treatment groups	H_2O_2 + Povidone Iodine	Fusidate sodium	Propolis-alginate
MTWS at Day 1	1.80 ± 0.57^a	2.20 ± 0.65^a	0.80 ± 0.55^b
MTWS at Day 7	2.20 ± 0.58^a	2.20 ± 0.58^a	1.40 ± 0.61^b
MTWS at Day 10	1.20 ± 0.52^a	1.20 ± 0.44^a	0.00 ± 0.00^b
MTWS at Day 14	0.00 ± 0.00^a	0.00 ± 0.00^a	0.00 ± 0.00^a
MDWH (days)	11.60 ± 1.52^a	11.60 ± 1.95^a	8.80 ± 0.45^b

Table 4. Mean (±SD) wound size (mm) of **incisional and surgical wounds of cats** treated with H2O2 + povidone iodine, fusidate sodium, and propolis-alginate at different periods.

	INCISIONAL			SURGICAL		
Treatment groups	H_2O_2 + Povidone Iodine	Fusidate sodium	Propolis-Alginate	H_2O_2 + Povidone Iodine	Fusidate sodium	Propolis-alginate
Day 0	30.00±0.00	30.00±0.00	30.00±0.00	52.8 ± 0.00^a	52.8 ± 0.00^a	52.8 ± 0.00^a
Day 7	26.29±2.78^{a*}	26.87±4.06^a	14.80±8.46^{b*}	42.18 ± 4.47^a	42.45 ± 4.89^a	35.24 ± 5.55^b
Day 14	14.79±10.47^{ab*}	22.80±4.23^{a*}	3.60±8.05^{b*}	0.00 ± 0.00^a	0.00 ± 0.00^a	0.00 ± 0.00^a
Day 21	0.00±0.00	0.00±0.00	0.00±0.00	0.00 ± 0.00^a	0.00 ± 0.00^a	0.00 ± 0.00^a

Table 5. Cost benefit analysis for the different treatment dressings.

	Cost per cat per application (Php/day)	Number of applications in a day	Cost per cat (Php) for duration		
			Incisional wound	Sutured wound	Surgical wound
H_2O_2 + Povidone Iodine	47.58	2	1712.88	1065.79	95.16
Fusidate sodium	41.39	2	1076.14	612.57	82.78
Propolis-Alginate	33.7	2	606.60	337.00	67.40

Figure 1. Gross appearance of completely (A-C) and incompletely (D-F) healed **incisional wounds** of representative **mouse** treated with H_2O_2 + povidone iodine (A, D), fusidate sodium (B, E), and propolis-alginate (C, F) dressings at Days 0, 1, 7 and 14. Take note of the complete healing of the wounds at the end of the 14-day treatment period

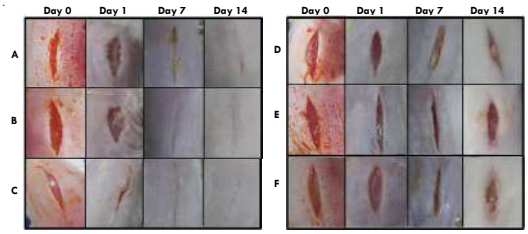


Figure 2. Gross appearance of **incisional** (A-C) and **sutured** (D-F) wounds of representative **cats** treated with H_2O_2 + povidone iodine (A, D), fusidate sodium (B, E), and propolis-alginate (C, F) dressings at Days 0, 1, 7 and 14.

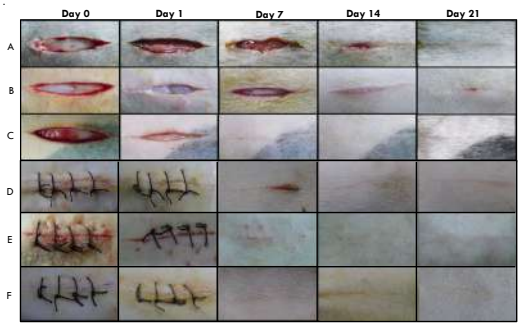


Figure 3. Skin sections from representative incisional (A-I) and sutured (M-R) wounded cats treated with H2O2 + povidone iodine (A-C, J-L), fusidate sodium (D-F, M-O) and propolis-alginate (G-I, P-R) treated cats at Day 7, 14 and 21. Take note of the normal epidermis and intact dermis with hair follicles, blood vessels and sebaceous in the propolis-alginate treated cats (blue asterisk). Marked epidermal thickening and dermal fibrosis were evident in the fusidate sodium and H_2O_2 + povidone iodine cats. There was disorganization of the collagen fibers in the dermis of the H2O2 + povidone iodine (C) treated cats. H and E stained.

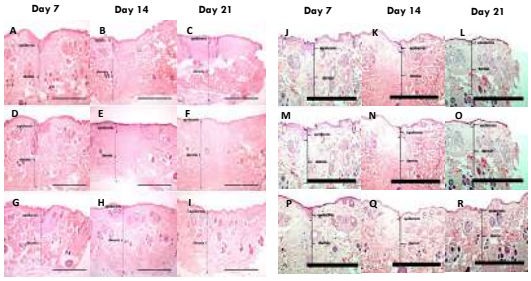
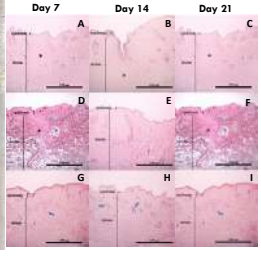


Figure 4. Gross appearance of surgical wounds of representative cats treated with H_2O_2+povidone iodine (A-E), fusidate sodium (F-J), and propolis-alginate (K-O) dressings at Days 1, 7, 10, 14 and 21. Propolis-alginate treatment showed faster surgical wound healing compared with the H_2O_2+povidone iodine and fusidate sodium treated cats.

Figure 5. Skin sections of representative cats treated with H_2O_2+povidone iodine (A-C), fusidate sodium (D-F), and propolis-alginate (G-I) dressings at Days 7, 14, and 21. Complete and rapid re-epithelialization and intact dermal matrix (ex. G-I) with abundant hair follicles and sebaceous glands (H-I, blue arrows) formation were noted in cats treated with propolis-alginate. Take note of the thicker epidermis, marked dermal fibrosis, few hair follicles and absence of sebaceous glands in the fusidate sodium (D-F, *) and H_2O_2+povidone iodine treated cats (A-C, *). (40x, H&E stain)



SUMMARY & CONCLUSION

Tetragonula biroi propolis-alginate dressings consistently demonstrated enhanced wound healing activity in both murine and feline models. These findings support its potential as an effective and economical veterinary treatment, where the use of normal saline solution for cleaning wounds is more recommendable.

PP-370 [Apitherapy]

BRAIN PROTECTING EFFECT OF PHILIPPINE STINGLESS BEE PROPOLIS: POTENTIAL FOR THE MANAGEMENT OF ISCHEMIC STROKE

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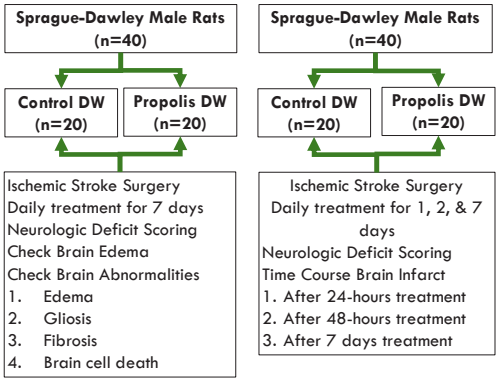
ABSTRACT

Stroke is the number two cause of mortality in humans globally. The neuroprotective activity of the Philippine stingless bee (PSB) propolis against the most common type of stroke, ischemic stroke was investigated using Sprague-Dawley (SD) rats. Rats were divided into two treatment groups (n=20/grp): Control group, treated with distilled water (DW) & PSB propolis group. Ischemic stroke was surgically induced in 8-week old SD male rats by occluding the blood vessel supplying the brain. Neurologic deficit scoring (NDS) was done daily during the 7-day treatment period. The PSB propolis & vehicle distilled water were given via gavage daily after performing NDS for the entire 7-day treatment period. PSB propolis treatment significantly improved the ischemic stroke-induced motor deficits like limb & tail paralysis, & immobility compared with the control DW treated rats. Moreover, PSB propolis treatment remarkably reduced the brain swelling, & attenuated brain microscopic abnormalities like hippocampal asymmetry, hippocampal fibrosis & gliosis, cerebro-cortical edema, fibrosis, neuronal degeneration due to ischemic stroke insult. Additionally, time course study using another set of ischemic stroke SD rats showed that PSB propolis treatment significantly minimized ischemic stroke-induced brain infarction compared with the control DW treated rats. These findings reveal the brain protecting effect of the PSB propolis against ischemic stroke.

INTRODUCTION

Stroke is an episodal impairment of sufficient cerebral vascular perfusion due to ischemia or hemorrhage that causes irreversible brain tissue damage manifested by neurologic deficits especially motor impairments & paralysis. Ischemia-induced stroke is primarily caused by lack of sufficient blood supply to the brain. This leads to a cascade of electrolyte imbalance, excessive free radical release, brain tissue injury, edema & brain cell death. Current management of ischemic stroke mainly involves surgery i.e. craniotomy, hemicraniectomy to reduce brain edema & thrombectomy remove blood clots. Thrombolytics & anticoagulants are used for lysis of clots & preventing further blood clot formation, respectively. Neuroprotectants are also given to prevent free radical formation, & inhibit inflammatory cells recruitment & brain cell death. Exploring the brain protecting activity of PSB propolis was investigated in ischemic stroke since it possesses potent anti-inflammatory & anti-oxidant activities which contributes to the causation of stroke.

MATERIALS & METHODS



RESULTS

Fig. 1 Mean Neurologic Deficit Scores Treated Ischemic Stroke Rats

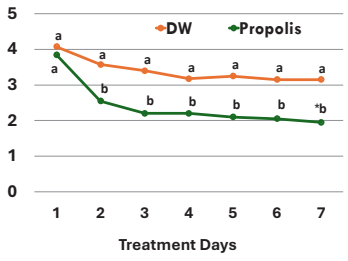


Fig. 3. Neuroprotection of PSB Propolis: Hippocampal Asymmetry and Lesions

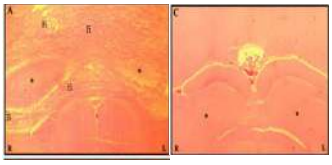


Table 1. Mean Infact Size in Hippocampus of Treated Ischemic stroke Rats

Treatment groups	Hippocampal Infarct (%) Day 1	Day 2	Day 7
Distilled water	31.34%	29.02%	45.27%
PSB Propolis	3.21%	4.20%	4.01%

Fig. 2. Brain of Treated Ischemic Stroke Rats

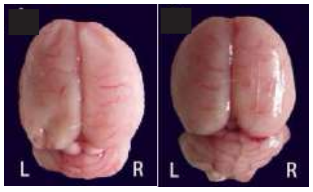
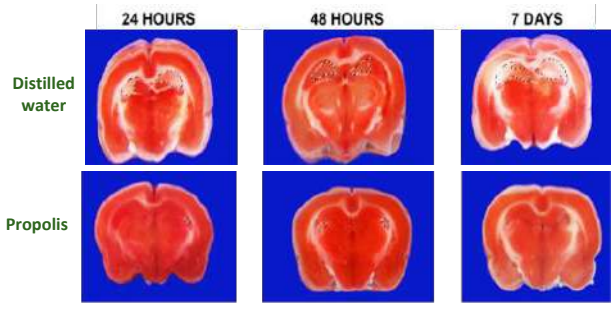


Fig. 4. Brain Infarct of Treated Ischemic Stroke Rats



CONCLUSION

The Philippine stingless bee propolis contains bioactive compounds with potent neuroprotective activities which abrogated the neurologic motor deficits, brain edema, infarction, and pathologic lesions induced by ischemic stroke which shows its high potential as an alternative substance for the management of ischemic stroke.

PP-371 [Apitherapy]
Bioassay-guided Isolation of Compounds from Sunflower (Helianthus annuus) Bee Pollen

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Bee pollen is among the most popular natural products used for various medical uses due to both its nutritional benefits, powerful therapeutic properties and many bioactive compounds. Today, bee pollen is consumed as a dietary supplement and for some alternative medical treatments, and has significant potential as a "fortification and survival food" [1]. In studies focusing on the bioactive compounds of bee pollen, more than 250 bioactive substances consisting of lipids, amino acids, proteins, carbohydrates, fatty acids, phenolic compounds, terpenes, carotenoids, flavonoids, vitamins and bio-elements have been identified [2]. It has been emphasized that these compounds are related to the antioxidant, antimicrobial, antidiabetic, anti-hyperglycemic, anti-inflammatory, hepatoprotective, nephroprotective and anti-cancer properties of bee pollen [1,3].

The aim of this study is to obtain pure compounds from sunflower (Helianthus annuus) bee pollen as bioassay-guided isolation. In the first step of the study, antioxidant (DPPH• scavenging, ABTS•+ scavenging, β-carotene linoleic acid, CUPRAC, and metal chelating assays), α-amylase and α-glucosidase inhibition activities of sunflower bee pollen, methanol and water extracts and fractions (hexane, dichloromethane, ethyl acetate, butanol and water) obtained from the methanol extract were screened. The ethyl acetate (IC50: 79.97±0.89, 112.61±1.89 µg/mL) and butanol (IC50: 84.38±0.92, 230.13±2.14 µg/mL) fractions were recorded as the highest antioxidant active in ABTS•+ and DPPH• scavenging assays. The hexane fraction (IC50: 92.36±1.07 µg/mL) and methanol extract (IC50: 80.32±0.92 µg/mL) indicated the highest antioxidant activity in β-carotene linoleic acid assay. The ethyl acetate (A0.50: 80,03±0,36 µg/mL) and butanol (A0.50: 79.16±0.58 µg/mL) fractions possessed higher antioxidant activity than α-tocopherol (A0.50: 89.47±0.87 µg/mL) in CUPRAC assay. All fractions and methanol extract (80,13±2,39-90.43±1.22%) showed close metal chelating activity to EDTA (96.30±0.11%) at 800 µg/mL concentration. The hexane extract was found to be the best inhibitor on α-amylase (IC50: 516.67±2.67 µg/mL) and α-glucosidase (IC50: 346.86±2.13 µg/mL). In the second step of the study, the hexane fraction was subjected to silica gel column chromatography and a total of 16 sub-fractions were obtained. All sub-fractions were tested for antioxidant, α-amylase and α-glucosidase inhibition activities. Δ7-Avenasterol, a fatty acid and kaurenoic acid were isolated and their structures were confirmed based on spectroscopic analyses (IR, NMR and MS) and comparison with literature data.

PP-372 [Apitherapy]
Investigation of Antioxidant Activities of Pamucak (Cistus creticus) and Söğüt (Salix sp.) Bee Pollens

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Oxidative stress is defined as an imbalance between the production of oxidants that can damage biological systems and antioxidant defense mechanisms. Oxidative stress is the most triggering component of a wide range of health problems, including atherosclerosis, chronic obstructive pulmonary disease, Alzheimer's disease, diabetes and cancer [1]. Synthetic antioxidants are used in the food industry to prevent oxidative stress and daily intake limits have been determined as safe. However, studies have proven the adverse effects of long-term and acute exposure to synthetic antioxidants [2]. Therefore, studies on antioxidant properties of bee pollen, one of the most popular natural compounds, are increasing in the discovery of natural antioxidants with fewer side effects [3].

In this study, the methanol and water extracts of pamucak (Cistus creticus) and söğüt (Salix sp.) bee pollens and hexane, dichloromethane, ethyl acetate, butanol, and water fractions from the methanol extracts were obtained. Antioxidant activities of all bee pollens, extracts and fractions were tested by using DPPH• scavenging, ABTS•+ scavenging, β-carotene linoleic acid, CUPRAC, and metal chelating assays. In DPPH• and ABTS•+ scavenging assays, söğüt ethyl acetate (IC50: 2.46±0.04, 1.21±0.08 µg/mL) and butanol fractions (IC50: 7.97±0.08, 3.38±0.14 µg/mL) and pamucak ethyl acetate fraction (IC50: 6.56±0.08, 4.98±0.03 µg/mL) were found higher antioxidant active than BHA (IC50: 19.76±0.36, 11.76±0.09 µg/mL) and α-tocopherol (IC50: 37.18±0.41, 38.46±0.54 µg/mL). Pamucak hexane fraction and methanol extract and söğüt butanol and ethyl acetate fractions displayed the highest β-carotene linoleic acid activity with IC50 values of 78.71±0.67, 101.98±0.88, 125.06±1.91, and 137.84±1.33 µg/mL, respectively. In CUPRAC assay, when söğüt ethyl acetate (A0.50: 32.09±0.58 µg/mL) and butanol (A0.50: 25.34±0.57 µg/mL) fractions showed higher antioxidant activity than α-tocopherol (A0.50: 89.47±0.87 µg/mL), pamucak ethyl acetate (A0.50: 20.41±0.87 µg/mL) exhibited higher antioxidant activity than α-tocopherol and BHA (A0.50: 24.42±0.69 µg/mL). In addition, söğüt hexane fraction (85.06±0.20%) and pamucak water extract (79.26±0.13%) showed near standard metal chelating activity to EDTA (96.30±0.11%) at 800 µg/mL concentration.

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BEE BIOLOGY

PP-374 [Bee Biology]

Evaluation of Hygienic Behaviour in Honey Bees *Apis mellifera intermissa* Through Pin Testing: Implications for Sustainable Beekeeping and Environmental Resilience

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Abstract

Honey bee health is increasingly challenged by parasites and environmental stressors. Hygienic behavior where bees detect and remove unhealthy brood is a key adaptive trait enhancing colony resilience. This study evaluated the hygienic behavior of *Apis mellifera intermissa* colonies in northern Algeria using the pin-killed brood (PKB) test across different seasons. Out of 40 colonies tested, 35% demonstrated a high hygienic response (>95% brood removal in 24 hours), while 40% showed moderate responses (50–95%). Colonies with strong hygienic behavior were also less affected by Varroa destructor and visible brood diseases. Seasonal variation was observed, with better performance during spring and early summer. These findings highlight significant intra-population variability in hygienic behavior within *A. m. intermissa*, suggesting potential for selective breeding to enhance disease resistance and colony survival under local environmental conditions.

Key words: Hygienic behaviour; *Apis mellifera intermissa*; pin test; disease resistance; colony health; selective breeding.

Introduction

Honey bees (*Apis mellifera*) are essential pollinators and key contributors to food security and ecosystem stability. However, their health is increasingly threatened by Varroa destructor, viruses, and climate-related stressors. Hygienic behavior—where worker bees detect and remove diseased or dead brood—is a natural defense that reduces parasite loads and limits disease spread. In Algeria, the local subspecies *Apis mellifera intermissa* plays a vital role in agriculture, yet its hygienic behavior is poorly documented. This study aims to evaluate the hygienic behavior of *A. m. intermissa* colonies using the pin-killed brood (PKB) test, in order to identify resilient colonies and support future selection programs.

Results & Discussion

The hygienic behavior of *Apis mellifera intermissa* colonies showed significant regional variation, with colonies from Médéa displaying the highest removal rates (83.6 ± 4.2%) compared to those from Boumerdès and Bordj Bou Arréridj. This suggests a potential influence of environmental conditions such as altitude and microclimate on the expression of hygienic traits. A seasonal decline in hygienic performance was also observed, with mean rates decreasing from 79.8% in March to 73.4% in September, possibly due to changes in colony strength, brood availability, or foraging pressure. Although inter-colony differences were not statistically significant, several colonies consistently exhibited high hygienic rates across all months, indicating potential candidates for selective breeding. A strong negative correlation was observed between hygienic behavior and Varroa infestation levels; colonies with higher hygiene rates had significantly lower Varroa loads. These findings reinforce the importance of hygienic behavior as a natural resistance mechanism and support its inclusion as a selection criterion in breeding programs for *A. m. intermissa* under Algerian conditions.

Results & Discussion

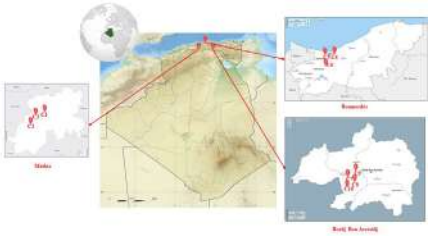

Figure 1. Distribution of colony locations.

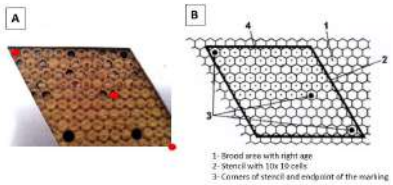

Figure 2. Pin Test Application for Assessing Hygienic Behaviour in *A. m. intermissa* Colonies. (A) The targeted brood area is punctured to simulate dead brood. (B) A pattern (10×10 cells) is placed over the comb to measure brood removal rates post-pin test.

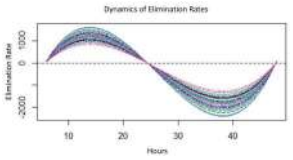

Figure 5. Dynamic elimination rate trends showing sinusoidal fluctuations influenced by environmental rhythms and colony activity.

Table 1. Analysis of variance (ANOVA) of the hygienic behavior of bee colonies by region and colony

source of variation	F-value	p-value	interpretation
Region	4.18	**0.030**	**Significant:** hygienic behavior varies significantly between regions.
Colony	1.72	0.150	**Not significant:** differences between colonies (in the same region) are not statistically significant.

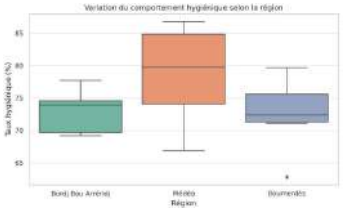

Figure 3. Box plot of hygiene rates by region.

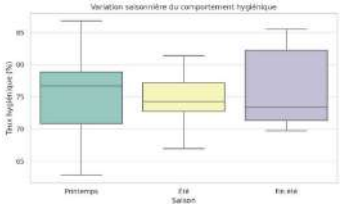

Figure 4. Seasonal boxplot of hygienic behavior.

Materials & Methods

Study Location and Period
Study Period and LocationThe study was conducted from March to September 2024 in three Algerian regions with contrasting climates: Médéa, Tipaza, and Boumerdès. Each region hosted one apiary with 3 to 4 colonies, totaling 10 colonies of Apis mellifera intermissa.

Hygienic Behaviour Assessment
The pin-killed brood (PKB) test was used to evaluate hygienic behaviour. A **10×10 cm metal pattern** (100 cells) was placed on brood combs to ensure standardized selection. **Fifty sealed brood cells** were pierced with an insect pin (No. 2), simulating diseased brood. The frame was reintroduced into the hive, and brood removal was observed at **6h, 24h, and 48h**. The removal rate (%) was calculated based on the number of cleaned cells.

Varroa Infestation Monitoring
The **sugar dusting method** was applied to assess *Varroa destructor* infestation. **300 bees** from the brood area were dusted with powdered sugar, dislodging mites for counting. Infestation rates were recorded monthly.

Data Analysis
Results were analyzed using R software. Seasonal and regional effects were tested via ANOVA. Correlations between hygienic behavior and Varroa infestation were examined using Pearson's correlation coefficient.

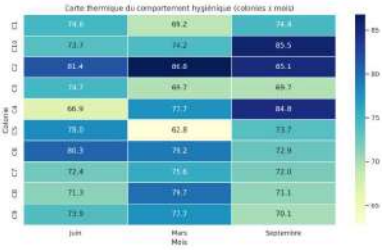

Figure 6. Carte thermique des performances hygiéniques.

Conclusion

This study confirms regional variability in hygienic behavior among *Apis mellifera intermissa* and highlights the effectiveness of the pin test as a practical, reproducible tool for behavioral selection in Algerian beekeeping. Among the ten colonies tested across three ecologically distinct regions, those in Medea demonstrated significantly higher hygienic performance—suggesting that environmental factors (altitude, temperature, flowering) influence this adaptive trait. Although intra-apiary variation was not statistically significant, observable trends indicate exploitable genetic potential for local selection. Seasonal monitoring revealed a progressive decline in hygienic behavior by late summer, emphasizing the need for increased vigilance during critical colony health periods. In parallel, detergent-based assessment of Varroa destructor infestation rates revealed a clear negative correlation with hygienic behavior: colonies scoring >80% exhibited the lowest infestation levels. This supports the role of hygienic behavior as a natural defense mechanism and underscores the value of including the pin test in sustainable breeding programs aimed at improving colony resilience while reducing chemical treatments. Overall, these results demonstrate the strategic importance of hygienic behavior for improving colony health and preserving the local diversity of *A. m. intermissa*. Future research should explore associations between behavioral traits and additional vitality indicators such as varroa tolerance, viral load, longevity, and productivity to develop integrated selection profiles tailored to Algeria's ecological and socio-economic contexts.

PP-375 [Bee Biology]
Global discovery, expression pattern, and regulatory role of miRNA-like RNAs in Ascosphaera apis infecting the Asian honeybee larvae

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Ascosphaera apis, a specialized fungal pathogen, causes lethal infection in honeybee larvae. miRNA-like small RNAs (milRNAs) are fungal small RNAs similar to miRNAs, which have been shown to regulate fungal hyphal growth, spore formation, and pathogenesis. Based on our previously obtained transcriptome data, differentially expressed miRNA-like RNAs (DEmilRNAs) in A. apis infecting the Apis cerana cerana worker 4-, 5-, and 6-day-old larvae (Aa-4, Aa-5, and Aa-6) were screened and subjected to trend analysis, followed by target prediction and annotation as well as investigation of regulatory networks, with a focus on sub-networks relative to MAPK signaling pathway, glycerolipid metabolism, superoxide dismutase, and chitinase. A total of 606 milRNAs, with a length distribution ranging from 18 nt to 25 nt, were identified. The first nucleotide of these milRNAs showed a bias towards U, and the bias pattern across bases was similar across the three groups. There were 253 68 up-and 54 down-regulated milRNAs shared by the above-mentioned three groups. Additionally, the expression and sequences of three milRNAs were validated by stem-loop RT-PCR and Sanger sequencing. Trend analysis showed that 79 DEmilRNAs were classified into three significant profiles (Profiles 4, Profiles 6, and Profiles 7). Target mRNAs of DEmilRNAs in these three significant profiles were engaged in 42 GO terms such as localization, antioxidant activity, and nucleoid. These targets were also involved in 120 KEGG pathways including lysine biosynthesis, pyruvate metabolism, and biosynthesis of antibiotics. Further investigation suggested that DEmilRNAs -targeted mRNAs were associated with MAPK signaling pathway, glycerolipid metabolism, superoxide dismutase, and chitinase. Moreover, the binding relationships between aap-milR10516-x and ChsD as well as between aap-milR-2478-y and mkh1 were confirmed utilizing a combination of dual-luciferase reporter gene assay and RT-qPCR. Our data provide new insights into the A. apis proliferation and invasion, lay a basis for illustrating the DEmilRNA-modulated mechanisms underlying the A. apisinfection, and offer candidates for functional dissection.

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PP-376 [Bee Biology]

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NEW ZEALAND

Genetic Structure of the New Zealand Honey Bee

Unexpected African lineage markers and their implications for selective breeding

Between 2022 and 2023, honey bee samples were collected from four distinct regions of New Zealand. DNA analysis and SNP genotyping were conducted to determine genetic origins and assess hybridisation levels. The study focused on identifying markers distinguishing Eastern European (C lineage), Western European (M lineage), African (A lineage), and Middle Eastern (O lineage) genetic origins.

New Zealand's honey bee populations present a unique case study in genetic isolation and controlled breeding. This research investigated the genetic structure of Apis mellifera populations in New Zealand, focusing on unexpected African genetic markers and their implications for breeding programs. The study utilized high-resolution SNP genotyping to characterize genetic admixture patterns and evaluate their potential significance for apicultural practices.

METHODS

1. Comprehensive genetic analysis revealed varying levels of lineage admixture across sampled populations *(see figure. 1)*:
   - Eastern European (C) lineage was dominant, comprising 78-94% of genetic composition
   - Western European (M) lineage was consistently present in all samples, ranging from 4.2% to 22.1%
   - African (A) lineage markers were either absent or present at low levels (0.7-6%)
   - Middle Eastern (O) lineage showed minimal contribution
2. The presence of African genetic markers, despite no historical records of direct African honey bee introductions, suggests complex patterns of genetic inheritance through indirect pathways.
3. The consistent presence of M-lineage markers in all samples indicates the persistent influence of historical A. m. mellifera imports.

   Three primary hypotheses explain the presence of African genetic markers:
   1. Indirect introduction through Australian imports, where honey bees contain ~4-5% African genetic admixture
   2. Possible undocumented historical imports of reproductive material
   3. Natural selection favoring specific African genetic traits beneficial in local conditions

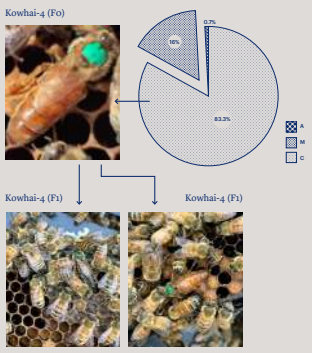
Regional variations in genetic composition were observed. This genetic heterogeneity across regions likely reflects the complex interplay between human-mediated breeding choices and the historical development of beekeeping in different parts of New Zealand, rather than representing a single causative factor. While previous understanding of New Zealand honey bee populations was based on managed European lineages, our findings reveal more complex patterns of genetic admixture. The detection of African genetic markers, even at low levels, highlights the importance of using advanced genetic monitoring tools in breeding programs. This unexpected genetic complexity emphasizes the need for more precise molecular diagnostic approaches in selection programs, as even moderate levels of genetic introgression can affect breeding outcomes and population management strategies. *(see figure. 2)*

CONCLUSION

Our research demonstrates the complexity of honey bee genetic structure in isolated populations and highlights the importance of comprehensive genetic monitoring in breeding programs. Future breeding strategies should focus on maintaining beneficial genetic diversity while ensuring population stability and preventing uncontrolled hybridisation.

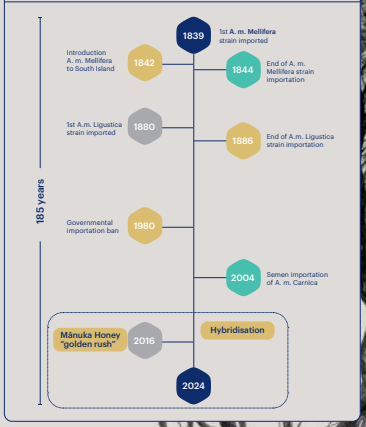
The findings contribute to our understanding of honey bee evolution in isolated environments and provide valuable insights for apicultural practices worldwide. This research emphasizes the need for continued genetic monitoring and evidence-based breeding strategies in maintaining sustainable honey bee populations NZ.

Figure 1. *Proportion of ancestry from Eastern European (C), Western European (M), and African (A) lineages.*



Genomic ancestry of queen Kowhai-4 (F), inferred from SNP-based admixture analysis. Results indicate predominance of C lineage (Carniolan, 83.3%), with minor M (16%) and A (0.7%) lineage components. Analysis performed externally; reference panel not disclosed.

Figure 2. *History Timeline (185 years)*



PP-377 [Bee Biology]
Improvement of the sequences and functional annotations of the eastern honeybee reference genome with the Nanopore long reads

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The eastern honeybee (Apis cerana) is a bee species of great importance used in beekeeping industry across Asian countries, with crucial ecological and economical value. Due to the short reads from second-generation sequencing, the current reference genome assembly version (ACSNU-2.0) of A. cerana still needs to be improved.. In this study, based on the obtained high-quality Nanopore long reads, the structures of the annotated genes in the A. cerana reference genome were optimized using bioinformatics, and the unannotated novel genes and transcripts were then identified and annotated, followed by prediction of SSR loci, complete ORFs and transcription factors (TFs). Here, 4648 annotated gene structures in the reference genome of A. cerana were optimized. In addition, 2148 new genes were identified, of which 818, 298, 587, 359 and 333 new genes were annotated to Nr, KOG, eggNOG, GO and KEGG databases, respectively. A total of 35432 new transcripts were identified, of which 30974, 21222, 29025, 19852 and 9214 new transcripts were annotated to the above five databases, respectively. Also, 22541 SSR loci were found, and the type with the highest distribution frequency was single base repeat (153.37/Mb). Totally, 58 TF families and 1611 members were predicted. Moreover, 28775 complete ORFs were predicted, of which the ORFs with coding length of 100-200 amino acids (38.99%) were the most. These results optimized the structure of the annotated genes on the reference genome of A. cerana, supplemented the unannotated novel genes, novel transcripts, SSR, complete ORF and TF on the reference genome, and improved the sequence and functional annotation of the reference genome of A. cerana. This work is believed to offer a valuable reference for relevant study on other species.

PP-378 [Bee Biology]
Construction and annotation of the Apis cerana full-length transcriptome

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Apis cerana is a major bee species used in beekeeping practice in many Asian countries including. Third-generation sequencing technology, such as Nanopore long-read sequencing, has been applied for construction of chromosome-scale genome and full-length transcriptome in an array of animals and plants. However, Nanopore sequencing-based study on honeybees is currently limited. In the present study, the gut tissues of A. cerana worker 4-, 5-, and 6-day-old larvae were prepared and subjected to Nanopore sequencing, followed by identification of full-length transcripts as well as construction and annotation of the full-length transcriptome. Here, from tehe 4-, 5-, and 6-day-old larval guts, 14474634, 10461827, and 11890978 raw reads were obtained, including 27815, 21781, and 20004 non-redundant full-length transcripts, with the N50 lengths of 1900, 1961, and 2294 bp. A total of 40562 non-redundant full-length transcripts were identified, and 35415, 24646, 34054, and 23053 transcripts could be annotated to the Nr, KOG, eggNOG, and GO databases, respectively. The species with the highest number and proportion of annotated full-length transcripts was A. cerana (20310 transcripts, accounting for 57.35%), followed by A. mellifera (4686 transcripts, accounting for13.23%), A. dorsata (2536 transcripts, 7.16%) and A. florea (2079, accounting for 5.87%) in the Nr database. The non-redundant full-length transcripts were annotated to 25 functional categories such as unknown function, and post-translational modification, protein turnover and molecular chaperones in the eggNOG database, 25 functional categories such as general function prediction only and signal transduction mechanisms in the KOG database, 50 functional terms relevant to three major categories of biological process, cellular component and molecular function in the GO database, and 196 pathways such as ribosome and RNA transduction in the KEGG database. A total of 2301 lncRNAs with high confidence were identified, involving four types including sense lncRNA, anti-sense lncRNA, intronic lncRNA and intergenic lncRNA. In conclusion, the constructed full-length transcriptome provides high-quality reference background and key foundation for study on molecular biology and omics of A. cerana.

PP-379 [Bee Biology]
Identification and investigation of piRNAs in the midguts of Apis cerana workers

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piRNAs (Piwi-interacting RNAs), a class of small non-coding RNAs, have been suggested to be involved in an array of life activities such as genome rearrangement and epigenetic regulation and to serve as novel biomarkers and therapeutic targets for disease. However, study on honeybees is scarce, especially Apis cerana. In this study, on basis of the obtained small RNA-seq data, 534 and 495 piRNAs were discovered in the midgut of 7- and 10-day-old A. cerana workers (Ac7 and Ac10 groups), respectively, including 602 non-redundant ones. The length distribution of piRNAs in the above-mentioned two groups were ranged among 24~34 nt, with the highest number of one distributed at 27 nt in length, and the first base is biased toward C. Two DEpiRNAs were screened in the Ac7 vs Ac10 comparison group, targeting a total of 472 mRNAs, which could be annotated to 26 GO terms including biological regulation, catalytic activity and organelle, and 167 KEGG pathways such as endocytosis, Wnt signaling pathway and JAK-STAT signaling pathway. There are 27 and 11 target mRNAs respectively involved in seven developmental signaling pathways (Wnt, Notch, mTOR, AMPK, Hippo, TGF-beta and Hedgehog) and eight immune pathways (endocytosis, lysosome, phagosome, MAPK, PI3K-Akt, JAK-STAT, TGF-beta and FoxO). The stem-loop RT-PCR results demonstrated that seven randomly selected piRNAs were truly expressed in the midguts of A. cerana workers. The results of RT-qPCR indicated that the expression trends of the two DEpiRNAs were in accordance with those observed in the sequencing data, confirming the reliability of sequencing data. In conclusion, the 602 piRNAs expressed in the midgut of the A. c. cerana worker exhibit structural features analogous to those of piRNAs in other animals, and these piRNAs are potentially engaged in the development and immunity of A. cerana worker's midgut by targeting and regulating the expression of related genes.

PP-380 [Bee Biology]
Functional dissection of piR-ame-1186994 in apis mellifera

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piRNA is a kind of small non-coding RNA which plays an essential part in genome stabilization by suppressing transposons and modulation of biological processes through regulating target gene expression. Currently, little is known about the regulatory role of piRNAs in honeybees due to a lack of functional study. Here, molecular validation of piR-ame-1186994 in the Apis mellifera worker's midgut, drone's testis, and queen's ovary was conducted, and followed by prediction and annotation of target mRNAs of piR-ame-1186994. Additionally, regulatory networks relative to developmental signaling pathways, energy metabolism-associated pathways, and cellular and humoral immune-relevant pathways were analyzed. Further, functional investigation of piR-ame-1186994 was performed via feeding-based overexpression and knockdown. The specific fragment of piR-ame-1186994 was amplified from the A. mellifera worker's midgut, drone's testis and queen's ovary. piR-ame-1186994 targeted 1097 mRNAs annotated to 30 GO terms such as metabolic process, binding and cell as well as 182 KEGG pathways including Wnt signaling pathway, endocytosis and oxytocin signaling pathway. Thirty-six and 16 target mRNAs were respectively involved in 5 developmental pathways (mTOR, Wnt, Hippo, AMPK and Notch signaling pathways) and 4 pathways relative to energy metabolism. Additionally, 29 and 8 target mRNAs were engaged in 4 cellular immune pathways (lysosome, endocytosis, phagosome and ubiquitin-mediated protein degradation) and 3 humoral immune pathways (PI3K-Akt, MAPK and FoxO signaling pathways), respectively. As compared with that in the mimic-NC group, the expression level of piR-ame-1186994 was significantly up-regulated in the 1, 2, 3, 4, and 5-day-old workers' midguts in the mimic-piR feeding group, the expression level of target gene YAP1 was significantly downregulated in the 1, 3, 4, and 5-day-old workers' midguts and downregulated in the 2-day-old worker's midgut, the expression level of target gene PLD2 was significantly downregulated in 2, 3, 4, and 5-day-old workers' midguts. These results suggest that piR-ame-1186994 expresses in the A. mellifera worker's midgut, drone's testes, and queen's ovary, piR-ame-1186994 potentially modulates the development and immunity of worker's midgut through targeting and negatively regulating the expression of YAP1 and PLD2. Our findings reveal the function of piR-ame-1186994 at molecular level and deepen the understanding of modulatory role of bee piRNAs.

PP-381 [Bee Biology]
Full-length transcriptome construction and systematic characterization of virulence factor-associated isoforms in Nosema ceranae

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Honeybees are an indispensable pollinator in nature with pivotal ecological, economic, and scientific value. However, a full-length transcriptome for Apis mellifera, assembled with the advanced third-generation Nanopore sequencing technology, has yet to be reported. Here, Nanopore sequencing of the midgut tissues of un-inoculated and Nosema ceranae-inoculated A. mellifera workers was conducted, and the full-length transcriptome was then constructed and annotated based on high quality long reads, followed by the improvement of sequences and annotations of the current reference genome of A. mellifera. In total, 5 942 745 and 6 664 923 raw reads were produced from midguts of workers at 7 days post-inoculation (dpi) with N. ceranae and 10 dpi, while 7,100,161 and 6,506,665 raw reads were generated from the midguts of corresponding uninoculated workers, respectively. After strict quality control, 6 928 170, 6 353 066, 5 745 048, and 6 416 987 clean reads were obtained, with a length distribution ranging from 1 kb to 10 kb. Additionally, 16 824, 17 708, 15 744, and 18 246 full-length transcripts were respectively detected, including 28 019 nonredundant ones. Among these, 43 666, 30 945, 41 771, 26 442, and 24 532 full-length transcripts could be annotated to the Nr, KOG, eggNOG, GO, and KEGG databases, respectively. For the first time, 501 novel genes (20,326 novel transcripts) were identified, among which 401 (20 255), 193 (13 365), 414 (19 186), 228 (12 093), and 202 (11 703) were respectively annotated to each of the aforementioned five databases. The expression and sequences of three randomly selected novel transcripts were confirmed by RT-PCR and Sanger sequencing. The 5′ UTR of 2082 genes, the 3′ UTR of 2029 genes, and both the 5′ and 3′ UTRs of 730 genes were extended. Moreover, 17 345 SSRs, 14 789 complete ORFs, 1 224 long non-coding RNAs (lncRNAs), and 650 transcription factors (TFs) from 37 families were detected. Findings from this work not only refine the annotation of the A. mellifera reference genome, but also provide a valuable resource and basis for relevant molecular and omics studies.

PP-382 [Bee Biology]
Genomic and transcriptomic investigation of honeybee microsporidian based on PacBio SMRT sequencing technology

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Nosema ceranae is a unicellular fungal parasite for bees and causes bee nosemosis, severely damaging colony health and apicultural industry. Currently, the chromosome-scale reference genome of N. ceranae is still lacking. Here, the clean N. ceranae spores were subjected to cDNA library construction and PacBio single molecule real time sequencing, followed by assembly and annotation of the chromosome-level genome of N. ceranae. Following construction and annotation of the full-length transcriptome, and annotations of the current reference genome of N. ceranae was than improved with the generated long reads. The genome sequencing produced approximately 1.73 Gb data, including 36 contigs with a N50 of 457301 bp. The assembled genome included 19 scaffords (N50=728543 bp) and1685624 bp of repeated sequences and 2047 transposons. Additionally, 3112 protein-coding genes were predicted, among which 1076, 872, 1310, 1349, 1154,2709,and 2696 could be annotated to the GO,KEGG, KOG, Pfam, Swiss-Prot,TrEMBL and Nr databases. There were 1598 (1885) homologous genes between N. ceranae and N. apis (Nosema bombycis), and 1838 genes were found to be homologous between N. ceranaeand (Encephalitozoon cuniculi). Intriguingly,the ABC transporter gene family were highly conservative among different microsporidian species. The full-length transcriptome of N. ceranae was constructed, including 4387 non-redundant full-length transcripts. Among these, 778, 2083, 1202, 1559, 1457, 1232, 1702, and 3896 full-length transcripts could be annotated to COG, GO, KEGG, KOG, Pfam, Swiss-Prot, eggNOG and Nr databases, respectively. A total of 362 (699) new genes (transcripts) unannotated on the reference genome were identified, among which 359 (695), 202 (329), 133 (153), 65 (108),145 (251),5 (351),103 (420) and 166 (310) could be annotated to the aforementioned databases. The structures of 225 annotated genes in the reference genome were optimized. Moreover, 172 SSRs, 472 complete ORFs and 29 lncRNAs were discovered. Totally, 11 alternative splicing (AS) events occurred in six genes were identified, including 10 intron retained and one alternative 5′ splice site. Together, these results lay a solid foundation for continuous and further study and enrich the information about genes and transcripts in N. ceranae.

PP-383 [Bee Biology]
Effect of overexpressing ace-miR-14-y on target gene expression and weights of Apis cerana worker larva and gut

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Abstract miRNAs play a central part in modulating diverse life activities such as gene expression, development, and immunity. Apis cerana is a bee species of great importance widely used in beekeeping practice in many parts of Asian continent, with remarkable ecological and economical value. In this study, the molecular validation of ace-miR-14-y in the larval gut of A. cerana worker was performed, followed by prediction and annotation of target mRNAs, further, overexpression of ace-miR-14-y was conducted to investigate its regulatory role in target gene expression and weights of larval individual and gut were utilized to confirm the expression and sequence of ace-miR-14-y. Relevant bioinformatic software was used to predict and analyze the target genes of ace-miR-14-y. Overexpression of ace-miR-14-y in the larval gut was performed by feeding mimic, followed by examination of the effect of overexpression and the relative expression level of target genes after overexpression. Electronic balance was employed to weigh the larval individual and gut. The results of Stem-loop RT-PCR and Sanger sequencing suggested that ace-miR-14-y was expressed in the A. cerana worker larval gut. Bioinformatics analysis showed that ace-miR-14-y targeted a total of 265 genes, involving 33 GO terms like metabolic process and cellular component as well as 180 KEGG pathways such as Hippo signaling pathway and endocytosis. As compared with that in the mimic-NC group, the expression level of ace-miR-14-y was significantly up-regulated in the 5-day-old larval gut in the mimic-miR-14 group. After overexpression of ace-miR-14-y, the significant down-regulation of target genes Wg and AP-1 were detected. Additionally, the weights of larval individual and gut were significantly increased after ace-miR-14-y overexpression.ace-miR-14-y, as a potential regulator,may control the weights of A. cerana worker larval individual and gut by negative regulation of the expression of Wg and AP-1.

PP-384 [Bee Biology]
Molecular property, phyletic evolution and gene expression profile of DNA transmethylase 3 gene in Apis cerana

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DNA methylation is a vital epigenetic modification involved in an array of processes such as genomic imprinting and embryonic development. Here, the molecular property and phyletic evolution were analyzed using bioinformatics tools, followed by detection of spatiotemporal expression profile of Apis ceranaDNA methyltransferase 3 (AcDNMT3) gene as well as the expression pattern of AcDNMT3 in workers' midguts inoculated by two widespread fungal pathogens, Ascosphaera apis and Nosema ceranae. The prediction results showed that AcDNMT3 encoded a 758-amino acid protein with an approximate molecular weight of 88.24 kDa and a molecular formula of C3945H6182N1076O1134S44, and the average hydrophilic index is -0.454. AcDNMT3 may interact with 10 proteins such as adenosylhomocysteinase. DNMT3 from species including A. cerana, A. mellifera, and other insects such as Bombus terrestris, Frieseomelitta varia, and Solenopsis Invicta exhibited four common structural domains (PWWP_DNMT3, ADDz_Dnmt3, Dcm superfamily, and PWWP superfamily) and five common conserved motifs. Phylogenetic analysis indicated that AcDNMT3 was closely related to DNMT3 from A. mellifera. RT-qPCR assay demonstrated that AcDNMT3 was differentially expressed in the eggs, larvae, prepupae, and pupae of workers, with the highest expression level in 8-day-old pre-pupae. Additionally, AcDNMT3 is differentially expressed in adult workers at 1-, 2-, 6-, 12-, 15-, and 18-day-old, with the highest expression level in 1-day-old adult. Differential expression of AcDNMT3 was observed across various tissues, with the highest levels in the antennae and the lowest in the midguts. The expression of AcDNMT3 in the gut of 4-day-old larvae was significantly inhibited at 3 days post inoculation (dpi) with A. apis. Its expression level in the midgut of worker was significantly increased at 2 dpi, 4 dpi, and 5 dpi, but significantly decreased at 3 dpi. Our data indicate that AcDNMT3 is a putative hydrophilic, intracellular, non-transmembrane protein highly conserved across A. cerana and several other insect species, AcDNMT3 may play a key part in the development of A. cerana workers, in the larval response to A. apis infection, and in the adult's response to N. ceranae invasion.

PP-385 [Bee Biology]
Cloning, molecular characteristics and expression pattern of transmethylase-like protein 5 gene in Nosema ceranae

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N6-methyladenosine (m6A) is a kind of widespread and abundant RNA modification in eukaryotes. Nosema ceranae exclusively infects adult bees and results in nosemosis, giving rise to severe losses for apicultural industry. In this work, N. cerana methyltransferase-like protein 5 encoding gene NcMettl5, with an expected size of 600 bp, was for the first time cloned. The molecular weight of NcMettl5 was approximately 22.64 kDa, with the molecular formula of C1039H1645N269O284S6, theoretical isoelectric point of 9.37, the fat-soluble coefficient of 98.98, the unstable coefficient of 13.96, and the average hydrophilic coefficient of -0.230. There were 20 phosphorylation sites, a superfamily structural domain (AdoMet_MTases superfamily), and seven same conserved motifs included in NcMettl5, but no transmembrane domain and signal peptide were detected. NcMettl5 was simultaneously located in cytoskeleton, cyto_nucl, nucleus, mitochondria and peroxisome. The Mettl5 had high sequence identity and close evolutionary distance among Nosema ceranae, Nosema bombycis CQ1 and Nosema granulosis. The expression of NcMettl5 in the Nosema ceranae infection of Apis mellifera ligustica workers' midguts was down-regulated ($P>0.05$) at 2 days post inoculation (dpi) and 3 dpi without significant difference, while significant down-regulated ($P<0.05$) at 4 dpi, as compared with that at 1 dpi. These findings suggested that NcMettl5 may be a hydrophilic, non-transmembrane, and intracellular protein, Mettl5 in Nosema species are highly conservative, NcMettl5 is likely to be involved in the Nosema ceranae infection of A. m. ligustica worker.

PP-386 [Bee Biology]
Identification and analysis of SNP and InDel loci in Nosema ceranae

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N. ceranae is a single-cell fungal pathogen that exclusively infects honeybee midgut's epithelial cell, widely infecting bee colonies throughout the world. The objective of this study is to perform identification and analysis of single nucleotide polymorphism (SNP) and insertion and deletion (InDel) loci in N. ceranae using the obtained high-quality transcriptome data from clean spores of N. ceranae, aiming to enrich the information of SNP and InDel loci in N. ceranae and provide a basis for developing novel molecular markers. SNP and InDel loci in N. ceranae were detected using GATK software. SnpEff software was used to predict genomic regions occurred with mutation sites and affection caused by mutation. Genes containing SNP or InDel loci were respectively aligned to GO and KEGG databases to gain corresponding function and pathway annotation. A total of 28 195 SNP loci were identified in N. ceranae, and the numbers of conversion and transversion were 21 403 and 6 792. These SNP loci had 12 mutation types, among them the most abundant one was C/T. SNP loci distributed in CDS region were the most. Additionally, the largest mutation type of codons of SNP loci was synonymous mutation. Moreover, genes containing SNP loci can be annotated to 43 GO terms such as metabolic process and cellular process, and 85 KEGG pathways such as metabolic pathway and ribosome. In N. ceranae, 2 831 InDel loci were identified, and those distributed in intergenic region were the most, while those distributed in CDS region was the least. The most abundant mutation type of codons was frameshift mutation. Genes containing Indel loci could be annotated to 38 GO terms including cellular process, cell and binding, and 73 KEGG pathways including metabolic pathways and biosynthesis of secondary metabolites. There are plenty of SNP and InDel loci in N. ceranae; the main mutation type of SNP loci is conversion. The genomic distribution rule of functional elements and mutation type of SNP loci are obviously different from those of InDel loci. Genes containing SNP and InDel loci have potential relationship with adaptation of N. ceranae to intracellular environment and pathogen proliferation process.

PP-387 [Bee Biology]
Identification and investigation of peptidoglycan recognition protein-associated genes and isoforms in Apis mellifera

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In this study, based on the obtained Nanopore sequencing data from the midguts of A. mellifera workers, a total of four genes (PGRP-3, PGRP-S2, PGRP-LC and PGRP-LB) and 19 isoforms associated with peptidoglycan recognition proteins (PGRP) in Apis mellifera were identified. RT-PCR and Sanger sequencing results confirmed the authenticity of expression and sequences of five isoforms of PGRP genes. The 5' and 3' ends of PGRP-3 were respectively elongated by 8 and 1 055 bp, while those of PGRP-S2 were respectively extended by 27 and 234 bp. The authenticity of AS events of PGRP-S2 was verified by RT-PCR. The isoform ONT.6350.2-encoded protein included a signal peptide and a PGRP structural domain, with an average hydrophilicity of -0.119. Additionally, the protein encoded by isoform ONT.6350.6 had an average hydrophilicity of -0.324, without signal peptide and transmembrane domain. PGRP-S2 from A. mellifera and A. cerana were clustered into a single clade on the evolutionary tree, indicative of the highest homology of PGRP-S2 between A. mellifera and A. cerana. The expression level of isoform ONT.6350.2 in the midguts of workers inoculated with N. ceranae was significantly upregulated at 2 days post inoculation (dpi) and 3 dpi in comparison with that in the un-inoculated midguts. Additionally, the expression level of isoform ONT.6350.6 in the midguts of N. ceranae-inoculated workers was significantly upregulated at 3 dpi and 4 dpi as compared with that in the midguts of un-inoculated midguts. Moreover, both ONT.6350.2 and ONT.6350.6 in the midguts of adult workers inoculated with N. ceranae exhibited an overall increasing expression trend at the stage of 1 4 d post inoculation as compared with that in the un-inoculated midguts. The results demonstrate that the isoform ONT.6350.2-encoded protein is a potential secretary protein, whereas the ONT.6350.6-encoded protein is a putative intracellular protein, both ONT.6350.2 and ONT.6350.6 are induced to activation in host response to the N. ceranae infection. Findings from this current work not only enrich the information about proteins encoded by ONT.6350.2 and ONT.6350.6, but also offer a basis for functional investigation of these two isoforms relative to A. mellifera PGRP-S2.

PP-388 [Bee Biology]
Spatio-temporal expression pattern and antibody preparation of Apis mellifera AGO1 protein

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As a highly conserved protein family in evolution, Argonaute (AGO) is mainly engaged in the formation of RNA-induced silencing complex (RISC) in eukaryotes to silence gene expression, further participating in numerous biological processes. However, study on AGO proteins of honeybees is still limited until now. Here, the CDS of AGO1 gene in Apis mellifera (AmAGO1) was successfully cloned based on PCR amplification and Sanger sequencing. It's predicted that AmAGO1 contained 928 amino acids, with the molecular formula of C4624H7332N1316O1325S51, the molecular weight of about 104.20 kDa, the isoelectric point of 9.31, an average hydrophilic coefficient of -0.2965. There were 86 phosphorylation sites included in AmAGO1. Two typical domains, PAZ and PIWI, were identified in AmAGO1, however, no typical signal peptide was detected. A high identity of amino acid sequences among AGO1 proteins from Homo sapiens, Danio rerio, Drosophila melanogaster, Bombyx mori, A. mellifera, A. cerana, and Bombus terrestris were observed. Following investigation of, AGO1 proteins from A. mellifera and A. cerana were clustered into one branch, with the highest homology. Additionally, AmAGO1 was differentially expressed in egg, larva, prepupa, pupa, and adult of A. mellifera workers, and its expression level in the 3-day-old larva and 7-day-old prepupa were significantly lower than that in the eggs. Similarly, AmAGO1 was differentially expressed in the 1-, 2-, 6-, 12-, 15-, and 18-day-old adults, and its expression level in the 2-, 6-, 12-, 15-, and 18-day-old adults was significantly lower than that in the 1-day-old adult. Also, the dynamical expression of AmAGO1 was observed in the antenna, venom gland, brain, midgut, hypopharyngeal gland, fat body, and cuticle of adult worker, and its expression level was the highest in the antenna and hypopharyngeal gland. The expression form of AmAGO1 fusion protein was inclusion body. The prepared AmAGO1 polyclonal antibody had high titer, sensitivity, and specificity. In conclusion, AmAGO1 may be a hydrophilic and intracellular protein, AmAGO1 plays a potential part in various tissues and developmental stages of A. mellifera workers, and the AmAGO1 polyclonal antibody with high titer, sensitivity, and specificity was successfully prepared.

PP-389 [Bee Biology]

In vivo evaluation of "progen" probiotic against *Nosemaceranae*

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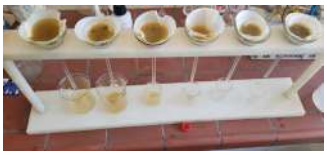
ABSTRACT

Nosema ceranae is a microsporidian fungus that infects the epithelial cells of the midgut of honey bees. The honey bee gut microbiota consists of a wide range of bacteria, including numerous Lactic Acid Bacteria. In this research, the effect of the specific honey bee probiotic "Progen" on *N. ceranae* spores and honey bee survival was tested. Briefly, *N. ceranae* spores were first extracted and confirmed by DNA extraction and PCR. Then, the frames containing covered pupa from colonies without *N. ceranae* infection and without previous treatment with antibiotics or Fumagillin were kept overnight in the incubator. The newborn bees were collected the next day and starved for 2 hours. Each bee was inoculated with approximately 50,000 spores. After feeding, groups of 40 bees were placed in wooden cages and kept in an incubator at a temperature of 30 degrees Celsius and a relative humidity of 65%. The negative control bees were fed separately with 5 microliters of sugar syrup without spores and the positive control with 5 microliters of sugar syrup with spores without probiotics. The treatments with three doses of 0.5, 1 and 1.5 grams per liter of probiotic "Progen", positive control treatment and negative control treatment in most of them were treated in a completely randomized design for 21 days. Daily mortality, number of spores, feed consumption and water consumption were recorded. The results showed that the highest percentage reduction of *N. ceranae* spores in each bee compared to the positive control is related to the treatment containing 1.5 grams of probiotic with an average of 2.99E±06 spores per bee, with 82.63%. The treatment containing 1.5 grams of probiotics with 15.5% deaths had the lowest amount of mortality during the experiment. The treatment containing 1.5 grams of probiotics had a significant difference with the positive control treatment in the factors of spore count, survival and mortality at the level of 5%.

MATERIAL AND METHODS

Nosemaceranae Spore Extraction



Inoculation of Honey bees with *Nosemaceranae* Spores

Incubation overnight of the pupa frame → Collected newly hatched bees → Inoculated each bee with approximately 50,000 spores

Incubated at 30°C and 60% relative humidity for 21 day

Feeding with probiotics and applying treatments

Probiotic doses of 0.5, 1 and 1.5 g/l syrup → Feeders changed every four days

Weighing the amount of water and syrup consumed → Removed daily dead bees and spores counted in dead bees → Transferred and maintained at -20°C

Spore counting using a hemocytometer → Statistical analysis

RESULTS

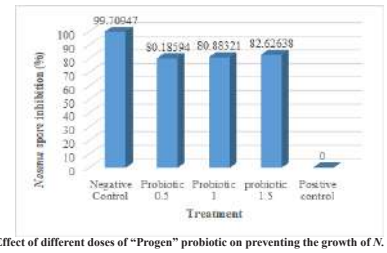


Figure 1: Effect of different doses of "Progen" probiotic on preventing the growth of *N. ceranae* spore.

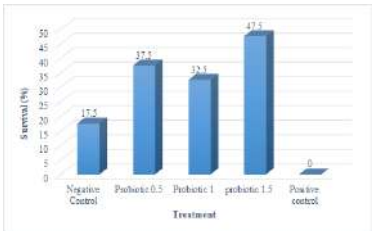


Figure 2: Effect of different doses of "Progen" probiotic on Survival of honey bee after infection with *N. ceranae*

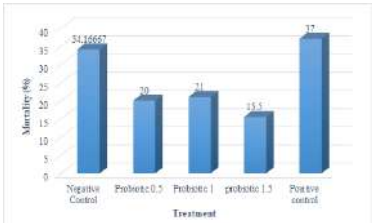


Figure 3: Effect of different doses of "Progen" probiotic on Mortality of honey bee after infection with *N. ceranae*

The results showed that the highest percentage reduction of *N. ceranae* spores in each bee compared to the positive control is related to the treatment containing 1.5 grams of probiotic with an average of 2.99E±06 spores per bee, with 82.63%. The treatment containing 1.5 grams of probiotics with 15.5% deaths had the lowest amount of mortality during the experiment.

CONCLUSION

In conclusion, the use of "Progen" probiotic at a dose of 1.5 g/L of sugar syrup significantly reduced *Nosema* spore count in *Nosema* spore-infected bees. These results showed that treatments consuming probiotics had a lower mortality rate than the negative control treatment. Therefore, it can be said that feeding with probiotics reduces the negative effects of stressors in honeybees.

ACKNOWLEDGMENTS

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Agricultural Research Education and Extension Organization, Karaj, Iran
and
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PP-390 [Bee Biology]
Regulatory roles of long non-coding RNAs relevant to antioxidant enzymes and immune responses of Apis cerana larvae following Ascosphaera apis invasion

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Long non-coding RNAs (lncRNAs) play an essential part in controlling gene expression and a variety of biological processes. However, whether and how lncRNAs regulate responses of Apis cerana larvae to Ascosphaera apis invasion has remained unclear until now. Here, the identification and analysis of lncRNAs in the guts ofA. cerana worker larvae were conducted. In total, 76 sense lncRNAs, 836 antisense lncRNAs, 184 intron lncRNAs, 362 bidirectional lncRNAs, and 2181 intron lncRNAs were discovered in the larval guts. Additionally, 30 known and 9 novel lncRNAs were potential precursors for 36 and 11 miRNAs, respectively. In the three comparison groups, 386, 351, and 272 DElncRNAs were respectively identified, indicating the change in the overall expression pattern of host lncRNAs following the A. apis invasion. Analysis of cis-acting effect showed that DElncRNAs in the 4-, 5-, and 6-day-old comparison groups putatively regulated 55, 30, and 20 up- and downstream genes, respectively, which were involved in a series of crucial functional terms and pathways, such as MAPK signaling pathway, and cell process. Analysis showed that 31, 8, and 11 DElncRNAs as potential antisense lncRNAs may interact with 26, 8, and 9 sense-strand mRNAs. Moreover, investigation of the competing endogenous RNA (ceRNA) network indicated that 148, 283, and 257 DElncRNAs were putatively regulated. The expression of target genes by targeting corresponding DEmiRNAs included those associated with antioxidant enzymes and immune responses. These results suggested that DElncRNAs played a potential part in the larval guts responding to the A. apis infection through a cis-acting manner and ceRNA mechanisms. Our findings deepen our understanding of interactions between A. cerana larvae and A. apis and offer a basis for clarifying the DElncRNA-mediated mechanisms underlying the host response to fungal invasion.

PP-391 [Bee Biology]
Diverse regulatory manners and potential roles of lncRNAs in the developmental process of Asian honey bee (Apis cerana) larval guts

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Long non-coding RNAs (lncRNAs) are crucial modulators in various biological processes. However, little is known about the function of lncRNAs in the development of Asian honey bee (Apis cerana) larval guts. In this work, on the basis of our previously obtained deep-sequencing data from the 4-, 5-, and 6-day-old larval guts of A. cerana workers (Ac4, Ac5, and Ac6 groups), an in-depth transcriptome-wide investigation was conducted to decipher the expression pattern, regulatory manners, and potential roles of lncRNAs during the developmental process of A. cerana worker larval guts, followed by the verification of the relative expression of differentially expressed lncRNAs (DElncRNAs) and the targeting relationships within a competing endogenous RNA (ceRNA) axis. In the Ac4 vs. Ac5 and Ac5 vs. Ac6 comparison groups, 527 and 498 DElncRNAs were identified, respectively, which is suggestive of the dynamic expression of lncRNAs during the developmental process of larval guts. Additionally, it was found that 79 and 76 DElncRNAs as potential antisense lncRNAs may, respectively, interact with 72 and 60 sense-strand mRNAs. An investigation of competing endogenous RNA (ceRNA) networks suggested that 75 (155) DElncRNAs in the Ac4 vs. Ac5 (Ac5 vs. Ac6) comparison group could target 7 (5) DEmiRNAs and further bind to 334 (248) DEmRNAs, which can be annotated to 33 (29) functional terms and 186 (210) pathways, including 12 (16) cellular- and humoral-immune pathways (lysosome pathway, necroptosis, MAPK signaling pathway, etc.) and 11 (10) development-associated signaling pathways (Wnt, Hippo, AMPK, etc.). The RT-qPCR detection of five randomly selected DElncRNAs confirmed the reliability of the used sequencing data. Moreover, the results of a dual-luciferase reporter assay were indicative of the binding relationship between MSTRG.11294.1 and miR-6001-y and between miR-6001-y and ncbi_107992440. These results demonstrate that DElncRNAs are likely to modulate the developmental process of larval guts via the regulation of the source genes' transcription, interaction with mRNAs, and ceRNA networks. Our findings not only yield new insights into the developmental mechanism underlying A. cerana larval guts, but also provide a candidate ceRNA axis for further functional dissection.

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PP-392 [Bee Biology]

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A nutritionally complete Pollen Replacing Feed protects honeybee colonies during stressful commercial pollination — requirement for isofucosterol

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A steady supply of nutritionally adequate pollen from diverse flower sources is crucial for honeybee colonies. However, climate instability, large-scale agriculture, and the loss of flower-rich landscapes have made this supply increasingly scarce and unpredictable, threatening both apiculture and sustainable crop pollination.

We developed a nutritionally complete Pollen Replacing Feed that supports continuous brood production from May to October (more than 108 days) in honeybee colonies in tented enclosures, without access to pollen and nectar. This represents more than six cycles of brood production and more than two full replacements of all worker bees in the colony.

The complete Pollen Replacing Feed has a Feed Conversion Ratio that is c. 30% better than pollen and is in line with that of commercial shrimp and chicken livestock feed (1.8 kg diet required to produce 1 kg of honeybees). Colonies fed a (third party) commercial diet severely declined in brood production after 36 days and died out.

Honeybees cannot synthesize or interconvert sterols and source them from pollen. Six sterols make up 90% of the total sterols in honeybees. Prior to this research, it was not known whether individual sterols are functionally interchangeable or are essential nutrients which cannot be fully interchanged.

Omitting isofucosterol, the third most abundant sterol in honeybees, from this complete Pollen Replacing Feed containing all six major honeybee sterols in concentrations and ratios similar to pollen, causes significant reductions in brood production and neuromuscular dysfunction in adults and identifies isofucosterol as a critical micronutrient for honeybees. In contrast, omitting 24-methylene cholesterol, the most abundant honeybee sterol, does not significantly affect brood production and, surprisingly, bees with no 24-methylene cholesterol in their tissues are viable.

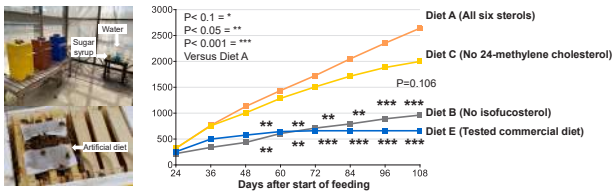
In a season-long experiment investigating the commercial pollination of blueberry and sunflower fields, a treatment group fed two versions of the diet overcame the detrimental effects of nutritional stress, unlike colonies that did not receive supplemental feed ("unfed" group) and colonies that received a third-party commercial pollen protein supplement.

Finally, extensive field trials, both in number of colonies and in geographic diversity, were conducted over two consecutive winter seasons in the U.S. to assess the impact of the new diet on survival and colony strength for almond pollination. The results show that colonies fed the new diet had 48–63% lower mortality over two years when compared to best-in class commercial pollen protein supplement used by beekeepers.

This research shows that:
- It is possible to make a nutritionally complete Pollen Replacing Feed for honeybees, with a Feed Conversion Ratio that is in-line with other livestock and c. 30% more efficient than pollen.
- Isofucosterol is a newly identified essential micronutrient for honeybees.
- Supplementary feeding with a nutritionally balanced Pollen Replacing Feed can address the root causes of honeybees' growing nutritional deficiencies, supporting their health and their vital pollination services.

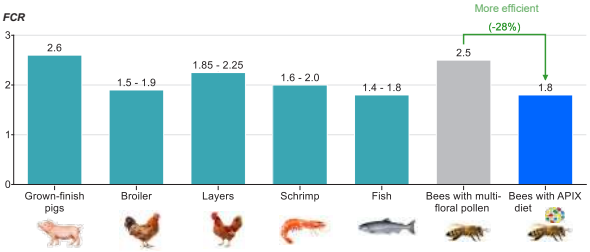
Deep nutrition research identifies isofucosterol as an essential micronutrient for honeybees in a nutritionally complete Pollen Replacing Feed

A recent study published in the Proceedings of the Royal Society B: Biological Sciences, April 2025: https://doi.org/10.1098/rspb.2024.3078



- 96 new equal colonies were kept in tents and fed water, sugar syrup and a diet from May to October measuring capped brood, consumption, and bee quality every 12 days.
- Colonies fed a diet from which isofucosterol was omitted but still included the five other main sterols, significantly reduced brood production and caused neuromuscular dysfunction in adult bees.
- In contrast, colonies fed the complete Pollen Relacing Feed containing all six main sterols found in bees maintained continuous brood production over six brood cycles (May to September), compared to only just over two cycles with a standard commercial diet.

This new Pollen Replacing Feed delivers a Feed Conversion Ratio that is better than pollen, in-line with other livestock industries



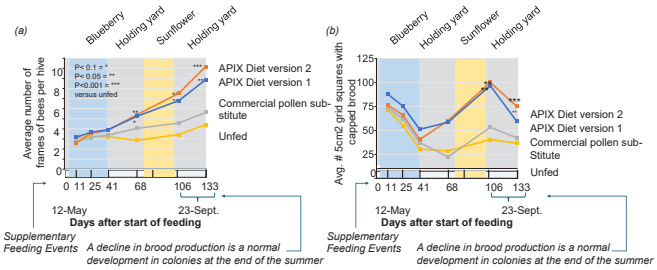
- The Feed Conversion Ratio is defined as the number of kg of feed required to make 1 kg of livestock.
- The lower the Feed Conversion Ratio, the more efficient the feed is converted into livestock. This is a key management tool in livestock nutrition management.
- The results of the tent study show that the newly developed complete Pollen Replacing Feed for honeybees has a Feed Conversion Ratio that is c.30% better than pollen.

Extensive field validation in commercial beekeeping conditions shows APIX Biosciences' new pollen-replacing feed is a step change versus existing honeybee nutrition products and a valuable tool for beekeepers

Colonies fed the new diet overcome nutritional stress in commercial pollination of blueberry and sunflower

A recent study published in the Proceedings of the Royal Society B: Biological Sciences, April 2025: https://doi.org/10.1098/rspb.2024.3078

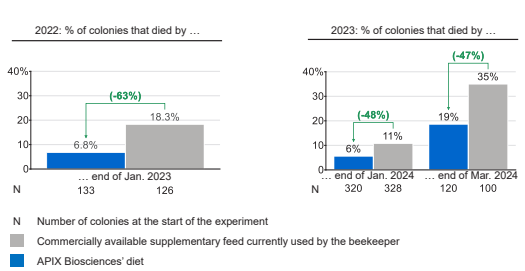
- In a field trial in the U.S. diets were fed to colonies serially pollinating two crops known to present nutritional challenges for honeybees, namely blueberry and sunflower. The colonies were all established from new packages, sent to blueberry pollination, followed by a period in a holding yard and subsequently moved into sunflowers.
- The 64 colonies were split into four groups: APIX Biosciences' diet version 1 and diet version 2, a pollen protein supplement currently available on the market, and the last group remained unfed.
- Colonies supplemented with the diets developed by APIX Biosciences consistently and substantially outperformed those given current commercial pollen protein supplement and those receiving no supplemental feed. The commercial pollen protein supplement had no beneficial effect.
- This can ensure stronger colonies going into winter and higher pollination income for beekeepers.



Colonies fed the new diet in commercial beekeeping operations have lower winter mortality and are stronger in early spring

With 259 colonies in five locations in the fall of 2022 and 648 colonies across nine California locations in the fall of 2023, managed by professional beekeeping operations:

- Colonies were split into two groups: one fed the APIX Biosciences diet, the other fed the commercial protein supplement currently used by each respective beekeeper.
- Colonies fed the APIX Biosciences diet had on average 47–63% lower winter mortality.
- This directly improves the percentage of colonies ready for early spring pollination (e.g. almonds), the resulting pollination income for beekeepers, and the number of splits that can be made in spring.



PP-393 [Bee Biology]

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Diastase Activity in Honey Stomachs of New Zealand Bees

Unique Findings and Their Significance

Mānuka honey (Leptospermum scoparium) is a unique product created by honeybees (Apis mellifera) that collect nectar from mānuka flowers native to New Zealand. One distinguishing feature of this honey is its high content of dihydroxyacetone (DHA), a precursor to methylglyoxal (MGO)—a key bioactive component. Mānuka nectar has a more complex and bioactive-rich composition compared to other floral nectars. Diastase activity (a-amylase) plays a crucial role in transforming nectar into honey by breaking down complex carbohydrates and is an essential indicator of honey quality.

This study analyzed enzymatic activity not only in mānuka honey as the final product but also during the primary processing of nectar by bees in their honey stomachs. It provides new insights into the physiological characteristics of New Zealand bees and the unique qualities of mānuka honey.

METHODS

Conducted in 2023, the study involved 15 mānuka honey samples from three locations in Taranaki, with five samples from each site. From each location, 30 worker bees were sampled, and their honey stomach contents analyzed. Diastase activity was measured using the Phadebas method, with three technical replicates per sample *(see figures 1 & 2)*.

RESULTS

In unsealed honey, diastase activity ranged from 6.2 to 30.6 DN. *(see figure 3)* Variability among samples can be attributed to environmental factors such as mānuka vegetation density, seasonal conditions, and resource availability. However, diastase activity in honey stomachs was significantly higher than in unsealed honey—a novel finding. Enzyme concentrations in honey stomachs were 16 times greater than the standard for honey, highlighting bees' exceptional enzymatic capacity during nectar processing *(see figure 4)*.

Figure 1, *Materials & Methods - Nine fresh honey samples were collected across three hive sites (three samples per site) in the Taranaki Region. These sites were Post Office 1, Gavins 1 and Post Office 8*

Post Office 1
- 1A honey taken from uncapped honey from honey box above the excluder.
- 1B honey taken from uncapped honey from top honey box.
- 1C honey taken from uncapped honey from top honey box.

No Honeybees were collected from this hive.

Gavins 1
- 2A honey taken from uncapped honey from top honey box.
- 2B 2B(1) – honey taken from uncapped portion of frame in top box.
  2B(2) – honey taken from capped portion of same frame in top box.
- 2C honey sample taken from uncapped honey from top honey box.

Honeybees were taken from this hive for honey stomach sampling.

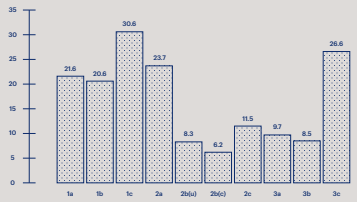
Post Office 8
- 3A honey taken from uncapped honey from top honey box.
- 3B honey taken from uncapped honey from a part drawn foundation frame in top honey box.
- 3C honey taken from uncapped honey from a part drawn foundation frame in top honey box.

Honeybees were taken from this hive for honey stomach sampling.

Figure 2, *Honey Stomach Samples*

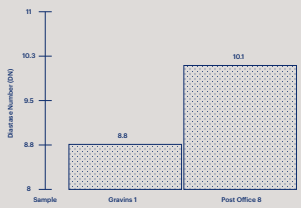
Each Honeybee sample consisted of approximately 350-400 individual forager bees. The honey stomachs from these bees were extracted and collected in airtight 50mL tubes. 5mL of honey stomach content was extracted from each sample, which was the required amount for diastase testing.

Figure 3, *Fresh Honey Diastase Test Results*



- We can see that there is a lot of variation in the DN across all of the samples. The sample with the highest DN is sample 1C (30.6DN), while the lowest DN was observed in sample 2B(C) (6.2DN).
- Samples1A-1C were collected from the same hive and are all uncapped samples. We see a difference in the DN between 1B and 1C even though these samples were collected from the same honey box. Sample 1A also differs from the other two samples from this hive but is somewhat similar to sample 1B.
- Samples 2A-2C were taken from the same hive at the hive site Gavins 1. Sample 2B(U) is uncapped honey, while 2B(C) is capped honey. The rest of the samples obtained are uncapped honey. Sample 2A has the highest diastase result (23.7), while the other three samples all had low results 6.2, 8.3 and 11.5). We can see that there is a difference between the capped and uncapped samples collected from the same frame. We expected to see a lower DN value in the capped sample since enzyme activity will deplete as the honey ripens.
- Samples 3A-3C were taken from the same hive at the hive location Post Office 8. All samples from this site are uncapped honey. The highest diastase activity from the samples at this location is 3C (26.6) , while the other samples results are considered low (8.5 and 9.7).

Figure 4, *Honey Stomach Content Diastase Test Results*



- The DN of both samples are considered low but the samples were diluted 16X more than normal honey to produce a readable result, indicating that honey stomach content is very potent/concentrated. At full concentration, we could assume that these read in at 140.8DN for Gavins 1, and 161.6 for Post Office 8.
- The two hive sites that these samples were collected from are 800m away from each other in a straight line, therefore it is likely that these two hives are collecting Manuka nectar from the same trees. The DN values of honey stomach content from Post Office 8 (10.1DN) is higher than that at Gavins 1 (8.8DN).
- This difference in DN could be due to further manipulation by the bees at Post Office 8, and/or it is due to hive related causes such as the genetics of the bees or health and age of the hive.

CONCLUSION

Diastase activity in honey stomachs ranged from 140.8 DN to 161.6 DN, indicating bees' adaptation to mānuka nectar, rich in complex sugars and DHA.

The unique composition of mānuka nectar may have driven evolutionary enhancements in New Zealand bees' enzymatic systems.

High enzymatic activity suggests a healthy physiological state for bees, even under intensive commercial beekeeping. Proper management and ecosystem preservation are critical for maintaining healthy colonies in New Zealand.

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PP-394 [Bee Biology]

COMPUTER MODELLING FOR EXTREME ENVIRONMENTS – HOW BEEHAVE MODEL CAN BE USED FOR EXTRATERRESTRIAL APPLICATIONS AND ESTABLISHING DIRECTIONS OF FUTURE STUDIES

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MOTIVATION

Extraterrestrial settlement

The food production system is one of the most important parts enabling long-term extraterrestrial settlement. A well-balanced, highly nutritious diet is crucial for astronauts' health and good cognitive functions. However, many plants providing fresh fruits and vegetables require pollination. For this purpose, using bees in extraterrestrial greenhouses should be considered, as being low-energy and low-resources consuming. An additional advantage is the possible positive impact of beekeeping on human mental health and the ability to cope with prolonged isolation and high-stress environment.

History of bees in space

The record of space and extraterrestrial setllement-related experiments is very scarce. Only a few experiments on space conditions and space travel impact on bees were done in the history, focusing on:

- microgravity impact on specimens mobility (1,2),
- greenhouse air pressure requirments (4)
- space travel impact on survivability and reproductive traits (3,5,6).

Bee colony modeling

Establishing the impact of specific conditions on honey bee colony development requires perennial observation to collect sufficient data for concluding. Using modeling tools for the long-term effects assessment might help to fill the existing knowledge gaps while simultaneously saving time. Simulating the required life period of a bee colony under the considered stressor and later comparing obtained results with the healthy, Earth-based colonies may significantly support the process.

BEEHAVE

BEEHAVE is a computer model of a bee colony simulating its development while considering both in-hive dynamics and external activities. The model considers factors such as: foraging activity, queen's egg-laying rate, diseases presence, beekeping activities, weather. It is based on free, open-source software, the NetLogo, easily understandable for non-specialists.

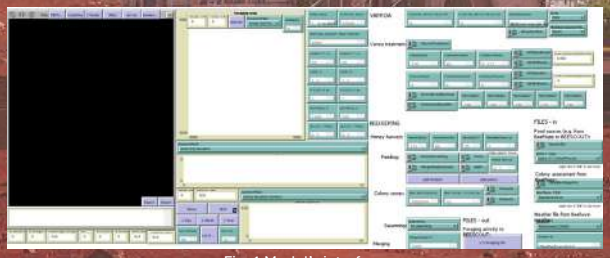


Fig. 1 Model's interface

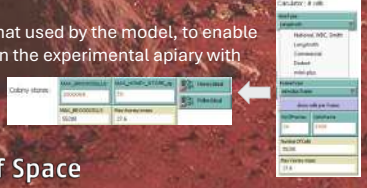
Model expansion

Three modules were added to the model to enable simulation of development of colonies with queen bee given to the launching rocket acceleration pattern:

I. **Queen bee assets module**

II. **Real-life input data**
Modification of data format used by the model, to enable usage of data collected in the experimental apiary with *Liebefeld* method.

III. **Hive type modification**



Input data

An experiment was performed to gather the data necessary for creation of a model considering space travel impact on bee colony development. Collected data showed that honey bee queen given to the acceleration pattren of launching rocket reacts twofold:

1) High response scenario: queen maximizes the numer of eggs laid, with the increase in drone to worker ratio
2) Low response scenario: queen minimizes the numer of eggs laid, following pattern similar to overwintering preparation

Modelling accuracy

Stability analysis

Stability analysis shows which parameters the model is most sensitive to. It enables to support the decision on future real-life studies direction.

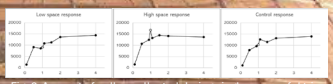


Fig. 2 Amount of pollen collected during single, succesful trip.

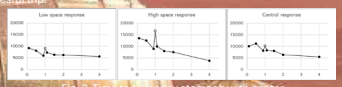


Fig. 3 Time to fill honey stomach with nectar

CONCLUSIONS

Space exploration & future studies directions

Based on the obtained results and existing knowledge gaps, future studies on space conditions impact on honey bee shall include altered gravity impact on foraging activities, emerging from overwintering state after space travel , and extraterrestrial crops nutritional composition.

Extreme environments

The presented example proves that computer modeling tools, such as BEEHAVE, can succesfully be used to simulate bee colony development in extreme environment conditions. Such application requires initial collection of the input data for validation of the model and critical analysis of the obtained results. However, such an approach can significantly shorten the time of the research, limit the number of required deepening experiments and therefore, reduce the expenses necessary to conduct comprehensive research.

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Background image created with OpenAI

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AGH Faculty of Space Technologies

APIMONDIA SCANDINAVIA 2025
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PP-395 [Bee Biology]]

APIMONDIA SCANDINAVIA 2025 23-27 SEPTEMBER
Abs Ref: 0185

BIOMETRIC ANALYSIS AND ESTIMATION OF THE AFRICANIZATION DEGREE OF *Apis mellifera* L. (HYMENOPTERA: APIDAE) FROM TWO COLOMBIAN ISLAND ZONES

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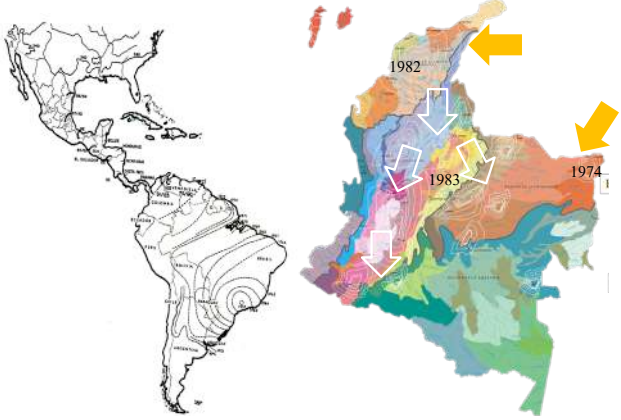
REMARKS

The morphometrics of *Apis mellifera* (L.) are essential for the study of races or subspecies and their hybrids, enabling their classification and identification. Morphometry has been key to documenting the Africanization process since the 1970s. Studies in Argentina, Colombia, Brazil, Mexico, and the Caribbean confirm morphometrics as a reliable tool alongside genetic markers. Morphometry can be influenced by environment (nutrition, climate). Genetic markers (mtDNA, microsatellites, SNPs) provide more robust ancestry confirmation. Best practice: combine morphometrics + molecular analysis for bee population studies.



This study aims to characterize wild honey bee colonies on Múcura and San Andrés Islands using morphometric and discriminant analyses, with the objective of evaluating the dispersion and introgression of Africanized bees in the San Bernardo Archipelago and San Andrés. **Múcura Island** (9°39′N – 75°52′W), part of the San Bernardo Archipelago in the Colombian Caribbean, covers about 1.5 km² and lies 35 km from Tolú and 80 km from Cartagena. The island harbors diverse ecosystems, including remnants of tropical dry forest, introduced coconut and beach palms, coastal mangroves, seagrass meadows, and coral reefs that support high marine biodiversity. **San Andrés Island** (12°34′N – 81°42′W), part of the Colombian archipelago of San Andrés, Providencia, and Santa Catalina, lies 619 km northwest of mainland Colombia and 150 km east of Nicaragua. With a hot, humid climate (≈80 °F) and annual rainfall of ~1,950 mm, the island hosts tropical dry forest, mangroves, seagrass beds, biodiverse coral reefs, and coconut palms.

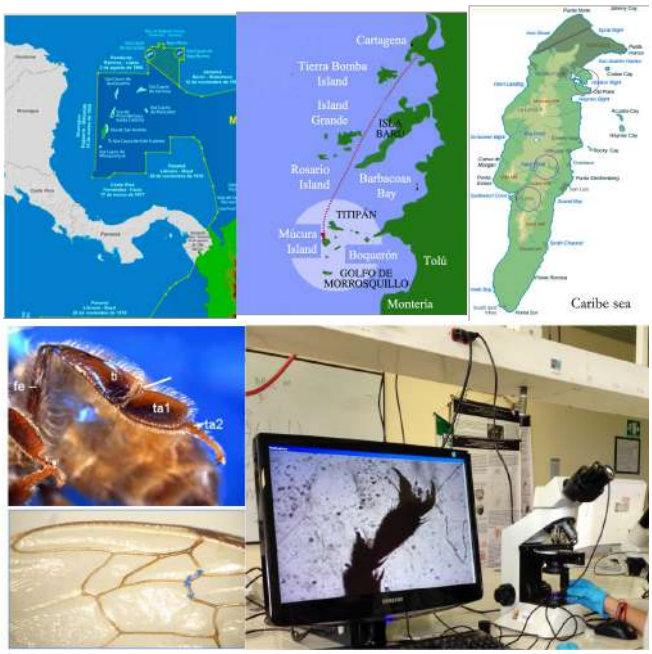
MATERIALS AND METHODS

Adult worker bees were collected or removed from brood chamber combs and preserved in 70% ethanol for subsequent analysis. From each sampled colony, 6 to 10 specimens were dissected. The morphometric variables analyzed included forewing length (Laa) and width (aL), hindwing length (Lp), femur length (Fm), tibia length (Tb), the cubital index (Ic). The dissected specimens were properly mounted for subsequent image analysis using ImageJ 1.47v (National Institutes of Health, USA).

Discriminant factor (FDm) used to differentiate Africanized and European honey bees: $Fdm = \sum (a * b) - 46.5884$

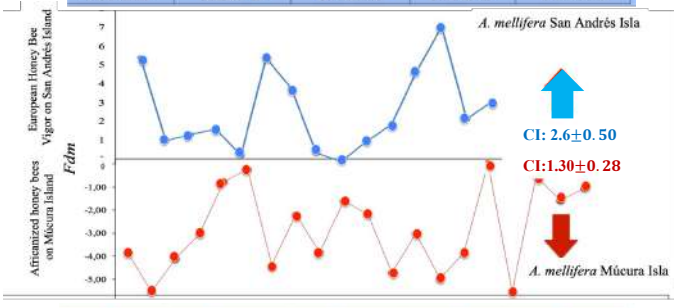
RESULTS

San Andrés is part of an overseas archipelago, while Múcura Island is influenced by the continental mainland.



In the bees from these areas, the continental proximity of Múcura Island is reflected in the Africanization process, whereas San Andrés does not show evidence of this phenomenon. The honey bee colonies from San Andrés exhibited forewing lengths ranging from 9.95 to 9.08 mm, values comparable to those reported for bees from San Cosme, Argentina [comparative study]. In contrast, colonies from Múcura Island showed shorter ranges of 8.06–8.77 mm, clustering morphologically with Africanized bees (Ruttner, 8.66 ± 0.16 mm). Therefore, the bees of San Andrés display morphometric traits consistent with European lineages.

La. mm	L_{aa} mm	L_{ap} mm	L_{tb} mm	L_{fm} mm
9.61±0.20	3.25±0.12	6.55±0.16	3.11±0.19	2.36±0.12



La. mm	L_{aa} mm	L_{ap} mm	L_{tb} mm	L_{fm} mm
8.43±0. 26	3. 11 ± 0. 14	4.25±0. 30	3.00±0. 14	2.30±0. 14

On San Andrés Island, beekeeping with European honey bees, *A. mellifera ligustica*, has been actively promoted. the island has been declared a Genetic Reserve for *Apis mellifera ligustica*, emphasizing its importance in the conservation and genetic improvement of this species. Implementing selective breeding processes of European honey bees in areas with continental influence is not recommended due to the pronounced effect of introgression from Africanized bees.

PP-396 [Bee Biology]

Honey Bee Drone Husbandry

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Honey bee colony productivity and fitness are influenced by the quality, quantity and genetic diversity of drones mated to the queen. Mating requires massive numbers of drones from numerous colonies to form mating congregating areas, creating a genetically diverse pool. The queen's extreme hyper-polyandrous, risky, in-flight mating behavior produces high intra-colony genetic diversity, enhancing colony fitness. Rearing a plentiful supply of healthy, mature drones from select stocks can be challenging for breeding programs. Drones have a high rate of attrition at every life stage. Often overlooked, drones are highly susceptible to stressors, affected by many concurrent and interacting biotic and abiotic factors. Drone production requires proper attention, as in queen rearing.

Limited Reproductive Season

Seasonally produced, colonies highly regulate drone rearing, dependent upon resources, colony health, population size, queen status and seasonal conditions. Primarily produced in spring and peak in summer, preparations begin in winter to ensure strong, healthy mother colonies. Slower to develop, areas of sealed drone brood are greatest a month before swarm season. Drones require 40 plus days to reach maturity; peak flight is 20 days post emergence. Queens will mate with an average of 15 - 20 drones, up to 77. Of semen collected, 90% is expelled, the queen retains sperm representing all the drones mated, 0.5 to 12 million sperm stored in her spermatheca. To increases drone numbers and health, supplemental feeding is recommended

Development and Nutrition

Per colony, hundreds to several thousand drones are produced vs a few queens. Their nutritional requirements, high weight gain during development and numbers are demanding on colony resources. The feeding requirements of drones are comparable to queens, fed high protein royal jelly. Spermatogenesis occurs at the larva stage, completed in the pupa stage. Highest drone larval nutritional demand is 2 to 4 days. Day 6 sperm multiplication is complete, established and unchanged. Nutrition influences semen concentration, viability, body mass, and ejaculate volumes. Temperature is also a critical factor, extremes resulting in sperm mortality. Drone quantity and quality vary, semen volume ranging 0.5 µL to 1.7µL, 3 to 12 million sperm. Drone Weight, 200 - 300mg., is similar to queen weight, 175 - 290mg. Ensuring proper colony conditions and high quality nutrition is critical for good drone production. A high ratio of well-fed young nurse bees supplies good nutrition, and a strong colony population maintains a good field force and brood nest temperature.

High Vulnerability

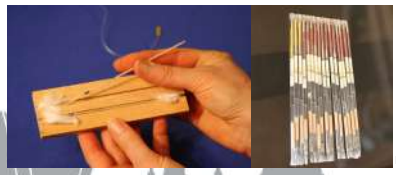
Drone mortality risk increases exponentially from early to late life stages. The haploid condition and longer development time increases susceptibility of drones to parasites, pathogens, pesticide residues, temperature extremes and environmental changes. These stressors reduce drone numbers, quality and semen viability. In response, drone brood is cannibalized and adults expelled, as they are not essential to colony survival. Mature drones tend to be sacrificed over developing and young drones. Often exposed to concurrent stressors, affecting drone numbers and quality, there is no recovery. As drones are expendable, quality care is required at every life stage. The fragility of drones, well known to practitioners of Instrumental insemination, is a limiting factor that requires attention.

Drone Care for Instrumental Insemination

The rearing, care and identification of drones is an essential element of controlled mating. Drones can be marked and caught free flight or confined to nursery colonies for identification purposes. Recovery of mature drones, using either method, tends to be less than 50%. To bank mature caged drones, a well-fed queen-less nursery colony, cell builder or virgin bank is optimal vs a queen-right colony. Avoid temperature extremes in handling and transporting drones. During semen collection, which varies with inseminator experience, anticipate about half the drones will not yield usable semen due to various factors; maturity, quality, contamination during the eversion process. For an adequate supply of drones, prepare to rear 3 to 4 times the numbers required.

Unique Advantages

Drones offer unique opportunities for selection and research. Referred to as "clones," all the spermatozoa of an individual is identical. Instrumental insemination is a proven tool to control mating and enables unique and novel crosses; from the single drone insemination to pooling semen from hundreds of drones to inseminate a batch of queens. Traits occurring in low frequency or not expressed phenotypically can be amplified. Increasingly, molecular tools offer the ability to explore gene expression patterns, identify genetic markers, diagnose colony health and traits of resistance to pests and pathogens. The ability to store semen, short-term at room temperature for several weeks, allows easy transport. Cryo-preservation of semen enables longterm storage, although some damage occurs in the processing. This technique is sufficient for stock reconstruction, conservation and selection across time. Best management practices for successful drone husbandry support research programs, selective breeding and commercial queen production.



Poster 0192

References Available Upon Request

PP-397 [Bee Biology]
Bacterial supplementation shapes honey bee gut microbiota, metabolism and proteome under controlled and field conditions

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Gut microbiota influence immunity, metabolism, and behavior in honey bees (Apis mellifera). While numerous studies have explored microbiota-driven health benefits, most have been conducted either under controlled laboratory conditions or directly in the field. However, how gut microbiota interventions transition from controlled environments to natural hive conditions remains unclear.

We conducted a cage experiment (controlled conditions) and a field experiment (natural conditions) using four bacterial isolates—Lactobacillus helsingborgensis, Bifidobacterium asteroides, Bombilactobacillus mellis, and Lactobacillus apis—to assess the effects of bacterial supplementation on honey bee gut microbiota and metabolism. In the cage study, newly emerged bees were assigned to four groups: control (C) and bacterial supplementation (B) (strictly controlled microbiome) and control with older bees (COB) and bacterial supplementation with older bees (BOB) (semi-controlled with social interaction). All groups received ad libitum feeding. In the field study, bees were supplemented once by trickling a bacterial mixture (TRT) or a sucrose solution (CONT) directly onto the clustered bees within the hive. Gut samples from 10-day-old bees were analyzed using 16S rRNA sequencing (microbiota), ^{1}H-NMR metabolomics, and LFQ-proteomics (cage only).
Results showed that bacterial supplementation (B, BOB, and TRT) significantly altered gut microbiota composition, increasing Lactobacillus and Bifidobacterium abundance compared to respective controls (C, COB, and CONT). Lactobacillus helsingborgensis was significantly enriched in TRT compared to CONT (q-values < 0.05), demonstrating its resilience under natural conditions. Metabolomic analysis revealed significant shifts in organic acids and neurotransmitter-related metabolites in supplemented groups compared to their respective controls (q-values < 0.05). Proteomic analysis identified upregulation of major royal jelly proteins and defense response pathways in B, while C showed increased expression of ribosomal and other translation-related proteins. Additionally, BOB exhibited increased expression of proteins involved in detoxification and stress responses, while COB showed similar patterns to C (q-values < 0.05).

These findings illustrate how bacterial supplementation influences the gut microbiota, with certain species demonstrating resilience and consistent metabolic patterns across controlled to natural conditions, providing a comprehensive perspective on microbiome modulation.

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PP-398 [Bee Biology]

Abstract no.0243

MASS QUEEN REARING TECHNIQUES

in Apis mellifera in South India

Jaykumar, Manager, Shamee bee farm
Daisy Thomas, Dy Director, Retd., CBRTI

Apis mellifera even though biologically similar to A. cerana, A mellifera queen rearing in South India, is not carried out. This Project is a novel attempt.

Problems

Non availability of A mellifera colonies,
Bee eater menace,
Beekeepers are not aware of grafting method.
Beekeepers multiply colonies by simple division.
Colonies have undesirable characteristics.
To ensure large supply of colonies with quality queens for commercial bee keeping practices suggested.

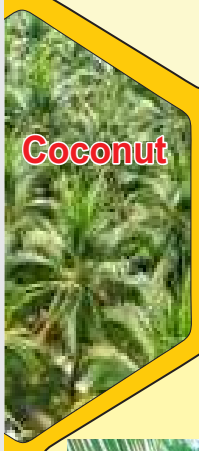
Materials and Methods

Pollachi-Anamalai region is known for its high-quality coconuts and identified apiary in 60 hectares of coconut cultivation.

124 A. mellifera colonies in the apiary, 24 were selected for this study. The colonies had six frames of strength and sufficient pollen and honey stores.

Experiments on artificial queen rearing done in A. mellifera during the months August to September in2024 and August to October in 2025.

Doolittle method of queen rearing was followed.



Preparation of cell-builder colonies

Preparation of cell-builder colonies. A cell-builder colony is conditioned with 3 frames of fully sealed brood, honey, and pollen and without queen.

As there was ample supply of pollen, growth of the colony and royaljelly production is optimum.

Queen Rearing

In the A mellifera queen rearing technique, queen cell cup size, double layered cell bars, age of larvae, bee flora, climatic conditions were considered.
It is showed that the highest larval acceptance and adult emergence was noted in the month of August and in Coconut field with abundant pollen source.
Out of 120 larvae grafted, 98 larvae accepted and 81% success noted in the grafting procedure.

FINDINGS

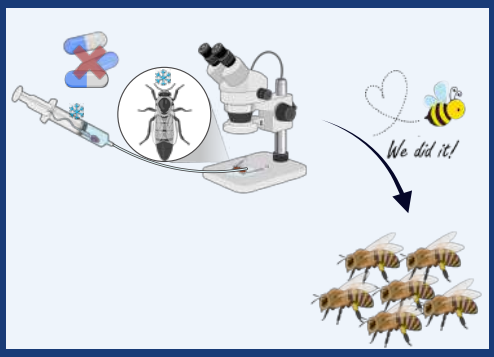
Management of bee colonies for honey production on different bee floral crops like Sunflower, Sesame, Rubber, Cashewnut and for colony multiplication Coconut orchards are considered, and thrust is given to its nectar pollen production potential.

Good quality queens can be produced by breeding the selected maternal and paternal lines. The performance of grafted queens in comparison with the queens reared by simple division was studied and noted that the grafted queen colony was superior to the naturally reared and simply divided colony.
•Hence, it is important to standardize queen rearing methodology in A. mellifera in order to multiply large number of queens and supply superior-character queens to the beekeepers .

49th APIMONDIA INTERNATIONAL APICULTURAL CONGRESS scheduled at Copenhagen, Denmark From 23-27 Sept- 2025

PP-399 [Bee Biology]

- **Drone semen freezing success**
  - Female brood production after instrumental insemination
- **Keep it simple**
  - One step dilution protocol
- **One health**
  - Avoid unecessary use of antibiotics



Evaluation of a Simple Antibiotic-Free Cryopreservation Protocol for Drone Semen

S. Egyptien, J. Ponthier, F. Ectors, B. Thibaut, S. Deleuze

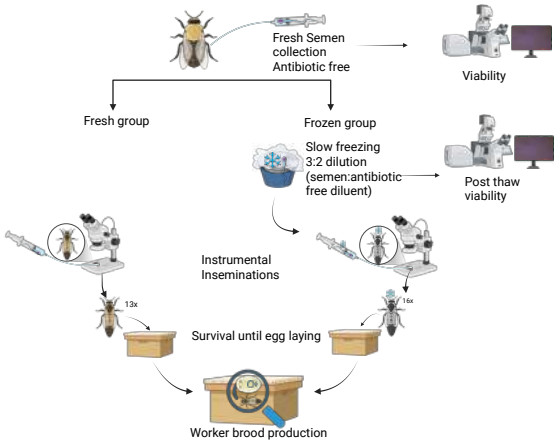
Antibiotic free drone semen bank - Interest

- Increased reliance of modern agriculture on honey bee pollination
  => Preserve and enhance bee populations by breeding/ selection (*ie* VSH colonies)
- Semen bank = back-up for genetics
- Antiobitic free = one health - avoid antibiotic resistance

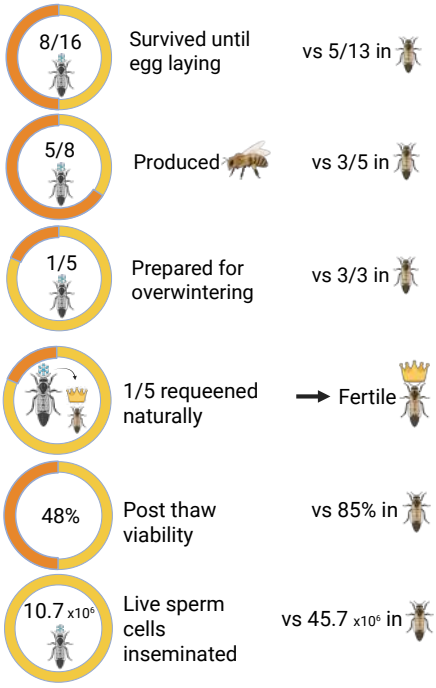
METHODS

1. Semen collection from mature drones. Conservation at 16°C in the dark.
2. Semen viability evaluation by epifluorescence (SYBR/PI vs CaV/PI).
3. Freeze half of the sample using antibiotic free diluent. One step dilution.
4. Inseminations: 2 groups of queens: Fresh and Frozen thawed.
5. Survival and worker brood production evaluation.

Queen inseminated with Fresh semen (left) and Frozen thawed semen (right)



RESULTS



DISCUSSION / CONCLUSION

The absence of antiobiotics on queen survival rate still needs investigation.
This is the first report of female brood production post-instrumental insemination with frozen thawed semen avoiding anticrobial agents addition.

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PP-400 [Bee Biology]

Physiological Effects of Electroshock Stimulation on Western Honey Bee

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Abstract

Bee venom contains various bioactive substances, and numerous studies have confirmed its potential for medical applications. Consequently, the production and purification of bee venom have gradually developed into a commercial model. Electroshock is one of the methods used to stimulate honey bees to produce a larger amount of clean crude bee venom. This study investigates whether electroshock affects bee behavior and internal physiology. Commercial bee venom extractors were used applying electric shocks the intensities of 58, 61, 64, 67, and 70 for 3 seconds with 3 second intervals, continuously for 10 minutes. The average temperature increase at the center of the honeycomb was 1.9 °C ,1.8°C, 1.6°C, 2.1°C, and 1.8°C, respectively. The temperature increases at the top of the beehive, where the electric shock plate was placed, was 6.8 °C, 5.8°C, 5.6°C, 5.7°C, and 5.2°C, respectively compared to before the treatment. The top temperature peaked 2.2 to 9.8 minutes after the end of the electric shocks and then gradually returned to a stable temperature within approximately 90 minutes. RT-qPCR (Reverse transcription quantitative PCR) was used to measure the RNA expression levels of *abaecin*, *hymenoptaecin*, and heat shock protein 70 genes in worker bees after electroshock treatment. The results showed higher expression levels of *abaecin* 1.3 to 3.3 times, *hymenoptaecin* 3.5 to 4.6 times, and *heat shock protein 70* 1.2 to 4.8 times respectively, from treatments compared to before treatment, indicating increased expression of antibacterial peptides and heat shock protein due to electroshock. Additionally, the lifespan of newly emerged worker bees subjected to electroshock was observed in the laboratory, revealing that the average lifespan of electroshock-treated worker bees (23.5 days) was longer than the control group's (21.8 days). In conclusion, the results suggest that electroshock treatment may positively impact bee lifespan and antibacterial peptide expression.
Keywords: electroshock, colony temperature, lifespan, antibacterial peptide

Research aim:
Honey bees (*Apis mellifera*) exhibit a remarkable defensive behavior known as "heat balling" to neutralize predators like hornets. This involves a coordinated aggregation of bees to generate a localized increase in temperature, effectively overheating the intruder. Our prior research on electroshock stimulation for bee venom collection serendipitously revealed a similar aggregation response in honey bees. This intriguing observation prompts us to investigate whether electroshock stimulation, beyond its venom-inducing properties, also elicits a measurable temperature increase within bee colonies, potentially mimicking aspects of their natural heat-balling defense mechanism. Furthermore, we aim to systematically quantify the immediate and delayed thermal responses, as well as the broader biological impacts, of varying electroshock parameters on honey bee colonies.

Experiment 1: Electroshock Stimulation Induces Temperature Increase in Bee Colonies

We studied how electric shocks affect bee colony temperature. Four experimental and four control colonies (each 8 frames of bees) were set up as shown in Figure 1 (A), with temperature loggers in the brood nest. Temperatures were recorded minute-by-minute from 8:00 AM to 7:00 PM. At 11:00 AM, experimental colonies received an electric shock (intensity 67, 20 minutes, 3-sec on/3-sec off pulses), and temperature changes were monitored.

Result 1: The temperature peaked at a 2.9°C increase 22 minutes after the shock began (2 minutes after it ended). By 30 minutes (10 minutes after it ended), the temperature had dropped by 0.5°C from its peak (Figure 1 (B)).

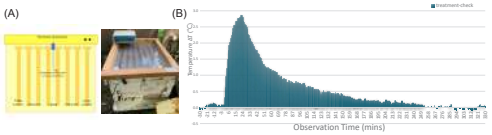

Figure 1: Brood Frame Distribution and Temperature Logger Placement in Exp.1(A). Brood Nest Temperature Changes in Electrically Stimulated Bee Colonies (B) shows how electric shock treatment affects bee colony brood nest temperature. The x-axis indicates time relative to the shock (0 = start), and the y-axis shows the temperature difference (ΔT) between experimental and control groups.

Experiment 2: Localization of Temperature Increase Response to Electroshock in Bee Colonies

Four experimental and four control colonies (8 frames each) were placed temperature loggers in the central brood nest and at the top of the frames, recorded data minute-by-minute from 10:00 AM to 4:00 PM. At 11:00 AM, experimental colonies received a 120-minute shock (intensity 67, 3-sec pulse/30-sec pause). We then recorded temperature changes in both locations.

Results 2: The central brood nest temperature rose by a maximum of 2.7°C, peaking at 67 minutes after the treatment began. It then dropped to within 0.5°C of this peak by 133 minutes (13 minutes after the treatment concluded) (Figure 2). The temperature at the top of the frames showed a larger increase, peaking at 6.4°C after 51 minutes. This temperature declined to within 0.5°C of its peak by 109 minutes (11 minutes before the treatment stopped).

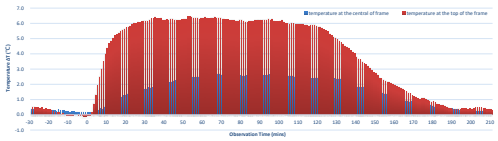

Figure 2: Brood Nest Center and Frame Top Temperature Changes in Electrically Stimulated Bee Colonies

This figure shows the temperature changes (ΔT) in bee colony brood nests and frame tops after electric shock. The x-axis represents time relative to the shock (0 = start), and ΔT is the experimental group's average temperature minus the control group's average.

Experiment 3: Effect of Different Electric Intensity on Bee Colony Temperature Increase

This experiment used four experimental and four control bee colonies, each with eight frames. Electric shock treatments were applied weekly to one experimental colony at a time, cycling through intensities of 58, 61, 64, 67, and 70 over five weeks. Each shock lasted 10 minutes with 3-second pulses and pauses. Before and after each treatment, we measured temperatures in the central brood nest and at the top of the frames, using the same logger setup as Experiment 2.

Results 3: The average temperature increase at the center of the honeycomb was 1.9 °C ,1.8°C, 1.6°C, 2.1°C, and 1.8°C, respectively (Table 1). The temperature increases at the top of the beehive, where the electric shock plate was placed, was 6.8 °C, 5.8°C, 5.6°C, 5.7°C, and 5.2°C, respectively compared to before the treatment (Table 2). The top temperature peaked 2.2 to 9.8 minutes after the end of the electric shocks and then gradually returned to a stable temperature within approximately 90 minutes.

Table 1: Effects of Different Electric Shock Intensities on Brood Nest Center Temperature Increase

Intensity	Time to High Temp (min)	Temperature before treatment (•C)	Highest Temp after treatment (•C)	ΔTemp (•C)	Time to Highest Temp decrease 0.5 degree after treatment (min)
58	26.6±5.9	35.8±0.3	37.7±0.6	1.9±0.4	53.2±8.0
61	19.8±5.1	35.8±0.3	37.5±0.4	1.8±0.4	55.2±15.3
64	21.8±5.8	35.8±0.2	37.4±0.2	1.6±0.2	36.9±0.2
67	20.4±6.4	35.7±0.4	37.8±0.5	2.1±0.6	45.8±8.9
70	19.8±9.0	35.6±0.3	37.5±0.2	1.8±0.2	47.6±11.2

Mean ± SD, n=5; Analysis of variance (ANOVA) showed Pr > F > 0.05, indicating no significant difference in brood nest center temperature increase among different Intensities.

Table 2: Effects of Different Electric Shock Intensities on Frame Top Temperature Increase

Intensity	Time to High Temp (min)	Temperature before treatment (•C)	Highest Temp after treatment (•C)	ΔTemp (•C)	Time to Highest Temp decrease 0.5 degree after treatment (min)
58	12.2±0.4	33.6±0.8	40.4±0.7	6.8±0.6	24±4.4
61	19.8±5.1	34.0±0.8	39.8±0.8	5.8±0.7	27.2±7.2
64	13.2±3.8	34.3±0.9	40.0±0.5	5.6±1.1	25.6±5.9
67	13.0±2.9	34.1±0.7	39.9±0.7	5.7±1.2	26.6±5.0
70	11.2±1.9	34.6±0.6	39.8±0.6	5.2±0.9	23.4±8.5

Mean ± SD, n=5; Analysis of variance (ANOVA) showed Pr > F > 0.05, indicating no significant difference in frame top temperature increase among different Intensities.

Experiment 4: Effect of Electric Voltage Shock on Bee Longevity

We collected 800 newly emerged bees, splitting them into experimental (400) and control (400) groups. On day 5, experimental bees were chilled (-18°C, 15 min) and then received two electric shocks (intensity 67, 3-sec on/off). Control bees were only chilled. After recovery, both groups were housed in rearing cages (100 bees/cage, with pollen and sugar water) in a 33°C, 70% humidity incubator. We daily recorded bee mortality until all bees died.

Results 4: The lifespan of newly emerged worker bees subjected to electroshock was observed in the laboratory, revealing that the average lifespan of electroshock-treated worker bees (23.5 days) was longer than the control group's (21.8 days) (Figure 3) (B). There was no significant difference in longevity between shocked (n=379) and control (n=381) bees (Welch's t-test, $p < 0.05$).

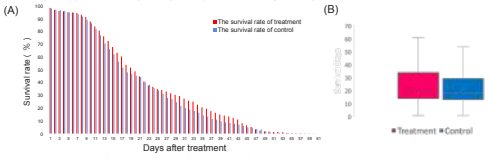

Figure 3: Longevity of Worker Bees After Electric Shock Treatment (A) shows the observed longevity of worker bees following electric shock treatment and control. Average Longevity of Worker Bees After Electric Shock Treatment (B) shows the average lifespan of worker bees after electric shock and control. There was no significant difference in longevity between shocked (n=379) and control (n=381) bees (Welch's -test, $p < 0.05$).

Experiment 5: Effects of Electrical Shock on Honeybee Gene Expression

We studied how electric shocks affect honeybee gene expression. Four experimental and four control colonies (each with eight frames) were set up, and the comb center temperatures were recorded from 8:00 AM to 7:00 PM. Experimental colonies received a 20-minute electric shock (intensity 67, 3-sec on/off) at 11 AM, with temperature changes monitored. Shocks were repeated weekly. Before each shock, 10 worker bees were collected and frozen. Total RNA was extracted from bee abdomens, then reverse-transcribed and analyzed via RT-PCR to measure *abaecin*, *hymenoptaecin*, and *hsp70Ab-like* gene expression, using *β-actin* as a control, and the sample collected before the first shock as the gene expression baseline.

Results 5: RT-qPCR (Reverse transcription quantitative PCR) was used to measure the RNA expression levels of *abaecin*, *hymenoptaecin*, and *heat shock protein 70 genes* in worker bees after electroshock treatment. The results showed higher expression levels of *abaecin* 1.3 to 3.3 times, *hymenoptaecin* 3.5 to 4.6 times, and *heat shock protein 70* 1.2 to 4.8 times respectively, from treatments compared to before treatment (Figure 4), indicating increased expression of antibacterial peptides and heat shock protein due to electroshock.

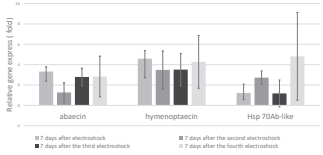

Figure 4: This figure shows the average expression of bee genes (*abaecin*, *hymenoptaecin*, *Hsp70A b-like*) normalized to *β-actin*. Workers (n=10/colony, 4 colonies) were sampled 7 days after a 20-minute, intensity 67 electroshock (3-sec on/off) for RT-qPCR analysis.

Conclusions:

1. **Electric shock stimulation induces an increase in bee colony temperature.** The central brood nest temperature increased after electric shock treatment, for example, by a maximum of 2.9°C at intensity 67. After the shock stopped, the temperature gradually returned to stable levels. Temperatures at the top of the frames, closer to the shock plate, showed a larger increase, peaking at 6.4°C.
2. **There was no significant difference in bee colony central temperature increase across different electric shock intensities.** Analysis of variance (ANOVA) indicated no significant difference in the increase of brood nest center temperature among various intensities (58, 61, 64, 67, 70). Similarly, no significant difference was observed in the frame top temperature increase across these intensities.
3. **Electric shock significantly increased the gene expression of antimicrobial peptides and heat shock protein in honeybees.** Compared to pre-treatment levels, *abaecin* gene expression increased 1.3 to 3.3 times, *hymenoptaecin* 3.5 to 4.6 times, and *heat shock protein 70* (*Hsp70Ab-like*) 1.2 to 4.8 times after electric shock treatment. This indicates increased expression of antibacterial peptides and heat shock protein due to electroshock.
4. **Electric shock treatment did not significantly negatively impact the average longevity of worker bees.** The average lifespan of electroshock-treated worker bees (23.5 days) was observed to be longer than that of the control group (21.8 days). However, a Welch's t-test revealed no significant statistical difference between the treated group (n=379) and the control group (n=381) ($p < 0.05$).
5. **Electric shock treatment may positively influence bee lifespan and antibacterial peptide expression.** The study ‘s findings suggest that electroshock treatment, in addition to its use for bee venom collection, could have positive effects on bee longevity and the expression of antibacterial peptides.

PP-401 [Bee Biology]

Bumblebee Infestation and Interspecific Competition with Honeybees Intensify Near Honeybee Hives

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INTRODUCTION

Human activities are driving declines in insect populations, including a 75% reduction in flying insect biomass in protected areas. This loss is contributing to a pollination crisis, affecting global food production. While honeybees are essential for agriculture, they are often non-native and may not pollinate all plants as effectively as native bumblebees, which are facing declines due to stressors. Honeybees also compete with bumblebees for resources and can transmit pathogens, further threatening bumblebee populations, particularly through parasites like Aphomia sociella.

THEKRAMSLAB

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AIMS

- Investigate the dual threats (competition and parasites) to native bumblebees Bombus terrestris
- Examine the impact of competition on bumblebee immunity
- Assess the effects of parasite infestation on immunity
- Evaluate the combined effects of competition and infestation
- Implications for agricultural ecosystems and biodiversity conservation

METHODS

Study site and insects: B. terrestris colonies were placed near apiaries in southeast Latvia in 2019 and 2024 at distances of 0, 150, 300, 450, and 600 m from honeybee colonies. Colonies were monitored until peak reproductive output in early July.

Infestation monitoring: A. sociella infestations were checked 2-3 times weekly, with presence recorded as binary (yes/no) based on silk spin by larvae.

Reproductive effort: Queen and worker cell counts, along with young queens and workers, were measured to assess reproductive success.

Immunity testing: Worker bees from both infested and non-infested colonies were subjected to a sterile nylon monofilament implant to measure the immune response (encapsulation and melanization) after 5 hours.

Immune assays: Melanization of the nylon implant was measured using a microscope and image software to assess immune activity.

Statistical Analysis: Logistic regression assessed infestation rates, while linear models analyzed reproductive success and encapsulation response, with significance determined using two-way ANOVA.

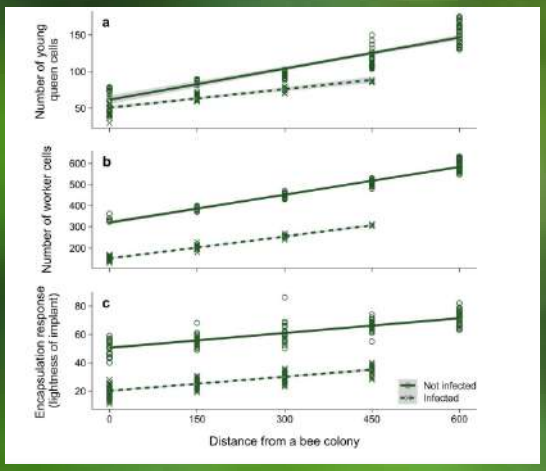

Fig. 2. Relationship between the distance (m) of bumblebee nests from a honeybee colony and (a) number of young queen cells, (b) number of worker cells, and (c) encapsulation response of worker bees, depending on the status of infestation with Aphomia sociella larvae. Shaded areas represent a 95% confidence interval.

RESULTS

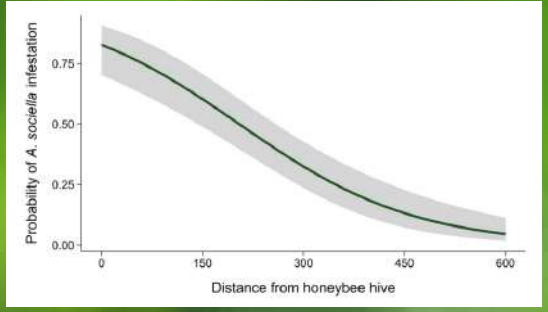

Fig. 1. Probability of Aphomia sociella infestation in bumblebee colonies, and its relationship with distance (m) from an apiary. The shaded area represents a 95% confidence interval.

CONCLUSION

Parasites and pathogens, particularly those potentially spread from honeybees to bumblebees, are a major concern for bumblebee health in both agricultural and natural environments. This study highlights the reduced immune response in bumblebees near apiaries, which could increase their susceptibility to additional infestations and diseases. The findings suggest the need for further research on parasite diversity and its impact on bumblebees near honeybee colonies. Conservation efforts should aim to balance honeybee introduction with minimizing negative effects on native pollinators' health and reproductive success.

FUNDING

This study was supported within the framework of the the European Union's Recovery and Resilience Mechanism project Nr. 5.2.1.1.i.0/2/24/I/CFLA/001 "Consolidation of the Latvian Institute of Organic Synthesis and the Latvian Biomedical Research and Study Centre".

PP-402 [Bee Biology]
Regulation of AmTret1 mediated chitin synthesis on cold tolerance of honey bees

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Bees are the most important pollinating insects globally, and low-temperature stress severely affects their overwintering and agricultural pollination activities. Studying the cold tolerance mechanisms of bees will help to better maintain and even expand their population numbers. This study used Apis mellifera sinisxinyuan and Apis mellifera ligustica as research subjects, collecting 10-day-old worker bees before overwintering to compare their cold tolerance differences, as well as the content of cold tolerance-related substances and gene expression levels. It was found that the A. m. sinisxinyuan has a lower supercooling point than the A. m. ligustica, with a lower freezing rate and a lower foraging temperature than the A. m. ligustica, indicating that the cold tolerance of the A. m. sinisxinyuan is significantly higher than that of the A. m. ligustica. At the same time, the content of trehalose and chitin in the A. m. sinisxinyuan was significantly higher than that in the A. m. ligustica. After low-temperature gradient treatment of A. m. ligustica worker bees, the expression changes of the AmTret1 gene and the content changes of chitin were measured, and combined with transcriptome sequencing analysis, it was found that the differential genes were enriched in the sugar metabolism pathway. The expression of AmTret1 in the A. m. sinisxinyuan was significantly higher, and low temperature could induce the upregulation of AmTret1 expression. The content of trehalose and chitin in bees also significantly increased after low-temperature treatment. It is speculated that AmTret1 is involved in the synthesis of chitin, thereby regulating the cold tolerance of bees. The results of this study not only help to reveal the molecular regulatory mechanisms of bee cold tolerance but also improve the mechanisms of bee sugar metabolism and substance synthesis. By clarifying the key genes for bee cold tolerance, it is expected to breed new bee strains with cold tolerance traits.

PP-403 [Bee Biology]

Feed supplementation with a molybdenum complex improves honey bee health

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Introduction

Nutrition is key to improving the health of colonies [1]. Several products based on vitamins, peptides, proteins or probiotics have been developed for beekeepers. However, despite their essential role in numerous physiological processes for animal health, metals have been surprisingly understudied.

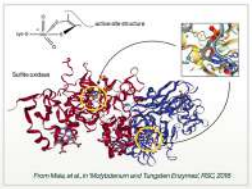
Among crucial trace elements, molybdenum (Mo) is often neglected and its role on honey bee health is almost unknown to date. In this presentation, we investigated the potential benefits of a molybdenum-based dietary supplement.

What is molybdenum?

Molybdenum is an essential trace element involved in more than **50 enzymes** [2].

For humans, Mo is involved in detoxification of body and growing of bones and teeth.
The daily requirement is 50-100 µg/day, primarily found in vegetables and organ meats.

Mo is naturally present in honey bees, at an average concentration of 0.4 ppm [3]. Its role remains poorly understood to date.



What is Pep'up?

Pep'up, developed by Oligofeed, is the result of **10 years of interdisciplinary and international academic research.**

- A patented molybdenum-based molecule considered as a biomimetic model of enzymes [4]
- Highly stable, non-toxic and easy to handle: soluble in both syrup and fondant [3-6].
- Antioxidant in honey bees [3]
- Can increase the honey production without any impact on honey quality [3,5]

Assimilation of Mo by bees

Monitoring molybdenum levels in food storage confirms **Pep'up consumption over several weeks** [3].

Mo level analysis in larvae and worker bees demonstrates **assimilation of the Mo complex by both groups** within hives after feeding with Pep'up in sugar syrup (at D0) [3].

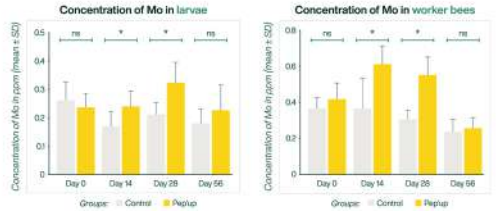


*Figure 1. Molybdenum concentration in larvae (left) and worker bees (right) over time, after Pep'up supplementation. Control group compared to Pep'up supplemented group at days 0, 14, 28, and 56. Statistical significance indicated by * (p < 0.05) and ns (non-significant).*

Laboratory feeding trials with Pep'up (400 mg/L) combined with X-ray fluorescence studies conducted at synchrotron SOLEIL, France (collaboration with Dr J.C. Sandoz, CNRS, France) evidenced:

- Mo naturally occurs in hypopharyngeal glands (HPGs),
- Pep'up supplementation caused a 14-fold increase in HPG molybdenum content.

These findings suggest that **HPGs appear as a primary target of Pep'up in honey bees.**

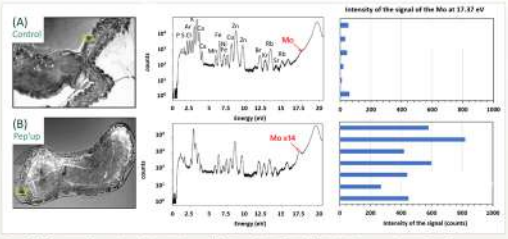


Figure 2. HPGs extracted from workers of the control group (A) and bees fed with Pep'up (B) with their corresponding total X-ray fluorescence spectra. The peak energy corresponding to Mo is indicated in red. 6 HPGs from the control group and 7 HPGs from the group fed with Pep'up were analyzed [3]. Mo is naturally present in HPGs. The intensity of the Mo signal increased 14 times in average after feeding with Pep'up.

Winter mortality reduction

To evaluate the effectiveness of Pep'up in reducing winter mortality, we conducted a large scale field trial across 6 apiaries in France and Spain (2023-2024), involving 247 hives from professional beekeepers.

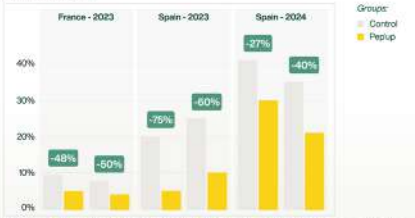


Figure 3. Winter mortality reduction in 2023-2024 in 6 apiaries in Spain and France. Control group compared to Pep'up supplemented group.

Results demonstrate **44% average winter mortality reduction across all apiaries**, with individual reductions **ranging from 27% to 75%** (GLMM, p = 0.029).

Demonstrated efficacy across Europe

Building on **10 years of academic and applied research**, Pep'up has demonstrated consistent efficacy through large-scale field studies conducted in **5 European countries**.

These studies involved **over 1,500 hives** in partnership with independent laboratories and professional beekeepers.

Perspectives

- Conduct new field tests in other environments to consolidate our results.
- Highlight environmental deficiencies in trace elements in Europe and elsewhere.
- Understand how our molecule works in bees: impact on HPGs, impact on royal jelly, impact on bee vitality, impact on the gut microbiota, etc.
- Obtain marketing authorizations in Europe, Canada, and the United States (in progress).

SATT PARIS-SACLAY · cnrs · UVSQ Université Paris-Saclay · CHARMMAT · IUF institut universitaire de France · oligofeed

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PP-404 [Bee Biology]

GENE EXPRESSION RESPONSES TO THERMAL STRESS IN MEDITERRANEAN *APIS MELLIFERA* SUBSPECIES

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INTRODUCTION & AIM

Thermal stress poses a serious ecological threat to honey bees (*Apis mellifera* L.), affecting their physiology, behaviour, and colony viability under global warming. Transcriptomic analyses, particularly through RNA-sequencing (RNA-Seq), have become indispensable for identifying genes and regulatory networks activated in response to high temperature, revealing mechanisms of tolerance at molecular resolution.

The aim was to determine gene expression after RNA-Seq in bees exposed to comfort, stress and hyperthermia temperatures and to understand the effect of humidity as a way to study cellular stress. The tests were survival rate assay and body water loss (BWL) using native subspecies from Italy, Spain, Malta, Jordan, Lebanon and Turkey

MATERIAL & METHODS

Survival rate assay: Bees were exposed to six different temperature and humidity conditions in order to study the different survival rates. Here, two additional cages with 33 bees each were also included, one for be exposed 2 hours (acute stress) and the other for 2 days (chronic stress). This design was intended to study cellular stress using molecular tools such as enzymatic activity assays

Acute Stress- 2 hours			
T 35ºC H 15% (n=10)	T 35ºC H 30% (n=10)	T 35ºC H 50% (n=10)	T 35ºC H 75% (n=10)
g	g	g	T 40ºC H 75% (n=10)g
g	g	g	T 45ºC H 75% (n=10)g

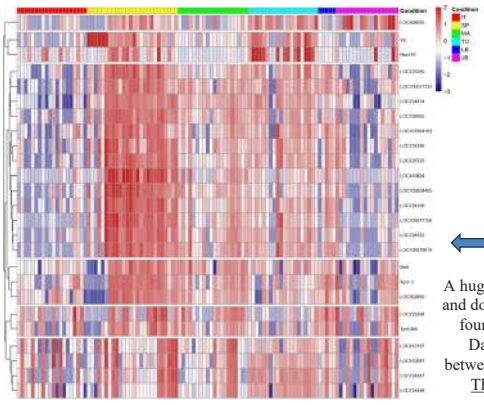
Chronic Stress- 2 daysg			
T 35ºC H 15% (n=10)g	T 35ºC H 30% (n=10)g	T 35ºC H 50% (n=10)g	T 35ºC H 75% (n=10)g
g	g	g	T 40ºC H 75% (n=10)g
g	g	g	-

T 35ºC H 15% (n=10)	T 35ºC H 30% (n=10)	T 35ºC H 50% (n=10)	T 35ºC H 75% (n=10)
T 40ºC H 15% (n=10)g	T 40ºC H 30% (n=10)g	T 40ºC H 50% (n=10)g	T 40ºC H 75% (n=10)g
T 45ºC H 15% (n=10)g	T 45ºC H 30% (n=10)g	T 45ºC H 50% (n=10)g	T 45ºC H 75% (n=10)g

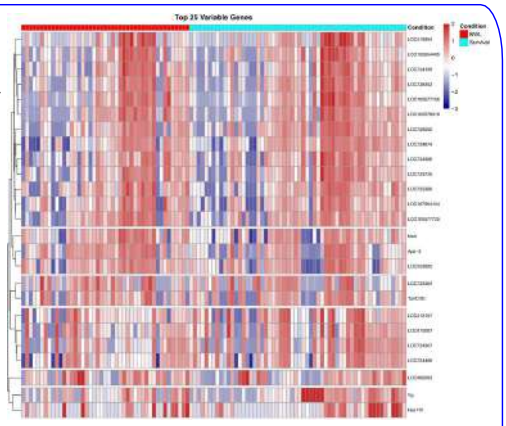
Body water loss assay (BWL): Bees were exposed to nine different temperature and humidity conditions for 2 hours to determine the dehydration effect. In addition to the cages designated for BWL measure, an independent one was included to provide bees exposed to those conditions for molecular studies, including the enzymatic assays.

RNA was extracted by each sample pool (5 bees) and RNAseq analysis was designed to deliver high quality. Sequencing was performed using Illumina, and raw sequenced reads were analyzed, using NovaSeq Control Software.

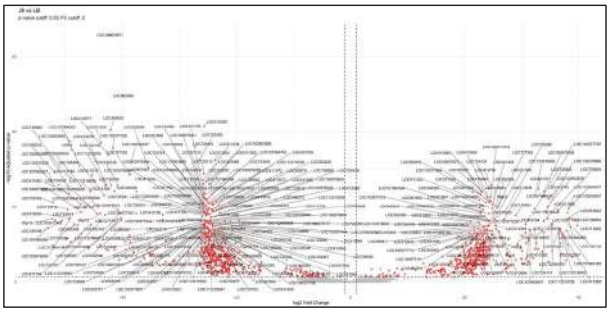
RESULTS



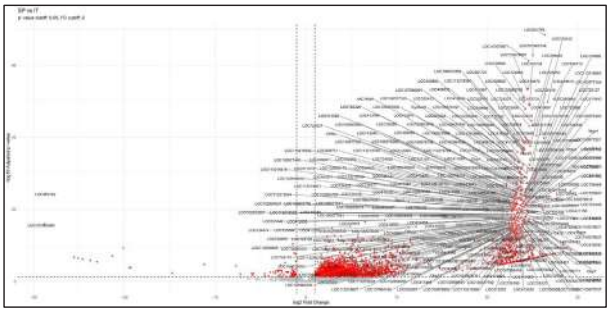
Comparing the difference between the two experiments (Survival and BWL), differences between upregulation and downregulation of genes were found, considering all 109 samples. The 25 most detected genes are reported.



A huge variability of upregulation (red) and downregulation (blue) of genes was found considering all 109 samples. Data confirmed highly variation between the different treatment groups. The 25 most detected genes are reported.



Considering *A. m. syriaca* investigated in Jordan (JB) and Lebanon (LB), a very similar proportion of up-regulate (right) and downregulated (left) genes was found related to thermal stress



Local subspecies from Turkey, Malta, and Spain highlighted opposite trends, with a high number of upregulated gene related to thermal stress compared to *A. m. ligustica*. Specifically, *A. m. iberiensis* (figure) and *A. m. ruttneri* samples showed a higher upregulation (right) of investigated genes

CONCLUSION

This study revealed that the transcriptomic analyses demonstrated clear subspecies-specific molecular responses to thermal and humidity stress, highlighting distinct regulatory pathways involved in stress adaptation and offering valuable insights into the genetic mechanisms underpinning honey bee subspecies (*Apis mellifera ligustica, A.m. iberiensis, A.m. ruttneri, A.m. syriaca, A.m. anatoliaca)* resilience in Mediterranean environments

The analyses are still in progress, especially for specific genes ... Stay tuned!

PP-405 [Bee Biology]
Zarnam honeybee syrup as reliable source of carbohydrate in beekeeping

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[2]Department of Honeybee, Animal Science Research Institute of Iran, Agricultural Research Education and Extension Organization (AREEO), Karaj, Iran

Climate changes and extended periods of forage dearth, habitat loss and monoculture landscape necessitate the artificial feeding of the honeybee colonies to achieve the optimum pollination and also an ideal yield including honey, pollen, royal jelly and etc. Moreover, prevention of honeybee colonies from starvation can strengthen the colony which can have significant impacts on pollination efficiency and the ability for combating with pathogens, pesticides and pollutants which can lead to reduced colony loss. Carbohydrates are the main source of energy for honey bee colony and worker bees are exclusively dependent to their provision after a certain age stage in their life. White sugar is used for many decades as a safe and trustable source of energy for honeybee colonies. Due to high price of white sugar, work force needed for making syrup, tendency to crystalize and ferment and impurity and being used as human food, high fructose corn syrup (HFCS) got popularity in beekeeping as a cheap and easy to use alternative source of energy. The effects of HFCS were controversial at the beginning due to presence of polysaccharide residues as a consequence of incomplete starch breakdown and also formation of some other derivatives with potential toxicity for honeybees. Moreover, the process was acid-based which when coupled with high temperature, would lead to formation of hydroxy-methyl furfural (HMF), a component highly toxic to honeybees. However, continuous improvement in refining technologies including more efficient enzymatic hydrolysis without using acid and high temperature leaded to products without any polysaccharide residues and also HMF making it more reliable source of energy for honeybee. Due to similar sugar profile of HFCS derived syrups with honey, these products can better meet honeybee nutritional requirement and not imposing further work for converting and processing the sugars in their diet. Zarnam Honeybee Syrup, a new product from corn hydrolyzed carbohydrates is formulated according to honeybee requirement, resistance to microbial contamination and fermentation, resistant to crystallization, high dry matter content, optimum pH and easy to use which make it a reliable energy source to sustain colony performance while reducing the feeding cost.

APIMONDIA SCANDINAVIA 2025
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PP-406 [Bee Biology]

Difference between uncapping and removal behaviors in *Apis cerana* from the perspective of long non-coding RNAs

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Background/Purpose

Hygienic behavior is a critical immune response in social insects, essential for protecting colonies from disease. In honeybee colonies, this behavior involves two distinct steps: uncapping and removal of unhealthy or deceased brood. While previous research has explored the development of hygienic behavior, the mechanisms driving the division of labor between uncapping and removal remain poorly understood. Long non-coding RNAs (lncRNAs) have been implicated in regulating honeybee physiology, but their role in these specific tasks has not been investigated. This study aims to elucidate the differences between uncapping and removal behaviors in Apis cerana from the perspective of lncRNAs.

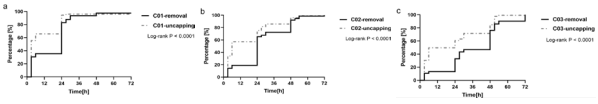
Methodology

We used strong hygienic *A. cerana* worker bees and assessed uncapping and removal behaviors in three colonies using freeze-killed brood. Antennal RNA sequencing was performed to identify differentially expressed lncRNAs, followed by lncRNA-mRNA association analysis to explore the molecular differences between the two behaviors.

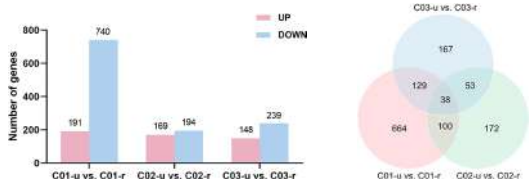
Results and Conclusion

1. Data recording and statistical analyses of freeze-killed broods

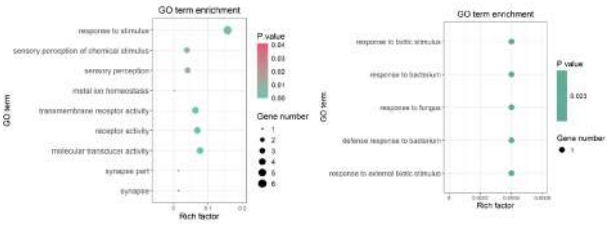
For all of the assessed colonies, the results revealed significant differences in task performances of uncapping and removal worker bees ($P < 0.0001$).



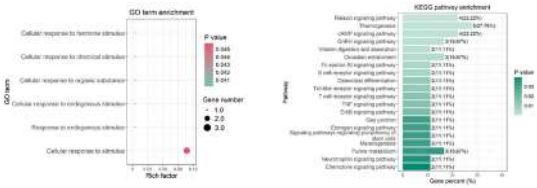
2. RNA sequencing of honeybee antennae



3. GO analysis of DElncRNAs via antisense and *cis* regulatory mechanisms



4. Analysis of the core target genes regulated by common DElncRNAs between "uncapping" and "removal" bees



We identified 1,323 differentially expressed lncRNAs in the antennae. The lncRNA-mRNA association analysis revealed that target genes of these lncRNAs were primarily associated with response to stimulus, receptor activity, and synapse. Notably, the lncRNA XR_001766094.2, enriched in cellular response to stimulus, was exclusively expressed in uncapping worker bees. This suggests that XR_001766094.2 may play a key role in distinguishing uncapping from removal behaviors by modulating responsiveness to external stimuli. Our findings highlight distinct molecular profiles underlying uncapping and removal behaviors, with uncapping bees potentially exhibiting faster stimulatory responses and heightened olfactory sensitivity. These differences may facilitate the rapid execution of hygienic behavior in colonies. This study provides a hint for understanding lncRNA-mediated gene regulation in hygienic behavior.

Practical Implications for Beekeepers

Understanding the molecular basis of hygienic behavior could aid in breeding programs to enhance colony health and disease resistance. XR_001766094.2 emerges as a promising molecular genetic marker that can potentially assist this targeted breeding endeavor.

BMC Genomics. 2024; 25(1): 921.

PP-407 [Bee Biology]

A rapid cost-effective genotyping method for Africanized *Apis mellifera* bees with high honey production potential

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INTRODUCTION

Beekeeping has increasingly incorporated technological advancements, particularly in genetic improvement and colony selection for high honey productivity, aiming to enhance profitability. However, most beekeepers still rely on capturing migratory swarms, dividing colonies, and purchasing colonies from other producers, without implementing any structured breeding program. These practices may reduce efficiency and competitiveness, highlighting the need for precise and accessible genetic selection techniques.

OBJECTIVES

This study aimed to develop a rapid and cost-effective genotyping kit for high honey-producing colonies using the G-quadruplex PCR technique. A total of 220 colonies from 10 beekeepers in the Pólo Cuesta region, São Paulo, Brazil, were evaluated.

MATERIALS AND METHODS

Honey production was individually assessed during the orange blossom (2021), wildflower (2021), and eucalyptus (2022) honey flows. The two highest- and lowest-producing colonies from each beekeeper were selected, forming the High Honey Production (HHP) and Low Honey Production (LHP) groups (20 colonies each) (Figure 1). The HHP and LHP groups produced an average of 89±23.9 kg and 25±9.3 kg of honey per colony over the three seasons, respectively. A total of 120 worker bee pupae larvae were collected from each selected colony, and genomic DNA was extracted and genotyped for two pre-selected SNPs (FAPESP Project 2013/01588-1) using allele-specific primers for G-Quadruplex-based genotyping and Taqman probes.

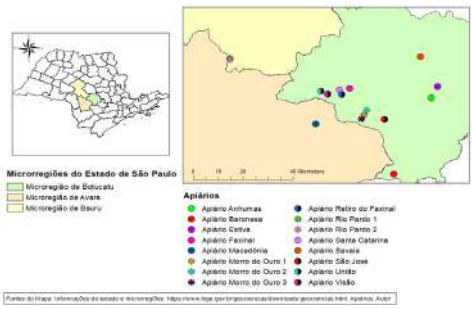

Figure 1. Locations of apiaries in São Paulo State

RESULTS

The comparison between TaqMan probes and the G-quadruplex technique for SNP 1 and SNP 3 genotyping results is shown in Figure 2. Samples that turned blue after the G-quadruplex reaction were considered positive for the SNP tests.

The genotyping results were analyzed using a chi-square test (χ^2) to assess the correlation between SNPs 1 and 3 and honey production, revealing a significant association ($P<0.05$). Thus, the G-Quadruplex genotyping method effectively validated SNPs 1 and 3 as markers for honey production.

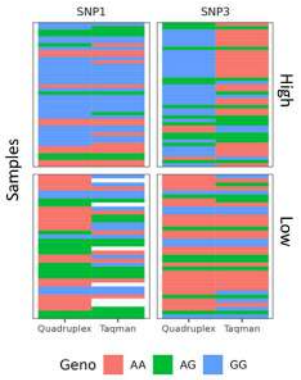

Figure 2. Genotyping results of SNP 1 and SNP 3 using TaqMan probes and the G-quadruplex technique.

CONCLUSION

This technique offers a precise, cost-effective alternative to TaqMan® probe-based genotyping, providing rapid and easily interpretable results for honeybee breeding programs.

ACKNOWLEDGMENTS

This research project was supported by FAPESP Process Number 2020/09231-9 and 2025/12634-1

PP-408 [Bee Biology]
Primal Bee Thermodynamic Hive Increases Bee Population by Optimal Heat Efficiency

Gianmario Riganti, Alessandro Gamberoni, Jason Graham, Tomer Moldovan, Yotam Melman, Eitan Nir
Primal Bee, Giornico Switzerland

Honey bee population dynamics are driven by each new generation of brood which develop into workers who fulfill each role allowing the colony to survive and thrive. The cost and effort to grow each new generation of brood has been defined in entomology as the honey to brood equivalence. This can be measured by the quantity of capped food storage available to the colony to produce the equivalent capped brood (next generation) area.

This study, conducted from 2017 to 2024, aimed to develop an internal hive environment which provided honey bee colonies with optimal growth conditions. This was accomplished by applying engineering methodologies to understand i) the dependencies of honey to brood equivalence to the hive design, and ii) to validate the innovative methodology based on new optimal hive design fulfilling the maximization of the honey to brood equivalence in the field.

First, methods were used to assess and measure honey to brood equivalence and rank these for the existing hives designs. Results show that 1) the honey to brood equivalence is no longer to be considered a constant, but a bee/hive combined parameter; 2) unexplored increase of bee population can be obtained with hive design: an advantage of 25% is found for standard modified hives, while a double population 200% is achieved for innovative, Primal Bee hives, compared to wooden standard hive; 3) the new hive design is fully integrated with the biological needs of honey bees and it is a fully natural solution.

Second, pilot tests were put in place in several climatic environments to test the colony response in optimal hive design. Practical advantages were found for the bees and beekeeper, including double (+200%) bee population, early blossom harvest capability, higher flight activity, higher splitting potential, and superior climate adaptability.

These results provide a fresh perspective demonstrating significant improvements to standard beekeeping methodology resulting in stronger bee populations through enhancement of their hive environment to support their biological processes enabling the colony to overcome challenges while also providing a broad range of economic and operational advantages for beekeepers.

PP-409 [Bee Biology]
Resistance of Local Efe F1 Honey Bee Ecotype (Apis mellifera anatolica) against Varroa destructor and effects on colony development

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[2]Ege University, Faculty of Agriculture, Depertman of Animal Science, İzmir, Turkey

Hygienic behavior, defined as one of the social defense and resistance mechanisms of honeybees, is a highly complex process represented by worker bees detecting infected brood, uncapping the cells and removing them. This behavior is considered a crucial defense mechanism against brood diseases, including those caused by the ectoparasitic mite Varroa destructor.

The effectiveness of hygienic behavior depending on the genetic structure of honeybee species and the geographical conditions which they are located. Türkiye has diverse honeybee species and subspecies, including Apis m. caucasica, A. m. syriaca, A. m. meda, A. m. carnica, and A. m. anatoliaca, along with various ecotypes adapted to different climates. These ecotypes have evolved to withstand regional diseases and environmental conditions. The study focuses on the Efe bee ecotype, which has specifically adapted to the ecological conditions of the western Aegean region.

In this study, the relationship between hygienic behavior and Varroa destructor prevalence in the Efe bee ecotype was examined and the effects of hygienic behavior on colony performance were evaluated by measuring colony development parameters.

According to the results, a statistically significant relationship was found between hygienic behavior and Varroa destructor prevalence in the Efe bee ecotype. However, no significant relationship was observed in subsequent measurements, which can be attributed to various factors such as nectar flow, seasonal variations, and challenges in queen acceptance. In terms of colony development parameters, it was found that Efe bee ecotype showed a higher colony development performance than the average of the existing species and ecotypes in certain periods. The study findings showed that despite the difficulties experienced in the brood rearing process, the brood development of Efe bee ecotype is generally above average and these results draw attention to the performance of local ecotypes in colony development parameters.

It is important to investigate the defense mechanisms such as hygienic behavior in local honeybee ecotypes is important for the development of sustainable beekeeping practices. Understanding the resistance potential of local ecotypes against diseases and pests will reduce dependence on chemical control methods and contribute to the dissemination of economic and sustainable beekeeping practices.

PP-410 [Bee Biology]

THE ROLE OF NITRIC OXIDE IN HONEYBEE EPITHELIAL IMMUNITY

Tölgová Linda, Janků Martina, Jiří Danihlík, Petřivalský Marek
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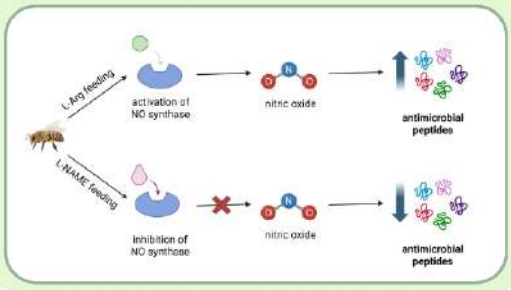
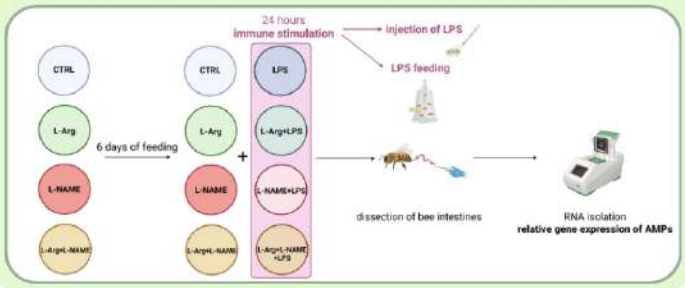
INTRODUCTION

The digestive tract of invertebrates is essential for nutrient absorption and immune defense, acting as a **primary barrier against orally acquired pathogens.** Epithelial immunity, which involves the symbiotic microbiome and epithelial cells, plays a key role by producing **immune molecules such as antimicrobial peptides (AMPs) and nitric oxide (NO).** NO is synthesized from L-arginine by NO synthase[1] and functions as both a signaling and cytotoxic molecule, which makes it an essential component of invertebrate immune responses. For example, **NO has been shown to regulate AMP expression** in *Drosophila melanogaster*[2,3]. The hypothesis is that **L-arginine, as a substrate for NO synthase, stimulates NO production and thereby increases AMP expression**, whereas **L-NAME inhibits NO synthase, reducing NO levels and AMP expression**.

HYPOTHESIS

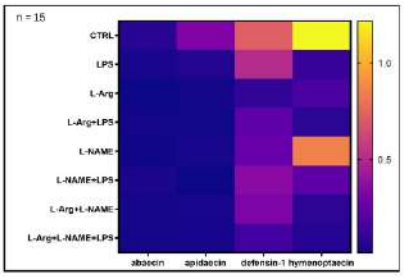


MATERIAL AND METHODS



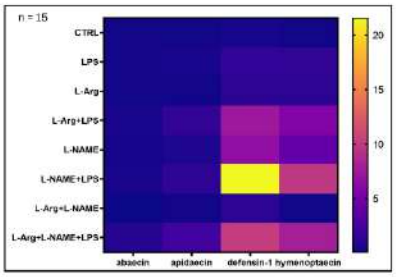
RESULTS

Immune stimulation by LPS via oral administration



- oral LPS stimulation did not induce a clear epithelial immune response, complicating interpretation of the results
- qPCR analysis of *aba*, *api*, *def-1*, and *hym* showed only limited and inconsistent effects of NO synthase inhibition
- overall relative gene expression of AMPs was low across all treatments

Immune stimulation by LPS via injection



- injection of LPS elicited stronger AMP responses, particularly for def-1 and hym
- relative gene expression of *def-1* and *hym* was higher with the NO synthase inhibitor (L-NAME) than with its substrate (L-Arg)
- the combined treatment (L-Arg+L-NAME+LPS) resulted in expression levels of *def-1* and *hym* falling between those observed with L-Arg+LPS and L-NAME+LPS

DISCUSSION

Relative gene expression of AMPs was generally low in groups receiving LPS via feeding, indicating **weak immune activation via oral administration**.
In contrast, injection of LPS induced stronger responses, particularly for *def-1* and *hym*, demonstrating that **the route of administration strongly affects immune activation.**
Relative gene expression of *aba* and *api* remained unchanged across all treatment groups, whereas relative expression of *def-1* and *hym* was unexpectedly higher in L-NAME+LPS compared to L-Arg+LPS within the injected groups, suggesting that **NO inhibition may enhance AMP expression through compensatory mechanisms.** Treatments combining L-Arg+L-NAME+LPS often resulted in intermediate expression levels, highlighting the complex and context-dependent effects of NO.
Overall, these results suggest that **NO can modulate AMP expression in honeybees.**

CONCLUSION

The initial hypothesis that NO plays a key role in regulating AMP expression in the honey bee gut **was not conclusively supported**. **Relative AMP expression differed only modestly and inconsistently** between treatment groups. **Oral administration of bacterial LPS was insufficient** to elicit robust immune responses, whereas **injection of LPS provided a more reliable immune challenge.** These findings indicate that honey bee immune responses are influenced by **multiple overlapping factors** and cannot be attributed solely to NO availability. Further studies, particularly at the protein level, are necessary to clarify the precise role of NO in epithelial immunity.

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PP-411 [Bee Biology]

APIMONDIA SCANDINAVIA 2025 23-27 SEPTEMBER
Abs Ref: 0435

THE PALMER METHOD FOR MASS PRODUCTION OF *Apis Mellifera* L. (HYMENOPTERA: APOIDEA) IN TROPICAL ZONE AS A CONDITION FOR REDUCING INTROGRESSION BY AFRICANIZATION

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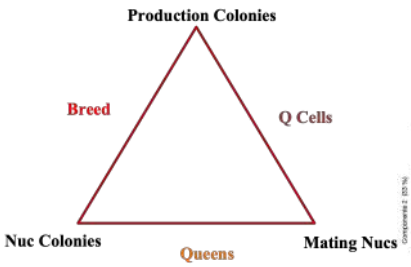
[2]Honey Land beekeeping company San Andrés Island, Colombia. [3]Facultad de Ciencias -Universidad del Tolima Colombia.

REMARKS

The large-scale production of genetically superior queen bees constitutes a central component of selective breeding programs aimed at improving *Apis mellifera* populations. In tropical regions, apiculture is hindered by the continuous introgression of Africanized genes through natural hybridization, which is associated with heightened defensive behavior and reduced colony productivity.

Controlled mating, particularly through instrumental insemination, has therefore become indispensable for genetic conservation and the stabilization of desirable traits within managed populations. The Palmer´s Method in beekeeping is a system focused on making beekeeping more sustainable and self-sufficient. Instead of relying on buying queens or packages every year, the method emphasizes internal resource management within the apiary.



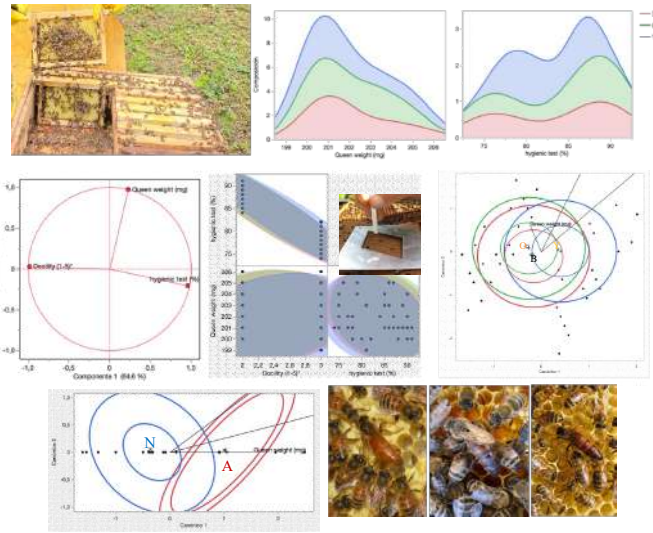
Palmer Method: "Sustainable Apiary" maintain a standing fleet of nucleus colonies (nucs) that (i) supply brood to production hives, (ii) supply high-quality queens reared locally, and (iii) are continuously replenished by splits from production colonies-creating a closed loop of Queens/Brood/Nucs.

In practice, the method reports extremely high brood output from nuc Banks: temporal data from a temperate system. illustrating the scalability of the approach for mass queen/colony production.

RESULTS

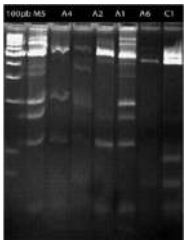
Palmer´s method, centered on nucleus colony management, offers a scalable framework for sustainable queen and colony production in tropical systems. By maintaining nuc banks that supply brood, queens, and drones while being continuously replenished, the method establishes a closed cycle of colony renewal.

Field data indicate high brood yields and efficient queen pipelines, while complementary tools such as drone flooding and spatially managed mating yards enable partial control of open matings, reducing Africanized introgression. This integrated framework provides a practical and field-tested foundation for mass propagation and gradual genetic redirection of managed *Apis mellifera* stocks in tropical regions.



Queens: Provide fresh, locally adapted genetics that sustain vigorous, productive colonies. Brood: Maintain a steady supply of young bees that support both queens and nucleus colonies. Nucleus Colonies (Nucs): Act as a biological bank, ensuring a constant reserve of living resources.

The evaluation of honey bee populations in the region revealed haplotypes A1, A2, A4, and A6.



Following the implementation of the Palmer Method, the selection of colonies with European ancestry was confirmed by mitochondrial DNA analysis, which identified lineages M and C.

Queens are selected based on performance and reared under optimal conditions. This helps produce locally adapted queens, enhancing colony resilience and performance.

PP-412 [Bee Biology]
Knocking on a honeybee hive: quantitative analysis of a colony's reaction to an artificial vibrational knock

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[2]Harry Butler Institute, Murdoch University, Perth, Australia
[3]Centre of Functional Ecology, Department of Life Sciences, University of Coimbra, Portugal
[4]Ghent University, Department of Biochemistry and Microbiology, Ghent University, Krijgslaan 281, 9000 Ghent, Belgium

In the past many beekeepers have been simply knocking on their hives, with their hand, to check and listen for a positive buzzing response, indicating the liveliness of the colony.

In this work we aim to provide a quantitative method allowing the probing of the physiological status of honeybee colonies by providing them with a gentle, short, external artificial vibrational shockwave, and recording their response.

The knock is provided by an external electromagnetic shaker attached to the outer wall of a hive, driven by a computer with a 0.1 s long, monochromatic vibration at 340Hz set to an amplitude that occasionally yields a mild response from the bees, recorded by an accelerometer placed in the middle of the central frame of the colony.

To avoid habituation, the stimulus is supplied at randomised times, approximately every hour. The method is pioneered with a pilot study on a single colony hosted indoors, then extended onto eight outdoors colonies.

The results show that we can quantitatively sense the colony's overall mobility, independently from another physiological aspect, which is phenomenologically explored. Using this, a colony that is queenless is easily discriminated from the others.

The method is presently deployed on a collection of colonies in Europe, including Holland, Norway and Romania, with the aim of discriminating survivor from failing colonies, in apiaries where honeybees are not treated for varroa infestation. When the method's specific diagnostic strengths are fully clarified, it will provide beekeepers with a quantitative startle response measurement tool, providing colony status assessment without having to open the hive.

PP-413 [Bee Biology]

BEE SCIENCE NUTRITION

By DULCOFRUCT

Development of a carbohydrate feeding product for honey bees (Apis mellifera) with beneficial effects on their lifespan

Authors: Dr. Popovici Daniel Cristian, Ing. Pătrașcu Grațiela

ABSTRACT:

Background and problem description: Recent researches has shown that the longevity of honey bees (Apis mellifera) is more and more affected by specific pathogens but also by xenobiotic components existing in the environment. In order to counteract their negative effects as much as possible, the use of phytonutrients with strong antioxidant role in supplementary feeding is one of the solutions.

Purpose: To this end, we focused on testing a hydric extract of Siberian ginseng root (Eleutherococcus senticosus) administered on solid carbohydrate support of fondant and candy type (Candy board energetic®) equivalent of 0.1g root powder/100g product.

Methodology: In this regard, a laboratory experiment was set up in Romania, carried out and repeated during the active season (May-July) of 2022 and 2023, for a duration of up to 28 days, on two groups (experimental and control), each consisting of 3 cages populated with 100-300 young non-flying bees collected from the same colony at time of cages population. The cages were checked out daily to record honeybee mortality. Two statistical tests were used to evaluate honeybees' longevity (SPS: Kaplan-Meier; Cox regression).

Practical implications for beekeepers: Supplementary feeding with Siberian ginseng root extract (Eleutherococcus senticosus) represents a promising option to improving supplemental feeding with substances that have beneficial effects on the lifespan of honeybees, having a positive impact both during the production period and during inactive periods of the year that involve resource conservation.

Materials & Metodology:

1st Stage, 2022:

- Period: May 15 – June 10, 2022
- 400–800 bees per group, in 3 cages, with 100–300 bees per cage
- The bees were fed with various substances and extracts, all using the same carbohydrate base
- Group 33 stood out, fed with an aqueous extract of ginseng (Eleutherococcus senticosus) = extract from 1 g of dried root per 1 kg of energy feed
- Carbohydrate base = Candy Board Energetic, to which the plant extract specific to each group was added
- Commercial Candy Board Energetic feed without any added extract = Group 1, control group
- Bees used = from artificially created swarms of controlled age – bees younger than the orientation flight stage
- Dead bees were counted every 2 days

2nd Stage, 2023:

- Period: July 1–21, 2023
- A procedure similar to the 2022 stage was applied
- Number of bees used: between 148 and 353 bees per group, divided into 2–3 cages per group
- Dead bees were counted daily, and on day 21 — the final day of the experiment — the live bees were also counted
- Test feeds: fondant – Group 1, fondant with ginseng extract – Group 2, Candy Board Energetic – Group 6, and candy with ginseng extract – Group 7
- The candy-based feed used in Groups 6 and 7 was 17 months old at the time of the experiment
- At the end of each experiment, the data obtained were entered into an SPS database, and Kaplan-Meier tests along with Cox regression were used for analysis

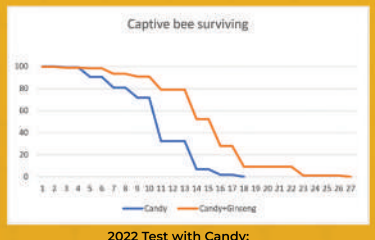
At the end of each experiment, the data obtained were entered into an SPS database, and Kaplan-Meier tests along with Cox regression were used for analysis

Results:

The obtained results show that the honey bees in all experimental variants had significantly higher longevity ($p<0.001$) compared to the control group in which the bees were maintained only on carbohydrate feeding, free of added phytonutrients.

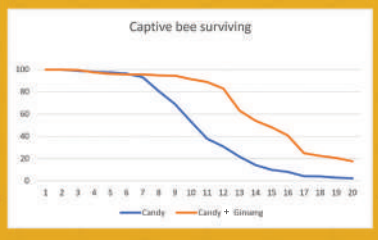
Lot	Number of dead bees, per day										Total
	Day2	Day4	Day6	Day8	Day10	Day12	Day15	Day17	Day19	Day24	Day28	
Candy Board Energetic (control)	0	5	61	69	64	276	180	36	13	0	0	714
Candy with Ginseng	1	5	3	27	14	65	145	132	103	44	7	556

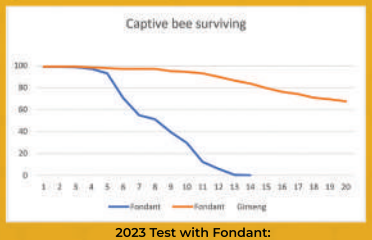
Group	Number of dead bees per day																			Living in 21 day	Total
	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	
Fondant (control group)	3	0	1	6	14	80	55	13	42	34	61	23	19	2	0	0	0	0	0	0	353
Ginseng Fondant (experimental group)	1	0	0	1	1	1	0	0	3	1	2	5	5	4	6	5	3	5	2	3	148
Candy with Ginseng (experimental group)	0	0	1	5	3	1	0	2	1	7	6	14	46	21	14	17	37	6	4	7	233
Candy Board Energetic (control group)	0	0	4	3	2	4	11	43	40	55	53	24	32	26	15	6	13	1	4	2	346



2022 Test with Candy:

2023 Test with Candy:





2023 Test with Fondant:

PP-414 [Bee Biology]

BEE SCIENCE
NUTRITION

By DULCOFRUCT

Testing the palatability of some protein supplements administered in honeybee supplementary feeding late in winter

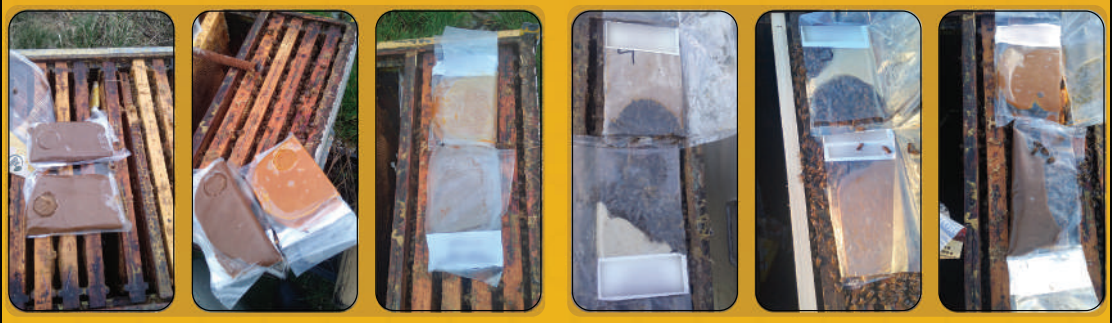
Authors: Dr. Craiu Ovidiu, Ing. Pătrașcu Grațiela

ABSTRACT:

In the production of nutritional supplements based on pollen substitutes, there are often problems related to attractiveness and consumption, even if their composition responds to the nutritional requirements of honeybees. Attractive substances (e.g. volatile oils) but also the ratio of proteins to carbohydrates can influence consumption. As a result, carbohydrate-protein formulas based on pollen substitution require palatability testing, a property that reflects the degree of their attractiveness and consumption. Since there are various protein ingredients on market, simple (e.g. soybean flour), in mix (products with more ingredients) or ready to use (protein candy or patties), beekeepers can test the palatability of various formulas for personal use.

Materials & Metodology:

In order to support these evaluations, a rapid comparative test was developed for several formulas (4 home-made formulas based on protein substitutes including a home-made formula based on monofloral pollen with 23% crude protein, 4 ready to use protein products of the patty type). The carried-out tests took into account the application of some standardization principles for experimental purposes: use of the same carbohydrate base, equivalence of the protein percentage, equality in the administered quantity and equality in contact surface with the honeybee's cluster. The experiment was carried out on 24 colonies divided into groups of 3 colonies/group, standardized as bees intervals and brood surface, in February (2023) in order to benefit from protein "hunger", a natural physiological state in this year period. For the comparative testing, we applied a comparison method in pairs of two different patties (250 grams/patty) placed similarly above the wintering cluster on each experimental colony. Patty consumption was evaluated after 5 days of administration.

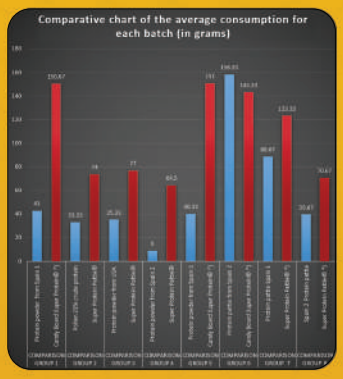


Results:

Following this test, variable results were obtained with maximum of 158 g consumed product (commercial patty) and a minimum of 9 g (home-made formula, equally with a ready-to-use formula). The pollen-based products recorded an average consumption of 33 grams. By comparing several and different formulas in pairs under the same experimental conditions, with the evaluation of the consumed quantity before complete consumption, it is possible to quickly assess the palatability degree of protein formulas, in protein necessity conditions generated by brood rearing for wintering bee replacement.

Table 1: Comparison table results from study

Experimental group	Product	Product type	Total crude protein in final product	Mean consumption in 5 days (in grams)	Relative frequency of consumption	Difference between percentage of consumption
COMPARISON GROUP 1	Protein powder from Spain 1	Raw material (pollen substitute) for bees	5.75%	43.00	17.20	-43.07
	Candy Board Super Protein©*)	Commercial product Romania	5.75%	150.67	60.27	43.07
COMPARISON GROUP 2	Pollen 23% crude protein	Defreezed pollen	12.5%	33.33	13.33	-16.27
	Super Protein Pattie©	Commercial product Romania	12.5%	74.00	29.60	16.27
COMPARISON GROUP 3	Protein powder from USA	Raw material (pollen substitute) for bees	12.5%	35.33	14.13	-16.67
	Super Protein Pattie©	Commercial product Romania	12.5%	77.00	30.80	16.67
COMPARISON GROUP 4	Protein powder from Spain 1	Raw material (pollen substitute) for bees	12.5%	9.00	3.60	-22.20
	Super Protein Pattie©	Commercial product Romania	12.5%	64.50	25.80	22.20
COMPARISON GROUP 5	Protein candy from Spain 2	Raw material (pollen substitute) for bees	5%	40.33	16.13	-44.27
	Candy Board Super Protein©*)	Commercial product Romania	5%	151.00	60.40	44.27
COMPARISON GROUP 6	Protein candy from Spain 2	Commercial product Romania	3%	158.33	63.33	6.00
	Candy Board Super Protein©*)	Commercial product Romania	3%	143.33	57.33	-6.00
COMPARISON GROUP 7	Protein pattie Spain 1	Commercial product Romania	16,3%	88.67	35.47	-13.87
	Super Protein Pattie©*)	Commercial product Romania	16,3%	123.33	49.33	13.87
COMPARISON GROUP 8	Protein pattie Spain 2	Commercial product Romania	10%	39.67	15.87	-12.40
	Super Protein Pattie©*)	Commercial product Romania	10%	70.67	28.27	12.40



Conclusions:

By adhering to the principles outlined in the Materials and Methods section, most beekeepers can test the palatability of commercially available products through an accessible and relatively simple method, yielding results that are both statistically and scientifically conclusive, as well as relevant for beekeeping practice. In all protein content variants, the products from Dulcofruct Bee Nautrition Science outperformed competing products in terms of palatability, with only one exception, which we will mention.

The product Candy Board Super Protein© outperformed all competing products, except for the product in experimental group 6, which recorded a consumption 6% higher than Candy Board Super Protein©, adjusted to the 3% level—this difference being justifiable due to the consistency difference.
The competing product had a softer consistency, which makes it more attractive for consumption by the bees.

We consider that products with less than 8% protein content do not meet the physiological requirements of the bee colony for a balanced protein supply and can only be used as a protein supplement feed in the presence of other natural protein sources, not as the primary source of protein.

Additionally, the product Super Protein Pattie© was more palatable than any competitor, although it showed slightly lower palatability than Candy Board Super Protein©, a difference attributed to variations in composition, including protein content (10.5% crude protein vs. 12.5% crude protein).

PP-415 [Bee Biology]

BEE SCIENCE NUTRITION

By DULCOFRUCT

Testing the effectiveness of a nutritional supplement based on carbohydrate-protein substitutes during the replacement period of wintering honeybees

Author: Dr. Popovici Daniel Cristian

ABSTRACT:

Background and problem description: The period of replacement of wintering honey bee generations represents a critical period, when depopulation and mortality can occur. The quality and quantity of food reserves, when the consumption of energetic and protein substances from the honeycombs increases, is very important. To support the nutritional needs of the progressive increase in the number of larvae and to avoid depletion of the adult population, the administration of protein patties at the end of winter becomes a necessity, therefore their quality must be known and scientifically validated for the safety of administrations.
and soybean (Glycine max) rich in essential amino acids, embedded in a mass of carbohydrate substances with added vitamins and minerals, probiotics, oils and phytonutrients from 14 medicinal plants. **Methodology:** Thus, a comparative experiment was set up, to test the effectiveness of carbohydrate-protein patties as supplementary feed on groups of standardized honeybee colonies consisting of 10 colonies/group. The experimental group was administered protein patties based on pollen substitutes (SPP) and one control group was administered protein patties based on 56% frozen pollen with 12,5% crude protein, collected in spring, containing pollen from the species: willow (Salix spp.), rapeseed (Brasica spp.), hawthorn (Crategus spp.) and fruit trees (Prunus spp., Pyrus spp., Malus spp.). The measurements targeted the amount of brood at the beginning and end of the testing period (February 15 - March 21), using the Netz frame. **Results and conclusion:** Statistical analysis of the obtained data (SPSS, T-student test for independent samples) shows that no significant differences were found between the two groups (t=-0.968, two tailed p=0.35), although in the control group it was found that the mean brood area was larger than in the experimental group (Mean exp.=22.45; Mean ctrl. =25.58) and significant difference compared to one unfed group (t=5.388, two tailed p=0.000; Mean=11,23). **Practical implications:** Based on the datas, the administration of tested carbohydrate-protein substitutes patties during certain periods when their administration is allowed contributes to supporting brood rearing and the development of honeybee colonies.

Materials & Metodology:

A total of 26 honey bee colonies were used, each forming a winter cluster on 5–6 well-populated Dadant frames, in Timiș County, Romania. All colonies were kept under similar conditions, including genetics and queen origin. As of February 15, no brood was present in the colonies, with only a few queens having laid their first eggs.

The stages of the study were:

a) Evaluation of the bee colonies, assessment of food reserves, and brood nest reduction. Carbohydrate feed reserves were supplemented by adding frames from storage. (February 10–15, 2023).

b) Protein feeding (February 15). It is worth mentioning that the feeding was carried out in several successive stages, with supplements added to the colonies that had consumed the previously provided feed.

c) Data collection (brood measurement was performed in the apiary using a wire frame on March 20, 2023). The measured brood area included larval brood surrounded by capped brood but did not include marginal larval brood—very little of which was present due to the cold weather during the period of March 10–20.

d) Data entry and interpretation (March 21 – April 1). The data were entered into SPSS,

The first group (10 colonies) was fed with Super Protein Patties, while the second group (6 colonies) received patties containing 12.5% crude protein from pollen and the same carbohydrate base as the Super Protein Patties. The third group (10 colonies) was not fed.

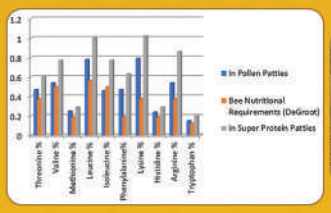
The pollen mixture used (frozen for preservation and of high biological quality) came from willow (Salix spp.), rapeseed (Brassica napus), and hawthorn (Crataegus spp.).

Nutritional profile of the pollen: Moisture: 19.2%, Crude protein: 22.5%, Fat: 7.2%, Minerals: 2.4%, Starch: 1.9%, Total sugars: 29.2% (Weslling laboratories).

Essential amino acids in pollen patties (%): Arginine 0.54, Histidine 0.24, Isoleucine 0.46, Leucine 0.78, Lysine 0.79, Methionine 0.25, Phenylalanine 0.47, Threonine 0.47, Tryptophan 0.15, Valine 0.54 (Weslling laboratories).

Nutritional profile of Api Pollen Substitute (protein source in Super Protein Patties, based on ingredient specs): Crude protein: 51%, Fat: 7.7%, Minerals: 2.3%, Fiber: 3.4%, Carbohydrates: 4.4% (Weslling laboratories).

Essential amino acids in Super Protein Patties (%): Arginine 0.86, Histidine 0.29, Isoleucine 0.77, Leucine 1.0, Lysine 1.02, Methionine 0.29, Phenylalanine 0.63, Threonine 0.6, Tryptophan 0.19, Valine 0.77



Conclusions:

Although the average amount of brood was higher in the colonies fed with pollen (M = 25.58, SD = 6.81) compared to those fed with Super Protein Patties (M = 22.45, SD = 5.94), the differences were not statistically significant (t = -0.968, two-tailed p = 0.350). The reliability of obtaining the same results if the experiment were repeated is very low.

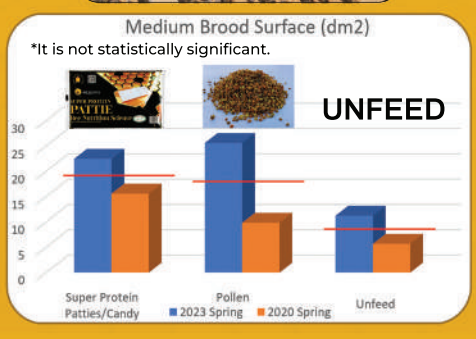
Statistically significant differences (t = 5.388, df = 17, two-tailed p = 0.000) were found between the Super Protein Pattie group (M = 22.45, SD = 5.94) and the unfed group (M = 11.23, SD = 1.95). We can conclude that Super Protein Pattie supports approximately twice the amount of brood compared to colonies that were not given protein supplements.

A similar test of brood quantity was carried out between August 1, 2019 – March 3, 2020, in the same apiary, where nuclei were fed both in autumn and during February–March. The products used were prototype commercial protein feeds available at that time:

Group 1 – Super Protein Candy 10% Crude protein (based on Api Pollen Substitute, the same protein source as in Super Protein Pattie)
Group 3 – unfeed
Group 5 – Pollen-based feed, approx. 10% Crude protein

The pollen used was collected in spring 2019 from Rosaceae species (Prunus spp., Pyrus spp., Malus spp.), willow (Salix spp.), and a small percentage of rapeseed (Brassica napus), and was preserved by freezing. No amino acid composition analysis was performed on the pollen.

The average measured brood areas were:
Group 1 – 15.58 dm² brood mean
Group 3 – 5.67 dm² brood mean
Group 5 – 9.83 dm² brood mean



PP-416 [Bee Biology]

Testing the quality of carbohydrate patties during honeybee colonies wintering period by total substitution of natural food reserves

BEE SCIENCE NUTRITION By DULCOFRUCT

Authors: Adrian SICEANU, Grațiela PĂTRAȘCU, Gabriela Oana VIȘAN
Dulcofruct Bee Nutrition Science SRL, Goleştii de Sus, Coteşti, Vrancea County, 627102, Romania

Colonies wintering and replacement of winter honeybee generations represent critical periods in beekeeping. Nutrition plays an important role as both quantity and quality, therefore in a first stage of this period the nutritional requirements of honeybees are mainly based on honey reserves in combs to ensure the thermal regime inside the cluster. Further on, as bees resume the activity of brood raising, the consumption of carbohydrate-protein food intensifies proportionally with the brood quantity, based on fat body and stored food. However, natural food reserves (honey and bee bread) may be insufficient or inadequate for various reasons such as the lack of honey flora resources, their contamination or the presence of honeydew honey or heather honey, therefore ensuring the winter reserves may require total or partial substitution; as a result, testing the quality of some substitutes during the winter period becomes imperative.

METHODOLOGY

A comparative experiment to winter two groups of honey bee colonies (*A. m. carpatica*) was set up on a period of three months (December 9th, 2023 - February 12th, 2024), in Romania:

- **10 experimental colonies group** fed exclusively on carbohydrate patties - ***Ideal Bee Ginseng*** - *Dulcofruct Bee Nutrition Science*™, prepared as sugar fondant with ginseng extract (*Eleutherococcus senticosus*);
- **5 control colonies group**, colonies wintered on the basis of natural reserves, honey and bee bread.

Colonies were standardised as strength and successively provided with more carbohydrate patties placed above the colonies' nest.

The quality of wintering was assessed by measuring 2 parameters:

- The *quantity of bees* registered at the begininmg and the end of experiment when time allowed interventions in the hive;
- The *surface of brood rearing area* at the end of experiment, including observations on starting moment.

RESULTS

- The data statistics show ***equal group variances*** between the two groups by *Bartlett test*, α=0,05 regarding the difference in the honey bee quantity, between the two moments of the experimental period - begining and the end of experiments, as well as regarding the brood surface at the end of experiment.
- *ANOVA test* show ***no significat differences*** between the means of the two groups in terms of honeybees quantity, expressed as percentage out of the initial quantity (Figure 1), respectively brood surface (Figure 2) at the end of period: F-ratio (α=0,05) = 1,24 (Parameter 1), respectively 0,79 (Parameter 2).
- The resumption of brood rearing in the experimental colonies based on the bees' body nutritional reserves took place as compared to the control colonies, starting at the end of December 2023 and increasing regularly by the end of experimental period, when all the colonies begun the brood rearing.

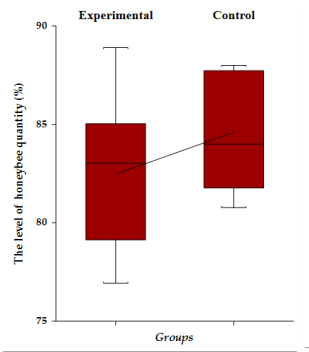


Figure 1. Parameter 1 – the quantity of bees (%) at the end of the experimental period (February 12th, 2024) as compared with the begining moment (November 97h 2023)

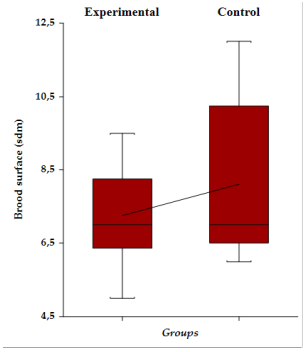


Figure 2- Parameter 2 - the brood surface (sdm) at the end of the experimental period (February 12th, 2024)

CONCLUSIONS

- ***A very good wintering***, without significant losses.
- During the feeding, ***the honeybees forms a bell where the bees move freely to feed*** themselves and carry the food, the temperature and humidity inside helping the consumption process;
- The needs for supplementation are met by ***adding patties when the consumption reaches the last upper patty***;
- At the wintering end (February, in Romania conditions), the brood rearing consumes the fat body of bees, being mandatory to providing protein substitutes (as for example ***Superprotein patties – Dulcofruct Bee Nutrition Science***™);
- The proposed method of feeding assure the supplements of feed ***in critical periods,*** whenever it is necessary (winter preparation, wintering, swarm formation);
- The obtained results show that partial or even total replacement of honey stores, with quality carbohydrate patties, represents ***a true insurance policy*** to avoid food risks in different periods of the year.

Complete mitochondrial genome of *Apis cerana* (Hymenoptera: Apidae) from two geographical regions: insights into structure and genetic differentiation

Yuhui Chen, Runlang Su, Rui Zhu, Guiling Ding, Zhanbao Guo, Lin Du, **Jiaxing Huang**

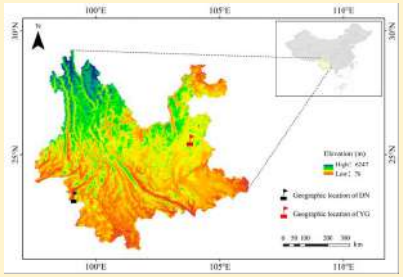
State Key Laboratory of Resource Insects, Institute of Apicultural Research, Chinese Academy of Agricultural Sciences

Introduction

- Honeybee *Apis cerana* as an important pollinator in China.
- *Apis cerana* evolved rapidly under diverse ecological environments.
- *Apis cerana*-Diannan (DN) and *A. cerana*-Yun-Gui (YG) are two distinguish geographic populations.
- Genetic diversity is fundamental to the conservation and utilization of the local honeybee.
- Mitochondrial DNA is inherited maternally in bees, the mtDNA of a single bee can represent the entire colony.
- The difference of mtDNA genome was used to compare the differentiation of these two geographical populations.

Methods

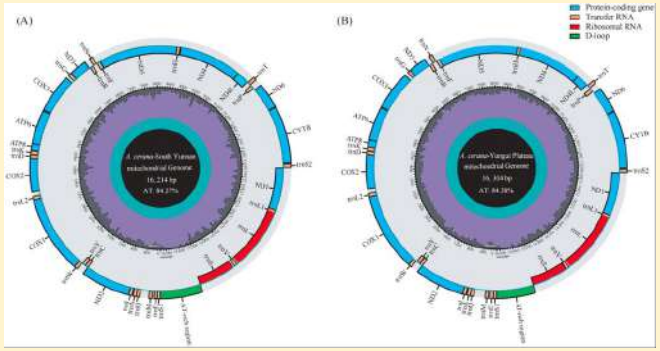
- Sampling site information on DN and YG.



- Sequencing, genome assembly , annotation and phylogenetic analyses.

Mitogenome organization and base composition

- The length of the complete mtDNA for DN was 16214 bp, with an AT content of 84.27%, while that for YG was 16304 bp, with an AT content of 84.38%.
- 13 protein-coding genes, 22 tRNA genes, 2 rRNA genes and an AT-rich region.



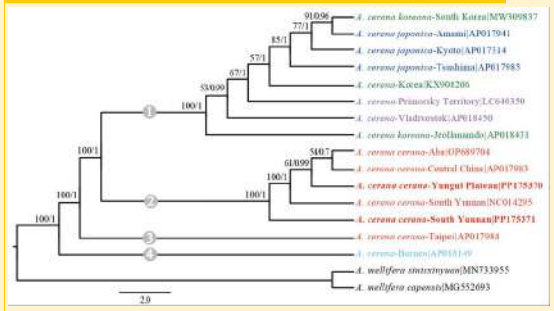
Protein-coding genes

- The total length of the 13 PCGs in both DN and YG was 11,048 bp, accounting for 68.14% and 67.76%, respectively, of the entire mitochondrial genome.
- Except for the A + T content of COX1 and COX2 in DN and YG, the A + T content of the other PCGs was greater than 80%, indicating an AT preference.
- The RSCU values for the 13 PCGs were greater than 1, except for those of the two amino acids Met and Trp, which were encoded by only one codon.
- Codons with an A at the third position were the most frequent.

Transfer RNAs and Ribosomal RNAs

- The typical set of 22 tRNAs was scattered throughout each circular, double-stranded DNA molecule, ranging from 60 bp for trnS1 to 78 bp for trnP.
- The total tRNA lengths in DN and YG were 1486 bp and 1487 bp.
- The tRNA A + T% was 87.28% for DN and 87.35% for YG.
- Both large ribosomal RNA and small ribosomal RNA were located on the N chain, and the lengths of the lrRNAs and srRNAs were 1322 bp and 773 bp.

Phylogenetic analysis



Conclusion

- *Apis cerana* with different geographic distributions exhibit genetic diversity at the mitochondrial genome level.
- A large fragment was found to be inserted or deleted in the AT-rich region, shedding light on the genetic differentiation of *A. cerana* in different ecological environments.

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PP-418 [Bee Biology]
Honey bee haemocyte cell culture as a tool for innate immune response in honey bee

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Honey bee (Apis mellifera L.) immunity is characterized by a range of responses to both biotic and abiotic stress factors, occurring at different levels, from the colony (social immunity) to the individual, cellular, humoral, and molecular levels (innate immunity).

Honey bee hemocytes are essential for immune responses, playing a key role in defending against pathogens and responding to various stressors, primarily parasites and pathogens. They are involved in processes such as phagocytosis, encapsulation, and the production of antimicrobial peptides. Understanding the modulation of hemocyte activity is crucial for assessing the impact of stress factors. However, to better understand the molecular mechanisms, an established and standardized cell line is necessary.

In this study, we will assess a standardized honey bee hemocyte cell culture integrated with automatic sensors to evaluate innate immune responses, focusing on cell survival, in vitro encapsulation, and melanization, with variations in nutritional intake. This study aims to provide a foundation for understanding immune function at the cellular and individual levels, particularly in the context of heterogeneous nutritional food sources from the environment.

PP-419 [Bee Biology]
Nutritional landscape as a driver for honey bee immunity

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Honey bee immunity is a complex system that is shaped by a wide range of responses to both biotic and abiotic environmental stressor factors. The immune mechanisms operate across several levels of organization, from the colony, where social immunity plays a critical role in protecting against external threats, to the individual bee. At the individual level, immunity is further refined through cellular, humoral, and molecular responses, all of which are integral to the innate immune system's ability to defend against pathogens and environmental stressors. A known relationship exists between immune function and the colony's nutritional state, where the presence of parasitic Varroa mites and associated viruses disrupt this balance by suppressing individual immune responses and facilitating pathogen transmission. These interactions can be further exacerbated by climate change and the presence of xenobiotics, particularly pesticides and chemicals used in beekeeping management. This study, as work package of the project BeeGuards, aims to investigate honey bee immune functions, focusing on how differential nutritional value of the landscape affects both individual and colony-level immune responses, pathogens resilience and holobiont impact. A vegetation analysis will be performed to characterize the environment within the foraging range of honeybees, providing further insights into the surrounding landscape and its potential influence on colony health. Additionally, we plan to incorporate artificial intelligence approaches to better understand these complex dynamics

PP-420 [Bee Biology]
Hypopharingeal glands' morphology, morphometry and vitellogenin transcription level in honey bee few with enriched diet

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Pollen is crucial for the development of hypopharyngeal glands (HPGs) and the synthesis of vitellogenin (VG), a key component of royal jelly, which is essential for larval development and queen nutrition. This study investigated the morphology and morphometry of HPGs, as well as VG transcription levels, in caged worker honey bees fed different diets. HPG morphology and morphometry were assessed using hematoxylin and eosin (H&E) stained samples, while VG transcription levels were measured via qRT-PCR. Histological analysis revealed that honey bees fed a diet of sucrose and multifloral pollen patty had more developed and functional HPG acini compared to honey bees fed only a sucrose patty. Morphometric analysis confirmed the increased HPG size in the Diet B group. While VG transcription levels varied significantly over time, they were not affected by the diet. These findings confirm that pollen-rich diets are essential for proper HPG development and function, with a positive correlation observed between glandular activity/acinar size and secretion amount. Therefore, pollen-supplemented diets represent a promising strategy for enhancing honey bee health and productivity

PP-421 [Bee Biology]
Characterization of the intestinal proteome of Apis mellifera: protein extraction and mass spectrometric analysis

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Honey Bees (Apis mellifera, L.), social insects of the Apidae family, play a crucial role in the pollination of numerous plants, including many agricultural crops of significant economic value, and are essential for their products, such as honey, wax, pollen, propolis and venom. Their ecological function, which contributes to world biodiversity and global food security, makes them an indispensable resource for the environment. Their social structure, organized into a hierarchy of queen, drones, and workers, also makes them a model organism of great interest for scientific research.

In this study, a protocol was developed and optimized for the extraction of proteins from the intestinal tissue of honey bee workers. The extracted proteins were digested with trypsin and analyzed by nano-liquid chromatography coupled to tandem mass spectrometry, according to a shotgun proteomics approach. Resulting mass spectrometric data were used to search a protein sequence database of Apis mellifera, enabling the identification and detailed characterization of the proteins occurring in the intestinal tissue. The inventory of the identified proteins was further subjected to bioinformatic analysis to map the functional role of the identified components within key biological processes and cellular districts, and to explore their eventual mutual interaction/relation.

In conclusion, this study provides a detailed description of the proteome of the intestine of Apis mellifera, contributing to a deeper understanding of the molecular functions in this organ and offering new insights into bee biology, with implications for their conservation and the enhancement of their ecological productivity.

PP-422 [Bee Biology]
Project MoBeeFo: Monitoring of honey Bee immunomodulation and resilience to stress factors by Fiber Optic technology

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Honey bees (Apis mellifera L.) are bioindicators of environmental pollution levels. During their wide-ranging foraging activity, these hymenopterans are exposed to pollutants, thus becoming a useful tool to trace environmental contaminants like heavy metals, pesticides, radionuclides, and volatile organic compounds. It has been demonstrated that various environmental stresses, including both abiotic and biotic stresses, functioning singly or synergistically, are the potential drivers of colony collapse. All these factors can negatively impact bees' immune response as a key target for environmental stress factors, making them more susceptible to pathogens and parasites. Early diagnosis of factors predisposing to immunosuppression of colony mortality can facilitate rapid interventions to contain and prevent the spread of mortality. On this line of arguments, there is a wide demand for innovative technological solutions offering efficient and cost-effective monitoring of the honeybees' health. In this scenario, the project MoBeeFO, funded by the Italian Ministry of University and Research, proposes to develop an efficient tool based on fiber optic technologies for real-time monitoring the dynamic of honeybee's innate immunity mediated by various biotic and abiotic stressors. In particular, MoBeeFO will address a real-time measurement tool for detecting a cellular response, such as encapsulation index and melanization index along the surface of fiber optic transducers, as a nonself object, and a humoral response by developing of innovative optical fiber biosensor for antimicrobial peptide detection. The results will allow us to develop a unique niche in the field of Eco-Immunology that will be important for world agriculture and environment.

PP-423 [Bee Biology]
Impact of Cocaine on Biogenic Amine Profiles in Honey Bees (Apis mellifera): Insights into Neurotransmitter Dynamics

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Cocaine, an alkaloid of the coca plant, originally evolved to deter herbivorous insects. As a nervous system stimulant for mammals, it modulates biogenic amine signaling pathways, inducing euphoria and arousal. Biogenic amines are organic nitrogen compounds essential for various physiological functions in animals. In honey bees (Apis mellifera), biogenic amines such as dopamine, octopamine, tyramine and histamine act as neurotransmitters, playing also roles in memory and learning, reward behavior, social interaction, vision, and defense mechanisms. While honey bees share similarities with mammals in dopamine signaling, they uniquely utilize octopamine and tyramine, which are specific to invertebrates. Histamine, common to both mammals and insects, serves distinct functions across different phyla. We analyzed the profiles of biogenic amines in various honey bee tissues following cocaine administration. Using liquid chromatography coupled with mass spectrometry, we monitored biogenic amine levels at several time-points within 8 hours post-injection. Our results revealed a rapid fluctuation in dopamine and tyramine levels in the brain (initially declining, then rising), whereas changes in octopamine levels were delayed and prolonged for up to 2 hours. Additionally, we observed alterations in biogenic amine content in the venom sac. Cocaine administration affects locomotion in honeybees, which might correspond with the observed elevation of octopamine levels in muscles. Decreased histamine and tyramine levels in the gut might be associated with metabolic changes. The effect of the cocaine wore off within eight hours of administration. This research helps to explain underlying biochemical processes in honey bees exposed to cocaine. Understanding how substances like cocaine affect bee behavior can provide deeper insights into the neurochemical basis of behaviors such as foraging, social interaction, and defense mechanisms of honey bees.

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PP-424 [Bee Biology]

Food storage behaviour in stingless bee *Melipona quadrifasciata*

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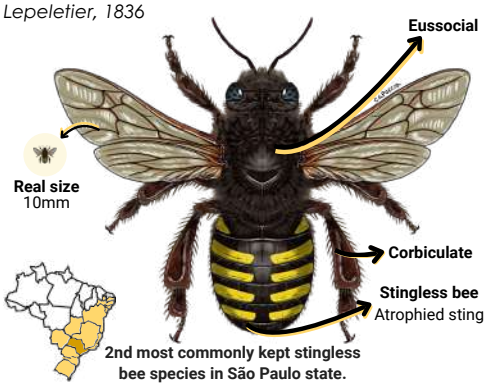
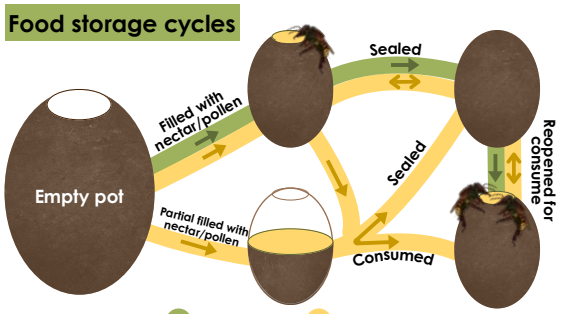
LABBEES

Meliponini: *Melipona quadrifasciata*

Lepeletier, 1836



Food storage cycles



Previous studies describe a **linear cycle** for food pots: construction, filling with pollen or nectar, sealing for weeks, and reopening for consumption[1,2]. However, a new research[3] using pollen pots, suggests this process is **dynamic** rather than strictly linear.

Objectives

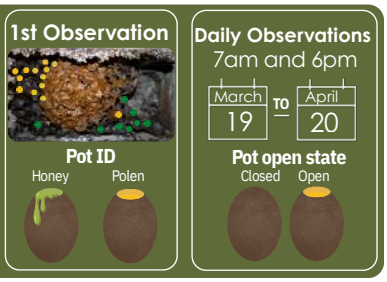
Analyze the **storage behaviour of pollen and honey** from a *Melipona quadrifasciata* nest. Furthermore, **compare** the dynamic of pots across time.

Scientific and beekeeping applicability

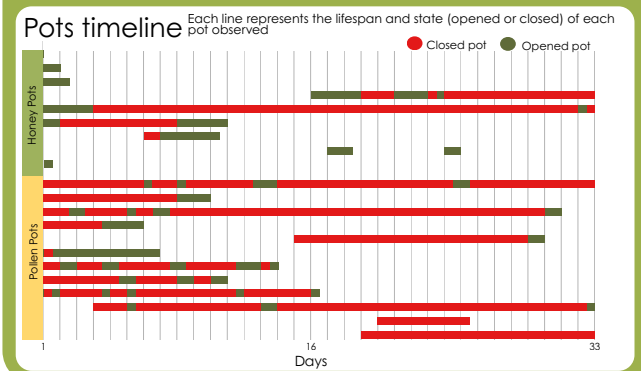
Understanding food storage behavior of stingless bees is crucial both for **scientific research** (i.e fermentation of food, nutriotional topics) and for the **development of products** for human consumption, such as samburá and honey.

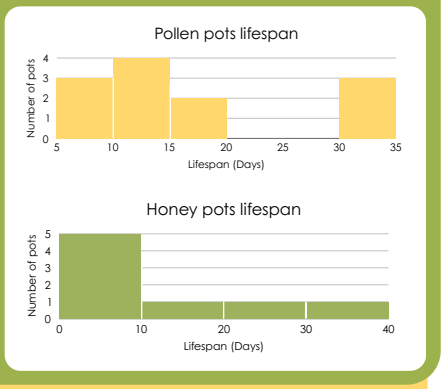
Data collected

A *Melipona quadrifasciata* hive was observed during 33 days. Initially, food pots were checked for honey or pollen. Data was collected twice a day, and pot status (whether opened or closed) was noted down as well as pot content (honey or pollen).



HOW DO HONEY AND POLEN POTS CHANGE OVER TIME?





HONEY
7 POTS
MEDIAN 7 DAYS LIFESPAN
LIFESPAN MAX: 30 DAYS MIN: 0,5 DAY
ONE CHANGE IN STATE EVERY 6 DAYS
Honey pots remain **open** for most part of their lifespan
70% Opened

POLLEN
12 POTS
MEDIAN 28 DAYS LIFESPAN
LIFESPAN MAX: 33 DAYS MIN: 6,5 DAY
ONE CHANGE IN STATE EVERY 4 DAYS
Pollen pots remain **closed** for most part of their lifespan
78% CLOSED

Conclusions

The dynamic processes in storage previously described for **pollen pots** was also observed for **honey pots**.

Storage of honey and pollen pots follow different pattens. Pollen pots are more **numerous** than honey pots, and they have a **longer lifespan.**

Next Steps

Build a **sensor** to mesure stingless bees' internal activities

Describe the composition of the pollen and honey **microbiota**

Analyze content **moviment** between pots

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PP-425 [Bee Biology]

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Assessing Hybridisation in *Apis mellifera ruttneri*: Morphometric Insights from Gozo and Malta

Dylan Farrugia[1,2]

Farrugia, D. (2025). Insights from Traditional and Geometric Morphometric Analyses of Selected *Apis mellifera ruttneri* Colonies in Gozo and Malta. *Journal of Apicultural Science*. https://doi.org/10.2478/jas-2025-0008

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About Author: After completing his M.Sc. at the University of Malta, Dylan Farrugia co-founded the NGO-VO **Foundation for the Conservation of the Maltese Honey Bee**, where he currently serves as president. He has also worked as a Research Support Officer on an EU-funded project at the same university, focusing on the conservation of Mediterranean honey bee subspecies, with particular emphasis on the endemic Maltese honey bee (*Apis mellifera ruttneri*).

Abstract

This study assessed **hybridisation in Malta's endemic honey bee**, ***Apis mellifera ruttneri*** using **traditional and geometric morphometry**. Findings revealed **hybrid traits in both Gozitan and Maltese samples**, linked to foreign subspecies and/or other breeds introductions. linked to foreign subspecies introduction. Results highlight **urgent conservation needs** to preserve the native subspecies' genetic integrity and adaptive value amid ongoing genetic introgression.

Introduction

Long-term geographic barriers drive reduced gene flow in honey bees, leading to allopatric evolution and formation of distinct subspecies (Ruttner, 1988). The **Maltese Islands** found 93 km south of Sicily and 288 km east of Tunisia in the centre of the Mediterranean Sea host the endemic honey bee ***Apis mellifera ruttneri***, commonly referred to as the **Maltese Honey Bee** (Sheppard et al., 1997). It is well-suited for Malta's dry conditions and displays distinct traits and adaptive strategies (Farrugia et al., 2022).

However, **extensive importation of foreign honey bee subspecies and breeds**, particularly *A. m. ligustica* and *A. m. carnica* due to their perceived beekeeping superiority, has raised concerns regarding genetic hybridisation and loss of adaptive alleles. Controversially in 2015, a commercial queen rearing enterprise using foreign subspecies on Gozo was authorised to operate despite local beekeepers' genetic integrity concerns for the native *A. m. ruttneri*.

Aim

This study aimed to assess the **morphological integrity of *A. m. ruttneri* in Gozo and Malta** through separate **discriminant analyses** using **traditional and geometric morphometric data** to give indications on the **extent of hybridisation**.

Methodology

Sampling

Between **August and November 2021**, a total of **55 colony** samples were collected from **14 apiaries in Gozo** (n=34) and **7 apiaries in Malta** (n=21), with multiple colonies being sampled from each apiary (Fig. 1).

Figure 1: Sampling locations across Gozo (blue) and Malta (red).

Traditional morphometry

Assessment using traditional morphometry was based on **11 angles** (A4, B4, D7, E9, G18, J10, J16, K19, L13, N23 and O26), **four distances** (right forewing length, width, lengths of segment a and b of cubital cell) and one **index ratio** (Cubital Index) measured with Swift Imaging 3.0 software. Character measurements were averaged per colony sample.

Geometric morphometry

Geometric morphometry utilised **19 landmark points at vein intersections** plotted with Identify software version 1.6.2, which were then aligned using Procrustes fit method and averaged per colony with MorphoJ version 1.04 software.

Discriminant analysis

SPSS Version 25.0 was used to construct **separate discriminant analysis models for each approach** to classify sampled Gozitan and Maltese colonies relative to reference subspecies. The reference subspecies data for the **traditional model** was based on *A. m. intermissa*, *A. m. ligustica*, *A. m. ruttneri* and *A. m. sahariensis*, and the **geometric model** was based on *A. m. carnica*, *A. m. intermissa*, *A. m. ligustica*, *A. m ruttneri* and *A. m. sahariensis*. Each model generated discrimination scores, probabilities, scatterplots and predicted classified subspecies.

Results

Discriminant analyses indicated **clear hybridisation trends**. Traditional morphometry classified 82.35% of Gozitan colonies and 76.19% of Maltese colonies as *A. m. ruttneri*, with others showing affinity to *A. m. ligustica*. The scatterplot generated from the **traditional data discriminant analysis** showed a **continuous distribution from Gozitan and Maltese *A. m. ruttneri* sampled colonies towards *A. m. ligustica* reference colonies** (Fig. 2), with some also clustering near A-lineage reference subspecies

Geometric morphometry revealed a stronger hybridisation trend, with only 41.18% of Gozitan and 23.81% of Maltese colonies classified as *A. m. ruttneri*. The scatterplot generated from the **geometric data discriminant analysis** showed that **most Gozitan and Maltese *A. m. ruttneri* sampled colonies were distributed continuously between the A and C-lineage reference subspecies** (Fig. 3). The wireframe analyses showed subtle but consistent wing venation differences between hybrid and pure colonies.

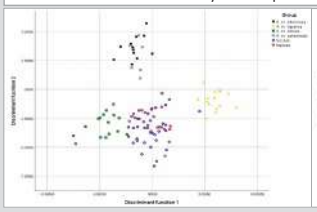

Figure 2: The scatterplot generated from the traditional data discriminant analysis.

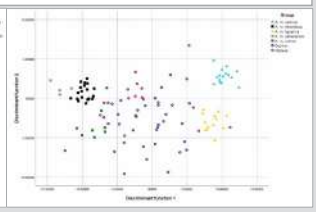

Figure 3: The scatterplot generated from the geometric data discriminant analysis.

Discussion & Conclusion

Hybrids of two different honey bee breeds/subspecies **exhibit intermediate wing venation patterns**, reflecting **continuous morphometric measurements and reduced subspecies resolution**. The presence of **hybrid traits in both Gozitan and Maltese populations highlights ongoing genetic introgression**, likely exacerbated by the operation of a commercial queen-rearing enterprise in Gozo since 2015. As hybridisation can occur between colonies from 15 km away (Jensen et al., 2005), and Gozo's coastlines are only 14 km apart, hybridisation potential is markedly higher given the island's small area of 67 km². Furthermore, this is worsened by a relatively high mean hive density on Gozo, with around 20 colonies per km² from 2021 data (Gemma, P. & Francesco Luca, A., unpubl. data, 2023).

Hybridisation threatens the adaptive genetic traits of *A. m. ruttneri*, which are crucial for **local apiculture sustainability**. Studies on performance and *Varroa destructor* tolerance of *A. m. ligustica* versus *A. m. ruttneri* on the Maltese Islands has categorically shown the **native subspecies' superiority** in hygienic behaviours and performance (Uzunov et al., 2023).

Urgent conservation measures are necessary to preserve this unique subspecies. A study by Chetcuti Dimech et al. (2023) outlining legal measures to holistically safeguard the Maltese honey bee, and thereafter action to declare ***A. m. ruttneri* as Malta's national insect**, is a positive step towards conservation. However **more decisive actions** needs to be taken, including **restricting foreign honey bee imports** and **establishing nation-wide breeding programs for *A. m. ruttneri***. Without intervention, *A. m. ruttneri* faces irreversible decline due to continued hybridisation.

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- MEDIBEES (Monitoring of the Mediterranean Honeybee Subspecies and their Resilience to Climate Change for the Improvement of Sustainable Agro-Ecosystems) financed by the EU PRIMA programme under Horizon 2020
- Tertiary Education Scholarships Scheme financed by the Ministry for Education, Sport, Youth, Research and Innovation in Malta.

PP-426 [Bee Biology]

Convoluted aorta of *Apis mellifera*

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Professor Giles Budge, School of Natural and Environmental Sciences, Newcastle University, UK

SCAN ME FOR UPDATES

Introduction

We investigated the anatomy of the convoluted aorta in honeybee (*Apis mellifera*) by comparing worker, drone and queen castes (Fig.1). The convoluted aorta is an extension of the dorsal vessel as it passes from the coelom, through the petiole, thorax exiting behind the brain.

Sampling

Castes were sampled at different times of the year. Most of the queens examined were young virgin queens and were reared in cell raisers and finished in an incubator in the summer. Drones were also sampled in the summer. Workers were harvested in the summer and winter to compare their respective anatomy.

Fig..1

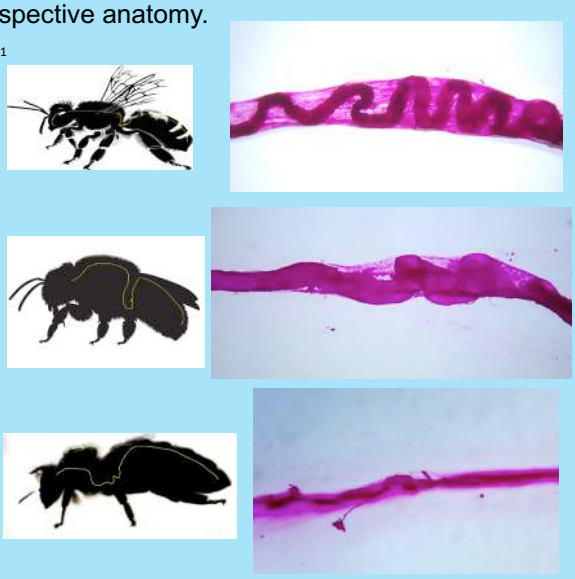

Fig. 1 Outlines highlighting the physical differences between honey bee worker (top), drone (middle) and queen (bottom), with their respective stained and dissected convoluted aorta. Stained with fuschin and fixed in Xylene

HISTOPATHOLOGY

Fig.2

Fig. 2.
Each bee was dissected with ventral access. The dorsal vessel and the convoluted aorta was identified and removed. The samples were fixed in isopropyl alcohol, standard histological embedding and staining. There is significant cellular differences between the castes and drones. Drones have large amounts of muscle around the dorsal vessel whilst the castes have less

Caste-Specific Differences in Coelom Length (Adjusted for Size)

A generalised linear model tested the effect of caste and body length on coelom length in *Apis mellifera*. Fig3

- **Caste effect:** After controlling for body length, drones had significantly shorter coeloms (~0.75 mm less) than workers ($p = 0.037$), while queens had significantly longer coeloms (~1.85 mm more) than workers ($p < 0.000001$).
- **Body length effect:** Body length was a strong positive predictor of coelom length ($p < 0.0000000001$), confirming its inclusion in the model.
- **Model fit:** The model explained ~84% of variation ($R^2 \approx 0.84$), indicating a strong relationship between caste, body size, and coelom length.

Conclusion: Coelom length differences between castes persist even after accounting for body size, suggesting biological factors beyond simple scaling.

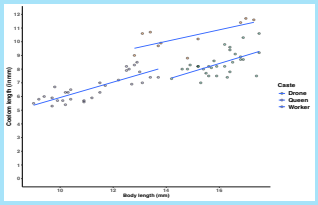

Fig.3. Significant difference between coelom length between castes, that goes beyond simply due to body length

Fig 4. CT of *Apis mellifera*

COMPUTED TOMOGRAPHY / SEGMENTATION

.High-resolution CT scanning of the worker bee was undertaken to visualise the internal morphology without dissection. Fig.4 Further work is in progress to segment the dorsal vessel, including the convoluted aorta, and to compare these digital measurements with those obtained from direct dissection. This approach will allow validation of imaging techniques and provide a non-destructive method for anatomical studies.

CONCLUSION

Structural variation in workers: The abdominal convoluted aorta, when present, attaches to tergites A9–A2 before detaching via soft tissue to the crop, passing through the petiole in a bundle with the oesophagus and nerve bundle, then entering the thorax (~5 µm wide). Not all workers had this feature, possibly due to age-related differences.

Drone morphology: Drones have a larger dorsal vessel that remains attached to the tergites, follows the A2 tergite through the petiole, and travels dorsally through flight muscles, often with a single, flatter convolution compared to workers.

Future research: Expanded seasonal and age-based sampling, improved dissection/CT techniques, and larger datasets will clarify intraspecific and caste-specific patterns.

Acknowledgements
We gratefully acknowledge **Professor Giles Budge** for his expertise and guidance with statistical analysis, and **Dr. Mat Lawson** for his contributions through imaging and analysis at **CT Manchester, National X-ray Computed Tomography (NXCT)** facility.
Dr Emma Clear for her support and input.

University of Central Lancashire UCLan
Newcastle University

PP-427 [Bee Biology]
New York State Beekeeper Tech Teams: Working Directly With Beekeepers to Improve Honey Bee Health and Profitability

Randall Cass, Scott McArt
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BRAP
In response to raising concerns of honey declines across the state, New York State unveiled a Pollinator Protection Plan in 2016. This plan helped create the NYS Beekeeper Tech Team. The Beekeeper Tech Team is an interdisciplinary group that works directly with beekeepers to improve honey bee health, reduce colony losses, and increase profitability of the beekeeping industry. The program began in August 2016 and is open to hobbyists, sideliners, and commercial beekeepers who operate a beekeeping business that generates $1000 USD in revenue each year. The Tech Team meets with participants to provide them with data from their colonies and recommendations that they can implement in their operations. In addition to providing one-on-one extension to individual beekeepers, the Tech Team also collects samples from colonies to test for the presence of pesticides and disease in the hives. This robust data provides insights on the challenges New York Beekeepers have faced over the past decade and aid in the design and implementation of Cornell University's beekeeping extension program.

PP-428 [Bee Biology]
Bee-yond ants: Evidence for complex colony structures in honey bees

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As a eusocial organism, individual honey bees cooperate to function as a collective colony and superorganism. Within the honey bee literature, it is widely assumed that a colony consists of a single nest with a single queen. Other eusocial organisms, like ants and termites, demonstrate that colony structure can range from simple, with a single nest and queen, to very complex, with multiple nests and queens covering a large geographic region. Complex colony structures (CCSs), like polydomous colonies and supercolonies, have been well studied in ants but are rarely investigated in other eusocial organisms, including honey bees. We examined the current literature to identify common behavioral, chemical, spatial, genetic, and life history characteristics found in ants with CCSs. Additionally, we evaluated potential evidence for or against characteristics of CCSs in the current honey bee literature. Honey bees share many common characteristics with ants displaying CCSs, such as sophisticated communication, superorganism reproduction by budding, aggregation of nest sites, and movement of individuals among nest sites. Key behavioral characteristics to identify CCSs definitively have yet to be investigated in honey bees, especially in unmanaged populations. To identify CCSs in honey bees, future research should investigate behavioral and chemical aspects of nestmate recognition, drivers of nest aggregations, and the presence of multiple queens in a colony. Exploring CCSs in honey bees can provide insights into conserving wild populations and managing problematic feral populations. Challenging the accepted social structure of honey bee colonies may transform our understanding of honey bee biology and, in turn, reform management strategies for beekeepers.

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PP-429 [Bee Biology]

BEE-GUARDS
for resilient beekeeping

Creation of honey bee germplasm repositories across Europe to enhance the protection of honey bee genetic resources

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INTRODUCTION

Honey bee germplasm repositories may play a crucial role in the conservation and improvement of honeybee populations. By preserving genetic material from diverse bee strains, these banks would ensure the maintenance of genetic diversity, which is vital for the resilience and adaptability of honeybee populations in the face of environmental changes, diseases, and pests. They would provide a valuable resource for researchers and beekeepers to access genetically diverse stock, which can be used to breed bees with desirable traits, such as disease resistance or increased productivity. Additionally, germplasm banks help safeguard against the loss of unique or endangered bee species/subspecies, contributing to long-term sustainability in apiculture and pollination services.

Within the framework of the BeeGuards project, consortium partners will establish at least six germplasm repositories across six additional countries, encompassing a minimum of six honey bee subspecies: Croatia (A. m. carnica), Greece (A. m. cecropia, A.m. macedonica), Italy (A. m. ligustica, A. m. siciliana), North Macedonia (A.m. macedonica), Poland (A. m. mellifera, A. m. carnica) and Spain (A. m. iberiensis). The repositories will store a variety of biological materials, including semen, tissues for DNA extraction, and whole bee specimens for morphometric and other analyses. Furthermore, the BeeGuards project will advance research on the cryopreservation of honey bee embryos and embryonic cells, potentially opening new avenues for the conservation of a broader range of pollinator species.

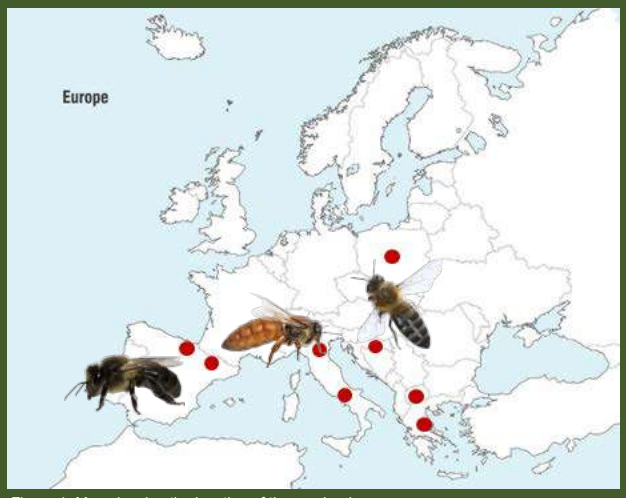

Figure 1. Map showing the location of the cryobanks

Figure 2. Honeybee drone spermatozoa

CONCLUSION

Cryopreserved samples will support the conservation of endangered subspecies and ecotypes by mitigating inbreeding risks in small, vulnerable populations and facilitating the restoration of biodiversity losses resulting from diverse scenarios such as the introduction of exotic pests, extreme weather events, natural disasters, or excessive genetic introgression due to migratory beekeeping. Moreover, these samples will serve as a genetic resource repository, providing customized responses to emergent challenges in apiculture and ecosystem management. Once established, these germplasm collections will be maintained at a low cost and may qualify for national conservation funding dedicated to the preservation of local genetic resources.

Funded by the European Union

Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or European Commission. Neither the European Union nor the granting authority can be held responsible for them

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PP-430 [Bee Biology]

The registration and monitoring of dwarf honeybee (*Apis florea* F.) in Iran

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Abstract

The dwarf honey bee, *Apis florea* F. is one of the two species of honey bees in Iran which is found in southern, southeastern and western provinces. The purpose of the current project was to implement the legal duty of registration, monitoring and protection of the dwarf honey bee, which was carried out in the framework of the national plan for the registration and monitoring of indigenous populations of the country and jointly by the Animal Science Research Institute and the Breeding Center of Iran. For this purpose, 1050 worker bees were collected from 35 colonies from 7 provinces in 2021-2023. Then, 17 morphological characteristics were measured and 17850 data were obtained. Analysis of variance of morphometric characters showed that characteristic of hind metatarsus width had the lowest diversity. However, length of half loop over the third and fourth dorsal abdominal segments, length of hind leg and tongue had the highest diversity as the most distinctive morphological characteristics throughout the Iranian dwarf honey bee. The number of right wing hooks were more than left wing hooks. So, it is suggested to count just the number of right hooks. There was a significant positive correlation between the width of the third and fourth dorsal abdominal segments, length and width of the front wing and length of hind leg. There was also a significant negative correlation between the length of tongue and length of fore wing and cubital index. Besides, there was a significant positive correlation within specification of the third and fourth dorsal abdominal segments, length and width of the front wings, and length of legs in dwarf bees with latitude, elevation and annual rainfall. Results indicated that bees from highlands are larger and also confirmed that wing of honey bees in elevated and high rainfall areas has less hook numbers. Based on the results from the investigation of the biological characteristics, the average honey production, calmness, aggressiveness, brood rearing, colony area and number of queen cells were 1.35 kg, 1.79, 1.7, 619.25 cm3, 907.31 cm3 and 2.34 numbers, respectively.

Materials and methods

Table 1. Evaluation form for functional and behavioral traits of dwarf honey bee colonies

Colony Number	Visit Date	Colony Location	Number of Queen Cell	Honey production rate (Kg/Year)							Behavior								Brood Area (cm2)	Total area of the frame (cm2)	Honey Harvesting Date	Migration Date	Reasons of Migration	Other Items
				1>	1-1.5	1.5-2	2-2.5	2.5-3	3-3.5	3.5-4	4<	Defence				Calmness									
												1	2	3	4	1	2	3	4						

Fig 1. Sampling and evaluation of morphological, functional and behavioral traits of dwarf honey bee colonies

Results

According to the results from the investigation of the biological characteristics, the average honey production, calmness, aggressiveness, brood rearing, colony area and number of queen cells were 1.35 kg, 1.79, 1.7, 619.25 cm3, 907.31 cm3 and 2.34 numbers, respectively.

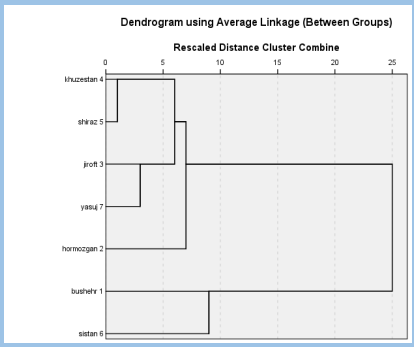

Fig 2. Dendrogram using the distinguishing traits of proboscis length and the sum of the widths of the third and fourth dorsal-ventral segments, hind leg length, forewing length, number of right hindwing hooks, and wing vein length b

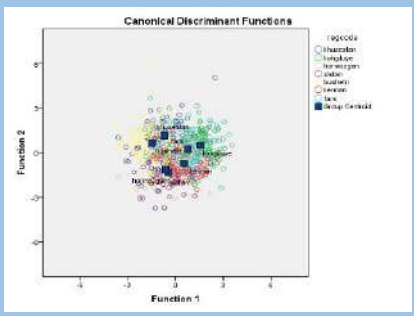

Fig 3. Distribution diagram of *Apis florea* honey bee colonies based on the results of discriminant function analysis in Iran

Table 2. Comparison of some morphological characteristics of *Apis florea* with previous studies conducted in Iran

Morphological Traits	Ruttner 1988	Ruttner 1995	Tahmasbi 2002	Prichehreh 2022
Front wing length	6.706	6.73	6.85	6.276
Front wing Width	2.313	2.33	_	2.22
Number of right wing hooks	11.37	_	_	12.155
Hind leg length	5.431	5.43	5.54	5.197
Proboscis Length	3.37	_	_	2.782
Total width of the third and fourth dorsal-ventral segments	2.85	2.94	2.96	2.655

Acknowledgement

Agricultural Jihad of Bushehr Province

A group of beekeepers from south provinces of Iran

PP-431 [Bee Biology]
GenoDrone: Advancing mating control evaluation in honeybee breeding

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In honeybees, a virgin queen mates with multiple drones during nuptial flights, storing their sperm in the spermatheca for lifelong use. Controlling this mating process is one of the biggest challenges in honeybee breeding, as it directly influences genetic gain in breeding programs. Mating control success is typically measured by genotyping worker brood to estimate the number and origin of patrilines within a colony. However, such evaluation requires waiting for egg-laying and brood development, delaying evaluation by up to three weeks, and demands a large number of samples for accurate colony representation.

The GenoDrone project, a collaboration between research teams from Slovenia and Poland, aims to overcome these limitations by developing a novel methodology for evaluating mating control success in a timely manner. The project explores csd allele variation in selected honeybee colonies and investigates whether drone DNA stored in the queen's spermatheca can serve as a direct and timely indicator of mating control efficiency.

The initial step of the project is investigation of the csd gene variation within selected honeybee colonies and assessing whether this genetic diversity reliably reflects the colony's patriline composition. Our approach includes instrumental insemination, sampling of the selected colonies, followed by DNA extraction, fragment amplification, csd allele genotyping, sequencing, and data curation. To assure the detection of all patrilines, we complemented our analyses with genotyping-by-sequencing (GBS) and compared the outcome. Our results show the power of csd gene as a single-marker tool for accurately resolving patriline composition within honeybee colonies.

The GenoDrone project represents a forward-looking initiative with the potential to revolutionize our understanding of honeybee mating biology. It will coordinate an international effort in providing an enhanced practical solution for sustainable and effective honeybee breeding as well as conservation of local honeybee populations.

PP-432 [Bee Biology]

METABARCODING APPROACHES FOR WILD BEE DIVERSITY ASSESSMENT IN FRENCH AGRICULTURAL LANDSCAPES

With COI and 16S markers

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INTRODUCTION

- 90% of wild flowering plants and 70% of crops are pollination dependant[1]
- Drastic decline of pollinator populations worldwide [2,3,4]
- Land management and pesticides have been reported as partly responsible for that decline [5]
- Lack of entomologists represents a significant bottleneck for ecological studies [6,7]
- Need to develop alternative high-throughput identification methods : molecular (metabarcoding, eDNA), acoustic-based, image-based..[8]
- Metabarcoding is widely used in pollinators studies, mainly with the COI (Cytochrome c oxidase subunit I) marker [9,10,11] and other markers (16S, 18S..) [12,13]
- Traditionnal metabarcoding, using bee tissue (legs, whole body..) :
  - is destructive : need to conserve bee integrity for rare species or for morphological (re-)identification
  - only targets trapped bees, not traces of bees that escaped or were predated

QUESTIONS

- **Is metabarcoding a suitable approach for wild bees ecological and conservation studies ?**
- **Can metabarcoding of liquids be an alternative to the use of bee tissues ?**

METHODS

Sampling :
- 17 sites in ZA PYGAR[14] (France)
- Conventionnal vs organic crops
- 3 pan-traps / site, on crop edges, 3 days in april 2024

- Filtered insects transferred in ethanol and trapping liquids (water + detergent) stored at -20°C during 4 months

DNA Extraction :
- Trapping liquids (x57) and storage liquids (x51) filtration + DNA extraction per pan-trap
- Bee pinning for morphological identification (positive control)
- 114 bee legs sampling (31 species) + DNA extraction per site (x17)

Sequencing and analysis :
- PCR amplification with 250 bp 16S and 400 bp COI
- Aviti 2x300 bp sequencing at Get-Plage Platform
- Demultiplexing markers and trimming : cutadapt
- Denoising : Qiime2 denoise-paired
- Taxonomic assignment : BLASTn on Genbank nt database

Preliminary Conclusions

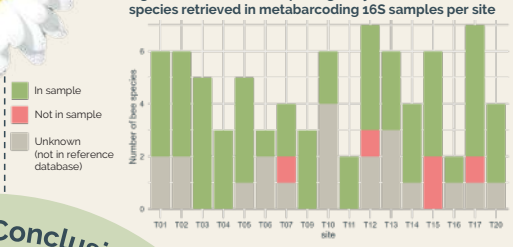
- 16S marker is performant for bee tissue metabarcoding
  → more efforts needed to complete databses
- Liquids capture less wild bee diversity than traditionnal metabarcoding with 16S marker
  → Not an alternative to destructive metabarcoding as is
  → Liquids containing only bee species could improve their detection
- Liquids detect non-bee taxa trapped in field
  → Can be used for multi-taxa studies
  → Need to design bee specific markers with available mitogenomes

What's Next?

- Continue previous efforts[15,16] to complete COI and 16S databases
- 2024 COI metabarcoding (tissue, liquids) analysis + 2025 field sessions
- Investigate mismatches between morphologically identified specimens and metabarcoding results
- Compare how agricultural practices influence bee biodiversity
- Environmental DNA analysis of flowers to detect traces of wild bees with 16S and COI markers

PRELIMINARY RESULTS

Figure 1 : Number of morphologically identified bee species retrieved in metabarcoding 16S samples per site



- Between 2 and 7 wild bee species per site
- Missing species in 4/17 sites

Table 1 : Proportions of bee species retrieved in 16S samples

	Bee legs	Sampling liquids	Storage liquids
In sample	67%	37%	30%
Not in database	27%	27%	27%
Not in sample	6%	37%	43%

- 67% of morphologically identified species found in bee legs samples
- 27% lacking barcode reference in database
- 2 species missing in bee legs samples due to :
  - Blast parameters (*L. politum*)
  - Same barcode sequence for E. *nigrescens* and *E. nigrifacies*
- 1 species unaccountably missing in T07 bee legs sample *(L. puncticolle)*
- Liquid samples capture ~⅓ of trapped bee species

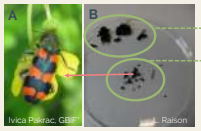
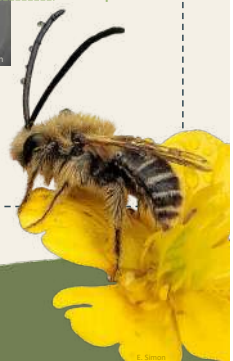


Figure 2 :
A. *Trichodes* genus
B. Specimens in T14 sample

- Detection of non-bees species in liquid samples with the 16S marker
- Example : One of the most abundant sequence in T14 liquid samples blasts on the *Trichodes* genus, trapped in the field



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* *Trichodes apiarius* (Linnaeus, 1758) Observed in Croatia by Ivica Pakrac, cropped vegetation ** Xylocopa violacea (Linnaeus, 1758) Observed in Austria by Andreas Pospisil, cropped background

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PP-433 [Bee Biology]

Thermoregulation in Indian bees, *Apis cerana indica* F. during Winter and Summer Seasons

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Introduction

- Honey bees are highly social insects that maintain colony survival through precise thermoregulatory behavior. In the Indian honey bee, *Apis cerana indica*, thermoregulation ensures stable brood nest temperature and humidity, which are critical for colony health, development, and productivity.
- Sensors enable continuous and non-invasive monitoring of hive temperature and humidity. They provide real-time insights into how honey bee colonies regulate their microclimate, help to understand seasonal adaptations and supporting better colony management.

Material and Methods

- Three bee colonies with full strength capacity were selected from the Apiary of Centre of Excellence in Apiculture, Department of Entomology, COA, Gangavathi during 2024-25
- The automatic monitoring systems were Govee Smart Indoor Outdoor Thermo-Hygrometer (Model No: H5178, US). Goovee device was placed above the brood chamber at the centre and the outdoor sensor unit which was placed above the top cover to collect external temperature and humidity.
- Bee counter was installed at the entrance of the hive, with the solar panel oriented towards the sun .

Plate 1. Experimental setup

Objective

- Monitoring of internal and external temperature and humidity along with worker bee movement using advanced sensors.

Results and Discussion

- **WINTER:**
- From 47th to 51st SW, the mean internal temperature was 29.23 ± 1.33°C, higher than the external 24.17 ± 1.71°C. Internal RH averaged 76.81 ± 3.01%, compared to external 74.16 ± 6.38%. Mean bee traffic was 36.65 ± 14.96 incoming and 48.6 ± 15.13 outgoing.
- From 51st SW to 03rd SW, the mean internal temperature increased to 33.92 ± 1.09°C, while external was 25.06 ± 1.12°C. Internal RH was 74.79 ± 2.79%, lower than the earlier period, while external RH was 69.28 ± 4.97%. Incoming bees averaged 39.00 ± 14.73, and outgoing 51.01 ± 19.13. (Fig. 1; Fig. 2)

- **SUMMER:**
- From 09th to 13th SW, the mean internal temperature was 33.02 ± 1.58°C, higher than external 28.71 ± 1.52°C. Internal RH averaged 66.59 ± 1.96%, external 61.90 ± 4.73%. Bee traffic was much higher with 132.38 ± 29.15 incoming and 146.71 ± 28.67 outgoing.
- From 14th to 18th SW, the mean internal temperature rose to 33.78 ± 0.90°C, while external was 30.41 ± 1.44°C. Internal RH averaged 68.86 ± 2.54%, external 61.94 ± 7.37%. Incoming bees averaged 105.54 ± 23.57, and outgoing 126.27 ± 25.64. (Fig. 3; Fig. 4)

- Honey bees buffered internal temperature in the range from -2°C to 8°C and internal humidity in the range from -18 per cent to +16 per cent

Fig. 1. Daily Average Temperature Relative Humidity and Worker Bee Movement (47th SW -51st SW)

Fig. 2. Daily Average Temperature Relative Humidity and Worker Bee Movement (51st SW to 03rd)

Fig. 3. Daily Average Temperature Relative Humidity and Worker Bee Movement (09th to 13th SW)

Fig. 2. Daily Average Temperature Relative Humidity and Worker Bee Movement (14th to 18th SW)

Conclusion

- In winter, bees maintained internal temperatures at 26.72–33.39°C despite ambient 18.88–31.28°C, and in summer at 32.56–35.47°C despite external 23.13–37.56°C.
- Internal RH remained 75.19–78.94% in winter even at 90.61% outside, and 64.43–68.71% in summer despite external drop to 41.34%, showing strong thermoregulation by *Apis cerana indica*.

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PP-434 [Bee Biology]

ECOLOGICAL IMPLICATIONS OF *APIS FLOREA* FABRICIUS DETECTION IN THE PHILIPPINES: POTENTIAL IMPACTS AND INTER-SPECIES DYNAMICS

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ABSTRACT

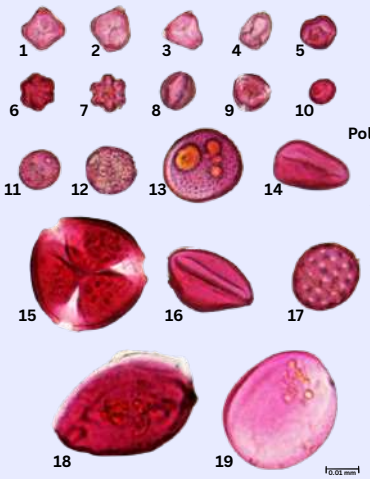
- The red dwarf honey bee, *Apis florea*, was recently introduced to the Philippines, first reported in 2020 and confirmed in 2025.
- Populations are currently limited to Mindanao Island (Davao del Norte, Davao del Sur, Davao de Oro).
- Nests were observed on *Tamarindus indica, Theobroma cacao, Pinus kesiya, Mangifera indica, Terminalia catappa* (6–30 ft above ground).
- Combs oriented in varying directions (SSW, WSW, ENE) with angles 5°–60°, suggesting thermoregulatory preferences.
- Ten colonies were recorded; slow expansion indicates limited population growth.
- Pollen analysis showed dominance of *T. catappa* (53.39%) and *Moringa oleifera* (24.90%), with contributions from *M. indica*, *Syzygium* sp., and Poaceae.
- Nesting traits differ from *A. breviligula*, minimizing nest-site competition.
- Monitoring is recommended to prevent ecological risks, while exploring potential pollination benefits.

INTRODUCTION

- The Philippines is a biodiversity hotspot, rich in plant and pollinator diversity.
- Several honey bee species are present, including *Apis cerana, A. dorsata breviligula, A. mellifera,* and stingless bees (*Tetragonula, Lepidotrigona*).
- The presence of *A. florea* in the Philippines was confirmed by Baroga-Barbecho et al. (2025) where it was first seen in Davao region in 2020 and is believed to be an introduced species due to the lack of zoological and taxonomic records of the species in the country.
- Key concern: What is the impact of an introduced honey bee on local bee populations and ecosystems?
- In this study, we aimed to: (1) determine the distribution pattern of *A. florea* in Mindanao; (2) assess its nesting behavior and orientation; and (3) identify major foraging resources using pollen analysis.

METHODOLOGY

1. Map the distribution Pattern
2. Describe Nesting Behavior
3. Identify Pollen and Nectar Sources



Pollen source of *A. florea* (400X)
Syzygium sp. (1-4),
Mangifera indica L. (5),
Terminalia catappa L. (6-8),
Moringa oleifera L. (9),
Unidentified (10-13),
Cocos nucifera L. (14),
Bignoniaceae (15-16),
Ipomoea (17),
Poaceae (18-19)

RESULTS

DISTRIBUTION PATTERN

- Mindanao Island (Davao del Norte, Davao del Sur, Davao de Oro).
- Only 10 nests were recorded
- The absence of colonies outside the Davao region may be temporary and should be closely monitored, as this information forms an important part of the baseline knowledge on the population dynamics of *A. florea* and its potential impact on the ecosystem.

NESTING BEHAVIOR

- Prefers branchy host plants with fine twigs (e.g., *Tamarindus indica, Theobroma cacao, Pinus kesiya, Mangifera indica, Terminalia catappa*).
- Nests are small and shielded by leaves—distinct from *A. dorsata* (large canopy combs) and *A. breviligula* (partially sheltered sites).
- These unique requirements reduce competition among open-nesting honeybees.

POLLEN SOURCES

- The pollen spectra of *A. florea* are dominated by *T. catappa* (53.39%), followed by *M. oleifera* (24.90%).
- This indicates that *A. florea* foraged extensively on *T. catappa*, which flowers during multiple periods throughout the year, and on *M. oleifera*, which blooms continuously.

CONCLUSION

The confirmation of *A. florea* in the Philippines updated the database on bee diversity. Its introduction does not appear to threaten native bee populations. Since its first observation in 2020, the population has not expanded, with only ten colonies recorded. Other areas where *A. florea* was not located and should be closely monitored, as this information forms an important part of the baseline knowledge on the population dynamics of *A. florea* and its potential impact on the ecosystem.

ACKNOWLEDGMENTS

This study was supported by the National Academy of Science and Technology (NAST) through the Research Fellowship Grant. The Department of Agriculture-Bureau of Agricultural Research provided the travel fund. Epifanio C. Loyola Jr., Marlon Cababan, and Lea Walker guided us in the field survey.

REFERENCES

APIMONDIA SCANDINAVIA 2025
SWEDEN | DENMARK | NORWAY

PP-435 [Bee Biology]

Field realistic stressors alter the bee gut microbiome

Marcela A Díaz, Carmelo Fruciano, Cristina Botías, Darren P O'Connell, Katie-Jane Marshall, Falk Hildebrand, Nicholas JB Brereton, Dave Goulson, William OH Hughes, Julia C Jones

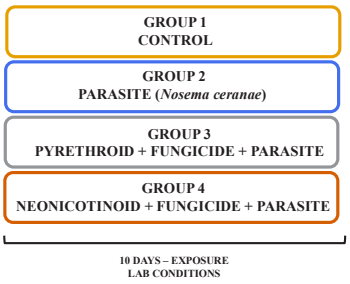
Introduction

Pollinator populations are declining worldwide. Bumblebees are some of the most important wild pollinators in natural and agricultural habitats and are no exception to these declines. Such declines are reportedly due to a combination of factors including exposure to pesticides and pathogens. These factors likely alter the bee gut microbial community. However, the interactions, potential sensitivity, and role of key gut bacterial taxa in combating these factors, remain largely undetermined. Insight can be gained by investigating the interaction between bumblebee gut microbial communities and field-realistic combinations of pesticides and a pathogen.

Methods

Forty *Bombus terrestris* colonies were exposed to different field-realistic combinations of stressors (pesticides and a pathogen) under controlled laboratory conditions. Groups of 10 colonies were assigned to four different treatments, and exposed to the treatments for 10 days. The gut bacterial communities of the bees were subsequently determined using amplicon sequencing (16S rRNA).

Bumblebee colonies ✕ 40



Results and Discussion

- We find that there are no significant differences in gut bacterial community diversity, including alpha and beta diversity, in bees exposed to field-realistic combinations of stressors (Shannon diversity, Kruskal-Wallis, $\chi^2 = 0.250$, df=3, p=0.969; PERMANOVA: p=0.395 using Bray-Curtis dissimilarity) (Fig. 2). This suggests that the overall gut microbial community remains stable when bees are exposed to pesticide and parasite combinations.
- Using the DESeq2-based procedure, no significant differences in relative abundance of the core gut bacterial taxa were detected in pairwise comparisons between any of the treatment groups.
- However, interestingly, we find that some non-core gut bacterial taxa differ in relative abundance between controls and bees exposed to the different stressor combinations (Fig. 3).
- One key example is the gut bacterial taxa *Burkholderiaceae*. This taxa was significantly reduced in relative abundance in the treatment groups exposed to a neonicotinoid, fungicide and parasite; and a pyrethroid, fungicide and parasite, compared to controls. This suggests that *Burkholderiaceae* taxa may be contributing to bumblebee adaptation to pesticides and pathogens, and are therefore important targets for future functional analyses.

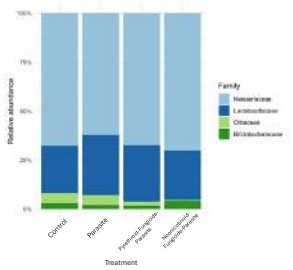


Figure 1. Taxonomic composition (relative abundance) of bumblebee gut microbial communities when exposed to different field-realistic stressors.

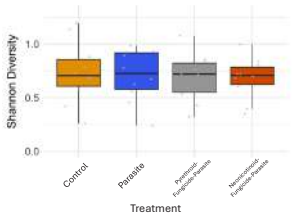


Figure 2. Shannon's diversity index of OTU frequencies. Lines represent the median index value, boxes mark the interquartile range. No significant difference was found in diversity between treatments.

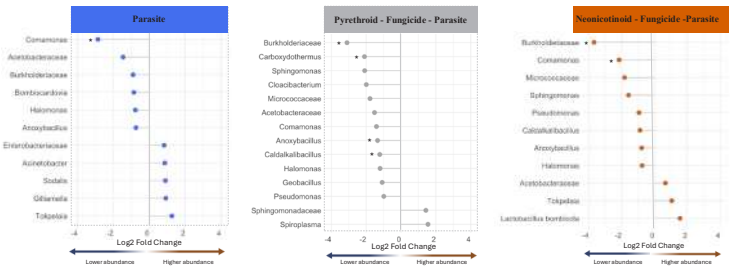


Figure 3. Log2 Fold Change in relative abundance of gut microbial taxa in bees exposed to different field-realistic stressors. The Fold Change shown is between the control group and each of the treatment groups (parasite; pyrethroid-fungicide-parasite; and neonicotinoid-fungicide-parasite). Significant differences are indicated by*.

Conclusion

Together our results suggest that exposure to field-realistic pesticide-pathogen combinations in bumblebee colonies does not impact the core gut microbial taxa, however there is an impact on some non-core taxa, including declines in relative abundance of *Burkholderiaceae*. These often overlooked taxa may play important roles in bumblebee host health and resilience to human-induced stressors.

PP-436 [Bee Biology]

Where do Honey Bees Mate?

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Background

It is generally accepted that to mate, (i) drones leave their colonies and fly to a drone congregation area (DCA) where they await queens; (ii) queens fly to DCAs; and (iii) most (if not all) matings occur within these aerial aggregations of males.

This view of mating behavior has emerged from discovery of DCAs on every continent where *Apis mellifera* occurs and occasional observations of queens mating in DCAs.

Problems with this interpretation of mating behaviour are:

- Some matings have been observed outside of DCAs, along routes drones follow ("flyways") through the landscape or near their hives.
- DCAs do not exist in flat, featureless landscapes with few landmarks.
- In some landscapes, drones are attracted upwind to queen pheromone lures for 60-300+ m.
- Drone tracking by radar indicates that:
  - Drones fly from their colonies along fairly linear paths ("flyways") that follow landmarks; where a flyway bends, branches, or terminates, they fly higher and rapidly change directions in what look like DCAs; *therefore,* ***DCAs may be reorientation points*** as drones navigate across the landscape;
  - Drones fly further as they age, presumably as they become familiar with landmarks in the landscape (O.R. Taylor & G. W. Otis, unpublished research).
  - Drones do not wait in DCAs for queens; they fly from one DCA to the next.
- We have never been able to track queens on their mating flights, so there has been no unbiased and systematic research on where queens go on mating flights.

Left: Comet of drones in pursuit of a queen; courtesy of Pierre Giovenazzo.

Right: Drone attempting to copulate with a queen; courtesy of Markus Imhoof, "More than Honey", and Boris and Barbara Baer-Imhoof, University of California, Riverside.

Review of statements in the literature about where honey bees mate

My review of the literature found 158 refereed journal articles, 42 books and 3 theses with statements about where honey bees mate. I scored them in four categories:

S = definitive statement that matings occur in DCAs;

I = statement that implies that matings occur in DCAs:

E = equivocal wording about where mating occurs;

N = neutral: mating frequencies across the landscape match local drone densities.

The results of my analysis of the literature are:

	S	I	E	N	Total
Pre-1997	12 (23.1%)	20 (38.4%)	15 (28.8%)	5 (9.6%)	52
1997-present	125 (82.8%)	18 (11.9%)	5 (3.3%)	3 (2.0%)	151

- **Conclusion:** most researchers have accepted that queens and drones mate predominantly in DCAs (**S** + **I**) despite a lack of proof.
- This belief has become entrenched over time.
  - Prior to 1997, *61.5%* of sources stated or implied that DCAs were the sites of mating.
  - From 1997 to July, 2025, that percentage increased to ***94.7%*** of published sources.

Evolution of viewpoints over time (Italics added for emphasis):

Roger A Morse:

- *"…* definite drone congregation areas exist, and *it would appear* that queens search out these areas and are there pursued by drones" (Zmarlicki & Morse, 1963). (Note: no queens were observed in that study.)
- "*The fact* that drones and virgin queens fly to specific areas, now called drone congregation areas, for mating, was discovered by Zmarlicki" (Morse & Hopper, 1985).
- "*… generally queens fly to areas called 'drone congregation areas*.' These are locations where the males congregate and apparently wait for the mating queens" (Morse, 1986).

Friedrich Ruttner:

- "*We must assume* that matings take place in the drone congregation areas" (Ruttner, 1996).
- "*It was not proved for sure but it is likely* that most queens mate in the drone congregation areas" (Ruttner, 1972).
- "*The assumption* that queens mate mainly in drone areas is supported by…" (Ruttner, 1986).
- "The queen risks her life on *mating flights, which drive her to the drones' courtship grounds. The entire male population of the region assembles 'in certain gathering places in the sky'"* (Ruttner, 1992).

Recent shifts that recognize how little we know about where honey bees mate:

- "Whether these [DCAs] are actually mating hot-spots is *yet to be proven*, but they have similar properties to other species' mating swarms" (McAfee, 2021).
- "There is *conflict* over whether drone congregation areas are truly sites of mating in a natural setting or are instead convenient locations for researchers to find drones" (Metz & Tarpy, 2022).

Where do we go from here?

Researchers have demonstrated that drone behavior is influenced by:

- Landmarks or lack thereof (DCAs do not form in featureless landscapes);
- Topography (drones follow valleys and fly further in mountainous regions);
- Drone density (distinct DCA boundaries at low drone density disintegrate at high density);
- Magnetic fields and drone pheromones (both affect drones in flight, but by how much?)
- Queen mandibular pheromone (drones are attracted upwind from flyways to queens and queen lures, but how far seems to vary between sites and studies).
- Weather (DCAs form in the lee of hills or large trees in windy weather).

There have never been controlled experiments to test the the effects of these factors on drone behavior; consequently, we have a poor understanding of them.

- In 1892, Gilbert Doolitte wrote: "If drones congregate in certain places, it would be but natural that the queens should be drawn to these places; and the fact that one queen was known to mate at such a congregation of drones went quite a way with me in leading me to believe that queens in general were so mated."
- That logic seems to have been adopted by most honey bee researchers **in the absence of unbiased information on where queens mate**.
- **Most matings may occur in DCAs but there have been no studies that demonstrates that.**

Why is it important that we learn where mating occurs?

- Considerable research has gone into trying to understand where DCAs occur, but it has little application to beekeeping because queens fly unknown distances to mate with drones from the surrounding 50 km².
- Queen producers and beekeepers who rear their own queens would like to maximize the mating of their queens with desired drones.
- If we do not know where mating occurs, or how far queens and drones fly on their mating flights in various landscapes and at different densities of drones, we cannot place drone source colonies in the best locations and numbers to exert the best influence on matings.
- **DNA-analyses can be used to determine purity of queen matings under various conditions.**

We currently lack the technology for long-distance tracking of individual drones and queens. When that technology becomes available, we will finally learn where honey bees go to mate.

For a detailed review of honey bee mating, go to:

Otis, G.W. (in press). Where do honey bees (*Apis mellifera*) mate? *Apidologie*

PP-437 [Bee Biology]
Modeling the influence of environmental features on wild honey bee colony density in South Africa

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Wild and unmanaged honey bee colonies face myriad challenges to survive in harsh environments. Without provisions from a beekeeper, colonies must obtain limited resources, such as pollen, nectar, water, propolis, and suitable nest sites. The dynamic availability of these resources influences where unmanaged colonies establish and persist. To conserve honey bees, the complex interactions between colonies and their environments must be understood. In turn, we can characterize colony survival strategies and ecosystem carrying capacities. Geographic Information Systems (GIS) provide powerful tools to explore environmental features relevant to colony establishment and survival. We aimed to identify environmental features influencing wild and unmanaged honey bee populations (Apis mellifera) in the Eastern Cape Province, South Africa. We surveyed 1 km by 1 km grids for wild and unmanaged honey bee colonies using beelining techniques. In each grid, we set up four stands of sugar water from which we followed foraging bees returning to their nest entrances. We used colony density data (colonies/km²) alongside environmental predictor variables to construct generalized linear mixed effect models and perform model selection. We explored vegetation type, water availability, and topography as environmental predictor variables using satellite imagery and digital elevation models. In total, we surveyed 16 km² across five field sites and located 105 colonies. Colony density ranged from 0 to 14 colonies per km². Our research associated the spatial distribution of environmental features with wild and unmanaged colony density over a limited study area. Future research should be conducted to monitor changes in resources and colony populations over larger spatial and temporal scales. Investigating the spatial ecology of wild and unmanaged honey bees informs conservation initiatives while providing beekeepers insights into optimal management practices.

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PP-438 [Bee Biology]

49. APIMONDIA Conference 2025, Kopenhagen, Denmark

The use of season specific assessment of mite population growth and SMR level in selection programs for Varroa resistant honeybees

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Background and introduction

Varroa resistance in honeybees represents a complex trait caused by multiple environmental effects, polygenic background, and/or gene regulatory networks. However, measuring reliable and cost-effective resistance traits in the framework of honeybee breeding programs still remain an open issue to many breeding organisations and breeding companies.

Material and methods:

In this study we used commonly applied phenotyping approaches to characterize resistance traits in Austrian Apis mellifera carnica populations of different genetic background. The basic concept of this study was to use date dependent mite population growth to filter out colonies with low infestation rates and higher SMR (suppressed/non mite reproduction) level at the end of season. The field study was performed in the years 2022 to 2024 and included 205 colonies from two genetic origins (origin a) = long term selected population; origin b) = rather unselected population with introgression of resistance traits of origin a). Phoretic mite infestation got measured from early August on (30th week) and measurements were periodically repeated every three-weeks using dust shaking method. When phoretic mite infestation reached thresholds defined by AGT (2018), worker brood combs were sampled from each colony. Those got evaluated for brood infestation and SMR and were classified for resistance status using empirical thresholds given by Grindrod et Martin (2021).

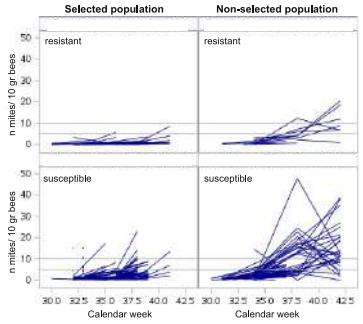


Figure 2: Individual growth curves of phoretic mite infestation rates from week 30 (1st August) to week 42 (20th Octobre) for selected and unselected populations by resistance categories (resistant and susceptible)..

Conclusions:

As a conclusion, the combination of behavioural traits (SMR) with bee- or brood infestation rates within a time window of substantial mite population development, can aid to discriminate resistant colonies from those, not being successful in controlling mite population growth. Consequently, this approach can assist in the selection of successfully operating colonies as mating partners in a breeding population.

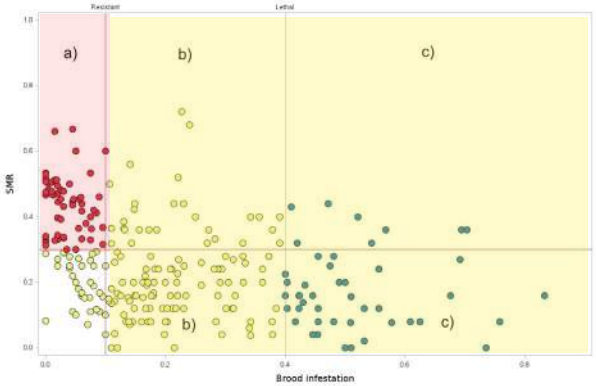


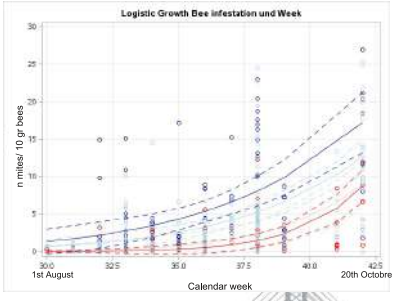
Figure 1: SMR and brood infestation profile plot of the 205 A.m.carnica colobiies. Successfully operating colonies (resistant) were able to keep brood infestation in late season below 10% and exhibited SMR level above 30%. Susceptible (non successful) colonies could not shift mite infestation below 10% level.

Results:

By segmentation of the data applying empirical thresholds for SMR and brood infestation (SMR>30% and Brood infestation <10%), 16.1% of colonies could be characterized resistant (mean SMR=56.2%; brood infestation rate=4.7%) and remained untreated up to week 39 (+/- 24th septembre). Susceptible colonies (67.8%) showed on average a SMR level of 23.7%, brood infestation rate of 33.1% and remained untreated up to week 38 (+/- 18th septembre). Phoretic mite infestation rates derived from this longitudinal study were in correspondence to resistance categories and SMR/brood infestation level. In resistant colonies phoretic final mite infestation reached a level of 3.7% (1.9% in selected and 6.9% in unselected population) and susceptible populations had an infestation level of 7.2% (5.6% in selected and 9.2% in unselected population). In general mite population levels were significantly higher in unselected population underlining intervention effect of resistant bees in controlling mite population growth.

Table 1: Percentage of Population in Resistance categories, mean values for SMR level, brood infestation rate, phoretic mite infestation rate (n mites/10 gr bees) for the selected, unselected and the total population studied.

	Category		SMR		Brood infestation		Phoretic mite	
Population	resistant	susceptible	resistant	susceptible	resistant	susceptible	resistant	susceptible
selected	18,92	67,57	55,65	26,55	4,15	33,59	1,90	5,56
unselected	12,77	68,09	57,08	20,30	5,65	32,52	6,86	9,19
all	16,10	67,80	56,20	23,70	4,70	33,10	3,70	7,20



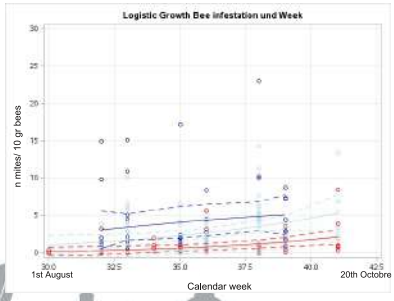


Figure 3 and 4: Estimated growth curves for phoretic mite infestation in the total population (left) and in the selected population (right). Red curve (solid = mean; dotted = +/- 95% confidence interval) illustrates mite population growth in resistant colonies and blue (dark and light) curves illustrate mite population growth in susceptible colonies.

APIMONDIA SCANDINAVIA 2025
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PP-439 [Bee Biology]

THREE DECADES OF CONSERVATION WORK FOR THE DARK EUROPEAN HONEY BEE

(*Apis mellifera mellifera*)

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Brigitte Hilfiker[6,10], Frankie de Dobbelaere[7,10], Emma Buckley[8, 9,10], Jo Widdicombe[9,10], John Greenaway[7,10]
[1]Föreningen Nordbi and Swedish University of Agricultural Sciences SE; [2]Naturalis Biodiversity Center Leiden NL; [3]Fédération pour la conservation de l'abeille noire FR; [4]Nature Research Centre Vilnius LT and Lithuanian Dark Bee Association Mer kinė Varėna distr. LT; [5] Suomen Tumman Mehiläisen Hoitajat FI; [6]Verein Schweizer Mellifera Bienenfreunde CH; [7]Native Irish Honey Bee Society IE; [8]Buckley´s Bees UK; [9]Bee Improvement & Bee Breeders Association UK; [10]SICAMM

Conall McCaughey, Native Irish Honeybee NIHBS

Martin Feurer Mellifera CH, Switzerland

ABOUT SICAMM

SICAMM was founded in 1995 and is an **international federation of the dark European honey bee** (*Apis mellifera mellifera),* and its primary goals are to conserve, protect and promote the dark European honey bee.

SICAMM is managed by an elected Main Board. Over the last **thirty years**, SICAMM has played a vital role in organizing biennial conferences, which foster communication and collaboration among beekeepers, scientists, policymakers and conservationists.

In addition to the Main Board the Federation has **National Delegates from across Europe,** a **Science Board**, and dedicated work teams. The SICAMM Federation will work co-operatively to link with stakeholders and promote the conservation of the dark European honey bee.

SICAMM hopes to play a crucial role in **raising awareness of the importance of conservation areas for the dark European honey bee populations**, and in **supporting scientific and applied projects** aimed at protecting this precious natural resource. Similarly, SICAMM is interested in **offering support to** initiatives whose objectives are the welfare of **localised, wild and free-living bees that are under threat.**

SICAMM membership is open to organisations and individuals. SICAMM supports also **other organisations with similar goals**, e.g. the European Beekeeping Association (EBA).

Other features: Conferences, work teams on e.g. conservation, bee product quality, science, bee health, apitherapy, social and PR management, and education.

HOW TO SUPPORT SICAMM: ● Become a member. ● Offer financial support, practical help, your speciality or expertise. ● Join our work teams. ● Become a beekeeper of the dark European honey bee. For promotion, our SICAMM social manager can offer social media support and get magazine and publication for a press release.

For more information:

- **Weblink:** https://sicamm.org
- **Email:** info@sicamm.org
- **SICAMM WhatsApp**

SICAMM Newsletter

Audun Braastad/NTB-scanpix, NBBL, Norway

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Patrycja Sołtysik, Kampinoska, Poland

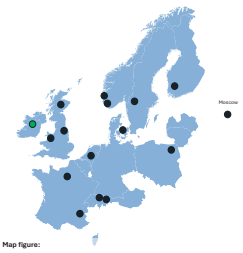
Armin Lochner, Landesv. Dunkle Biene Bayern e.V.

Markku Pöyhönen, Finnish Dark Bee Assocation, FI

Hubert Guerriat, Mellifica, Belgium

Roger Patterson, BIBBA, UK

Henk Kok, Duurzame Bij, NL



Map figure:
Blue labelled countries: Countries with dark European honey bee associations with ongoing conservation work.
Black dots: Locations for former international SICAMM conferences.
Next SICAMM conference: 2027, in Ireland, hosted by the Native Irish Honey Bee Society (NIHBS).

A few more countries, such as Estonia and Czech republic are believed to harbor minor amounts of dark European honey bees. Further, countries in the East, such as the Russian Federation, Belorussia and Ukraine are believed to have dark European honey bees, but due to current political situation it is hard to obtain further information about these. In future, more research on this and contacts to local beekeepers in these countries would be needed in order to explore this further.

Dark European honey bees have also been occasionally imported to other countries like Iceland and Greenland, or continents like America and Australia. More research is needed to follow up their fate.

ASSOCIATIONS WORKING ON THE CONSERVATION OF THE DARK EUROPEAN HONEY BEE

Robert Svensson, Föreningen Nordbi, Sweden

APIMONDIA SCANDINAVIA 2025
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PP-440 [Bee Biology]

Protein existence of sperm proteome of *Apis mellifera iberiensis* drones

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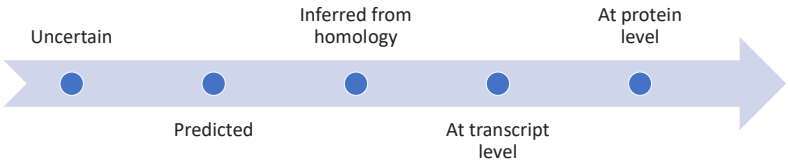
INTRODUCTION

- The identification and characterization of sperm proteins is essential for a better understanding of their physiological function.
- One way **to assess the confidence of the proteins** that make up spermatozoa from species that are not widely studied, as honeybees, is to examine the evidence type that supports the protein existence in UniprotKB.

OBJECTIVE

To study the **evidence types of protein existence of UniprotKB** in sperm of *Apis mellifera iberiensis* adult drones



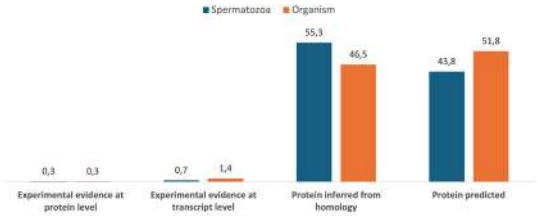
MATERIAL AND METHODS

- **38 ejaculates** were obtained from ***Apis mellifera iberiensis*** adult drones using manual procedures and were pooled in 4 samples of 8-10 drones.
- Semen samples were washed four times in PBS discarding the supernatant and storing the wet pellet.
- Proteome were analyzed in the Proteomics Unit (University of Valencia). **The LC-MS/MS was performed in a tims TOF fleX mass spectrometer and data were acquired using the DIA-PASEF mode**.
- Results were generated with the unique genes and protein groups quantified with **FDR ≤ 1%.** Protein existence data from the proteome (gene count) of the organism and spermatozoa were obtained from the Uniprot database (UP000005203; 06/02/2025).

RESULTS

- A total of 1,425 **proteins** (unique genes) were detected, of which 733 were common to all 4 pooled **sperm samples, representing 3.8% of the total proteins in the proteome of the organism** (19,054).

Percentage of evidence types of protein existence in *Apis mellifera*



CONCLUSIONS

- **The low protein evidence rate at protein or transcript level** could make functional analysis difficult.
- We have validated, at protein level, a significant number of predicted proteins that will contribute to consolidate the honeybee proteome and facilitate its annotation.

This work was supported by the Spanish AEI-MICINN (grant PID2023-148475OB-I00), DGA-FSE (grant A07_23R), and Generalitat Valenciana CIAICO/2022/174.

PP-441 [Bee Biology]
Primal Bee: a thermodynamic hive for optimal heat efficiency

Tomer Moldovan, Gianmario Riganti, Alex Gamberoni, Jason Graham, Eitan Nir, Yotam Melman, Assaf Shachar
Primal Bee

Honey bee population dynamics are driven by each new generation of brood which develop into workers who fulfill each role allowing the colony to survive and thrive. The cost and effort to grow each new generation of brood has been defined in entomology as the honey to brood equivalence. This can be measured by the quantity of capped food storage available to the colony to produce the equivalent capped brood (next generation) area.

This study, conducted from 2017 to 2024, aimed to develop an internal hive environment which provided honey bee colonies with optimal growth conditions. This was accomplished by applying engineering methodologies to understand i) the dependencies of honey to brood equivalence to the hive design, and ii) to validate the innovative methodology based on new optimal hive design fulfilling the maximization of the honey to brood equivalence in the field.

First, methods were used to assess and measure honey to brood equivalence and rank these for the existing hives designs. Results show that 1) the honey to brood equivalence is no longer to be considered a constant, but a bee/hive combined parameter; 2) the amplitude of advantage for bees is 30% for standard modified hives, rank 200% for innovative hives; 3) the new hive design is fully integrated with the biological needs of honey bees.

Second, pilot tests were put in place in several climatic environments to test the colony
response in optimal hive design. Practical advantages were found for the bees and beekeeper, including early blossom harvest capability, superior population, higher flight activity, higher splitting potential, and superior climate adaptability.

These results provide a fresh perspective demonstrating significant improvements to standard beekeeping methodology resulting in stronger bee populations through enhancement of their hive environment to support their biological processes enabling the colony to overcome challenges while also providing a broad range of economic and operational advantages for beekeepers.

PP-442 [Bee Biology]
Antibacterial and antioxidant activities of honey samples of stingless bee, Tetragonula pagdeni Schwarz and Asiatic hive honey bee, Apis cerana Fabricius

Sanchai Naree[1], Alexis Beaurepaire[2], Guntima Suwannapong[3]
[1]Pharmacology And Biopharmaceutical Department, Faculty Of Pharmaceutical Sciences, Burapha University, Chon Buri, Thailand 20131
[2]Institute Of Bee Health, Vetsuisse Faculty, University Of Bern, Bern, Switzerland
[3]Department of Biology, Faculty of Science, Burapha University, Chon Buri, Thailand 20131

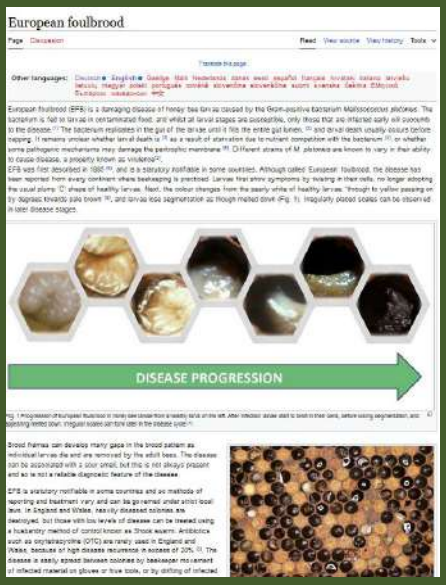
Stingless bees and honey bees are crucial pollinators worldwide, they also provide high-value products, especially honey containing medicinal properties collected from medicinal plant sources. This study aimed to investigate the antibacterial and antioxidant activities of honey samples of stingless bees, Tetragolula pagdeni compared to those of Apis cerana honey collected from five different regions of Thailand. For the antioxidant activity, we used the 2,2 diphenyl-1-picrylhydrazyl (DPPH) assay. The disc diffusion method was used to determine the size of the inhibition zone, and the broth microdilution method was used to find the minimum inhibitory concentration (mic) and the minimum bactericidal concentration (mbc). The finding revealed that the percent of antioxidant activity ranged from 40.34-76-21%, and the EC50 value raged from 0.005-0.66 (g/ml). Honey samples of A. cerana exhibited antibacterial properties on three isolated bacteria. The inhibition zone of honey samples of A. cerana was smaller than that of stingless bee, T. pagdeni. The results indicate that both honey samples of A. cerana and T. pagdeni provided antibacterial properties on foodborne pathogenic bacteria. It can potentially be developed as a natural preservative for food spoilage caused by certain bacteria.

PP-443 [Bee Biology]

BEE-GUARDS
for resilient beekeeping

wikiBeedia.eu
a multilinguistic encyclopedia on bees and beekeeping

Georg Schaunitzer & Robert Brodschneider
University of Graz, Austria | info@beeguards.eu | www.bee-guards.eu

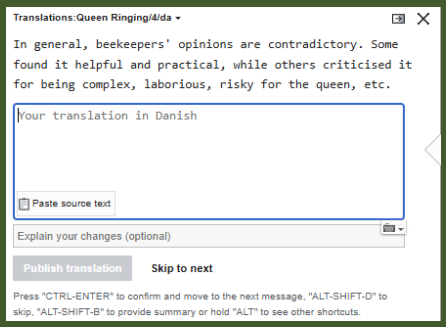


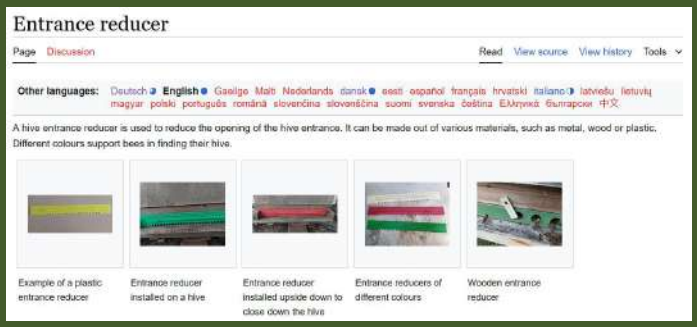
What is WikiBeedia?

This encyclopedia on honey bees and beekeeping was created within the EU project BEE-GUARDS. It aims to be the world's number one open encyclopedia on bees and beekeeping. It is available in many languages and beekeepers and honey bee researchers from around the globe are invited to contribute. So far, we assigned our articles to six categories: **Research, Biology, Diseases, Hive management, Forage** and **Hive Products**. See screenshot left for article on European foulbrood.

WikiBeedia as a dictionary?

The multi-lingual approach enables WikiBeedia to act as an online dictionary of beekeeping terms and knowledge on honey bees. The article on entrance reducer as shown in the screenshot below, directs to the corresponding Fluglochschieber in German, Flyvesprække reducer in Danish, or Riduttore per ingresso in Italian. Photos further clarify the meaning. Translations are simple using the translation-box (see below left)





WikBeedia was created by the BEE-GUARDS consortium but shall be extended and maintained not only by beekeepers and scientists but anybody interested in bees and beekeeping. When as many people as possible work together, we can create a great source of beekeeping knowledge.

← Participate! We are looking forward to your contribution!

www.wikibeedia.eu

Spread the word about our project and download a three-page article on WikiBeedia

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Grant Agreement No. 101082073

PP-444 [Bee Biology]

STATEMENT FOR THE CONSERVATION AND RESTORATION OF THE DARK EUROPEAN HONEY BEE (*Apis mellifera mellifera*)

Vincent René Douarre [1,8], Jacques van Alphen[2,8], Laima Blažytė-Čereškienė [3,8], Markku Pöyhönen [4,8], Frankie de Dobbelaere [5,8], Natuschka M. Lee[6,8], Jo Widdicombe[7,8], John Greenaway [5,8]

[1] Fédération européenne pour la Conservation de l'abeille noire (FedCAN) FR; [2] Naturalis Biodiversity Center Leiden NL; [3] Nature Research Centre Vilnius and Lithuanian Dark Bee Association, Mer kinė, Varėna distr. LT; [4] Suomen Tumman Mehiläisen Hoitajat FI; [5] Native Irish Honey Bee Society (NIHBS) IE; [6] Föreningen Nordbi and Swedish University of Agricultural Sciences SE; [7] Bee Improvement & Bee Breeders Association (BIBBA) UK; [8] Conservation team of SICAMM

Karen Kloppenborg Møller, Denmark, Brunebier

BACKGROUND

After the last ice age, the dark European honey bee, *Apis mellifera mellifera*, (also known as the black or the brown bee) one of the subspecies of the Western honey bee (*Apis mellifera*), extended its range across Northern and Western Europe. For the last one million years, it has evolved independently of other subspecies, except for *A. m. iberiensis* which shared the same refuge during the last glaciation period.

Jan Gutzeit, Der Bundesverband Dunkle Biene Deutschland e.V. Germany

CURRENT SITUATION - FOUR SCENARIOS

Dark European honey bees in a tree stem in Lithuania (verified by wing index and DNA analyses). Laima B.-Čereškienė, Lithuanian Dark Bee Association

Existing populations of dark European honey bees in Europe are either:

(1) *Endangered by imports*. Local populations of the dark European honey bee are largely intact across much of the country.

(2) *Viable in reserves*. Local dark European honey bee populations remain viable in some reserves in the country but are threatened.

(3) *Strongly hybridised*. Dark European honey bee populations have been replaced, or severely hybridized, by non-native subspecies and artificial hybrids. This is the situation in most of the area of the original distribution of the dark European honey bee.

(4) *Wild populations in forests*. Fortunately, some dark European honey bee populations still exist, locally, as free-living colonies, in large forested areas with few economic interests for commercial beekeepers.

Original distribution of the dark European honey bee (*Apis mellifera mellifera)* and other honey bee subspecies (hybrid species like Buckfast not included)
Green line: original distribution limits to the west, north and east; **Vertically hatched line:** transition zone to the honey bee subspecies of southern and eastern Europe (*A. m. ligustica, carnica, macedonica* and *caucasica*); **Red dashed line:** northern limit of beekeeping (in current time).
Map distribution adapted from Thomas D. Seeley, 2019; The Lives of Bees: The Untold Story of the Honey Bee in the Wild; Princeton University Press, by V.R. Douarre. Source of Europe map: https://www.cartograf.fr/continent-europe-4.php

GUIDELINE FOR TOOLS FOR CONSERVATION

(i) ***Strategic ban on non-native imports in all scenarios***. A ban on the import of non-native subspecies would be a hugely beneficial step forward for the sustainable recovery of the dark European honey bee. The large genetic variation still present in dark European honey bee populations makes them potentially more able to adapt to a changing climate and to become resistant against new pathogens and parasites.

(ii) ***Creation of reserves, or conservation areas, for the dark European honey bee***. When all the beekeepers on a homogeneous territory cooperate, a reserve or conservation area can be created, using the specifications of FedCAN (https://fedcan.org). This conservation programme can be implemented at a site where the dark European honey bee communities are still present. A central area where only dark European honey bees are kept, is surrounded by a buffer zone, where non-native bees can be replaced by dark European honey bees produced locally. In this way a population of around 150 colonies can be maintained, whose diversity can be preserved under natural selection, in the sanctuary at the centre.

(iii) ***Restoration programme*** to increase the percentage of dark European honey bee alleles outside of reserves or conservation areas. This could be a process of distributing young dark queens to interested beekeepers, thus promoting drone producing colonies in an area. Dark European honey bees used in restoration programmes should originate from areas comparable in climate and flora.

(iv) ***Promotion of free-living dark European honey bee populations existing in the wild***. Dark European honey bee populations must be preserved in European forests. This is important for the evolution of resistance to new diseases, parasites and to adapt to other environmental changes.

(v) ***Free distribution of genetically verified dark European honey bee colonies in and around buffer zones***. This approach supports the expansion of alleles of the native subspecies, encourages local beekeeper engagement, and creates a living protective ring around core conservation areas. Distribution programs should be accompanied by training, basic record-keeping, and periodic monitoring of genetic integrity.

Conall McCaughey, Native Irish Honeybee NIHBS

MORE INFORMATION

Reference: ***Statement for the conservation and restoration of the dark European honey bee (Apis mellifera mellifera)***

By The SICAMM conservation work team: Jacques van Alphen, Vincent R. Douarre, Laima Blažytė-Čereškienė, Markku Pöyhönen, Frankie de Dobbelaere, Natuschka Lee, Jo Widdicombe, John Greenaway. September 2025. More information can be downloaded from the SICAMM website.

Contact info:

- **Weblink**: https://sicamm.org
- **Email:** info@sicamm.org
- **WhatsApp SICAMM**

SICAMM Newsletter

HOW TO SUPPORT SICAMM Become a member, offer financial support, practical help, your speciality or expertise, join our work teams, or become a beekeeper of the dark European honey bee. For promotion our SICAMM social manager can offer social media support and get magazine and publication for a press release.

Disclaimer: This statement is intended to suggest the best practices and promote the conservation and restoration of the dark European honey bee (*Apis mellifera mellifera*) throughout Northern, Western and North-Eastern Europe. While not a set of rules, we propose a framework that can also be used for conservation efforts of other native honey bee subspecies within their natural evolutionary distribution ranges.

PP-445 [Bee Biology]
Alternative Splicing and Alternative Polyadenylation-Regulated Cold Stress Response of Apis cerana

Yuanchan Fan[1], Dan Yao[2], Xiaoping Wei2, Ting Ji[1]
[1]Apicultural Research Institute, College of Animal Science and Technology, Yangzhou University, Yangzhou, China
[2]Guizhou Institute of Integrated Agriculture Development, Guizhou Academy of Agricultural Sciences, Guiyang, China

Bees, as individual poikilotherms capable of group homeothermy, possess temperature tolerance and regulatory mechanisms crucial for biodiversity conservation. The Asian honeybee Apis cerana, a key pollinator for alpine and winter-flowering plants, exhibits superior cold tolerance over Apis mellifera, making it a dominant model species for insect cold resistance studies. While extensive research has delved into the behavioral and physiological facets of honeybee cold resistance, the post-transcriptional regulation in response to cold stress remains understudied. In this study, full-length transcriptome data obtained from PacBio and Illumina sequencing identified 25,443 events of alternative splicing (AS) and 2821 genes of alternative polyadenylation (APA) involved in the cold stress response of honeybees. GO and KEGG functional annotations were performed on the differential AS and APA between the cold stress (T vs. CK) and cold tolerance (TR vs. CK) groups in A. cerana workers of different ages, (3 days (Ac3d), 10 days (Ac10d), and 21 days (Ac21d) old), and the results indicated that these differentially expressed AS (DASs) and differentially ex-pressed APAs (DAPAs) implicate signal transduction, energy metabolism, and oxidative metabolism. Venn analysis, expression clustering, and trend analysis highlight the roles of DASs in regulating high-stress proteins like HSP70 and BAG, with increasing expression levels, while DAPAs are mainly associated with signal transduction and energy metabolism, including genes like CUBN and UGCG, with gene expression levels initially decreasing and then increasing. We verified the isoforms of three DASs and the polyadenylation sites of three DAPAs using RT-PCR and 3′ RACE. In conclusion, the post-transcriptional regulation of AS and APA in A. cerana may respond to chilling stress by participating in the regulation of different metabolic pathways and antifreeze proteins. The results of this study have reference value for the study of the molecular mechanisms of insect cold resistance and provide clues for the development of molecular breeding targets for cold-resistant strains of bees.

PP-446 [Bee Biology]
Effects of royal jelly and its extracts on endometrial receptivity and MCF-7 cell growth in rats with thin endometrium

Ming Zheng[1], Zhi Wang[2], Ting Ji[1]
[1]College of Animal Science and Technology, Yangzhou University, Jiangsu, China,
[2]Apiculture Science Institute of Jilin Province, Jilin 132108, China

Royal jelly (RJ) is rich in various nutrients, including proteins and amino acids. RJ consumption improves sexual and urinary function in postmenopausal women, possibly owing to its hor-mone-like effects. Currently, hormone level regulation and assisted reproductive technologies are widely used to treat thin endometria; however, high doses of these drugs can add to the liver burden. In this study, RJ proteins and fatty acids were isolated, and their therapeutic effects on thin endometria were investigated in vivo and in vitro to verify their hormone-like regulatory effects. The results showed that RJ and its extracts could regulate endometrial receptivity-related factor expression levels in rats with a thin endometrium, accelerate MCF-7 cell apoptosis, and increase estrogen receptor expression in MCF-7 cells. These findings further suggest the estro-gen-like effects of RJ and that fatty acids may be the main contributors. RJ may present a potential natural hormone replacement therapy. Abstract text goes here. The abstract should be a single paragraph that summarises the content of the article

APIMONDIA SCANDINAVIA 2025
SWEDEN | DENMARK | NORWAY

PP-447 [Bee Biology]

Occurrence and survival of free living honeybees in the Tribeč forests, Slovakia

Matus Pavle, Robert Chlebo

SUA Slovak University of Agriculture in Nitra

Faculty of Agrobiology and Food Resources, Slovak University of Agriculture in Nitra, Slovak republic

In 2017, an observational experiment was launched in the Tribeč Mountains to study the survival of bee colonies in natural conditions of broadleaf forests. Initially, colonies placed in traditional log hives barely survived. In 2020, the experiment shifted to a purely observational one, focusing on swarms. Despite preparations, the swarms mostly did not survive the winter. Genetic tests showed a significant occurrence of the Italian honey bee (Apis mellifera ligustica) in the area. Data from following years showed that the colonies were unable to maintain a stable populations. In 2024, swarms occupied ten of the fifteen designated locations, and none survived until autumn. The ongoing experiment aims to provide more data leading to an answer to the question of why colonies cannot survive from year to year in natural conditions.

Introducing colonies into the forests (2018 – 2019)

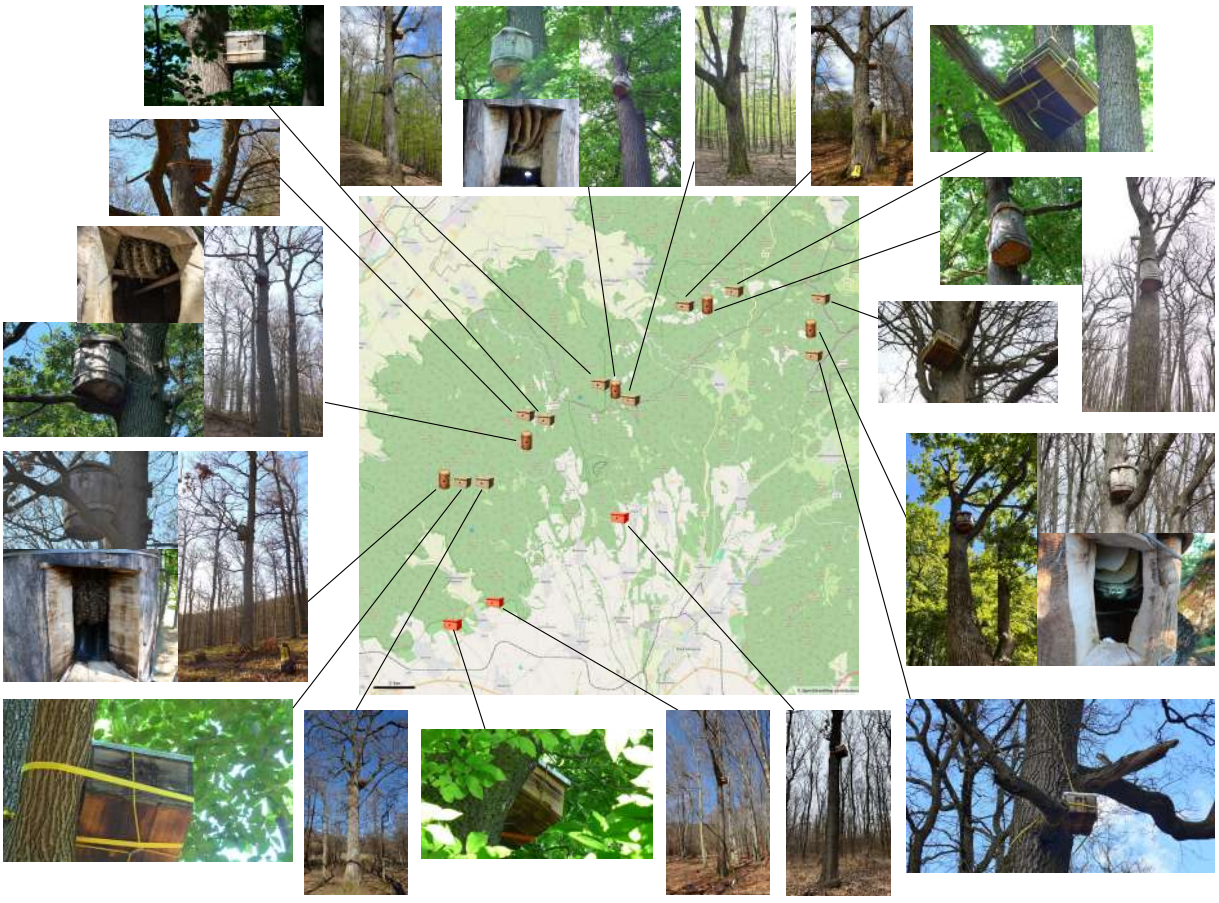
We set up five observational locations with hivelogs situated on trees. We place there honeybees and support them with feeding and gentle antivarroa treatment with essential oils. Not one has overwintered.

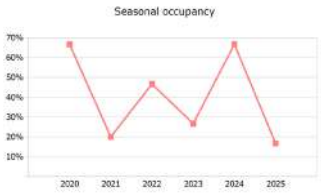
Observational study of presence and survival of swarms

We transformed the study to poor observational one, as we placed ten more swarm traps into the forests. We monitored them one time per month in the season and when they were occupied, we took some samples from the bees. We focused on survival time of honeybees at each location and after their death we examined the hive and (if present) the dead honey bees.

To prove the causes of zero survival rate by experimental methods

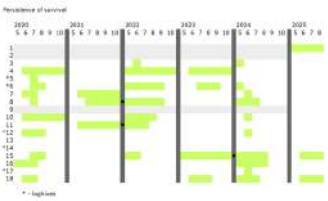
Until now, it is not clear, if there is only one or more factors and conditions behind zero survival rate in this area. We try to experimentally eliminate some disturbing factors, for example predators disruption. In this year (2025) we placed three more swarm traps on the edge of forrest area to see if there is some change in survival rate when forage radius is more diverse (agricultural land, inhabited land).





Interesting findings to add to the discussion so far

Years with higher and lower numbers of swarms seem to alternate. Although the annual occupancy of bait hives and loghives was relatively high (almost 40%), the monthly occupancy was just over 21%. Over six years, there were nine swarms that lived for only about a month and then died (most of them in 2024 season). Only seven swarms (19%) survived to the end of the seasons. Even these did not overwinter due to lack of supplies.



PP-448 [Bee Biology]

APIMONDIA SCANDINAVIA 2025
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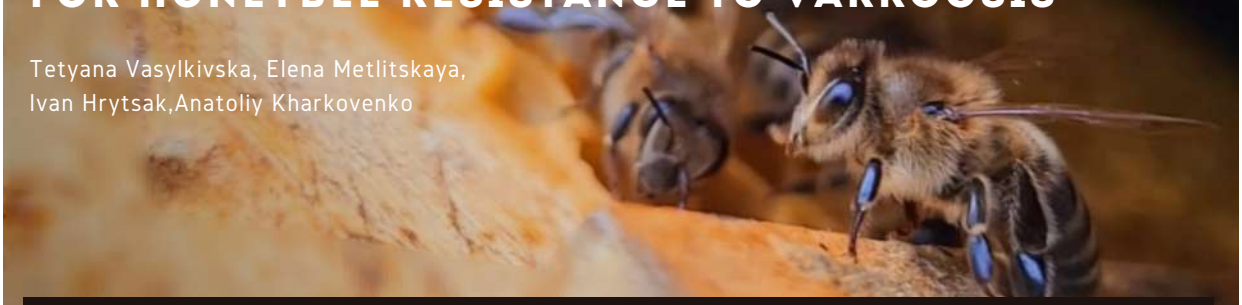
23-27 SEPTEMBER
COPENHAGEN-UKRAINE

IDENTIFICATION OF INFORMATIVE DNA MARKERS FOR HONEYBEE RESISTANCE TO VARROOSIS

Tetyana Vasylkivska, Elena Metlitskaya,
Ivan Hrytsak,Anatoliy Kharkovenko



Understanding the genetic mechanisms underlying honey bee resistance to Varroa destructor is crucial for identifying DNA markers associated with this trait. This may enable marker-assisted selection to improve the genetic structure of bee populations. Key resistance-related behaviors, such as hygienic behavior and grooming, contribute to mite control in colonies. Hygienic behavior, which involves the removal of dead or infested brood, is controlled by multiple genetic loci (Spötter et al., 2012). Grooming behavior, including self-grooming and mutual grooming among worker bees, remains less studied in terms of inheritance mechanisms (Traynor, Mondet 2020).

AIM

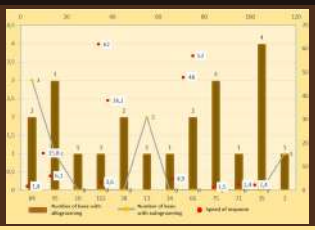
The aim of this study was to evaluate the informativeness of three ISSR primers for the detection of genetic polymorphisms associated with honey bee resistance traits, in particular grooming behaviour.

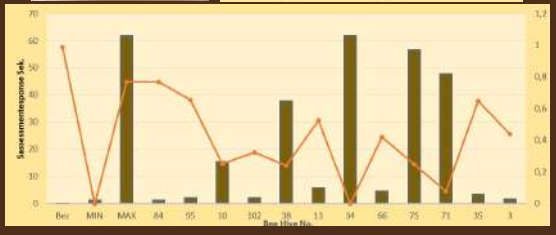
METODS

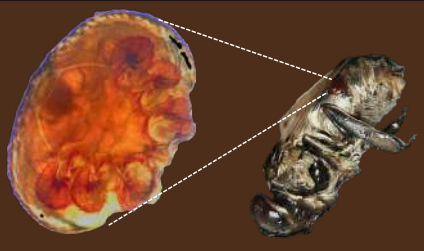
The research was conducted at an apiary in Donets village, Kharkiv region, Ukraine, where 57 colonies were assessed morphometrically. The colony composition included A.m. carnica (78%), A.m. macedonica (A.m. sossimai) (20%), and A.m. buckfast (2%). Only A.m. carnica (var. ukrainica carpatica) colonies were selected for further analysis. Based on ethological assessments, two groups of seven hives were formed, representing high and low grooming activity. Worker bees were collected, preserved in ethanol, and stored at -20°C before DNA extraction using the NeoPrep100 DNA Magnen Plant kit. PCR amplification was performed using primers S1, S6, and S8 under previously established conditions (Metlytska, 2012), with amplicon separation in 2% agarose gel.

RESULTS

The analysis of ISSR-PCR electrophoregrams revealed a significant level of polymorphism only with the ISSR-S1 primer: (AGC).C. The other primers used were not informative for detecting genetic differences between the studied honeybee groups. The use of ISSR-S1 identified amplicons of 500, 550, and 600 bp in bees from resistant lineages, whereas these fragments were absent in bees with low grooming behavior. The presence of ISSR-S1 marker loci in colonies exhibiting high grooming activity suggests potential genetic determinants of varroosis resistance. However, due to the anonymous nature of ISSR markers, further sequencing of identified amplicons is required to determine their chromosomal localization and genomic function. Additionally, subspecies variations in bee grooming behaviour and mechanisms of its inheritance require further study.







Brotherhood of Ukrainian Beekeepers NGO, Lviv, Ukraine
The State Scientific Restearch Forensic Center of the MIA of Ukraine, Poltava, Ukraine
V.N. Karazin Kharkiv National University, Kharkiv, Ukraine
Association "Professional Pollination: Innovations, Bioresearch, Pollinator Health", Lviv, Ukraine

PP-449 [Bee Biology]
Computational analysis to predict the impact of non-synonymous mutations in a protein: an example with the Odorant Receptor 49b

Sana Bashir[1], Carlos S. H. Shiraishi[2], Carlos Yadró[1], Dora Henriques[1], M Alice Pinto[1], Rui Abreu[1]
[1]CIMO, LA SusTEC, Instituto Politécnico de Bragança, Campus de Santa Apolónia, 5300- 253 Bragança, Portugal
[2]CIMO, LA SusTEC, Instituto Politécnico de Bragança, Campus de Santa Apolónia, 5300- 253 Bragança, Portugal; 2Nutrition and Bromatology Group, Universidad de Vigo, Department of Analytical Chemistry and Food Science, Faculty of Sciences, E-32004 Ourense, Spain.

Non-synonymous mutations lead to amino acid substitutions within proteins, potentially affecting protein structure and function. While some mutations have a minimal impact on protein structure and function, others can alter their stability, conformation, and biological activity. Therefore, predicting how mutations affect proteins is important when uncovering the genetic basis of honey bee response to selective pressures.

In a recent whole-genome scan for signatures of selection in Apis mellifera syriaca, we found a non-synonymous mutation under selection in the Odorant Receptor 49b (Or49b) gene. According to the literature, this gene plays a role in honeybee foraging, communication, and environmental adaptation. In an attempt to understand the biological impact at the molecular level of the discovered mutation, we assembled a pipeline that integrates bioinformatics and protein modelling techniques to evaluate the structural and functional consequences of a mutation in a protein. Protein structures were generated from a FASTA file using AlphaFold3, converted from mmCIF to PDB format, and visualized in PyMOL, where mutations were introduced. Functional site predictions were performed using Proteins Plus, and molecular dynamics simulations were conducted in YASARA to assess stability and conformational changes.

Our findings suggest that the mutation under selection in the OR49b gene, which replaces tyrosine with histidine, alters protein dynamics by modifying its energy landscape and stability. At the end of the molecular dynamics simulation, the total potential energy of the wild-type protein was calculated as -384,675 kcal/mol. In contrast, this value increased to -287,075 kcal/mol for the mutant protein. This difference suggests that the mutation may affect the OR49b conformation, flexibility, and eventually its biological function. Whether this change affects honey bee olfactory perception remains uncertain. However, given that the mutation is under selection, it is plausible that the alternative amino acid variants confer an adaptive advantage in different environments. From a practical perspective, understanding how mutations affect biological function can ultimately assist honey bee breeders in selecting colonies for breeding programs, enhancing resilience and adaptability.

PP-450 [Bee Biology]

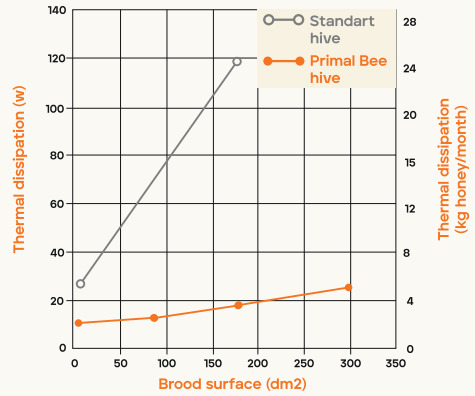
Primal Bee®

Increasing Honey Bee Populations through Thermodynamic Hive Design

G. Riganti, A. Gamberoni, T. Moldovan, E. Nir, Y. Melman, J.R.Graham

Energy as the Limiting Resource

Honey bee population dynamics are driven by each new generation of brood which develop into workers who fulfill each role allowing the colony to survive and thrive. The cost and effort to grow each new generation of brood has been defined in entomology as the honey to brood equivalence. This can be measured by the quantity of capped food storage available to the colony to produce the equivalent capped brood (next generation) area.

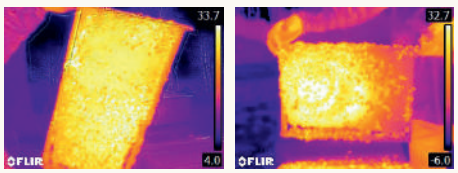


Thermal Regulation and Hive Design

This study, conducted from 2017 to 2024, aimed to develop an internal hive environment which provided honey bee colonies with optimal growth conditions. This was accomplished by applying engineering methodologies to understand 1) the dependencies of honey to brood equivalence to the hive design, and 2) to validate the innovative methodology based on new optimal hive design fulfilling the maximization of the honey to brood equivalence in the field.

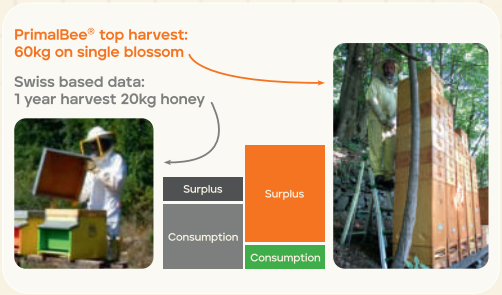
Variable Honey-to-Brood Conversion

First, methods were used to assess and measure honey to brood equivalence and rank these for the existing hives designs. Results show that 1) the honey to brood equivalence is no longer to be considered a constant, but a bee/hive combined parameter; 2) unexplored increase of bee population can be obtained with hive design: an advantage of 25% is found for standard modified hives, while a double population 200% is achieved for innovative, Primal Bee hives, compared to wooden standard hive; 3) the new hive design is fully integrated with the biological needs of honey bees and it is a fully natural solution.



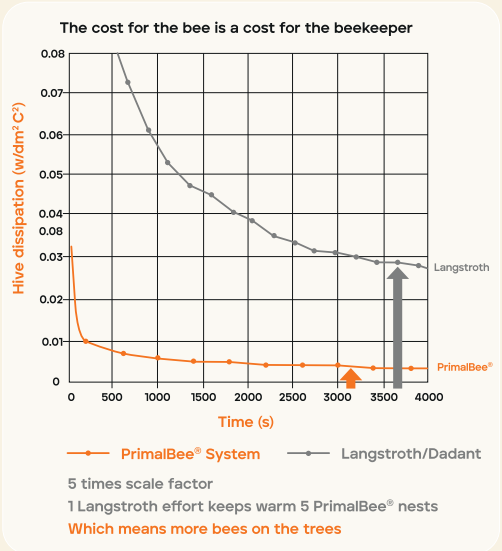
Outstanding Outcomes

Second, pilot tests were put in place in several climatic environments to test the colony response in optimal hive design. Practical advantages were found for the bees and beekeeper, including double (+200%) bee population, early blossom harvest capability, higher flight activity, higher splitting potential, and superior climate adaptability



Implications for Beekeeping Practice

These results provide a fresh perspective demonstrating significant improvements to standard beekeeping methodology resulting in stronger bee populations through enhancement of their hive environment to support their biological processes enabling the colony to overcome challenges while also providing a broad range of economic and operational advantages for beekeepers.



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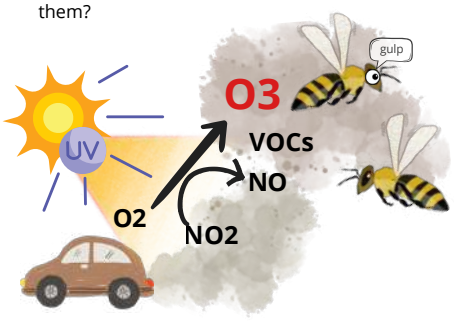
PP-451 [Bee Biology]

Studying ozone pollution effects on honey bee behaviour and cognition

***Mariana Rodriguez Lopez**, Judy Saka-Amini, Amro Zayed*
Department of Biology, York University
Toronto, Canada

INTRODUCTION

- Cities promote projects to include native bees and urban beekeeping, but how is life in the city for them?



- Ground-level **ozone (O3)** is an air pollutant, a strong oxidant, and considered highly harmful to human health(1), but what about honey bees?

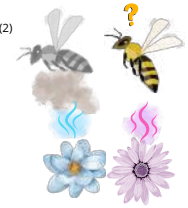
- **Foragers** and air pollution:

→ Lower foraging activity(2)

→ Scent perception changed (3)

→ Lower survivability (2)

→ Learning and memory impairments (4)

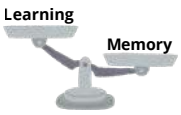


What happens to the rest of the bee hive?... to someone younger...like a nurse bee?

AIMS

1. Determine if ozone exposure impairs learning and memory in nurse bees

2. Assess which cognitive processes are the most susceptible towards ozone

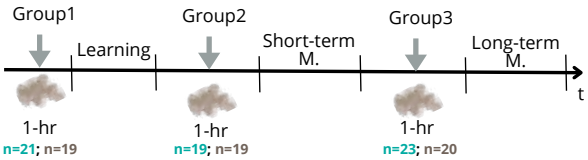


METHODS

- **Discrimination learning, PER conditioning**
- **Short-term memory test**
- **Long-term memory test**

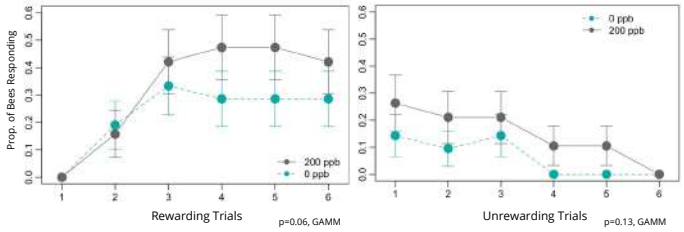
- **Exposure to different O3 levels for 1 hour**

- **Three exposure groups**



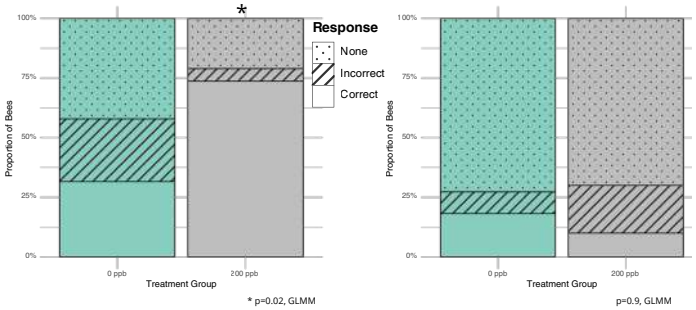
RESULTS

Group1: Learning



Group2: Short-term memory

Group3: Long-term memory



CONCLUSION

- Discriminative learning and long-term memory are not changed by ozone exposure, **BUT** short-term memory appears to be significantly improved by it.

- A theory might be that **younger** bees have a **better** antioxidant system that can fight the oxidative stress effect caused by ozone, and 1 hour of exposure might not be enough to affect them.

- Future work will analyse **gene expression** for learning/memory and antioxidant genes, both for unique and **chronic exposures.**

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PP-452 [Bee Biology]

Gene expression analysis in different working groups of Indian Honey Bees, *Apis cerena indica* F.

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Introduction

- Honey bees (*Apis cerana indica* F.) are highly social insects exhibiting a clear division of labor among different working groups, such as foragers, nurse bees, and thermoregulatory bees.
- Each group performs specialized tasks essential for colony survival, including foraging, brood care, and maintaining hive temperature.
- These behavioral differences are underpinned by distinct gene expression profiles that regulate metabolism, stress response, and task-specific functions.

Material and Methods

- Bee samples from different working groups were collected with forceps, flash-frozen in liquid nitrogen, and stored at –80 °C until RNA extraction.
- Total RNA was extracted using the Direct-zol Mini Prep Kit, and quality/quantity were assessed with NanoDrop.
- Paired-end sequencing libraries were prepared in technical replicates using the NEBNext® Ultra™ II Directional RNA Library Prep Kit (Illumina).
- Raw reads from six samples were processed with Trimmomatic v0.39 to obtain high-quality clean reads.

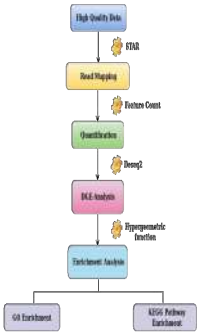

Plate 1. Different work group of bees

Objective

- To analyze differential gene expression in forager, nurse, and thermoregulatory bees

Results and Discussion

RNA from all bee groups showed high yield, purity, and integrity (RIN ≥ 8.1). Libraries were of good quality (369–387 bp, 23.4–26.1 ng/µL) with no adapter contamination. Sequencing yielded 19.3–27.3M reads/sample with >85% HQ retention; >90% mapped to the *Apis cerana* genome. PCA explained 99% variance (PC1: 83%, PC2: 16%), clearly separating foraging, nurse, and thermoregulatory bees by transcriptional profiles.

Foragers vs. Thermoregulatory Bees (AET_GVT-1 vs. AET_GVT-3): 2,405 DEGs (1,213 ↓, 1,192 ↑); 7 unique to foragers. Thermoregulatory bees showed higher expression of PA2 Phospholipase (Gene_8430), Zinc finger protein (Gene_3999), hypothetical protein APICC_01063 (Gene_624), Zinc carboxypeptidase PBC26020.1 (Gene_3263), Lysosomal aspartic protease (Gene_6190).

Nurse vs. Thermoregulatory Bees (AET_GVT-2 vs. AET_GVT-3): 2,970 DEGs (1,497 ↓, 1,473 ↑); 4 unique to nurses, 2 to controls. Thermoregulatory bees showed higher expression of Phospholipase A1 (Gene_7204), carboxypeptidase Q-like isoform X2 (Gene_7949), retinoid-inducible serine carboxypeptidase-like (Gene_3493).

Shared DEGs (Both comparisons): 11 common genes.
Upregulated in thermoregulatory bees: cytochrome P450 9e2-like, esterase FE4, vitellogenin receptor, histone H2B-like, kinesin KIF20B, and uncharacterized proteins. Downregulated: cuticle protein 18.7-like, zinc finger 512B-like, neuronal acetylcholine recetor subunit α4-like.

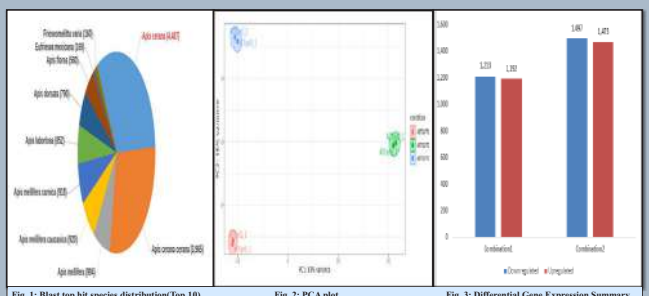

Fig. 1: Blast top hit species distribution(Top 10) | Fig. 2: PCA plot | Fig. 3: Differential Gene Expression Summary

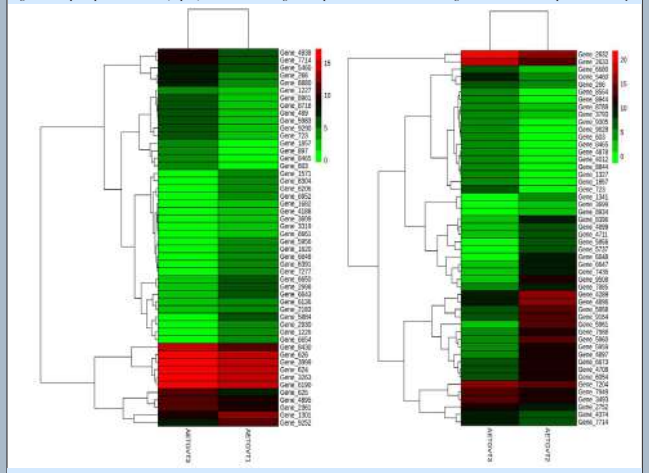

Figure 4. Heatmap of differentially expressed genes (top 50) in Combination 1 and 2

Table 1: Genes expressed in upregulated genes of thermoregulatory bees

Sl. No.	Gene	Proteins	Function
1	Gene_7714	cytochrome P450 9e2-like [Apis cerana]	Heme binding, iron ion binding, monooxygenase activity, oxidoreductase activity, acting on paired donors, with incorporation of molecular oxygen
2	Gene_5460	Esterase FE4 [Apis cerana cerana]	
3	Gene_266	Vitellogenin receptor [Apis cerana cerana]	Calcium ion binding
4	Gene_723	histone H2B-like [Apis cerana] PBC33380.1 Histone H2B.1/H2B.2 [Apis cerana cerana]	DNA binding proteins heterodimerization activity structural constituent of chromatin
5	Gene_8465	uncharacterized protein LOC107998826 isoform X2	
6	Gene_1857	kinesin-like protein KIF20B [Apis mellifera caucasica]	ATP Binding, microtubule binding, plus end directed microtubule motor activity
7	Gene_6680	hypothetical protein APICC_09832 [Apis cerana cerana]	
8	Gene_8430	PA2 Phospholipase	PLA2 catalyzes the calcium-dependent hydrolysis of the 2-acyl groups in 3-sn-phosphoglycerides.
9	Gene_3263	Zinc carboxypeptidase PBC26020.1	Metallo-carboxypeptidase activity , zinc ion binding
10	Gene_6190	Lysosomal aspartic protease	Aspartic-type endopeptidase activity
11	Gene_7204	Phospholipase A1	Phospholipase A1 activity, triacylglycerol lipase activity
12	Gene_7949	carboxypeptidase Q-like isoform X2	
13	Gene_603	uncharacterized protein LOC108001624 [Apis cerana]	

Conclusion

- Thermoregulatory bees exhibit distinct gene expression profiles compared to foragers and nurse bees, with key metabolic, structural, and regulatory genes upregulated to support colony homeostasis.
- Shared DEGs indicate conserved molecular mechanisms underlying thermoregulation, highlighting its essential role in maintaining hive function.

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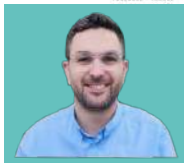
PP-453 [Bee Biology]

Genetic diversity in honey bees:

a glimpse into long-term evolutionary history and recent human impacts



Thibault Leroy[1], Benjamin Basso[2], Sonia Eynard[1], David Wragg[3], Alain Vignal[1], Pierre Faux[1]

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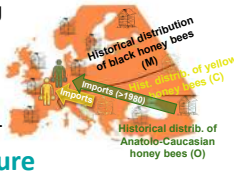
[3] Beebytes Analytics CIC, Roslin Innovation Centre, Easter Bush Campus, Midlothian, UK

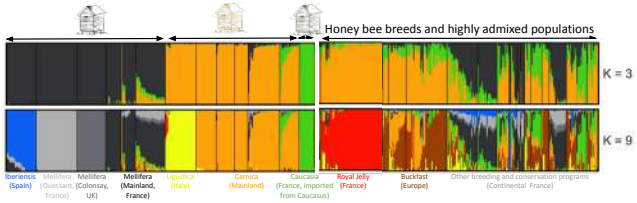
Background & Main Results

For *Apis mellifera*, as with any species, **preserving high genetic diversity is key to maintaining adaptability** and ensuring long-term persistence. However, the dynamics of its genetic diversity and the impacts of modern beekeeping remain debated.



During the last decade, we collected **and whole genome sequenced 1000+ haploid males from several subspecies** (including M, C and O lineages) and breeds (including Buckfast and Royal Jelly-producing ones) in Europe.

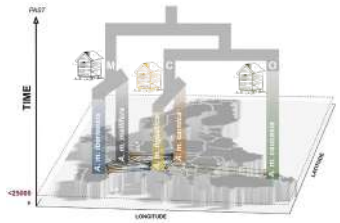
1 Population structure



We revealed clear genetic structure, with distinct lineages corresponding to regions of origin, as well as specific backgrounds for the Buckfast and Royal Jelly breeds *A. m. mellifera* populations conserved on small islands exhibited no introgression.

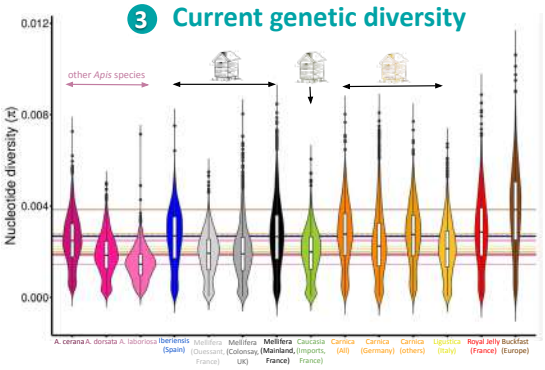
For more details regarding the genetic structure:

2 Long-term evolutionary history



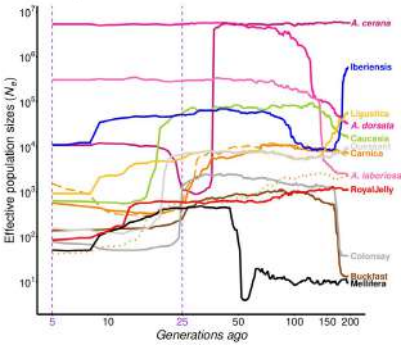
Using demographic modeling based on Approximate Bayesian Computation, we inferred long divergence (up to 1 million generations) and relatively recent (postglacial) secondary contacts pre-dating modern beekeeping.

3 Current genetic diversity



We observed variable levels of diversity among the different clusters. Black honey bee populations from island conservatories exhibited the lowest genetic diversity.

4 Recent demography

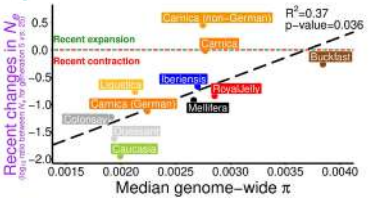


We inferred recent changes in population sizes (*Ne*) and detected bottlenecks in most populations over the last 25 gen.

Conclusions

We uncovered secondary contacts between lineages pre-dating modern beekeeping. However, recent practices have induced bottlenecks, reducing their genetic diversity, especially in black honey bees from conservatories, raising concerns about the long-term sustainability.

5 Recent human impacts



We observed that the widespread bottlenecks over the past 25 generations, consistent with the impact of modern beekeeping practices, explains their present-day diversity.

Prospects

We aim to explore how reduced genetic diversity translates into deleterious mutation load. Although an increased load is expected under the nearly neutral theory of molecular evolution, haplodiploidy may counterbalance its accumulation.

More in our recent paper:

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PP-454 [Bee Biology]

PHC Tassili 2021-2023
N° 46060VM

Mitochondrial genome analysis of *Apis mellifera intermissa* and *sahariensis* reveals alignment biases and genetic variability

Amira Chibani Bahi Amar[1*], Alain Vignal[2], Nacera Tabet Aoul[1,3], Pierre Faux[2], Thibault Leroy[2], Emmanuelle Labarthe[2], Kamila Canale-Tabet[2*]
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[3] Department of Biotechnology, Faculty SNV, University of Oran1 Ahmed BENBELLA, Oran, Algeria

Introduction

→ Characterizing the genetics of *Apis mellifera* subspecies plays a key role in understanding biodiversity, tracing population evolution, and guiding conservation efforts [1].

→ During the last decades, many mitochondrial DNA–based studies have explored the genetic diversity of honeybee populations across the world. Mitochondrial genomes, inherited maternally and highly conserved, provide valuable insights into honeybee evolution and diversity [2].

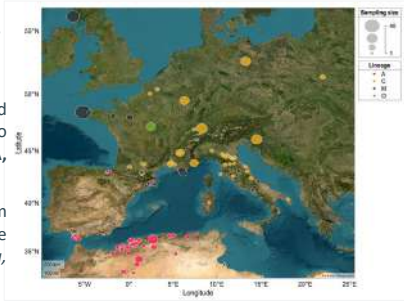
→ Despite extensive research on *Apis mellifera*, the genetics of some African subspecies remains poorly described. In Algeria, *A. m. intermissa* and *A. m. sahariensis* show distinct ranges and morphologies.

→ **What can mitochondrial genome analysis of *A. m. intermissa* and *A. m. sahariensis* reveal about the diversity and genetic composition of Algerian honey bee subspecies?**

Methods

Dataset: Illumina sequencing

- **151 Algerian drone samples**
  A. m. intermissa (n = 108)
  A. m. sahariensis (n = 43).
- **344 samples** described previously as belonging to the evolutionary lineages **A, M, C** and **O** [3, 4].
- **18 sequences** retrieved from NCBI, representing the African lineage **A** (*scutellata, monticola, capensis*).



Algerian and European honey bees geographical locations.

SNP detection and genotyping performed as in Wragg et al., 2022 [4].
Our analysis focused only on **SNPs** within the **13 protein-coding** and **2 rRNA genes**, to avoid potential biases from false-positive SNPs arising due to read mapping in repetitive genomic regions.

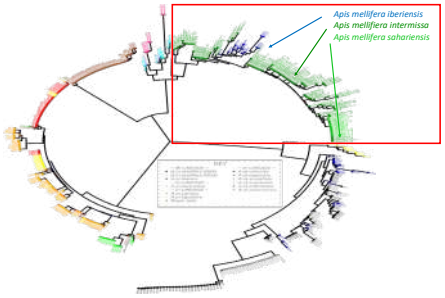
Genetic diversity and phylogenetic analyses were conducted on a final VCF containing **464 sequences and 207 SNPs**. To determine the phylogenetic relationship, median-joining network and Maximum Likelihood Tree were constructed.

Conclusions

- Our analysis revealed **no significant genetic admixture** (not shown here) in Algerian honey bees, confirming their **belonging to African lineage A**. It also showed **no genetic differentiation between the two subspecies**, as no distinct mitochondrial haplotypes were detected.
- The analysis highlighted the **genetic relatedness of Algerian subspecies to *A. m. iberiensis*** from the south of the Iberian Peninsula.
- The **reference genome used for read mapping influences the results**, potentially creating coverage gaps or misalignments.
- **Pangenome approaches will solve the problems** of using a single reference genome.
- Careful bioinformatics analyses are essential for mitochondrial sequences analyses.

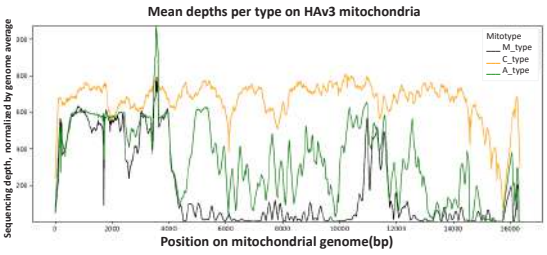
Results

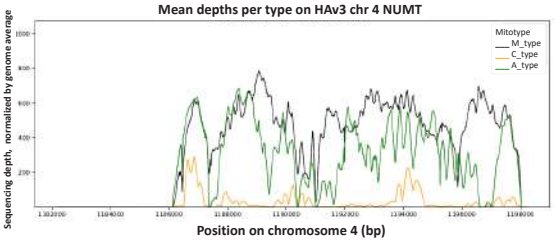
1 - Absence of distinct mitochondrial haplotypes between *A. m. intermissa* and *A. m. sahariensis*.



2- Mapping reads from Type A and M samples to the HAV3 reference genome (Type C) showed low coverage in some mitochondrial regions.

3 – These reads map instead to a large NUMT (Nuclear Mitochondrial insertion) on chromosome 4.





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PP-455 [Bee Biology]

Selection of Varroa-resistant honeybees in central eastern Argentina. 15 years' experience

Loiseau Marcelo / [1] Miel Loiseau

Introduction

Two basic concepts separate current beekeeping from what we knew in the past: Varroa and artificial feeding. Producing honey again in a sustainable way and without contaminants was the motivation behind this experience. In this sense, the objective of this development was to obtain bee populations that could sustain themselves without varroa treatment and, at the same time, be productive in a commercial approach.

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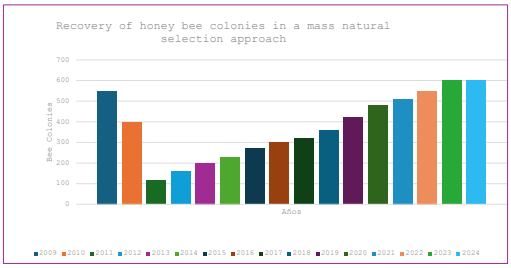
Magdalena, Buenos Aires Province, Argentina

Material and methods

The experience began in 2009 with 550 productive hives located in 10 different apiaries in the central-eastern area of Argentina, Department of Islas del Ibicuy in Entre Rios province and district of Magdalena, in Buenos Aires province. The method was the suspension of all forms of mite control (synthetic or organic acaricides, biological or thermal control), and no artificial or proteins feed were added it.



Results

In the spring of 2011, the second year without treatment, 80% of the colonies were dead, leaving only 116 alive. For repopulation, we decided to use the capture of swarms, which showed a high survival rate when found in natural hive conditions.

During the first 6 years, we installed in two different ways: 1- offer the swarms the possibility of building natural nests in spaces formed by 2 Langstroth supers nailed together without frames or stamped wax, trying to replicate natural conditions. And 2- swarms were installed in standard Langstroth material with the difference that empty frames were interspersed, without stamped wax, so that they could freely make their combs. In the sixth year, it was decided to continue only with Langstroth material, given that the similarity of winter survival was confirmed between hives with natural nests and swarms that were captured and installed in Langstroth material.

Apiary

Natural Honey Combs

Bee hive

Discussion:

After 15 years of experience, we have more than 600 hives, which have never been treated with acaricides, and are maintained exclusively with the honey and pollen collected by them, with winter mortality rates close to 25%. This production method can be certified by the absence of residues.

1 The apiaries of Miel Corapi are part of the Scientific and Technological Research Project PICT-2021-I-A-01100 entitled 'Dynamics of the mite-virus relationship in honey bee populations with different degrees of susceptibility to *Varroa destructor* in the Argentine Republic' (RESOL-2023-31-APN-DANPIDTYI#ANPIDTYI), directed by Dr. Francisco Reynaldi (CEMIBA FCV UNLP – Argentina) and Dr. Matías Daniel Maggi (IPROSAN FCEyN UNMdP – Argentina).

PP-456 [Bee Biology]
The role of innate immunity for virus tolerance in the Gotland honeybee population

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Background and Purpose
Pathogens lead to numerous pressures on the health of honeybees (Apis mellifera) worldwide. Honeybees, being social insects, have a complex immune system to cope with pathogens, with both innate immunity at the individual level and social immunity at the colony level. The honeybee population from the island of Gotland, Sweden, are well-known for their independent resistance to Varroa destructor mite infestation and tolerance to virus infections, in particular Deformed Wing Virus (DWV) and Acute Bee Paralysis Virus (ABPV). However, the immune mechanisms underlying the virus tolerance in this population are still unclear. The purpose of this study was to investigate the innate immunity of Gotland honeybees towards virus infections to determine possible genetic variation of the expression of different immune genes.

Methodology
Adult honeybees from the Gotland population and a local mite-susceptible population were collected at series of time points following an oral inoculation of virus infections to detect the function of innate immunity in the competition between honeybees and viruses. Several genes related to the production of antimicrobial peptides along with the genes involved in RNA interference pathways were tested in these bees using qRT-PCR. The differential expression of genes from ABPV orally inoculated adults from sugar feed adults as a control group, was analyzed.

Results and conclusions
The Gotland honeybees survived the oral virus inoculation better than the susceptible honeybees in this study. We found that the expression of immunity-related genes changes over time and changes differently between populations. The biggest differentiation gene expression between the Gotland population and the susceptible population appeared at 24h after viral inoculation. However, some genes did not show difference between populations at all. More results will be discussed.

Practical implications for beekeepers
Comprehensively investigating honeybee innate immune strategies, and their relative importance for bee health, will benefit disease tolerance breeding efforts to safeguard honeybees and the important pollination services they provide for our well-being.

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PP-457 [Bee Biology]

APIMONDIA SCANDINAVIA 2025
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Evaluating Bee Feeding Practices of Turkish Beekeepers: Insights from the COLOSS Nutrition TaskForce Survey

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Introduction

Bee nutrition plays a critical role in honey bee health, influencing both colony strength and productivity. Understanding the feeding habits of beekeepers is essential for developing sustainable beekeeping practices and ensuring the health of honeybee colonies. This study aims to evaluate the feeding strategies of Turkish beekeepers using the Coloss Nutrition Task Force (NUTRI TF) survey. The NUTRI TF is a community of independent experts in bee nutrition, working to establish a multinational network that facilitates collaboration and produces scientifically sound outputs. The task force identifies nutrition as a major driver of bee health and an important beekeeping management practice, involving stakeholders such as beekeepers, researchers, and associations. This study seeks to fill the gap by investigating the motivations and practices surrounding carbohydrate, protein, and other supplementation among Turkish beekeepers.

Keywords: Honey bee nutrition, nutritional stressors, supplemental feeding, malnutrition, monitoring

Materials and Methods

A comprehensive survey was developed based on a preliminary study conducted the previous year. The survey included 34 questions on beekeepers' practices related to carbohydrate and protein supplementation, as well as the use of additional feed sources. Additional questions aimed to explore the primary motivations behind these feeding strategies, including supporting colony strength, enhancing productivity, and mitigating adverse environmental conditions.

The survey was translated into Turkish and administered using Google Forms to facilitate participation. Data were collected from Turkish beekeepers, compiled, and analyzed statistically to identify trends in feeding practices and the factors influencing beekeepers' decisions. Descriptive statistics and, where appropriate, comparative analyses were applied to examine differences in feeding strategies across beekeeper demographics and regional contexts.

Figure 1. Turkish version of Coloss Nutrition Task Force Survey

Results

The survey results revealed diverse feeding practices among Turkish beekeepers. Carbohydrate supplementation was the most common practice, followed by protein and other supplementary feeds. Motivations for feeding largely centered on maintaining colony strength and mitigating environmental stress, with productivity enhancement cited less frequently. Statistical analysis indicated variation in feeding strategies based on factors such as the size of the apiary, years of beekeeping experience, and regional differences in floral resource availability. These findings provide a snapshot of contemporary beekeeping nutrition management in Turkey and highlight areas where targeted guidance could support sustainable practices.

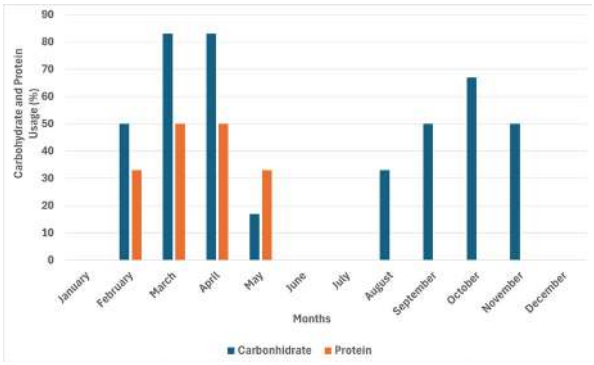


Figure 1. Distribution of monthly carbohydrate and protein feed

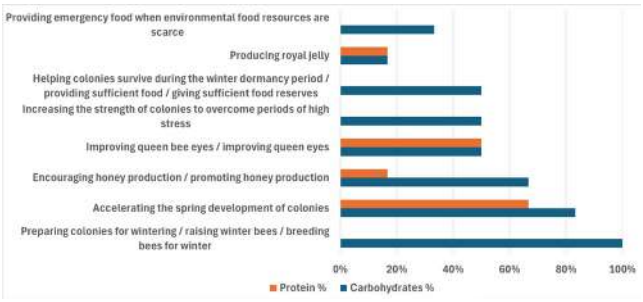


Figure 2. Reasons for providing artificial feed to colonies

Discussion

The results demonstrate that Turkish beekeepers employ a range of feeding strategies to maintain colony health and productivity. The predominance of carbohydrate supplementation reflects the critical role of energy provision in sustaining colonies, particularly during periods of nectar scarcity. Protein and supplementary feeds are used less frequently, suggesting potential gaps in knowledge or resource availability. Understanding the motivations behind feeding practices provides insight into beekeeper decision-making. Supporting colony strength and mitigating environmental stress emerged as primary drivers, emphasizing the importance of adaptive management in response to fluctuating environmental conditions. Conducting this survey in collaboration with beekeepers also highlights the value of citizen science, showing that engaging practitioners in data collection not only strengthens scientific understanding but also ensures that research findings are practically relevant and actionable.

PP-458 [Bee Biology]

Apimondia International Beekeeping Congress
Copenhagen, 2025

Summer Bee / Winter Bee

Physiological & Temporal Comparisons

Successful overwintering is a Honey bee colony's biggest challenge, requiring long-lived bees and internal resources.

As a beekeeper, understanding the physiological components and the epigenetic factors impacting individual longevity can improve practical management at critical transition points in the colony year.

Specific beekeeping tasks involve managing Varroa mites prior to the winter brood being raised, to attain bees with healthy Fat Bodies, and being mindful of food supply when the metabolism of the colony ramps up with brood-rearing headed into spring, so the colony does not starve and freeze as bees age out.

Apis mellifera, the western Honey bee, has evolved to survive as a superorganism in challenging temperate regions, and other seasonal cycles of dearth, without external resources. Winter survival requires a healthy cohort of diutinus (Latin for long-lasting) worker bees, commonly called winter bees, which can live four to five times longer than summer bees. The DNA for these bee phenotypes are the same, although their seasonal gene expression results in different proteins and physiological traits, as well as behavioral adaptations which affect longevity.

The study of epigenetics has made clear that social and environmental stimuli affects gene expression, and these factors affect the temporal polyethism, or age plasticity, of worker bee life history.

Colony level population dynamics, including brood pheromone or lack there of, provides internal-hive stimuli which regulate worker bee behavior in response to colony needs, which in turn influences the physiological state of the individual worker bees. External environmental factors provide additional stimuli.

WINTER BEE

Averaging 165 to 280 DAYS

HIVE BEE

High Vitellogenin protein and lipid storage in Fat Body

May act as nurse bee early in life, before building up and storing proteins

Worker does not transition through hive bee tasks at this juncture

Temperature and daylight hours are shortening

External food supply is dwindling

Brood rearing slows requiring less tending and foraging tasks

Thermoregulation in the winter cluster is the main task in early winter, using internal nutrients and carbohydrates in honey for energy

Hemocytes, honey bee immune cells in the hemolymph, remain high, and unthreatened by external influence

Reduced oxidative stress due to continued high Vitellogenin which is a potent zinc carrier

Insulin-like peptides (ILP), proteins acting as hormones, remain low influencing longevity through metabolism and nutritional homeostasis

Aging is negligible during this winter bee life stage

BROOD-REARING COMMENCES

Colony level metabolic rate and food consumption increases with brood-nest temperature requirements

Thermoregulation becomes more exacting, with Pupae requiring additional vigilance

Depleted internal protein stores due to aging and feeding brood

As Vitellogenin drops Juvenile hormone rises

FORAGER STATE

Immunity plummets

LONG-LIVED WINTER BEE

BEEKEEPING MANAGEMENT: Varroa mites feed on the Fat Body of Honey bees compromising its viability. Managing mites is critical heading towards the lean months before the winter bees are reared. Vitellogenin, synthesized in the Fat Body, plays a role in immune integrity and retards aging in the long-lived winter bees.

Vitellogenin (Vg)
protein storage and immune builder
high in summer hive bees,
additionally high in winter bees

Highly Dense Fat Body

Hypertrophied Hypopharyngeal Gland (HG)c

Hemocytes, honey bee immune cells are high

There is an inverse relationship between Vitellogenin (Vg) and Juvenile Hormone (JH). As Vg drops JH rises.

As brood-rearing commences in mid-winter, population dynamics and colony needs become epigenetic factors in worker bee aging.

The Vitellogenin gene expression and the insulin-like peptide ILP1, a chain of amino acids that act as a hormone, down regulate and juvenile hormone increases.

The Hypopharyngeal gland shrinks (in summer season, the gland transitions from generating Royal Jelly as a nurse bee to the enzyme invertase, to assist in honey processing.)

BEEKEEPING MANAGEMENT: Most colonies that perish in winter do so once the colony is brooding. Maturation in bees accelerates with social responsibility, causing die-off just as the brood nest is growing larger and food reserves are depleting. It's critical to be aware of colony food supply as the brood nest expands.

Juvenile Hormone (JH)
regulated by the endocrine gland corpora allata
(two tiny glands behind the brain)

The rise in JH down regulates the immune system as bees enter the forager state. Risk rises and immunity plummets.

Age Plasticity

SUMMER BEE

Averaging 35 DAYS

HIVE BEE

Vitellogenin protein used for creating royal jelly

Worker transitions through hive bee tasks based on colony needs

As Vitellogenin drops Juvenile hormone rises

FORAGER

Immunity plummets

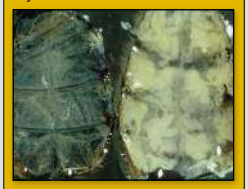
Age Plasticity

The most significant physiological adaptation for the survival of winter bees is the increased internal nutrient storage, primarily in the form of Vitellogenin (Vg), a pre-yolk high-density protein.

Vg is synthesized, stored and secreted by the Fat Body and released into the worker bee hemolymph. The hemolymph circulates the hemocytes, the honey bee immune cells.

Vg plays a critical role in lipid transport and zinc-binding, and limits oxidative stress.

This organ is negatively impacted by Varroa mites.



Fat Body
Forager on left, Nurse bee on right

By permission Swiss Bee Research Centre, Agroscope

Grai St. Clair Rice
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Thank you to the Apimondia Scientific Committee for Biology and Nutrition, Copenhagen 2025.

The research of many individuals and teams have been accessed during my investigation of this subject. I wanted to find a good balance between scientific understanding and applicable understanding for beekeepers to improve their beekeeping success.

A deep thanks for the work of: Karl Crailsheim, Peter Fluri, Stig W. Omholt, Gro V. Amdam, Gene E. Robinson, Heather Mattila, Gard Otis, Mehmet Ali Doke, Maryann Frazier, Christina M. Grozinger, and many others who have elevated our knowledge of Honey bees.

Thank you to fellow beekeepers Karen Sabagh and Jim Luckner, plus New York University Bobst Library and the NY Public Library.

Honeybee Illustration: Robin K. Herman

Summer bee Vitellogenin protein level as nurse bee

Winter bee Vitellogenin protein level is higher & Fat Body denser

Inverse relationship of Vitellogenin & Juvenile hormone

High Juvenile hormone represents the forager state

Beekeeping Management Notes

PP-459 [Bee Biology]
Insights into probiotic-based disease management from a 24-week field trial in California

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Managed honey bee (Apis mellifera) populations play a crucial role in supporting adequate pollination of food crops but are facing unsustainable colony loss as the result of rampant disease spread within agricultural environments. Antibiotics have failed to resolve the issue so far, whereas mounting evidence from in vitro experiments suggest that select lactobacilli strains (some of which are symbionts in honey bees) can inhibit a broad range of important pathogens via multifaceted mechanisms. Focusing on three select strains of lactobacilli (LX3), our group has performed several probiotic field studies in distinct regions across North America. Cumulative evidence indicates that the LX3 strains can significantly improve resistance to disease outbreaks, partially mitigate the negative effects of antibiotics in bees, and increase queen egg laying – the latter of which has the potential to increase the number of bees present in a hive and thus overall pollination capacity which is relevant to agricultural crop yields. Furthermore, our studies show that certain effects derived from LX3 treatment are directly dependent on the way in which the strains were administered to the hive. This highlights that consideration of delivery method is essential for deriving an expected probiotic benefit in honey bees. Overall, the collective scope of this work is expansive and broadly relevant to microbial disease management in terrestrial ecosystems.

PP-460 [Bee Biology]

UNIVERSIDAD DE LA REPÚBLICA URUGUAY

FVET Facultad de Veterinaria Universidad de la República Uruguay

Effect of supplementation with multifloral pollen on the strength and honey production of honey beecolonies located in " Eucalyptus grandis " monocultures

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INTRODUCTION

In Uruguay, forest development has created an opportunity for beekeeping in *Eucalyptus grandis* plantations. Flowering begins in late summer and extends until mid-autumn. However, since these plantations cover large areas of a single crop whose pollen is deficient in certain essential amino acids, colonies tend to weaken towards the end of the season, compromising their ability to survive the winter. In this context, the aim of this study was to assess whether supplementation with multifloral pollen could help improve colony strength and productivity.

METHODOLOGY

The experiment was conducted during the flowering of eucalyptus in a forest field.

24 standardized hives with more than 40,000 adult bees

12 hives without supplementation (control)

12 colonies supplemented with multifloral pollen

The following variables were evaluated

Honey production of each colony at the end of the experiment

The adult bee population, estimated as the number of bee streets (spaces occupied between frames), recorded at the beginning and at the end of the trial.

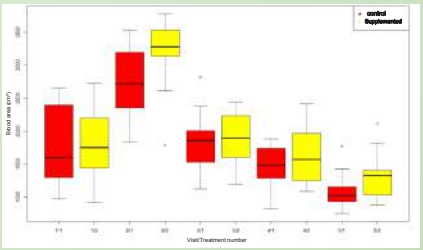
The capped brood area was evaluated throughout the experimental period using image analysis. Five measurements of the brood area were taken for each colony over the course of the experiment.

Statistical analysis

The Mann–Whitney test was used to compare the adult bee population between groups, while ANOVA was employed to assess differences in capped brood area and honey production. All analyses were performed in R version 4.3.2 (R Core Team, 2023), using the packages stats (for ANOVA and Mann–Whitney test), and ggplot2 (Wickham, 2016) for data visualization

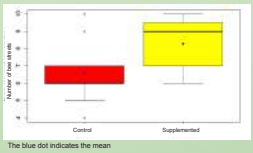
RESULTS

Brood area



No significant differences were detected between groups in capped brood area during the study; however, significant differences were observed among evaluation dates.

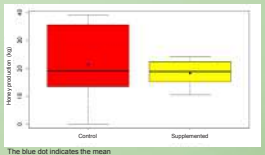
Adult bee population



The blue dot indicates the mean

At the end of the trial, the adult bee population was significantly higher in the Supplemented group compared with the Control (Mann–Whitney, $p = 0.04$).

Honey production



The blue dot indicates the mean

Regarding honey production, although no significant differences were found between treatments, the Supplemented group showed lower variability (18.3 ± 4.9 kg) compared with the Control (22.0 ± 13.8 kg).

CONCLUSION

Multifloral pollen supplementation enhances adult bee survival by improving the nutritional balance in response to the essential amino acid deficiency of *E. grandis* pollen. The larger adult bee population observed at the end of the trial reflects a direct benefit to colony vitality, and this effect may be further amplified in the following weeks, given that nutritional stress can have long-term consequences.

Although honey production did not differ significantly between groups, the lower variability recorded in supplemented colonies represents a practical advantage for beekeeping management, as it results in more homogeneous colonies in terms of productivity.

Overall, multifloral pollen supplementation helps maintain stronger colonies at the end of the *E. grandis* flowering period, which is a key factor for improving overwintering success.

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PP-461 [Bee Biology]

APIMONDIA SCANDINAVIA 2025 23-27 SEPTEMBER COPENHAGEN

Using nutritional ecology as driver of pollen preferences in the ApisRam honey bee model

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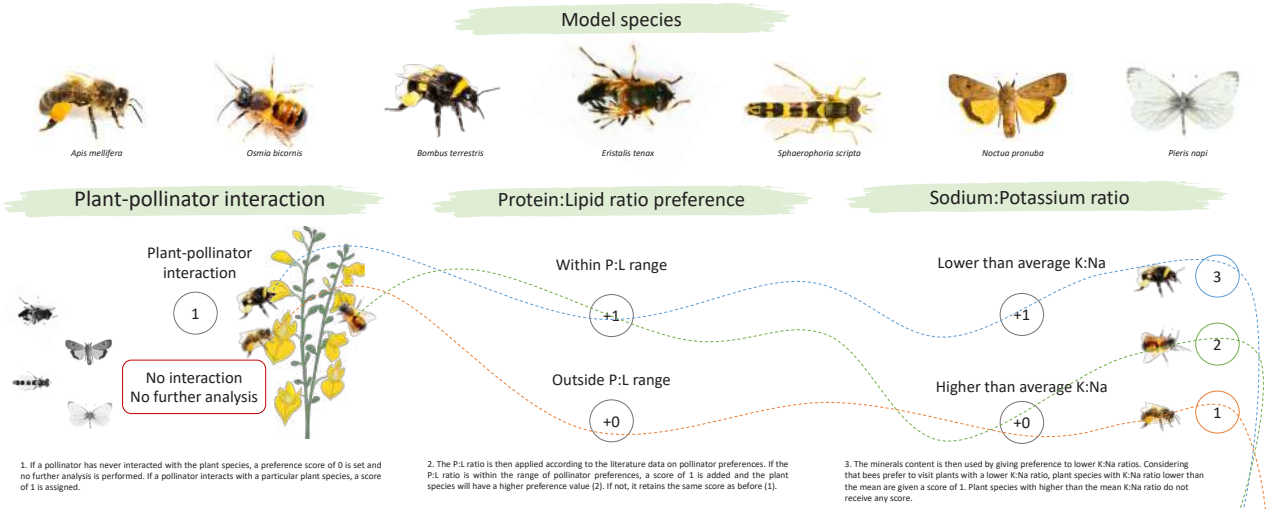
[2]Social-Ecological Systems Simulation Centre, Department of Agroecology, Aarhus University, Aarhus, Denmark
[3]Institute of Environmental Sciences, Faculty of Biology, Jagiellonian University
[4]Institute of Geography and Spatial Management, Faculty of Geography and Geology, Kraków, Poland

INTRODUCTION

The European Food Safety Authority (EFSA) aims to increase the complexity and realism of the Environmental Risk Assessment (ERA) of bees, to better protect these pollinators and their services. To achieve this goal, there is a need to develop models that capture our landscapes spatial and temporal heterogeneity. The ALMaSS is a system of spatially explicit agent-based/subpopulation-based models with a landscape simulation model for use in predicting the effects of human landscape management on a range of key animal species, including pollinators. In the system, several landscape layers are created based on ecological data. For pollinators, one of the most relevant layers is the food availability over time. At this moment, the system already integrates data on the amount of pollen, nectar and sugars produced by a single flower/inflorescence of a given plant species with information on flower/inflorescence abundance (i.e., density of flowers/inflorescences per unit area), flowering phenology, plant composition of the flora/habitat and flora/habitat composition and configuration within the ecosystem/landscape. This approach enables the spatio-temporal availability of floral resources to be predicted within different flora/habitat types and across different ecosystems/landscapes. Nevertheless, to predict landscape-specific pollinator carrying capacities, the pollinators' (agent) behavior and interaction with the virtual landscape also needs to be considered. In here we present a framework to drive these interactions based on the pollen quality for some model species and discuss its implementation within the ApisRam honey bee colony model, which is under development to be implemented by EFSA to increase the ERA realism.

METHODS & RESULTS

A **semi-qualitative scale from 0 to 3** was created to infer the pollinator pollen preference for each plant species that is currently in ALMaSS (total of 408 plant species). The scale follows a stepwise approach based on their possible interaction, and on their nutritional needs and preferences. Each plant species can have a score from 0 to 3, which determines the level of preference of the pollinator: 0 = no interaction, 1 = poorly preferred, 2 = moderately preferred and 3 = Strongly preferred.



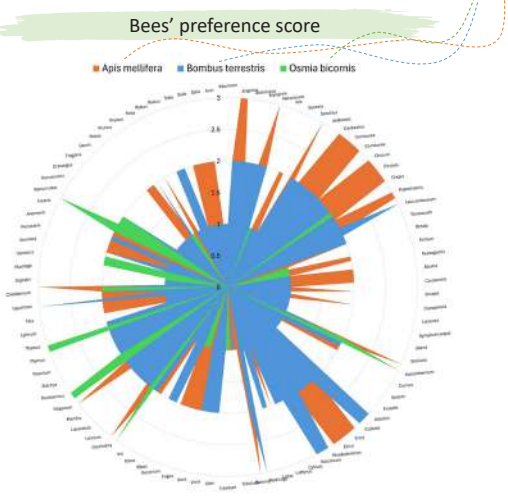
KEY MESSAGES

It is not possible to use the pollen quality strategy to set preferences for syrphids, butterflies and moths. Only for bee species, which collect pollen to feed their larva.

There are plenty of data on plant-pollinator interactions for most of the model species. The exception is *Noctua pronuba*. The organism's nocturnal behaviour makes it harder for researches and citizen scientists to register their interactions.

When considering only bees, 37% of the coded plant species are not visited by any of these pollinators, while 19% of them are visited by only one species. **Thus, possible competition** events between bee species can occur on the remaining **44% .**

Of the 230 species visited by *Apis mellifera*, a preference score of 3 was attributed to 32 species, a score of 2 to 118 species, and a score of 1 to the remaining 80. The implementation of these metrics in the ApisRam honey bee colony model can help to stir the bees (agents) interaction with the landscape.



FUNDING

Better-B has received funding from the European Union, the Swiss State Secretariat for Education, Research and Innovation (SERI) and UK Research and Innovation (UKRI) under the UK government's Horizon Europe funding guarantee (grant number 10068544).

PP-462 [Bee Biology]
Fine-scale assessment of Chorella syrup as a nutritional supplement for honey bees

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3USDA-ARS, Honey Bee Breeding, Genetics and Physiology Research, Baton Rouge, LA, United States
One of the many challenges in modern beekeeping is the declining diversity and availability of flowering plants that provide pollen and nectar to bees, driven by global agricultural expansion. One solution to this shortfall is the additional feeding to honey bee colonies of feed supplements. However, the effectiveness of nutritional supplements on bee health and vitality (e.g., oxidative stress, immune function) is usually not well studied. Recently, microalgae have been a widely studied dietary supplement with promising applications due to a nutrient profile similar to natural pollen. This study evaluated Chlorella vulgaris-enriched syrup as a bee dietary supplement regarding its effect on honey bee and larvae oxidative stress, digestive enzyme activity, and protein vitellogenin level. After the application of Chlorella syrup to the colonies, no changes in digestive enzymes activity were observed in adult worker bees; however, higher gene expression of the antioxidant enzymes catalase (Mann-Whitney U test, p=0.017, Z=-2.390) and superoxide dismutase1 (Mann-Whitney U test, p=0.044, Z=-2.016) was observed. However, in larvae, the expression of those genes was not affected. In Chlorella-fed colonies, a three times higher concentration of vitellogenin was recorded in the hemolymph of worker bees (Mann-Whitney U test, p=4×10-6, Z=-4.629); vitellogenin is a phospholipoglycoprotein which has many roles in honey bees as an antioxidant, as a store of nutrients for the individual, and in immunity. Our findings brought evidence that Chlorella vulgaris-enriched syrup did not negatively affect the digestive capacity or oxidative balance of honey bees. The results provide a solid base and guidelines for further implementing Chlorella as an effective and safe pollen substitute in apiculture practice.
This research was funded by the Inter-Action program of the Ministry of Education, Youth and Sport of the Czech Republic (grant no. LTAUSA17116 and LUAUS24085).

PP-463 [Bee Biology]
The use of fungal extracts as a dietary supplement to improve bee health and immunity

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Bees are key pollinators for a wide variety of crops and contribute significantly to maintaining biodiversity worldwide. However, various stressors, including pathogens, contribute to colony decline and are linked to the detriment of honey bee health. Recent studies suggest that fungal extracts have antimicrobial and antioxidant properties, which can prevent viral infections in bees and may be used as a dietary supplement. Despite this, limited research exists on the effects of fungal extracts on honey bee immune system enzymes. In this study, we aimed to investigate the potential of fungal extracts as a dietary supplement for honey bees, focusing on their effects on immune system enzymes. Ten experimental honey bee colonies (Apis mellifera carnica Pollmann, 1879) were divided into five groups, each consisting of two colonies. The colonies were fed with the following fungal extracts: Ganoderma lucidum (4%), Inonotus obliquus (4%), Trametes versicolor (4%), and Hericium erinaceus (4%), diluted in sugar syrup (sugar: water; 1:1), along with one control group, where bees received only sugar syrup without fungal extracts. The colonies were fed three times a week for three weeks, with a total of three liters of food provided to each colony by the end of the experiment. From each group, 3 µL of hemolymph was collected individually from 10 bees per treatment group at 7, 14, and 21 days, respectively. The samples were then added to a sterile microtube containing 127 µL of 0.6% NaCl and promptly chilled at -25°C for biochemical analyses. Cholesterol, Glutathione S-Transferase, and Triglycerides were analyzed, and our results showed that when bees were fed with fungal extracts, the activities of these enzymes increased ($p<0.0001$), especially after 14 days, compared to bees that were only fed syrup without fungal extracts. Our study has demonstrated that fungal extracts can improve the natural immunity of bees, and based on these results, we can suggest that this supplementation can help bees during their development, but more studies on this area are needed.

PP-464 [Bee Biology]
Understanding and improving honey bee nutrition

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Poor nutrition is a one of the major factors implicated in honey bee colony declines world wide. Optimal nutrition is critical in maintaining strong immunity and better survival of honey bee colonies. Although honey bee nutrition has been studied for a relatively long time, there are still huge gaps in knowledge, especially regarding the role and requirements of micronutrients. Further, beekeepers (especially commercial beekeepers) invest significantly in protein supplements, purchasing large quantities annually to maintain colony health. However, despite the widespread use of these protein supplements, there is a scarcity of information on their efficacy or their return on investment (ROI). The existing research on protein supplements is often incomplete, with many studies lacking critical data on the impact of these diets under both laboratory and field conditions.

The goal of our research was to understand and improve honey bee nutrition by (1) investigating the role of 24 methylenechlesterol (24MC) in honey bee nutritional physiology (2) building a comprehensive pollen nutritional composition database by analyzing protein, lipids, amino acids and phytosterol profiles in 100 pollens utilized by bees and (3) evaluating efficacy of commercially available protein supplements.

Our findings suggest that honey bees fed diets with a sterol concentration of 0.5% survived the longest and their head protein and abdominal lipid levels were also among the highest. Our study also provides additional insights regarding the role 24MC in honey bee nutritional physiology and suggest that 0.5% concentration of 24MC may be an ideal concentration for formulating supplemental protein diets for honey bees. We have analyzed pollen nutritional composition of 100 pollens from various plant species utilized by bees. This nutritional composition data will also be discussed in this presentation. Further, the findings from the protein supplement efficacy study will also be presented and discussed.

PP-465 [Bee Biology]
Mycorrhizal fungi associated with vetch increases honeybee nutrition and honey production examined with biomarker fatty acids

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Plants associate with a complex network of biota both below and above-ground, including microorganisms and arthropods, important for crop health and nutrition. Among plant-associated arthropods honeybees (Apis mellifera L.) play a key role in agroecosystems, particularly in terms of crop pollination and honey production. On the other hand, root associated microorganisms like arbuscular mycorrhizal fungi (AMF) and Rhizobium are key players in plant growth and nutrition, which may affect flowering and the quality of pollen and nectar, and thereby indirectly affect honeybee nutrition. Despite this clear above and belowground link between honeybees and plant growth promoting microorganisms, the knowledge of soil-plant-honeybee interactions is still limited. Here we present results from a greenhouse experiment on the influence of root associated plant growth promoting microorganisms (AMF and Rhizobium) on honeybee performance in terms of honeybee nutrition, health and honey production with vetch (Vicia sativa L.) as host plant. Besides common soil-plant-honeybee variables we measured the fatty acid composition in all soil-plant-honeybee compartments including soil, roots, honeybee and bee bread. Fatty acids are present in all organisms principally as phospholipids in membranes and as energy reserves in terms of neutral lipid fatty acids. Fatty acids have been used as biomarkers to study soil microbial communities and for the quantification of the abundance of specific groups of microorganisms in soil and roots including AMF (16:1ω5) and Rhizobium (17:0cyclo), while the fatty acid composition in honeybees and beebread has been less explored. Our results show that the fatty acid composition in the different soil-plant-honeybee compartments clearly differed. Interestingly, we found a clear positive correlation between the AMF biomarker fatty acid 16:1ω5 in soil and the fatty acid 20:4ω6,9,12,15 in honeybees. Furthermore, honey production was also positively correlated with the abundance of 16:1ω5 in soil. On the other hand, no clear associations between the Rhizobium fatty acid 17:0cyclo in roots and honeybee performance were observed, though 17:0cyclo correlated positively with host plant growth. In conclusion, here we show clear indirect positive effects of AMF on honeybee nutrition and honey production.

PP-466 [Bee Biology]

Advancing Genetic Resiliency in Honeybee Populations Through Long-Term Breeding and Matriline Tracking

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Introduction

Two main aspects of beekeeping are responsible for a large proportion of colony turnover and result in a significant quantity of beekeeper inputs in the form of labor and materials to maintain colony numbers. Foremost is Varroa mites, which parasitize honeybee brood and are the main driver of temperate winter mortality. Secondarily is the maintenance of each colony in a queen-right state, the lack of which is responsible for losses throughout the year.

Thus, the two main activities in managing honeybee colonies in temperate climates are confirming the presence, health, and vitality of the queen in each colony, and the evaluation and mitigation of Varroa infestation levels.

In efforts to increase the frequency of advantageous traits associated with survival, hardiness, and queen longevity, we began a long-term breeding program within our commercial honeybee operation in 2016.

Now, using a newly developed tracking system, we hope to identify matrilines within the operation that demonstrate superior rates of reproductive success and survivorship. We aim to document the matrilines that contribute the greatest amount of genetic material to the maintenance of the total population of colonies, and to then begin investigation into the survivor traits present in these matrilines that contribute to their improved success rates.

Background

Using our small-scale commercial operation based in SW Oregon, USA, as the model system for an interbreeding meta-population (maintained above 260 colonies since the start of the project), we seek to encourage the increase in frequency of multiple survivor traits associated with resistance to Varroa mites, and to increase self-perpetuating habits associated with honeybee queen supersedure and queen longevity in the total population.

We manage our colonies with minimal intervention, using only techniques consistent with organic management practices, seeking only to maintain colony survivorship above minimum levels of economic viability while maintaining selection pressure on the population to evolve toward a greater level of self-reliance and vigor (analogous to a Soft-Bond approach[1]).

To maintain maximal levels of genetic diversity and the preservation of rare alleles associated with survivor traits, we seek to reproduce new colonies from a large sample set within the operation, consisting of roughly 50% of the total colonies each season. This number varies annually based upon needs within the operation for replacement colonies and is dependent upon factors such as mortality rates and the quantity of colonies sold.

We sought to minimize the introduction of any new matrilineal genetics into the operation by discontinuing the introduction of purchased queens from outside the operation and by carrying out rearing and mating of new honeybee queens in isolated locations lacking the presence of other commercial operations.

All new colonies generated in the operation since 2016 are reared either from queen cells originating in the maternal colonies or through inducing the rearing of emergency queens utilizing the walk-away split technique.

Image 1: Lead author and his wife, Joy McEwen, managers and owners of Diggin' Livin' Farm and Apiaries
Image 2: Emergency queen cells used in the production of walk away splits
Image 3: Heritage colonies in the process of removing walk away splits. Note: prepared walkaway splits with additional QR code tags above queen excluders.

Methods

Varroa treatments are applied uniformly across the entire operation at intervals constituting 2–3 times per year as a means of minimizing total colony losses, while also standardizing treatments for statistical purposes.

All colonies are visited twice annually during the months of March–May, which includes the season of natural tendency of colonies to swarm, in order to ascertain the colony size and overall health. If colonies are in a state of vigor roughly above the median level found in the entire operation, a divide is made from the colony in the form of a walk-away split (for details regarding methods used for preparing divides see *Raising Resilient Bees* [1]). The only criteria used to decide if a colony is eligible for a divide is simply the lack of overt disease symptoms and a robust population. It is assumed that forgoing additional selection criteria for reproduction will allow for a suite of resistance mechanisms to increase in frequency in the population simultaneously. Drone source colonies are selected at random from within the operation annually.

The other main means of genetic conversion of maternal genetics within the operation, aside from generation of new colonies, results from the remedy of hopelessly queenless colonies found during apiary inspections. In addition to tracking the maternal origin of germplasm for divides, we likewise track the maternal origin of any germplasm used to fix or re-start a hopelessly queenless colony, and the subsequent success of queen rearing in these instances is likewise recorded.

When a colony is found to lack a queen or the means of rearing a queen, and a suitable amount of time has lapsed to ensure that queen rearing is not in process (aka. the presence of a virgin or newly mated queen), and a colony is found to have sufficient strength to attend to queen rearing, it is designated as a Restart. Brood of a known maternal origin is inserted and subsequently inspected to ascertain the success of queen rearing. If a colony is lacking the vigor to maintain colony functions, it is terminated in the database and a new queen-right colony may be inserted to return the colony to queen-right status.

A tracking system was developed, and a prototype implemented in 2024 to record the maternal origin of the germplasm used to originate new colonies and to measure the relative reproductive success and lifespan of each matriline within the operation. 511 colonies living at the time of the origination of the database were designated as Heritage Colonies. Furthermore, all matrilines are recorded as terminated if the colony fails to maintain a queen-right state. To aid in comparison of reproductive success of each colony and its maternal relatives, a series of simple computations is conducted periodically to aid in identification of matrilines with superior levels of survivorship.

Scoring Metrics

Each colony is scored for the following metrics:

- Mother score = # of living daughters × (# living daughters ÷ total number of daughter colonies originated)
- Sister score = # of living sister colonies × (# living sisters ÷ total number of sister colonies originated)
- Legacy score = # of living descendants × (# living descendants ÷ total number of descendants originated)

Daughter colonies are defined as colonies which reared a new queen from germplasm that originated as eggs laid by a given mother colony. Sister colonies are defined as colonies originating from germplasm obtained from the same maternal colony. Descendent colonies are defined as daughters of a given colony as well as daughters from any colony derived from a given maternal colony (daughters of daughters, and daughters of daughters of daughters etc.).

Results

Eighteen months of data for colony survivorship and relative reproductive success have been recorded, and initial analyses are presented here. After 18 months of colony management the composition of colonies changed significantly from the onset of the data tracking component of this project. Of the original 511 Heritage Colonies, 205 have maintained intact queen lines in their hives without beekeeper intervention. While this number is lower than anticipated, the 2024 season included multiple stochastic events that had deleterious effects on successful supersedure events, resulting in high levels of summer mortality not common in this operation.

Fig. 1. Living Colonies by Colony Type (Aug 24, 2025)

Investigating this matter further, we see in Fig. 2 that the main month of mortality recorded is February of 2025, when colonies were inspected upon the initiation of brood-rearing. Colonies were terminated if they failed to maintain suitable cluster size sufficient for pollination grading or to build up suitable brood area prior to colony rental. Varroa parasitization is likely the driving factor behind failing colonies, though termination was only coded as Parasitic Mite Syndrome if actual brood infestation symptoms were noted, including hygienic behavior, irregular brood patterns, malformed larvae, and mite feces.

The subsequent peaks noted in the months of April and May coincide with the investigation of new colonies initiated to rear new queens, and represent the failed attempts at walk-away splits conducted in March and April. The high levels of mortality reported for the month of August reflect a summation of summer mortality driven by queen failure and are indicative of queen-less colonies being left alone in the months of June and July to ensure they were hopelessly queen-less. The August peak also reflects that data entry was delayed due to a busy season of apiary tasks in the months preceding.

Fig. 2. Mortality by month 2025

In summary of our 2025 mating season, we present that a total of 286 colonies were used to prepare walk-away splits, of which ()% were Heritage Colonies. Additionally, in 2025, new colonies previously generated in 2024 comprised 30% of reproductive colonies and represent a continuation of the increase in the representation of individual matrilines that were reproductive in 2024.

Fig.3 Total New Colonies by Mother Type

Since the start of the 2024 season of increase, we have made a total of 802 new colonies from a total of 384 mother colonies, (see Fig. 4). Amongst reproductive colonies, there was a mean of 2.09 colonies generated per mother colony. This mean value represents another measure of the slow conversion of the genetic composition of the meta-population towards a greater representation of the matrilineal genetics of colonies with a presumed greater level of fitness. As well, many individual mother colonies made much larger contributions to the total population composition, with as many as 8 daughter colonies.

Fig. 4. Daughter Colonies Per Mother Colony

Results continued

Two previously mentioned activities within the meta-population management result in changes in maternal genetic representation. First, and of greatest significance, is the origination of new colonies generated from either queen cells or emergency queen rearing in response to a walk-away split action. In 2025 we initiated a total of 390 walk-away splits from 286 colonies. At the time of writing, 64%, or 250 new colonies, were alive and present within the operation's apiaries. Combined with the 5% of colonies that were sold, we see that a total success rate of 69% was achieved in 2025 using this method of queen rearing.

Additionally, we present the success rate of initiating a Restart of hopelessly queenless colonies. Figure 6 presents our success in initiating queen rearing in colonies lacking the ability to rear a new queen from existing germplasm. The results demonstrate that this technique is less successful as a means of generating new queens than properly constructed walk-away splits. Complexities such as the palletized format of colonies in this season and the presence of laying workers may contribute to the lower success rates observed.

Fig. 5. 2025 Walk-Away Split Outcome

Fig. 6. 2025 Restart Outcome

In preliminary investigation of the metrics of our first two years of genealogical tracking, we have documented significant variation in levels of reproductivity amongst mother colonies. Colonies ranged from non-reproductive, with zero daughter colonies generated, to highly reproductive, with as many as 8 daughter colonies generated. As well colonies have been documented with large variability in reproductive success, ranging from 0 living daughter colonies to as many as 5 living daughter colonies.

Discusssion

Looking at the metrics for individual colonies within the operation is provocative. It is apparent that our lineage tracking system is already elucidating useful information on the relative rate and success of reproduction with the meta-population comprised as our commercial operation. Despite stochastic events, we see that certain individual colonies have reproductive patterns that are anomalies that distinguish them as worthy of further investigation. Interestingly, we see in Fig. 7, that despite Colony 1678 being robust and presumably found to be above the average state of vigor on all visits during swarm season in both 2024 and 2025, and a total of 8 daughter colonies originating from it, none of the daughter colonies are alive today. One could infer that either the colony is failing to impart any significant level of fitness to its daughter colonies, or the daughter colonies have all been very unlucky.

Fig. 7. Metrics for Colony 1678

Fig. 8. Metrics for Colony 1715

Note: Lineage Score is defined here as the Legacy Score of a colony's Mother Colony. It shows how large of a 'family' of living colonies the colony is part of, compared with how many descendants it has of its own. Of greater interest, and the first example of data this project was designed to produce, are the metrics for Colony 1715. Colony 1715 has a Mother Score of 3.57 and a Mother Score Percentile of 98%, due to the fact that 7 daughter colonies have been generated from it and 5 are still living within the operation. With a Legacy Score of 6.25, this colony already has 10 living descendants, showing that several of its daughters have gone on to generate living colonies of their own.

Another example of the relationship between Mother Score, Daughter Score and Legacy Score is seen in Colony 1185 and one of its living daughters. Colony 1185 scores a Mother Score of 5, and a Mother Score Percentile of 100%, signifying it is the highest Mother Score in the operation, as it has generated 5 daughter colonies, all of which are still alive. Furthermore, it has a Legacy Score of 10, denoting that all 10 of its descendants remain alive in the operation.

Fig. 9. Metrics for Colony 1185 (mother of Colony 1406)

Fig. 10. Metrics for Colony 1406 (daughter of Colony 1185)

This provides early evidence for the existence of inheritable traits contributing to survivorship. While these scores will likely be diluted by stochastic events over time, the metrics appear robust enough to give a clear signal that can help identify colonies with enhanced survivorship characteristics.

Summary

As preliminary data for a long-term breeding and tracking project, we are pleased to report on the observed variability within our meta-population. With additional years of data, our tracking system will offer greater resolution of the matrilines responsible for increases in genetic representation within our operation.

Coupled with genetic sampling, this system of observation will allow documentation of gene introgression into a quasi-natural population. We hope that this project will serve as a model of honeybee reproduction that may be repeated, in part as a response to myopic attempts to select 'superior' breeding lines under narrow criteria, which may result in the loss of rare alleles associated with latent or unobservable selection pressures.

References:

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PP-467 [Bee Biology]

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Immunoregulation mechanism and key technologies for high-value utilization of Major Royal Jelly Proteins

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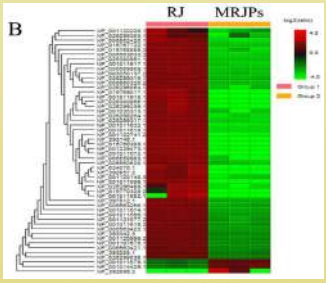
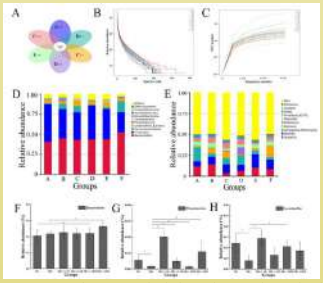
Abstract: China currently is the largest producer of royal jelly. Royal jelly major proteins (MRJPs) are the key active ingredients of royal jelly and have various health functions such as enhancing immunity. Our team had previously analyzed the architecture of the native MRJP1 oligomer, which provided a molecular basis for elucidating its physiological function, and subsequently demonstrated that royal jelly could regulate gut microbiota, and high-pressure processing effectively regulated the aggregation of royal jelly proteins. We have obtained the results as follows: (1) MRJPs could regulate the structure of the flora, taking the phylum level as an example, the abundance of *Bacteroidota* was increased and the abundance of *Proteobacteria* decreased with adding MRJPs, and MRJPs also increased the generation of short chain fatty acids (acetic acid and propionic acid), lowered the pH of the fermentation broth to improve the structure of the gut microbiota; (2) The development of the spleen and liver, the quantity of peripheral blood leukocytes, immunoglobulin content, immune factor level, and the proliferation ability of spleen lymphocytes were improved significantly by feeding MRJPs. 16S rRNA high-throughput sequencing technology analysis showed that the immunity of mice was enhanced by regulating the component and richness of the gut microbiota; (3) Royal jelly could decrease intestinal permeability and the expression of IL-6, increase the expression of IL-10 and sIgA, regulate the relative abundance of the intestinal flora to improve symptoms of DSS induced IBD in mice; (4) high-pressure processing treatment regulated the aggregation behavior mainly by affecting the higher-order structure (tertiary and quaternary structures) of MRJPs and the inter-chain hydrogen bonding and hydrophobic interactions. This study will provide a new perspective for the study of structure-activity relationship and biological activity mechanism of MRJPs and provide a scientific basis for the development and utilization of royal jelly, which has important theoretical and practical significance.

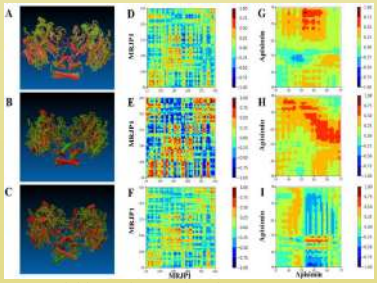
Keywords: major royal jelly proteins; immunoregulation mechanism; high-pressure processing; the aggregation behavior



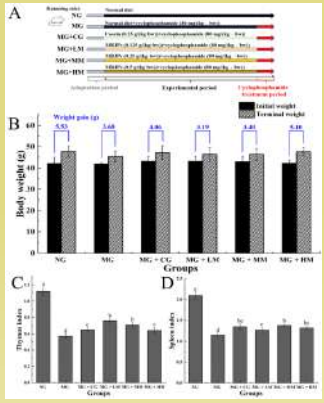
Protein cluster analysis of differences in content between royal jelly and MRJPs



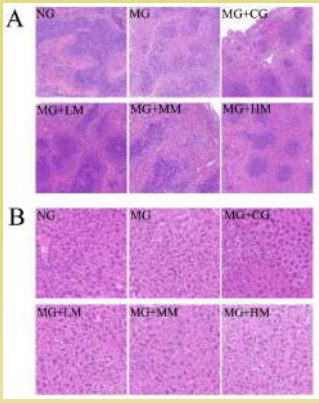
Impact of MRJP administration on intestinal microbiota in cyclophosphamide-induced mice



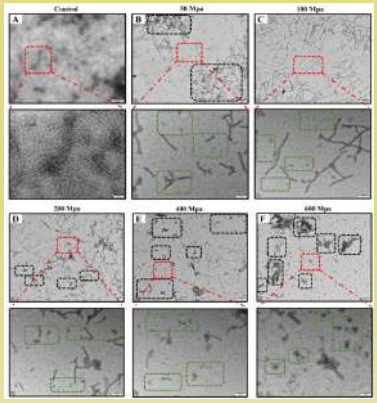
Variable motion results of MRJP1 complex under high-pressure conditions



Influences of MRJPs on the body weight and organ index of cyclophosphamide-induced immunodeficient mice



Effect of MRJPs on H&E staining of the spleen and liver



Transmission electron microscopy (TEM) results of MRJPs solution under HPP treatment

BEEKEEPING ECONOMY

PP-468 [Beekeeping Economy]

TRACING THE ORIGINS OF HONEY: A STUDY OF PUBLIC PROCUREMENT PRACTICES IN SLOVENIAN SCHOOL CANTEENS

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BACKGROUND

FOLLOW ME

- School meals play a vital role in children's nutrition, **covering up to 70% of a student's daily energy intake.**
- National public procurement legislation for educational institutions promote locally sourced food, requires a **minimum of 15% organic food** and **a minimum of 20% food from certified quality schemes.**
- **Honey, a staple in Slovenian cuisine,** is a significant component of school meals, particularly in morning snacks.
- The strong **emphasis on price in public procurement could limit the inclusion of local, high-quality Slovenian honey** in school meals, despite legislative encouragement.

OBJECTIVE

To investigate the procurement practices for honey in Slovenian elementary schools, determining the proportion of local, organic, and quality scheme honey being sourced.

METHODOLOGY

The study was conducted using:
(A) Structured questionnaire on food procurement
- Distributed to all Slovenian elementary schools (N=488), 157 valid responses

(B) One-month (20 days) menu analysis
- 100 publicly available school menus analyzed and frequency of honey's inclusion in meals assessed

HONEY IS ONE OF THE MOST FREQUENTLY PURCHASED LOCAL PRODUCTS, BESIDE FRUIT, VEGETABLES AND MILK.

CONCLUSION

- Slovenian elementary schools demonstrate a **clear and dominant preference for locally produced honey.**
- The **direct sourcing model is highly effective for honey**, as nearly three-quarters of schools procure it directly from beekeepers.

The results confirm that schools are a significant and reliable market for Slovenian beekeepers.

RESULTS

FREQUENCY OF HONEY ON SCHOOL MENUS

78% at least once a month
33% at least twice a month

Most common use: As a spread (with or without butter) and as a sweetener for tea.

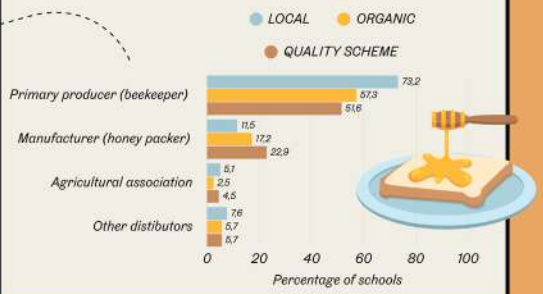
HONEY PROCUREMENT BY TYPE

A high percentage of schools opt to purchase honey with added value:

89% LOCAL HONEY
76% QUALITY SCHEMES HONEY
75% ORGANIC HONEY

THE GAP: PURCHASING VS. MENU LABELING
Despite the high rates of procurement, this information is rarely communicated on the school menus.

SOURCING CHANNELS FOR HONEY



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SCHOOL PLATE

PP-469 [Beekeeping Economy]

Poster 0003

The Apitourism Regions for boosting the Tourism Heritage of the Republic of Benin

(49th APIMONDIA Congress, APIMONDIA 2025. Copenhagen, Denmark 23-27 September 2025. www.apimondia2025.com)

By Felicien AMAKPE[1], Dirk C. de GRAAF [2], Brice SINSIN[3], Honore BIAOU[4]

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Unlike classic tourism, Apitourism is the sharing of goods and services of the bees in a given society. It integrates apitherapy and the promotion of beehive products for strengthening the interrelationships between human beings, the bees, and floral resources. It helps achieve socio-economic, cultural, environmental, and spiritual needs without compromising the ecological functions for living in harmony with nature.

Traditional hives in northern Benin

Apitourism regions in Benin

North Beninese Apitourism region

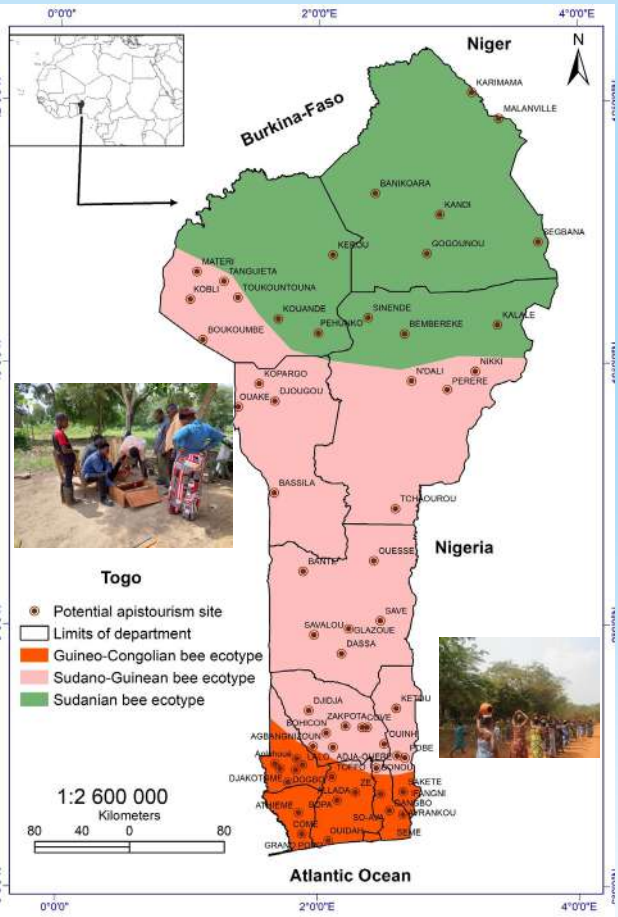
- Giant honeybee of the *adansonii* genotype;
- The oldest beekeeping practices with traditional hives;
- 8% of the country's tourism reception capacity;
- Areas of Nationals Parks with big games, hunting trails, geological landscapes;
- Apitourism sites to be integrated into the functional classic tourism itineraries in the cities of Kandi, Banikoara, Malanville, Natitingou, Tanguieta, and Porga.

Central Beninese Apitourism region

- Medium sized honeybees of *scutellata* and *adansonii* genotypes;
- Best honey potential and highest beekeeper population in Benin;
- 18% of national tourism reception capacities of Benin;
- Suitable Apitourism sites in the cities of Abomey, Bohicon, Djidja, Dassa, Savalou, Parakou, Djougou, Bassila, and Nikki.

South Beninese Apitourism region

- Small-sized honeybees of *iberiensis* and *scutellata* genotypes;
- Few beekeepers and low honey potential;
- 75% of national tourism reception capacities of Benin;
- Suitable Apitourism sites in the cities of Ouidah, Abomey-Calavi, Porto-Novo around Museums, sacred groves, Research centres or dedicated apiaries, Industrial quarries,



The integration of bees into existing tourism heritage of Benin will help strengthen the existing tourism site management sustainability, environmental sustainability, cultural, and socio-economic sustainability, the four key principles of the worldwide tourism development. This allows an optimal exploitation of tourism potentials while preserving their authenticity and long term ecological and social values. It requires a strong public-private partnership and actors capacity strengthening,

PP-470 [Beekeeping Economy]
Developing your CSA (Community Supported Apiary)

Emily Bondor
Emily Bondor

Your apiary is a fertile and productive place, and the public is hungry for quality beekeeping experiences. Your apiary can be a hub for community education and a way to build a resilient network of local makers, chefs, farmers, scientists, artists, healers and everyone in between. By using your expertise in apiculture, you can generate revenue by offering a variety of events, from honey tastings and hive tours to interactive maker workshops and even advanced beekeeping symposia. There are a number of creative ways the bees can inspire different community events. These events can build your brand which in turn can lead to the sale of additional hive products, and depending on your market, even on-going hive management contracts. In addition, there are opportunities to collaborate with local videographers at these events to create content that can be uploaded into online learning platforms. There, you can monetize your content to have a steady stream of revenue for your beekeeping operation.

PP-471 [Beekeeping Economy]

Abstract no.0329

BEEKEEPING ENTREPRENEURSHIP, ITS SCOPE IN Yamunanagar District, Haryana, India

Naresh Pal, Jt. C.E.O.,Retd,KVIC,Daisy Thomas Dy. Director,Retd, CBRTI,KVIC

Beekeeping entrepreneurship is a concept that involves bee management and conversion of sector into business. Beekeeping helps in economic development of the country. Entrepreneurs plays an important role

STRENGTH

HARYANA is a potential state in honey production, due to Its floral sources. Both small and medium scale beekeeping in urban and rural areas of Yamunanagar have good scope as the area is potential for beekeeping. Majority of the beekeepers are having high level of economic motivation, desire for achievement and risk taking ability. Majority of the beekeepers are youths belonging to the age of 20 to 35 years .

WEAKNESS

Beekeeping can be an important agro-based enterprise. The beekeepers are to be equipped with appropriate training programs and in-depth beekeeping knowledge. The willingness to design appropriate strategies in beekeeping venture to be developed. Government Beekeeping schemes to be provided , which helps the entrepreneurs to take various new initiatives in the field of beekeeping and allied enterprise.

OPPORTUNITY

MARKETING of honey and other bee hive products like bees wax, pollen, propolis, royal jelly , bee venom, sale of packaged bee, the rearing and sale of good colonies, renting out bee colonies for pollination etc. leads to tremendous scope as entrepreneurship activity . Apart from direct employment, hive manufacturers, apicultural equipment and machinery manufacturers, transport system for migration of colonies, traders, quality experts, packers, sellers, raw material dealers, etc. also offers tremendous scope.

THREAT

Climate: Unconditional weather and prolonged rainy season
Pest and diseases: bee diseases ,mites and wild animal attack
Pricing of bee products: Fluctuations in prices of honey and other hive products
Interference of Traders: Beekeepers sell their honey directly to the traders, no opportunity to decide or get satisfactory price of their products

Value-added honey products make Y'nagar farmer leading agripreneur

Bees are the world's best and largest source of pollination; beekeeping thus provides sustainable livelihoods
Boost for beekeepers: Haryana CM Nayab Saini announces inclusion of honey in Bhavantar Bharpai Yojana
Aug 16, 2025,- T.O.I.

49th APIMONDIA INTERNATIONAL APICULTURAL CONGRESS scheduled at Copenhagen, Denmark From 23-27 Sept- 2025

PP-472 [Beekeeping Economy]
Assessing the Impact of PESTEL Factors on the Growth and Resilience of Iran's Beekeeping Industry

Soma Rahmani[1], Forough Mohammadi[2], Meysam Shahbazi[3], Behzad Bankipour[1]
[1]Apitherapy department, Ghazal Danesh Pazhouh institute of technology
[2]Management and Economic faculty, Tarbiat Modares University
[3]Faculty of Management and Accounting, Farabi compus, Tehran University

The beekeeping industry plays a crucial role in environmental sustainability, agricultural productivity, and rural economic development. Given Iran's significant position in global honey production, understanding the external factors shaping this industry is essential for ensuring its long-term growth and stability. Based on this, This study investigates the external environmental factors influencing the development of Iran's beekeeping industry through a comprehensive PESTEL (Political, Economic, Social, Technical, Ecological and Legal) analysis. By examining political, economic, social, environmental, and public policy dimensions, the research aims to provide strategic insights for sustainable industry growth. A mixed-methods approach was adopted, beginning with qualitative content analysis of semi-structured interviews conducted with industry experts to identify key influencing factors. These factors were then categorized within the PESTEL framework, and twelve critical sub-criteria were selected for further quantitative analysis using MICMAC software. The influence-dependence matrix revealed that public policy-related variables, along with cultural and social factors, play a dominant role in shaping industry dynamics, acting as both key drivers and highly reactive elements. The findings highlight the significant impact of regulatory policies on the beekeeping sector's stability and expansion. Ultimately, the study underscores the necessity of targeted policy interventions to mitigate risks, enhance industry resilience, and leverage strategic growth opportunities.

APIMONDIA SCANDINAVIA 2025
SWEDEN | DENMARK | NORWAY

PP-473 [Beekeeping Economy]

Abstract No- 0417

TRENDS IN MARKETING OF HONEY IN INDIA

Vijendra Singh, Asst. Director, KVIC, Daisy Thomas, Dy. Director, Retd. CBRTI, KVIC, Pune,

In India, about 36 lakh bee colonies (both A. cerana and A.mellifera) reared by about 5 lakh beekeepers. Quantum of honey produced is about 1, 34,000 Metric. tonnes . India stands 7th position in world honey production.

STATE WISE HONEY PRODUCTION IN INDIA

Honey Production in various states of India during 2023-24 (Source: NHB,GOI)

PRESENT STATUS OF HONEY MARKETING

The global honey market is expected to experience significant growth in 2024, driven by many factors

1 Growing consumer awareness: due to its health benefits
2 Technological Advancements: like Modern Honey processing plants and extraction methodology.
3 Sustainability Concerns : The industry faces challenges related to environmental sustainability and the protection of bee populations.
4 Climate Change: Impacts bee colony development, health and honey production leading to fluctuations in supply.

INDIA- A SOURCE OF UNIQUE FLORA

Availability of many Unifloral sources in India

Based on the flavour, the market has been segmented into multiflora honey, Eucalyptus honey, Ajwain honey, Sidar honey, Plectrathus, Kadipatha, Sunflower, Mustard, Litchi ,Berseem, Tulsi, Acacia ,Sandal wood, Jamun, Sesame, Tamarind, Rubber, Drumstick etc. Multiflora honey of the above flora combination exhibits a clear dominance in the market. Stingless bee honey and comb honey are popular in India.Infused honeys: Ginger infused honey, Tulsi Infused Honey, Garlic infused honey, Haldi Infused Honey, Cinnamon infused honey, Clove Infused Honey, Cardamom infused honey are in demand.

Ajwain-Gujarat

EUCALYPTUS- U.P.

MUSTARD HARYANA, U.P.

LITCHI- BIHAR, U.P.

TRENDS IN HONEY MARKETING-1

1. Honey Consumption Patterns

Honey for Health and Wellness
Honey as Food and Beverage Honey in Cosmetics and Personal skincare and beauty products due to its moisturizing and soothing properties, eg. Soaps, Masks, Honey as a natural alternative to refined sugar Honey as a flavour enhancer in a wide range of food, Sauces and condiments Honey as medicine due to Antioxidant properties ,Anti-inflammatory effects ,Improved immune function

2. Honey Trade and Import/Export Dynamics

Exporting Countries. China, Argentina, and India are among the leading Countries globally.
Importing Countries. United States, Germany, and Japan are major importers of honey.
Trade Agreements :International trade agreements and regulations influence honey trade flows.
Market Access: Honey producers face challenges in accessing new markets due to import restrictions and quality standards.

3. Honey Pricing and MarketVolatility

Supply and Demand in Global Market fluctuates which is due to factors like weather, bee health and affects prices. Economic conditions, currency exchange rates, and geopolitical events influence honey prices.
Consumer Preferences ,Competition from other sweeteners, such as high- fructose corn syrup and artificial sweeteners, can affect honey pricing. Demand for specific honey varieties, such as organic or raw honey, medicinal honey like stingless bee honey, unifloral honey, comb honey can impact pricing.
Emergence of unique sale counters like Honey parlour leads good marketing.

MODERN HONEY PROCESSING PLANT

HONEY PARLOUR , CBRTI, PUNE

CHALLENGES IN MARKETING

Lack of quality testing facility district wise
Logistics and migration
Unscientific management
Unskilled labour
Storage facility of honey
Processing, packing, grading as per parameters,
Pricing, minimum price support,
Market promotion, export facilities

CONCLUSIONS

Honey Market Trends In India:

- Nowadays, key players are launching different flavors of honey, such as tulsi, ajwain, litchi, jamun etc, which is driving force of market growth.
- Rising utilization of honey as a medicinal honey, usage in home remedies due to its antibacterial and antiseptic qualities wounds and burns.
- Scientific validation of the medicinal properties of honey ,usage as nutraceuticals creates a favourable market outlook.
- Easy product availability through e-commerce platforms are escalating the product demand across the country.
- IMARC Group expects the market to reach INR 50.0 Billion by 2033, exhibiting a CAGR of 7% during the forecast period (2025-2033).

SUNFLOWER PUNJAB , A.P.

SHISHAM HARYANA

PP-474 [Beekeeping Economy]

COPENHAGEN

Production and marketing experience of honey and pollen in the high tropics with seven beneficiaries and apiaries with average heights of 3,500 MSL in the municipalities of Aquitania, Sogamoso and Tota, Boyacá Colombia

Parrado, Mario; Calle, Sara. **COMAPIS APICULTURA**. Bogota DC, Colombia. 2025. contacto@comapis.com
www.comapis.com

Colombia has 3 departments (Boyacá, Cundinamarca and Santander) that produce pollen. Having productions during 33 weeks of the year, hives that produce up to 55Kg of pollen/hive/year.

Colombia may be the largest producer and exporter of pollen in the world.

They are apiaries installed in places far from urban centers, crops and roads. COMAPIS developed and executed a project financed by AICCA in the Boyacá region for the restoration of the upper basin of the Lake Tota ring

Height, **3500 MSL**
36 hives.
Lake Tota ring, one of the highest lakes in the world.
Daily and indiscriminate use of insecticides is the greatest impact along with the reduction of forests to plant onions in the region.
The main challenge was to locate the apiaries, with the experience of COMAPIS it was determined: to reduce impact by insecticides, little wind, low humidity and high solar radiation; 2 apiaries were located in Sogamoso, two in Aquitania and three in Tota, Boyacá

Pollen

6 month
Sep 2021 – Mar 2022

257Kg collected

Fresh pollen price
US$4,62/Kg
COP$20.000/Kg

Today

1.254Kg collected pollen

Honey

6 month
Sep 2021 – Mar 2022

127Kg collected honey

Seal of designation of origin
US$16/Kg

Today

+750Kg collected honey
9 apiaries

+57 311 568 59 19
comapis_apicultura
comapis_apicultura

PP-475 [Beekeeping Economy]

JEOMETRY BEEWEAR™

Using smart design to reinvent the beekeeping suit for women and streamline production for affordable domestic apparel manufacturing

INTRODUCTION

I am a third-generation, SC Journeyman beekeeper with 20+ years' experience sewing apparel for women. At a 2023 conference, a panel of women beekeepers expressed frustration with their beekeeping suits. "The crotch is at my knees!" said one. "I bend over and stuff falls out of the pockets!" said another. I shot up my hand saying, "I'll design one." Cheers all around! In 2024, I won a research grant from the South Carolina Beekeepers Association to develop a better women's beekeeping suit and produce it locally in America.

PROBLEM

- Unisex suits based on men's workwear: oversized and awkward
- Ignore fit for women's proportions and feminine curves
- Detaching veil introduces vulnerabilities and prohibits easy washing
- Hot, heavy, bulky multi-layered fabrics restrict ventilation
- Complicated design sustains obsolete and redundant features
- Overbuilt product demands cheap offshore labor for production

METHODOLOGY

- Survey 100+ female beekeepers for design input
- Tailor suit body to fit women's proportions
- Draft, design, and sew progressive prototypes
- Wear-test each prototype with bees in active apiary
- Scrutinize, innovate, and improve every aspect
- Eliminate vulnerability, redundancy, and waste
- Hire domestic contractors throughout development
- Source high-performance yet sustainable materials

RESULTS

- **"Sunny Suit"** women-specific beekeeping suit
- Designed for women's curnes and proportions
- Performance details inspired by athletic gear
- One-zip simplicity for quick dress and access
- Integrated veil eliminates seam vulnerability
- Entire suit is machine washable and bleachable
- Entire suit weighs less than 1KG/2 pounds
- Fabric: 100% recycled PET 3-layer mesh
- Standard women's sizes from XS to XXL
- Manufactured locally in North Carolina, USA

PRACTICAL IMPLICATIONS

- Better fit = comfort, safety, and confidence
- Streamlined design = affordable production
- 100% recycled fabric reduces landfill waste
- Greige (undyed) fabric reduces water usage

- **Empower women to help save the bees!**
- Attractive & stylish—a suit women actually want to wear
- Encourage new beekeepers by removing fit barriers
- Keep women active in beekeeping with better gear
- Strengthen community and women's role in beekeeping

SOUTH CAROLINA BEEKEEPERS ASSOC.

MADE IN USA

MADE FROM RECYCLED PET BOTTLES

Jeometry Beewear™ by Jennifer York
founder, designer, author & entrepreneur
Charleston, South Carolina USA
jeometrybeewear.com @jeometrybeewear
+1 (828) 275-0305 | jennythreads@gmail.com

jeometrybeewear.com

PP-476 [Beekeeping Economy]
World Bee Day: Promoting Bee Conservation and Awareness

Peter Kozmus
Slovenian Beekeepers` Association

In 2017, following an initiative by the Republic of Slovenia, the United Nations declared May 20th as World Bee Day (WBD) to raise awareness about the vital role of bees and other pollinators in food security and biodiversity. Since then, WBD has been observed annually, not just as a celebration but as a global call to action.

Each year, WBD serves as a platform to educate the public and policymakers about the challenges bees face, such as habitat loss, climate change, and pesticide use. Encouragingly, more organizations dedicated to bee conservation, environmental sustainability, and planetary health actively participate in WBD initiatives. The Food and Agriculture Organization (FAO), in collaboration with Apimondia, continues to play a key role in these efforts, underscoring the urgency of protecting pollinators.

While the annual WBD theme evolves, its three core objectives remain constant:
(A) Raising awareness of the crucial role of bees and pollinators,
(B) Informing decision-makers about the threats bees face, and
(C) Encouraging collective action to safeguard bee populations for future generations.

The specific challenges affecting bees vary across regions, making it essential to identify local threats and implement targeted solutions. Without concrete action, awareness alone is insufficient. In Slovenia, for example, recognizing the need for better summer forage for bees led to a national initiative to plant over two million honey plants. Another key initiative is the Golden Bee Award, presented annually by the President of Slovenia, honoring individuals and organizations worldwide for their contributions to pollinator conservation.

World Bee Day is a crucial opportunity to take meaningful steps toward protecting bees and their habitats. By improving conditions for pollinators, we not only support biodiversity but also contribute to a healthier planet for future generations. Let's use this day as a catalyst for lasting environmental change.

PP-477 [Beekeeping Economy]

APIMONDIA SCANDINAVIA 2025 23-27 SEPTEMBER COPENHAGEN

A new device to detect the adulterated honey: Business plan

Josely Borges-Ortiz*, Luis Alberto García-Domínguez, José Ramón Atoche-Enseñat, Elizabeth Ortiz-Vázquez
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Keywords: Honeybee, exportation, adulteration, authenticity, entrepreneur

Introduction

The importance of honey authenticity is becoming more relevant today due the adulteration of this product in the world market; affecting not only exporters but also beekeepers. Mexico is one of the leading honey exporters, with Yucatán being the largest producer, according to Baena-Díaz et al. (2022). More than 50% of total honey production is exported to countries such as Germany, USA,UK, Switzerland and Netherlands, generating revenues of more than $2.25 million in 2024. The main objective of this research is to create a business plan with its benefits and advantages in a business environment. We are presenting the structure of a business plan that evaluates the market potential and advantages of this product. Honey adulteration has increased from 14% to 35% between 2019 and 2021, in México. Global trends suggest it could reach 60% (Figure 1), also reported by scientists and businesses. This is why a product is needed that quickly identifies adulterated honey; in our institute it has been designed and constructed a device to detect adulterated honey.

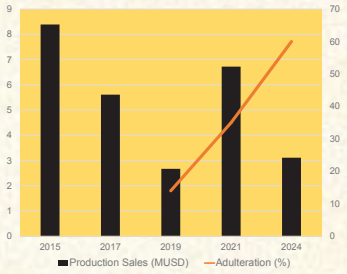

Fig. 1. Production and adulteration in México.

Methodology

A mixed method approach was used, combining quantitative and qualitative data. Information from books, articles, websites and field observations of beekeepers, exporters and laboratories is used.
The business plan is based on Balanko (2007), "How to prepare a Successful Business Plan", and is divided in to nine sections, that provides insight into important business aspects and evaluates the entrepreneur potential. The business plan is not linear, information is used in every chapter, so it is important to review several times and complete each chapter until every chapter is ready to present it to an investor and use it in business operations.

Results

The business plan provides an overview of the business environment, with a focus on the state of Yucatan. This project offers technological solutions to beekeeping in Yucatan, where around 7,000 beekeepers depend on honey sales. Beekeeping in Mexico is one of the main agricultural economic activities; in 2021, the country ranked 7th worldwide showed in figure 2 (Mena-Roa, 2023). Market analysis identified that producers and exporters consider it a priority to differentiate authentic honey from adulterated products. One solution has been laboratory services, which requires long and high costs, limiting their use in difficult circumstances.

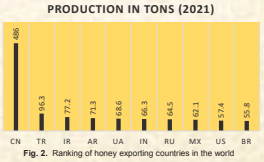

Fig. 2. Ranking of honey exporting countries in the world

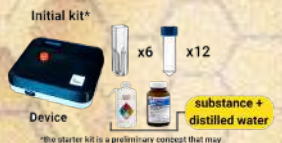

Fig. 3. Starter kit, device and tools for honey authenticity testing.

Therefore, an innovative, portable and quick device (figure 6) is proposed that, through a patented scientific procedure (MX/a/2015/01788), guarantees honey authenticity. It will be sold in a starter kit with 60 tests, showed in figure 3, covering two annual honey harvests. The device also incorporates 3D printing technology with recyclable materials and reusable components up to 10 times. The business model will be based on the initial kit and refills in packs of 50 and 100 tests. The break-even point is projected for the second year, with financial stability by the third year.

The project's vision and mission are to lead the development of natural food authentication technologies through affordable and reliable devices that guarantee transparency throughout the value chain. The marketing strategy will focus primarily on product positioning, including collaborations with associations and participation in industry trade shows and events. To support this, management structure is flexible and divided into three areas: administrative, marketing, and production (figure 4). Tasks will be distributed among these areas to maintain efficiency and avoid overload.

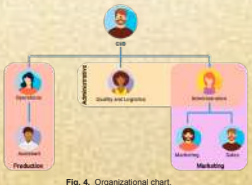

Fig. 4. Organizational chart.

Fig. 5. Future business phases.

The implementation plan continues to be developed, structured in three major phases (figure 5): (1) pilot and field validation, and market launch. (1) national expansion and, (3) international scaling in the future. Risks include fluctuations in honey prices, regulatory barriers, and potential slowdown in initial adoption. The main strategy is to establish the device to become and official verification tool, expand on to other beekeeping-related products, and secure financial investments.

Fig. 6. 3D printed device, USB-C charged, lightweight and compact

Conclusions

This business plan demonstrates an opportunity to position a new device in the Mexican beekeeping sector. Financial projections indicate sustainability within three years. This business will help beekeepers and exporters verify the authenticity of honey, protecting production and its competitiveness in local, national and international markets.
This business is an innovative proposal which contributes improving the competitiveness of Mexican honey in international markets, and enhances traceability throughout the honey supply chain and responsible production and consumption.

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PP-478 [Beekeeping Economy]

TO THE FRONT LINE OF FOOD SECURITY: HONEYBEE POLLINATION AS A PART OF SECURITY OF SUPPLY

Anna-Maria Borshagovski[1], Sakari Raiskio[2], Liisa Vigelius[2], Jarmo Ketola[2]
1 Finnish Beekeepers' Association, 2 Natural Resources Institute Finland

Background

Pollination is a critical ecosystem service for agricultural productivity, and it directly impacts food security and security of supply.

Declining pollinator populations with increasing agricultural demands create a potential shortfall in the stability of food supply. In addition, all the bumblebees used for crop pollination in Finland are imported, while honeybee pollination is generally underutilized.

MEHIVARMA-project emphasizes the importance of beekeeping in nationwide food security. it aims to develop honeybee pollination practices and networks in Finland to increase the role of pollination in food security, to better connect the supply and demand of pollination services and to be better prepared for future crisis situations.

Methods

We will create 1) a national model of operation for beekeepers and farmers consisting of guidelines for crisis situations and strategies for developing pollination services, and 2) a pollination service network where farmers (demand) and beekeepers (supply) can more easily connect.

We achieve these objectives with different experiments on pollination services and beekeeping practices as well as organizing workshops and webinars for farmers and beekeepers to develop future pollination services together.

Expected results

Increased demand for food security and managed pollination services creates potential expansion opportunities for beekeepers. They will be able to offer better tailored services and develop their field. By working closely together with farmers, beekeepers will have the latest knowledge of pollination demands and therefore the ability to adapt in changing times, placing them at the front line of food security.

More information

PP-479 [Beekeeping Economy]

Expanding market opportunities with High-ROI Top-Bar NUC production

by Nathalie B. @ Bee-Mindful.com

APIMONDIA SCANDINAVIA 2025 23-27 SEPTEMBER COPENHAGEN

BEE MINDFUL
Horizontal, Natural Beekeeping

Standardized Horizontal Top-Bar Hive and NUC production allows suppliers to tap high-profit, underserved niche markets.

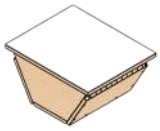
NEED

A competitive market demands new, innovative strategies

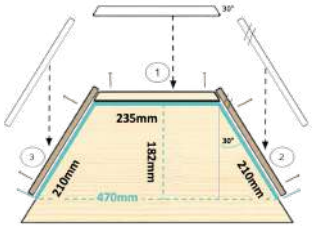
- The Langstroth and honey markets are crowded with large-scale producers, making it **hard for smaller operations to stand out.**
- Meanwhile, hobbyists and small farmers are **looking for affordable, ergonomic, sustainable hives and NUCs** – a high-demand product segment that remains in scarce supply.

HTBH

MATCHING NUC



STANDARD INTERNAL DIMENSION



OPPORTUNITY

Standardized Top-Bar NUCs are a profitable, untapped niche

- **Standardized** Horizontal Top-Bar Hives (HTBHs) and matching NUCs create a **high-demand, high-ROI product** for an **underserved market**.
- **Offering Standard Top-Bar NUCs** helps suppliers stand out, diversify, and attract a growing niche of customers seeking accessible, bee-centered systems and comb honey access.

COMB HONEY PRODUCTION

DESIGN STANDARD

Interchangeable, Efficient and Flexible

- **Standardized Internal Dimensions** create **full interchangeability** between hives and NUCs, fueling scalable production and niche market growth for **high-ROI Top-Bar Hives and matching NUCs,** while creating downstream opportunities for specialized training, consulting, and sustainable, accessible beekeeping .
- The **Flex Hive Adapter** lets Lang owners easily produce standardized Top-Bar NUCs with their existing Lang colonies.

SCAN ME

SCAN ME

For free, easy, DIY plans and instructions

IMPACT

More Options, More Revenue, while building a Sustainable, Inclusive Future

- **Standard Top-Bar Hive and NUC production** gives early adopters a first-mover advantage in a wide-open market with no large-scale competitors.
- With **high margins**, **low costs**, and **strong demand**, they help producers stand out, diversify offerings, and grow market share.
- Customers seeking sustainable solutions are willing to pay more for Top-Bar NUCs, helping **early adopters** position themselves as **leading suppliers** in a **fast-growing**, **profitable niche market**, while growing the sustainable beekeeping movement.

Standardized Horizontal Top-Bar Hive and NUC production allows suppliers to tap high-profit, underserved niche markets.

PP-480 [Beekeeping Economy]

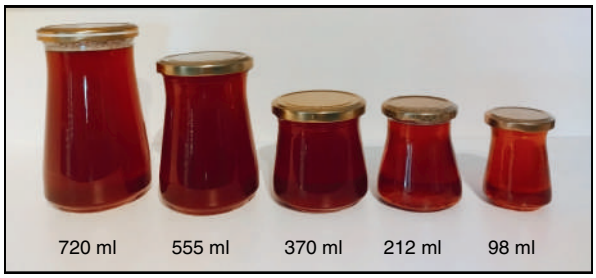
Slovenian Honey and Bee Products Jars

QUALITY AND RECOGNITION

Tina Žerovnik, Advisor for Beekeeping Economics, Slovenian Beekeepers' Association

Keywords: Standardized jars, Packaging design, Consumer confidence, Competitive advantage, Local honey and beeproducts.

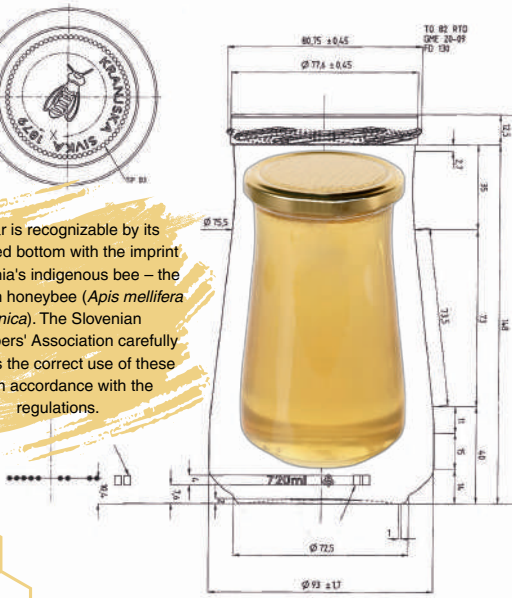
Due to its diverse flora, geographical conditions, and good beekeeping practices, Slovenian honey and other bee products are synonymous for quality, and therefore deserve recognizable and carefully designed packaging. This not only serves to protect and preserve the product, but also plays an important communication role.



A standardized honey packaging was developed in Slovenia 17 years ago – a glass jar with a capacity of 720 ml, intended exclusively for bee products and products of Slovenian origin. Today we have 5 different sizes of jar. Different sizes of honey jars are adapted to different target groups and marketing strategies. The larger jars are intended for families and regular honey consumers. The smaller jars are suitable as gifts, for buying several different types of honey or for packaging other bee products and products with added value. The smallest jar is ideal for gift sets and tourists, as it is easy to carry and suitable for hand luggage in case of air travel. Selling in smaller packages allows beekeepers to charge a higher price per unit.

The main purpose of standardized jars is to strengthen consumer confidence in Slovenian bee products. The packaging attracts attention with its motivational role. Based on the positive experience with the use of foods in standardized packaging, its commemorative role provides a return to purchase. The jars enable beekeepers to be more competitive on the market, and make it easier for consumers to recognize honey and bee products of Slovenian origin. This way, they can distinguish high-quality local honey from imported products that often flood the market.

The jar is recognizable by its embossed bottom with the imprint of Slovenia's indigenous bee – the Carniolan honeybee (*Apis mellifera carnica*). The Slovenian Beekeepers' Association carefully monitors the correct use of these jars in accordance with the regulations.



The Slovenian Beekeepers' Association is working to ensure that as many Slovenian beekeepers as possible put their products exclusively into standardised jars. The greater use of these jars means greater recognition of both the packaging and the honey and bee products among consumers. Greater interest in purchasing leads to greater demand for Slovenian bee products, which, given the limited supply, which depends on the beekeeping harvest, can contribute to higher sales prices and improved sales economics.

PP-481 [Beekeeping Economy]

APICULTURE & MELIPONICULTURE PRACTICES

A Story from Malaysia

Wan Iryani Wan Ismail[1,2,3,4]
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4 Head of Working Group for Malaysian Honey Bee Honey and Stingless Bee Honey, Department of Standards, Malaysia

HIGH POTENTIAL OF THE BEEKEEPING INDUSTRY

Rising Industry
≥ **60,000** hives throughout Malaysia

Boosted Income
Especially from a low-income background (ie. single mother)

High Revenue
Total honey revenue ≥**USD 5m** (2024)

Trehalulose & antioxidant
Honey, propolis & bee bread with high in Trehalulose & nutrients antioxidants

Therapeutic Applications
Potential therapeutic role in treatment of many disease

High Commercial Value

Honey
Premium pharmaceutical, nutraceutical & cosmetic applications

Beebread
Niche nutraceutical, sport nutrition & animal feed additive

Propolis
High-value pharmaceutical & cosmetic applications

Beekeeping in Malaysia has a long history. Department of Agricultural Malaysia recorded that modern beekeeping with honey bees started in the 1980s. In 2016, stingless bee farming began to support honey bee farming. Both practices benefit many people involved.

1980 - 1990
National apiary & modern beekeeping establishment

2008 - 2016
Rising trend of stingless beekeeping and research

2017 - 2020
1st National Kelulut Honey Standard & 10 years Industry Development Plan

2025 onwards

CHALLENGES

OPPORTUNITIES

More specific and strategic plan to combat several issues:

- **Food Security**
- **Climate Change**
- **Socioeconomics**
- **Health challenges**

"Strengthening local beekeeping involves recognizing bee species diversity, enhancing activities and products, building beekeeper capacity, and aligning with global practices."

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PP-482 [Beekeeping Economy]
The Profile of Beekeeping Sector in Poland

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The number of honey bee colonies is continuously growing in the European Union and Poland is among the top five member countries with the highest amount of colonies. The beekeeping sector is an important part of the Polish agricultural economy, therefore beekeepers are provided with subsidies for overwintered colonies – which was adjusted and increased through years.
The profile of beekeeping sector in Poland was created with data published in annual reports based on materials from: Veterinary Inspectorate (registers of apiaries made by District Veterinary Inspectorates), Ministry of Agriculture and Rural Development, Agency for Restructuring and Modernization of Agriculture, and market analysis. The readily available data that could be compiled starts from 2011 and was published every year until 2024.
There were 1 246 633 honey bee colonies in Poland in 2011, increasing every year and reaching 2 354 299 in 2024 – so the number of honey bee colonies nearly doubled. This translates to an increase in the average colony density per square kilometre from 3.99 (in 2011) to 7.53 (in 2024). Similarly, the number of beekeepers increased from 49 432 in 2011 to 96 918 in 2024, which means that currently out of every 1,000 Polish residents, nearly 3 are beekeepers. The distribution of the number of beekeepers and honey bee colonies varies geographically and will be shown on a voivodeship basis.
Due to the large number of beekeepers, Poland is an important European Union member country that should be taken into account when conducting studies on factors affecting the beekeeping sector.

*based on reports (2011-2024) prepared by Semkiw P., published at the website of the National Institute of Horticultural Research (inhort.pl)

PP-483 [Beekeeping Economy]
Beekeeping in Québec, Canada: Challenges, Innovations, and Contributions to Sustainable Agriculture in Northern Climates

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Beekeeping in Québec, Canada, is vital to agricultural productivity and environmental sustainability. By 2023, the province had 533 registered beekeepers managing approximately 66,700 colonies, contributing to Canada's national honey yield of 91.8 million pounds, valued at $277 million. The province's diverse apicultural sector provides essential pollination services for key crops like apples, blueberries, cranberries, and canola, while producing high-quality honey and hive products. In 2021, Québec reported 79,091 acres of blueberry fields and 11,477 acres of cranberry bogs, emphasizing the importance of effective honey bee pollination. Despite its significance, the industry faces major challenges, including harsh winters, habitat loss, and increasing pressure from pests and diseases, particularly the Varroa destructor mite. In 2023, Canadian beekeepers imported 343,125 queen bees—mainly from California and Hawaii (75.9%)—to mitigate colony losses and sustain pollination services crucial to both Canada and Québec's agriculture. In response to these challenges, Québec has become a leader in apicultural research and innovation. Institutions like the Centre de recherche en sciences animales de Deschambault (CRSAD) and Université Laval collaborate on developing sustainable beekeeping practices for Canada and Québec. Studies focus on bee genetics, organic nutrition, queen banking, and pest management to control Varroa populations. By fostering knowledge exchange and embracing evidence-based practices, Québec's apicultural community continues to support honey bee health and the resilience of agricultural ecosystems. This poster highlights the province's diverse apicultural sector and the collaborative efforts driving innovation and sustainability.

PP-603 [Beekeeping Economy]
Educational program for introducing middle and high school students to fundamental principles of honey beekeeping

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[1]Hudson River Apiary Society
[2]Hudson County Schools of Technology

This educational program aims to introduce middle and high school students, particularly those from disadvantaged communities, to the fundamental principles of honey beekeeping, fostering an understanding of bee biology, hive management practices, and the critical role of pollinators in our ecosystem. By providing hands-on experience with beehives, students will develop scientific literacy, environmental awareness, and potential career pathways related to agriculture and sustainability, while simultaneously addressing food security concerns within their communities through honey production. The curriculum is designed to be accessible, incorporating culturally relevant approaches and engaging activities to empower students to become active stewards of their local environments.

Key elements include:
• Bee Biology Basics: Exploring the complex social structure of a bee colony, the life cycle of bees, and their vital role in pollination.
• Hive Management: Practical lessons on setting up and maintaining a beehive, including inspecting frames, identifying pests and diseases, collecting honey harvests and selective breeding.
• Environmental Impact: Discussing the importance of pollinators for crop production and biodiversity, along with the threats faced by honey bees and strategies for conservation.
• Community Engagement: Opportunities to share knowledge with local residents, promote urban beekeeping initiatives, and contribute to food security efforts.
• STEM Integration: Utilizing experience, data collection, observation, and analysis to foster critical thinking and scientific inquiry.
This program aims to cultivate a new generation of environmentally conscious citizens with a
deep appreciation for bees and their vital role in our ecosystem, while simultaneously
empowering individuals from underserved communities with valuable knowledge and skills.
• Economic roles: Provides vocational development and growth of participants to include training future generations and participants to expand program development.

Note: This abstract is tailored to highlight the social impact of teaching beekeeping to youth, target groups, and underprivileged communities, emphasizing the educational and environmental benefits alongside potential career pathways.

PP-001 [Bee Health]

EFFECTIVENESS OF OXALIC ACID IN THE CONTROL OF VARROA MITES IN AFRICANIZED HONEYBEE COLONIES IN THE TROPICAL CONDITIONS OF COSTA RICA

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Introduction: At present, synthetic acaricides are regularly used for the control of *Varroa destructor.* However, acaricide resistant mites have appeared in different countries. This problem has led to the development of natural, non-toxic products for the control of varroa mites, such as different organic acids.

Objective: In the present study, oxalic acid´s effectiveness in controlling varroa mites in Africanized honeybee (AHB) colonies was evaluated in the tropical conditions of Costa Rica.

Figure 1. Dorsal view of an adult female of varroa mites in AHB colonies (*Calderón, 2019*).

Materials and methods: The experiment was conducted during July and August (rainy season) in an apiary of 16 Africanized colonies in Atenas, province of Alajuela, Costa Rica. The colonies were divided into four groups to apply oxalic acid in different ways. 1- Trickling method: it was applied weekly to the top of the frames by the means of a syringe. 2- Glycerin shop towel method: impregnated shop towel was placed on the top of the frames. 3- Impregnated cardboard method: four impregnated cardboard strips were used per colony. 4- Control group: no oxalic acid was applied. The treatments were applied during four weeks in the brood chamber, and observations were made to determine possible adverse effects. Further flumethrin treatments were subsequently applied during five weeks as a shock product to eliminate surviving mites and calculate the effectiveness of oxalic acid treatment. The cumulative mite-fall after oxalic acid and shock product was assumed to be 100%. Fallen mites were collected using a bottom board trap.

Results: The effectiveness of the different methods for varroa control corresponded to 74.4% with the glycerin shop towel, 63.0% with trickling and 50.0% with cardboard strips. For the control group, a 34.1% natural fall of mites was registered. According to the results, oxalic acid showed effectiveness in the control of *V. destructor* in AHB colonies under tropical conditions. The towel method presented the greatest effectiveness, followed by trickling method, so both can be considered as an alternative in the integrated management of varroa mites by beekeepers.

Figure 2. To assess the number of fallen varroa mites a bottom board trap was used in AHB colonies. A white card coated with a thin layer of vaseline was placed inside the trap (*Calderón, 2019*).

Conclusion: The concentrations of oxalic acid used in the study showed effectiveness in the control of varroa mites in AHB colonies. It was also safe for use in AHB´s since no queens were lost, and there was no brood or adult bees mortality in any of the colonies during the experiment.

Acknowledgements: The financial support to take part in APIMONDIA 2025 was provided by the Scholarship Department, Universidad Nacional (UNA), Costa Rica.

PP-002 [Bee Health]

SMALL HIVE BEETLE (*AETHINA TUMIDA*) IN AFRICANIZED HONEYBEE COLONIES IN COSTA RICA: STRATEGIES FOR DETECTION AND MONITORING

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Introduction: The small hive beetle (SHB), *Aethina tumida*, is a pest of honeybee *(Apis mellifera)* colonies. Endemic to sub-Saharan Africa, this pest has been reported in Africanized honeybee (AHB) colonies in North, Central, and South America. Specifically in Central America, it was first found in El Salvador in 2013, in Nicaragua in March 2014, and in Guatemala in August 2020. In Nicaragua, the SHB was confirmed in AHB colonies in San Juan del Sur, Department of Rivas, approximately eight kilometers north of the Costa Rican border, which increased the risk of entry to this country.

Objective: In this study the strategies for the SHB detection and monitoring in AHB colonies in Costa Rica are presented.

Figure 1. Dorsal view of an adult small hive bettle, *Aethina tumida*, in AHB's (*Calderón & Ramírez, 2015*).

Materials and methods: After the SHB was confirmed in Nicaragua, a sentinel apiary with four AHB colonies was established close to the border in Santa Cecilia, La Cruz, province of Guanacaste, Costa Rica. In addition, an epidemiological surveillance was conducted in the main beekeeping areas of the country (2015 - 2022) to determine the SHB's possible distribution. Beehives were monitored visually by examining all individual honeycombs, hive covers, and bottom boards. Furthermore, training was offered to beekeepers such as workshops and fieldwork, and training materials were distributed such as brochures focused on SHB recognition and identification, and methods for colony inspection.

Results: SHB was detected and confirmed in the sentinel apiary in August 2015 in La Cruz, Guanacaste, Costa Rica, where only adult beetles were detected inside AHB colonies. In addition, in September 2018, adult SHBs were found in a honeybee swarm located in Heredia-Central Valley in the middle of the country, about 265 km south from the first detection site. Furthermore, in October 2019, the SHB was confirmed in a apiary in Liberia, province of Guanacaste, approximately 25 km south from the initial point of detection in the country. Nowadays (2025), the SHB has been found in different apiaries in collaboration with trained beekeepers, especially in the provinces of Guanacaste, Heredia, Alajuela and San José. Adult beetles are the most frequent observed in AHB's, while larvae have been detected in weak colonies.

Figure 2. A larva of the small hive bettle detected in weak AHB colonies in Costa Rica (*Calderón, 2023*).

Conclusion: Implementing strategies to detect and monitor the SHB, as it spreads to new countries or beekeeping areas, requires implementing sentinel apiaries, developing of epidemiological surveillance, and providing training activities for beekeepers, as demonstrated in the case of Costa Rica.

Acknowledgements: The financial support to take part in APIMONDIA 2025 was provided by the Scholarship Department, Universidad Nacional (UNA), Costa Rica.

PP-003 [Bee Health]
Transcriptional dynamics and regulatory function of milRNAs in Ascosphaera apis invading Apis mellifera larvae

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Ascosphaera apis is a fungal pathogen that infects bee larvae and causes chalkbrood, leading to a sharp reduction of adult bees and colony productivity. Here, small RNA (sRNA) data from Ascosphaera apis were filtered from sRNA-seq datasets from the gut tissues of A. apis-infected Apis mellifera ligusticaworker larvae, which were combined with the previously gained sRNA-seq data from A. apis spores to screen differentially expressed microRNA-like RNAs (DEmilRNAs), followed by trend analysis and investigation of the DEmilRNAs in relation to significant trends. Additionally, the interactions between the DEmilRNAs and their target mRNAs were verified using a dual-luciferase reporter assay. In total, 974 A. apis milRNAs were identified. The first base of these milRNAs was biased toward U. The expression of six milRNAs was confirmed by stem-loop RT-PCR, and the sequences of milR-3245-y and milR-10285-y were validated using Sanger sequencing. These miRNAs grouped into four significant trends, with the target mRNAs of DEmilRNAs involving 42 GO terms and 120 KEGG pathways, such as the fungal-type cell wall and biosynthesis of secondary metabolites. Further investigation demonstrated that 299 DEmilRNAs (novel-m0011-3p, milR-10048-y, bantam-y, etc.) potentially targeted nine genes encoding secondary metabolite-associated enzymes, while 258 (milR-25-y, milR-14-y, milR-932-x, etc.) and 419 (milR-4561-y, milR-10125-y, let-7-x, etc.) DEmilRNAs putatively targeted virulence factor-encoded genes and nine genes involved in the MAPK signaling pathway, respectively. Additionally, the interaction between ADM-B and milR-6882-x, as well as between PKIAand milR-7009-x were verified. Together, these results not only offer a basis for clarifying the mechanisms underlying DEmilRNA-regulated pathogenesis of A. apis and a novel insight into the interaction between A. apis and honey bee larvae, but also provide candidate DEmilRNA-gene axis for further investigation.

PP-004 [Bee Health]
Evaluation of the Development of Resistance of the Mite Varroa destructor to the Chemical Acaricides Apistan® and Bayvarol® in Costa Rica

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The control of the mite Varroa destructor, the primary parasite of the honeybee Apis mellifera, largely depends on the use of chemical acaricides. However, the prolonged and indiscriminate use of synthetic pyrethroids, such as fluvalinate (Apistan®) and flumethrin (Bayvarol®), has promoted the development of resistance in mite populations worldwide. This study aimed to determine the presence of resistant Varroa populations to these acaricides in Costa Rica and to establish whether cross-resistance exists between them. Standardized bioassays were conducted on 62 hives from 17 apiaries across different beekeeping regions of the country to assess the mites' susceptibility to pyrethroids. Additionally, information was collected on beekeeping management practices, including the historical use of acaricides and strategies for rotating chemical and organic products. A bioassay based on the method described by Pettis (1998). The results showed that 57% of the apiaries had mites resistant to at least one of the evaluated acaricides, while 70% of these cases exhibited cross-resistance between fluvalinate and flumethrin. Furthermore, 100% of the apiaries that had not used pyrethroids for more than three years still exhibited non-susceptible populations, indicating that resistance can persist even in the absence of recent chemical pressure. The study identified critical factors associated with the development of resistance, such as repetitive and non-rotational use of pyrethroids, lack of comb replacement in brood chambers, and low implementation of organic alternatives. This work documents the first formal case of Varroa destructor resistance to pyrethroids in Costa Rica, highlighting the urgent need to adopt integrated pest management strategies. Recommendations include rotating chemical and organic acaricides, constant monitoring of infestations, and educating beekeepers on proper product use. This study provides significant contributions to tropical apiculture by offering a scientific basis to address the challenges posed by mite resistance and ensuring the sustainability of beekeeping in the region.

PP-005 [Bee Health]
Dynamics and regulatory role of circRNAs in Asian honey bee larvae following fungal infection

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Non-coding RNA (ncRNA) plays a vital part in the regulation of immune responses, growth, and development in plants and animals. Here, the identifcation, characteristic analysis, and molecular verifcation of circRNAs in Apis cerana cerana worker larval guts were conducted, followed by in-depth investigation of the expression pattern of larval circRNAs during Ascosphaera apis infection and exploration of the potential regulatory part of diferentially expressed circRNAs (DEcircRNAs) in host immune responses. A total of 3178 circRNAs in the larval guts of A. c. cerana were identifed, with a length distribution ranging from 15 to 96,007 nt. Additionally, 155, 95, and 86 DEcircRNAs were identifed in the in the 4-, 5-, and 6-day-old larval guts following A. apisinfection. These DEcircRNAs were predicted to target 29, 25, and 18 parental genes relevant to 12, 20, and 17 GO terms as well as 144, 114, and 61 KEGG pathways, including 5 cellular and 4 humoral immune pathways. Complex competing endogenous RNA (ceRNA) regulatory networks were detected as being formed among DEcircRNAs, DEmiRNAs, and DEmRNAs. The target DEmRNAs were engaged in 36, 47, and 47 GO terms as well as 331, 332, and 331 pathways, including 6 cellular and 6 humoral immune pathways. Further, 19 DEcircRNAs, 5 DEmiRNAs, and 3 mRNAs were included in the sub-networks relative to 3 antioxidant enzymes. Finally, back-splicing sites within 15 circRNAs and the diference in the 15 DEcircRNAs' expression between uninoculated and A. apis–inoculated larval guts were confrmed based on molecular methods. These fndings not only enrich our understanding of bee host–fungal pathogen interactions but also lay a foundation for illuminating the mechanism underlying the DEcircRNA-mediated immune defense of A. c. cerana larvae against A. apis invasion.

PP-006 [Bee Health]
First characterization and regulatory function of piRNAs in the Apis mellifera larval response to Ascosphaera apis invasion

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piRNAs are a class of small non-coding RNAs that play essential roles in modulating gene expression and abundant biological processes. To decode the piRNA-regulated larval response of western honeybees (Apis mellifera) to Ascosphaera apis infection, the expression pattern of piRNAs in Apis mellifera ligustica larval guts after A. apis inoculation was analyzed based on previously obtained high-quality small RNA-seq datasets, followed by structural characterization, target prediction, regulatory network investigation, and functional dissection. Here, 504, 657, and 587 piRNAs were respectively identified in the 4-, 5-, and 6-day-old larval guts after inoculation with A. apis, with 411 ones shared. These piRNAs shared a similar length distribution and first base bias with mammal piRNAs. Additionally, 96, 103, and 143 DEpiRNAs were detected in the 4-, 5-, and 6-day-old comparison groups. Targets of the DEpiRNAs were engaged in diverse pathways such as the phosphatidylinositol signaling system, inositol phosphate metabolism, and Wnt signaling pathway. These targets were involved in three energy metabolism-related pathways, eight development-associated signaling pathways, and seven immune-relevant pathways such as the Jak-STAT signaling pathway. The expression trends of five randomly selected DEpiRNAs were verified using a combination of RT-PCR and RT-qPCR. The effective overexpression and knockdown of piR-ame-945760 in A. apis-infected larval guts were achieved by feeding a specific mimic and inhibitor. Furthermore, piR-ame-945760 negatively regulated the expression of two target immune mRNAs, SOCS5 and ARF1, in the larval gut during the A. apis infection. These findings indicated that the overall expression level of piRNAs was increased and the expression pattern of piRNAs in larval guts was altered due to the A. apis infection, DEpiRNAs were putative regulators in the A. apis-response of A. m. ligustica worker larvae. Our data provide not only a platform for the functional investigation of piRNAs in honeybees, especially in bee larvae, but also a foundation for illuminating the piRNA-involved mechanisms underlying the host response to the A. apis infection.

PP-007 [Bee Health]
Effect of Ascosphaera apis infestation on the activities of four antioxidant enzymes in Asian honey bee larval guts

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Ascosphaera apis infects exclusively bee larvae and causes chalkbrood, a lethal fungal disease that results in a sharp reduction in adult bees and colony productivity. However, little is known about the effect of A. apis infestation on the activities of antioxidant enzymes in bee larvae. Here, A. apis spores were purified and used to inoculate Asian honey bee (Apis cerana) larvae, followed by the detection of the host survival rate and an evaluation of the activities of four major antioxidant enzymes. At 6 days after inoculation (dpi) with A. apis spores, obvious symptoms of chalkbrood disease similar to what occurs in Apis mellifera larvae were observed. PCR identification verified the A. apis infection of A. cerana larvae. Additionally, the survival rate of larvae inoculated with A. apis was high at 1–2 dpi, which sharply decreased to 4.16% at 4 dpi and which reached 0% at 5 dpi, whereas that of uninoculated larvae was always high at 1~8 dpi, with an average survival rate of 95.37%, indicating the negative impact of A. apis infection on larval survival. As compared with those in the corresponding uninoculated groups, the superoxide dismutase (SOD) and catalase (CAT) activities in the 5- and 6-day-old larval guts in the A. apis–inoculated groups were significantly decreased ($p < 0.05$) and the glutathione S-transferase (GST) activity in the 4- and 5-day-old larval guts was significantly increased ($p < 0.05$), which suggests that the inhibition of SOD and CAT activities and the activation of GST activity in the larval guts was caused by A. apis infestation. In comparison with that in the corresponding uninoculated groups, the polyphenol oxidase (PPO) activity was significantly increased ($p < 0.05$) in the 5-day-old larval gut but significantly reduced ($p < 0.01$) in the 6-day-old larval gut, indicating that the PPO activity in the larval guts was first enhanced and then suppressed. Our findings not only unravel the response of A. cerana larvae to A. apis infestation from a biochemical perspective but also offer a valuable insight into the interaction between Asian honey bee larvae and A. apis.

PP-008 [Bee Health]
ame-miR-34 modulates the larval body weight and immune response of Apis mellifera workers to Ascosphara apis invasion

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Ascosphaera apis exclusively infects bee larvae and causes chalkbrood disease. However, the function and mechanism of miRNAs in the bee larval response to A. apis infection is poorly understood. Here, ame-miR-34, a previously predicted miRNA involved in the larval response to A. apis invasion, was subjected to molecular validation, and overexpression and knockdown were then conducted to explore the regulatory functions of ame-miR-34 in larval body weight and immune response. Stem-loop RT-PCR and Sanger sequencing confirmed the authenticity of amemiR-34 in the larval gut. RT-qPCR results demonstrated that compared with that in the uninfected larval guts, the expression level of ame-miR-34 was significantly downregulated in the guts of A. apis-infected 4-, 5-, and 6-day-old larvae. In comparison with the corresponding negative control (NC) groups, the expression level of ame-miR-34 in the larval guts in the mimic-miR-34 group was significantly upregulated, while that in the inhibitor-miR-34 group was significantly downregulated. Additionally, the body weights of 5- and 6-day-old larvae were significantly increased compared with those in the mimic-NC group; the weights of 5-day-old larvae in the inhibitor-miR-34 group were significantly decreased in comparison with those in the inhibitor-NC group, while the weights of 4- and 6-day-old larvae in the inhibitor-miR-34 group were significantly increased. Furthermore, the expression levels of both hsp and abct in the guts of A. apis-infected 4-, 5-, and 6-day-old larvae were significantly activated after ame-miR-34 overexpression. In contrast, after ame-miR-34 knockdown, the expression levels of the aforementioned two key genes in the A. apis-infected 4-, 5-, and 6-dayold larval guts were significantly downregulated. Together, the results demonstrated that effective overexpression and knockdown of ame-miR-34 in both noninfected and A. apis-infected A. mellifera larval guts could be achieved by the feeding method, and ame-miR-34 exerted a regulatory function in the host body weight and immune response to A. apis invasion through positive regulation of the expression of hsp and abct. Our findings provide a valuable reference for the functional investigation of bee larval miRNAs and a promising molecular target for the treatment of chalkbrood disease.

PP-009 [Bee Health]
Circular RNA ame_circ_000115 regulates gene expression immune response of European honeybee larvae to Ascosphaera apis infection

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Circular RNAs (circRNAs) are a new class of non-coding RNAs, which have been confirmed to regulate insect gene expression and immune response through multiple manners such as competing endogenous RNA (ceRNA) regulatory network. Currently, function of circRNA in the immune response of Apis mellifera ligustica to Ascosphaera apis infection remains unclear. PCR and Sanger sequencing confirmed the existence of back splicing (BS) site within ame_circ_000115 (ac115). RT-qPCR assay showed that as compared with that in the un-inoculated group, the expression level of ac115 in 4-day-old larval gut of the A. apis-inoculated group was significantly up-regulated, while that in 5- and 6-day-old larval guts were significantly up-regulated. The brightness of specific band for ac115 in 4-, 5-, and 6-day-old larval guts of the siRNA-circ_000115-fed group gradually became weak, whereas that of the siRNA-scramble-fed group was pretty high without obvious variation. Compared with that of the siRNA-scramble-fed group, the expression of ac115 in 4-day-old larval gut of the siRNA-circ_000115-fed group was significantly down-regulated, whereas that of the 5- and 6-day-old larval guts were significantly down-regulated. Dual-luciferase reporter gene assay suggested that ame-miR-13b was truly existed and expressed in the larval guts, and there was true binding relationship between ac115 and ame-miR-13b. In comparison with that in the siRNA-scramble-fed group, the expression levels of antimicrobial peptide genes hymenoptaecin and abaecin in 6-day-old larval gut of the siRNA-circ_000115-fed group were significantly up-regulated, while that of ecdysone receptor (Ecr) was significantly down-regulated. These results indicate that ac115 is truly expressed in A. m. ligustica larval guts, BS site truly exists within ac115, and effective interference of ac115 in A. m. ligustica larval guts can be achieved via feeding siRNA. Moreover, ac115 potentially regulates Ecr expression through adsorption of ame-miR-13b and expression of hymenoptaecin and abaecin using a non-ceRNA manner, further participating in host response to fungal invasion.

PP-010 [Bee Health]
Breeding for disease and mite resistance in the small commercial apiary

Troy Hall
Hall Apiaries

Breeding for disease and varroa mite resistance in the European honeybee. Is it possible to achieve this in the small commercial apiary?

Problem / OBJECTIVE: Varroa mite resistant bees make up a very small percentage of the managed honeybee population. Small commercial apiaries centered around a breeding program for resistance can contribute to greater resistance and diversity in the overall managed honeybee population while also strengthening the beekeeping industry.

Methodology
A multi-faceted management plan consisting of breeding, honey, and nucleus colony production, provides the foundation for optimal selection and vetting (primarily utilizing natural selection). At the same time production of other revenue streams via honey and bees are secured (commercial viability in the breeding stock). Further assays are used to quantify disease and mite resistance in the breeder queens.

RESULTS: Results have shown and continue to show improvement for mite resistance in the managed honeybee population in my apiary, that primarily being the very low to no chemicals needed to treat for the varroa mite. New developments in quantifying resistant traits (primarily SMR/VSH) using the Harbo Assay further verifies the selection for breeder queens

CONCLUSION: My career as a full-time beekeeper (15 yrs) has been built on breeding and managing for mite resistance. I have seen great success and hardships, overall, the successes have outweighed the hardships. Using this paradigm is a proven way to breed for resistance and make a peaceful living with the honeybee while doing so.

Practical Implications for beekeepers
The future of the beekeeping industry is in mite resistant stock. This is one way we can achieve that objective. With more small commercial apiaries engaged in a mite resistant breeding program the stronger and more resilient our bees and our industry will become.

APIMONDIA SCANDINAVIA 2025
SWEDEN | DENMARK | NORWAY

PP-011 [Bee Health]

Nutrition of the honey bee parasite *Varroa destructor*: insights from behavioural and molecular studies

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Introduction

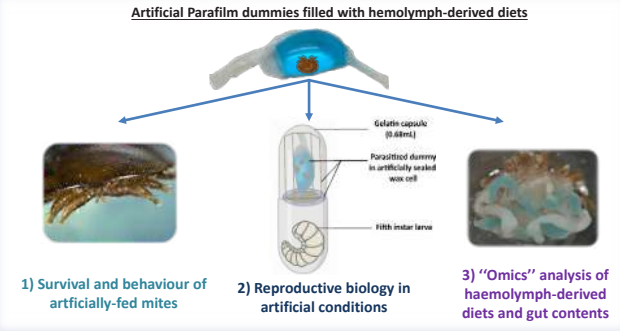
Varroa destructor, major pest of the Western honey bee, infests larval, pupal and adult hosts. As in ticks, the mite follows a feeding sequence [1] that can be broken down as:

- Host detection that combines appetence and engagement of interactions
- Attachement, host exploration and penetration
- Ingestion, molecular interactions and engorgement
- Separation and meal processing

Many aspects are poorly known, such as host exploration and penetration or molecular interactions, along with their impact on crucial traits of the parasite biology. New methods to explore the parasite feeding biology are needed.

Objective and Methods

- Artificial feeding bioassays were carried out to explore behavioural interactions and survival under controlled conditions.



Results

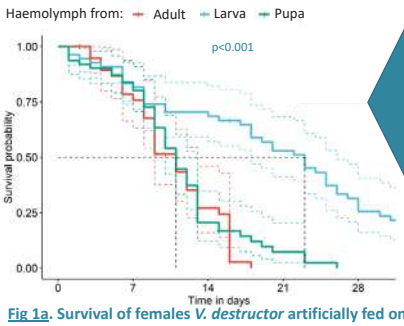


Fig 1a. Survival of females *V. destructor* artificially fed on dummies with honey bee larval, pupal or adult haemolymph [2]

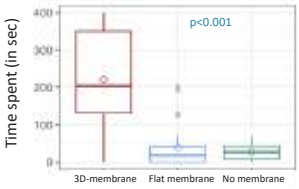


Fig 1b. Amount of time interacting with artificial membranes. Mites interact with a 3D membrane more than with a flat membrane [3]

Fig 1c. Mites with impaired olfactory organs (*i.e.* varnished forelegs) are still able to detect an artificial food source [3]

1 Survival and Behaviour

2 Reproduction

V. destructor feeding on an artificial diet

3 Omics analyses of diets and mite guts

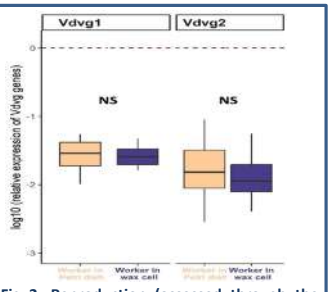


Fig 2. Reproduction (assessed through the expression of Vitellogenin genes) is not triggered in artificial conditions (0 being the natural level when the females lay eggs) [4]

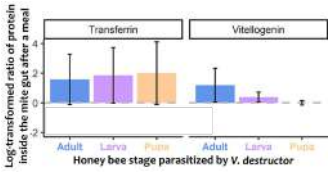


Fig 3b. Example of two major honey bee proteins detected inside mite guts after a meal [5]

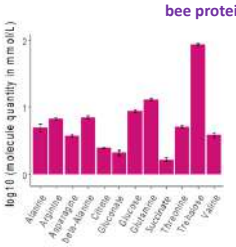


Fig 3a. Log-transformed quantitites of polar metabolites detected through RMN in the larval haemolymph-derived diet [4]

Conclusions

- The mite does not necessarily rely on olfactory cues to feed and can detect artificial 3D shaped membranes.
- *V. destructor* survives for two to three weeks on haemolymph-derived diets; filtered larval haemolymph is the most efficient diet to ensure mite survival.
- Trehalose (a carbohydrate) is the most abundant metabolite detected. Many proteins found in larval haemolymph such as Vitellogenin or Transferrin seem important and can be found abundantly in the mite gut after a meal. The quantity of nutrients depends on the stage parasitized.

Future directions

- This new protocol to explore behavioural interactions and survival paves the way to studies about virus transmission, acaricide efficacy or resistance…
- A better comprehension of the parasite nutritional needs could lead to the development of potential new targets to limit the impact of *V. destructor*.

Sources:
[1] Mans, B. J. (2014). "Heme processing and the evolution of hematophagy," in Biology of Ticks, Vol. 1, 2nd Edn., eds D. E. Sonenshine and R. M. Roe (New York, NY: Oxford University Press), 220–239.
[2] Piou et al. 2023. Hemolymph as a Source of Key Nutrients and Proteins Offers a Promising Medium for *Varroa destructor* Artificial Rearing. *Int. J. Mol. Sci.* 2023, *24*
[3] Piou et al. 2023. *Varroa destructor* relies on physical cues to feed in artificial conditions. Parasite 30, *49*
[4] Piou et al., 2025. Metabolites from honey bee larval hemolymph are essential nutrients for *Varroa destructor* survival but not sufficient to trigger its reproduction. Entomologia generalis
[5] Piou et al. 2024. The proteomic content of *Varroa destructor* gut varies according to the developmental stage of its host. *PLOS Pathogens*, *20*(12), e1012802.

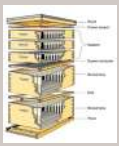
PP-012 [Bee Health]

Considerations when sampling honey bee *Apis mellifera* colonies for volatile organic compounds (VOCs) associated with honey bee disease and environmental contamination

M.C. Gill , B. King , D. vanEnglesdorp and F. Drijfhout

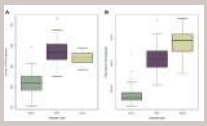
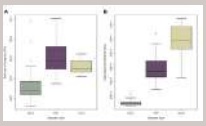
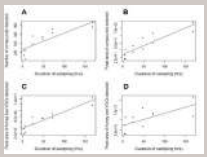
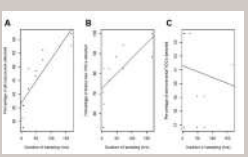
Introduction.

Method.



Discussion.

Results.

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PP-013 [Bee Health]

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Biopolymer carriers of natural miticides with application in organic beekeeping

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Institute of Polymers-Bulgarian Academy of Sciences, Sofia, Bulgaria

Funded by the European Union
NextGenerationEU

Introduction

The development of sustainable and environmentally friendly pest management strategies is critically important in modern organic apiculture. Varroa destructor, a parasitic mite, remains one of the most serious threats to honeybee health and colony sustainability worldwide. While synthetic miticides initially demonstrated high efficacy, widespread resistance among Varroa populations has significantly reduced their long-term effectiveness. This situation highlights the pressing necessity for sustainable, environmentally safe alternative methods of control that are consistent with organic principles.
Among natural acaricides, formic acid is well-established and highly effective due to its ability to penetrate capped brood cells and target mites both on the surface and inside brood chambers. However, traditional application methods—such as vaporizers or pads—often face limitations, including uncontrolled volatilization, uneven distribution, and potential negative effects on bees if not carefully dosed. These issues limit optimal use.
The use of formic acid in gel form offers a promising solution. Gel formulations allow controlled, sustained release of the active compound, increasing mite mortality while reducing volatilization and stress on bees. Furthermore, gels can be easily applied, take various shapes, and distribute evenly in the hive, ensuring uniform treatment. Encapsulating formic acid in biopolymer-based gels, especially those derived from natural sources, enhances these benefits by ensuring biodegradability, biocompatibility, and environmental safety. A key advantage is that after evaporation, only minimal biodegradable waste remains—eliminating environmental pollution. Additionally, the formulation contains only natural components, making it fully compatible with organic beekeeping practices.

Results

Conclusions

This research demonstrates that biopolymer-based gels encapsulating formic acid offer a promising solution for controlling Varroa destructor in organic beekeeping. The innovative gel formulations facilitate controlled and sustained release of the active compound, significantly improving efficacy while minimizing stress on bee colonies. The use of this biodegradable carrier ensures that the treatment is environmentally friendly, leaving minimal residual fully biodegradable waste and aligning with organic principles.

Acknowledgment

This research was funded by the European Union – NextGenerationEU, Investment C2I2, grant number BG-RRP-2.017-0025-C01 "Biopolymer Carriers of Natural Acaricides with Application in Organic Beekeeping".

PP-014 [Bee Health]

Combining high-resolution smartphone images with new open-source software based on deep learning techniques will make *varroa* diagnosis easier and more efficient

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1 BIOFITER research group, Environmental Sciences Institute (IUCA), Department of Animal Production and Food Sciences, University of Zaragoza, Huesca, Spain.
2 Department of Mathematics and Computer Science, University of La Rioja, Logroño, Spain.
3 Department of Mechanical Engineering, University of La Rioja, Logroño, Spain.
4 Department of Cell Biology, Functional Biology and Physical Anthropology, University of Valencia, Burjassot, Spain.

Introduction

Varroosis is a significant threat to beekeeping, severely impacting *Apis mellifera* by weakening their immune system, shortening their lifespan, and facilitating the spread of viral diseases, which can lead to colony collapse. Given the vital role of bees in pollination and food security, controlling *Varroa destructor* is essential for hive health.

Although eradication is unfeasible, effective management strategies are crucial to mitigating its impact. One of the most accurate infestation monitoring methods involves analyzing mites that naturally fall onto adhesive plates at the hive base. However, this process is manual, time-consuming, and resource-intensive, limiting its large-scale implementation.

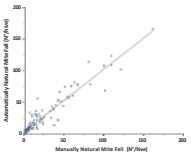
Our goal

To develop an optimized and accessible deep learning-based system for automated detection and quantification of *Varroa destructor* in images of sticky plates placed at the base of the hive.

Results

A Deep Learning Model

YOLOv11 Nano was utilized to detect and quantify *Varroa* mites in images of sticky sheets. The model achieved a mAP score of 0.956, ensuring accurate and efficient mite detection without the need for a GPU.



Innovative and realistic dataset

The dataset included 357 images of *Varroa* mites from 90 sticky sheets, randomly split into training and validation sets. Experts manually annotated each mite using bounding boxes.

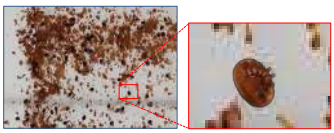


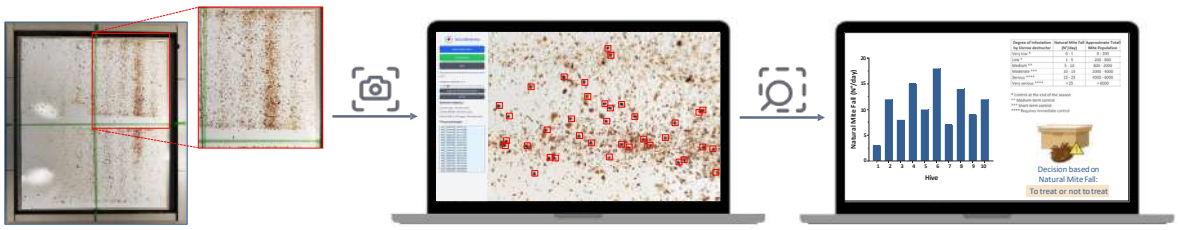
Image processing system

VarroDetector employs color-based filtering, Hough transform for boundary detection, and a one-stage neural network for accurate *Varroa* identification. It provides a user-friendly interface, allowing for zooming, manual correction of detections, and region-of-interest selection.

Easy application

VarroDetector is free, requires no installation or internet connection, and runs on low-end computers.

Its user-friendly interface allows image uploading, sensitivity adjustment, and result export in CSV format.



Conclusion

The automatic counting method exhibits a strong correlation with the manual approach, achieving an mAP of 0.956, which indicates accurate mite detection regardless of their population density. It enhances efficiency by significantly reducing the time and effort required compared to the manual process, which is more prone to human error due to observer fatigue or subjectivity.

By providing a precise, cost-effective, and easily implementable alternative, this method can greatly benefit beekeepers and researchers, improving experimental protocols and hive health management.

Acknowledgement

This work was supported by the Spanish AEI-MICIN (grant PID2023-148475OB-I00), the EU Horizon Europe (grant 101082073), the DGA-FSE (grant A07_23R) and La Rioja Government (grant INICIA2023/02).

Funded by the European Union

PLAY & LEARN

Download *VarroDetector*

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PP-015 [Bee Health]

LACTIC ACID TREATMENT WORKS THROUGH A LOCAL WAY OF ACTION AGAINST *VARROA DESTRUCTOR*

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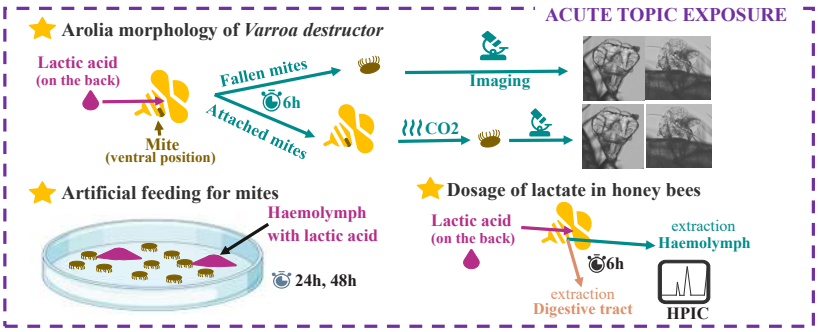
[2] Conservatoire National des Arts et Métiers (CNAM), Unité Métabiot, Ploufragan, France

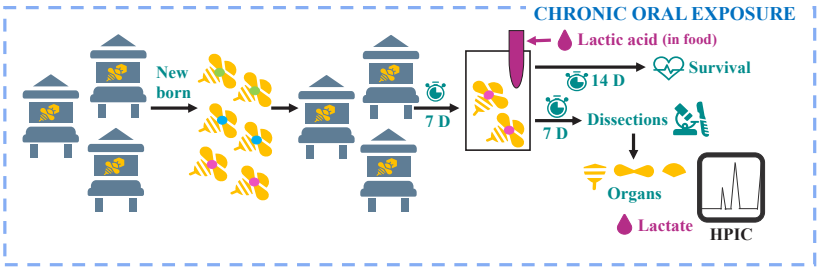
Introduction

Lactic acid is an alternative treatment to hard chemicals against *Varroa destructor*, the parasitic mite of the Western honey bee *Apis mellifera*. This soft acaricide is used only for small apiaries due to its laborious administration [1]. However, the mode of action of this honey bee medication remains unknown. We investigated the nature of lactic acid activity in the hive treatment context: local or systemic. A local way of action indicates that the effects of the treatment does occur at the site of contact, in this case the honey bee cuticle, whereas a systemic way of action indicates that the effects of the treatment occur at a location distant from the point of contact.

In addition, the off-target effects of such medication should not be overlooked either as many acaricides are known to impact honey bees health [2]. Therefore, we investigated the effect of contaminated with field-relevant concentrations of lactic acid on honey bees and measured the lactate in their organs or haemolymph. Studies focusing on the mode of action of alternative treatments are of prime interest and could give rise to new opportunities for control strategies against *V. destructor*.

Materials & Methods





Results

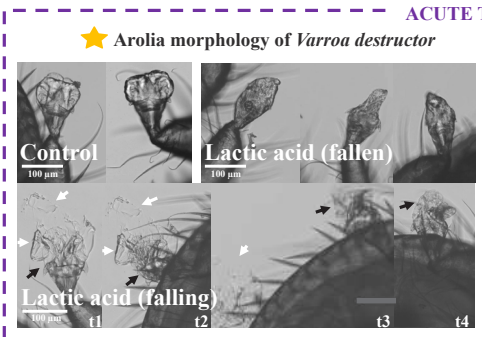


Figure 1. Effects of lactic acid (150 mg/mL) on *V. destructor* arolia during the first six hours after the treatment of honey bees. (Control) Arolia with a normal cushion-like shape from control parasites. (Fallen) Altered arolia from fallen mites before six hours. (Falling) Kinetics showing that the fluid is drained from the arolium. *White: fluid; Black: arolium*

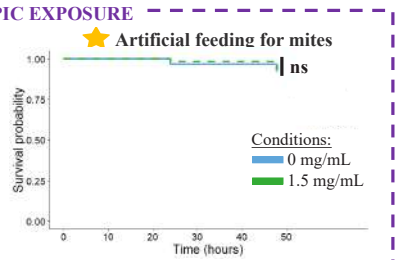


Figure 2. Survival rate of *V. destructor* when fed on lactic acid contaminated diet was not different between control or treated mites (N=30 mites/concentration).

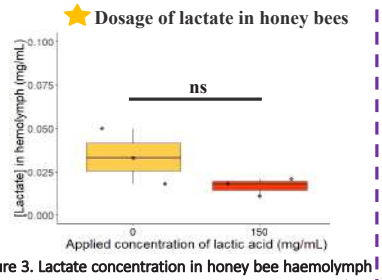


Figure 3. Lactate concentration in honey bee haemolymph 6h after topical exposure of lactic acid at 150 mg/mL. Each dot represents a hive (N=30 bees/concentration).

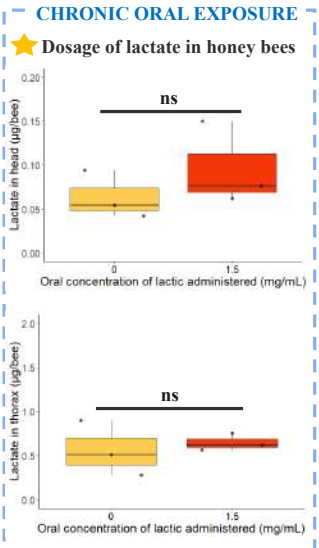


Figure 4. Lactate concentration in honey bee heads and thorax after chronic oral exposure of lactic acid at 1.5 mg/mL. Each dot represents a hive (N=15 honey bees/ [C])

Conclusions & Perspectives

- Mite arolia are altered after bee topical treatment (150 mg/mL).
- Contaminated haemolymph with lactic acid does not affect mite survival.
- No significant accumulation on lactate in bees organs after a chronic oral exposure of field-relevant residual concentration of lactic acid (1.5 mg/mL).
- Lactic acid activity presents consistency with a local mode of action against *V. destructor*.
- Future perspectives : Assessing the combined effects of topic and oral exposure on honey bees health.

Sources: [1] Kraus, B. & Berg, S. Effect of a lactic acid treatment during winter in temperate climate upon *Varroa jacobsoni* Oud. and the bee (*Apis mellifera L.*) colony. *Experimental and Applied Acarology* 18, nº 8 (1994): 459-68.

[2] Benito-Murcia, M et al. Evaluating the Chronic Effect of Two Varroacides Using Multiple Biomarkers and an Integrated Biological Response Index. *Environmental Toxicology and Pharmacology* 94 (2022): 103920.

Acknowledgements: We are grateful to our funders M2i Biocontrol and the Région Occitanie (ADEME grant n°2082C0061).

APIMONDIA SCANDINAVIA 2025
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PP-016 [Bee Health]

UBeeO: A Novel Tool for Selecting Pest- and Disease-Resistant Honey Bees

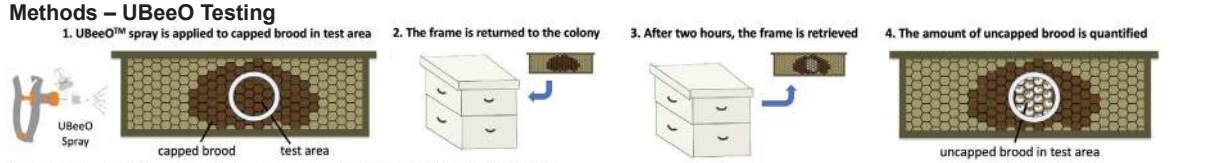
Kaira Wagoner[1], Samantha Alger[2], Sydney Miller[2], Alexander Burnham[3], Corinne Jordan[4], Yosef Hamba Tola[5], Esmaeil Amiri[6]

[1] Biology Department, University of North Carolina, Greensboro, NC, United States; [2] Agriculture, Landscape, and Environment Department, University of Vermont, Burlington, VT, United States; [3] Biology Department, University of Vermont, Burlington, VT, United States; [4] Bee Lady Apiaries, Carbrook, QLD, Australia; [5] Department of Applied Ecology, North Carolina State University, Raleigh, NC, United States; [6] Delta Research and Extension Center, Mississippi State University, Stoneville, MS, United States.

Introduction

- The health of the honey bee *(Apis mellifera)* is declining and sustainable solutions are needed to address the primary threat, the parasitic mite *Varroa destructor* (*Varroa*)
- To be sustainable, solutions must meet the needs of both bees and beekeepers; they must be long-term, low-cost, and capable of generating healthy and productive honey bee colonies
- One of the most important *Varroa* and disease resistance traits is ***hygienic behavior***, the ability to detect and remove *Varroa*-infested and diseased brood from the colony
- The selective breeding of truly *Varroa*-resistant hygienic stock is a promising long-term, low-cost, and effective solution to the current honey bee health crisis
- Numerous hygiene selection methods exist to aid in the identification of mite- and disease-resistant colonies, however these selection methods vary in their utility and sensitivity
  - ➢ Measuring suppression of mite reproduction is highly effective for ID of resistant colonies, but is labor intensive & most accurate late-season when mite & virus loads are already high
  - ➢ In contrast, brood-kill selection methods are relatively rapid, but less effective at IDing mite-resistant colonies, likely because they rely on removal of dead rather than unhealthy brood
- ***UBeeO is a heritable, predictive, practical tool*** for measuring honey bee colony hygiene, providing new opportunities for rapid and reliable selection of pest and disease-resistant bees

Methods – UBeeO Testing



(Detailed methods for studies described below can be found in corresponding publications or obtained by contacting Kaira Wagoner: kmwagone@uncg.edu)

Results

UBeeO scores are negatively correlated with mite, viral, *Vairimorpha*, and chalkbrood loads.

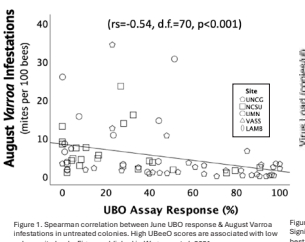


Figure 1. Spearman correlation between June UBO response & August Varroa infestations in untreated colonies. High UBeeO scores are associated with low colony mite loads. Figure published in *Wagoner et al. 2021*.

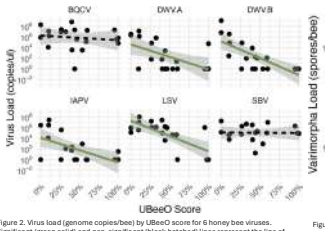


Figure 2. Virus load (genome copies/bee) by UBeeO score for 6 honey bee viruses. Significant (green solid) and non-significant (black hatched) lines represent the line of best fit generated by a linear model. For four viruses, pathogen load decreased significantly with increasing UBeeO score (DWVA (p = 0.011); DWV-B (p = 0.0002); IAPV (p = 0.007); LSV (p = 0.0004)). Figure published in *Alger et al. 2025*.

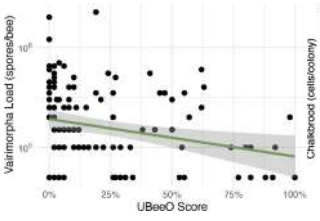


Figure 3. Vairimorpha load (spores/bee) by percent UBeeO score. Green regression line represents the line of best fit generated by a linear model. Vairimorpha load decreased significantly as UBeeO score increased (p < 0.0001). Figure published in *Alger et al. 2025*

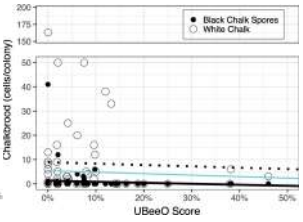


Figure 4. Chalkbrood load as a function of UBeeO score. Solid and hatched lines represent lines of best fit for black & white spores, respectively. The blue line represents all spores. Chalkbrood decreased significantly as UBeeO score increased (p = 0.01). Black spores were significantly less numerous in high UBeeO colonies (p < 0.0001). Figure published in *Alger et al. 2025*.

Disease brood virulence and UBeeO resistance thresholds are inversely related

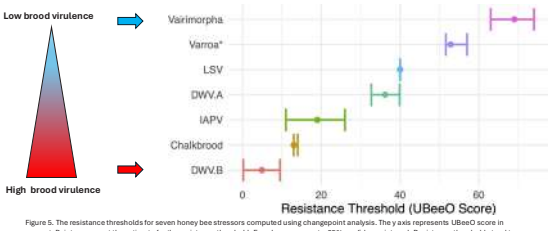


Figure 5. The resistance thresholds for seven honey bee stressors computed using changepoint analysis. The y axis represents UBeeO score in percent. Points represent the estimate for the resistance threshold. Error bars represent a 95% confidence interval. Resistance thresholds tend to be higher for stressors with lower brood virulence. Figure adapted from *Alger et al. 2025*.

High UBeeO scores are linked to low viral loads in *mites*

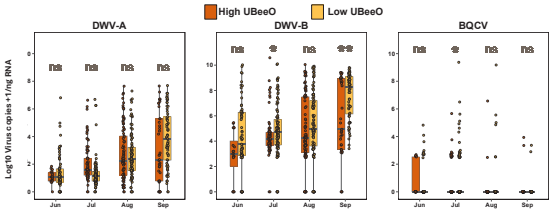


Figure 6. Temporal pattern of viral titers in *Varroa* mites from high and low UBeeO colonies. Sampling took place from July to September, and samples were tested for 7 viruses including: DWV-A, DWV-B, BQCV, LSVs, SBV, BRV-1, and VDV-2. Statistically significant differences were assessed using Bayesian posterior distributions p < 0.05 (*), p < 0.01 (**), p < 0.001 (***), and ns= not significant as estimated via Bayesian pairwise comparisons. Figure submitted for publication in *Amiri et al. 2025*.

UBeeO-linked hygiene is heritable

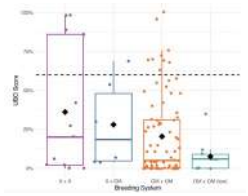


Figure 7. The UBeeO scores of daughter colonies produced from high scoring UBeeO mothers with varied mating strategies:
II+II: both mother and daughter queens instrumentally inseminated (II)
II+OM: open mated daughter queens from II mothers
OM+OM: both the mother and daughter queens were open mated (OM)
OM+OM (low): OM daughter queens from low UBeeO, OM mothers
Figure published online by University of Vermont, 2024.

UBeeO scores are heavily influenced by environment

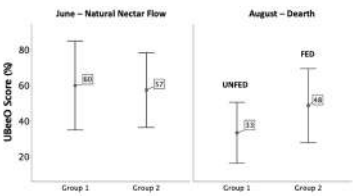


Figure 8. Preliminary evidence indicating effects of season and nectar flow on UBeeO scores. Colonies were tested for UBeeO response in June during a nectar flow and divided into two groups of roughly equivalent UBeeO scores. All scores were lower when colonies were retested during August dearth, however scores from colonies fed a 1:1 sugar solution prior to testing (Group 1) more closely resembled those from the natural June nectar flow.

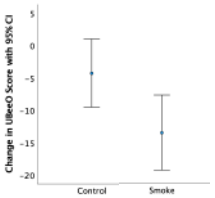


Figure 9. Preliminary evidence indicating the effects of smoker use on UBeeO scores. Colonies UBeeO tested twice consecutively tended to score lower if a smoker was used during the second UBeeO test. Smoke was applied directly to area from which experimental frame was removed and returned, and fuel type impacted the extend of the effect (fuel type data not shown).

Gut microbiota differs in hygiene performers

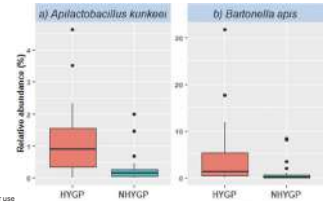


Figure 10. Relative abundance of three bacterial species was significantly higher in hygiene performers (HYGP) than nonhygiene performers (NHYGP).
a. Apilactobacillus kunkeei (p = 0.0439), b. Bartonella apis (p = 0.0338), and c. Frischella perrara (p = 0.0438 – not shown here). Figure adapted from Tola et al 2025.

Conclusions and Way Forward

- UBeeO can predict colony-level resistance to mites, viruses and fungal diseases, and thus serves as a promising new tool for selective breeding of pest- and disease-resistant honey bees
- The UBeeO score associated with disease resistance (the resistance threshold) varies with pest and pathogen virulence, underscoring the importance of brood stress and brood signal detection in colony hygiene, and indicating that honey bee disease resistance can be achieved by targeting disease-specific responses to UBeeO
- UBeeO-linked hygiene is heritable, however UBeeO scores are heavily influenced by environmental factors such as food availability and beekeeper smoker use
- Hygienic behavior of honey bees is associated with changes in the abundance of several other species, including virus loads in *Varroa* mites and microbial communities in honey bee guts
- More research is needed to understand colony virus dynamics & how environmental variables like nutrition & climate influence hygiene performance & related pest- and disease-resistance
- Work is underway to better understand impacts of nectar flow on hygiene, to simplify & standardize UBeeO scoring, & to determine the role of gut microbes in colony pest & disease resistance

Acknowledgements

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SPECIAL THANKS TO: H. Boncristiani, Olav Rueppell, Marla Spivak, Rex Roberton, Cory Stevens, Phoebe Snyder

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Want to learn more about UBeeO? Visit opterabees.com for more information, including links to full publications.

SCAN ME

PP-017 [Bee Health]
The German Bee Monitoring (DeBiMo) Project: pesticide residues in stored pollen from 2009 to 2024 reflect changes in agricultural practices

Kirsten Shoshanna Traynor[1], Elke Genersch[2], Marina Meixner[3], Christoph Otten[4], Stefan Berg[5], Gertje Petersen[6]
Marc Schäffer7, Tabea Streicher[1]
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The German Bee Monitoring (Deutsches Bienen Monitoring - DeBiMO) has existed for over 20 years and aims to understand drivers of colony losses, especially during winter. We have collected health measures, such as Varroa destructor infestation, pathogen presence, viral infections, and overwintering success since 2004. This citizen science project involves over 120 beekeepers nationwide with more than 1,200 colonies monitored annually. The overwintering dynamics of colony strength are monitored. Bee, honey and pollen samples for disease and residue analyses are taken up to three times per year in spring, summer and fall. Although pesticide residue analysis was first added in 2006, it has regularly been part of the annual analysis since 2009.

Here we report the preliminary pesticide residue results for N = 2,410 apiary samples. In the last few years, our multi-residue analysis has looked for residues in stored pollen of 475 different pesticides and their metabolites. Honey bees function like environmental monitors, foraging in a wide radius from their point-source colony. The residues detected thus essentially reflect current agricultural practices within a 2-6 km radius of the apiary, the typical foraging distance of honey bees.

We typically find only 15% of the suite of pesticide residues we investigate (n = 75 detected of 475 investigated), though this varies by sampling year. The residues are mostly in the trace range. We report five different ways of assessing pesticide risk: prevalence, diversity, concentration, relevant pesticides (contributing at least 50 points to the hazard quotient), and the actual hazard quotient. We compare the pesticide residues found in Germany with similar monitoring studies published in the United States. We also report on the overall trends of pesticide residues from 2009-2024, which mimic current agricultural plant protection policies.

PP-018 [Bee Health]

Harmonised Diagnostic Methods for *Tropilaelaps* Mites: Strengthening Surveillance and Control Against an Emerging Global Threat to Beekeeping

Stéphanie FRANCO, Aurélie DEL CONT, Nicolas COUGOULE, Cristina GASTALDI, Amandine TISON & Véronique DUQUESNE

Bee Pathology Unit, French Agency for Food, Environmental and Occupational Health and Safety (ANSES), 06902 Sophia Antipolis, ance, eurl.bee@anses.fr
WOAH Reference Laboratory for Infestation of Honey Bees with spp., European Union Reference Laboratory (EURL) for Bee Health

Background:

- *Acari: Laelapidae* external parasites of honeybees, native to East, South and Southeast Asia.
- morphologically species are described: *T. mercedesae* *T. koenigerum*
  Species known to parasitise
- *Tropilaelaps mites* feed and reproduce in the brood, transmit viruses, and can cause high severe damages to colonies: weakening, absconding, and mortality.
- Infestation by *Tropilaelaps* listed by the World Organisation for Animal Health (WOAH) and regulated in the European Union (EU).

The recent spread of *Tropilaelaps* mites into Central Asia, Western Siberia, Eastern Europe poses an increasing threat to global beekeeping, exacerbated by climate change and global trade.

Reliable, standardised diagnostic tools are essential for early detection, particularly in regions where *Tropilaelaps* has not yet been reported.

Official Methods for Identification of *Tropilaelaps* spp. and Differential Diagnosis from Other mites in Honey Bee Hive Environment:

pecies level identification:
High Resolution Melting (HRM) PCR & Sequencing

Confirmation of morphological results:
Conventional PCR

Primary diagnosis:
Morphological identification
→ *Tropilaelaps*

Sophia Antipolis

Method adapted from Anderson D.L. & Morgan M.J. 2007. Genetic and morphological variation of bee mites (Acari: Laelapidae): New and defined species. Experimental Applied Acarology. 43 10.1007/s10493

(Mesostigmata

The performance of the methods has been validated using specimens from various geographical origins:

	Performance	Main Information on Characterisation
Morphology	Sensitivity = 100% Reproducibility	• **Test population:** Philippines (n=3); *T. mercedesae* Georgia, Indonesia, Nepal, Sri Lanka, Thailand (n=36); • **Data consolidation through a literature review** • **laboratory caracterisation:** comparative laboratory testing organised in 2019, six EU NRLs participating
Conventional	Analytical specificity = 100% = 100 copies / reaction Diagnosis sensitivity = 100% Diagnosis specificity = 100%	• **Test population:** Philippines (n=3); Georgia, Indonesia, Nepal, Pakistan, New Guinea, Sri Lanka and Vietnam (n=19); targeted species
		• **Test population:** Philippines (n=3); Georgia, Indonesia, Nepal, Pakistan, New Guinea, Sri Lanka and Vietnam (n=19);

** Validated and accredited according to the international standards ISO 16140 and ISO 17025

Methods published in the WOAH Terrestrial Manual of Diagnostic Tests and Vaccines

And disseminated within the European Union network of national reference laboratories: publication on the EURL for Bee Health website, organisation of trainings, reference material for PCR adoption, proficiency

Establishing a robust, harmonised diagnostic framework ensures reliable identification, supports surveillance programs, and strengthens international efforts to prevent the spread of *Tropilaelaps*

These tools are essential for early detection and response, helping to safeguard honeybee populations and mitigate the potential impact of *Tropilaelaps* on apiculture.

Apimondia, Copenhagen, 23 27 September 2025

APIMONDIA SCANDINAVIA 2025
SWEDEN | DENMARK | NORWAY

PP-019 [Bee Health]

Api-vectoring potential of the entomopathogenic fungus *Beauveria bassiana* by *Bombus terrestris* for thrips control in strawberry production

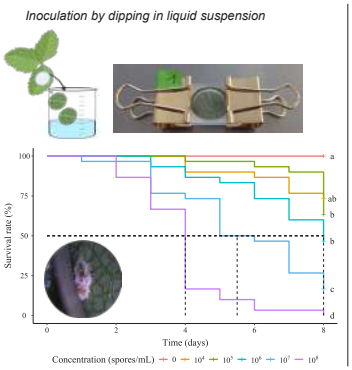
Morgane Ourry, Marta Montoro, Søren S. Henriksen, Anastasia Karatza, Katja K. Nielsen, Paulo Stipanic, Zhicong Wu, Shuhan Zhang, Antoine Lecocq, Annette B. Jensen, Nicolai V. Meyling

Background and objective

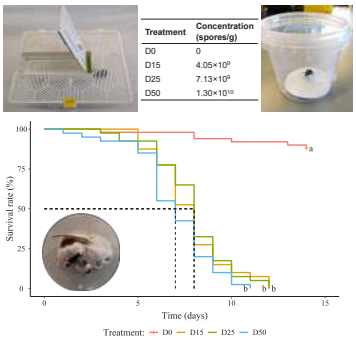
Thrips are an increasing problem in early-season tunnel strawberry production, with limited control options available. The fungus *Beauveria bassiana* shows potential as a microbial control agent, though direct targeting of thrips is difficult. While api-vectoring using the 'Flying Doctors' hive (BioBest, Belgium) is used against grey mold (Iqbal *et al.*, 2022), its application for insect pest control remains largely unexplored (Temmermans & Smagghe, 2022). **Project BUMBLEBIO aimed to evaluate the possibility of api-vectoring BotaniGard by bumblebees for thrips (*Frankliniella occidentalis*) control in strawberry crops.**

How lethal is BotaniGard to thrips and to bumblebees in lab conditions?

Inoculation by dipping in liquid suspension



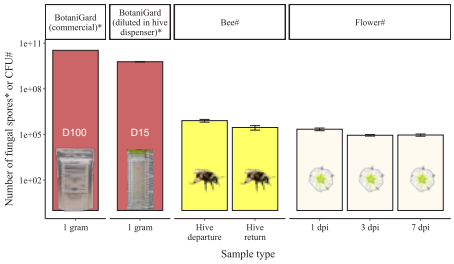
Inoculation by walking through powder in artificial dispenser

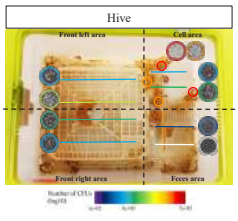


Treatment	Concentration (spores/g)
D0	0
D15	4.05×10^{9}
D25	7.13×10^{9}
D50	1.30×10^{10}

- *Beauveria bassiana* suspensions **(≥10^5 spores/mL)** applied to leaf discs significantly **reduced survival in adult thrips, but also in larvae**.
- The biopesticide BotaniGard (*B. bassiana*), diluted with corn flour, caused **0% survival in individually exposed bumblebees to the tested doses** (D15, D25, D50).
- **Observation of fungal growth** on cadavers confirmed that death was caused by *B. bassiana* in both thrips and bumblebees bioassays.

How much BotaniGard can be vectored by bees?





- Bumblebees **carried and deposited 10^5 CFUs** of fungus on flowers.
- The same fungal load remained **detectable for 7 days** in flowers.
- Fungal residues were also **traced back to the hive**, with:
  - 10^2–10^3 CFUs in hive areas
  - Up to 10^5 CFUs in cells

Is api-vectoring of BotaniGard efficient for thrips control in greenhouse conditions?

Scan here—this bee's got a video to show you!

Heterogenous hives and bee activity

Standardized flying hives		
Treatment	Average bee survival rate (SE)	
Control	87.36% (3.27)	ns
BotaniGard	92.71% (4.36)	

Treatment	Repetition	Average number of individuals per flower (SE) Larva		Adult	
Control	R1-R2	9.69 (1.28)	ns	0.92 (0.11)	ns
BotaniGard		9.78 (0.92)		0.70 (0.09)	
Control	R3	6.89 (1.49)	ns	0.61 (0.15)	ns
BotaniGard		6.64 (1.80)		0.47 (0.10)	

- Api-vectored BotaniGard had **no effect on the number of thrips (adults or larvae)** and very few individuals were infected by *B. bassiana*.
- A **microclimate gradient** (Δ_{RH} = 7 to 18%, Δ_{temp} = 2 to 4°C) was observed in the greenhouse: the **number of larvae was correlated**, negatively to air relative **humidity** and positively to air **temperature**.
- Surprisingly, **no impact of BotaniGard on bee survival** was observed in standardized hives (*i.e.*, contained the same number of bees).

Conclusions

BotaniGard was successfully vectored to flowers by bumblebees, despite variability in hive activity, and persisted over time. However, its lethality against both thrips and bumblebees appeared reduced under greenhouse conditions—less harmful to the bees, but less effective for pest control. This reduced efficacy may result from variable climate in the greenhouse that favor thrips reproduction while hindering fungal pathogenicity.

References: Iqbal *et al.* (2022), doi: 10.1094/PHYTO-05-21-0205-R; Temmermans & Smagghe, 2022, doi: 10.20506/rst.41.1.3308

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Ministry of Environment and Gender Equality
Environmental Protection Agency

UNIVERSITY OF COPENHAGEN
DEPARTMENT OF PLANT AND ENVIRONMENTAL SCIENCES

PP-020 [Bee Health]
Defining the Molecular Markers of Honey Bee Health: The Role of Nutrition and Seasonal Dynamics

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Honey bees are essential for ecological balance and agriculture, producing substances beneficial to human health. However, molecular markers of honey bee health remain poorly understood, despite widespread reports of colony collapse. To address this, we studied health markers in Apis mellifera ligustica populations sampled in winter and spring, free from DWV and SBV viruses, by analyzing ten defense-related genes. We also examined the effects of nutrition on overwintered honey bee health in early spring by testing four diets: pollen substitutes Diets 1, 2, and 3, and natural food with bee bread (control). We analyzed diet effects on honey bee metabolism using qPCR to assess ten defense-related and three development- and nutrition-related genes, and monitored virus dynamics in spring. Additionally, we examined protein content and digestibility of the diet proteins using the BCA method. Five molecular health markers were identified: two seasonal markers, domeless and spz, downregulated in overwintering bees, and the task-related marker apid-1, downregulated in both overwintering and newly emerged bees. Two general health markers, SOD1 and defensin-2, were upregulated. Pollen substitute Diet 2, with high protein content and digestibility, significantly improved metabolic health, showing effects similar to bee bread, the optimal food. Machine learning identified six diet-related markers: SOD1, Trxr1, defensin-2, JHAMT, TOR1, and vg. These markers exhibited distinct patterns in bees with chalkbrood symptoms, emphasizing the nutritional impact on health-compromised bees. These findings led to the development of a molecular model describing the transition of healthy long-lived honey bees from diapause to active development, driven by nutrition. The study highlights the interaction of seasonal changes, nutrition, and molecular health markers, offering valuable insights for beekeeping. It also may provide diagnostic tools for monitoring honey bee health during low-temperature months to prevent seasonal losses, with further validation needed across subspecies and climates.

PP-021 [Bee Health]
Improving Honey Bee Health: Analysis of Pollen Substitute Diets in Field and Cage Studies

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Honey bees (Apis mellifera L.) play a crucial role in agricultural pollination and honey production. However, global colony losses are increasing due to multiple stressors, including malnutrition, making the development of effective pollen substitute diets essential for maintaining colony health and productivity. This study evaluated the effects of four different pollen substitute diets (Diet 1, Diet 2, Diet 3, and Control) through both field and cage experiments. A total of 11 parameters and 21 amino acids were analyzed to assess diet performance comprehensively. Among the tested diets, Diet 1 demonstrated the most significant improvements in the field experiment, showing higher honey bee population, brood area, diet consumption, preference, colony weight, and honey production compared to the other diets. Similarly, in the cage experiment, Diet 1 resulted in increased dried head and thorax weight, as well as elevated vitellogenin (vg) gene expression, a critical marker of honey bee health and longevity. Advanced statistical analyses, including canonical discriminant and principal component analyses, highlighted Diet 1's distinct characteristics. Key factors contributing to its superior performance included histidine levels, diet digestibility, consumption rate, vg gene expression, and isoleucine content. Additionally, arginine was found to be significantly correlated with multiple parameters, such as honey bee population, brood area, and consumption, with Diet 1 exhibiting the highest arginine levels. Diet 1's exceptional performance can be attributed to its unique formulation. These findings suggest that Diet 1 could be an effective enhancement for pollen substitute diets, ultimately improving honey bee nutrition, strengthening colony health, and potentially mitigating the impact of malnutrition on global honey bee populations.

PP-022 [Bee Health]
The gypsy mushroom (Cortinarius caperatus) as a source of antiviral activity against the deformed wing virus

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[2]Biology centre, Czech Academy of Sciences, Ceske Budejovice, Czech Republic

No antiviral treatment against honey bee viruses is currently available for practical applications and the level of viral infection can only be controlled indirectly by reducing the number of Varroa mites in honey bee colonies. In this study, we investigated the ntiviral potential of the gypsy mushroom (Cortinarius caperatus) to reduce DWV infection in honey bees.

Our results indicate that the alcohol extract of C. caperatus prevented the development of DWV infection in cage experiments as well as after direct application to honey bee colonies in a field experiment. The applied doses did not shorten the lifespan of honey bees. The reduced levels of DWV in C. caperatus-treated honey bees in cage experiments were accompanied by significant changes in the gene expression of Tep7, Bap1, and Vago. No residues of C.caperatus were found in honey harvested in the spring from colonies supplemented with the mushroom extract for their winter feeding. These findings suggest that C. caperatus alcohol extract could be a potential natural remedy to treat DWV infection in honey bees. Future studies will concentrate on the identification of specific active compounds with antiviral activity against DWV.

PP-023 [Bee Health]
Five-year surveillance of AcSBV prevalence in Apis cerana in Northern Taiwan explore the risk of co-cultured with Apis mellifer

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The sacbrood virus (SBV) presents a threat to Apis cerana larvae, resulting in high mortality rates and potential colony collapse. In Taiwan, outbreak of AcSBV was reported from 2015, when the SBV-like symptom was first found in the A. cerana colonies. Subsequent studies also indicated that AcSBV strains, which found in Taiwan, were closely related to the CSBV-FZ strain originating in China. Since then, AcSBV has rapidly spread throughout A. cerana colonies in Taiwan, and substantially impacted local A. cerana populations. Based on the infected honey bee host species, the virus is known as AmSBV (SBV infects A. mellifera) and AcSBV (SBV infects A. cerana). The cross-infection of AcSBV and AmSBV between A. cerana and A. mellifera in the co-cultured apiaries has been documented in Taiwan. A five-year monitoring program of A. cerana colonies in northern Taiwan from 2019 to 2023 was performed for assessing changes in AcSBV prevalence and investigating the impacts of A. cerana and A. mellifera co-culturing. The results revealed that AcSBV prevalence peaked in 2019, with infection rates of 66.47% in A. cerana-only apiaries and 56.51% in co-cultured apiaries. The prevalence of AcSBV in both types of apiaries were decreased in 2021. Furthermore, AcSBV prevalence was significantly higher in the A. cerana-only apiaries in the autumn in 2019 and co-cultured apiaries during the winter in 2023, indicated the cross-species infection of AcSBV, and the risk of SBV spillover from A. mellifera. The long-term surveillance data indicated the high risk of SBV cross-species infection during seasonal transitions in autumn and winter, which could provide the advice for beekeeping strategy to minimize the sacbrood disease in Taiwan.

PP-024 [Bee Health]
The Impact of Emotions on Honeybee Health

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The study of emotions in animals, particularly honeybees, is a contentious yet significant area of research. Given that animals cannot verbally express their feelings, we must assess their emotions through physiological, cognitive, and behavioral indicators. Emotions can profoundly affect both human and animal health; negative feelings are linked to poor decision-making and adverse health outcomes, while positive emotions are associated with improved immune responses. Research shows that individuals experiencing positive emotions tend to enjoy better health, as these emotions enhance immune function, whereas negative emotions can weaken it, especially following stress. However, the connection between emotions and health in invertebrates, such as honeybees, remains underexplored. In my research, I aimed to determine whether emotions affect honeybee health through two experiments: (1) examining how emotions influence disease prevention and (2) exploring how emotions impact disease progression in previously infected bees. In first experiment, I exposed bees from seven colonies to various odors (alarm pheromone, geraniol, and a control) to assess their emotional responses. After one week, I infected the bees with Nosema sp. spores. Each colony contained twelve cages—six designated for longevity testing and six for measuring Nosema infection levels. In the second experiment, previously infected bees were exposed to the same odors, again utilizing twelve cages per colony for longevity and infection assessments. The results revealed that bees exposed to geraniol lived longer and exhibited lower infection rates compared to those exposed to alarm pheromone and the control group. Conversely, bees exposed to alarm pheromone had the shortest lifespan and highest infection levels. These findings support the hypothesis that honeybee health is influenced by their emotional states, highlighting a crucial link between emotions and health in these essential pollinators. This research could significantly impact beekeeping practices by encouraging beekeepers to create environments that promote positive emotional states in bees, potentially enhancing their health and productivity.

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PP-025 [Bee Health]

BeePal

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#0312

An automated AI-based diagnostic method for assessing Varroa destructor-infestation in honeybee colonies – First results and findings

Introduction

- Varroosis, classified as a Category C, D, and E disease under EU Regulation 2018/1882, is a primary cause of winter losses in beekeeping.
- The parasite, **„Varroa destructor"**, directly weakens affected colonies as a brood parasite and serves as a vector for various viruses[4].
- Traditional diagnostic methods include „wash tests, the "powdered sugar method" and counting mites dropping onto a bottom board.
- This study aims to validate an automated, AI-based method for determining within-colony mite fall.

Methods

The **automated diagnostic device "BeePal ONE"** was validated to manual counting of mites in the debris and compared with the results from the standard **"wash-test"**.

- The error-quota between manual debris analysis vs AI –analysis were determined
  - all the debris-pictures taken and analyzed by the **BeePal ONE** sytem where validated manually, the rate of false positives and false negatives was calculated.

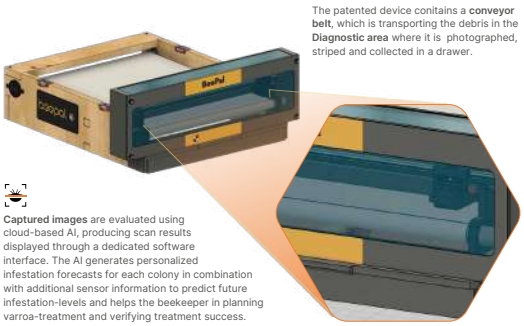
The wash test method

- aprx. 300 bees (30-50g) are taken from brood-combs and killed with ice-spray.
- They are put in 500ml water with dishwashing detergent, shook and let go for 15 min. The water is filtered and the mites are counted.

- **BeePal ONE** utilizes "debris diagnosis" at the bottom board combined with AI-driven image recognition.
  - The debris is transported on a **conveyor belt** into a diagnostic area where it is photographed, stripped, and collected in a drawer. **Captured** images are evaluated using cloud-based AI, producing scan results displayed through a dedicated software interface.

- The number of bees in the hive were calculated using the „modified Liebefeld Method"[3].

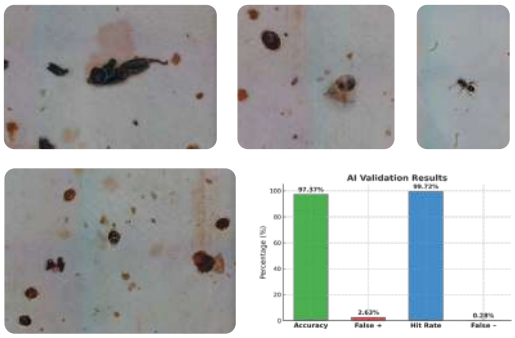
The BeePal ONE & how it works



The patented device conitains a **conveyor belt**, which is transporting the debris in the **Diagnostic area** where it is photographed, striped and collected in a drawer.

Captured images are evaluated using cloud-based AI, producing scan results displayed through a dedicated software interface. The AI generates personalized infestation forecasts for each colony in combination with additional sensor information to predict future infestation-levels and helps the beekeeper in planning varroa-treatment and verifying treatment success.

BeePal AI vs. Human Eyes



Results & conclusion

Infestation forecasts differed strongly depending on the diagnostic method. The „BeePal ONE" debris counting is very accurate and removes subjectivity of manual counting and offers solid scientific data gathering with less effort.

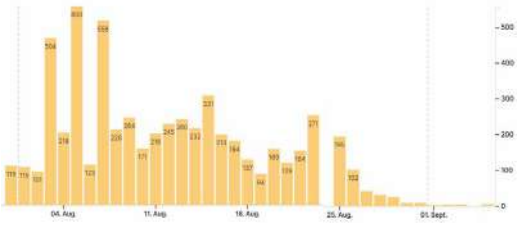
All results based on 20,000 bees in one hive:
Wash samples (n=2): 2.5–2.8% infestation → approx. 500–560 mites.
Debris diagnosis (AI-based): 50–119 mites/day (mean: 74.6).
Estimation according to Boecking et al.[2]: ≈ 11,190 mites (≈ 55.9%). (Rule of thumb: daily mite fall × 120 = total infestation.)

To further investigate these results, the colony was treated with 60% formic acid after sampling. The effectiveness of mite control with 60% formic acid is well documented and reported to be 75–95% (Bachert et al. 2022)[1].
Mite drop was analyzed using the **BeePal ONE**.

The Assumption of mite infestation in the colony based on
Wash sample: ≈ 560 mites
Debris count: ≈ 11,190 mites

Post-treatment mite drop: 5,754 mites

Amount of mites



02.08.2024 – Start of the treatment

The chart out of the Usercockpit of BeePal shows the increase of the mitecount starting 03/08/2024.
Until 23/08/2024 **5310** mites are counted.

05.09.2024 – Treatment success

The mite count decreases continiously to 5 mites
Total amount of mites counted till 05.9.2024: 5754

Error discussion

General: Just one hive observed with **BeePal ONE** prototype

Debris diagnostics: Detected only dead or groomed-off mites. High counts may also indicate good hygienic behavior. Accuracy depends on colony and requires repeated observations across multiple colonies under identical conditions. Ant activity can remove mites and bias results; frequent automated scanning would help reduce this effect.

Wash sample: About 400 bees from a brood comb are tested. Result assumes even mite distribution within the colony.
Colony strength determination: Strongly observer-dependent; assessments may vary despite identical conditions.

Bigl, G. */ Hardt, M.**
* BeePal UG, Leipzig, www.beepal.ai /
** State Institute of Health and Veterinary Affairs of Saxony

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PP-026 [Bee Health]

Exploring virome dynamics in *Varroa destructor* resistant and susceptible honey bee colonies

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Introduction

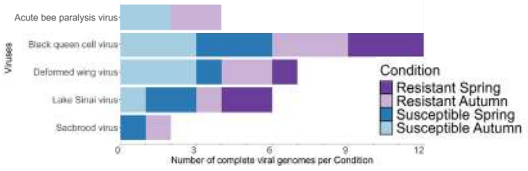
Varroa destructor feeds primarily on the fat body and hemolymph of honey bee pupae and adults, impairing host immunity, reducing lifespan, and acting as a highly effective vector for several honey bee viruses[1]. Honey bee colonies often host multiple RNA viruses including Acute Bee Paralysis Virus (ABPV), Black Queen Cell Virus (BQCV), Deformed Wing Virus (DWV), Lake Sinai Virus (LSV), and Sacbrood Virus (SBV) whose prevalence and viral loads can vary considerably across seasons[2].

Some bee populations exhibit natural resistance to *V. destructor*, thanks to traits like hygienic behaviour, grooming, suppressed mite reproduction, and potentially enhanced antiviral responses[3]. In the northeast part of Uruguay, a population of Africanized honey bees has demonstrated resistance to *V. destructor* without the use of acaricides, due to a high hygienic behavior. In a previous study, we sequenced the virome (viral communities) from nurse honey bees collected from both *V. destructor* - resistant and susceptible colonies in nearby apiaries during spring and autumn.

This study aimed to characterize the diversity and phylogenetic relationships of honey bee viruses present in Uruguay using high-throughput sequencing

Materials and Methods

In a previous work, we obtained the complete genomes of ABPV (n=4), BQCV (n=12), DWV (n= 7), LSV (n= 6) and SBV (n= 2) from resistant and susceptible colonies. Whole genomes of each virus were aligned using Clustal Omega 1.2.2 with thoseavailable at NCBI[5], and maximum-likelihood phylogenetic trees were built with 1000-replicate bootstraps using MAFFT and FastTree plugins with default settings in Geneious Prime 2024.0.5 software.



Results and discussion

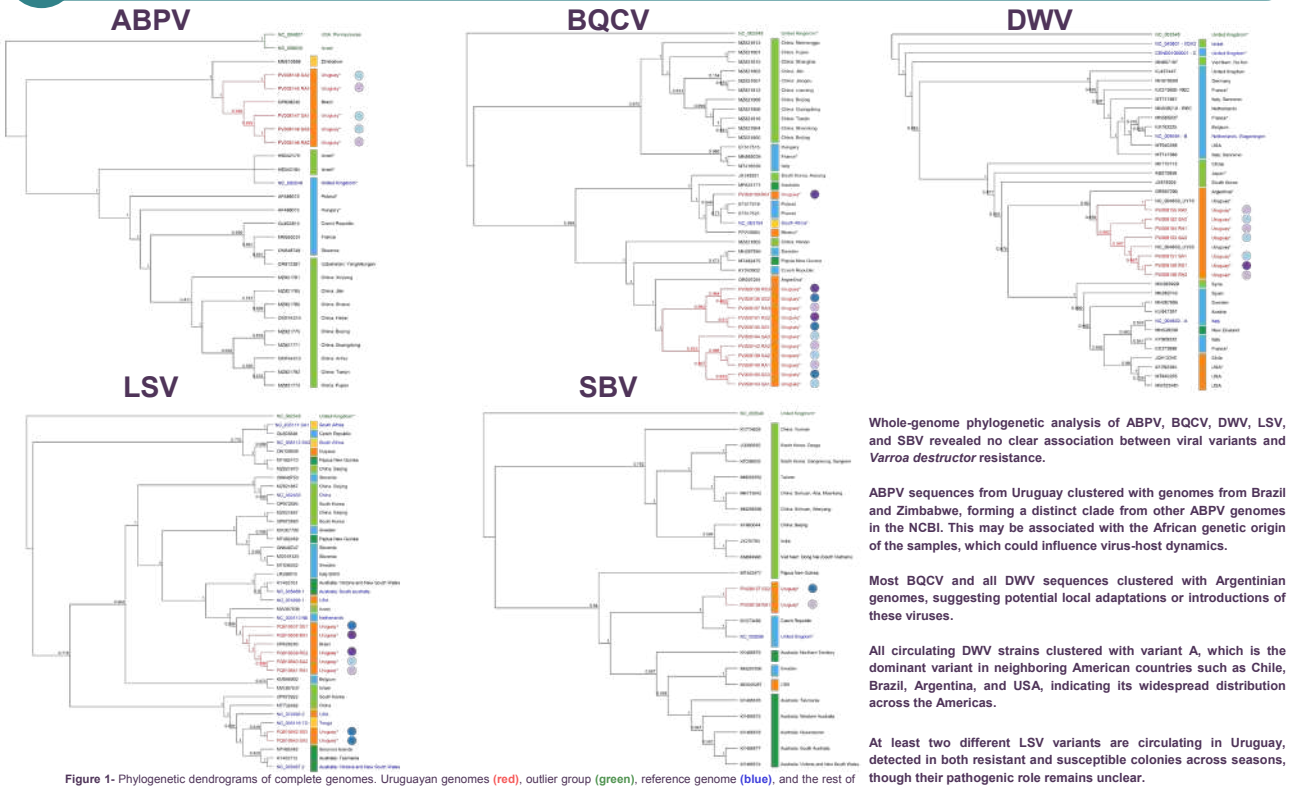


Figure 1- Phylogenetic dendrograms of complete genomes. Uruguayan genomes (red), outlier group (green), reference genome (blue), and the rest of the sequences (black). All sequences used for comparison were obtained from the NCBI database (accession numbers are indicated). The continents are rectangles marked with colours: Africa, America, Asia, Europe and Oceania.

Whole-genome phylogenetic analysis of ABPV, BQCV, DWV, LSV, and SBV revealed no clear association between viral variants and *Varroa destructor* resistance.

ABPV sequences from Uruguay clustered with genomes from Brazil and Zimbabwe, forming a distinct clade from other ABPV genomes in the NCBI. This may be associated with the African genetic origin of the samples, which could influence virus-host dynamics.

Most BQCV and all DWV sequences clustered with Argentinian genomes, suggesting potential local adaptations or introductions of these viruses.

All circulating DWV strains clustered with variant A, which is the dominant variant in neighboring American countries such as Chile, Brazil, Argentina, and USA, indicating its widespread distribution across the Americas.

At least two different LSV variants are circulating in Uruguay, detected in both resistant and susceptible colonies across seasons, though their pathogenic role remains unclear.

Conclusions and Perspectives

We report the complete genomes of ABPV and SBV for the first time in South America.

We successfully reconstructed the phylogenetic relationships of the studied viruses.

High-throughput sequencing proved to be a powerful approach for characterizing the honey bee virome.

Distinct viral variants were found circulating in Uruguay

Future research will focus on detecting novel viruses beyond reference-based mapping.

This study provides key insights into the complex interactions among viruses, varroa mites, and honey bees in resistant and susceptible colonies, contributing to a better understanding that supports sustainable beekeeping.

Acknowledgments

The authors thank the Ministerio de Educación y Cultura (MEC-DICYT) (FVF_2023_421) and Programa de Desarrollo de las Ciencias Básicas, PEDECIBA-MEC-UdelaR (Despegue científico 2023) for their financial support.

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PP-027 [Bee Health]
Are Apis mellifera Filamentous Virus (AmFV) and Lake Sinai Virus (LSV) emerging viruses in Uruguay? A retrospective survey

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The honey bee is a key pollinator in natural and agricultural ecosystems. Unfortunately, around the world, beekeepers face high colony losses due to several factors, including infection with RNA viruses. Many honey bee viruses remain in a subclinical state and are often considered emergent, although they may have been present for a long time. However, in combination with other factors, such as poor nutrition, high Varroa destructor infestations, or the presence of bacterial infections, the honey bee viruses can significantly contribute to honey bee colony losses. Using next-generation sequencing, our group studied the viromes of V. destructor-resistant and susceptible colonies and detected the presence of Apis mellifera Filamentous Virus (AmFV) and Lake Sinai Virus (LSV) for the first time in Uruguayan apiaries.

This work aimed to detect AmFV and LSV using a cheaper molecular technique (qPCR) and perform a retrospective survey to establish whether their presence is recent or has been circulating within the population for an extended period.

We analyzed 202 samples from single honey bee colonies collected in Uruguay during three different studies: (i) 28 DNA samples from a regional study (2004–2005), (ii) 74 cDNA samples from a nationwide survey (March 2011), and (iii) 100 DNA and 93 cDNA samples from another nationwide survey (March–June 2021).

Our results show that AmFV and LSV are currently widespread across the country and have been present at least since 2004 and 2011, respectively. The detection of AmFV revealed its wide distribution across the country and a national prevalence of 82 ± 14%. Similarly, the qPCR detection of LSV in the samples revealed a prevalence that has increased between 2011 and 2021 from 37 ± 18% in 2011 to 99 ± 4% in 2021.

Although no cure exists for viral infections in honey bees, early detection and molecular surveillance are essential for monitoring disease dynamics and implementing effective control measures to support beekeeping sustainability.

PP-028 [Bee Health]
Effects of Rapid Heat Hardening of Honeybee Mother Queens (Apis mellifera) on the Oxidative Response of Their Daughter Workers during Heat Stress

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Rapid heat hardening is the process whereby organisms exhibit improved survival in extreme temperatures following a short period of exposure to milder temperatures. This study aimed to investigate the effects of rapid heat hardening of honeybee mother queens (Apis mellifera) during the larval stage on the oxidative response of their daughter workers during heat stress. Twenty accepted mother queen (MQ) larvae at the age of two days were selected and divided into two incubation treatment groups (n = 10). The control group (non-heat-treated mother queens, nH-T MQ) was maintained at 34.5 C for 15 min and 70% relative humidity (RH), and the pre-heat-treated (pre-heat-treated mother queens, pH-T MQ) group was subjected to 41 C for 15 min and 70% RH. After queens mating and establishing good colonies, about 300 workers were collected from brood combs of each treatment group. Workers were incubated in digitally controlled thermo-incubators for one hour at temperatures of 35, 40, 45, 50, and 55 °C. mRNA levels of several antioxidant genes in the thorax were evaluated using real-time qPCR, including catalase, glycosylase domain-containing protein-4, superoxide dismutase, thioredoxin-2, thioredoxin reductase-1, vitellogenin, methionine sulfoxide reductase, thioredoxin peroxidase-4, and glutathione peroxidase-like-1. Furthermore, the concentrations of glutathione peroxidase, super oxidase dismutase catalase, cytochrome P450, peroxidase, and glutathione reductase were determined by ELISA. Results showed that daughter workers of the pH-TMQ exhibited higher survival rates at elevated temperatures than those of the nH-TMQ. The pH-TMQ also showed improved basal and dynamic expression of several of the tested genes and enzymes, which indicated a protective response against heat stress and the effectiveness of tissue hardening in oxidative stress and antioxidant activity response. These recorded changes may improve the thermotolerance acquisition of workers during heat stress conditions and ultimately help to formulate a comprehensive improvement program.

PP-029 [Bee Health]
How does the new acaricide 1-allyloxy-4-propoxybenzene work? Studies on the mode of action using proteomics and fluorescence microscopy

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[2]Department of Biochemistry and Molecular Biology, The University of British Columbia, Vancouver, BC, Canada

The compound 1-allyloxy-4-propoxybenzene, coded 3c(3,6), causes paralysis and death of the mite Varroa destructor. We addressed the mode of action of compound 3c(3,6) by exploring the proteins the compound binds to and their location in the mites. The studies began with the preparation of probes that have the structure of 3c(3,6) at one end and either a bead for protein capture or a fluorescent dye for imaging of tissues, connected through a flexible linker. To capture proteins, we prepared extracts of soluble and membrane proteins, and incubated them with the beads modified with 3c(3,6). As negative controls we used beads modified with a structure that resembles 3c(3,6) but we knew from structure-activity studies not to be paralytic to the mites, as well as beads modified with the linker chain only. After washing the various beads, the proteins bound to them were analyzed by proteolysis, followed by liquid chromatography-mass spectrometry (LC-MS). Comparison of the peptides detected in the 3c(3,6) treatment vs. the negative controls enabled us to determine which proteins bind the active compound. To image the binding sites of 3c(3,6) in the mites and bees, we incubated tissues with the fluorescent probes with 3c(3,6) or the inactive structure or the linker, the latter two being the negative controls. Tissues were embedded, cryosectioned and imaged on a confocal microscope.

Soluble proteins we found include lipid-binding proteins and chaperones. Structural proteins include actin and its binding proteins. Membrane proteins found include a G-beta protein, receptor fragments and the oligomycin sensitivity conferral protein of the mitochondrial ATP synthase. Imaging of labeled mite sections revealed that specific neuronal fibers stain most densely with the treatment and not with the controls. These neuronal fibers lead to either the front legs into sensory hairs or to the zone behind the fourth legs, to bristles on the edge of the mite's dorsal plate and to the air sac. Muscles stain lightly, perhaps due to actin binding. The mite's digestive or reproductive systems never stain with our probes, indicating that the compound interacts most strongly with specific components of the central and peripheral (sensory/motor) nervous system.

PP-030 [Bee Health]
Atrazine exposure can dysregulate the immune system and increase the susceptibility against pathogens in honeybees

Kang Wang, Ting Ji, Zheguang Lin
College of Animal Science and Technology, Yangzhou University, Jiangsu, China

Recently, concerns regarding the impact of agrochemical pesticides on non-target organisms have increased. The effect of atrazine, the second-most widely used herbicide in commercial farming globally, on honeybees remains poorly understood. Here, we evaluated how atrazine impacts the survival of honeybees and pollen and sucrose consumption, investigating the morphology and mRNA expression levels of midgut tissue, along with bacterial composition (relative abundance) and load (absolute abundance) in the whole gut. Atrazine did not affect mortality, but high exposure (37.3 mg/L) reduced pollen and sucrose consumption, resulting in peritrophic membrane dysplasia. Sodium channels and chitin synthesis were considered potential atrazine targets, with the expression of various genes related to lipid metabolism, detoxification, immunity, and chemosensory activity being inhibited after atrazine exposure. Importantly, 37.3 mg/L atrazine exposure substantially altered the composition and size of the gut microbial community, clearly reducing both the absolute and relative abundance of three core gram-positive taxa, Lactobacillus Firm-5, Lactobacillus Firm-4, and Bifidobacterium asteroides. With altered microbiome composition and a weakened immune system following atrazine exposure, honeybees became more susceptible to infection by the opportunistic pathogen Serratia marcescens. Thus, considering its scale of use, atrazine could negatively impact honeybee populations worldwide, which may adversely affect global food security.

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PP-031 [Bee Health]

Prevalence of honeybee pathogens in South Korea: A five-year nationwide surveillance (2020-2024)

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3. POSTBIO, Gyeonggi, Republic of Korea
4. Department of Veterinary Pathology, College of Veterinary Medicine, Seoul National University, Seoul, Republic of Korea

Introduction

- Since the winter of 2021, South Korea has experienced increasing honeybee colony losses, often associated with colony collapse disorder (CCD).
- Multiple stressors such as climate variability, pesticides, and floral resource decline contribute to this trend.
- However, the role of pathogens remains under-characterized at the national level.
- Objective: Conduct a 5-year nationwide molecular surveillance of 12 major honeybee pathogens in managed *Apis mellifera* colonies.

Methodology

- **Study period:** 2020–2024
- **Sample size:** 1,825 colonies from 4,953 apiaries
- **Region division:** Northern, Central, Southern
- **Diagnostic method:** qPCR and RT-qPCR for virus, bacteria, fungi
- **Data analysis:** Prevalence by year, season, region; co-infection network

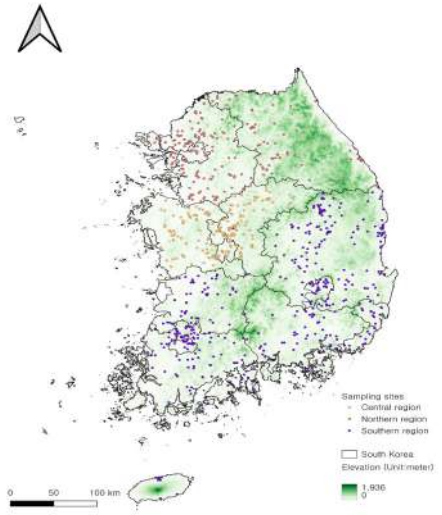

Fig. 1. Sampling sites across South Korea (2020-2024), categorized into northern, central, and southern regions considering mean annual temperature and beekeeping practices. Dot colors indicate regional classification.

Results

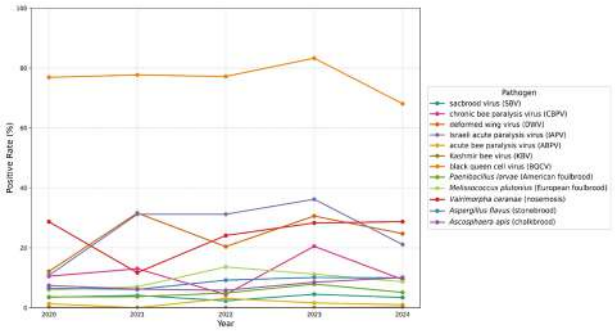

Fig. 2. Annual prevalence of 12 major honeybee pathogens in South Korea (2020–2024). Viral pathogens, particularly BQCV, IAPV, and DWV, showed the highest prevalence, whereas *Vairimorpha ceranae* was the most common fungal pathogen.

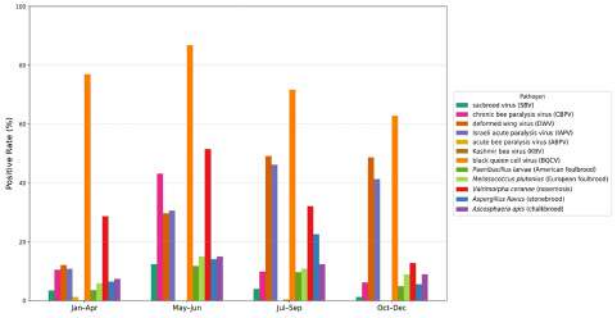

Fig. 3. Seasonal prevalence of 12 honeybee pathogens across four seasonal periods (Jan–Apr, May–Jun, Jul–Sep, Oct–Dec) during 2020–2024. BQCV maintained high prevalence year-round, while DWV, IAPV, and *Vairimorpha ceranae* exhibited marked seasonal variation.

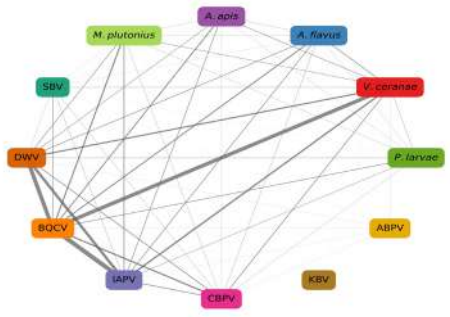

Fig. 4. Co-infection network of 12 honeybee pathogens detected from 1,825 colonies in South Korea (2020–2024). Edge thickness indicates the frequency of co-infection between each pathogen; thicker lines represent higher co-infection rates. BQCV formed the central hub, frequently co-occurring with DWV, IAPV, and *Vairimorpha ceranae*.

Conclusion

- **Nationwide surveillance revealed consistently high prevalence of viral pathogens, particularly BQCV, IAPV, and DWV, as the major contributors to colony health deterioration during 2020–2024.**
- **The fungal pathogen *Vairimorpha ceranae* remained consistently prevalent, especially in spring and summer.**
- **Seasonal peaks in DWV and IAPV prevalence underscore the need for season-specific diagnostic and control strategies.**
- **High frequency of co-infections, especially combinations involving BQCV, highlight the importance of multiplex detection and integrated management.**
- **These results provide a scientific basis for establishing a national honeybee pathogen monitoring and surveillance system in South Korea.**

PP-032 [Bee Health]
Natural antibacterial solutions: essential oils and hydrolates for beehive health

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Beekeeping environments, where thousands of honeybees coexist in confined spaces, are prone to microbial infections. Some honeybee-associated bacteria, like Bacillus larvae, Melisococcus plutonius, Streptococcus apis, Pseudomonas, and Salmonella paratyphi are pathogenic, while others, such as Lactococcusspp., provide beneficial effects. Varroa destructor mites, infecting honeybees, further spread harmful microbes like Erwinia, Enterococcus, Stenotrophomonas, and Bacillus. Plants and their substances can affect the survival of microorganisms that are common in honeybee environments. Plant-based essential oils (EOs) can influence microbial growth, either inhibiting or stimulating bacteria depending on the type, dosage and target organism. This study aims to identify essential oils and hydrolates that inhibit pathogens without harming beneficial bacteria.

Molecular methods, including PCR, restriction analysis, and sequencing, were used to identify bacteria on honeycombs and bee larvae. Seven genera were detected: Bacillus, Pseudomonas, Moraxella, Priestia, Micrococcus, Hafnia, and Staphylococcus. Moraxella sp. and Micrococcus sp. were most common on honeybee larvae, while Bacillus spp. dominated honeycombs. Seven bacterial strains were selected for testing with EOs and hydrolates: B. subtilis, P. aeruginosa, Streptococcus pyogenes, Moraxella osloensis, Staphylococcus warneri, Lactobacillus brevis and L. plantarum. Eleven EOs were used, including mint, oregano, lemon balm, lemon tea tree, various thyme chemotypes, lemongrass, linden flower, and carrot seed. Disk diffusion and evaporation tests showed that oregano, lemongrass, lemon balm, thyme-mint blend, and all thyme EOs had the strongest antimicrobial effects. Lemon balm EO was unique in inhibiting potential pathogenic bacteria but not beneficial Lactobacillus spp. Seven hydrolates were selected for antimicrobial analysis: aniseed lofant, lemongrass, wormwood, medicinal chamomile, lavender, and calendula. Lavender hydrolate had the strongest antibacterial properties, while medicinal chamomile was the weakest. No hydrolate selectively inhibited pathogens while not affect Lactobacillus.

The identification of microorganisms in the honeybee environment is important to know the microbiological status and susceptibility to disease. Natural plant-based substances possessing antimicrobial properties may help to maintain hive health. Among essential oils tested, lemon balm shows promise for pathogenic bacteria control, but further research is needed on their interaction with beeswax and honeybee response. This study was funded by the Research Council of Lithuania (project no. S-MIP-24-55).

PP-033 [Bee Health]
Diseases and parasites in managed honey bees in Europe (Horizon 2020 project B-GOOD)

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To obtain an overview of the diseases and parasites in managed Apis mellifera colonies, and to deduce the impact of these pathogens on honey bee colony health, colonies from 14 European countries were sampled three times per year (spring, summer, autumn) in the framework of the Horizon 2020 project B-GOOD (Giving Beekeeping Guidance by cOmputatiOnal-assisted Decision making). Sampled bees were examined at two National Reference Laboratories for Bee Diseases for the presence of 12 known honey bee pathogens.

From 2020 to 2022, 1580 samples from 352 colonies were examined (obtained from research institutes and beekeepers in Belgium, Finland, France, Germany, Greece, Italy, Latvia, Netherlands, Poland, Portugal, Romania, Sweden, Switzerland, United Kingdom). Of these colonies, 64 were sampled during the three years (2020-2022); 120 colonies were sampled during two years (2021-2022) and in 2022, bees from an additional 168 colonies were collected. All samples were tested for the viruses DWV-A, DWV-B, BQCV and SBV, for the presence of Malpighamoeba mellificae and the level of infestation with Varroa destructor was determined. All spring and summer samples were also analysed for Nosema apis and Nosema ceranae. Additionally, spring and autumn samples were tested for ABPV and CBPV. Infection with Paenibacillus larvae and Melissococcus plutonius (American and European foulbrood) was checked in autumn samples only.

The results give an insight in the honey bee health situation in Europe. Differences in the levels of parasites and pathogens were observed between different countries and seasons. The most prevalent viruses were BQCV, DWV-B and SBV, although with variable viral loads in the different countries. Nosema ceranae was frequently detected while Nosema apis seems nearly vanished in Europe. The frequencies of different viral loads were used to suggest a threshold for each virus above which occurrence of clinical symptoms is more likely. The co-occurrence of various diseases and the relationship between presence and intensity of pathogen infection and the death of colonies during winter was studied and compared for different climate zones within Europe. Knowledge of the risk factors could help beekeepers in preventing winter mortality.

PP-034 [Bee Health]
Effect of rapid heat hardening of honeybee mother queens (Apis mellifera) on the immune response of their daughter workers during heat stress

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Global warming has become a clear threat to beekeeping worldwide. Rapid heat hardening in organisms, also known as “acclimation”, is defined as a physiological process that includes fast pre-exposure to non-lethal temperatures for minutes to hours, these processes involve the induction of several heat stress proteins (HSP) and other stress proteins. To assess the effect of queen larval preheat hardening on the immune response of daughter workers during heat stress, twelve accepted mother queen (MQ) larvae with the age of 4 days were selected and divided into two treatment groups (n = 6). The non-heat-treated mother queens (nH-T MQ) were kept for 15 min at 34.5 °C and 70% relative humidity (RH), and the pre-heat-treated mother queens (pH-T MQ) group was subjected for 15 min to 41 °C and 70% RH. About 500 workers were collected from the brood combs of each treatment group. The worker bees in their cages were incubated for 1 h in digital-controlled thermo-incubators at the following temperatures: 35, 40, 45, 50, and 55 °C. The expression of several immune pathways genes in the intestine was assessed by relatively quantitative Real-Time qPCR (RT-qPCR). In general, pre-heat treatment of the mother queen's larvae changes the basal and dynamic expression of all tested genes in immune pathways, which significantly increases the expression of Toll-1, Spz, DI, Cact-1, Rel, Hem, PPO, and Apid-1 after heat stress in several temperatures, decreased the expression of Tab-3 and Aba, had no effect at all on the expression of Myd88 gene, and had a fluctuated effect on the expression of Hym and Def-1 in both thermoneutral and heat stress conditions of daughter workers. Furthermore, it decreased the death rate under heat stress probably indicating a significant improvement in honeybees' immune response and thermotolerance acquisition in hot areas.

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PP-035 [Bee Health]

Varroa Monitoring and Biomechanical Treatment

Background

My project investigates the possibilities of avoiding chemical treatments - if not completely then at least only when need be.
Identifying when there is a need for treatment is not trivial. Aspects include the local environment, beekeeping practices and the bee families. Monitoring the infestation level is essential for assessing the Varroa population and making decision when to treat or not to treat.

Comparing Varroa Monitoring Techniques

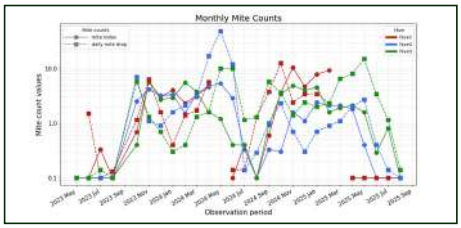
- **Alcohol wash** of 300 bees. Reflects the size of the Varroa population relative to the adult bee population, i.e. the **mite index**
- **Natural mite drop** on sticky board under an open mesh floor: The mite drops are counted over a period of 5–7 days and the average **daily mite drop** is calculated. The daily mite drop reflects the total size of the Varroa population

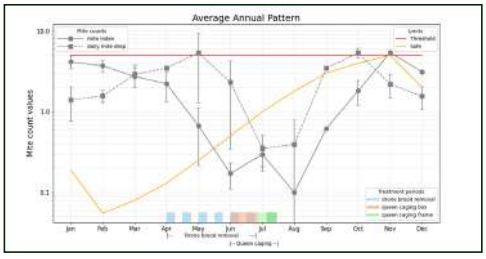
Varroa Monitoring

I have sampled my 3 bee hives each month, year-round, for almost three years. The 3 hives are located in my garden under almost similar conditions.

Although not reflecting the same aspects of the Varroa population, both techniques seem equally effective at estimating the infestation level.

The values display considerable variations among the 3 hives but also that there seems to be a common seasonal pattern





Varroa Annual Pattern

I have calculated the annual pattern by averaging the monthly data from the three hives over the available time period.

The annual trend shows a distinct reduction in Varroa infestation levels from April/May to July/August. This coincides with the period during which biomechanical methods were applied to reduce mite levels.

If no treatment is applied at all, the mite counts should lay below the constructed yellow line, which represents an approximate doubling of the infestation level from February to a peak in November and remain below the critical threshold of 5 mites in daily natural drop or a 5% infestation index (the red line).

Biomechanical Methods

- **Drone brood removal**
  In the season, approx. April to middle of Juli, I have removed capped drone brood regularly from a drone frame.
- **Brood breaks**
  I have caged the queen 25 days from 1st of June to 25th of June. This causes all brood to emerge from the cells and all the Varroa mites are free on the bees.
- **Worker brood removal**
  The queen is caged on a foundation frame for 9 days to fill it with brood. This first frame is then placed in the hive and replaced with a second frame, where the queen again is confined for 9 days. After this, the brood on the first frame will be sealed and the Varroa mites trapped, and the frame is removed. After an additional 9 days, the second frame is also removed with sealed brood and trapped mites.

Conclusions

The amount of data in my investigation is quite sparse, but based on my monthly Varroa mite counts over 2½ years, I dare to make the following conclusions:

The infestation level is estimated equally well using natural mite drop and alcohol wash. The mite drop method is non-intrusive and suitable during colder periods, whereas the alcohol wash provides a more immediate result. The mite drop method typically counts mites over a period of 5–7 days.

The biomechanical methods I have used are able to keep the Varroa infestation below a critical threshold of 5 mites per day or a 5% mite index. **Medical/chemical treatments are no longer needed.**

The Varroa population increases from January through April until drone brood removal starts to show its effect. After the biomechanical treatments end in July, the mite population rises again, peaking around October 1st. I don't observe any significant drop in the infestation level during the winter.

To estimate and monitor the Varroa infestation level, suitable sampling dates are May 1st, August 1st, and October 1st.

Next Steps?

A natural next step would be to select and breed queens that maintain a low daily mite drop, in order to obtain bees that require less, or even no, treatment against Varroa mites.

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Bee Inspector, Chairman of
Nordsjællands Bivenner.
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AARHUS UNIVERSITY

This work would not have been possible without the guidance and support of Per Kryger, Senior Researcher at the Department of Agroecology – Agricultural Biodiversity, Aarhus University, and Annette Bruun Jensen, Associate Professor at the Department of Plant and Environmental Sciences, University of Copenhagen, as well as the inspiration from their project *Bedre Biavls Praksis*."

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PP-036 [Bee Health]

Field-deployable molecular diagnosis of Sacbrood virus using a rapid point-of-care assay

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Introduction

- Sacbrood virus (SBV) is a significant pathogen affecting honeybee colonies, leading to larval mortality, colony weakening, and substantial economic losses in apiculture. In South Korea, SBV has caused severe outbreaks, particularly in *Apis cerana*, and remains a risk for *Apis mellifera*. While laboratory-based RT-qPCR offers high diagnostic accuracy, its reliance on centralized facilities causes delays due to sample transportation and long processing times, limiting its utility for timely disease control.
- To overcome these constraints, we developed the XQ SBV Dx Kit, a portable molecular assay for point-of-care (POC) SBV detection. This compact system integrates sample preparation, amplification, and real-time detection, enabling results within approximately 90 minutes significantly faster than conventional laboratory workflows. The primary aim was to evaluate the diagnostic accuracy, sensitivity, specificity, and field applicability of this assay, with a particular focus on its ability to detect low viral loads for early intervention and mitigation of SBV spread.

Materials & Methods

- **System Components**
  - ➢ XQ Station (Integrated nucleic acid extraction, amplification, and detection)
  - ➢ XQ SBV Dx Kit (Dedicated diagnostic kit for SBV)

- **Workflow**
  - ➢ Sample homogenization
  - ➢ Load 50 uL sample + 10 uL magnetic bead
  - ➢ Insert Kit into XQ Station
  - ➢ Total time : 90 min (45 cycle) / Positive Ct cut off : < 35
- **Comparison**: Laboratory RT-qPCR vs POC RT-qPCR using identical sample sets.
- **Performance metrics**: Diagnostic sensitivity, specificity, agreement rate, and limit of detection (LOD).

Results

SBV Titers (copies/reaction)	RT-qPCR test (Laboratory)		POC RT-qPCR test (XQ SBV Dx Kit)	
	% positive (out of 24)	Mean Ct value	% positive (out of 24)	Mean Ct value
10^0	0%	-	0%	-
10^1	58.3% (14/24)	37.71	83.3% (20/24)	34.11
10^2	95.8% (23/24)	34.55	95.8% (23/24)	30.82
10^3	100% (24/24)	30.85	100% (24/24)	26.62
10^4	100% (24/24)	27.57	100% (24/24)	23.11

Table 1. Comparison of the limit of detection (LOD) between laboratory RT-qPCR and point-of-care (POC) RT-qPCR for SBV. Each concentration was tested in 24 replicates. Both assays achieved an LOD of 10^2 copies per reaction, with 95.8% detection.

Pathogen	Ct value	PCR Protocol	RT-qPCR test (Laboratory)		POC RT-qPCR test (XQ SBV Dx Kit)	
			% positive (out of 3)	Interpretation	% positive (out of 3)	Interpretation
A. apis (chalkbrood)	28.45	qPCR	0 (0/3)	Not Detected	0 (0/3)	Not Detected
A. flavus (stonebrood)	23.54	qPCR	0 (0/3)	Not Detected	0 (0/3)	Not Detected
M. plutonius (EFB)	23.99	qPCR	0 (0/3)	Not Detected	0 (0/3)	Not Detected
P. larvae (AFB)	24.60	qPCR	0 (0/3)	Not Detected	0 (0/3)	Not Detected
V. ceranae (nosemosis)	24.35	qPCR	0 (0/3)	Not Detected	0 (0/3)	Not Detected
ABPV	23.95	RT-qPCR	0 (0/3)	Not Detected	0 (0/3)	Not Detected
BQCV	23.86	RT-qPCR	0 (0/3)	Not Detected	0 (0/3)	Not Detected
CBPV	24.00	RT-qPCR	0 (0/3)	Not Detected	0 (0/3)	Not Detected
DWV	25.75	RT-qPCR	0 (0/3)	Not Detected	0 (0/3)	Not Detected
IAPV	25.17	RT-qPCR	0 (0/3)	Not Detected	0 (0/3)	Not Detected
KBV	24.03	RT-qPCR	0 (0/3)	Not Detected	0 (0/3)	Not Detected

Table 2. Analytical specificity of the POC RT-qPCR assay. No cross-reactivity was observed with 11 major honeybee pathogens (6 viruses, 2 bacteria, and 3 fungi). All non-SBV pathogens tested negative, confirming high analytical specificity.

		POC RT-qPCR (XQ SBV DX Kit)	
		Detected	Not Detected
RT-qPCR (Laboratory)	Detected	63	1
	Not Detected	3	97
	Total	66	98
Positive percent agreement (PPA)		95.5%	
Negative percent agreement (NPA)		99.0%	
Overall agreement (OA)		97.6%	

Table 3. Clinical evaluation of the POC RT-qPCR assay. A total of 164 field samples (64 SBV-positive, 100 SBV-negative) were tested against laboratory RT-qPCR. The assay showed high clinical performance (Sensitivity 98.4%, Specificity 97.0%, PPA 95.5%, NPA 99.0%, OA 97.6%), confirming its reliability for field application.

Conclusion

- **The XQ SBV Dx Kit offers rapid, accurate, and field-deployable SBV detection.**
- **Detects low viral loads, enabling early intervention before clinical symptoms spread.**
- **Reduces dependency on centralized laboratories, improving response time and supporting sustainable beekeeping.**

PP-037 [Bee Health]
Honeybee Vaccination – from the lab to the field

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3Laboratorio de Patología Apícola, Centro de Investigación Apícola y Agroambiental (CIAPA), Instituto Regional de Investigación y Desarrollo Agroalimentario y Forestal (IRIAF), Consejería de Agricultura de la Junta de Comunidades de Castilla-La Mancha, Marchamalo, Spain

Insects lack antibodies, the key mediators of immunological memory that vertebrate mothers transfer to their offspring. However, empirical research has demonstrated that maternal exposure to pathogens can enhance the immune competence of insect progeny. The underlying mechanisms of this trans-generational immune priming, despite the absence of antibody-mediated immunity, have remained elusive. This study identifies vitellogenin, an egg-yolk protein, as the molecular conduit for immune priming in honeybees. Vitellogenin binds bacterial fragments and facilitates their transfer to developing eggs, thereby conferring pathogen-specific immune benefits to offspring.

This naturally occurring immunological mechanism provides protection against multiple pathogens, with findings indicating that honeybee queens, when orally exposed to pathogen-derived fragments, can augment the immune defenses of their progeny. Given that honeybees are susceptible to a wide range of infectious and often highly virulent diseases throughout their life cycle, the limitations of existing treatment approaches necessitate a paradigm shift in disease management. Conventional therapeutic interventions have frequently proven inadequate, resulting in substantial colony losses. Consequently, prioritizing honeybee health with the same rigor as other livestock is imperative.

A major advancement in this regard is the development of the first vaccine designed to mitigate the spread of Paenibacillus larvae, the causative agent of American Foulbrood (AFB). This conditionally licensed vaccine was introduced in the United States in December 2022 and has since been implemented in thousands of hives. The present study reports on the initial observations and experiences from the deployment of this innovation among beekeepers. The overarching objective is to decelerate and ultimately prevent the spread of this highly contagious bacterial disease while promoting a more sustainable and evidence-based approach to honeybee disease management.

PP-038 [Bee Health]
Microbiota of honeybee drones and biocontrol potential

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Nature Research Centre, Vilnius, Lithuania

Honeybee drones host diverse microbial communities, which play an essential role in development, and pathogen resistance, and are also important for maintaining the honeybees and the overall hive health. Pathogenic microorganisms pose significant threats to honeybee populations, contributing to colony decline worldwide. On the contrary, biocontrol properties-possessing microorganisms can naturally inhibit honeybee pathogens such as Paenibacillus larvae, Nosema spp. fungi or others. Resolving the microbial composition of honey bee drones and revealing the biocontrol potential of their compounds will aid in developing targeted approaches for disease management. This study aims to explore the microbial diversity of honeybee drones and assess the potential of isolated microorganisms in the suppression of potential pathogens.

During this study, the Next Generation Sequencing-based metagenomic analysis of bacterial and fungal communities associated with honeybee drones was performed. The culturable bacterial and fungal microorganisms distributed on honeybee drones at different stages of development were isolated and identified using molecular biology methods. Biocontrol properties were analyzed by performing antimicrobial assays.

The bacterial community on honeybee drone was shown to be prevalent by Acetobacteraceae, Lactobacillaceae, and Orbaceae, the abundance of which differed depending on the life stage. The diversity of fungal microorganisms was low and mainly represented by Saccharomycetaceae, Cladosporiaceae, and Debaromycetaceae families. The molecular analysis of morphologically distinct cultivable microorganisms allowed us to detect Starmerella spp. and Metschnikowia spp. yeasts in all honeybee drone development stages, while Pantoea, Moraxella, and Micrococcus bacteria dominated at the larva stage. The biocontrol properties of identified microorganisms were analyzed by focusing on the prevention of honeybee diseases and improving the bee's immune system. Antimicrobial assays demonstrated that Metschnikowia and Starmerella showed the highest biocontrol activity.

A healthy microbiome in the hive is essential for honeybee colony development and success. Biocontrol measures can be designed to maintain favorable conditions for hive microbial communities that naturally suppress pathogens. The focus on bioactive microorganisms can lead to the development of human and environmentally friendly biological tools that can be applied to pathogen control and improvement of hive health. This study was funded by the Research Council of Lithuania (project no. S-MIP-24-55).

PP-039 [Bee Health]
Applicability of the greater wax moth (Galleria mellonella) as a model organism in the biodegradation of various materials

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The greater wax moth (Galleria mellonella) is a parasite in honey bee hives, feeding on honey, beeswax, and bee bread, causing colony losses and economic damage. In some cases, it consumes bee larvae and pupae and can even show cannibalism. They are commonly used as model organisms in studies of physiology, immunology, proteomics, and genomics. Recent studies show they can also consume low-density polyethylene (LDPE), making them important not just as bee pests but also as valuable model organisms. In this study, the ability of the greater wax moth to metabolize certain materials that it does not naturally feed on was investigated. To the best of our knowledge, this may be the first study to report that greater wax moths consume materials that are not their primary food, such as paper and dead adult bees. Our experimental groups consisted of the greater moth larvae that consumed beeswax, dead adult bees, paper, and plastic. In this study, the last larval stages of the greater wax moths, reared in vitro, were starved for a few hours before being transferred to specialized containers. After 48 hours of feeding, hemolymph extraction was performed. Scanning electron microscope (SEM) images were taken to document perforations caused by the consumption of materials such as beeswax, paper, dead adult bees, and plastic. Additionally, the chemical bond structures of hemolymph components were analyzed using FTIR spectroscopy,hydrocarbon profiles were identified by GC-MS, and the sugar profile was determined using HPLC. The FTIR analysis revealed molecular bond vibrations associated with structural changes in the materials consumed by the larvae, consistent with the GC-MS and HPLC results. Biochemical analyses showed that the greater wax moths metabolize organic products such as beeswax, dead adult bees and paper as well as plastic, a synthetic polymer. Hemolymph analysis revealed that hydrocarbon profiles varied depending on the diet. When comparing trehalose levels, the organic-fed groups (beeswax, dead adult bees, and paper) showed similar results, while the plastic-fed group had a higher trehalose level. Our study shows that the greater wax moth larvae can biodegrade and metabolize various materials other than their primary food.

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PP-040 [Bee Health]

Efficacy of Queen Isolation and organic Acid Treatment as control strategy against *Varroa destructor*

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Abstract

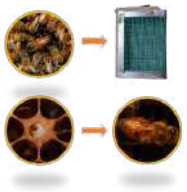
The global beekeeping industry faces ongoing losses due to *Varroa destructor*. In Korea, large-scale overwintering colony losses from 2022 to 2024 were linked to Varroa infestations. Despite various control methods, climate change and resistance to conventional treatments have hindered effective management. Integrated pest management (IPM) strategies combining multiple approaches are increasingly emphasized. This study evaluated the efficacy and side effects of queen isolation combined with formic acid treatment for Varroa control. Results showed that queen isolation effectively exposed mites on worker bees, and 98.7% of those mites were eliminated by formic acid. However, this method caused a 60% reduction in worker bee population higher than in other groups and negatively impacted queen survival. These findings underscore the need for further research to develop safer and more effective Varroa control strategies that ensure colony stability.

Keywords: Varroa destructor, Apis mellifera, Queen isolation, Formic acid, IPM

Materials & Methods

Queen isolation

- Rectangular isolation cage (7.5 × 5.7 × 1.8 cm) made of a wooden frame covered with a 1.5 mm² metal
- fully covered comb frame was considered to contain approximately 2,300 bees
- brood cell estimation, the area occupied by sealed brood was measured and converted into the number of brood cells based on a standard calculation of 100 brood cells per 5 × 5 cm section



Varroa detection methods

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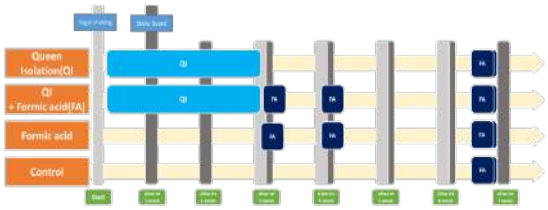
Processing schedule for trt



Results

Colony Strength by Group

Worker Bee Population &

Table 1. Linear regression analysis of standardized **worker bee population** (%) trends across experimental groups over the entire experimental period. * Indicates a significant difference.*: Indicates a significant difference

Experimental group	Slope	R-squared	p-Value
Queen isolation	-0.8117	0.1734	0.0678
Queen isolation + acaricide	-1.5851	0.4760	0.0008*
Acaricide	-0.0401	0.0003	0.9304
Control	-0.2239	0.0200	0.4998

Comparison of Brood Cell Numbers

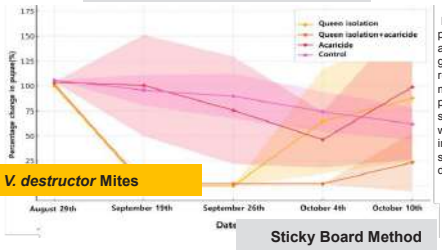


Figure 1. **Pupae** percentage (%) among treatment group. Each line represents the mean pupae percentage for a specific group, with shaded areas indicating the standard deviation.

Comparison of Detected *V. destructor* Mites

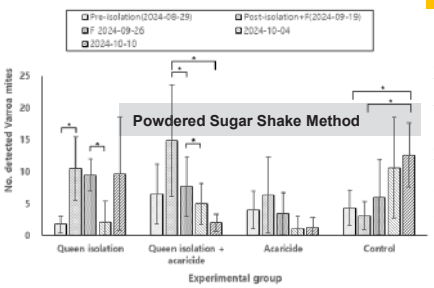


Figure 2. Comparison of detected Varroa mites using the sugar shake method after experimental treatments (queen isolation and formic acid application) across experimental groups. The data represent the mean and standard deviation of Varroa mites detected in each group. F=Formic acid, *: significant difference at P<0.05.

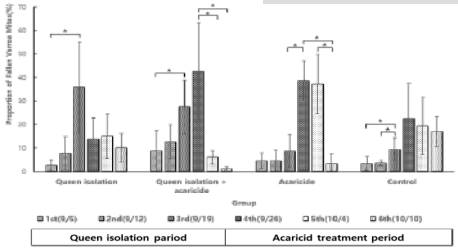


Figure.3. Comparison of fallen Varroa mite proportions during the queen isolation period and after acaricide treatments at weekly intervals. Error bars indicate standard deviation. Significant differences between groups are marked with an asterisk (*), P<0.05.

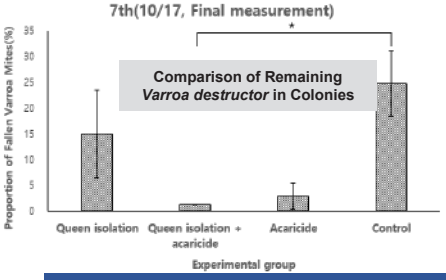


Figure. 4. Proportion of Varroa mites detected after the final intensive acaricide treatment. Error bars indicate standard deviation. Significant differences between groups are marked with an asterisk.

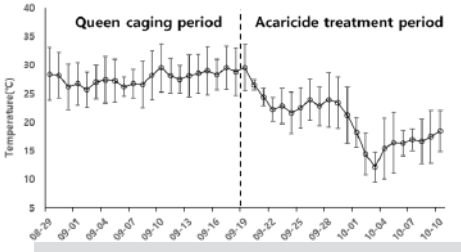


Figure. 5. Average external temperature during the queen caging and acaricide treatment periods. Error bars represent the standard deviation.

Discussion

1. A 20-day queen confinement effectively removes brood, causing Varroa mites to move onto worker bee bodies.
2. Combined treatment of queen confinement and formic acid shows high efficacy in Varroa mite control, but side effects occur, such as worker bee reduction and queen loss.
→ Additional treatment adjustment experiments are needed to reduce these side effects.
3. When formic acid is applied after queen confinement, a single treatment removes most Varroa mites.
→ Applying formic acid only once reduces side effects caused by formic acid treatment.
Further experiments are required to establish the optimal integrated Varroa mite control strategy that enhances control effectiveness while minimizing side effects.

National Institute of Agricultural Sciences
Republic of Korea

PP-041 [Bee Health]

Biotic and abiotic stresses on honeybee health

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Problem Description

The decline in honeybee populations is a global concern, driven by a combination of biotic threats such as *Varroa destructor* mites and vectored viruses, and abiotic factors like pesticide exposure and environmental changes. These stressors often interact synergistically, exacerbating their negative effects on colony health. Despite extensive research, the complex interplay between these factors remains poorly understood, hindering effective conservation and management efforts.

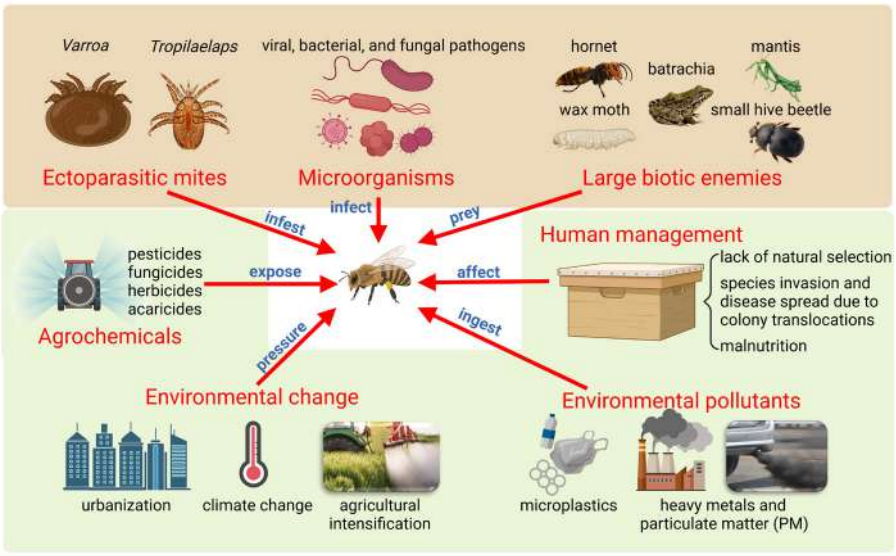
Background/Purpose

Honeybees are vital pollinators, playing a crucial role in sustaining ecosystems and agricultural productivity. However, they face a multitude of biotic and abiotic stressors that threaten their health and survival. These stressors include parasitic mites, pathogens, invasive species, agrochemicals, habitat destruction, and climate change. Understanding the interactions between these stressors is essential for developing strategies to mitigate their impact on honeybee colonies.

Methodology

This review synthesizes existing literature on the biotic and abiotic stressors affecting honeybee health. It examines the impacts of ectoparasitic mites, pathogenic microorganisms, invasive species, agrochemicals, and environmental changes on honeybee colonies. The review also explores the interactions between these stressors and their cumulative effects on colony survival and productivity.

Results and Conclusion



The review highlights that *V. destructor* and vectored viruses are among the most significant biotic threats, while agrochemicals and habitat loss are major abiotic stressors. Climate change further exacerbates these challenges by altering floral resources and increasing the prevalence of pathogens. The interaction between multiple stressors often leads to greater colony losses than any single stressor alone: pesticide exposure can weaken bees' immune systems, making them more susceptible to parasitic mites and viruses.

Practical Implications for Beekeepers

Beekeepers can adopt several strategies to mitigate these stressors, such as breeding mite-resistant bee strains, reducing pesticide use, and providing diverse foraging habitats. Regular monitoring and early intervention are crucial for managing colony health. Additionally, policymakers should consider the broader environmental impacts of agricultural practices and climate change to support sustainable beekeeping and pollinator conservation. By addressing both biotic and abiotic stressors, beekeepers can enhance colony resilience and ensure the continued provision of pollination services.

Integr. Zool. 2024; 19(3): 442-457.

PP-042 [Bee Health]
Acute and chronic viruses mediated by an ectoparasite target different developmental stages of honeybee (Apis mellifera and Apis cerana) brood

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Background/PURPOSE: Honeybees, particularly Apis mellifera, are vital pollinators facing significant health challenges globally, largely due to the ectoparasitic mite Varroa destructor and the viruses it vectors. In contrast, Apis cerana, the eastern honeybee, exhibits greater resistance to these threats. Understanding the mechanisms behind this resistance is crucial for improving honeybee health and mitigating colony losses.

Problem Description: The health disparity between A. mellifera and A. cerana is well-documented, yet the underlying mechanisms remain poorly understood. V. destructor and its associated viruses, such as deformed wing virus (DWV) and Israeli acute paralysis virus (IAPV), are major contributors to colony collapse. This study investigates how these viruses, mediated by V. destructor, affect the developing brood of both honeybee species.

METHODOLOGY: The study experimentally infested freshly capped brood cells of A. mellifera and A. cerana with V. destructor mites. Control groups included brood cells that were either pricked with a sterile needle or left untreated. Brood survival and viral loads were assessed at two developmental stages: 1.5 days post-capping and 1 day before expected emergence.

Results and CONCLUSION: The results revealed that V. destructor-mediated viruses caused significant mortality in both honeybee species, but the timing and nature of the mortality differed. IAPV, an acute virus, primarily caused mortality in late larvae, while DWV-A, a chronic virus, led to mortality during and after pupation. A. cerana exhibited higher brood mortality and lower viral tolerance compared to A. mellifera, suggesting that the susceptible immature individuals of A. cerana contribute to the overall survival of the colony by limiting pathogen spread.

Practical Implications for Beekeepers: These findings highlight the importance of managing V. destructor infestations to prevent virus transmission. Monitoring and early intervention can help mitigate the impact of these pathogens. Additionally, beekeepers are suggested to focus on breeding programs that enhance resistance to V. destructor and its associated viruses. The concept of social apoptosis, where susceptible individuals sacrifice themselves for the greater vitality of the colony, could be integrated into breeding strategies to improve colony resilience.

PP-043 [Bee Health]
The nanofibers based theranostic applications in controlling Varoa destructor

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[1]Czech Agrifood Research Center, Czech Republic
[2]Student Science,LTD, Czech Republic

Nanofiber based carriers are the state of art instrument used in medicine for theranostic (therapeutic and diagnostics) applications, like controlled and continuous delivery of the applied pharmaceuticals, leading to its decreased level, which we applied to controlling the Varroa destructor level in apiaries. The applied τ-fluvalinate in the PVP nanofiber based carrier led to the significant decrease of used active substance to 20 % with comparable result. The effectiveness has been checked using crossover check with Gabon-flum (flumetrine) and Formidol (formic acid) registered veterinary medicines as control.

The diagnostic part of the above mentioned theranostic was fulfilled by developing novel flask test, based on the deployment of the PVP based nanofiber carrier with logarithmic scale concentrations of the active substances – in our case τ-fluvalinate and amitraz. The determined LC50 and LC90 (0.000093 mg and 0,138 mg for amitraz, 0.0132 and 15.1 for τ-fluvalinate), results were comparable with the resistance reported in the literature

PP-044 [Bee Health]
Prevalence of diseases and pests in African honeybee Apis mellifera scutellata swarms in Costa Rica

Johan Wilhelm Van Veen, Rafael Angel Calderón Fallas
Centro de Investigaciones Apícolas Tropicales, Universidad Nacional, Heredia, Costa Rica

In Costa Rica beekeepers often lure or capture swarms of African honeybees Apis mellifera scutellata as a natural resource to establish or increase their apiaries without considering the risks of introducing pathogens. In order to assess this risk we studied the prevalence of Nosema sp, small hive beetles Aethina tumida, Varroa destructor and tracheal mites Acarapis woodi, during 2024 and 2025.

Reproductive swarms are abundant during the dry season between January and May, when major flowering occurs, and absconding swarms occur occasionally during the rainy season which lasts from June through December. In our study we sampled 27 swarms (sample size 153 ± 92), between January 18th and August 19th, 17 considered reproductive and 10 absconding swarms. Some interesting differences were observed regarding Nosema sp. infection levels, being very low in the reproductive swarms, 12 had less than 10,000 spores per count and the other five samples on average 365,000 ± 327,719 (30 bees taken from the samples and spores counted at 400X using a hemocymeter grid according to Cantwell) and the absconding swarms, where on average 1,263,000 ± 2,153,801 spores were counted per bee (prevalence 45%).

Varroa destructor infestation levels were low for most swarms, and no infestation was observed in 12 swarms and on average 3.6% ± 3.2 for the remaining 15 swarms (prevalence 60%).

In one swarm one small hive beetle Aethina tumida was observed within one week after being lured into an empty and new nuc hive at an isolated quarantine stand without any other hives, which might be an indication that small hive beetles can possibly migrate with swarms.

All samples were negative for Acarapis woodi.
It can be concluded from these preliminary data (our study continues during 2025) that capturing swarms in Costa Rica is of low to moderate risk for introducing diseases and pests in existing apiaries since Varroa and Nosema prevalence were moderate, but infestation levels were on average low or completely absent, especially for reproductive swarms.

Some interesting additional information about substrates where swarms were captured and their location will be presented.

APIMONDIA SCANDINAVIA 2025
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PP-045 [Bee Health]

STATUS OF THE YELLOW-LEGGED HORNET, *VESPA VELUTINA* Lepeletier, IN NORTH AMERICA

Benjamin A. Powell (Clemson Univ.), Lewis J. Bartlet, PhD. (Univ. of Georgia),

James D. Ellis, PhD (Univ. of Florida), James C. Fulton, PhD. (Florida Dept. of Agriculture and Consumer Services)

CHRONOLOGY OF DETECTION AND RESPONSE

2023

In July of 2023, a novice beekeeper near Savannah, Georgia, a historic port city on the southeastern coast of the United States, observed an unfamiliar predatory insect hovering at the entrance of his beehives catching forager honey bees. The beekeeper collected the insect and contacted authorities to get it identified. The insect was identified by entomologists at the Georgia Department of Agriculture (GDA) and the University of Georgia and later confirmed by the US Department of Agriculture's Animal and Plant Health Inspection Service (USDA APHIS) as a yellow-legged hornet (YLH), *Vespa velutina* Lepeletier, the first record of a living yellow-legged hornet in North America.

Georgia Ag Commissioner, Tyler Harper, presents first nest at the YLH press conference

The Georgia Department of Agriculture issued a press release (Aug. 15) and launched a website for public outreach and reporting (https://agr.georgia.gov/yellow-legged-hornet). They contacted beekeepers directly in the area and deployed Traps baited with a combination of grape juice and brown sugar. Traps began collecting hornets, and public reports confirmed YLH activity in and around Wilmington Island just southeast of downtown Savannah, GA. The first nest was located and removed from Wilmington Island on August 25. Traps in the area continued to collect YLHs after the nest was removed. Through trapping and public assistance, investigators located and removed four additional nests, but traps continued collecting hornets into winter.

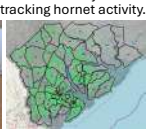
Savannah rests on the Savannah River, the border with the neighboring state, South Carolina. Upon learning of the confirmed sighting, officials with the South Carolina Department of Plant Industry (SCDPI) launched similar measures to monitor YLH activity, deploying traps, conducting outreach, contacting beekeepers, and launching a webportal for public reporting (https://www.clemson.edu/public/regulatory/plant-industry/invasive/invasive-spotlights.html), No YLHs were collected in SC traps until November when several drone hornets were caught. Despite nearly 300 submissions, no plausible YLHs were confirmed through public reporting nor were any nests located in South Carolina.

By the end of 2023, hornets had been confirmed only in Chatham County, Georgia (near Savannah) where five nests had been located and in Jasper County, South Carolina, just across the river from Savannah where only drones were collected. It is suspected that the initial introduction occurred in Savannah, which is a busy international shipping port.

2024

Monitoring, trapping, and public outreach efforts expanded significantly in 2024 with emergency funding provided through the USDA APHIS. Georgia's Department of Agriculture expanded trap numbers from 170 to 1,243, and the SC DPI expanded from 35 to 796. Both states increased trapping area well beyond the expected area of hornet activity to determine the range of expansion. Trapping data and public reporting led to the capture of more than 3,000 hornets and removal of 49 nests in GA. The range of YLH detections expanded nearly 45 km (25 mi) west and north from the area of first detection. In March 2024 South Carolina recorded its first nest, an embryo nest reported by a homeowner in the city of Bluffton, Beaufort County. This location marked an expansion of approximately 27 km (17 mi) east of the original sighting in Savannah. By the end of 2024, more than 4,000 hornets were trapped and 16 nests removed in South Carolina with hornet activity being confirmed in Jasper and Beaufort counties, approximately 32 km (20 mi) east of the original sighting.

Outreach efforts also intensified in both states with trainings and displays at the Georgia and South Carolina beekeeper associations conferences, presentations to local beekeeper clubs across both states, an expanded social media campaign, and additional education materials posted to websites. YLH teams in both states began sharing observations through newsletters, the Georgia "Yellow-legged Ledger" https://agr.georgia.gov/yellow-legged-hornet and the South Carolina "Hornet Herald" https://blogs.clemson.edu/regulatory/category/yellow-legged-hornet/. Beekeepers in the vicinity of the YLH traps were contacted directly to serve as sentinel hives for monitoring hornet activity and were instrumental in tracking hornet activity.



2025 (as of August 20th)

Trapping was again expanded in both states (GA 2,065 traps, SC 1,147). Georgia expanded trapping to include most of the coastal region. South Carolina expanded trapping into Charleston county. Hornet activity and nest eradications expanded beyond the previous year's reports, mostly along the coast in South Carolina approximately 20 km (14 mi) northeast to St. Helena Island, SC. Just over 1,000 adult hornets have been trapped and 18 nests removed in GA, and just over 500 hornets, including more than 300 spring dispersing queens, have been trapped and 27 nests removed in South Carolina this year. Traps continue to collect adult hornets, and teams are preparing to remove additional nests that were recently located. Hornet activity remains concentrated in the Savannah, Bluffton, and Beaufort areas

Public outreach has been effective. The majority of nests removed have been reported by the public, especially the early season embryo and primary nests which are difficult to locate through trapping. Public outreach has been expanded on several fronts. In SC, 47,000 brochures were mailed to residents in Jasper and Beaufort counties with an additional 80,000 to be mailed in September. Both states launched citizen trapping programs, providing guidance to residents who wish to deploy traps and report captures. Training about YLH biology and identification was expanded to arborists, foresters, and pest control operators. Training also was given to local beekeepers, at the Apiary Inspectors of America annual meeting, and at the American Bee Federation annual conference.

Other states are also taking action. The Florida Department of Agriculture and Consumer Services (FDACS) initiated a limited trapping program near the border with Georgia and around the port of Jacksonville and is involved in several research projects. Florida included trainings at their summer bee college, annual beekeeper conference, and local bee club meetings. They have not collected any YLH in their traps or through citizen reports. Nationally, YLH specimens have been distributed to apiculture extension educators for training and use with Master Beekeeper Programs, and a regional training for agriculture inspectors and extension professionals across the southern region is being planned for early 2026.

ACKNOWLEDGEMENTS

Stephen (Brad) Cavin, SCDPI; Kaitlin Deutsch PhD, UF; Anne LeBrun, USDA APHIS; Yong-Lak Park PhD, WVU; Mary Reed, FDACS, Lenny (David) Williams, GDA; Amy Vu, UF.

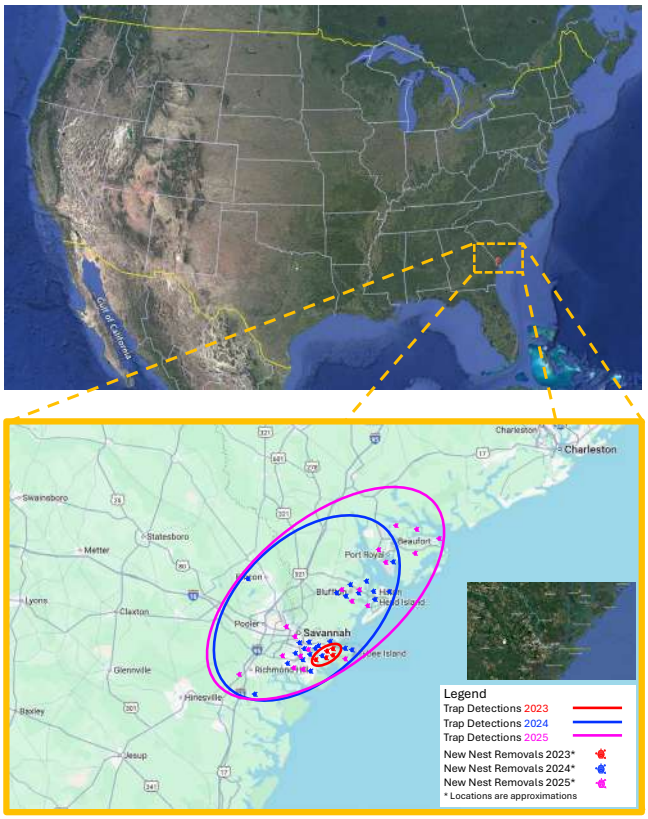


Table 1: Total YLH Detections and Removals

	Traps deployed	Hornets trapped	Nests removed	Total range of detections
2023	205	~ 100	5	30 km^2
2024	2039	7284	65	3000 km^2
2025 (as of Aug. 20)	3212 (as of Aug. 20)	1901 (as of Aug. 20)	45 (as of Aug. 20)	6000 km^2 (as of Aug. 20)

CURRENT AND PROPOSED RESEARCH

Several labs are investigating methods to enhance early detection and rapid response.

Univ. of Florida, Honey Bee Research and Extension Laboratory (Kaitlin Deutsch, James D. Ellis)
- Use of eDNA for early detection of hornet activity
- Observations of life history and nest dynamics

Florida Department of Agriculture and Consumer Services (James C. Fulton)
- Microsatellite panels for individual nest identification
- Lures/pheromones for male annihilation control
- Risk prediction modelling

Univ. of Georgia, Bee Lab (Lewis J. Bartlet)
- Genomics for YLH origins and population diversity
- YLH Diet Characterization
- Distribution modelling and projection
- Pathogen detection

West Virginia Univ., Davis College of Agriculture, Natural Sciences and Design (Yong-Lak Park)
- Use of drones and artificial intelligence to detect YLH nests

Clemson Univ., College of Agriculture, Forestry, and Life Sciences (Benjamin A. Powell)
- Nest morphometrics, detection and removal strategies

Clemson Regulatory Services, SC Department of Plant Industry (Matt Howle)
- Hornet tracking technology

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PP-046 [Bee Health]

KENTUCKY STATE UNIVERSITY

Effects of Diet and Probiotics on the Health of Honey Bees

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Kentucky State University, Frankfort, KY, 40601, USA

Introduction

Honey bees {*Apis mellifera*} depend on pollen as their primary source of proteins, lipids, and micronutrients. Pollen consumption is critical for their physiological functions and influences multiple health parameters, including metabolic processes, immunocompetence, pathogen resistance, and detoxification capacity against pesticides. To offset pollen dearths, beekeepers often feed pollen substitutes to their colonies; however, the nutritional efficacy of these substitutes remains uncertain. In addition to these protein supplements, other nutritional supplements like probiotics have been introduced to the market to enhance colony health. Probiotics contain live microorganisms that are directly fed to bees to boost their gut microbiome. In this study, we conducted a comparative analysis of diets comprising natural pollen and a pollen substitute, both independently and in conjunction with a probiotic supplement. Controlled feeding trials were performed to assess the impacts of these dietary regimens, utilizing 16S rRNA amplicon sequencing for bacterial profiling and quantitative polymerase chain reaction (qPCR) to evaluate differential expression of honey bee immune, developmental, and metabolic genes. Our results indicate that diet has a significant effect on gene expression and bacterial diversity and abundance in the midgut, and probiotic supplementation may offer benefits when combined with a pollen diet.

Materials And Methods

Caged Trials

Emerging brood frames were collected from healthy honey bee colonies at the Harold R. Benson Research Farm (Franklin County, KY, USA) and incubated at 32.5°C for 24 hours. After 24 hours, newly emerged bees were caged in groups of 100 individuals. Cages were randomly assigned to treatment groups of diets with and without probiotic application, with 3 cages per treatment group. Diet was provided ad libitum, in addition to 50% sucrose syrup (w/w). Probiotic treatment was applied by dusting 1.0 gram of SuperDFM probiotic onto wax foundation suspended in each cage. Cages were kept in an incubator at 32.5°C for the 10-day duration of the experiment. On day 10, bees were flash frozen in liquid nitrogen and frozen at -80°C.

DNA Extraction, Library Preparation, and Sequencing

DNA was extracted from honey bee midguts using the Qiagen DNeasy blood and tissue mini kit. After extraction, all samples were quantified, standardized, and uniformly pooled by cage into groups of 8 individuals for 16s sequencing analysis. Pooled DNA was re-quantified with Equalbit 1x dsDNA HS Assay Kit. 50ng of DNA was amplified via PCR with 341F+805R primers covering hypervariable regions V3-V4. Libraires were quantified by Qubit 2.0 and quality was evaluated by TapeStation D1000 ScreenTape with Illumina 8-nt dual-indices. Sequencing was performed on an Illumina MiSeq with a read length configuration of 250 PE for 0.1 M PE reads per sample. Analysis was performed using the CosmosID-HUB.

RNA Extraction, cDNA synthesis, and qPCR

RNA was extracted from individual honey bees using the Qiagen RNeasy mini kit with on-column DNase treatment. Extracted RNA was quantified using a BMG Labtech Omega plate reader equipped with a LVis plate. 200 ng of RNA was used for cDNA synthesis using the Bioline Sensifast cDNA kit. qPCR was performed using an Applied Biosystems QuantStudio 3 machine. Data was analyzed using the delta cT method, using the geometric mean of GapDH and S8 as a reference gene.

Results

Taxa Diversity

Alpha diversity was analyzed using the CHOA1 index method (Fig. 1). Diet had a significant impact on bacteria taxa present in honey bee midguts (p=<0.001) but probiotic did not (p=0.079). Post-hoc diet comparisons indicate statistical differences between megabee-pollen (p<0.001) and pollen-sucrose (p=0.005). While there was an increase in taxa diversity with probiotics amongst the Megabee fed bees (9.67 vs 6.33), the result was not significant (p = 0.130).

Taxa Abundance

Taxa abundance was analyzed using two-way ANOVA . Certain bacteria taxa exhibited differences between treatment groups (Fig. 2). Apibacter was only found in pollen fed bees (p<0.001) and had a significant interaction effect with probiotic application (p=0.007). Apilactobacillus was significantly increased in pollen fed bees (p<0.001) with no impact of probiotics (p=0.945). Bartonella was present in all treatments and was highest in sucrose fed bees (p=0.056), with no significant difference in probiotic (p=0.428). Bifidobacterium was impacted by both diet (p<0.001) and probiotic (p=0.001) with a significant interaction effect (p=0.011).

Gene Expression

Normalized delta cT values were analyzed with two-way ANOVA. 6 target genes showed statistical differences between treatment groups (Fig. 3). Defensin, Catalase, ILP1, Hex70B, and Vitellogenin were only impacted by diet (all p<0.001), while InR1 showed differences based on diet (p<0.001) and probiotic (p=0.006), with a significant interaction effect (p=0.041).

Figure 1. Taxonomic Diversity

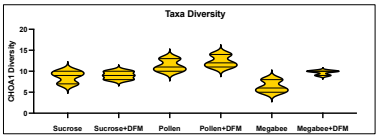


Figure 2. Taxa Abundance

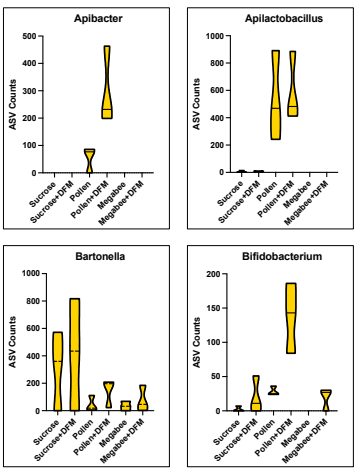
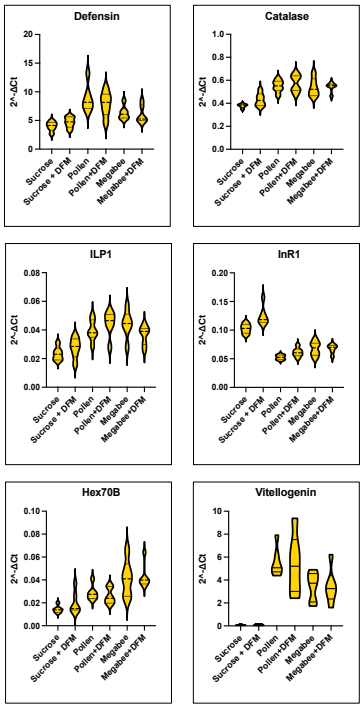


Figure 3. Gene Expression



Discussion

Pollen-fed bees exhibited significantly higher midgut bacterial diversity than those fed Megabee or sucrose, reflecting pollen's rich nutritional profile, which includes proteins, lipids, and micronutrients essential for microbial communities (Motta et al., 2018). Elevated Apibacter and Apilactobacillus in pollen-fed bees highlights their dependence on pollen-derived nutrients, while probiotic-enhanced Apibacter and Bifidobacterium suggest improved gut health under specific dietary conditions (Zheng et al., 2017). Conversely, Bartonella, which was most abundant in sucrose-fed bees, may indicate a less favorable microbial environment, as this genus is not typically associated with beneficial functions in honey bees. Gene expression analysis revealed protein-driven upregulation of Defensin, Catalase, ILP1, Hex70B, and Vitellogenin, underscoring protein's critical role in supporting immunity, detoxification, and development (Alaux et al., 2010). InR1's upregulation with a sucrose diet may be a compensatory response to ILP1 reduction, attempting to maximize nutrient utilization under poor dietary conditions. These findings affirm pollen's superiority, but suggest that pollen-substitutes are a valuable adjunct during pollen scarcity. Future research should be focused on improving pollen substitutes to match pollen's impact on midgut microbiota.

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PP-047 [Bee Health]

Utilization of No-Mite-Low-Mite-Queen Best Practices

Lisa Marie Ghezzi, Certified Master Beekeeper Eastern Apicultural Society

Introduction

Soon after the entry of the parasitic mite, *Varroa destructor,* into the United States in 1987, researchers and citizen scientists began exploring the viability of using selective queen stock to produce colonies of worker bees capable of managing mite populations, what I have termed "no-mite-low-mite-queen best practices" (NMLMQ). A mite resistant colony will have low mite loads, relative to unselected colonies, and treatments would be required less frequently. I use the term Varroa resistant bees ("VRBs") to refer to the mite resistant colony and its teamwork approach to decrease mite loads. This study focuses on determining the prevalence of queens bred to produce mite resistant honey bees and to achieve reduced Varroa mite loads in Maryland honey bee colonies.

At the American Beekeeping Federation's Annual Conference in January 2025, Marla Spivak, PhD posed an important question, **"Why do queen producers resist selecting for and using mite resistant bees?"** This prompted me to create the Varroa Management Survey to determine the percentage of Maryland beekeepers utilizing VRBs and beekeepers' rationale for or for not using them to reduce mite loads.

Methodology

The Varroa Management Survey was posted to the Maryland State Beekeepers Association's (MSBA) website on July 17, 2025. Data was collected via Google Forms. The survey closed August 15.

Acknowledgements

The author would like to thank Dr. Marla Spivak for reviewing the abstract and final poster prior to submission; Phil Frank, Jan Day, and Maureen Jais-Mick for assisting in the development and publishing of the survey on the MSBA website; and to the MSBA board for agreeing to host the survey and for their efforts to further beekeeping awareness and education across the State of Maryland.

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Oliver, Randy. Selective Breeding for Mite Resistance, Part 1. American Bee Journal, August 2025, pp. 887-891. ScientificBeekeeping.com.

Figure 1: Use Queens Bred to Overcome Varroa

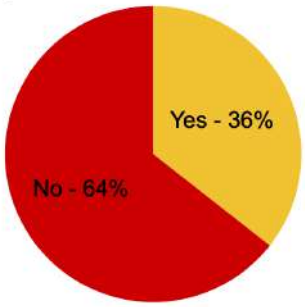


Figure 2. Control Colonies' Genetics to Reduce Varroa's Impact

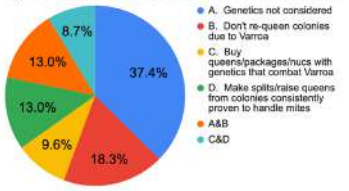


Figure 3. Zero Mite Count In at Least One Colony Last Time Tested

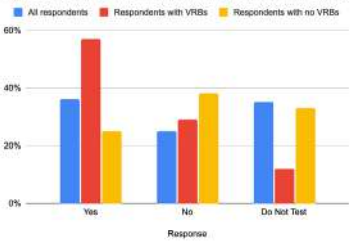


Figure 4. Treatment Threshold

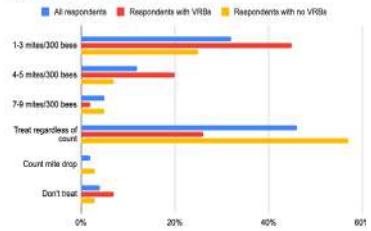
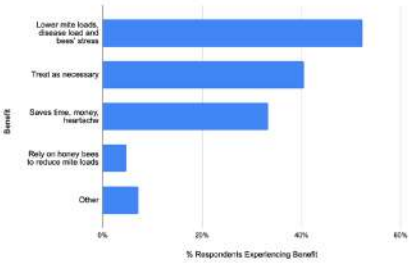


Figure 5. Benefits Practicing NMLMQ



Results

Of the 785 MBSA members, 118 unique members responded to the survey (15% response rate). Twenty of 24 Maryland counties were represented in the survey. Survey respondents included the following:

- Hobbyists (1-39 colonies): 79%
- Sideliners (40-500 colonies, incl. 3 queen breeders): 20%
- Commercial (500 or more colonies): 1%

The total number of bee colonies the respondents managed is 2,747 and ranged from 1-625 colonies for each beekeeper.

Twenty-two percent of respondents having been beekeeping up to 3 years, 47% more than 3 years and less than 10 years, and 31% 10 or more years.

Thirty-six percent of respondents have incorporated NMLMQs into their apiaries maintaining at least some VRBs (Figure 1)**.** These beekeepers actively control the genetics of their colonies taking one of two approaches, or both (Figure 2).

Ten percent of the beekeepers with VRBs **experienced zero mite loads across most of their colonies** the last time they tested (75% 3Q25, 25% 4Q24), vs. 1% of those who do not utilize VRBs (4Q24). **57% of the beekeepers with VRBs had at least one colony** with a zero Varroa mite load (Figure 3).

Seventy-two percent of respondents test for Varroa loads, whereas 28% do not test. Those beekeepers with VRBs test for Varroa loads more frequently than those who did not (83% vs. 66%); and they treat for Varroa slightly less than those who do not use VRBs (93% vs. 97%).

Sixty-seven percent of respondents with VRBs set thresholds to treat, whereas 37% of the respondents without VRBs set thresholds (and 57% treat regardless of threshold). The largest percentage (32%) of all respondents set **a treatment threshold of up to 3/300 or 1% mite load** (Figure 4).

Respondents with VRBs (36%) are three times more likely to treat only those colonies meeting Varroa thresholds (29%), than those respondents without mite resistant stock (7%); of the latter 91% treat all the colonies in their apiaries, vs. 64% of the beekeepers maintaining VRBs.

Respondents reported benefits from NMLMQ (Figure 5).

Discussion

Selective Breeding. More than one-third of MSBA members practice NMLMQ and use VRBs. To my knowledge, no survey has been completed to determine the number of beekeepers employing VRBs across the United States to compare; further study is needed.

Varroa Resistance. Beekeepers with VRBs are experiencing lower mite loads which should mean that their honey bee colonies will be exposed to lower disease load, possibly fewer diseases, and will be more productive than the colonies without VRBs. One-third of the beekeepers that do not have VRB do not test for Varroa, so they could not know the mite loads in their colonies. This could clearly skew the results.

Management Practices. Beekeepers who employ NMLMQ appear to manage their bees more closely than those who do not, perform more varroa tests, set thresholds for those tests in more cases and treat with greater frequency individual colonies, versus not all colonies in their apiaries. While a high number of Maryland beekeepers **test** for Varroa, a higher number **treat** for Varroa, indicating that about a quarter treat prophylactically (i.e., treat without testing).

Benefits. As more beekeepers across Maryland observe and/or experience the benefits of NMLMQ, it is anticipated more will try their hand at selectively breeding their own VRBs. An increase in beekeeper's demand may be the impetus needed to press queen breeders to offer Varroa resistant stock and the potential to reduce mite infestations on a more global scale.

Limitations

The Varroa Management Survey had a 15% response rate among MBSA members and only 2.7% of all Maryland beekeepers responded. Limitations of survey methodology include sampling errors, response biases, and the lack of depth. A broad-based, national survey with a larger sample size and higher response rate will be necessary to confirm these findings and to generalize the approach to other states and countries.

APIMONDIA SCANDINAVIA 2025
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PP-048 [Bee Health]

Use of a plant extract (ApiSave™), as a natural and novel alternative to synthetic chemicals, to control honeybee diseases in North America.

K.G. Bedie[1], R. Turrubiartes, and P.W. Veiga

Northwestern Polytechnic, Office of Applied Research and Innovation Department, National Bee Diagnostic Centre,

10726 106 Avenue, Grande Prairie, AB T8V 4C4

ABSTRACT

In north America, honeybees are affected by several diseases including European Foulbrood (EFB) and viruses. To address these problems, beekeepers often opt for antibiotics and chemical treatments which in time contribute to the development of resistance to the treatment compounds by the affecting organisms and the presence of chemical residues in bee products. This situation has lead beekeepers and the beekeeping industry to try alternative solutions with natural products. In our research projects, we tried a natural and novel plant extract (ApiSave), under different formats, to control bacterial and viral diseases affecting honeybee colonies. In one experiment, we reared honeybee larvae in the lab with 1% (v/v) and 5% (v/v) ApiSave and *Melissococcus plutonius* cells in royal jelly diets for 6 days. The resulting survival rate was greater or equal to 75% up to 4 days before declining, suggesting a potential for ApiSave to control EFB. The investigation of the virus load in the reared larvae showed the presence of all tested viruses (ABPV, BQCV, DWVA, DWVB, IAPV, KBV, LSV, and SBV) in all treatments but DWVB was the lowest in 5% (v/v) ApiSave treatment, Treatment 1, and Treatment 2, suggesting a possible inhibitory activity of the treatments against the virus. When the plant extract was used as treatment against *M. plutonius* in EFB infected colonies, the treatment with 15% (w/w) ApiSave suggested that the plant extract was able to control the disease in 3 colonies out of seven after loosing 3 colonies due the advanced state of the disease before treatment. This study demonstrated that at the right concentrations, the novel plant extract has the potential of controlling EFB and DWVB virus in affected honeybee colonies.

INTRODUCTION

European foulbrood (EFB) is one the several diseases affecting honeybee (Apis mellifera) larvae. Its causing agent, *Melissococcus plutonius*, a gram-positive bacterium which infects developing larvae through feeding are transferred to the larvae with contaminated food. It multiplies in the midgut of the larvae and competes for nutrients with the host, resulting in the death of the larvae by starvation before they pupate (Forsgren 2010). In Canada, antibiotics are used to treat the disease as prophylactic and curative treatments, leading to the development of resistance by the pathogen and potential contamination of honey. This has prompted the Canadian government to impose a veterinary prescription before an antibiotic can be used to treatment honeybee diseases in 2018. Since then, beekeepers have turned to alternative options such as the use of natural products to combat honeybee diseases (Hashish et al. 2016; Hassona, 2017; Khattiaby et al., 2011; khan et al. 2019; Kim et al., 2018). Viruses such as the acute bee paralysis virus (ABPV), Kashmir bee virus (KBV) and Israeli acute paralysis virus (IAPV), mostly transmitted by Varroa destructor, also cause devastating diseases in the beekeeping industry (de Miranda et al., 2010a). The present study aims to determine the effect a plant extract (Api-Save™) on *M. plutonius*-infected honeybee larvae in-vitro, the microbial and viral loads in the larvae after the in-vitro larvae rearing, and whether Api-Save™ can control EFB affected colonies in the field.

MATERIALS AND METHODS

- **In-vitro rearing:** The honeybee larvae rearing was based on work by Schmehl et al 2016. Honeybee larvae aged 90 h were transported to the lab, grafted, and fed three diets consisting of sterile water, sugars, yeast, royal jelly, and different concentrations of Api-Save™ for five days post grafting. Each day, larvae were monitored for mortality before feeding.
- **Bacteria and virus loads**: Larvae that survived the rearing were collected, crushed in PBS, serially plated on M110 agar for *M. plutonius* quantification followed by PCR confirmation and virus quantification by Real-time PCR.
- **ApiSave treatment in the field:** For the field experiment, 3 groups (1 control and 2 treated) of hives were treated with a mixture of lyophilized Api-Save™ and in icing sugar at different concentrations of ApiSave™ (2017 Manitoba Agriculture's Recommendations for Administering Antibiotics and Acaricides to Honey Bees) over 2 weeks.

Table 1. Larval feeding time and diet amount, based on Schmehl et al 2016.

Time after grafting	Diet	Amount of total diet (µl)
Day 0 (grafting day)	A	20
Day 1	No feeding	0
Day 2	A	20
Day 3	B	30
Day 4	C	40
Day 5	C	50

RESULATS AND DISCUSSION

Honeybee larvae *in-vitro* rearing

Figure 1. Honeybee larvae rearing: dead larvae (A and B), Live larvae (B), disintegrated (C and D)

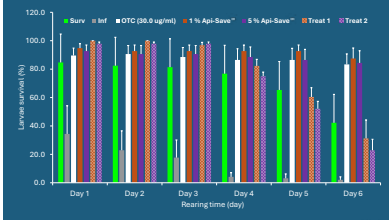

Figure 2. In-vitro rearing of *M. plutonius* infected honeybee larvae treated with liquid Api-Save™

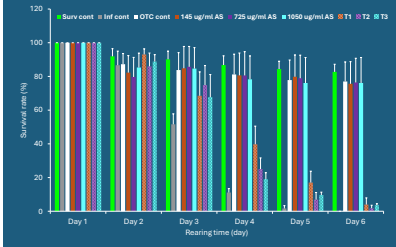

Figure 3. In-vitro rearing of *M. plutonius* infected honeybee larvae treated with lyophilized Api-Save™

Bacteria and virus loads

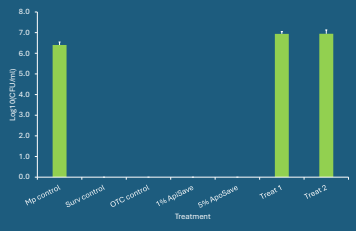

Figure 4. *M. plutonius* load in reared honeybee larvae

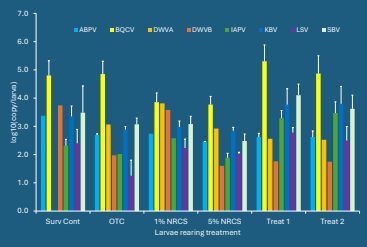

Figure 5. Assessment of colony health status before and after the last treatment with ApiSave

Honeybee hives treatment in the field

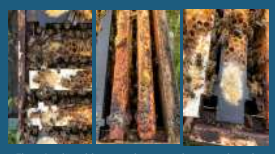

Figure 6. ApiSave-icing sugar mixtures spread out across the top bars of the frames.

Table 2. Assessment of colony health status before and after the last treatment with ApiSave

Colony #	# frames w/ bees out of 9)		% frame with bees		Visual symptoms		Disease Severity		Queen status	
	Before	After	Before	After	Before	After	Before	After	Before	After
3	6	6	67	67	>100	1-10	Severe	Low	Queen right	Queen right
6	1	Dead	11	0	10-100	Dead	Severe	Dead	Queen right	Dead
7	1	Dead	11	0	10-100	Dead	Severe	Dead	Eggs, no queen	Dead
8	4	4	44	44	10-100	1-10	Moderate	Low	No eggs, no queen	Queen right
10	2	Dead	22	0	>100	Dead	Severe	Dead	Queen right	Dead
11	1		11	11	10-100	None	Moderate	None	Eggs	Queen right
12	6		67	56	10-100	10-100	Not EFB	Moderate	Eggs	Eggs

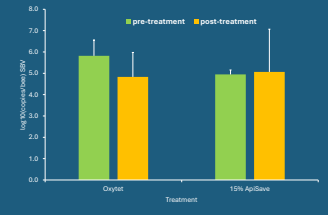

Figure 7. Assessment of colony health status before and after the last treatment with ApiSave

CONCLUSION

- *M. plutonius*-infected honeybee larvae treated with ApiSave™ (1 and 5%; 0.05, 0.07, and 0.1%) during in-vitro rearing provided survival rate of greater from 67 to 75% close to survival control but way greater than infected control (≤ 4.2%) on day 4.
- The analysis of bacteria and virus loads indicated that *M. plutonius* had a higher content in larvae with 1 and 5% ApiSave™ that the fresh bacteria culture used probably because of the sugar content in the royal jelly from the diet, compared to the growth medium (M110 agar). Although there was no drastic impact of ApiSave on the viruses, the low content of DWVB in 5% ApiSave™ treatment may suggest an inhibitory effect on DWVB.
- After treatment (15% ApiSave™ in icing sugar) of *M. plutonius-infected* colonies in the field, the pathogen was still detected but it was able to control the disease in 3 colonies out of 6. At the conditions of the experiment, ApiSaveTM could not control sacbrood virus (SBV).

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AKNOWLEDGEMENT

All my thanks to Rodrigo Turrubiartes, Rusha Patel, Elena Battle, and Alison Hancharuk for helping with the laboratory and field works, as well as our partner, ApSaveTM and funding agency, NSERC.

APIMONDIA SCANDINAVIA 2025
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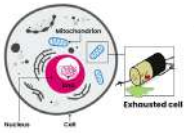
PP-049 [Bee Health]

LIGHT THERAPY APPLIED TO BEES
Protecting bees from climate, toxicity and transport stressors with deep red light
2019 - 2025 interim research report

Glen Jeffery, Jaimie Ho Kam, Micheal Powner, Christophe Brod, Stephen Peinado

Background
The ophthalmology department at University College London (UCL), led by Prof. Glen Jeffery, studies age-related macular degeneration for human. Over 30 years, they've shown long-wavelength light enhances mitochondrial membrane potential and ATP production. Trials in mammals and insects confirm this response is conserved across species.

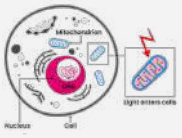
Beefutures began collaborating with UCL in 2019 to explore ways to improve bee health, based on the hypothesis that common stressors cause cellular stress and mitochondrial decline, as outlined in UCL studies.

Mitochondria and ageing principles


Mitochondria are vital for cell health, respiration, and energy. With age, mtDNA mutations impair mitochondrial function, reducing ATP and increasing reactive oxygen species (ROS). If cells can't adapt, they die—leading to lower energy, rising inflammation, and declines in CNS function, mobility, and immunity.

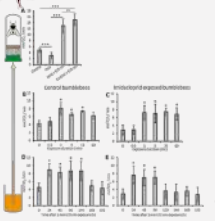
Purpose of the research & scientific questions
- Transpose light therapy from individual insects to whole colonies — how, and how to assess?
- How to bring long-wavelength light exposure to the entire bee colony without negatively impacting their behaviour.
- Assess how various challenges impact colony metabolism — which ones, and how?
- Determine if stress effects on bee colony can be reversed with light exposure.
- Evaluate the scalability of stress and light measurements.
- Consider side effects: overexposure, altered colony dynamics, population changes.

UCL´s background laboratory research

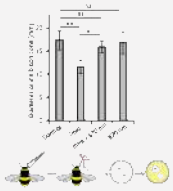


Cellular stress resembles accelerated ageing, marked by reduced ATP and increased ROS. UCL research (see PLOS ONE references) assessed various metabolic markers to evaluate stress and light effects. These metrics provided strong evidence and informed our selection for bee studies.

Respiration & Immunity metrics
Neonicotinoid exposure lab trial on bumblebees



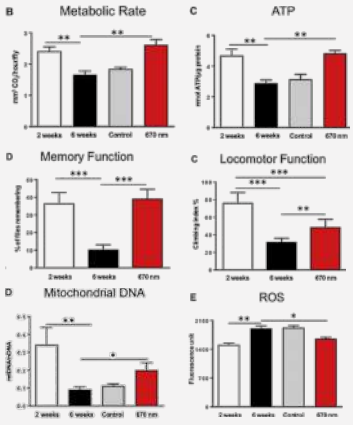
Imidaclopid disrupts mitochondrial function, likely affecting respiration. We measured whole-body CO_2 production in individual bumblebees exposed to Imidaclopid for 5 days. Imidaclopid reduced respiration by 36%, an effect reversed by 670nm light administered for 15 minutes twice daily.



To assess if 670nm light preserves immunocompetence, bumblebees were exposed to Imidaclopid and/or 670nm light for 4 days, then challenged with E. coli. Haemolymph was collected 24h later and analysed via inhibition zone assays. Imidaclopid reduced antibacterial activity, partially restored by 670nm light. n = 17 bees/group. Abbreviations: p < 0.05, p < 0.01, ns = not significant, Imid = Imidaclopid.

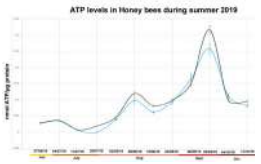
Improving mitochondrial function in *Drosophila melanogaster*

Drosophila, daily 670nm light for one week was used to assess metabolic and functional effects. Researchers measured changes in metabolism, motor function, retinal health, and memory to test if 670nm light mitigates age-related decline. The flies were sampled at 2 and 6weeks.

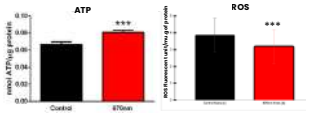


Preliminary field tests with honeybees - ATP/ROS metrics

Six colonies were used from June to October (3 light-exposed, 3 control), all identical in breed, strength, size, and queen age. Beekeeping interventions were consistent across hives. Each week, 10 bees per hive (50/50 nurse and worker) were sampled. ATP and ROS were measured to assess mitochondrial state.

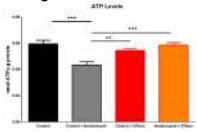


Baselining the ATP profile evolution of the colonies. ATP shifts over the months, lowest in July , rising in August and peaking in Sept/Oct. N= 10 bees per time point.



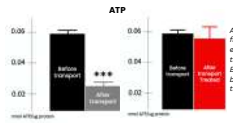
Average ATP & ROS of control colonies vs. 670nm light-exposed colonies throughout the test period. Inverted correlation of ATP/ROS validates the consistency of the readings, confirming higher ATP and less ROS in treated colonies

Inducing stress with neonicotinoids



ATP was measured in bees from four winter-treated hives: control, imidacloprid, 670 nm light, and both combined. By winter's end, ATP in the combined group matched control. The imidaclopid-only hive showed low ATP, shivering, poor brood, and collapsed.

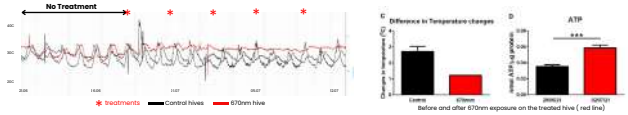
Inducing stress with transportation in truck



ATP was measured in from 20 bees from six equally strong hives transported 50km. Bees were sampled before and after transportation.

ATP/ROS & honeybee colony thermoregulation performance correlation

Honeybees maintain stable brood nest temperatures day and night. Colonies that fail to thermoregulate are often queenless, broodless, or too weak to control hive temperature. Effective thermoregulation demands coordinated effort: collecting water, fanning, and heating to manage humidity and heat. This process is energy-intensive. The trial revealed that non-thermoregulating colonies also exhibit low ATP, the test also revealed how colonies can recover and maintain thermoregulation with 670nm

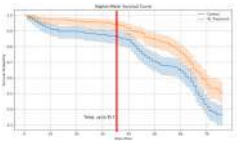


Climate stressors - scaled trial with thermoregulation metrics

Spring 2021 in France featured an abnormally warm March followed by a damaging, cold April frost, which severely impacted vineyards and fruit crops. A climate change attribution study by the World Weather Attribution found that human activity made these post-bud-burst frosts colder by about 1.2°C. All bee colonies in control group failed to thermoregulate for the entire spring period, the hives in light group thermoregulated well.

In the same year, France was affected by an intense heat wave Hives in control failed to cool down hives with temperatures reaching 39.5C for approx. 4hrs per day , 4 days in a row. Hives in light control kept temperatures below 37C

Effect of light therapy on survival in *B. terrestris*



Preliminary testing of 670 nm light exposure on survival used four commercial *B. terrestris* colonies (2 control, 2 RL treatment). A total of 720 workers (180 per colony) were tagged, fed per os, and monitored for daily mortality. From day 37, bees underwent temperature stress (35 °C, 35% RH, 6 hrs/day, 5 days/week). The experiment ended on day 76, and Kaplan–Meier analysis showed a significant survival difference between control and treated groups ($\chi^2 = 14.40$, df = 3, $p < 0.005$).

CONCLUSION, APPLICATIONS, NEXT STEPS
Field research aligned with UCL lab findings, showing that 670nm exposure improves individual insect metabolism and scales to whole colonies. While honeybee health is mainly impacted by parasites like Varroa destructor, various stressors further weaken metabolism and immunity. 670nm light appears to offer protective benefits against common challenges such as transport, neonicotinoids, and climate stress. A non intrusive and low powered device in hive could help beekeepers keeping healthier bees and providing higher foraging force for crop pollination.
Next work will consist in evaluating the influence of 670nm in larve/puppae development. Field tests in pollination will also determine the influence of 670nm on foraging activity of honeybees and bumblebees.

PUBLICATIONS

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PP-050 [Bee Health]
Results of monitoring the biological relationship of Africanized bees with Varroa since 2002 in two geographical areas of Santa Cruz, Bolivia

Nilo Padilla Osinaga
No Afilliation

Varroa has become the number one threat to beekeeping worldwide. The solution to this problem has been to control Varroa with sanitary treatments. Today we see that this solution has further complicated the possibility of a sustainable solution, leading hives to a state of dependence and Varroa to a state of resistance. In our Africanized region, since 2000 we have been monitoring the relationship between bees and Varroa, focusing on two factors: the hygienic behavior of bees and variations in Varroa populations in hives. The results show that our bees and Varroa have developed strategies of coexistence and balance, so that it is not necessary to carry out any type of sanitary treatment against Varroa. These results were published at different beekeeping conferences of ADAPICRUZ (Beekeepers Association of the Department of Santa Cruz, Bolivia). It is a fact that Africanized bees have populated the entire tropical zone of America from northern Argentina to Mexico, including southern Bolivia. In this area of our country the results are different. The bees are highly dependent on health controls. This shows that the factors of co-evolution between bees and Varroa have varied despite having the same genetic origin and the same environment. The differentiating factor is the management techniques and, above all, the implementation of preventive treatments on a sustained basis without a strategic objective. Pest and disease control in hives, which is in the minds of producers, continues to advance stealthily, seriously jeopardizing the results obtained in our production system, based on the biological balance of bees with their threats, on solutions based on nature and without health control. It is urgent to make an objective analysis, we all know that the only way out of this situation is through achieving a relationship of coexistence between bees and varroa that makes beekeeping viable as a productive sector and the survival of bees in the medium and long term.

PP-051 [Bee Health]
Indirect Effects of Pesticide Exposure on the Honeybees Gut Microbiota: Disruption through Altered Pollen Consumption

Kang Wang, Zheguang Lin, Ting Ji
College of Animal Science and Technology, Yangzhou University, Jiangsu, China

Increasing evidence indicates that pesticide exposure can disrupt the gut microbiota of social bees. The gut microbiota plays a crucial role in host health and performance, making it essential to understand how it is affected by pesticide exposure. However, it remains unclear why certain gut bacteria, particularly Bifidobacteriales and Lactobacillus species, are sensitive to various pesticides. In this study, we propose a potential explanation for this phenomenon. We demonstrate that pesticides may not directly disrupt the gut microbiota; instead, they interfere with pollen consumption, which subsequently alters the gut's nutritional environment. These changes may promote shifts in competition and cooperation among microbial communities, leading to the observed disturbance in the gut microbiota composition. Our research challenges the traditional assumption that pesticides directly inhibit the growth of resident microbes. Instead, we highlight the indirect effects mediated through alterations in bee diet. This novel perspective provides new insights into how environmental stressors influence microbial dynamics in honeybees and could inform more targeted approaches to mitigating the negative effects of pesticides on pollinator health.

PP-052 [Bee Health]

Greater wax moth control in apiaries can be improved by combining *Bacillus thuringiensis* and entrapments

Bo Han[1,7], Li Zhang[1,7], Lili Geng[2,7], Huiru Jia[2,7], Jian Wang[2], Li Ke[1], Airui Li[1], Jing Gao[1], Tong Wu[1], Ying Lu[1], Feng Liu[3], Huailei Song[4], Xiaoping Wei[5], Shilong Ma[6], Hongping Zhan[5], Yanyan Wu[1], Yongjun Liu[1], Qiang Wang[1], Qingyun Diao[1], Jie Zhang[2], Pingli Dai[1]✉

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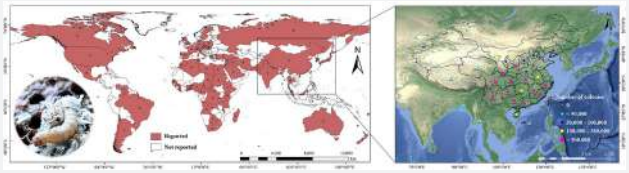
Introduction

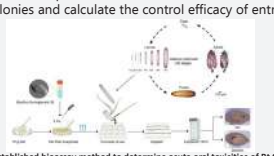
The GWM is a pervasive pest of honey bee colonies worldwide, especially *Apis cerana cerana*, a bee species indigenous to China, which is vulnerable to GWM. The larvae of GWM have destructive feeding habit and can feed on combs, causing significant damage to beehives and resulting in economic losses. At present, various methods have been proposed as alternatives for GWM control, and the use of biological agents, particularly toxins from the bacterium Bt, has emerged as a potential solution. Although the potential of Bt against GWM has been acknowledged, several issues hinder its widespread adoption. Thus, the application of Bt-based biological control of GWM in beehives is still rare.



Current damage status investigation of *Galleria mellonella*. **a** Worldwide distribution of the GWM. **b** Distribution of *A. cerana cerana* rearing colonies in China. Different colors or sizes indicated different population sizes.

Methods

Bioassay of Bt against GWM larvae: Using the self-established bioassay method, and spraying on or pressing into the comb to determine insecticidal activity of Bt to the GWM larvae.
Screening lures for the GWM larvae: In the Y-type olfactometer, six choice tests were performed with the 1st - 2nd instar GWM larvae, including (ⅰ) dark comb vs. beeswax; (ⅱ) dark comb vs. honey; (ⅲ) dark comb vs. pollen; (ⅳ) beeswax vs. honey; (ⅴ) beeswax vs. pollen; and (ⅵ) pollen vs. honey.
Indoor and field trapping experiments: Indoor experiments, two entrapment A (trapping device containing lure A + BiotGm) and entrapment B (trapping device containing lure B + BiotGm) were tested in pollination boxes, and GWM larval survival and comb loss were measured. Field tests used entrapment A in three *Apis cerana cerana* apiaries, to assess GWM damage for colonies and calculate the control efficacy of entrapment A against GWM.



Using the self-established bioassay method to determine acute oral toxicities of Bt to the GWM larvae.

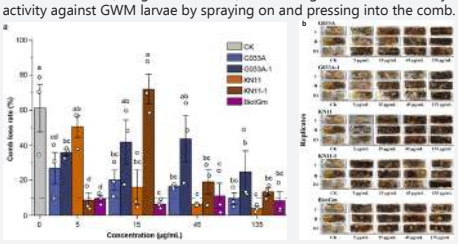
Trapping device that prevents bees from contacting the lure.

The materials and fabrication process for the preparation of biocontrol entrapment.

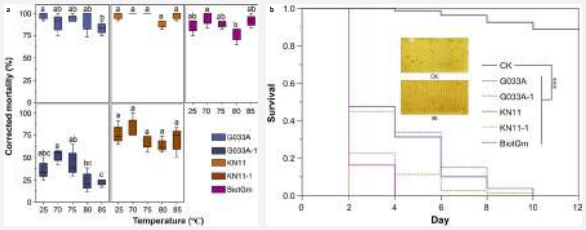
Results

BiotGm exhibits high insecticidal activity against GWM larvae

A novel Bt strain (designated BiotGm) exhibits high insecticidal activity against GWM larvae with a LC_{50} = 1.772 μg/g. Furthermore, BiotGm always showed high insecticidal activity against GWM larvae by spraying on and pressing into the comb.

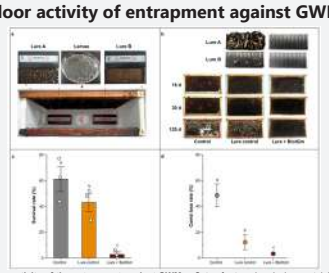


Activity of spraying Bt on comb against the GWM. The loss rates (**a**) and actual destruction situation (**b**) of combs sprayed with 5, 15, 45, and 135 μg/mL Bt solution and invaded for 4 weeks by 2nd instar GWM larvae.



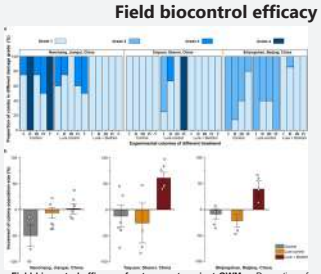
Activity of pressing Bt into the foundation against the GWM. a The effect of insecticidal activity of five Bt products after continuous heating at 25, 70, 75, 80, and 85 °C for 6 h. **b** The survival of 2nd instar GWM larvae exposed to the comb foundation containing Bt (4000 μg/g) for 12 days..

Indoor activity of entrapment against GWM



Indoor activity of the entrapment against GWM. a Setup for trapping device containing lure and schematic of the indoor trapping experiment. **b** Representative images of the attraction and control effects of entrapment after 120 days. **c** Survival of GWM larvae after 30 days. **d** the comb loss rate after 120 days employing entrapment.

Field biocontrol efficacy of entrapment against GWM



Field biocontrol efficacy of entrapment against GWM. a Proportion of comb in different GWM damage grades after finishing the trial in different test groups for three field sites. **b** Changes of population size before and after the trial in different test groups from three field sites.

Representative images of the attractive effect and control efficacy of entrapment in field conditions.

A new entrapment (lure for GWM larvae + BiotGm and matching a trapping devicethat prevents bees from contacting the lure) effectively controlled GWM larvae in both laboratory and field trials.

Conclusion

We design an entrapment method consisting of a lure for GWM larvae, a novel Bt strain BiotGm (with high insecticidal activity), and a trapping device that prevents bees from contacting the lure. All results find that this method reduces the population of GWM larvae in both laboratory and field trials, and the field control effectiveness of the entrapment against GWM was over than 93%.

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PP-053 [Bee Health]

An update on the colony loss report of the Apimondia 2023 Congress: Has Tropilaelaps passed the borders of Iran and is it among the causes of the massive devastating honey bee colony loss across Iran?

Pegah Valizadeh
Honey Bee Research Department, Animal Science Research Institute of Iran, Agricultural Research, Education and Extension Organization (AREEO), Karaj, Iran

At the previous Congress of Apimondia in Chile (2023), I reported a devastating massive colony loss of honey bees in apiaries across Iran with unidentified causes. The disastrous loss started four years ago throughout the country. The main symptoms have been dead larvae and/or pupae, perforated cappings and patchy brood pattern, causing an interruption of population growth and rapidly resulting in colony weakening or absconding with above 60% and in several cases even up to 100% losses. Back in 2023, I reported that against all logical expectations no valid national attempts in conducting a scientific analysis to identify the causes were made. That comment is still valid. Rather, regrettably without any accurate diagnosis a wide range of antibiotics (including for human consumption) were prescribed and applied extensively. During 2023 Apimondia Congress, in addition to several other hypotheses, a new one that Tropilaelaps mite could be one of the main causes of the loss was formed. Since then I personally have been officially demanding a nationwide collaboration on accurate scientific and comprehensive Tropilaelaps monitoring and also assessing other hypotheses. Through an incredible insisting, my official request in addition to the scientific elucidation of the significance of the demand, has reached to the uppermost level of the relevant decision makers of the country. However, sadly the important task has not yet been facilitated to initiate and meanwhile, the massive honey bee loss is still literally devastating the beekeeping industry and threatening the food security of the country. In fact, the consequence of the unidentified causes of the immense loss facing the inappropriate treatments has evolved the situation into much worse. Recently, I have been honored to receive the limited offer from the Health Commission of Apimondia and also WOAH for collaboration on identifying the causes of the loss by evaluating a few of the hypotheses. Although through this approach a comprehensive nationwide surveillance may not still occur, the results will definitely be nationally and internationally invaluable, as what has affected Iran could also reach the rest of the planet. The progress will be announced by the time of the 2025 Apimondia Congress.

PP-054 [Bee Health]

The diversity of insecticide target site mutations in *Apis mellifera*

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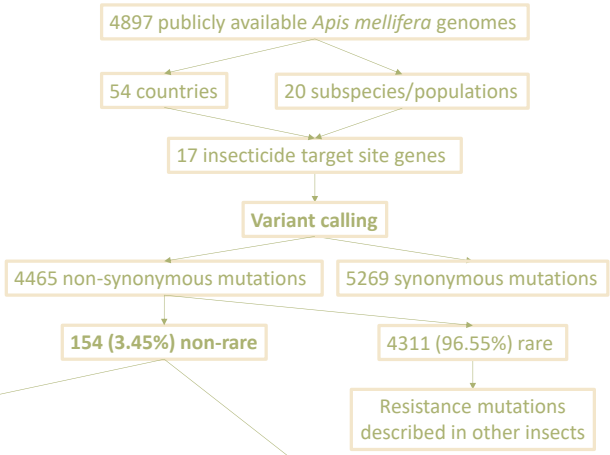
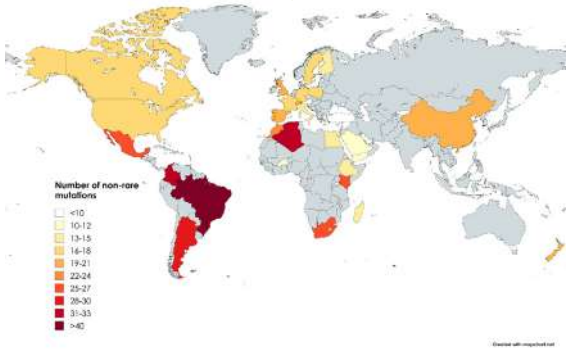
2) CIMO, LA SusTEC, Instituto Politécnico de Bragança, Campus de Santa Apolónia, 5300-253 Bragança, Portugal.
3) Laboratory of Toxicology and Pharmacology, KU Leuven, 3000 Leuven, Belgium.

Introduction

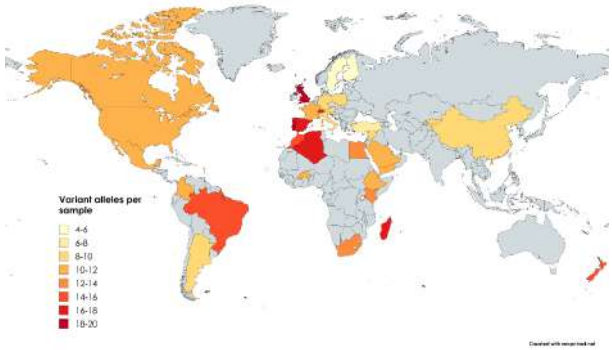
Insecticides are widely used to combat agricultural pest species, such as aphids, caterpillars, planthoppers and locusts, or to limit the spread of disease-carrying mosquitos. However, these insecticides do not only affect their target species but also non-target species such as pollinators which inadvertently encounter them while foraging. Over one hundred different pesticides and pesticide derivatives have been found in honey bee hives. Insecticides are one of the factors behind the decline of pollinator populations.

Pest species, such as aphids and Lepidoptera, have developed widespread resistance to many compounds. However, research on insecticide resistance in honey bees is rather limited and focuses on only one type of resistance: metabolic resistance. Therefore, we aim to expand the available data on insecticide resistance in honey bees by studying another type of insecticide resistance: target site resistance.

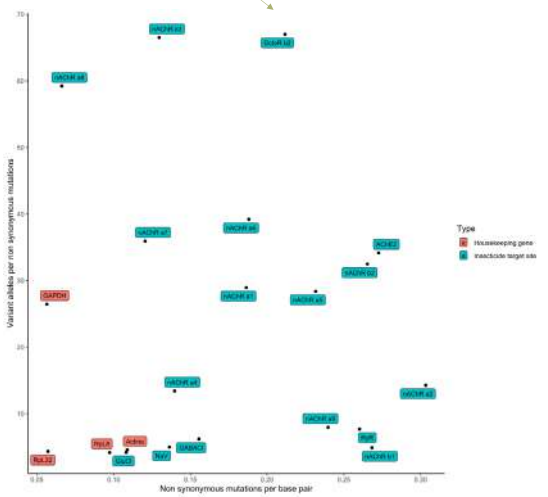




Geographic distribution of the number of non-rare mutations in all insecticide target sites. Countries with fewer than five samples were excluded. Non-rare mutations are defined as having a variant allele frequency (VAF) ≥ 5% and a variant allele count (VAC) ≥ 2.



Geographic distribution of non-rare mutations found in all insecticide target sites. The total count of variant alleles per country was divided by the number of samples from that country. Countries with fewer than five samples were excluded.



Genetic diversity of insecticide target sites. Comparison of the number of non-synonymous mutations corrected for the size of the protein coding sequence and the number of variant alleles per non-synonymous mutation. Abbreviations: RyR=ryanodine receptor, OctoR b2=octopamine receptor ß2, GABACl= GABA receptor Rdl, NaV=sodium channel para, GluCl=glutamate receptor, AChE2=acetylcholine esterase, nAChR= nicotinic acetylcholine receptor.

Conclusion

Several potential insecticide resistance mutations have been identified. The geographical and functional of the major insecticide target sites in *A. mellifera* is described. This study serves as a basis for further research on insecticide resistance and local adaptation in pollinators.

PP-055 [Bee Health]
Overcoming varroa destructor

Nilo Padilla Osinaga
No Afilliation

Varroa Varroa is today the greatest threat to honey bees globally, causing yield losses and, in extreme cases, the death of hives. Chemical and organic treatments, the basis of conventional management, have generated resistance in Varroa and dependence in bees, resulting in loss of genetic diversity. This loss limits the ability of bees to adapt to their own threats (Doñana Biological Station, 2025). However, in Santa Cruz, Bolivia, an innovative solution has been developed.
Since 2000, a different approach has been worked on, presented at events of the Departmental Association of Beekeepers (ADAPICRUZ) and at APIMONDIA Chile 2023. This model, based on observation and supported by natural processes, promotes a positive co-evolution between bees and Varroa.

The approach is based on two pillars: natural swarming and quantified honey reserves. Swarming encourages genetic diversity, adaptation and resilience. The honey reserve ensures that they have the resources to carry out these processes. These principles have shown that bees, by developing their own defenses, can coexist with Varroa without the need for external treatments.

This system, called "A More Natural Beekeeping Production System that generates genetic diversity and is easy to manage", not only reduces costs and simplifies management, but also promotes bee well-being and resilience. As Nogués states (cited by Larson, 2025), "a species with genetic solutions is better prepared to face changes."
The Santa Cruz experience is an example of how trust in natural processes can offer sustainable solutions. In a world facing biodiversity loss and the climate crisis, this beekeeping system represents a hopeful alternative, showing that sometimes the best intervention is no intervention.

PP-056 [Bee Health]
Beneficial bacteria-based feed additives for honeybees: current research and field application insights

Daniele Alberoni, Chiara Braglia, Loredana Baffoni, Diana Di Gioia
Department of agricultural and Food Sciences (DISTAL) - Università di Bologna

The use of beneficial microorganisms to counteract the colony diseases has long been hypothesized and tested by the scientific community. Research conducted around the world has involved not only microorganisms typical of the bee's gut microbiome but also environmental strains associated with the ecological niches frequented by bees. Depending on the target pathogen, the results have often been inconsistent. For instance, when beneficial microorganisms were applied against Paenibacillus larvae (the agent of American foulbrood), significant reductions in the total number of pathogen spores were observed; however, these reductions did not translate into a meaningful biological impact, as colonies continued to exhibit symptoms of the disease. In contrast, when these microorganisms were used to counter Nosema ceranae, important and significant decreases were highlited in both spore counts and vegetative forms counts of the pathogen, though these effects proved to be short-lived. Research conducted under the Horizon 2020 MSCA No PROBleMS project has shown that the advantages provided by these microorganisms extend beyond pathogen suppression to include the activation of the immune system. Of particular interest was the observed increase in vitellogenin accumulation in the bee's fat body following nutritional supplementation with specific environmental microorganisms. Could this be a key factor in implementing the application of these microorganisms in apiculture? To test the hypothesis that environmental microorganisms might play a crucial role in stimulating the immune system, the AGRITECH project evaluated multiple strains isolated from sunflower (Helianthus annuus) flowers and roots. Their effects on the bee immune system helped broaden our understanding in this field. This work aims to offer beekeepers and researchers insights into aspects that are rarely considered when selecting probiotic microorganisms for bee health. This research was carried out under the European Union Next-Generation Framework (PNRR – Mission 4, Component 2, Investment 1.4 – D.D. 1032 17/06/2022, CN00000022).

PP-057 [Bee Health]

Exploring the role of opportunistic pathogens in honeybee health: the case of *Serratia marcescens* synergy with *Nosema ceranae*

Chiara Braglia, Daniele Alberoni, Paula Melisa Garrido, Martin Pablo Porrini, Loredana Baffoni, Dara Scott, Martin Javier Eguaras, Diana Di Gioia and David Mifsud

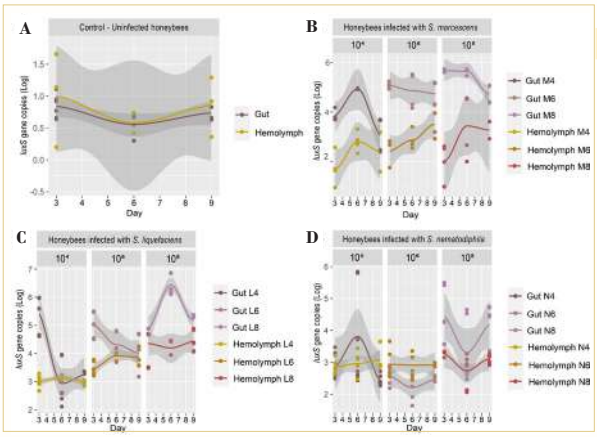
Background & Aim

Honeybee health is threatened by multiple pathogens, including the gut parasite *Nosema ceranae* and opportunistic bacteria such as *Serratia*. **This study wants to investigate a potential synergy between these pathogens, with *N. ceranae* promoting *Serratia* proliferation.** This interaction may exacerbate gut epithelial damage and lead to systemic infections. Understanding this relationship is key to improving disease control strategies in beekeeping.

What we did

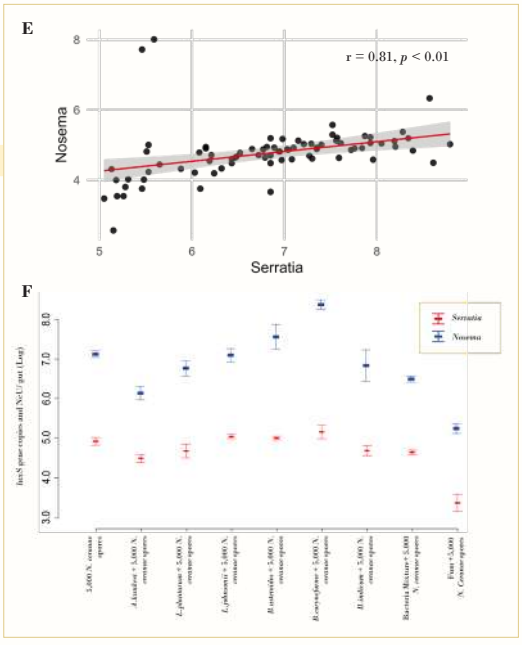
Three *Serratia* strains (*S. marcescens* [M], *S. liquefaciens* [L], *S. nematodiphila* [N]) were isolated from honeybee guts and orally administered to newly emerged bees at increasing doses. Parallel infections with *Nosema* spores were performed to evaluate potential synergistic effects. *Serratia* abundance in gut and hemolymph was quantified by qPCR targeting the *luxS* gene. Additional groups received fumagillin or beneficial bacterial strains to assess their effect on pathogens proliferation.

Panel for honeybee artificial-infection with *Nosema* spores and *Serratia* strains.



Serratia Systemic Spread Dynamics

Quantification of *luxS* gene copies revealed negligible *Serratia* levels in control bees (panel A). In bees infected with *S. marcescens* (panel B), a dose-dependent increase was observed, especially in the hemolymph, indicating systemic spread. *S. liquefaciens* (panel C) and *S. nematodiphila* (panel D) showed gut colonisation mainly at the highest dose (2.5×10^8 CFU/mL), but limited hemolymph proliferation. Among tested strains, *S. marcescens* showed the highest invasiveness and virulence. Moreover, *Serratia* exhibited a clear gut-to-hemolymph translocation, confirming its ability to breach the gut barrier and establish systemic infection.



The synergy between *Nosema* and *Serratia*

Serratia exhibits a strong positive association between bacterial proliferation (*luxS* gene copies) and *Nosema* load (NcU), indicating a synergistic interaction. This is especially evident under high *Nosema* doses, where a compromised gut barrier likely enhances bacterial translocation to the hemolymph. The Pearson correlation (+0.81, $p < 0.01$, panel E) supports this synergism. Moreover, microbial treatments influenced this dynamic (panel F): bees receiving beneficial strains such as *Apilactobacillus kunkeei* and a bacteria mixture showed significantly reduced levels of both *Nosema* and *Serratia*, highlighting a protective effect on gut integrity. In contrast, untreated or fumagillin-only groups did not prevent systemic spread (even if fumagillin decreased *Nosema* load). These findings underscore how both *Nosema* infection intensity and microbiota modulation critically shape the outcome of bacterial co-infections.

Our main findings

This study demonstrates that *Nosema* enhances the proliferation of opportunistic *Serratia* strains, particularly *S. marcescens*, by compromising gut epithelial integrity and promoting haemocel colonization. The strong correlation between *Nosema* load and *luxS* gene abundance supports a synergistic pathogen–pathogen interaction. Some beneficial bacteria treatments significantly reduced both pathogens levels, highlighting their potential as alternative strategies to mitigate infection spread and improve honeybee resilience. These findings underscore the importance of maintaining gut microbiota balance in the context of multi-pathogen stress scenarios in apiculture.

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PP-058 [Bee Health]

Semi-field tests of repellent and attractant molecules to *Aethina tumida*, a pest of *Apis mellifera*

Devan L.L. Rawn[1], Aaron D. Gross[2], and **Cameron J. Jack[1]**

[1]Entomology and Nematology Department, University of Florida, USA*Presenter: Devan Rawn (devan.rawn@ufl.edu)
[2]Department of Entomology, Virginia Polytechnic Institute and State University, USA

Introduction

There are currently no effective chemical treatments for small hive beetle (SHB) control within or outside honey bee hives. At the University of Florida's Plant Science Research Center in Citra, Florida, the Honey Bee Research and Extension Laboratory (HBREL) operates and maintains a building of 12 enclosed, mesh structures, referred to as flight cages (Fig. 1). Each flight cage is 12.8m long, 8m wide, and 3m tall. These flight cages can house honey bee colonies and have walls capable of containing small insects such as SHB. Several compounds have been identified that show promise in laboratory assays of being effective attractants and repellents to SHB[1]. Assays need to be developed to test these compounds and determine efficacies in more field realistic environments. Several trap designs have been used in research applications[2], but more research needs to be conducted to improve trap attractiveness.

Main Objectives

1: Develop a semi-field assay to identify compounds that repel SHB from honey bee colonies.
2: Develop a semi-field assay to identify compounds that attract SHB more effectively than honey bee colonies.

Methods

Preparation of Colonies: Honey bee colonies must be brought into the flight cages free of SHB (Fig. 2). To do this frames and equipment are visually inspected, frames are gently bumped to remove SHB, and adult bees are shaken onto a screen that is large enough for SHB to pass through but not honey bees. Any SHB found are aspirated.
Nucleus colonies of 5 frames are tested first. These colonies contain a queen, brood, and approximately 5000 adult bees. Nucleus colonies are easier to manage in the flight cages and lower the risk of large amounts of bee death, but still contain all the elements that would normally attract SHB to a honey bee colony.
Small Hive Beetles: Adult beetles are brought to the flight cages from rearing facilities at the HBREL. One hundred beetles are released in a flight cage for all assays (Fig. 4).

Figure 2. Nucleus colonies must be managed regularly in the flight cages. Without access to natural forage, colonies must be fed with supplemental sugar syrup. An aspirator is used to remove adult SHB from this colony 48h after they have been released in the flight cage.

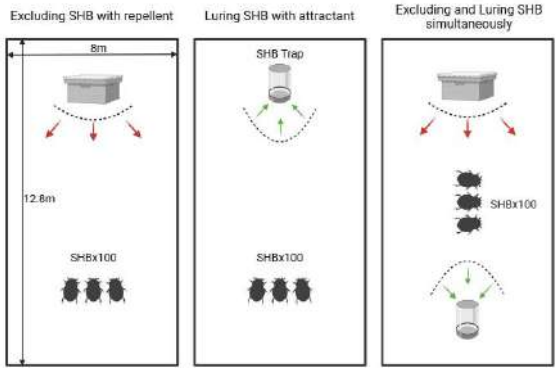

Figure 3. Examples of the three types of assays being developed. Repellent assays testing the exclusion of SHB. Attractant assays testing the effectiveness of SHB traps. An assay that includes both a repellent near a hive and attractant in a trap will be used to test "push-pull" strategies.

Figure 1. A view of the flight cages. Flight cages are fully enclosed and impermeable to insects as small as SHB. In total there are 12 individual cages, with six on either side of the gravel driveway, allowing for multiple assays to take place at once.

Assay Development

Repellent Assay: Pyrrolidine is being tested as the first repellent candidate to develop the assay. Repellent is being tested by lightly soaking an absorbent pad and placing it near the honey bee colony entrance. Repellents will continue to be tested to understand the placement, quantity, and application schedule that is the most effective way to reliably exclude SHB (Fig. 3).
Attractant Assay: Isopentyl Acetate and honey bee pollen substitutes are being tested to develop the attractant assay. Attractants are placed in a trap that has entrances large enough to allow SHB to enter but not honey bees (Fig. 3).
Combined Assay: Within a single flight cage, a honey bee nucleus colony with a repellent and a SHB trap with an attractant are placed at opposite ends (Fig. 3).
Measuring Efficacy: After 48 hours, SHB are counted. Within nucleus colonies, we visually inspect, bump frames and equipment, and shake adult bees over a screen to identify all SHB. Within traps, SHB are removed and counted.

Benefit to Beekeepers

- Our work allows for the continuation of SHB attractant and repellent research by providing a standardized set of methods that can be used to test the efficacy of many compounds under semi-field conditions.
- The flight cage assay also allows for continued research into SHB trap design. An effective environmental trap to catch adult SHB could be used for monitoring in areas on the edge of SHB invasive range, or for control in SHB infested areas.
- This research could ultimately lead to the development of products for beekeepers to better protect their honey bee colonies from SHB damage.

Figure 4. A petri dish of SHB adults is placed on the opposite end of the flight cage from a honey bee nucleus colony. SHB are released. Any SHB that enter the honey bee colony are counted at the end of the assay.

Acknowledgements

We gratefully thank Jennifer Martocci and Christopher Oster for providing technical assistance during the experiment. This research is being supported with funds provided by a USDA-APHIS grant.

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2. Arbogast et al. (2007) An effective trap and bait combination for monitoring *Aethina tumida*.

APIMONDIA SCANDINAVIA 2025
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PP-059 [Bee Health]

APIMONDIA SCANDINAVIA 2025
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COPENHAGEN

Fly aggression behavior and infestation rates of *Senotainia tricuspis* (Meigen, 1838) (Diptera, Sarcophagidae) in an apiary in Central Italy (Pisa province)

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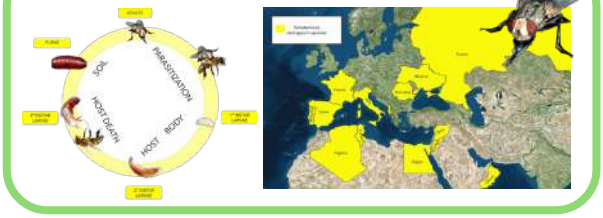
INTRODUCTION



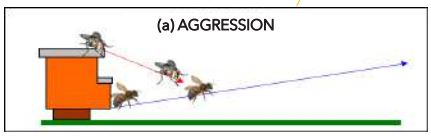
METHODS

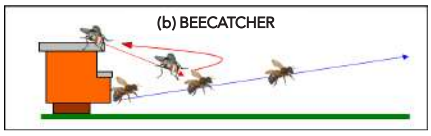
N=1 Apiary

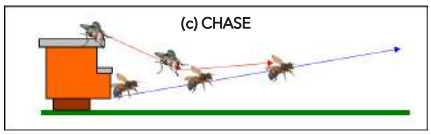
Pisa Province

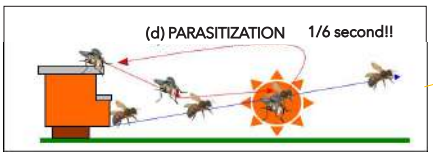
2004, 2005

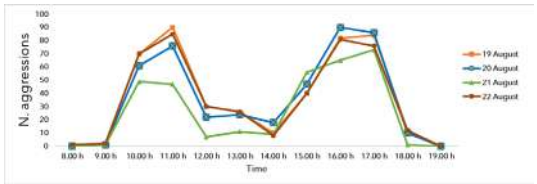
Direct and Indirect observations from June to November











Flying-out bees

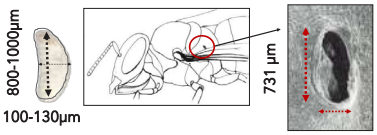
Flying-in bees

FIRST INSTAR LARVAE DEPOSITION

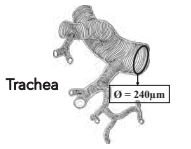
512 -602 LARVAE

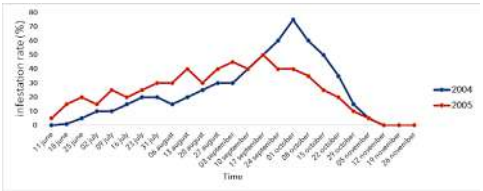
PENETRATION

Prothoracic spiracles

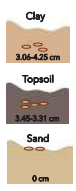


SECOND INSTAR LARVAE DEVELOPMENT





Type of soil	Boxes	N° developed pupae (tot=25)	Sink depth (cm)							Average sinking depth (cm)
Clay	1	4	3.0	3.4	4.7	5.9	-	-	-	4.25
	2	6	1.1	2.2	2.3	3.7	4.0	5.1	-	3.06
Topsoil	1	6	1.5	2.0	2.8	3.9	4.8	5.7	-	3.45
	2	7	0.8	1.2	1.2	3.9	4.0	5.6	6.5	3.31
Sand	1	0	-	-	-	-	-	-	-	-
	2	2	0	0	-	-	-	-	-	0



CONCLUSIONS

The peak of infestation of *S. tricuspis* in apiaries occurs in early autumn, and during the morning hours, flies seem to attack the honey bees when leaving the hives, while in the afternoon, they tend to attack the honey bees returning to the hives.

The aggressive behavior of *S. tricuspis* is modulated in four different behavioral events, and contact with the honey bees occurs only during the parasitization event, which lasts 1/6 s.

Measurements of the first-instars allowed us to hypothesize a penetration in the honey bee body through its thoracic spiracles.

Third-instars successfully pupate if sinking occurs in topsoil or clay soil. The high value of the mortality rate of larvae in sandy soil allows us to suggest that mulch and/or minimum soil tillage could prevent severe senotainiosis in apiaries.

DIPARTIMENTO DI SCIENZE VETERINARIE

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IN SUPREMÆ DIGNITATIS 1343

PP-060 [Bee Health]
Effects of mosquito larvicides and adulticides applied via truck-mounted and aerial spraying on honey bees (Apis mellifera) in Florida

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Ultra-low volume (ULV) mosquito adulticides are common in Florida, as they are highly effective at controlling mosquitos. Additionally, there are many Florida mosquito control districts in which water bodies are treated with mosquito larvicides. Currently, not much is known about how simultaneous exposure to these chemicals in realistic field scenarios will impact overall honey bee colony strength. In this study, we determined the impact of field-realistic mosquito control practices on colony strength parameters by placing 15 new honey bee colonies in three “hotspot” treatment sites (five colonies per site) where mosquito control operators treat three to five times during the space of three months. We also placed 15 new colonies in three sites (five colonies per site) receiving little to no mosquito treatment applications (negative control sites). The “hotspot” treatment sites were treated with Mosquito Mist II®, Dibrom®, and Vectobac12AS®. Colony strength parameters were measured before and after the three-month treatment period. Samples of hives matrices (pollen, nectar, bees, brood) were collected from all colonies and analyzed to determine the residue levels of mosquito control products present in the hives. Some mosquito control product residues were found at a low concentration in hive matrices (from 0.03 to 70.99 ng/g), with a high prevalence of chlorpyrifos in all of them. However, no significant differences were observed in colony mortality or health strength parameters between colonies located in treated and control sites, as well as no direct impact of a spray event was observed in adult bee mortality. The resulting data will be used to inform best management practices for mosquito control programs and apiculture in the future.

PP-061 [Bee Health]

UNIVERSITY OF LJUBLJANA
Veterinary Faculty

Application of MALDI-TOF Mass Spectrometry for the Identification of the Fungus *Ascosphaera apis*

Barbara Hočevar*[1], Irena Zdovc[2], Igor Gruntar[2], Metka Pislak Ocepek[1], Lucija Žvokelj[1], Majda Golob[2], Monika Kozar[1], Rene Rus[1]

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2 Institute for Microbiology and Parasitology, Veterinary Faculty, Slovenia
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Background/Purpose

Ascosphaera apis is a fungus responsible for chalkbrood disease in bees, which occurs sporadically in Slovenia and worldwide. Although it usually does not lead to colony collapse, chalkbrood weakens bee colonies, reduces their resistance to other infections, and decreases honey production, making it economically significant. Understanding the pathogen and using reliable diagnostic methods are essential for managing and preventing its spread. Diagnostic methods for chalkbrood disease and the influence of different *A. apis* isolates on the incidence and severity of the disease remain poorly researched. Traditional mycological diagnostics have primarily relied on the morphological and biochemical properties of fungi. However, the MALDI-TOF system (matrix-assisted laser desorption/ionization time-of-flight mass spectrometry) has been used for fungal identification. Many fungal species can be identified based on specific protein profiles, but the current manufacturer's database does not yet contain corresponding reference profiles for *A. apis*.

FIGURE 1: We sampled diseased larvae (a), incubated them on SDA medium and isolated pure cultures (b). The sample was stained with cotton blue in lactophenol, allowing observation of reproductive structures (c). The mycelium was then processed using a specialized protocol for further analysis with MALDI-TOF.

Methodology

Reference and Clinical Isolates

Four *Ascosphaera apis* and six other *Ascosphaera* species reference strains were obtained from the ARSEF (USDA) collection. Thirty clinical isolates were isolated from mummified honeybee larvae showing chalkbrood-like symptoms in Slovenian apiaries.

Cultivation and Sample Preparation

Isolates were cultured on Sabouraud dextrose agar at 30 °C. Three protein extraction protocols were evaluated for MALDI-TOF MS analysis:
Liquid Cultivation Protocol – Mycelium grown in broth was extracted using a modified commercial protocol.
Ethanol/Formic Acid Extraction – Mycelium was directly harvested from solid media and processed.
Mycelium Transfer (MyT) – Fresh mycelium was applied directly to the MALDI target plate with formic acid and matrix overlay.

MALDI-TOF MS Analysis

Protein spectra were acquired using a Bruker Microflex LT/SH instrument. A reference library was generated from ten *Ascosphaera* reference strains and validated using spectra from the clinical isolates. Identification scores were interpreted according to manufacturer guidelines.

Molecular Confirmation

DNA was extracted from selected isolates and reference strains. Whole-genome sequencing (WGS) was performed to confirm species identity.

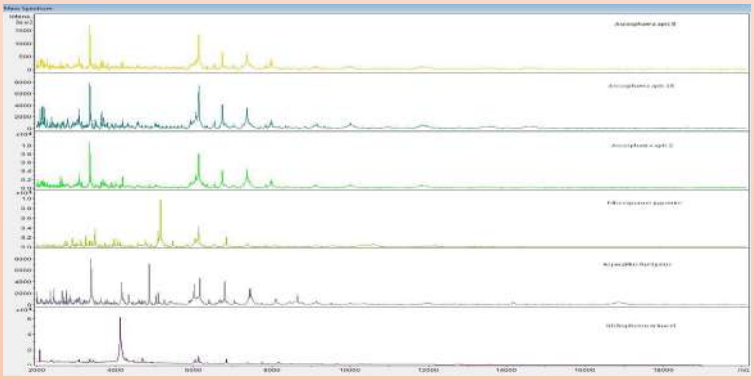

FIGURE 2: Protein profile graphs of *A. apis*. Comparison of curves indicates a similar profile among *A. apis* isolates, which significantly differ from those of other fungi

Results and Conclusion

Our findings demonstrate that MALDI-TOF MS is a rapid and reliable tool for species-level identification of *Ascosphaera*. Both the liquid cultivation and ethanol/formic acid extraction methods showed excellent performance in terms of identification accuracy under the tested conditions. While the direct mycelium transfer (MyT) method proved somewhat less consistent, it still demonstrated promising results and may serve as a useful rapid alternative.

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PP-062 [Bee Health]

APIMONDIA SCANDINAVIA 2025
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ADMINISTRATION OF COCONUT OIL-ENRICHED DIET IN HONEY BEES' NUTRITION: EFFECTS ON SURVIVAL AND HEALTH

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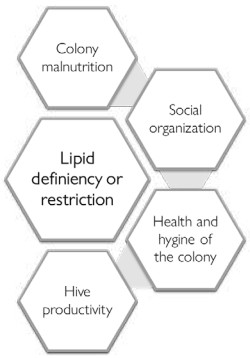
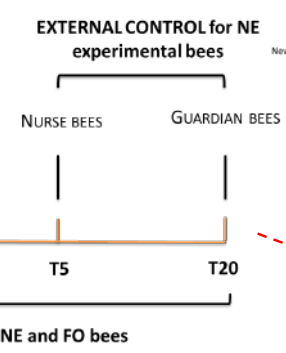


Administration of supplemented artificial diets is a common beekeeping practice to cope with honey bees nutritional deficiencies and mortality in critical periods. Lipids have a significant role in insect nutrition involved in many physiological processes. Mechanism regulating fat intake in bees is yet unknown.

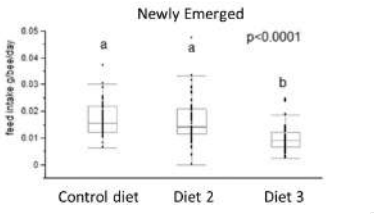
Diet 1
Beet sucrose candy

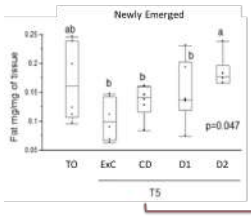
Diet 2
Candy with 0.5% of coconut-oil

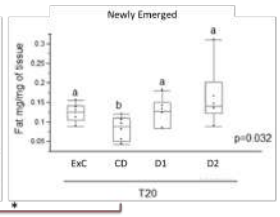
Diet 3
Candy with 1% of coconut-oil

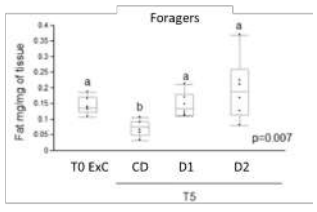


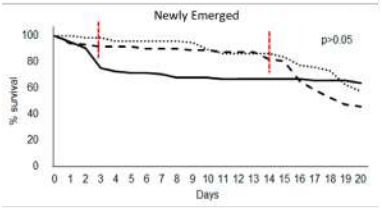
	Parameters analysed	Statistical analysis
Feed Intake	Daily Feed Intake	Kruskal–Wallis H-test, post hoc Mann–Whitney U-test
Survival	Daily survival rate	Wilcoxon rank test -Product Limit Kaplan-Meier
Bee health	Social immune system: glucose oxidase activity (GOX)	ANOVA – Tuckey's test
	Individual immune system: phenoloxidase activity (PO)	
	Antioxidant system Glutathione S-transferase	Kruskal-Wallis H-test Post-hoc: Mann-Whitney U-test
	Fat/Vitellogenin content	

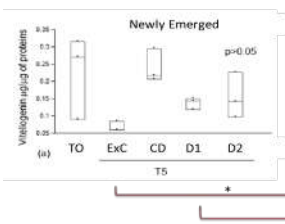


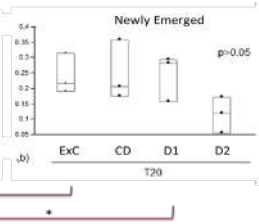


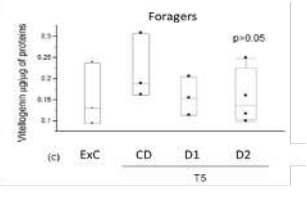












	Newly Emerged	Glucose Oxidase Activity (U/µg of Protein)	Phenoloxidase Activity (mU/mg of Protein)	Glutathione S Transferase Activity (U/mg of Protein)
T0	T0	29.92 SD 25.11 (27.48)	14.78 SD 12.11 (11.07) b	24.94 SD 29.20 (15.30)
T5	External control (Nuerse bees)	37.31 SD 12.37 (39.27)	41.34 SD 15.85 (44.34) a	32.34 SD 8.10 (29.05)
	Control diet	32.75 SD 14.36 (31.85)	29.61 SD 11.49 (29.48) a	52.34 SD 27.73 (49.35)
	Diet 2	37.70 SD 18.55 (38.10)	31.11 SD 10.51 (31.28) a	33.92 SD 28.05 (26.26)
	Diet 3	30.00 SD 9.40 (30.84)	11.64 SD 8.33 (9.89) b	20.66 SD 12.98 (17.70)
T20	External control (guardian bees)	43.68 SD 9.96 (40.45)	28.06 SD 19.14 (26.49) ab	30.20 SD 20.63 (23.25)
	Control diet	27.42 SD 8.51 (29.28)	42.66 SD 23.48 (36.06) a	30.93 SD 20.98 (26.85)
	Diet 2	29.62 SD 11.28 (28.13)	26.93 SD 18.65 (16.96) ab	32.93 SD 20.25 (31.98)
	Diet 3	31.21 SD 9.14 (32.62)	33.63 SD 44.42 (16.77) ab	38.76 SD 22.52 (41.47)
	p value, χ^2 test or F, DF = 8	$p = 0.5922$, F = 0.8163	$p = 0.0085$, $\chi^2 = 20.5449$	$p = 0.4315$, $\chi^2 = 8.0215$

Scan me!

In conclusion of low percentages of coconut oil in honey bee diets may enhance newly emerged bees' survival and the increase of fat body in summer bees suggesting a potential nutritional role of coconut oil inclusion in preventing lipid deficiency with a potential delay effect on bee aging. Further investigations to assess the suitability of the use of such supplement feed to prevent fat loss and bee aging also in weak families during winter are necessary.

DIPARTIMENTO DI SCIENZE VETERINARIE

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Wang, X.; Zhong, Z.; Chen, X.; Hong, Z.; Lin, W.; Mu, X.; Hu, X.; Zheng, H. High-fat diets with differential fatty acids induce obesity and perturb gut microbiota in honey bee. Int. J. Mol. Sci. 2021, 22, 834..

PP-063 [Bee Health]
Collateral effects of pesticides on plant-microorganism-bee interactions

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[2]Escuela Nacional de Estudios Superiores, Unidad Morelia, Universidad Nacional Autónoma de México

Honeybees (Apis mellifera) play a fundamental role in global agricultural production, as they are key pollinators for commercial crops and provide products such as honey. However, their importance is threatened by the indiscriminate use of pesticides in agriculture. These pesticides have been directly linked to the death of thousands of bee colonies. The problems caused by pesticides go beyond the direct lethal effects on colonies. Pesticides have numerous indirect collateral impacts on bee health, including negative effects on their nutrition, reproduction, and behavior. Additionally, pesticides can persist in soil and water for long periods, affecting bees long after their application.

The extensive use of pesticides not only harms bees but also disrupts the community of beneficial soil microorganisms. These microorganisms play a crucial role in nitrogen fixation and phosphorus solubilization, vital processes that occur in the soil to nourish plants and, consequently, feed bees. The disruption of these microorganisms directly affects nutrient availability for plants and indirectly for pollinators by altering plant nutrition. Poorly nourished plants have a reduced capacity to allocate nutrients to pollen and nectar production, which bees consume.

In this work, we observed that bees feeding on plants with low nitrogen and phosphorus levels in their tissues show reduced development. Furthermore, they have lower levels of essential fatty acids and proteins in their bodies. Finally, these bees have a diminished ability to defend against pests and diseases, as the activity of immune-related enzymes such as prophenoloxidase is reduced.

The lack of both basic and applied knowledge about the indirect effects of pesticides highlights the need for deeper research to understand all possible impacts of pesticides on bee health and nutrition. The relationship between pesticides and bees is more complex than initially believed.

Understanding how pesticides considered safe for bees can still have indirect effects on them can help us make better decisions regarding their safe use in agriculture, thus promoting pollinator conservation.

APIMONDIA SCANDINAVIA 2025
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PP-064 [Bee Health]

RNA metagenomics-based surveillance of diverse honey bee (*Apis mellifera*) pathogens revealing the seasonal pathogen dynamics in Taiwan

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Abstract

The honey bee (*Apis mellifera*) plays a crucial role in maintaining biodiversity within ecosystems. There has been a rising interest in beekeeping in Taiwan. However, the beekeeping industry still faces many challenges, especially various pests and diseases. In this study, RNA metagenomics was employed to investigate the composition of pathogens in honey bees collected from northern, central, southern, and eastern Taiwan in January, March, July, and November in 2024. This study aiming to elucidate the relationships between pathogen dynamics, seasonality, and geographic distribution. Our results showed that the fungal pathogen *Vairimorpha ceranae* was predominant throughout Taiwan in 2024, with *Vairimorpha apis* coexisting, except in northern Taiwan in January. Furthermore, *Serratia marcescens* and *Hafnia alvei* were prevalent bacterial pathogens in honey bees across Taiwan. For the honey bee viruses, Deformed wing virus, Black queen cell virus, Lake Sinai virus, and Sacbrood virus were the core honey bee viruses detected in all samples. This study represents the comprehensive honey bee pathogen surveillance and provides valuable insights into the temporal and spatial dynamics of honey bee pathogens in Taiwan. This information can improve disease management strategies to support bee health and the beekeeping industry.

Research gap

We are under threat from various pathogens, which affect colony health and survival.

Despite the importance of honey bee health, little is known about the spatial distribution and seasonal variation of pathogens in Taiwan.

Materials & Methods

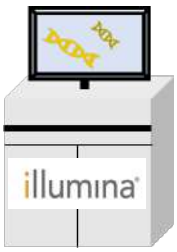
1 Sample collection

- Northern region
- Central region
- Southern region
- Eastern region

Honey bee samples were collected from four regions of Taiwan in January, March, July, and November 2024.

2 RNA extraction

3 Next-generation sequencing



4 Metagenomic analysis

Trimmomatic
Bowtie 2
Trinity
RSEM
Diamond

Results

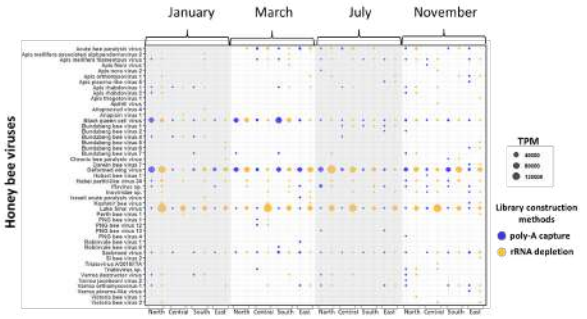


Figure 1. Transcripts per million reads (TPM) of viruses associated with *Apis mellifera* were quantified for each sample using two library construction methods: poly-A capture and rRNA depletion.

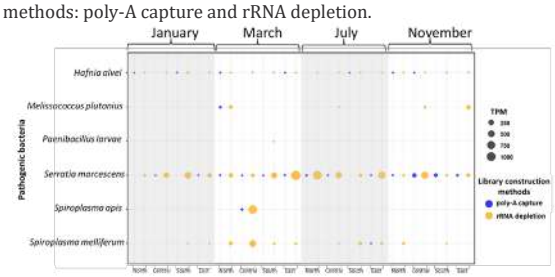


Figure 2. Transcripts per million reads (TPM) of pathogenic bacteria in *Apis mellifera* were quantified for each sample using two library construction methods: poly-A capture and rRNA depletion.

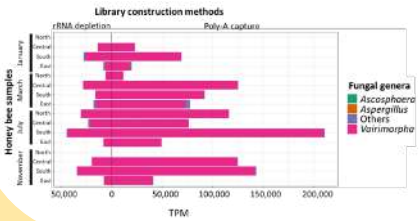


Figure 3. Transcripts per million reads (TPM) of fungi in *Apis mellifera* were quantified for each sample using two library construction methods: poly-A capture and rRNA depletion.

Conclusions and future works

- Sacbrood virus (SBV), Black queen cell virus (BQCV), Deformed wing virus (DWV), and Lake Sinai virus (LSV) represented the core viruses in the Taiwanese honey bee population.
- *Vairimorpha ceranae* was the predominant fungal pathogen, while *Vairimorpha apis* was also detected.
- *Serratia marcescens* and *Hafnia alvei* were prevalent bacterial pathogens in honey bees across Taiwan.
- Future work involves tracking the transmission routes of pathogens, elucidating pathogen interactions, and developing effective control strategies for honey bee diseases to enhance colony health and support the beekeeping industry.

Acknowledgements

- This research was financial supported by the project: **113AS-5.3.1-VP-01** from **the Animal and Plant Health Inspection Agency, Ministry of Agriculture.**
- We express our gratitude to the following **beekeepers** for providing samples for this research: Mr. Chi-Ming Liu, Mr. Ting-Wei Chen, Mr. Kuei-Fa Tseng, Mr. Chun-Sung Lin, Mr. Wei-Nien Chen, Mr. Lun-Te Li, Mr. Jen-Wei Yang, Mr. Sheng-Feng Tsai, Mr. Guo-Chang Chen, Mr. Chun-Yen Huang, Mr. Po-Han Chiang, and Mr. Jian-Guo Liu.
- Thank you to all the members of the **IPG lab** for their assistance with my experiments.

PP-065 [Bee Health]

Abstract number 0558

MAGNETIC RESONANCE IMAGING (MRI) OF THE HONEYBEE

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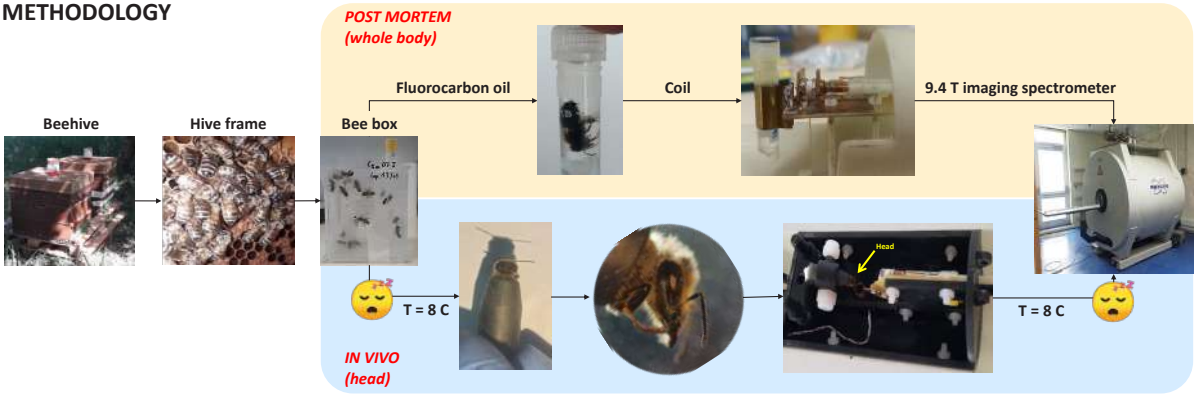
CONTEXT AND OBJECTIVES

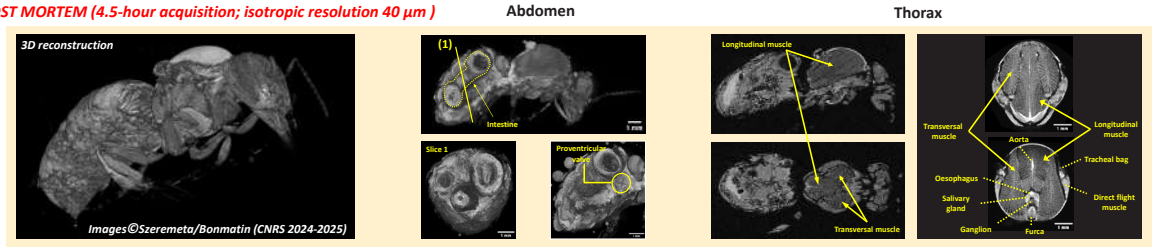
- MRI technology has the advantage of providing contrasted images of soft tissues such as muscles, organs and brain
- We developed methods for obtaining highly-resolved images of the whole honeybee and its organs by using high-field MRI (9.4 Tesla)
- These methods aim to study the soft tissues in the honeybee, both *post mortem* and *in vivo* and with/without pesticide

METHODOLOGY

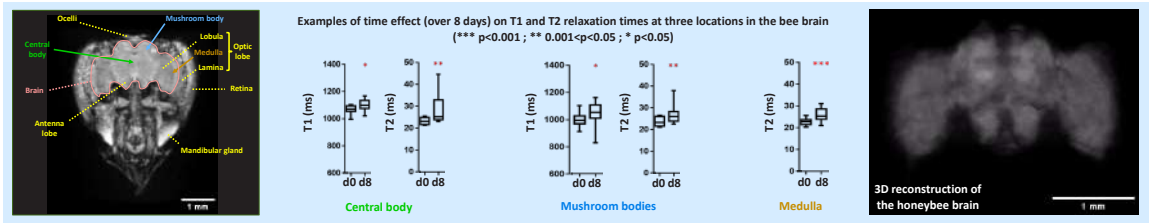


RESULTS

➢ *POST MORTEM (4.5-hour acquisition; isotropic resolution 40 µm)*



➢ *IN VIVO (1.5-hour acquisition; isotropic resolution 50 µm)*



CONCLUSION AND FUTURE PROSPECTS

- Our MRI methods allow very fine description of honeybee organs in abdomen, thorax and head. This without prior chemical fixation
- For instance, the brain volume was measured at 1.3 mm^3 and the volume of mushroom bodies at 0.027 mm^3
- These values are consistent with data from chemically-fixed honeybee brain (Haddad et al., 2004; Fu et al., 2024)
- T1 and T2 relaxation times are sensitive parameters to detect changes, for instance after 8 days in laboratory conditions (bee box)
- We measured the lethal dose 50% of imidacloprid (DL50 48h) at 12 ng/honeybee; DL50 decreased when exposure duration increases
- MRI *in vivo,* depicting changes in honeybees by imidacloprid, is under investigation (comparisons before/after chronic exposure)

Acknowledgements: Authors thank Sandra Même, Rudy Clémençon, Romain Gay, Frédéric Delbac and Marie Diogon for their help, and cnrs *for their support*

APIMONDIA SCANDINAVIA 2025
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PP-066 [Bee Health]

Apimondia, Copenhagen, 23 27 September 2025

Small Hive Beetle Outbreak in Reunion: A new Haplotype defined in Clade C

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WOAH Reference Laboratory for Infestation of Honey Bees with *Aethina tumida* European Union Reference Laboratory for Bee Health (EURL

1 Background

- **The Small Hive Beetle** *Aethina tumida* a parasite of the *Apis mellifera* causes major damage to honeybee colonies, particularly when weakened
- the last few decades, *tumida* spread to many countries around the world and, where it has been observed, eradication is often difficult, if not impossible.
- Infestation with *A. tumida* listed by the World Organisation for Animal Health (WOAH) and regulated in the European Union (EU

2 Context

- **July 2022** the presence of the Small Hive Beetle confirmed for the first time in a French department located in the Indian Ocean, **Reunion Island**
- this area of the Indian Ocean, species is known to be endemic in Madagascar and has been reported Mauritius since
- **Molecular characterisation** represents key approach for identifying the origin of the introduction of invasive species.

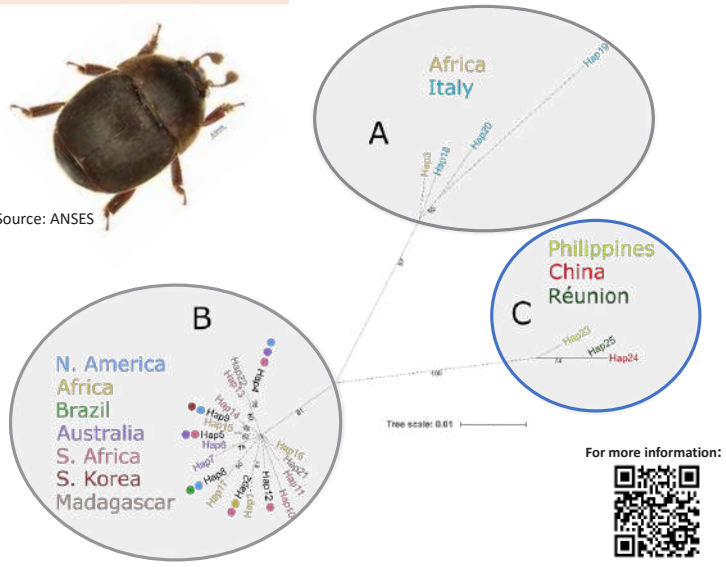
3 Which method?

- **Sequencing** mitochondrial cytochrome oxidase subunit I gene is a widely used tool for identifying insects. The sequences obtained are compared with those available in reference databases (e.g. BOLD genebank
- **Genomic DNA** from an adult and a larva collected in two separate outbreaks was extracted using the QIAamp® DNA Mini
- To amplify the **COI gene**, PCR assays were performed eight different oligo primers: SHB1, SHB2, SHB3, SHB4 (Evans 2000), AT3014 and A1859 (Howland and Hewitt, 1995) and LCO1490, HCO2198 (Folmer ., 1994
- Amplicons were sequenced with the same primers, in both directions, using a SeqStudio Analyser
- sequences were aligned with MUSCLE and the alignment was trimmed with trimAl resulting in 1,003 sites.
- maximum likelihood phylogenetic analysis was performed with RAxML v0.9.0 using the HKY+I substitution model which was selected by Modeltest v0.1.6.
- Node support was calculated from 600 bootstrap

Source: ANSES

4 Results

- The two sequences (758 bp) were deposited in GenBank databases under accessions OQ547271 OQ547272
- COI sequences from the two specimens belonged to a same new haplotype: **Hap25 defined in this study.**
- Phylogenetic analysis revealed that this haplotype is closely related to *tumida* specimens previously found in **Philippines (Hap23) and China (Hap24**
- **new haplotype Hap25** is assigned to the **clade C, one of the 3 clades previously described** ., 2021).



For more information:

5 To conclude

- pidemiological investigations provided substantial evidence source introduction
- Several hypotheses remain equally introduction exchanges continent, coming African independently introductions Reunion Island continent, directly linked recent presence *tumida* Mauritius
- sequencing currently available region, analysing specimens Mauritius essential

finding highlights the complexity of *tumida* global spread and the importance of further genetic studies to support biosecurity strategies and prevent future invasions.

PP-067 [Bee Health]
Fat and happy? The impact of Lotmaria passim on honey bee nutrition and lifespan

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Lotmaria passim is a recently characterized yet commonly encountered digestive tract parasite of the honey bee(Apis mellifera L.) that has been linked to increased colony mortality as well as changes in individual honey bee behaviour, physiology, longevity, and overall health. Despite these negative effects, no management strategies exist for this parasite because of its recent characterization. We conducted two laboratory experiments in an effort to develop accessible management strategies for beekeepers to combat this parasite and improve the health of their bees. In the first experiment, we individually inoculated newly emerged worker bees from four commonly used stocks (both domestic and imported) with cells from a locally isolated strain of L. passimto evaluate the effect of the parasite on honey bee longevity. This was done to determine if honey bee stock selection is a viable L. passim management strategy. In the second experiment, we investigated the effect of diet on L. passim infections by manipulating the protein (pollen) and carbohydrate (sugar) quality provided to individually inoculated newly emerged worker bees. In this experiment, we quantified parasite density, as well as vitellogenin expression and hypopharyngeal gland protein content to determine if honey bees can compensate for the negative effects of infection through dietary consumption. Additionally, this experiment provides an important addition toward our understanding of how different nutritional regimes can influence infection dynamics in honey bees. The results of these two experiments have the potential to offer beekeepers around the world the first management strategies (that are also chemical-free) for one of the most prevalent honey bee parasites.

APIMONDIA SCANDINAVIA 2025
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PP-068 [Bee Health]

Genomic variations among different isolates of *Vairimorpha ceranae* reveal the risk of microsporidian adaptation to thermal stress in Taiwan

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3. Department of Biology, Chiang Mai University
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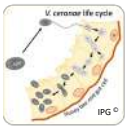
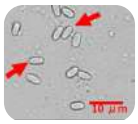
Abstract

Microsporidia are obligate intracellular parasites and *Vairimorpha ceranae* is one of the microsporidian pathogens causes microsporidiosis in *Apis mellifera*. Previous reports in 2012 suggested that mature spore counts increased as temperatures decreased in *A. mellifera* colonies. However, according to the monitoring data from 2020–2021 in Taichung, Taiwan, the mature spore load showed the different prevalence trend, spore counts increasing at higher temperatures. To better understand the potential genomic differences of *V. ceranae*, which may increase the thermotolerance, the genome of *V. ceranae* in Taichung, Taiwan (TV*c*) was compared to the *V. ceranae* isolate from Chiang Mai, Thailand (Thai*Vc*) in this study. Besides, two publicly available genomes from NCBI were also included. By using a combination of NGS and ONT sequencing, we assembled the genomes of TV*c* and Thai*Vc*. Comparative genomic analysis identified 162 distinctive genomic regions (DGRs) in TV*c*, including 87 DGRs longer than 450 bp, which were absent in Thai*Vc* and previously published *V. ceranae* genomes. Furthermore, the transcriptomic data showed that 112 genes overlapped with these DGRs. Among these genes, nine genes were selected for further investigation. Of these selected genes, three genes were highly expressed during the early stage of TV*c* infection, while the remaining six exhibited lower sequence identity to Thai*Vc* than to other isolates, assumed these genes might contribute to the different fitness between TV*c* and Thai*Vc*. Our findings first proposed the potential role of genomic variations in *V. ceranae*. However, the correlation between these DGRs and environmental fitness still need to be further investigated.

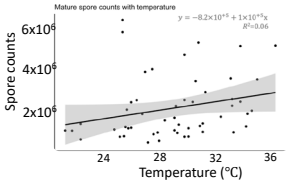
Background

- *Vairimorpha ceranae* infections of honey bees.





- Monitoring the Season–Prevalence of *V. ceranae*



In previous (Chen et al., 2012) showed the negative correlation between temperature and mature spore load, but our survey (2020-2021) showed positive correlation (Li et al., 2024).

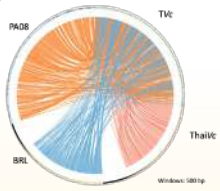
Genome sequencing and assembly

V. ceranae mature spores were collected from honey bees midgut tissues from apiaries in Taichung, Taiwan (TV*c*) and Chiang Mai, Thailand (Thai*Vc*), respectively . Oxford Nanopore Technology (ONT) and NGS was performed to re-sequence. The assembled genome was filted by orf identity.

	TV*c* filted genome	Thai*Vc* filted genome
Contigs	37	499
Total length	7,889,013 bp	5,864,918 bp
GC (%)	25.87	25.10
N50	310,165 bp	48,305 bp
N90	117,423 bp	4,366 bp
L50	6	36
L90	22	196
Complete BUSCO	94%	93.4%

Genome comparison

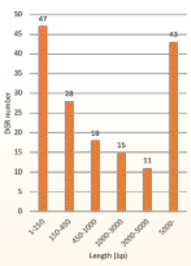
The assembled genomes and 2 published genomes (BRL, PA08; Accession number: PRJNA514060, PRJNA209464) was compared by using MUMmer.



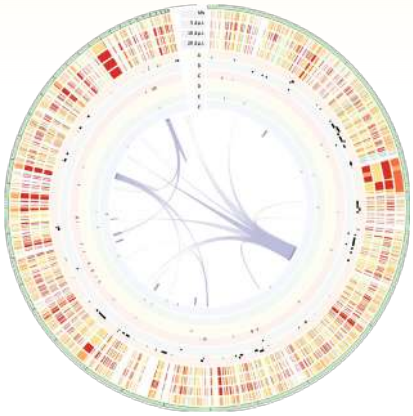
	Thai*Vc*	BRL	PA08
Avg Identity with TV*c* (ANI)	98.83%	98.01%	99.02%
Aligned Seqs with TV*c*	5,801,366 (98.92%)	8,146,464 (92.40%)	5611925 (98.61%)

Distinctive genomic regions (DGRs)

The comparisons identified 162 distinctive genomic regions (DGRs), 87 of which are longer than 450 bp.

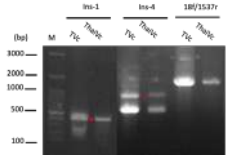


Gene expression and structure variant



The TV*c* structure variant (SV) were compared to Thai*Vc* and identify by using **Mum&co**. To validated the correction of SV especially insertion, we design primers to check the length of insertion region.

SV	Number
Total SV	71
Insertion	10
Deletion	32
Inversion	1
Duplication	10
Contractions	8
Translocations	10



	Ins 1	Ins-4	18f/1537r
Insertion length (bp)	415	885	+
No insertion length (bp)	206	560	+

Within these DGRs, transcripts were generated using **StringTie v2.2.3** from our previous transcriptome data (Accession number: PRJNA814859)

	No.	GeneID	Diamond annotation		Transcriptome gene expression			Identity with isolates (%)		
			Protein ID	protein name	Mature spore	5 d.p.i.	10 d.p.i.	20 d.p.i.	Thai*Vc*	BRL	PA08
High gene expression of TV*c* early stage	1	MSTRG.862	EEQ83004.1	hypothetical protein	1278	1332	281	244	99.239	99.459	99.459
	2	MSTRG.594	XP_024331945.1	-	770	947	237	221	97.5	95.652	95.652
	3	MSTRG.838	KAF5140173.1	hypothetical protein	116	457	108	74	98.523	98.297	97.689
Lower identity than other isolates	4	MSTRG.1021	XP_024329322.1	endonuclease-reverse transcriptase	355	22	20	18	97.677	99.209	99.342
	5	MSTRG.1011	XP_024330535.1	hypothetical protein	641	619	269	197	98.771	99.005	99.005
	6	MSTRG.981	EEQ81296.1	hypothetical protein	169	49	21	20	96.296	99.098	99.351
	7	MSTRG.916	XP_024329462.1	hypothetical protein	183	25	11	10	95.698	98.78	98.438
	8	MSTRG.156	XP_024329611.1	hypothetical protein	146	77	29	23	95.008	98.479	98.463
	9	MSTRG.514	XP_024329364.1	endonuclease-reverse transcriptase, partial	398	0	4	0	83.859	99.83	99.838

Conclusions

1. We created high-quality genome assemblies for two *V. ceranae* isolates, achieved by combining NGS and ONT sequencing technologies.
2. Comparative genomic analysis between four genomes and identified 162 DGRs unique to the TV*c*, 87 DGRs over 450 bp.
3. Transcriptomic profiling revealed 112 genes that overlap with these DGRs.

Future works

1. Check the relation between DGR, SV and gene expression between TV*c* and Thai*Vc*.
2. Validate the DGR uniq of TV*c* than Thai*Vc*.

Acknowledgments

This research was supported by 113-2313-B-005 -024 -MY3 from the National Science and Technology Council (NSTC). Thanks to all the IPG lab members.

Reference

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PP-069 [Bee Health]
Isolation of The Probiotic Strains from Honeybees and Assessment of Their Effect on Honeybee Health

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[2]Institute of Animal Physiology and Genetics of the Czech Academy of Sciences, Prague, Czech Republic

Honeybees harbor a core microbiota in their digestive tract, including species of lactobacilli and bifidobacteria, which play a crucial role in maintaining host health and defending against harmful pathogens. One key function of these bacteria is their ability to inhibit the growth of bacterial pathogens. This study assessed the inhibitory properties of various isolates from the honeybee gut against five strains of honeybee pathogens, providing a foundation for selecting strains that may enhance the bees' natural defense.

In this study, 111 bacterial strains (62 lactobacilli and 49 bifidobacteria) were isolated from the digestive tracts of honeybees collected from eight different sites in the Czech Republic. These strains were identified using 16S rRNA gene sequencing and subsequently tested for their ability to inhibit four clinical isolates of Paenibacillus larvae, one clinical isolate of Melissococcus plutonius, and one of the opportunistic pathogen Serratia marcescens by the plate agar diffusion method.

The results showed that 29 strains (15 bifidobacteria and 14 lactobacilli) were able to effectively inhibit at least two clinical isolates of P. larvae, with inhibition zones ≥ 21 mm and representing approximately 26% of all strains tested. Additionally, the inhibition of M. plutonius and S. marcescens was observed in three and 20 strains, respectively. The most significant inhibitory effects were found in species Bifidobacterium asteroides, B. choladohabitans, B. polysaccharolyticum, Bifidobacterium sp., Lactobacillus apis, L. helsingborgensis, L. kullabergensis, and L. melliventris.

These findings emphasize that the probiotic potential of lactobacilli and bifidobacteria varies by strain. Some strains exhibited stronger inhibitory effects against multiple clinical P. larvae isolates, underscoring their promise as potential probiotics for honeybee health. Due to the variation in inhibitory activity among strains, selecting those with proven broad-spectrum antimicrobial effects against relevant honeybee pathogens is crucial. This selection forms the basis for using specific probiotic strains as a strategy to mitigate bacterial diseases in honeybee populations, ultimately supporting colony health and resilience.

PP-070 [Bee Health]

Efficacy of lithium citrate and amitraz for the control of the mite *Varroa destructor* in honey bee (*Apis mellifera*) colonies in a subtropical environment

[1]Tapia-González JM,[1] García Chávez MA, [1]Tapia-Rivera JC,[1] Macías-Macías JO,[1] Petukhova T,[2] Contreras-Escareño F,[3] Guzmán-Novoa E.[1]
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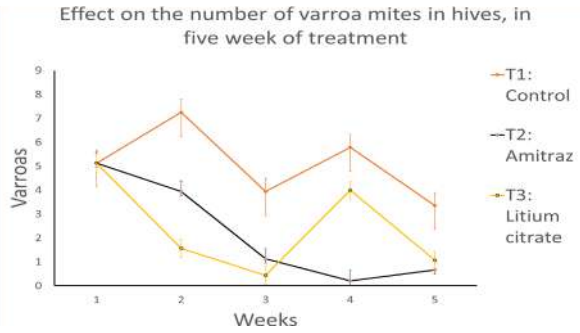
The mite *Varroa destructor* is considered the most damaging biotic factor to honey bees (*Apis mellifera*) worldwide. Therefore, many synthetic and organic compounds are continuously tested in different formulations for their acaricidal activity, mostly in temperate climate countries.

The objective of this study was to evaluate the efficacy of amitraz and lithium citrate applied with two different formulations for the control of *V. destructor* in honey bee colonies located in a subtropical environment

The evaluations were carried out in 21 colonies at the University of Guadalajara's Honey Bee Research Center, in Zapotlan Jalisco, Mexico. The colonies were standardized in population and levels of *V. destructor* and had young sister queens.

The mean mite infestation rate of the colonies at the pre-treatment period as determined with alcohol washes was 5.1±0.7%.

The colonies were randomly assigned into groups of seven units for each of three experimental treatments and received 1 L of 50% sucrose syrup and a weekly treatment for five weeks. Treatment (T) 1, the control group, received only sucrose syrup. T2, 10 ml of a 1% amitraz solution in vegetable oil, was soaked onto two Scott Shop® towels that were placed above the frames of the brood chamber of each T2 hive. T3, lithium citrate, was supplied in 50% sucrose syrup at a concentration of 6 mM.



Mean *V. destructor* infestation rates at the end of the five-week treatment period were 5.2±1.9, 1.9±1.4, and 2.1±1.7% for treatments 1, 2 and 3, respectively. There were significant differences between the treatments ($H = 31.7$, $p < 0.0001$), with both T2 and T3 having significantly lower mite infestation rates relative to the control (T1) and the pre-treatment infestation rate. No significant differences for mite infestation rates were found between T2 and T3.

These results suggest that both amitraz and lithium citrate are equally effective for reducing *V. destructor* infestation rates in honey bee colonies in a subtropical environment.

PP-071 [Bee Health]

Beeswax foundation as a new method of transporting medical substances for bee disease control

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Beeswax foundation+propolis

Result

The control of known bee diseases bacteria, bacilli, microbes, streptococci, fungi by way of existing methods is ineffective. We have offered a completely new method, not in use before, in treating and preventing bee diseases.

It is based on restoring the protection against pathogenic microflora to the bees, that they provide in nature for themselves, using propolis and other methods. It is known that the sterilization of wax is an indispensable condition in the production of wax foundation. In fact, as a result of this process, the wax becomes dead. The wax foundation made from this wax is devoid of natural protection from pathogenic microflora. The essence of our invention is that we created a technology that allows the propolis fractions to be introduced into the wax foundation. These fractions inhibit the development of pathogenic microflora.

For the first time in the world practice of beekeeping we have proposed a mechanism of delivering/transporting the protecting (therapeutic) components against pathogenic microflora to a bee family. It is important to note that the applied therapeutic and prophylactic substance is exclusively a product made by the bee itself, that is, organic! Then it is introduced into the wax foundation which performs several important functions.

For treating and preventing a number of diseases, of basic importance are:
- time of starting the treatment or its preventing
- time (period) of pathogenic microflora exposure to the drug
- a reliable and simple method of feeding the medical substance, ensuring a constant contact of a bee with the medical substance from an egg to adult.

The period of spring development of bee-colonies coincides with the period of growth of the mani diseases; at the same time the bees are forming their honeycombs most intensively. The bees are known to use sometimes up to 70-80% of wax from the wax foundation itself and add only 20-30% of their own, when rebuilding their honeycombs from beeswax. Using this circumstance, and the fact that the main component of protection against bee diseases is propolis, we have introduced propolis fractions into the beeswax. A new product "Propolis Beeswax Foundation" was tested in vitro in the laboratory conditions of the Prokopovych Institute of Beekeeping and other laboratories. The results of laboratory studies have shown that the beeswax foundation with propolis exhibits an inhibitory action, with anti-mycotic effect on the fungi Askosphaera apis, Aspergillius flavus making 85-95%.

The production tests have confirmed the results of laboratory studies and high efficiency.

We have developed a technology for the production of a propolis beeswax foundation, and the technical specifications for "Propolis beeswax foundation" have been approved. It is successfully produced more than 10 years.

Honey bees have a proven technology of controlling not only the fungal diseases through propolis; in their arsenal, there are also special protectors useful bacteria. Continuing our tests we have segregated bacteria of the Bacillus genus which are transported by beeswax into a bee-colony.

Using of previously used technology and the transporting mechanism of the therapeutic components to a bee family we have tested the beeswax - "Organic Super Probiotic".

Conclusion: Production tests confirmed the results of laboratory studies and high efficiency of the "Propolis wax foundation" using of which provides good development of bees.

It was identified according to the brood nests expand that the quantity of bees in the bee-hives with the propolis wax foundation was considerably higher (in 3,6 times as much) than in (control) bee-hives with standart wax foundation.

For 5 years of research, the honey-bee colonies with propolis wax foundation increased the quantity of the collected honey in 16,5 kilos more than the (control) bee hives.

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PP-072 [Bee Health]

Beeswax foundation Dombrovskyi «Antivarroa»

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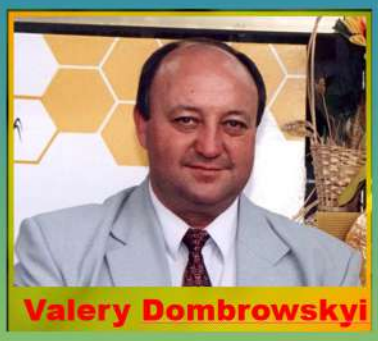

The Varroa destructor mite (hereinafter referred to as Varroa) is the biggest threat to bees worldwide.

Our research aims to develop a new ecological method that will help to curb the development of the mite by influencing its behavior in search of a host.

The mite is oriented by smell thanks to special sensors located on its forelimbs. Pheromones and chemical signals play an important role in maintaining its connection with the host, the bee. Taking advantage of this, we have proposed a new approach to curbing the development of Varroa destructor in bee colonies by adding extracts from medicinal essential oil plants and fruits to the wax that will be used to make the honeycomb base, which change its orientation.

Foreign odors disrupt Varroa's relationship with the honey bee at the stage when female mites have to enter the cells before sealing. Due to the unpleasant odor in the cell, it does not enter it, but remains on adult bees.

We have achieved two goals. First, the female mite does not enter the cell with the pupa, so it does not harm it, and the bee is born healthy. The second goal, which is achieved by using the Antivarroa honeycomb base, disrupts the Varroa reproduction cycle. The mite can only reproduce in sealed brood cells. For three years, the effectiveness of using the Antivarroa honeycomb base was tested both in the laboratory and in apiaries.

The results obtained in colonies relocated to Antivarroa wax in the spring, which were not treated with any chemicals during the year, had a Varroa infestation rate of 0.5% - 4%. Control families on a routine basis that were not treated with any product were affected by 35% - 47%. Families that were treated once with amitraz remained 8% affected.

Production trials have confirmed the results of laboratory studies and the high efficiency of Antivarroa wax in containing Varroa development.

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PP-073 [Bee Health]

The *Bidens pilosa* phytogenic treatment reveals a negative impact on *Vairimorpha ceranae* through the suppression of V-Type ATPase expression in infected honey bees (*Apis mellifera*)

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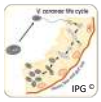
Abstract

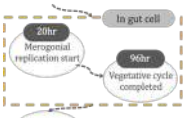
Microsporidia are obligate intracellular fungal parasites. ***Vairimorpha ceranae*** is a microsporidian pathogen that is primarily causes microsporidiosis in honey bees **(*Apis mellifera*)**. Despite extensive research on *V. ceranae* pathogenesis, the effects of phytogenic extract treatments on its infection dynamics still unknown. In particular, the precise role of ***Bidens pilosa* (BP)** in modulating *V. ceranae* gene expression during infection has not been thoroughly investigated. Herein, the **transcriptome** data revealed that the BP treatment significantly suppresses *V. ceranae* gene expression during infection, particularly affecting metabolic pathways. Among these pathways, the **V-type ATPase pathway** has demonstrated that positively correlated with spore counts and infection load in this study. The highly expressed genes, which were identified in previous study, during *V. ceranae* infection were investigated under BP treatment. The expression levels of these genes were down-regulated at the early stage of infection, suggesting that BP treatment influences *V. ceranae* infection process. Besides, **RNA interference (RNAi)** targeting to the V-type ATPase gene of *V. ceranae* was performed and further demonstrated that knock-down of *V. ceranae* ATPase gene can improved honey bee survival rate and also reduced the *V. ceranae* infection. Both mature spore counts and genome copy numbers decreased by approximately two-fold at 15 d.p.i., by dsRNA of V-type ATPase-related gene treatment, highlighting the importance of V-type ATPase in the life cycle of *V. ceranae*. Given its ability to suppress *V. ceranae* gene expression at the early infection stage, BP treatment could potentially serve as a promising strategy for reduction of microsporidiosis.

Background

Vairimorpha ceranae infections of honey bees.

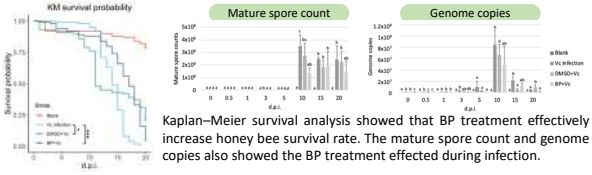
Bidens pilosa





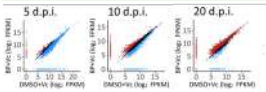
***Bidens pilosa* (BP)** has showed the effect to against protistan pathogens. This study uses transcriptomics to explain how BP treatment changes the *V. ceranae* infection.

BP treatment of *V. ceranae* infection

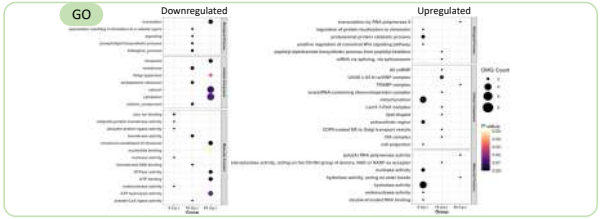


Kaplan–Meier survival analysis showed that BP treatment effectively increase honey bee survival rate. The mature spore count and genome copies also showed the BP treatment effected during infection.

Transcriptome of BP treatment



The majority of differentially expressed genes (DEGs) were downregulated at 5 dpi, while more genes were upregulated at 20 dpi, indicating a time-dependent transcriptional response to BP treatment.



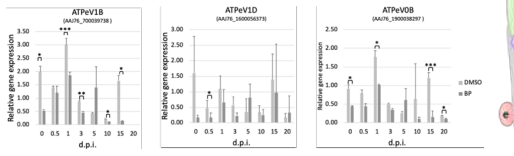
Gene Ontology (GO)

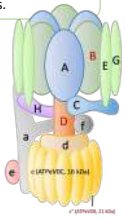
- GO annotation analysis highlighting the dynamic impact of BP treatment on gene functions during *V. ceranae* infection. Upregulated DEGs at 5, 10, and 20 dpi were annotated to 73, 285, and 1,226 GO terms, downregulated DEGs at the same time points were annotated to 152, 228, and 130 terms , respectively.

KEGG

- KEGG pathway analysis further clarified the functional roles of DEGs and revealed dynamic changes in biological pathways and key metabolic modules under BP treatment. Over all, **"V-type ATPase**, eukaryotes (M00160)" show the high match numbers of KEGG pathway, also is directly involve in host cell environment modulation, making it suitable target for validation.

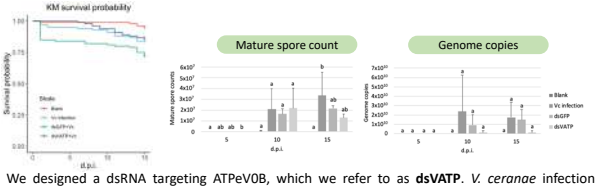
Relative gene expression during BP treatment



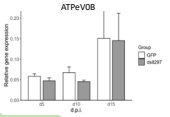


ATPeV0B showed the most significant and consistent decrease after BP treatment. It's also a key part of the V-ATPase complex, which is stable expression and more noticeable reduction.

dsRNA treatment of *V. ceranae* infection

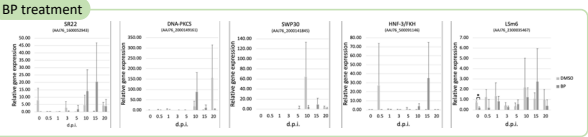


We designed a dsRNA targeting ATPeV0B, which we refer to as **dsVATP**. *V. ceranae* infection honey bee treated with dsVATP showed a higher survival rate and a significant reduction in *V. ceranae* spore and genome counts in the later stages of infection.

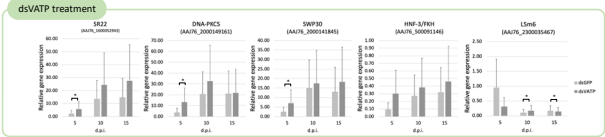


dsVATP treatment consistently lowered the expression of ATPeV0B in *V. ceranae*, with the most significant effect seen at 15 dpi, confirming that the treatment successfully altered the gene's expression.

BP treatment



dsVATP treatment



Five DEGs under dsVATP treatment exhibited expression patterns similar to those observed in the BP treatment.

Conclusions

1. BP treatment helped bees survive longer by slowing down the *V. ceranae* infection. It reduced the number of germs and delayed their growth.
2. Transcriptome analysis showed that BP affects many pathways, especially **V-type ATPase**.
3. By turning off the V-type ATPase gene with **RNAi**, we proved that this pathway is important for the germ's ability to grow and spread inside the bee.

Acknowledgments

This research was supported by 112-2313-B-005-023- from the National Science and Technology Council (NSTC). Thanks to all the IPG lab members.

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PP-074 [Bee Health]

The Role of Nitric Oxide in Honeybee Immunity: Assessing the Impact of Acetamiprid Exposure

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DEPARTMENT OF BIOCHEMISTRY

Faculty of Science
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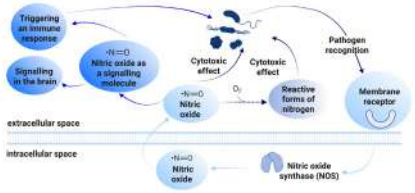
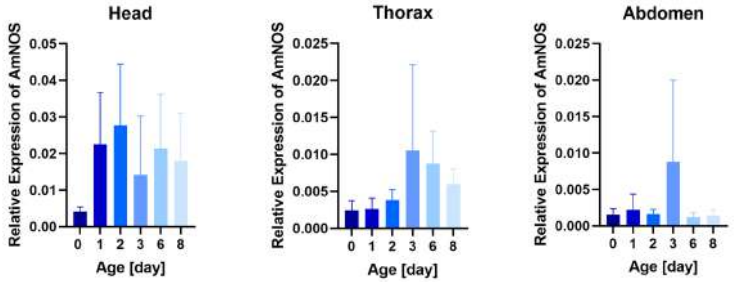
Role of Nitric Oxide in Bee Immunity



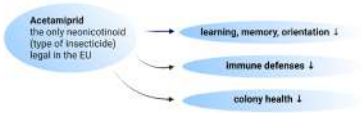
In honey bees (*Apis mellifera*), NO is produced by an enzyme called NO synthase (AmNOS). During the immune response, NO serves as a signal molecule that activates further immune responses and also has a direct cytotoxic effect against pathogens. AmNOS most closely resembles vertebrate neuronal NO synthase, suggesting its presence in the bee head. However, the expression of AmNOS in the bee body and its regulation has not yet been described in detail.

Relative Expression of AmNOS in Physiologically Normal Bees



Physiological levels of AmNOS were measured in normal bees by determining relative gene expression using qPCR method. In the head, expression increased until day 3 and then declined; in the thorax, levels were generally low with a slight rise at day 3; and in the abdomen, expression was low with a transient day-3 peak before decreasing.

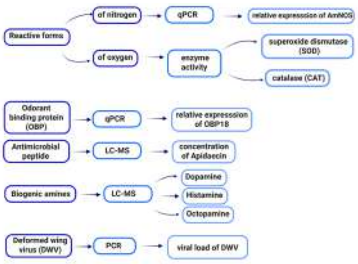
Acetamiprid



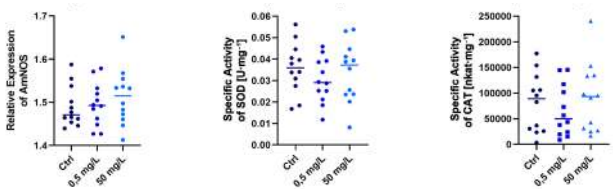
Neonicotinoids are a widely used class of insecticides that target the insect nervous system. Most have been banned in the EU because of their harmful effects on pollinators, but acetamiprid, the only neonicotinoid still permitted for outdoor use, remains widely applied. Even at low, sublethal doses, it can impair honey bee cognitive abilities (learning, memory, orientation), reduce reproductive success, and weaken immune defenses by altering antioxidant enzyme activity and antimicrobial peptide expression, ultimately compromising colony health.

The Scheme of the Experiment

Methods

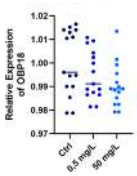


Reactive Nitrogen and Oxygen Species



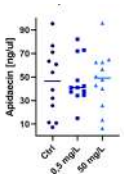
In acetamiprid-exposed bees, expression of AmNOS in bee heads remained unchanged. Activity of superoxide dismutase (SOD), which scavenges superoxide radicals ($2O_2^{\bullet-} + 2H^+ \rightarrow H_2O_2 + O_2$), showed no alterations. Activity of catalase (CAT), responsible for decomposing hydrogen peroxide to water ($2H_2O_2 \rightarrow 2H_2O + O_2$), also exhibited no significant changes. SOD and CAT activities were measured in the abdomens.

Odorant Binding Protein



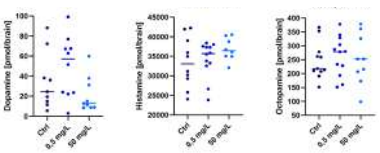
Odorant binding protein 18 (OBP18), involved in odor detection and chemical communication, suggested a trend towards decreased expression in the heads of bees after acetamiprid exposure.

Antimicrobial Peptides



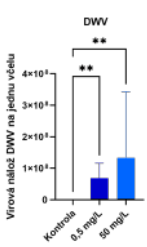
Apidaecin, an antimicrobial peptide involved in immune response, showed no significant changes in concentration in the hemolymph after acetamiprid exposure.

Biogenic Amines



Dopamine is linked to learning, memory, social interaction, and antioxidant capacity; histamine is involved in energy distribution, stress reaction, and olfaction; and octopamine is associated with light reception, mechanoreception, and venom activity. Their concentrations in the brains of bees showed no changes after acetamiprid exposure.

Deformed Wing Virus



Deformed wing virus (DWV), a widespread honey bee pathogen associated with wing deformities and colony losses, was measured in whole bees and showed significantly increased viral loads after exposure to 0,5 mg/L acetamiprid compared to controls. At 50 mg/L, viral loads were further elevated.

Conclusion

Acetamiprid exposure did not significantly affect AmNOS expression, antioxidant enzymes, odorant binding proteins, antimicrobial peptides, or biogenic amines. In contrast, deformed wing virus (DWV) loads were elevated, suggesting that acetamiprid may weaken antiviral defenses. Future work will include additional measurements to validate and extend these findings, with a focus on nitric–oxide–related pathways, including assessment of its key metabolites and related compounds.

Acknowledgements

This research was funded by the Ministry of Education, Youth and Sport of the Czech Republic through the Inter-Action grant LUAUS24085 and supported by the grant IGA_PrF_2025_025 from the Palacký University in Olomouc.

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PP-075 [Bee Health]
Brood activity in winter accelerates aging and increases the parasite load in honey bee colonies, which can be mitigated by caging of the queens

Annely Brandt[1], Valon Mustafi[2]
[1]LLH - Bee Institute Kirchhain,
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Honey bee colonies in temperate zones usually cease to rear brood in the fall. However, recent higher-than-average winter temperatures in Europe correlate with unusual brood activity, with unknown consequences for colony health. To investigate the effects of a brood pause, we caged queens for 0, 74 or 117 days in early October to prevent egg laying. We analysed the effects on the survival of queens, worker physiology, longevity and colony health. The caging had no negative effect on queen survival (control: 38 queens of 40 survived, 74 days caging: 38 queens of 40 survived; 117 days caging: 21 queens of 25 survived) or overall colony strength. Interestingly, the lifespan of the winter bees in the colonies with caged queens was significantly prolonged. The gene expression profiles of workers from these colonies resembled those of young winter bees or summer nurse bees, while workers from continuously breeding control colonies showed typical expression patterns of older, foraging bees. This indicates a connection between brood care and accelerated ageing. In addition, colonies with caged queens were found to have a lower Varroa destructor infestation, indicating reduced reproduction of this brood parasite. Our results indicate that brood activity in winter can lead to an increase in varroa infestation. We show, however, that caging of the queens in winter can help to mitigate the negative consequences of climate change for honey bee colonies. The potential of winter caging to influence the reproduction rate of V. destructor in spring should be evaluated in more detail.

PP-076 [Bee Health]
Selective trapping of Vespa velutina in apiary and non-apiary environments: a comparative study of trap efficacy and selectivity within the GO BIOVESP Project

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[2]Salut Ambiental, SCP, Centelles, Spain
[3]BUFALVENT Estudi de la Mediterrània, Anglès, Spain

The invasive Asian hornet, Vespa velutina, represents a significant threat to honeybee (Apis mellifera) colonies and native pollinator populations. The implementation of efficient and selective trapping methods is critical for mitigating the impact of this species while minimizing collateral effects on non-target insects.

Within the framework of the GO BIOVESP project, this study evaluated the efficacy and selectivity of three different trap types for V. velutina capture in both apiary and non-apiary environments. A total of five replicates per trap type were deployed across both environments, and collections were made every 15 days over a five-month period starting in March. The study aimed to identify the most effective trap designs that maximize V. velutina capture rates while reducing unintended bycatch of honeybees and other beneficial pollinators.

Our results revealed differential capture efficiency and selectivity among the trap types tested. Notably, certain trap models exhibited superior capture rates of V. velutina while minimizing the capture of non-target insects, including honeybees and other pollinators. The observed variations in trap performance suggest that factors such as trap design, attractant type, and placement location significantly influence capture efficiency.

These findings highlight the importance of selective trapping as a precision-targeted management strategy for invasive hornet populations.

The dataset generated contributes to the overarching objectives of the GO BIOVESP project, which seeks to develop and implement sustainable, science-based approaches for pollinator conservation and biodiversity preservation.

This research provides valuable insights for beekeepers and conservationists seeking to mitigate the impacts of V. velutina on honeybee colonies and ecosystem biodiversity. By optimizing selective trapping methodologies, we can effectively manage V. velutina populations while preserving beneficial insects and safeguarding pollination services.

PP-077 [Bee Health]

WAGENINGEN UNIVERSITY & RESEARCH

Prevalence of *Paenibacillus larvae* in *Apis mellifera* in the Netherlands

Heather Graham[1], Yvonne Dijkstra[1]*, Robin Ruuls[1]*, Dirk-Jan Valkenburg[2], Helen Goossen[2], Michel Jacques Counotte[1], Delphine Panziera[2]

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Background

American Foulbrood (AFB) is a globally prevalent brood disease in honey bees caused by the spore-forming bacterium *Paenibacillus larvae*. The disease leads to the death of infected larvae following oral spore uptake and is characterized by ropy decay and foul odor in the brood cells. Transmission occurs both within and between colonies through spores spread by adult bees and contaminated equipment. Notably, asymptomatic colonies carrying high spore loads can serve as infection sources. As in many countries, AFB is a notifiable disease in the Netherlands. In 2005, control of AFB in the Netherlands shifted from the government to beekeeper associations, with bee health coordinators managing suspected cases. Mandatory destruction of all colonies in affected apiaries was replaced by isolating and treating only symptomatic colonies using the shook swarm technique. A 2008 study assessed the impact of policy changes on AFB prevalence, finding *P. larvae* in only 0.6% of sampled apiaries and 3% of honey samples.

Introduction

Given the low number of reported AFB outbreaks in the Netherlands over the past two decades and the absence of recent prevalence data, this study aimed to assess the current presence of *Paenibacillus larvae* in Dutch apiaries. Understanding the present prevalence is essential to evaluate the long-term effects of the 2005 policy changes on disease control and to inform ongoing management strategies.

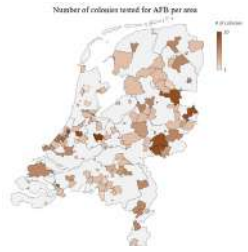
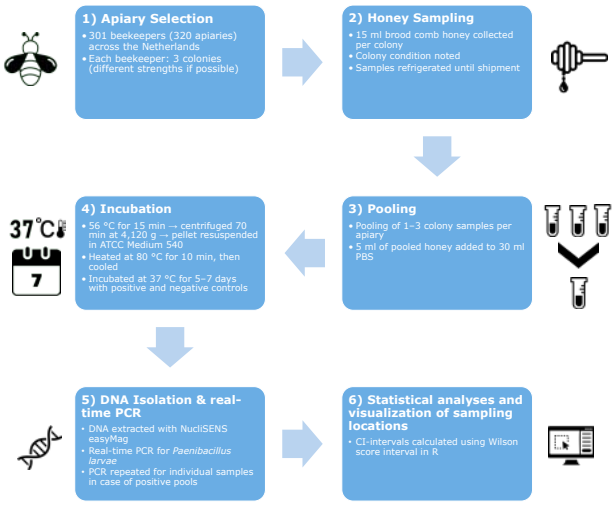


Figure 1. Map of the Netherlands providing an overview of the locations of the colonies participating in the survey based on the 4 digit postal code of the area where the colony was kept. Darker colors indicate a higher number of colonies in a postal code area.

Figure 2. Picture of a brood nest and the site of sampling for the brood comb honey as part of the instruction leaflet for participating beekeepers in our study.

Interested in activities of the Dutch NRL? Scan the QR-code

Methods



Results

One pool tested positive, indicating an apiary-level prevalence of 0.4% (95% CI: 0.02–2.9%). When the individual samples from this pool were tested, two of the three were positive, corresponding to a colony-level prevalence of 0.3% (95% CI: 0.06–1.3%).

Number of samples in pool	Number of PCR-positive pools/tested pools	Number of PCR-positive individual samples/number of individual samples tested
1	0/14	
2	0/21	
3	1/188	2/3
Total number of positive tested pools/total number of tested pools	1/223* (0.4%, 95% CI: 0.02-2.9%)	
Total number of positive tested colonies/total number of colonies tested in pools	2/620* (0.3%, 95% CI: 0.06- 1.3%)	

Figure 4. Overview of the number of samples per pool and the number of pools and individuals samples tested positive for *P. larvae* by real-time PCR. *One pool of honey samples was lost due to a technical failure and there was no material left to repeat the test.

Conclusions

These results confirm that the prevalence of *P. larvae* in Dutch *A. mellifera* colonies remains very low, consistent with the study in 2008 and the very few to no reported outbreaks of clinical AFB reported annually.

Acknowledgements

We thank Annebel Claassen, Rita de Man, Jonathan Kooi and Saskia Bouwmeester for their help and the EURL Bee Health for providing their SOP for the real-time PCR assay for *P. larvae*

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NextGenerationEU

Quantitative method for detection of formic acid in beehive air samples

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[1]Department of Polymers for Alternative Energy and Environmental Protection, Institute of Polymers-Bulgarian Academy of Sciences, Sofia, Bulgaria

Formic acid is utilized as a natural biocide in bee hives, offering an environmentally friendly alternative to synthetic chemicals. However, the quantitative determination of formic acid in air samples presents a significant analytical challenge due to its low concentrations and the complex nature of the sample matrices. To address this challenge, we employed a sophisticated hyphenated system that integrates gas chromatography (GC) with a mass-selective detector (MSD). Our setup includes a gas valve box featuring two gas valves, which enhances the efficiency of sample handling and minimizes contamination. The system utilizes a PE-5ms column, known for its ideal separation capabilities, along with a deactivated capillary to prevent any chemical reactions that could lead to the degradation of formic acid during analysis. In this analysis, the air sample is passed through a heated transfer line, which facilitates the rapid vaporization of volatile compounds, ensuring that formic acid is effectively introduced into the gas chromatograph. For the mass analysis, formic acid was specifically quantified using the mass-selective detector in Selected Ion Monitoring (SIM) mode. This approach allows for the selective detection of specific ions associated with formic acid, enhancing the sensitivity and specificity of the measurement. To further minimize errors related to sample introduction and ionization variability in the mass-selective detector, we employed chloroform as an internal standard. The internal standard compensates for potential fluctuations in detector response and sample variability. In addition to establishing the calibration curve, we conducted comprehensive investigations to determine the limits of detection (LOD) and quantification (LOQ) for the method. These measures are critical for assessing the analytical method's sensitivity and reliability, particularly when detecting formic acid at trace levels that may be present in environmental samples. This study provides a reliable framework for the quantitative analysis of formic acid in air samples, contributing valuable information to the field of environmental monitoring and assisting in the management of bee health through more precise assessments of biocide usage.

Used Equipment:

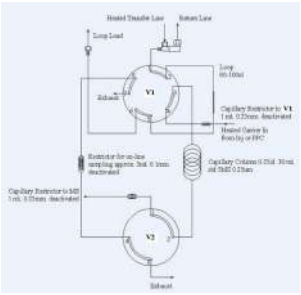
Hyphenated system PerkinElmer TGA4000 connected with RedShift gas valves to PerkinElmer Clarus 680S/Clarus SQ8S GC/MSD.

Instrument Control, Data Acquisition and Data Processing were performed by GC/MSD software TurboMass v.6.1.0.1963.

GC/MSD Conditions:

- GC Columns:
  - GC Injector to Valve1 - Fused silica capillary SGE (1.0 m x 0.25 mm).
  - Valve1 to Valve2 – PE-5MS (30 m x 0.25 mm x 0.25 µm).
  - Valve2 to MSD - Fused silica capillary SGE (1.0 m x 0.25 mm).
- Mobile Phase – Helium 5.0.
- Mobile Phase Mode - Constant Flow – 1.0 ml/min.
- GC Injector Temperature – 260°C.
- Transfer Line Temperature – 270°C..
- Valve Box Temperature – 270°C.
- GC Oven Temperature Program:
  - 35°C – hold 2.0min.
  - ramp 4°C/min to 70°C – hold 0min.
  - ramp 12°C/min to 280°C – hold 3.0min.
- VALVE 1 Program: 0.1min – ON; 2min – OFF.
- MSD Transfer Line Temperature – 280°C.
- MSD Ion Source Temperature – 220°C.
- MSD mode – 1.0 to 7.0min. - SIM - m/z 46 - 50ms, 83 - 50ms,
  - 7.0 to 30.0 min. - SCAN - m/z – 45 ÷ 450 amu.

Flow Diagram:

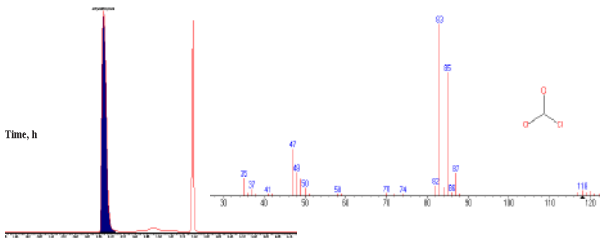


Calculation:

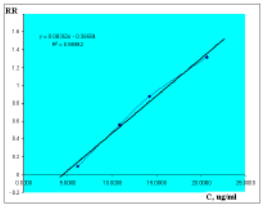
In order to minimize the analytical errors from gas valve filling, MSD ionisation, etc. a calculation of relative response (RR) have been done.

$$RR = \frac{AreaST * MassISTD}{AreaISTD}$$

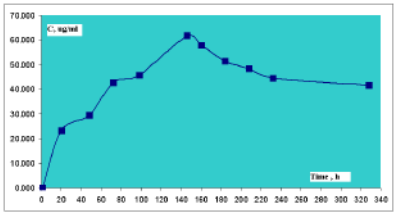
ISTD Response



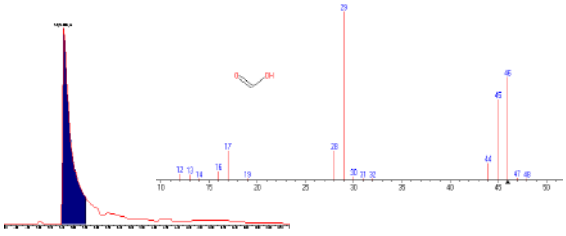
FORMIC ACID Relative Response Calibration:



FORMIC ACID concentration in beehive atmosphere – two weeks sampling.



Formic Acid Response:



Conclusions

A new feasible analytical method for quantitative determination of formic acid in bee hives has been developed. Calculation by specific response of selected ions from mass-selective detector allow us to make very good calibration curve - correlation factor 0.9899. Limit of detection of formic acid is less than 4 ug/ml. Calculated LOQ is 12 ug/ml.

Acknowledgment

This research was funded by the European Union – NextGenerationEU, Investment C2I2, grant number BG-RRP-2.017-0025-C01 "Biopolymer Carriers of Natural Acaricides with Application in Organic Beekeeping" .

PP-079 [Bee Health]

Varroaresistenz 2033
Varroa 2033

A German initiative to stepwise abandon chemical varroa treatment

Ralph Büchler, Jan-Dirk Bunsen, Torsten Ellmann, Leo Famulla, Tino Lorz, Jan Gutzeit, Marina Meixner, Thomas Van Pelt, Marie Förster

Keywords:
varroa resistance, selection, colony management, training, cooperation

Initial Situation and Goal
Many beekeepers in Germany are experiencing high colony losses due to Varroosis infestation of their bees (Apis mellifera), despite intensive medical treatment. The leading German beekeeping associations aim at a sustainable reduction of loss rates and a significant decrease in the use of medications by 2033 by increasing the availability and distribution of resistant bees.

Approach
The project focuses on systematic selection and dissemination of resistance traits, according to the methods outlined in the EurBeSt study (EU, 2022), as well as on adapted colony management using biotechnical methods (Büchler et al., 2020). The German Beekeepers' Association (DIB) and the German Professional Beekeepers' Association (DBIB) have signed a cooperation agreement with the leading breeding associations for Buckfast (GdeB), Carnica (AGT), and Mellifera bees (BDB), as well as the German Bee Research Association. Since March 2023, three specialist symposia of several days were organized, each with about 150 participants, and working groups for breeding, community-based selection, biotechnology, and education & science were established. A project homepage (www.varroaresistenz2033.eu), social media appearances, and presentations at conferences serve to reach out to the entire beekeeping community. The structures of the beekeeper associations and local clubs serve to disseminate the motivation and the specialized information prepared in the working groups to the beekeeping community in various ways and on a broad front. Some pioneer beekeeping operations that have successfully been managing their colonies medication-free for years serve as important flagships.

Perspective
A varroa resistant bee population will be established based on breeding strains selected for resistance mechanisms like VSH, SMR etc and a wide spread of breeding success through mating stations and community-based selection. This process will be supported by the application of biotechnical methods involving seasonal brood interruption which can ensure the rearing of healthy winter bees, improve the overwintering success and usually dispense the need for an additional winter treatment.
As a consequence, differences in mite susceptibility between colonies become more visible and motivate beekeepers in general to selectively propagate resistant colonies.

References
Büchler, R., Uzunov, A., Kovačić, M., Prešern, J., Pietropaoli, M., Hatjina, F., ... & Nanetti, A. (2020). Summer brood interruption as integrated management strategy for effective Varroa control in Europe. Journal of Apicultural Research, 59(5), 764-773.
European Commission, Directorate-General for Agriculture and Rural Development (2022). Büchler, R., Pilot project, Restructuring of the honey bee chain and varroa resistance breeding and selection programme – Final study report, Publications Office of the European Union, https://data.europa.eu/doi/10.2762/470707

varroaresistenzprojekt.eu

PP-080 [Bee Health]

Ultrasonic combating of Varroa Destructor and Acarine mites

APIMONDIA 2025, POSTER 0667

Marian Surowiec, Oliwia Myczkowska, msactivemail@gmail.com
Bee Healthy Honey sp. z o.o. Katowice, Poland

INTRODUCTION

Several years of research to date have clearly shown that bee colonies can be protected against of the Varroa Destructor by the acoustic field of the sonic emitter [1]. The aim of the presented study was to determine the number of adult Varroa Destructor as well as a mite offspring in the sonic drop.

METHODOLOGY

The power density of the emitter's acoustic waves does not exceed 1 milliwatt per square centimetre and frequency covers the range of 22 – 24 kHz, powered by 12-14 V, direct current [1]. The emitter is located under the bee hive and ensures full safety for biological animal cells. Bees are safe at every stage of their development, and the subtle ultrasonic massage is manifested by their increased activity. The acoustic waves of the emitter cause vibrations in the mechanosensory organs of the parasite like gnathosoma and seta (Fig. 1). The vibrations significantly disrupt communication between parasites during their development cycle, through the disfunction of mechanosensory organs.

RESULTS

The sonic fall of Varroa destructor mites includes foundress females, young daughters, three times smaller adult males and larval forms (Fig. 2,3,4). For example, on August 6th, the daily fall contained 111 mites, among them: 59 female founders, 43 daughters, 9 larval forms and 7 alive (Fig.3).

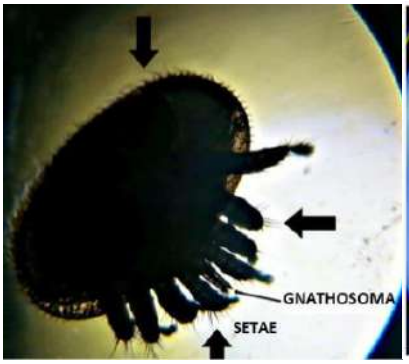


Fig. 1. Mechanosensory organs of Varroa mite

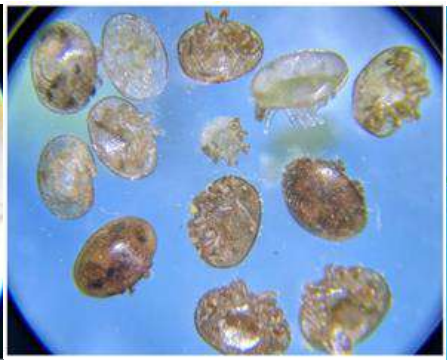


Fig. 2. Ultrasonic fall of parasites: young Varroa daughters

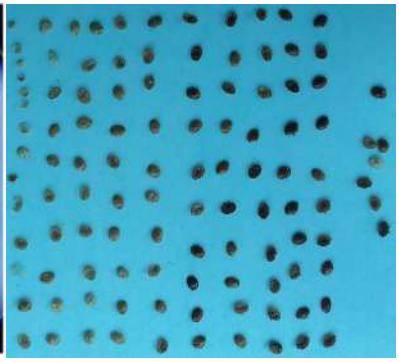


Fig. 3. Ultrasonic mites fall during 24 h; 111 pieces

An important feature of the sonic mites fall is the presence of young, light brown daughters - about 40%. In the period from October 1 to November 30, a total fall of 1572, usually dead or exhausted Varroa parasites, was recorded in one of the research bee colonies. On November 6, the daily fall contained 31 female founders, 22 daughter daughters, and 7 larval forms, a total of 60 Varroa mites. Additionally bees were stimulated to VSH and grooming behaviour (Fig. 5). In one of the surveyed bee colonies, the largest sonic fall of Acarine mites occurred so far - approximately 430 pieces per day (fig 6). The Acarine mite is unidentified till now, however the first report comes from 2011 (Giles San Martin) [2]. The fall of the Acarine mites, visible only under a microscope, subsided at the end of November.

Fig. 4. Adult males and larval stage of female - deutonymph

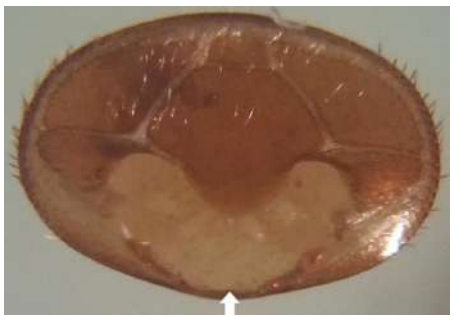


Fig. 5. Bees grooming behaviour - cut off part of ventral plate of Varroa female

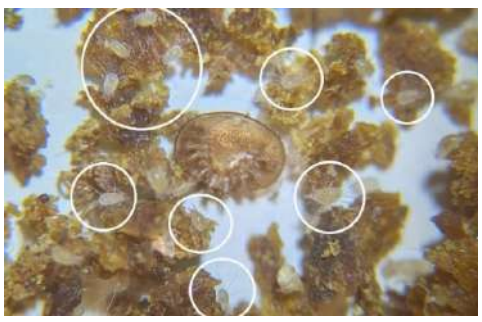


Fig. 6. Fall of the Acarine mites; in the middle - Varroa female

CONCLUSION

The ultrasonic emitter provides very easy and ecologic monitoring of Varroa mites as well as significant elimination of parasites in the bee colony – no less than 80%. In the case of autumn reinfestation it is advisable to apply an integrated support with one-time application of light chemistry, e.g. thymol. Ultrasonic vibrations accelerate diffusion of the chemical particles inside the hive and yield an integrated, multiplied effect in Varroa fall. Bee families are completely protected and safe.

References
[1] O. Myczkowska, T. Surowiec, Patent PL240934, 2020;
[2] Gilles San Martin, Bee nest mites, Uploaded by Jacopo Werther, 2011.

Keywords: ultrasonic Varroa Destructor fall, bee colony ultrasonic protection, Acarine mite drop

APIMONDIA SCANDINAVIA 2025
SWEDEN | DENMARK | NORWAY

PP-081 [Bee Health]

Pesticides in honey and beeswax and toxicity to honey bees (*Apis mellifera*) from hives kept in avocado (*Persea americana*) orchards managed with different cultural systems in Jalisco, Mexico

J. Octavio Macias-Macias[1], Carlos Martell Dominguez[1]
Octavio Gaspar Ramirez[2], Jose María Tapia-Gonzalez[1], Tatiana Petukhova[3], Ernesto Guzman-Novoa[3]
[1] Universidad de Guadalajara, México. [2] CIATEJ, México. [3] University of Guelph, Canadá

INTRODUCTION

Honey bee colonies are commonly used to provide pollination services to avocado orchards in Mexico. However, it is not known if the pesticides used in these orchards affect bee health and leave residues in hive products

OBJECTIVE

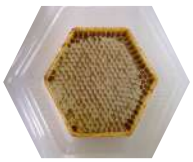
To detect pesticides in honey and beeswax and to document the damage from lethal and sublethal exposure of pesticides to honey bees from colonies placed in avocado orchards that follow certified, organic and conventional cultural systems in Southern Jalisco, Mexico

MATERIALS AND METHODS

Pesticide residues in honey and beeswax
Method: QuECHERS (165 pesticides)
Chromatographic analysis

Study sites
Cultural system: Organic, Certified and Conventional
In Zapotlan, el Grande.

Toxicity tests with bees in cages exposed to: Acetamiprid, Hexazinone Thiabendazole at recommended and empirical doses (twice the recommended dose)



RESULTS

In the experiments with live bees, significant differences between recommended and empirical doses were found for all the variables measured ($p<0.05$; Table 1).

Table 1. Mean ± S.D. for number of dead bees or showing abnormal behaviors after applying recommended and empirical doses of acetamiprid on avocado trees kept in cages

Dose	No flying	No walking	Walking in circles	Flying in circles	Immobile on the wall	Dead
Recommended	45.5 ± 6.6 a	37.2 ± 6.3 a	2.5 ± 2.3 a	0.0 ± 0.0 a	33.4 ± 17.0 a	236.1 ± 54.1 a
Empirical	55.9 ± 9.4 b	45.6 ± 8.3 b	16.6 ± 13.1 b	9.4 ± 4.5 b	62.8 ± 5.9 b	385.1 ± 12.5 b

* Diferent literals indicate significant differences (P < 0.05)

Sociedad Latinoamericana de Investigación en Abejas

RESULTS

There were significant differences in the concentration of pesticides in honey and beeswax from honey bee colonies located in the tree types of avocado cultural systems, with acetamiprid having the highest concentrations ($p<0.05$; Table 2)

Table 2. Mean ± S.D. for residues of pesticides in honey and beeswax samples

Treatments	Pesticides	Residues in honey (mg/kg)	Residues in wax (mg/kg)
Organic system	Acetamiprid	0.320 ± 0.121 a	0.190 ± 0.530 a
	Hexazinone	0.029 ± 0.008 b	0.070 ± 0.052 b
	Thiabendazole	0.005 ± 0.002 c	0.020 ± 0.010 c
Certified system	Acetamiprid	0.460 ± 0.212 a	0.250 ± 0.106 a
	Hexazinone	0.030 ± 0.018 b	0.070 ± 0.052 b
	Thiabendazole	0.010 ± 0.003 b	0.007 ± 0.001 c
Conventional system	Acetamiprid	0.340 ± 0.082 a	0.250 ± 0.045 a
	Hexazinone	0.007 ± 0.002 b	0.040 ± 0.029 b
	Thiabendazole	0.005 ± 0.001 b	0.020 ± 0.006 c

* Diferente literals between pesticides in every treatment indicate significant differences (P < 0.05)

CONCLUSIONS

- Of the three most common pesticides detected in honey and beeswax of colonies placed in all avocado cultural systems, acetamiprid predominated and had the highest concentrations
- The concentration of most pesticides in the samples were above the EU MRL.
- High mortality and behavioral abnormalities were observed in bees exposed to the recommended dose and even higher for empirical doses.
- Acetamiprid was more lethal than hexazinone and thiabendazole with both doses.

LITERATURE

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Cesar Valdovinos-Flores, Víctor M Alcantar-Rosales, Octavio Gaspar-Ramírez, Luz M Saldaña-Loza, José A Dorantes-Ugalde (2021). Agricultural pesticide residues in honey and wax combs from Southheastern, Central and Northeastern Mexico. *Journal of Apicultural Research* 56: 667-671.

PP-082 [Bee Health]

VET-ANIMAL®

SILVECO+ BEE® THE NEW TOOL FOR DISINFECTION AGAINST *PAENIBACILLUS LARVAE*

causative agent of American foulbrood (AFB)
preliminary studies

ANDRZEJ BOBER
(Technical Manager - TM)

MARCIN RACZYŃSKI
(Chief Executive Officer – CEO)

INTRODUCTION

American foulbrood (AFB) affects the larval stage of honeybee *Apis mellifera* causing their death and occurs throughout the world. AFB is considered the most widespread and destructive infectious honeybee disease, and it can cause serious economic losses to beekeeping. AFB is classified on "Listed Diseases and Other Diseases of Importance" by World Organisation for Animal Health (WOAH). *Paenibacillus larvae*, the causative organism, is a Gram-positive bacterium that can produce over one billion spores in each infected larva. Five different genotypes (ERIC I, II, III, IV and V) of P. larvae are differentiated. The spores are extremely resistant to heat and chemical agents and can survive for many years in scales (from diseased dead brood), hive products and equipment without losing infectivity. Therefore, disinfection aimed at destroying *P. larvae* spores is crucial both in good beekeeping practices (GBPs) and biosecurity measures in beekeeping (BMBs). Effective disinfection is also crucial when eliminating AFB outbreaks by competent authorities.

The aim of the study was to assess the effectiveness of a new product - Silveco+ Bee® in destroying *P. larvae* spores. The above-mentioned product contains hydrogen peroxide, formic acid, glycolic acid and nano silver complex as active substances.

METHODOLOGY

The research was carried out based on PN-EN 13704:2018-09 and PN-EN 16437+A1:2020-03 standards using additional of *P. larvae* spores – ATCC 9545 (ERIC I).

RESULTS

The research conducted proved that Silveco+ Bee® is effective (99,99%), in destroying *P. larvae* spores at a concentration of 40% with an exposure time of 60 minutes.

CONCLUSIONS

Silveco+ Bee® can be an excellent alternative to disinfection based on the use of agents containing in its composition sodium hypochlorite or sodium hydroxide. Thanks to its disinfecting properties, apart from beekeeping, it can also be successfully used in the area of food production to ensure consumer health protection.

SUPPLEMENTARY INFORMATION

As of the date of this report, the required documentation has been submitted to the Polish authority responsible for the registration of biocidal products, and the documentation is currently being reviewed.

There are plans to extend the registration to include vegetative forms and spores of *Paenibacillus larvae* bacteria. We will inform interested parties of the positive outcome of the above actions.

VET-ANIMAL sp. z o.o.
83-200 Starogard Gdański,
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Bee Health Center®
VET-ANIMAL

PP-083 [Bee Health]
Snapback high resolution melting assays for rapid and inexpensive detection of varroa treatment resistance markers for pyrethroids and amitraz

John Mackay, Noa Smith, Rebecca Hewett
dnature diagnostics & research Ltd, Gisborne, New Zealand

Genetic resistance of Varroa destructor to pyrethroid treatments has been well documented over the past decade. Originally described as the mutation L925V in the voltage-gated sodium channel of varroa, this single amino acid has been shown to mutate in 3 different forms (L925V, L925M and L925I). These variants vary geographically with L925V prevalent in Europe and L925M widespread in the USA. However, to detect and differentiate all three variants has typically required the use of variant-specific and expensive qPCR hydrolysis (TaqMan) probes, while simpler PCR-based methods have been used to detect only a single mutation per reaction.

These variant-specific probes have also been employed to detect the more recently discovered mutations in varroa that confer resistance to amitraz-based treatments. These mutations occur in various locations on the newly identified target gene for amitraz, the beta2-octopamine receptor.

High resolution melting analysis (HRMA) and the newer snapback form of this method utilise two inexpensive primers in a PCR reaction which can discriminate DNA sequences down to SNP level, without the use of separate dye-labelled probes. Indeed, snapback HRMA uses a simple unlabelled additional sequence on the 5' end of one of the primers, that acts as a probe element by folding over or 'snapping back' to bind to the SNP region of interest. Analysis is performed by monitoring the different melting curves between wild-type and mutated sequences. We demonstrate novel test designs that discriminate multiple mutations (in the instance of the multiple mutation L925 hotspot) in a single reaction or individual mutation reactions for the multiple amitraz resistance regions.

Combined with a rapid, single tube DNA-release buffer for individual varroa; these assays provide a rapid and inexpensive means to monitor the occurrence of chemical resistance in varroa as well as rapidly implement inexpensive new designs as novel mutations are discovered. Despite widespread use of registered pyrethroid and amitraz-based products in New Zealand since the introduction of Varroa destructor in 2000, no genetic resistance in the voltage-gated sodium channel (pyrethroids) or beta2-octopamine receptor (amitraz) has been confirmed in the varroa samples analysed to date.

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PP-084 [Bee Health]

Understanding and awareness on risks of synthetic pesticides use on honey bee colonies in Western Amhara, Ethiopia

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[2]Bahir Dar University, College of Agriculture and Environmental Sciences P.O. Box 5501, Bahir Dar, Ethiopia
[3]Pesticide Action Nexus Association(PAN-Ethiopia). P.O.Box 25765 Code 1000 Addis Ababa, Ethiopia
[4]Bees for Development UK Monmouth, UK

1 Background

In Ethiopia, excessive use of synthetic pesticides in agriculture threatens honey bee colonies. This is largely due to low awareness of eco-friendly pest control methods. From 2022 to 2025, we delivered a project in the Amhara Region to support beekeepers and farmers through awareness campaigns, skills training, and field demonstrations.

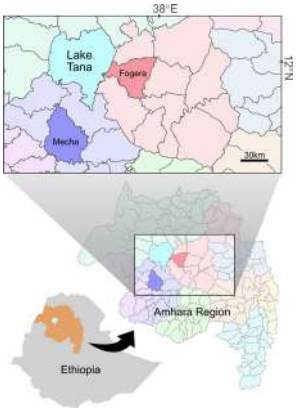
Objectives:

- Raise awareness on the risks of synthetic pesticides on honey bees.
- Promote agroecology and Integrated Pest Management (IPM) practices.
- Assess changes in knowledge, behaviour, and practice.

2 Methods

- Conducted capacity-building training for beekeepers on agroecology, Integrated Pest Management (IPM) and sustainable hive management.
- Demonstrated the efficacy of IPM through Farmer Field Schools by comparing:
  - IPM Plot: Applied improved IPM-based practices.
  - Non-IPM Plot: Followed traditional practices.
- Monitored colony productivity and number
- Assessed behavioural change through structured questionnaires.
- The approach allowed us to assess both practical outcomes and behavioural changes among trained beekeepers.

Figure 1. Maps showing Fogera and Mecha, where the work took place, in relation to Amhara and Ethiopia as a whole.



Data collection methods :

- Survey before and after the implementation of the project.
- KoboToolbox was deployed to conduct the survey and analyses.

3 Results

- 850 (224F) farmers trained on agroecology IPM, and beekeeping
- 22 Farmer Field Schools established
- 692 (193F) farmers participated in the FFS on average 230 farmers in each season.

Table 1. The average change in indicators of beekeeping success per capita before and after the project.

Indicator	Existing Beekeepers	New Beekeepers
Honey production	+31.5 kg	-
Income (ETB)	+15,836	+5,036
Number of Colonies	+6	+5.36

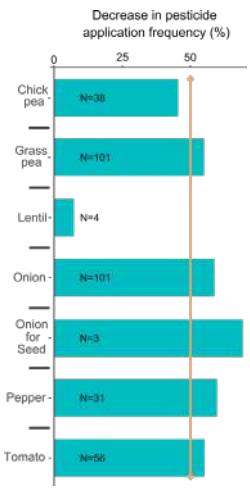


Figure 2. A bar chart showing the percentage decrease in pesticide application after the project, with an orange line to represent our 50% target.

4 Results

Figure 3. Stacked bar charts showing the responses of farmers and beekeeper to questions about the value of bees and insects on their land.

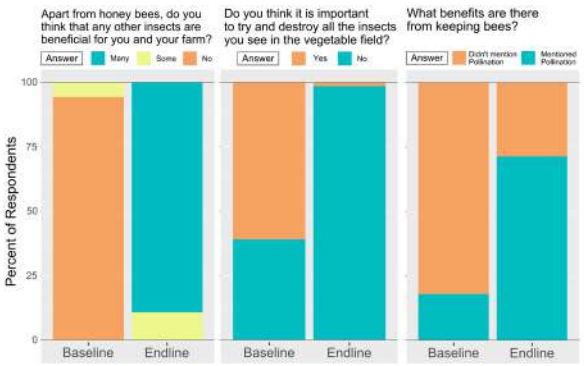
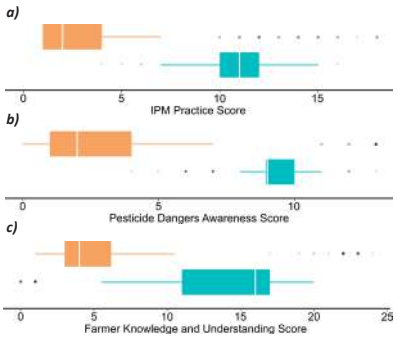
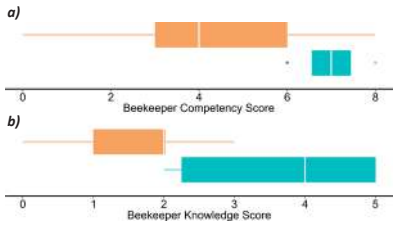


Figure 4. Boxplots showing ***a)*** the number of different IPM practices implemented by farmers, ***b)*** The farmers' awareness of the problems associated with pesticide use, including health, environmental, and economic issues and ***c)*** The farmer's knowledge and understanding of the benefits of beekeeping.



Baseline	N=369
Endline	N=167

Figure 5. Boxplots showing ***a)*** the competency of beekeepers across four apiculture tasks and ***b)*** the knowledge of beekeepers concerning successful management of honey bees.



Baseline	N=72
Endline	N=42

5 Conclusions and Next Steps

- Reduction in pesticide spraying led to increased bee colony health and income.
- IPM was proven to be viable alternative to chemical pesticides.
- Farmer Field School was effective for practical learning and adoption.
- Agroecology-based education changed attitudes and behaviour of farmers.
- Direct participation of stakeholders was important for achieving sustainable solutions.

Next steps

- Scale-up IPM-FFS in similar agroecological zones.
- Promote regulatory control of hazardous pesticides.
- Strengthen local extension services on pollinator-friendly practices (integration of disciplines)

Project Webpage

Acknowledgements

To the Donor (Darwin Initiative), Partners, Stakeholders, and Farmers, your valuable support and collaboration are highly appreciated!

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PP-085 [Bee Health]

Single-Nucleotide Polymorphisms (SNPs) in the ORβ-2R-L Gene of French and Spanish Varroa Mite Populations Are Not Directly Linked to Amitraz-Resistant Phenotypes

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INTRODUCTION

Amitraz resistance has been linked to **Single-Nucleotide Polymorphisms (SNPs) in the ORβ-2R-L gene**, suggesting a relatively simple genetic mechanism leading to a form of target site resistance. However, as highlighted by *Marsky et al.* (2024) in *Insects*, the resistance phenotype **may involve more complex, multifactorial processes beyond SNPs alone**, warranting deeper genomic and environmental investigation.

Here, we present data:

1. Investigating bioassay protocols

2. Supporting the hypothesis that SNPs in the varroa mite ORβ-2R-L gene alone can likely not explain the development of amitraz resistance.

These data were collected in an experimental (preliminary) bioassay test in Spain with mites samples from an organic apiary, and a bioassay test in France after reduced field efficacy had been observed on the sampled honey bee colonies.

METHODOLOGY

In autumn 2022, bioassays were conducted in France and Spain to assess amitraz resistance in *Varroa destructor*. In Spain, 12 colonies from an organic apiary near Léon were divided into three exposure groups (4, 6, and 8 hours) using 3.7×2.2 cm Apivar® strip pieces fixed in Varroa EasyCheck® baskets, with ambient temperature at 21 °C. In France, 200 bees from each of 7 colonies were placed in honey jars with mesh lids and exposed to 1×2 cm Apivar® strip pieces for 6 hours at 25–30 °C. Post-exposure, 52 mites from three of the sampled hives in France (26 survivors, 26 perished) and 50 mites from the five hives in Spain were genotyped to :

1. Determine if any Single-Nucleotide Polymorphisms (SNPs) potentially associated with amitraz resistance were present in the ORβ-2R-L gene.

2. Investigate correlations between sensitivity towards amitraz exposure and SNP expression in the *ORβ-2R-L* gene.

Figure 1: Varroa EasyCheck® devices including the bee samples and varroa mites.

Figure 2: Apivar® strip (including the V-shaped opening) attached to the white basket of the Varroa EasyCheck® device.

RESULTS FROM SPAIN

In the bioassays conducted in Spain, a total of 12 out of 204 tested varroa mites from an organic apiary survived the bioassay exposure to amitraz (Figure 3). We identified a previously unknown mutation in the *ORβ-2R-L* gene of these mites from the Léon region: the mutation T868C (a substitution of T to C at position 868). None of the mutations previously described in the literature about amitraz resistance in varroa mites (Hernández Rodríguez et al. (2022): substitution of A to G at position 260 (A260G) and substitution of T to C at position 643 (T643C)) were detected in these mites (Figure 4). Varroa mites which survived the exposure towards amitraz in the bioassay did not present any specific mutation more frequently compared to the mites which fell during the incubation period (mites from the M1 group).

Figure 3 - Spain: Bioassay Results

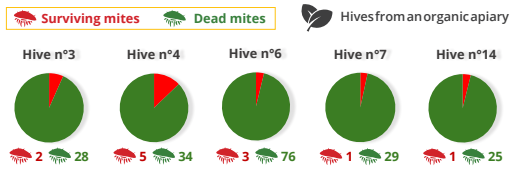

Figure 4 - Spain: Genotyping Results

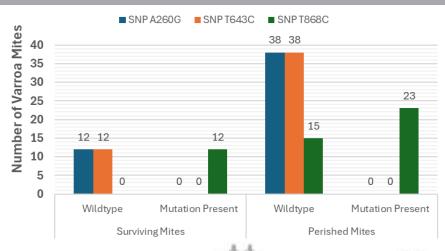

Figure 2: 50 mites from Spain (12 survivors, 38 perished) were genotyped. The Single Nucleotide Polymorphisms (SNPs) first identified in North America (Y215H) and France (Mutation N87S) were not present in these mites - independent of their sensitivity towards amitraz. A previously unknown mutation at location T868C was identified in all of the 12 mites which had previously survived the exposure to amitraz in a bioassay and in 23 of the 38 mites that had perished during the amitraz exposure.

RESULTS FROM FRANCE

In the bioassays conducted in France, a total of 49 out of 125 tested varroa mites survived the bioassay exposure to amitraz (See Figure 5). This corresponds to 39% of the tested varroa mites surviving the exposure towards amitraz and therefore being classified as "resistant". In a later genotypic analysis (Figure 6) of the mites' *ORβ-2R-L* gene, we identified 3 distinct mutations in these mites: the mutation described by Hernandez Rodriguez (A260G) (about 36.5% of mites), and two mutations already identified in previous unpublished analyses of French varroa mites: C248T and CA344-345AT. Neither the "American mutation" (T643C), nor the "Spanish mutation" (T868C) was identified within the part of the gene *ORβ-2R-L* analyzed for these mites. None of the mutations identified here occurred more or less frequently in resistant mites which survived the bioassay exposure towards amitraz.

Figure 5 - France: Bioassay Results

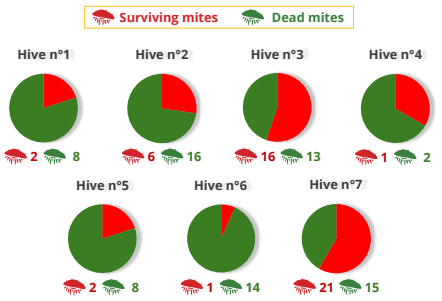

Figure 6 - France: Genotyping Results

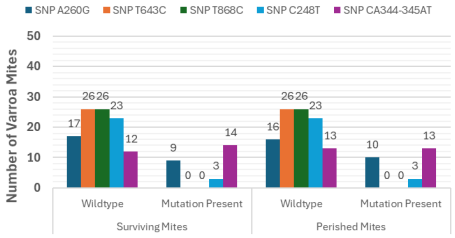

Figure 4: 52 mites from France (26 survivors, 26 perished) were genotyped. The Single Nucleotide Polymorphisms (SNPs) first identified in North America, T643C (or Y215H), and Spain (SNP T868C) were not present in these mites - independent of their sensitivity towards amitraz. The mutation N87S (SNP A260G), described by Hernández Rodríguez et al. (2022), was present in mites which survived amitraz exposure and mites that perished during the bioassays in the same frequency. Two previously unknown mutations were found at positions C248T and C344A-A345T. The frequency of these mutations did not differ between surviving mites and perished mites.

CONCLUSION

1. **No direct association was found between individual SNPs in the mites' ORβ-2R-L gene and their phenotype in French and Spanish Varroa mite populations.**
2. **Multiple SNPs were identified, including a novel T868C mutation in Spanish mites from an organic apiary that has not been treated with amitraz for several years.**
3. **None of the mutations was present predominantly in mites phenotypically resistant to amitraz.**
4. **Results indicate that amitraz resistance likely involves complex mechanisms, possibly extending beyond target site resistance.**
5. **Further research is recommended to investigate multifactorial genetic and environmental factors contributing to resistance.**

REFERENCES

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Hernández-Rodríguez, Carmen Sara, et al. "Resistance to amitraz in the parasitic honey bee mite Varroa destructor is associated with mutations in the β-adrenergic-like octopamine receptor." Journal of Pest Science 95.3 (2022): 1179-1195.

APIMONDIA SCANDINAVIA 2025
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PP-086 [Bee Health]

Monitoring the Health of Bee Populations in the Philippines: Pests and Pathogens

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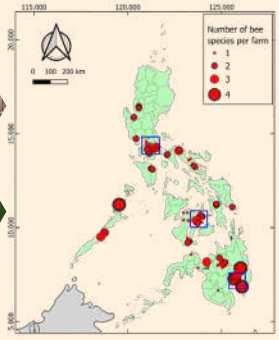
Introduction

- A major threat to beekeeping in the Philippines is bee pests and diseases. Among the pests, the SHBs and the mites are the most damaging (Cervancia et al. 2016). With the apparent decline of colony holdings of *Apis mellifera*, and stingless bees due to small hive beetle (SHB), and losses of honey bees to mites and diseases, it is imperative to conduct an assessment of their damage before we lose the colonies.
- The spread of these pests and diseases on native bees is a major concern, as it impacts food security, biodiversity maintenance, livelihood, and pollination services.
- If the SHB and the rest of the bee pests and diseases are not controlled, the bee industry will collapse.
- The project aimed to evaluate and mitigate the damage caused by bee pests and diseases nationwide. Specifically, (1) to determine the extent of distribution of SHB, mites, and other pests, (2) to determine the extent of distribution of American Foul Brood, Chalk Brood, and other diseases, and (3) to devise an integrated pest and disease management for bees.

Methodology



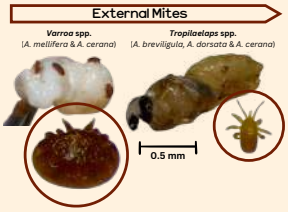
Region	Sampling sites
CAR	9
I- Ilocos Region	1
III- Central Luzon	1
NCR	4
IV-A CALABARZON	17
IV-B MIMAROPA	12
V- Bicol	10
VI - Western Visayas	4
VII - Central Visayas	17
VIII - Eastern Visayas	4
IX - Zamboanga	1
X- Northern Mindanao	10
XI - Davao	14
TOTAL	104

Samples of brood and adult bees were collected from 104 bee farms in the Philippines from April 2024 to May 2025. The map shows the bee farms visited and the number of bee(s) species present.

Results and Discussion

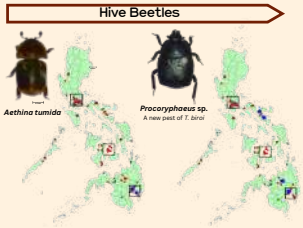
BEE PESTS

External Mites



First detection of *Tropilaelaps* sp. in *A. cerana*

Hive Beetles



A. tumida confined in Davao Region and now infesting *T. biroi*

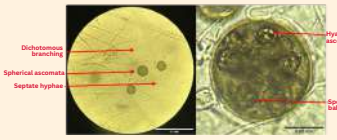
Other Bee Pests

First report of *Ac. externus* in *A. cerana*

BEE PATHOGENS

Chalk Brood Disease

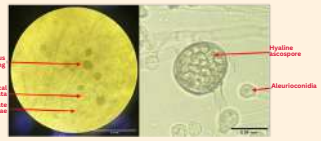
Ascosphaera apis
(*A. mellifera*)



Morphological characteristics of LBAM isolate from *Apis mellifera* under 400X

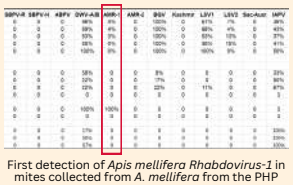
Monascus Fungi

Monascus ruber
(First report of the fungi in *T. biroi*)



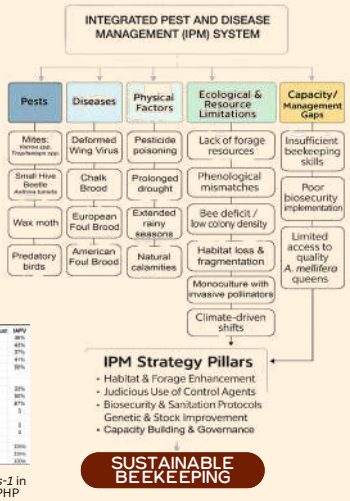
Morphological characteristics of LMTB isolate from *Tetragonula biroi* under 400X

Bee Viruses



First detection of *Apis mellifera Rhabdovirus-1* in mites collected from *A. mellifera* from the PHP

BEE IPM MODEL



Summary of Findings

From April 2024 to May 2025, a nationwide survey was conducted across 26 provinces in the Philippines to assess the health of managed and wild honeybee and stingless bee colonies. The study identified several key pests, including *Varroa* and *Tropilaelaps* mites, SHB, and wax moths. Notably, the ectoparasitic mite *Acarapis externus* was reported for the first time infesting *A. cerana*, and a suspected new pest, *Procoryphaeus* sp. was found in stingless bee colonies in Bicol and Mindanao. Microbial analyses revealed the presence of *Ascosphaera apis*, the causative agent of chalkbrood disease, in *A. mellifera*, including adult bee samples, while *Monascus ruber*, previously undocumented in stingless bees in the country was detected in *T. biroi*, highlighting its potential role in larval microbial regulation. Importantly, no *Paenibacillus larvae*, the agent of American Foulbrood, was found in the samples. These findings informed the development of a bee IPM framework that addresses major stressors, biological, environmental, and managerial toward promoting sustainable, science-based beekeeping practices in the Philippines.

Acknowledgments

References

PP-087 [Bee Health]
Wisdom of the elders: Social learning improves a parasite resistance trait in honey bees

Alexis Beaurepaire[1], Alix Klein[2], Elisa Putteman[2], Preeyaporn Phongutttha[3], Rujira Ponkit[3], Sanchai Naree[3]
Mélodie Friedmann[2], Wirawan Khemphet[3], Guntima Suwannapong[3], Vincent Dietemann[1], Peter Neumann[2]
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Social learning, the process through which individuals learn from others, has been long thought to be restricted to humans. Yet, in the past decades, social learning has been described from primates, birds, fishes and insects. Indeed, it is for example well known that honey bee foraging relies on social learning. However, whether parasite resistance traits can also be learned from nestmates remains largely unexplored. Here, we show that grooming against ectoparasitic mites, Varroa destructor, can be significantly enhanced via social learning in western honey bee workers, Apis mellifera. Newly emerged individuals ("learners") paired in cages with older workers ("demonstrators") displayed more frequent and faster grooming behaviours following mite exposure than controls paired with inexperienced newborn workers. A follow-up study was conducted in the native range of the mite in Thailand using the same design, but with the original and resistant host of the mite, Apis cerana, as demonstrator to test whether inter-specific social learning can lead to improved grooming behaviour in the new host of V. destructor. In addition to these individual-level assays, colony level assays in the field were conducted to verify whether the addition of A. cerana workers can enhance grooming abilities within colonies of A. mellifera, and whether these potential effects remain months later, after the introduced original hosts have died. Given that our laboratory data at individual level can be confirmed at the colony level in the field, this would suggest that social learning constitutes a previously overlooked key mechanism governing honey bee health. Altogether, these results would open novel promising strategies for beekeepers to control honey bee diseases.

APIMONDIA SCANDINAVIA 2025
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PP-088 [Bee Health]

Drone viral infection, immunity and flight performance

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3 Department of Entomology, The Robert H. Smith Faculty of Agriculture, Food and Environment, The Hebrew University in Jerusalem, Rehovot, Israel

Introduction

- Good flight ability is essential for successful drone mating in *Apis mellifera*.
- Mating flight is energetically costly and may be hindered by pathogen load.
- Viruses such as deformed wing virus (DWV) have been detected in the reproductive organs of sexually mature drones, with potential transmission through natural mating or artificial insemination.
- However, the impact of these viral infections on drone flight performance is still unknown.

Aim

To evaluate the impact of natural viral infection on the flight ability of drones from three age cohorts.

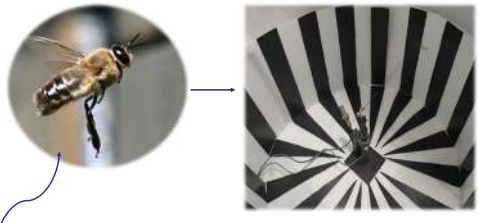
Methods

1. Rearing drones in 3 colonies

2. Marking emerging drones

3. Sampling drones at three ages
   Day: 7
   Day: 14-15 (sexually mature)
   Day: 20-21

4. Flight test using the flight mill

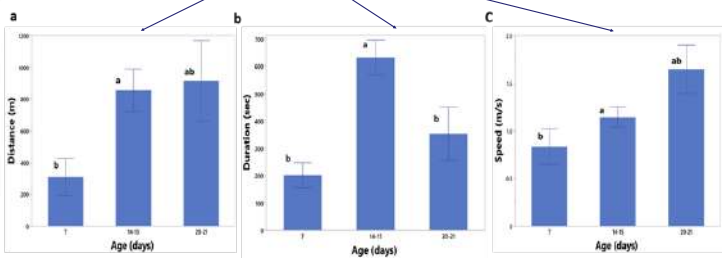


5. Virus and Immunity Assessment

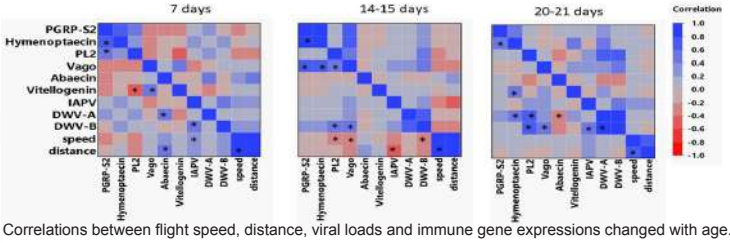
a. Viral load
   DWV-A
   DWV-B
   IAPV

b. Expression level of immune genes from different pathways
- Peptidoglycan recognition protein S2 (PGRP-S2)
- Protein lethal 2 (PI2)
- Abaecin
- Vago
- Vitellogenin
- Hymenoptaecin

Flight Distance, Duration and Speed of drones by age

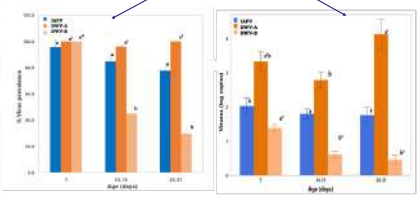


Sexually matured drones flew longer distances compared to immature drones.



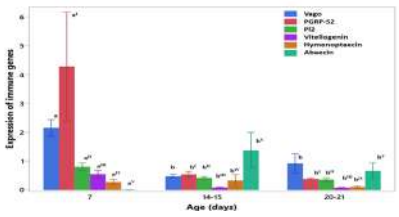
Correlations between flight speed, distance, viral loads and immune gene expressions changed with age.
*-significant correlation (Pearson, p<0.05).

Virus Prevalence and Loads



Drones were infected by the 3 tested viruses. DWV-A was the dominant and its loads increased as DWV-B loads decreased with age. There was no significant change in IAPV loads with age.

Immune genes expression in drones



Expression of the immune genes changed as the drone aged.

Conclusions

- Flight ability in drone was age-dependent
- Flight distance and speed were negatively correlated with loads of IAPV and DWV-B, respectively, in sexually matured drones
- Flight speed was negatively correlated with the expression of immune genes PI2 and PGRP-S2 in sexually matured drones.
- Our findings suggest effect of viral infection on drone flight and a possible trade-off between drones' flight ability and their immunity

For more details, please check: *https://doi.org/10.1007/s13592-025-01157-0*

PP-089 [Bee Health]
Impact of humidity on egg hatching in small hive beetles: laboratory and field data

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Eggs constitute a critical stage in insect life-histories. As they are often left unprotected, they can be highly sensitive to environmental conditions. Determining the optimal environmental conditions for egg hatching can serve as a valuable tool in developing targeted control and management strategies for pests and parasites. Surprisingly little is known about the role of humidity in egg hatching of small hive beetle, Aethina tumida, an invasive beetle parasite of honey bee colonies. Therefore, we decided to test the impact of humidity on small hive beetle egg hatching rate under laboratory conditions and complemented it with field experiments in honey bee colonies. The experiments were performed in summer 2024 in Auburn, USA. In the laboratory, slides with small hive beetle eggs were incubated at seven humidity levels ranging from 45% to 95% at 250 C and their hatching success was recorded over five consecutive days. In the field, slides with SHB eggs were placed on top of and underneath frames inside sun-exposed [N=6] and shaded colonies [N=6] for three days. In addition, humidity and temperature were recorded inside of the colonies. The preliminary results indicate that a humidity level above 65% is necessary for most eggs to hatch. Interestingly, in the field, egg hatching success at the bottom of the colonies was unaffected by sun exposure, while fewer eggs hatched at the top in sun-exposed colonies. The field hatching data will be further analysed in relation to the recorded humidity and temperature conditions. Full results and their implications will be presented and discussed.

PP-090 [Bee Health]
Nitric oxide as a key signalling molecule for antimicrobial peptide production in Apis mellifera

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Department of Biochemistry, Faculty of Science, Palacký University Olomouc, Czech Republic

Honey bees have an evolutionarily improved system of innate immunity, which is the basis of defensive reactions against pathogens. After pathogen recognition by the host cell, several biochemical reactions occur, including the production of nitric oxide (NO), an important signalling molecule that maintains cellular homeostasis and is a key host defense molecule. In the invertebrate immune system, NO is generally thought to regulate insect immune responses through signalling pathways leading to activation of antimicrobial peptide (AmP) production, or by a direct cytotoxic effect leading to the killing of invading pathogens. In bees, knowledge in this area is at its very beginnings. In our study, we focused on modulating NO production's effect on the humoral component of bee immunity, specifically on AmPs production. We achieved this under laboratory conditions by feeding newly emerged honey bees with substances that interfere with the metabolism of NO. After 10 days, bees were injected with lipopolysaccharides to stimulate their immune systems and we studied what happened primarily at the level of apidaecin, abaecin, hymenoptaecin and defesin-1/-2 gene expression and production of these AmPs on protein level. The data we obtained showed apidaecin gene expression is dependent on NO signalling. Moreover, lower levels of NO negatively affected apidaecin, abaecin, defensin-1, and hymenoptaecin production. These results support our hypothesis about the necessity of NO signaling for the production of effector molecules of humoral immunity of bees, such as AmPs. Our research is primarily set up as basic research and we bring a new view on the activation of honey bee immune system. However, it may provide insights that can be used in the near future as another approach to support bee health against pathogen infection.

This research was funded by the Ministry of Education, Youth and Sport of the Czech Republic through the Inter-Action grant LUAUS24085.

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PP-091 [Bee Health]

Real or fake friends?
Study of *Trichoderma* strains in Brazilian stingless bee hives

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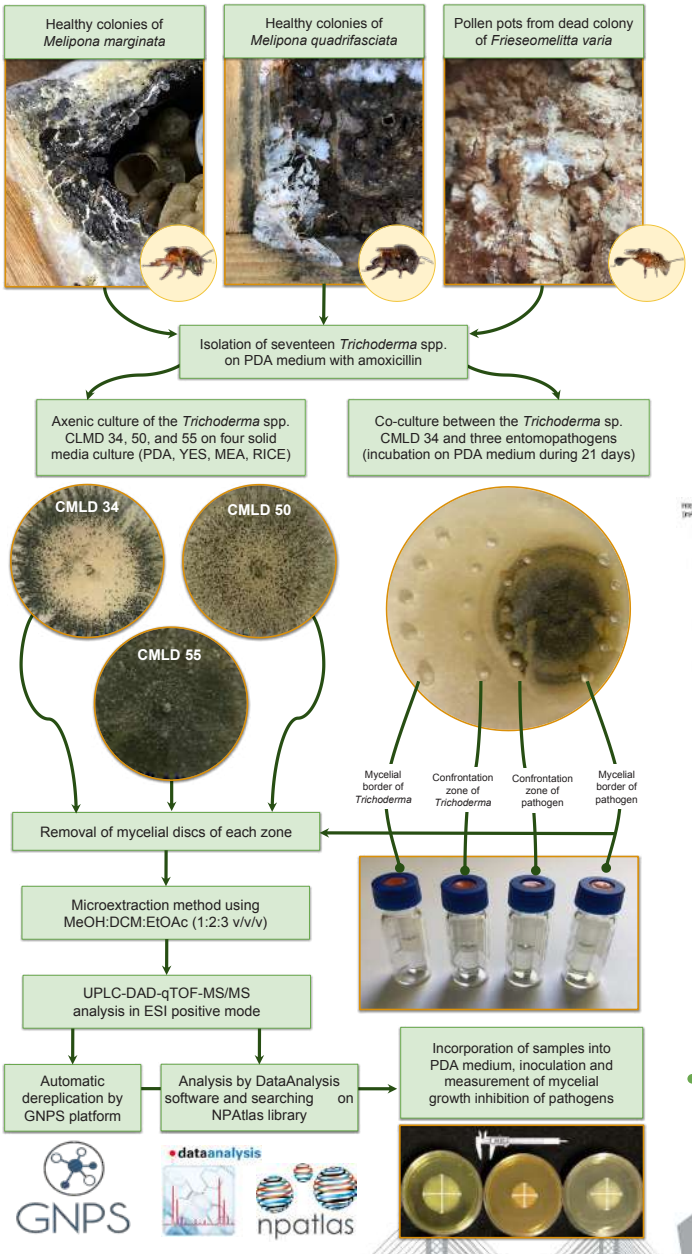
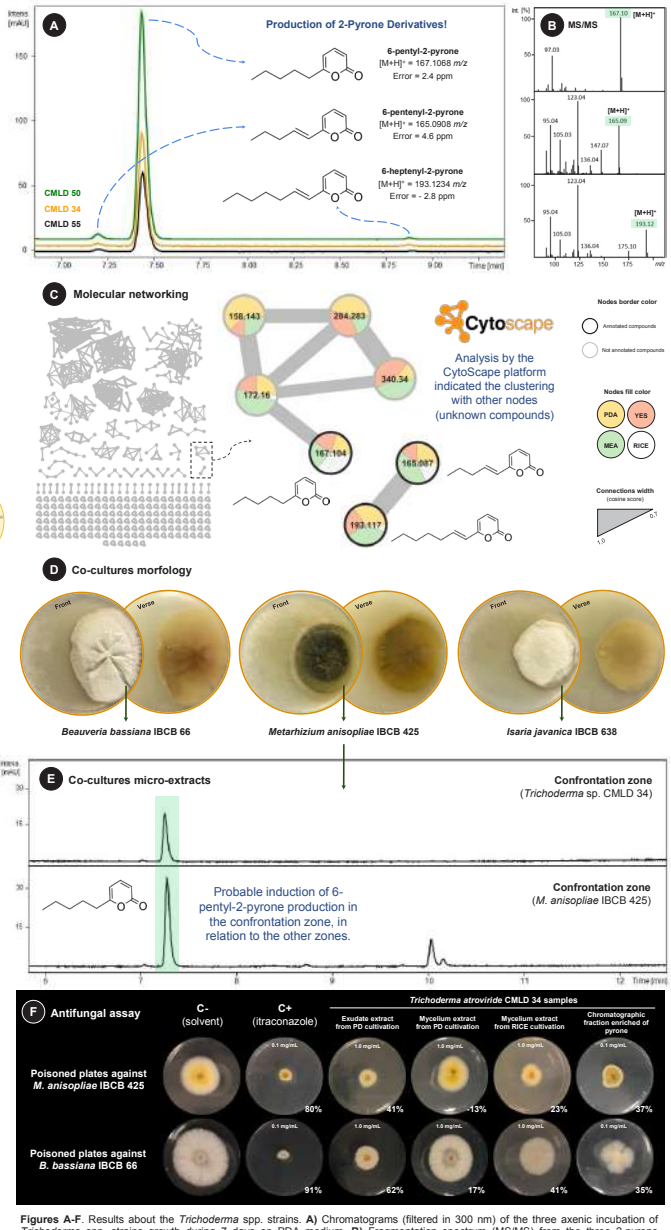
INTRODUCTION AND OBJECTIVE

The genus *Trichoderma* are usually present as components of biological control products for agricultural systems, besides being naturally found colonizing many terrestrial substrates like in bee environments. Although they are not considered bee pathogens, some *Trichoderma* species have recently been reported to significantly reduce the survival of honey bees. During the ongoing study, the predominance of *Trichoderma* spp. was observed in different parts of three stingless bee colonies. This stimulated the chemical ecology investigation about these fungi in the bee environment.

MATERIALS AND METHODS



RESULTS AND DISCUSSION



Figures A-F. Results about the *Trichoderma* spp. strains. **A)** Chromatograms (filtered in 300 nm) of the three axenic incubation of *Trichoderma* spp. strains growth during 7 days on PDA medium. **B)** Fragmentation spectrum (MS/MS) from the three 2-pyrone derivatives dereplicated. **C)** Molecular networking obtained from MS/MS data of micro-extracts of the strain CMLD 34. **D)** Pictures of co-cultures between the CMLD 34 and the three entomopathogens. **E)** Comparison of chromatograms (filtered in 300 nm) of the co-culture between CMLD 34 and *M. anisopliae*, enfocusing on induction of the 6-pentyl-2-pyrone. **F)** Antifungal susceptibility test against the three entomopathogens of chemical samples (extracts and fractions) obtained from the cultivation of strain CMLD 34.

CONCLUSION AND NEXT STEPS

The major production of 2-pyrone derivatives by *Trichoderma* spp. associated with stingless bees, added to their knowledge of having antimicrobial activities, made this group of compounds a promising target in ongoing studies. The detected metabolites will be investigated in toxicity tests against stingless bees. Thus, with the obtained results this work intends to assist the elucidation of the ecological roles of filamentous fungi associated with stingless bees through the comprehension of their metabolomic arsenal.

FUNDINGS

FAPESP 2020/08270-0, 2022/14896-5, 2025/10504-3
Finep 0558/21

PP-092 [Bee Health]
Biological distribution of honey bee vitellogenin and its fragments in bee organism

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Vitellogenins (Vg) are a group of proteins primarily associated with yolk formation in oviparous animals and insects, serving as precursors to storage proteins. Honey bee vitellogenin is a monomeric 180 kDa phospholipoglycoprotein, which can be cleaved into smaller fragments of 150 kDa and 40 kDa. In honey bees, Vg is one of the most abundant proteins in the haemolymph, with multiple biological functions beyond nutrition, including involvement in social organization, antioxidant protection, immunity or lifespan regulation. Despite recent advances, the precise mechanisms underlying these functions remain poorly understood. While in most organisms Vg is predominantly found in the ovaries of females, it is present in several other body parts in honey bees. Vg is crucial for winter bees as an essential biomolecule for the activation of immune response. Given the pivotal role of Vg in lifespan regulation and antioxidant defence, understanding its action in various body parts is essential for developing strategies to support honey bee health under challenging environmental conditions. Additionally, as Vg can bind several molecules, including pathogens, this research may enhance our understanding of its immune properties and contribute to implementation of these properties into beekeeping practice.

This study aimed to investigate the distribution of Vg in various honey bee tissues, including the brain, hypopharyngeal glands, digestive system, fat body, haemolymph or ovaries. The Western blot technique was employed to detect and relatively quantify Vg. Prior to immunodetection, two protein separation methods were applied: isoelectric focusing (non-reducing) and SDS-PAGE (reducing), which are most commonly used for protein separation in polyacrylamide gels. The results demonstrate that Vg is present in almost every body part of the honey bee, with varying distribution patterns of its fragments, which may suggest distinct functional roles for each fragment. These findings offer valuable insights into the diverse roles of Vg in honey bees. Deepening the knowledge about the biological functions of Vg can help to understand and emphasize the importance of protein supplementation in beekeeping, especially for overwintering bee populations.

This research was funded by the MŠMT of Czech Republic, grant LUAUS24085.

PP-093 [Bee Health]
Antiviral defence mechanisms in honey bees infected with deformed wing virus

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Department of Biochemistry, Palacky University, Olomouc, Czech Republic

Honey bees Apis mellifera are a eusocial insect species with ecological and economic importance. High colony losses indicate that the health and stability of bee populations are threatened by multiple pathogens. Due to their major impact on beekeeping and their role as one of the leading causes of colony losses, pathogenic viruses affecting honey bees are among the most intensively studied pathogens. Deformed wing virus (DWV) is a positive-sense single-stranded RNA virus transmitted by the ectoparasitic mite Varroa destructor. In infested colonies, V. destructor facilitates the rapid spread of DWV, leading to severe weakening or even colony collapse.

Honey bees detect and limit viral infections through the RNA interference (RNAi) pathway. One of the main components of RNAi is the enzyme Dicer, which cleaves viral double-stranded RNA into short RNA fragments, leading to the degradation of target mRNA and subsequent gene silencing. The RNAi mechanism regulates the expression of Vago gene, which increases in response to certain viral infections in honey bees. Additionally, bee antiviral protein 1 (Bap1) restricts viral infections through RNAi, while thioester containing protein 7 (Tep7) is involved in enhancing the immune response to infections, including viruses.

This study examines the antiviral defense in honey bees infected with DWV by measuring relative gene expression. RNA was isolated from the abdomens of infected bees and then converted into cDNA through reverse transcription. The expression of genes Dicer, Vago, Bap1 and Tep7 was quantified using quantitative PCR (qPCR). The results indicate significant changes in the expression of genes Dicer and Vago in DWV-infected bees. This suggests that honey bees are enhancing their antiviral defence mechanisms in an effort to limit viral replication and spread within the body.

These discoveries, along with a more comprehensive analysis of honey bee immunity, can enhance the understanding of protective mechanisms against viral infections. These insights could support selective breeding programs aimed at improving the resilience of honey bee colonies to viral diseases, ultimately helping beekeepers reduce colony losses and promote sustainable beekeeping practices.

This work was supported by NAZV, Czech Republic, project QL24010241.

PP-094 [Bee Health]

Altering the expression of *hsp* and *amp* genes to potentially enhance stress tolerance by curcumin and quercetin containing nutritional supplement in honey bees (*Apis mellifera*)

Evelin Kámán-Tóth[1], Fanni Huber[1], Zsuzsanna Neogrády[1], Gábor Mátis [1,2] and Máté Mackei[1,2]

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Introduction

Exposure of cells to stressors such as **high/low temperature, pesticides** and **pathogens** can damage cellular proteins. **Heat shock proteins (HSPs)** respond to various **abiotic** and **biotic stressors**, act as molecular chaperons to protect cells against apoptosis therefore they are essential for avoiding stress damage. However, in case of viruses elevated production of HSPs can be detrimental because **viruses** can hijack HSPs and utilize the native HSPs of the host to help them invade cells and nucleus. In addition, the different stressors affect the regulation of genes coding for **antimicrobial peptides (AMPs),** which are part of the **innate immune system**.

Aim of the study

We hypothesize that changes in the expression of *hsp* and *amp* genes can lead to increased stress tolerance depending on the type of stress. The aim of our research was therefore to **change the expression of genes encoding HSP**s and **AMP**s in honey bees, following treatment with **curcumin**, as a potentially applicable cytoprotective agent and with **quercetin**, as a plant flavonoid.

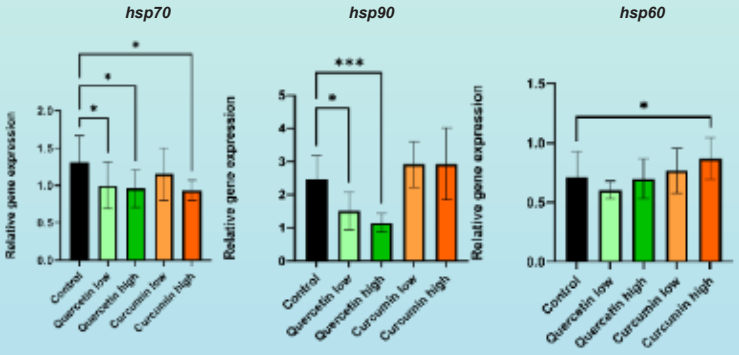
Materials and methods

5 treatment groups, n=15 bees/ group
48-hour treatment with **feeding solutions**:

- Curcumin in low (0.03 mmol) and in high concetration (0,3 mmol)
- Quercetin in low (0,1 mmol) and in high concentration (1mmol)
- Controll with normal feeding solution

RNA isolation from 3 head tissue homogenate *(Zymo Research, Direct-zol™ RNA Microprep)*
cDNA synthesis *(Thermo Scientific™ RevertAid First Strand cDNA Synthesis Kit)*
Determination of **relative gene expression by real-time PCR** *(Thermo Scientific™ DreamTaq PCR Master Mixes)* with the use of gene specific and β-tubulin primers (selected based on literature data).

Results



Relative gene expression of *hsp70*, *hsp90* and *hsp60*. The mean difference is statistically significant at P < 0.05 level, marked by asterisks. Statistical analysis was performed using one-way ANOVA and Dunnet's posthoc test. * p < 0.05, *** p < 0.001

Conclusion

- **Curcumin** and **quercetin** containing feeding solutions have **significant effect** on the **relative expression** of researched genes compared to their controls.
- With **curcumin treatment** we successfully **increased** the expression of *hsp60* and *hsp70* while **quercetin treatment** caused **reduced** mRNA levels of *hsp70* and *hsp90.*
- Interestingly in the case of *amp* genes no significant changes were observed due to the different treatments.
- Based on our research **curcumin** and **quercetin** can serve as nutritional supplements for bees to **help** them **tolerate** the various **stress factors** depending on the type of stressor that should be avoided.

Project no. FK146534 has been implemented with the support provided by the Ministry of Culture and Innovation of Hungary from the National Research, Development and Innovation Fund, financed under the NKFIH OTKA FK 23 funding scheme and the strategic research fund of the University of Veterinary Medicine Budapest (Grant No. SRF-001.)

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PP-095 [Bee Health]

Apimondia Copenhagen | 23-27.09.2025

Paenibacillus melissococcoides: a new pathogen of honey bee brood?

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1. Swiss Bee Research Centre, Agroscope, Bern – Liebefeld, Switzerland ; 2. Department Ecology Evolution, University of Lausanne, Switzerland

Introduction

We recently described a new bacteria found in a brood-diseased colony: *Paenibacillus melissococcoides* [1].
We then investigated whether this bacterium was pathogenic for honey bee brood by testing **Koch's postulates** [2].

Results

Koch's postulates

The microorganism must be isolated from a diseased organism…

…and grown in pure culture

The cultured microorganism should cause disease when introduced into a healthy organism.

The microorganism must be reisolated from the experimentally inoculated, diseased host …

…and identified as identical to the original causative agent.

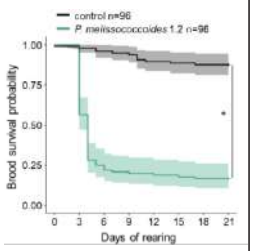
Our observations

P. melissococcoides found in
- adults of symptomatic colonies without *M. plutonius*
- nutritive jelly fed to larvae of EFB-diseased colonies
- larvae and adult workers of EFB-diseased colonies

P. melissococcoides was not found in healthy colonies.

P. melissococcoides was grown in pure culture

inoculation of healthy larvae reared in vitro led to death

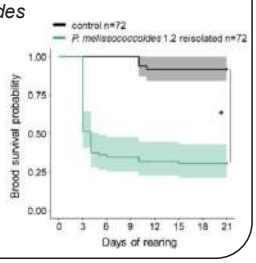


P. melissococcoides was reisolated from an inoculated dead larva and grown in pure culture

the cultured *P. melissococcoides* led to death

MALDI-TOF MS	
Organism	Score[x]
P. Melissococcoides	2.28
P. Melissococcoides	2.29

[x] value interpretation:
3.00–2.30: highly probable species identification;
2.29–2.00: secure genus identification, probable species identification
* P<0.05



Discussion

Our results indicate that *P. melissococcoides* is pathogenic to honey bee brood in laboratory conditions at natural concentrations[2]. There is as yet no strong evidence that *P. melissococcoides* triggers a disease at the colony level on its own but first evidence in field idiopathic cases suggests that colony level pathogenicity is possible.

Methods

Bacteria were grown on Basal medium for four days at 36°C under oxic conditions [1].
Freshly hatched larvae were reared in vitro [3] . Differences in brood survival between the inoculated and control groups were tested using log-rank tests for two group comparisons in R, version 4.1.0.
MALDI-TOF MS from Bruker were used following the Biotyper MSP Identification Standard Method.

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PP-096 [Bee Health]

EVALUATING POSSIBLE EFFECTS OF RADIO-FREQUENCY ELECTROMAGNETIC FIELDS (RF-EMF) EXPOSURE ON BIODIVERSITY, DEVELOPMENT & FITNESS OF INSECTS

Thielens Arno[1], Bouga Maria[*2], Charistos Leonidas[3], De Boose Pieterjan[4], Fröhlich Jürg[5] , Hatjina Fani[3], Kalapouti Anastasia[3], Ribas Oliveira Felipe[4], Schneider Fabian[5] Stavrinides Menelaos[6], Thanou Zoi[2], Tsagkarakis Antonios[2], Varnava Andri[6], Zahner Marco[5], and Huss Anke[7]

[1] Photonics Initiative, Advanced Science and Research Center, the Graduate Center of the City University of New York, New York, USA; [2] Department of Crop Science, Agricultural University of Athens, Athens, Greece; [3] Institute of Animal Science & Department of Apiculture, Hellenic Agriculture Org. "DEMETER", Nea Moudania, Greece; [4]Department of Information Technology, Ghent University, Ghent, Belgium; [5]Fields at Work GmbH, Zurich, Switzerland; [6] Department of Agricultural Sciences, Cyprus University of Technology, Limassol, Cyprus; [7] Institute for Risk Assessment Sciences, Utrecht University, Utrecht, The Netherlands

Introduction

- Insects play a vital role in maintaining ecosystem health.
- Insects are exposed to **Radio-Frequency Electromagnetic Fields (RF-EMFs)** emitted by telecom antennas.
- RF-EMF exposure of insects is expected to change due to evolutions (from 4G to 5G) in telecom networks [1].
- Pollinators, such as bees, are at risk of peak exposures close to powerful antennas
- RF-EMF exposure can have biological effects in insects [2], but the impacts of RF-EMF exposure on insects are unclear [2].

Goals: The Horizon Europe project 101057216, Exposure To electromagnetic fields and plaNetary health (**ETAIN**) aims to develop and validate approaches to assess the impact of existing and novel communication technology from a planetary health perspective. To this aim, we will focus on insect biodiversity and fitness w.r.t. RF-EMF exposure. The aims are:

- To define thresholds for wellbeing, health, behavior, and productivity of honeybee colonies under RF-EMF (3G to 5G) exposure
- To measure possible changes in the fitness of a solitary bee species under RF-EMF exposure
- To record possible impacts on insect biodiversity under RF-EMF exposure
- To create digital models for dosimetric analysis of bees and other insects

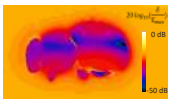
To this aim 6 tasks are defined, which are outlined below

T1: Development of 3D-EM Insect Models

- **Goal:** Create digital models of insects that can be used in EM simulations
- **Methods:** Micro-CT scanning and postprocessing in Python and Blender. Illustrated below in 5 steps for a bumble bee (*Bombus terrestris*).
- **Outcomes:** Models available for use online (https://skfb.ly/oTnsG)

T2: Numerical Quantification of RF-EMF exposure on insects

- **Goal:** Determine absorption of RF-EMFs in insects (0.1-120 GHz)
- **Methods:** Numerical simulations with 3D-EM Insect Models (T1) to obtain whole-body averaged absorbed power and specific absorption rates in insects under:
  (1) Far-Field exposure (environmental exposure)
  (2) Near-Field exposure (near telecom antenna)
  (3) exposure as experienced in T3-6.
- **Outcomes:** Quantification of insect exposure to RF-EMFs, necessary for The interpretation of biological effects [5].



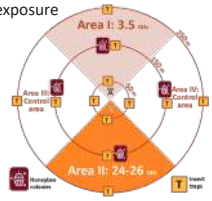
Example of RF-EMFs around a honey bee worker at 12 GHz [1]

T3: Controlled Experiments with Managed and Solitary bees

- **Goal:** Determine potential effects of RF-EMF exposure on HB colonies and SB under development
- **Methods:** HB colonies will be placed indoors with outlet for workers to freely forage outside. Hives will be continuously exposed at 3.5 and 26 GHz. HBs and brood will be monitored for at least 3 cycles (meaning one cycle before, one during, and one after the exposure). SBs will be exposed at same frequencies in artificial nests. (1) Molecular gene expression related to oxidative stress as function of different exposure times or conditions, (2) Colony health and development, & (3) SB Development time & sex ratio will be measured.
- **Outcomes:** Determine thresholds for effects on HB and SB under RF exposure

T4: Effects of Environmental RF-EMF exposure on Insect Biodiversity

- **Goals:** Determine effects of 5G RF-EMF exposure on insect biodiversity
- **Methods:** Installation of custom 5G-emulating exposure setup with RF-EMF emission in two 90° sectors. Insect traps and HB colonies (T5) are placed in all areas at different distances.
- **Outcomes:** Determine insect presence population fluctuations, & biodiversity w.r.t. RF-EMF exposure.



T5: Effects of Environmental RF-EMF exposure on Honey Bees

- **Goals:** Determine effects of 5G RF-EMF exposure on HB colony development and SB development
- **Methods:** HB Colonies and SB artificial nests will be placed in the same setup as T4. Colony and SB development, aggressiveness, colony growth/population/ brood, and queen survival will be measured during 2 years.
- **Outcomes:** same as T3, but for 5G environmental exposure.

T6: Survey monitoring of biodiversity of solitary bees (SB) under commercially installed 5G RF-EMF

- **Goal:** Determine influence of commercial 5G network on SB biodiversity
- **Method:** Monitoring SB at different locations (using artificial nests and variable transects) and compare species richness and abundance
- **Outcomes:** Determine potential impacts of 5G exposure on insect biodiversity

Envisioned Impact and Outlook

From a **policy perspective**, we aim to give recommendations to policy makers in terms of sustainable management of honeybee and wild bee populations.

From a **planetary health perspective**, RF-EMF effects on insects may also have indirect effects on human health and the economy. ETAIN is expected to generate scientific evidence of RF-EMF exposure effects on human, ecosystem and planetary health, feeding into policies and current regulatory frameworks.

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- **Acknowledgements:** The Exposure To electromAgnetic fields and plaNetary health (ETAIN) project is funded by the European Union's Horizon Europe research and innovation funding programme under grant agreement No 101057216.

PP-097 [Bee Health]
Causes of periodic mass bee mortality in Ukraine

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Since the 1990s, Ukraine has experienced periodic mass bee mortality, affecting 20-40% of colonies approximately every ten years. Similar occurrences have been noted in other beekeeping countries. Our objective was to investigate the causes of these periodic losses.

Materials and METHODS: Bee samples were collected from apiaries with significant colony losses and examined for Varroa destructor mites and Nosema apis and N. ceranae microsporidia. Data on other diseases and health improvement measures were analyzed.

RESULTS: Colony mortality was primarily caused by varroosis, often accompanied by nosemosis. Bees affected by varroosis died in autumn and winter, while nosemosis-related deaths occurred in late winter and early spring. During the summer honey collection period, mass mortality was often due to pesticide poisoning caused by non-compliance with application regulations.

The prevalence of V. destructor varied from 1% to 50%, depending on the season and treatments applied. These treatments included:

- Autumn (August-September): Acaricides with flumethrin, fluvalinate, or amitraz.
- Summer (between honey collections): Organic acids (oxalic, formic, lactic).
- During honey collection: Acaricides based on essential oils and thymol.

N. apis and N. ceranae were found in nearly all apiaries. Nosemosis outbreaks in late winter and early spring were linked to high V. destructor infestations in autumn before acaricide treatments. Weak colonies, unable to maintain the hive microclimate, further contributed to nosemosis development. In addition to the spring exacerbation of nosema in apiaries, where there was a significant mortality rate of families from varroa, viral diseases (paralysis in adults or sacbrood in larvae) became more active in the summer.

CONCLUSIONS: Periodic mass bee mortality in Ukraine results from mono- and mixed infestations with V. destructor and Nosema pathogens. Removing mites only from the winter bee generation is insufficient, as affected colonies continue to suffer autumn disappearances or winter deaths. The lowest colony losses occurred in apiaries where acaricide treatments targeted both winter and summer bees, and anti-varroosis measures were applied during broodless periods with mandatory mite infestation monitoring. The decreasing efficacy of chemical acaricides in autumn in recent years is not manufacturer-dependent but results from acquired V. destructor resistance to treatments.

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PP-098 [Bee Health]

Actinobacteria from Stingless Bees: Isolation, Characterization, and Antimicrobial Potential

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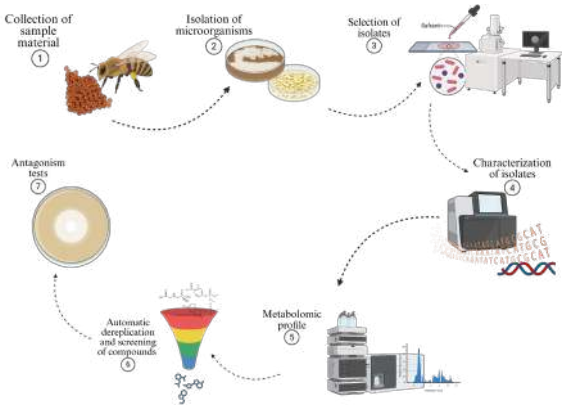
Introduction

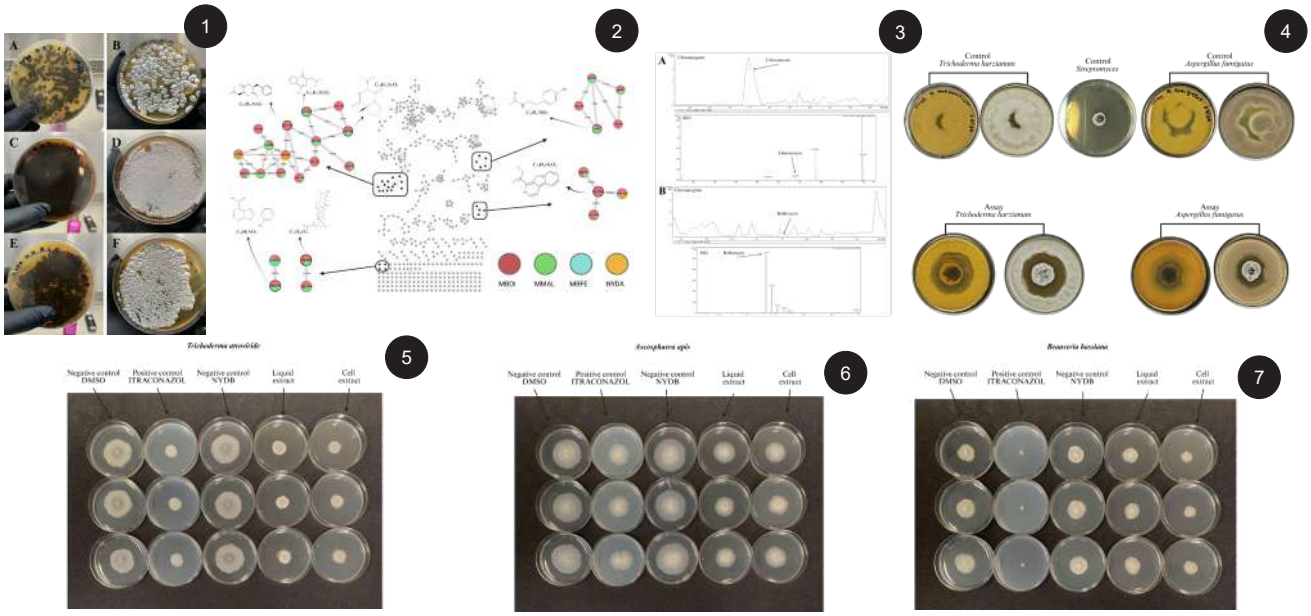
Stingless bees (tribe Meliponini) are eusocial insects commonly found in tropical and subtropical regions, where they play a crucial role in pollinating numerous plant species. Meliponiculture has gained growing interest due to its significance in environmental conservation and the production of medicinal honey. The colonies of these bees harbor a complex and largely unexplored microbiota, including bacteria from the phylum Actinobacteria, known for their capacity to produce bioactive secondary metabolites. Among this group, the genus Streptomyces is recognized as a major source of natural antibiotics. However, the interactions between stingless bees and their microbial communities, especially actinobacteria, remain poorly understood.

This study aimed to isolate and characterize actinobacteria associated with stingless bees of the species *Melipona bicolor*, *Melipona mondury*, and *Melipona quadrifasciata*, evaluate their potential in microbial interactions, and identify the secondary metabolites they produce.

Materials and Methods



Results and Discussion



Figures 1–7. (1) Isolated actinobacteria. (A and B) Reverse and obverse sides of the plate with an actinobacterium isolated from the cuticle of forager bees of *Melipona bicolor*. (C and D) Reverse and obverse sides of the plate with an actinobacterium isolated from the internal environment of worker bees of *Melipona bicolor*. (E and F) Reverse and obverse sides of the plate with an actinobacterium isolated from larval food of *Melipona mondury*. (2) Molecular network of extracts injected into UHPLC-HRMS in positive ESI mode. Node colors indicate the organism or culture medium from which the compound was annotated. (3) (A) Chromatogram of actinobacterium MBOI and below the MS1 spectrum of the compound Caboxamycin. (B) Chromatogram of actinobacterium MBOI and below the MS1 spectrum of the compound Bafilomycin. Results obtained by UHPLC-HRMS in positive ESI mode. (4) Reverse and obverse sides of the independent co-culture bioassay (14-day test). Control plates of the fungi used on the sides and of the actinobacterium in the center. Below, plates showing inhibition halos against *T. harzianum* and *A. fumigatus* in NYDA culture medium. (5) Obverse side of the mycelial growth inhibition bioassay with *Trichoderma atroviride* CMLD 34 after 3 days of incubation. (6) Obverse side of the mycelial growth inhibition bioassay with *Ascosphaera apis* CMLD 131 after 3 days of incubation. (7) Obverse side of the mycelial growth inhibition bioassay with *Beauveria bassiana* IBCB 66 after 7 days of incubation.

Conclusion

The findings of this study emphasize the potential of actinobacteria associated with stingless bees as important sources of bioactive secondary metabolites with antimicrobial effects. Additionally, the results offer new insights into the role of these bacteria in maintaining colony health in *Melipona bicolor* and *Melipona mondury*, highlighting their significance in protecting bees against pathogenic threats.

Acknowledgements

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PP-099 [Bee Health]

Brain Fatty Acid Profile Alterations in Honey Bees Induced by Neonicotinoid Acetamiprid

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INTRODUCTION

- Neonicotinoids pose a serious threat to pollinators such as the **Western honey bee** (*Apis mellifera*), which play a crucial role in ecosystem stability.
- Although lethal effects are infrequent, prolonged exposure to **sublethal doses** can adversely affect bee physiology and behavior.
- The biochemical pathways underlying such effects remain **poorly understood**
- Considering the **critical role of lipid metabolism in neural function**, this study explores how low-level acetamiprid exposure modifies the fatty acid composition in honey bee brains.
- **Acetamiprid**, widely applied in agriculture, may interfere not only with neural receptors but also **trigger oxidative stress and disrupt lipid metabolic processes**.

MATERIALS AND METHODS

- Field experiments were conducted at an apiary located in Ugod, Hungary.
- Honey bees were collected and maintained under strict laboratory conditions (30°C, 90% relative humidity) within specialized cages.
- The test groups were exposed to varying **sublethal concentrations of acetamiprid** (LD50/10, LD50/20, LD50/40 per bee per day) administered **orally** over a **48-hour** period.
- Post-exposure, brain tissues were dissected, homogenized, and subjected to **gas chromatography-mass spectrometry** (GC-MS) to quantify fatty acid profiles.

RESULTS

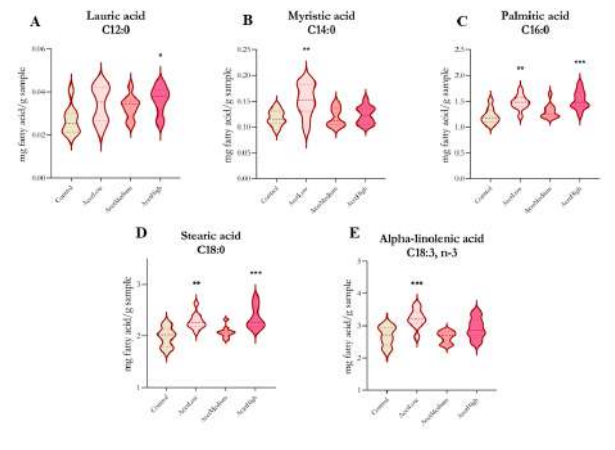
- Exposure to sublethal doses of acetamiprid induced marked alterations in the levels of specific fatty acids including **lauric** (C12:0), **myristic** (C14:0), **palmitic** (C16:0), stearic (C18:0), and **alpha-linolenic acid** (C18:3, n-3). **Total, saturated, and polyunsaturated fatty acid concentrations** were also significantly affected.

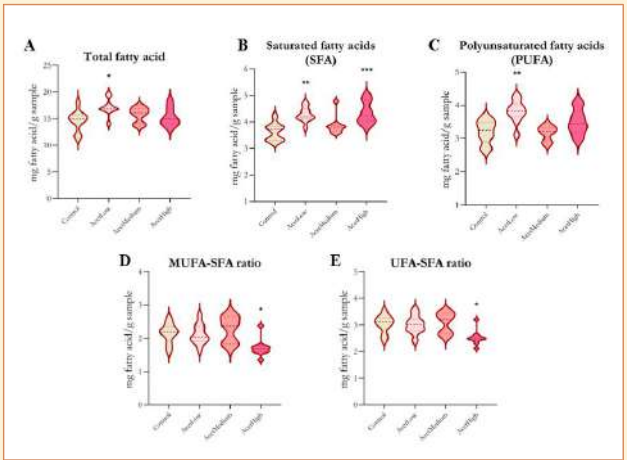
CONCLUSION

- These biochemical changes have **potential ramifications on neural integrity and colony health**, suggesting that even low-level pesticide exposure may impair bee populations.
- The findings underscore the importance for beekeepers to consider these subtle yet critical risks in agricultural landscapes. Further studies are warranted to elucidate **long-term ecological impacts and develop mitigation strategies** for pesticide use in apiculture.

AIM OF THE STUDY

INVESTIGATING THE EFFECTS OF ACETAMIPRID IN THE ALTERATIONS OF FATTY ACID STATUS OF HONEY BEE'S CENTRAL NERVOUS SYSTEM





The results were visualized using violin plots. AcetLow 9,09 µg/ml feeding solution, AcetMedium 18,17 µg/ml feeding solution, AcetHigh 36,33 µg/ml feeding solution, p<0.05

ACKNOWLEDGEMENTS
The study was supported by the Hungarian National Research, Development and Innovation Office, grant number OTKA FK 134940. Project no. RRF-2.3.1-21-2022-00001 has been implemented with the support provided by the Recovery and Resilience Facility (RRF), financed under the National Recovery Fund budget estimate, RRF-2.3.1–21 fund.

PP-100 [Bee Health]
Dispersal of Tropilaelaps mercedesae mites from honey bee colonies

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Tropilaelaps mercedesae mites are severe parasites of the western honey bee (Apis mellifera) that have spread to multiple countries outside of their native range. It is thought that phoresy on adult bees (e.g., during drifting or robbing) is one way that Tropilaelaps mites disperse between colonies. This idea is supported by our recent study documenting T. mercedesae leaving A. mellifera honey bee colonies on adult bees. Our data suggested that high brood infestations promote dispersal out of colonies, but it was not clear how brood infestation rate affected dispersal – including whether there is a threshold of brood infestation that triggers dispersal. A better understanding of factors driving dispersal is important to responding appropriately when Tropilaelaps mites are detected in new areas. To understand the relationship between brood infestation rate and phoretic dispersal, we uncapped worker brood to assess Tropilaelaps mercedesae and Varroa destructor infestation rate of colonies and used funnel traps to collect bees exiting the colonies. Collected bees were subjected to an alcohol wash to dislodge mites before being counted. We observed the first Tropilaelaps mites on exiting bees at 5% infestation of worker brood cells. Above 5% infestation, we observed a strong increase of dispersal with increasing brood infestation. The relationship of brood infestation and number of mites on exiting bees was remarkably similar for Tropilaelaps and Varroa mites. These results indicate that Tropilaelaps mites, like Varroa, can be a landscape-level problem where mite populations can disperse among hives, apiaries, and beekeeping operations. These results also have implications for appropriate responses if Tropilaelaps mites are detected in a new region; a brood infestation of greater than 5% in a colony would indicate a high risk that mites have dispersed through drift of bees or robbing, and warrant inspections of colonies within flight distance.

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PP-101 [Bee Health]

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Evaluation of Promising Novel Acaricide Against *Varroa destructor*

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Introduction

Infestation of honey bees by *Varroa destructor* is a significant cause of colony loss, particularly during winter months in Canada[1]. Currently, beekeepers have limited options available to treat bee colonies for varroosis. Varroa mites have quickly developed resistance to a number of registered compounds (i.e. fluvalinate, coumaphos, amitraz)[2-6], while remaining treatment options often pose health hazards to beekeepers[7,8] or have variable efficacy[9,10]. As such, alternative control strategies are urgently required, particularly those that involve new active compounds. Based on previous laboratory screening assays, we discovered a new acaricidal substance, 1-allyloxy-4-propoxybenzene, referred to as 3c{3,6}, which causes disruption of host-finding behaviour, paralysis and death of mites[11-13].

Objectives

A) To determine the efficacy of 3c{3,6} against *Varroa destructor* using full-sized honey bee colonies in the spring and in the fall.

B) To determine the effects of 3c{3,6} on colony productivity metrics.

Materials and Methods

Miticidal efficacy of 3c{3,6} was evaluated for colonies in single Langstroth hive boxes during the fall of 2022 and the spring of 2023, during which applicator design and dose of 3c{3,6} were varied. Experiments were conducted at Agriculture and Agri-Food Canda's Research Farm in Beaverlodge, Alberta, Canada.

Experimental Set-Up:

2022: Colonies were founded using 1-kg New Zealand package bees in the spring of 2022, with the original queens replaced with New World Carniolan stock. As the newly established colonies did not initially contain detectable varroa loads, they were inoculated with mites from local colonies. The average varroa infestation level on adult bees was 4.1 ± 0.7 % at the start of the experiment on 8 Sep 2022.

The 2022 experiment used 40 colonies equally distributed into five treatment groups. Two 3c{3,6} applicator materials were tested: wood and cardboard (Fig. 1). Treatment groups included 3c{3,6} impregnated on either wooden or cardboard applicators, negative solvent controls on wooden or cardboard applicators, and a positive control treatment of Thymovar®. A total of 8 g of 3c{3,6} was applied to treated colonies, with the active compound equally divided across 3 applicators per colony.

2023: Colonies were sourced locally, being selected from surviving overwintered hives, but did not include those used in the previous 2022 experiment. Queen sources consisted of locally bred of Italian and New World Carniolan stock. The starting size of colonies was 5 frame sides of adult worker bees and 3 frame sides of combined open and capped brood, with remaining frames consisting of food stores. The average varroa infestation level on adult bees was 2.5 ± 0.4 % at the start of the experiment on 11 May 2023.

In 2023, the same wooden applicator design was as used as in 2022 (Fig. 1). A total of 20 colonies were stratified into two equal treatment groups: 3c{3,6} (wood) and a negative solvent control (wood). Due to a lack of additional surviving colonies with mite loads after the winter of 2022, no positive control was included. A total of 10 g of 3c{3,6} was applied to treated colonies.

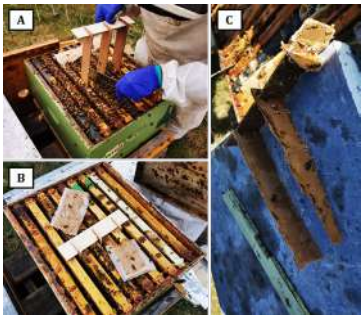

Figure 1. Applicators used in the fall 2022 and spring 2023 experiments. Three strips (24.0cm × 5.0cm × 0.5cm wood, or 24.0cm × 5.0cm × 0.3cm cardboard) were impregnated with a total of 8 g (2022) or 10 g (2023) of 3c{3,6} and suspended between frames. [A] A wooden 3c{3,6} applicator being inserted into an experimental colony. [B] Placement and positioning of a fully-inserted wooden 3c{3,6} applicator. [C] A heavily-degraded cardboard 3c{3,6} applicator, having been removed for examination following 21 days within colonies.

Efficacy Evaluation:

The exposure period for treatments was 42 days, followed by a subsequent "clean-up" phase of 42 days, during which treatments were removed and alternative miticides applied to kill any mites remaining in colonies. In 2022, Apivar® was employed as a clean-up treatment, while in 2023, multiple applications of 65% liquid formic acid were used. Efficacy was evaluated by counting the varroa mites falling onto adhesive boards placed beneath colonies during the treatment versus the clean-up phases, and by performing alcohol washes of adult bees at selected intervals. Mortality-based efficacies were calculated for each treatment group using Dieteman's formula. A GLS approach was used to model daily mite mortality per treatment over each measurement interval, to determine interactive effects between treatment and time[12].

Effects on Colonies:

Immediately prior to the application of treatments and following their removal, areas of brood, pollen and honey as well as adult worker populations were visually quantified using plexiglass grids. The infestation levels of mites in sealed brood were also counted from 100 sealed brood cells[14,15].

Results and Discussion

All 3c{3,6}-treated colonies showed significantly higher varroa mortality than their untreated counterparts. In 2022, 8 g applications of 3c{3,6} had treatment efficacies of 94.6 ± 2.6% for the wooden applicators and 94.6 ± 2.7% for the cardboard applicators, which was comparable to Thymovar® at 94.5 ± 1.6%. In 2023, the 10 g treatment of 3c{3,6} had an overall treatment efficacy of 94.6 ± 1.2%. Cardboard applicators, though as effective as wood, tended to be destroyed by worker bees within the hive (Fig. 1).

GLS models showed significant interactions between the Treatment and Day main effects in 2022 (F=2.49; df=72,665; P<0.001) and 2023 (F=4.81; df=1,396; P< 0.001). This is evident by examining the temporal patterns of mite mortality shown in Figs. 2 and 3 and the differences between treatments and controls. Noticeably, 3c{3,6}-treated colonies produced very high levels of mite fall within the first 1 - 2 weeks after application, with control treatments having high mite fall immediately after the clean-up treatments were applied. Overall, 3c{3,6} at doses of 8-10 g performed at efficacy levels comparable to most other registered varroacides used in commercially managed colonies. This offers tremendous potential for the development of a truly novel product for varroa control.

Though we found no changes in the areas of brood, pollen or honey after 3c{3,6} treatment, we did find a significant impact of the 10 g application on adult bee populations. After 6 weeks, this dose appeared to hinder the development of adult population levels compared with controls (Fig. 4). Nevertheless, we did observe this effect to be transitory with population levels becoming similar to controls later in the season. Consequently, future work should focus on effects on 3c{3,6} on bee colonies and their queens to ensure this promising miticide does not have deleterious off-target consequences.

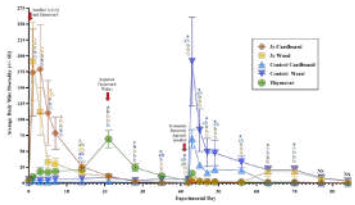

Figure 2. Daily varroa mortality per adhesive board interval, for each treatment group within the fall 2022 experiment, with a 3c{3,6} dose of 8 g per colony. Mortality data tracked from Day 0 (13 September 2022) to Day 84 (6 December 2022). Points represent mean ± SE error of 8 replicate colonies per treatment group. Five-way comparisons of daily mite fall across treatment groups were calculated using ANOVA and Tukey's HSD for pairwise significance (NS = not significant, pairwise significance p < 0.05).

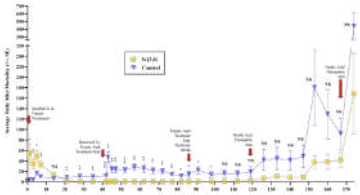

Figure 3. Daily varroa mortality per adhesive board interval, for each treatment group within the 2023 experiment, with a 3c{3,6} dose of 10 g per colony. Mortality data were tracked from Day 0 (11 May 2023) to the experimental end on Day 85 (4 July 2023), with post-treatment mortality tracking continuing until Day 174 (1 November 2023). Points represent mean ± SE of 10 replicate colonies per treatment group. Pairwise comparisons between the 3c{3,6} and control performed using two-sample, two-tailed t-tests; (NS = not significant, * = p < 0.05, ** = p < 0.01, *** = p < 0.001).

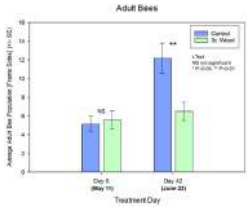

Figure 4. Adult bee populations (Mean frame sides ± SE) for colonies in the Spring 2023 experiment at the start of experimental treatment application (Day 0) and at the end of the application period (Day 42). Adult bee populations were significantly smaller at the end of the treatment period for the 10 g 3c{3,6} treatment.

Conclusions

1. 3c{3,6} demonstrates significant in-hive efficacy against Varroa, in both spring and fall, at doses of 8 - 10 g per colony.
2. 3c{3,6} may have a transitory impact on colony population size at doses of 10 g per colony. Target Animal Safety studies for 3c{3,6} are required.

Acknowledgements

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PP-102 [Bee Health]

Neurotoxic pesticides induced alterations in nursing behavior and foraging-related genes in the nurse bee of the honey bee, *Apis mellifera*. L

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Student Poster

Abstract

Honey bee, a vital pollinator in the natural and agricultural ecosystem, has been experiencing a global population decline, mainly attributed to pesticides. Both forager bees and nurse bees are exposed to pesticides, and the main exposure route in nurse bees is pesticide-contaminated food sources. Previous studies showed neurotoxic pesticides triggered an abnormally early transition of nurses to forager bee-like states, but their effects of pesticides on nursing behavior remain unclear. Therefore, we investigated the effects of five neurotoxic pesticides (acetamiprid, imidacloprid, carbofuran, cypermethrin, and fipronil) on nursing behavior in this study. Considering the possible exposure routes in nurse bees, nurse bees were exposed to field-realistic concentrations of pesticide-laced sucrose solution *ad libitum* for 10 days. After chronic exposure to pesticides, nursing behavior was assessed in three aspects: 1) the duration of nursing behavior per visit to the queen cell; 2) the total duration of nursing behavior; 3) the number of bees visiting to a queen cell. Moreover, we analyzed the transcriptome profiles of genes such as *cGMP-mediated kinase protein foraging* (*For*), *Kruppel homolog 1* (*Kr-h1*), *Adenylate cyclase 3* (*Ac3*), *Probable nuclear hormone receptor HR 38* (*Hr 38*), and *Early growth response 1* (*Egr1*), which are related to foraging activity and division of labor to understand the physiological mechanism underlying changes in caste differentiation and behavior using qRT- PCR. As a result, pesticides generally reduced all observed aspects of nursing behavior. In reverse, all selected foraging-related genes were upregulated by the treatment of pesticides, suggesting the inversely proportional relationship between the expression of tested genes and nursing behavior. These findings imply that pesticide-induced disruption of nursing behavior may alter colony composition, potentially leading to colony collapse. This study highlights the sub-lethal and chronic risks of neurotoxic pesticides, even at field-realistic concentrations, emphasizing the need for cautious pesticide use to prevent honey bee population declines.

Keywords: Honey bee, Nurse bee, Neurotoxic pesticides, Nursing behavior, Foraging-related genes

Introduction

❖ Pesticides and Honey Bee

- **Pesticide**
  - **Indispensable** with modern agriculture to prevent pests
  - A primary factor contributing to **honey bee population decline**
- **Effect of pesticide exposure on honey bee caste differentiation**
  - Causes **abnormal precocious transition** from nurse bee to forager bee (e.g., acetamiprid, imidacloprid)

→However, it is unknown how this precocious transition affects brood-rearing behavior, the primary task of nurse bees.

Materials & Methods

❖ Pesticide and Pesticide Treatment

- **Concentration:** Arithmetic "**field-realistic**" concentration, determined by averaging the mean residue concentrations in bee bread and honey samples collected in previous studies.

Table 1. Pesticides used in this study and their concentration

Pesticide Group	Pesticide Name	Concentration (ppb)
Neonicotinoid	Acetamiprid (ACE)	11.05 ± 6.16
	Imidacloprid (IMI)	4.58 ± 0.97
Carbamate	Carbofuran (CAB)	8.15 ± 2.19
Pyrethroid	Cypermethrin (CYP)	42.05 ± 5.63
Phenyl Pyrazole	Fipronil (FIP)	2.37 ± 0.16

- Newly emerged bee are **chronically exposed to pesticides for 10 days.**

❖ Nursing Behavior Assay

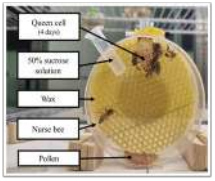

Fig 1. Experimental setup for nursing behavior assay

- Conducted after 10 days of pesticide exposure, using a queen cell
- **Behavioral index**
  1) Average number of bees performing nursing behavior (**NI**)
  2) Average number of visits to the queen cell (**NV**)
  3) Average total duration of nursing behavior (**TD**)
  4) Average duration of nursing behavior per visit to queen cell (**DV**)

❖ Transcriptome Analysis of Foraging-associated Genes Using qRT-PCR

- Total RNA extraction from pooled three heads → cDNA synthesis and qPCR

Table 2. Gene information used in this study

Gene function	Gene Name	Gene symbol
Foraging-associated gene	*cGMP-dependent protein kinase foraging*	*For*
	Kruppel homolog 1	*Kr-h1*
	Adenlyate cyclase 3	*Ac3*
	Early growth response protein 1	*Egr1*
	Probable hormone receptor 38	*Hr38*
Reference gene	*40s ribosomal protein S5*	*RPS5*

Results & Discussion

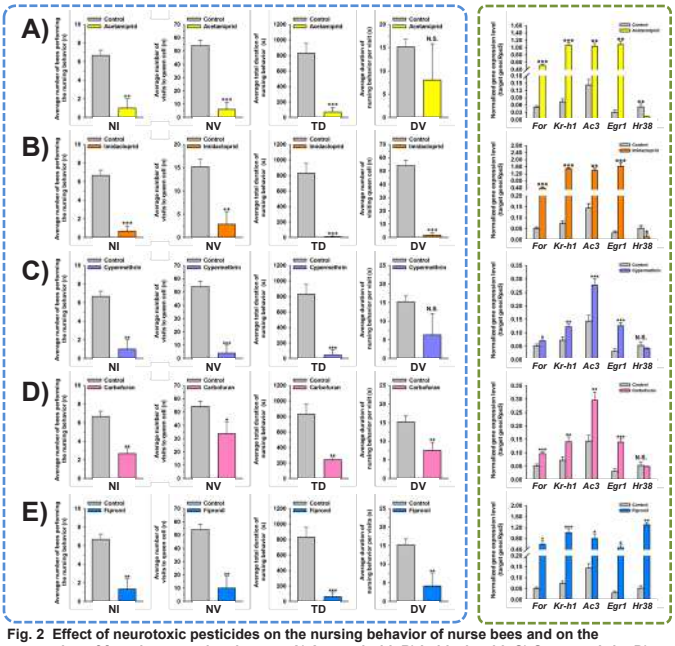

Fig. 2 Effect of neurotoxic pesticides on the nursing behavior of nurse bees and on the expression of foraging-associated genes. A) Acetamiprid; B) Imidacloprid; C) Cypermethrin; D) Carbofuran; E) Fipronil. Statistical analysis was conducted using Student's t-test to compare differences between the control group and the treatment group (N.S.: $p > 0.05$; **: $p < 0.01$; ***: $p < 0.001$).

❖ Relationship between Nursing Behavior and Foraging-related Genes

- **Inverse relationship following pesticide exposure**
  - Nursing behavior decreased.
  - Gene expression levels increased.

❖ Even Field-realistic Concentrations Can Significantly Affect Nursing Behavior and Foraging-related Genes

- **Concentrations used in this study**
  - Based on the field-detected concentration

→ However, even trace amounts of neurotoxic pesticides noticeably decreased nursing behavior and increased the expression of foraging-related genes.

❖ Possibility of Precocious Caste Differentiation Induced by Neurotoxic Pesticides

- **IMI and ACE**
  - Previously reported as causes of precocious foraging.
- **Other neurotoxic pesticides**
  - Showed patterns similar to ACE and IMI in both behavioral indices and gene expression.

→ These neurotoxic pesticides may also trigger precocious caste transitions in nurse bees.

❖ Potential Risk of Colony Collapse due to Abnormal Early Caste Transition

- **Imbalance between nurses and foragers**

→ This imbalance could ultimately lead to colony collapse.

Funding: This study was supported by the research fund (Z-1543081-2024-26-0101) from Animal and Plant Quarantine Agency, South Korea

PP-103 [Bee Health]
Treatment-free beekeeping: a case study of success in the Negev desert

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A successful story in chemical free beekeeping is presented.
It will describe the multi-disciplinar methodology developed and tested in the ten year operation from 2015 to 2025.
The apiary was settled in a semi desertic climate in BeerSheba city, Negev desert. Local bees are Italian breed already cultivated for 40 years now in the location.
As a result strong survivor colonies were obtained without applying chemical treatment for the last 5 years. Honey was also harvested in late fall through winter, where nearby professional operations in standard hives are fed to survive.

The project crossed the following phases:
1) Initial failures using standard hive and collecting swarms.
2) Pioneering experimentation on Primal hive in a warm climate as a central part of selective strategy
3) Final Hive design fine tuned in the field and symbiotic pseudoscorpion integration.

By practical operations, success key points are following resumed:
i) The hives being used are Primal Bee, the only hive providing the nest optimal living conditions which are humidity and warm microclimate. It was observed as a colony in the original Primal Bee hive raised the nest temperature up to 45 centigrade (Celsius) during December of that year while the outer temperature was 15 centigrade. This is important because the other standards of beehives can't hold this temperature or even reach it. Primal Bee has been tested as a successful model that maximizes colonies' abilities to survive against Varroa mites and diseases.
ii) There are genes that are continuously selected by the beekeeper over time.
iii) The symbiotic life of bees with pseudo-scorpions, black ants and thousands bugs that live inside the hive and around its environment; they are an important part of the bee's life and flora. This is a subject being researched globally, not only on honeybees, and its impact needs more study.

Work highlights synergistic results between the innovative Primal Bee hive design, the environment, and bee biology, bringing results unknown in industry and active beekeeping communities. More researches are planned in the years to come.

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PP-104 [Bee Health]

Effectiveness of innovative BeeSmoke pelleted fuel and remedy ApiBonum *ib* on the vitality of honeybee colonies

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An innovative and sustainable approach to beekeeping involves using commercially available pellet fuels, such as BeeSmoke Forte and BeeSmoke, for daily work in the apiary. A study was conducted to determine the effectiveness of these fuels, including their impact on the strength and behavior of honeybee colonies, their ability to reduce the number of parasitic mites *V. destructor*, and the presence of insecticide/acaricide residues in honey. At the same time, on another apiary, we aimed to determine the acaricidal properties of the innovative agent ApiBonum ib, and its impact on the vitality of honeybee colonies.

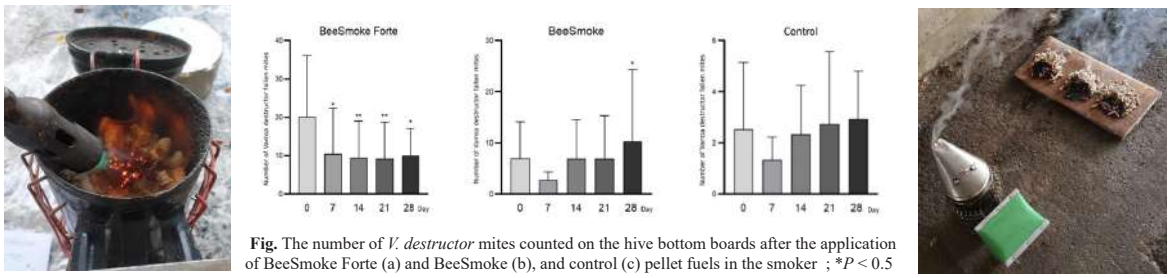

Fig. The number of *V. destructor* mites counted on the hive bottom boards after the application of BeeSmoke Forte (a) and BeeSmoke (b), and control (c) pellet fuels in the smoker ; *$P < 0.5$

It was observed that the smoke produced from burning BeeSmoke Forte, BeeSmoke, and pure wood pellets in a smoker did not alter the behavior of the honeybees or result in their death. Furthermore, the study indicated that BeeSmoke Forte and BeeSmoke significantly affect the number of fallen parasitic mites, specifically *Varroa destructor*. Also, the study analyzed the honey collected before and after using pellet fuels for the presence of insecticide/acaricide residues, and their negative results indicate that the honey collected during the active beekeeping season when these fuels were used is safe for bees and humans to consume.

Fig. The number of fallen *V. destructor* mites after honeybee colony treatment (ApiBonum *ib*; CheckMite+; control with no treatment), and after a single shock treatment with oxalic acid.

The research, which was conducted in field conditions, determined the decline of mites in all honeybee colonies treated with ApiBonum *ib*. Also, it was found that ApiBonum *ib* has a positive effect on the vitality, i.e., strengthening of honeybee colonies, since an increase in the number of honeybees was observed in half of the experimental colonies at the end of the study, compared to the initial clinical examination. As a natural remedy, ApiBonum *ib* is not harmful to bees. When used, there is a lower risk of developing resistance to mites, as well as the appearance of residues in honeybee products. ApiBonum *ib* can be a useful tool for maintaining the vitality and hygiene of colonies and possibly as an immunomodulator that stimulates the hygienic behavior of honeybee colonies.

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PP-105 [Bee Health]
Prebiotic Approach Research with Taraxacum officinale and Cichorium intybus for the Welfare of Honey Bees and Protection of Microbiota Dynamics and also against Nosemosis

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Microbiota dynamics play an important role that supports the immune system of honey bees against pathogens and pests. For this reason, many studies have been conducted on the effect of probiotic microorganisms on honey bee health. Although the use of probiotic microorganisms is the subject of scientific research, it is still a matter of debate which type of probiotic microorganism, in which combination and in what dose honey bees need. The beneficial microorganism diversity of honey bees shows almost individual differences according to race, region, climate and vegetation. The nutrients that induce the proliferation of individual microorganisms of each honey bee, are structural oligosaccharides defined as prebiotics. The most important prebiotic source is the exine outer layer of pollen, which has a cellulose and chitin structure. However, as one of the negative effects of climate change, the food source of beneficial microorganisms is also decreasing due to the decrease in pollen resources. This situation both weakens the immune system and induces intestinal diseases such as Nosemosis. Inulin was extracted from the roots of Taraxacum officinale and Cichorium intybus plants, which have high prebiotic properties, and made into a solution in 2 different concentrations in order to provide prebiotic support to the nutrition of honey bees, to encourage the reproduction of their own probiotic microorganisms and to strengthen the immune system. It was added to 1:1 w:v syrup and used to feed the bees in cages with 70 bees each. 4 cages were infected with Nosema spores at a rate of 0.9x106 spores/mL. It was found statistically significant that life expectancy increased in prebiotic supplemented feeding compared to the control groups. It was determined that the number of spores in bees infected with Nosema decreased by 38%. When both plant species were compared, it was determined that T. officinale increased the total biomass of microbiota by 33.6%. It is extremely important to support bee nutrition not only in terms of protein but also in terms of prebiotics, especially during periods of pollen shortage. Prebiotics would be a good alternative in tolerating food shortages and protecting bee health against climate change.

PP-106 [Bee Health]
Assessing the Impact of Indoor RF-EMF Exposure at 3.6 GHz on the Development of Honey bees

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Newly introduced telecommunication technology results in changes in exposure patterns of radiofrequency electromagnetic fields (RF-EMFs) that can be absorbed in organisms (like insects) which have unclear biological consequences. The current study aims at investigating the effects of RF-EMFs at 3.6 GHz on honeybee brood development under controlled conditions (ETAIN- HORIZON project).

To achieve this objective, three honey bee colonies were exposed to a 5G-like modulated RF-EMF signal at 3.6 GHz with an incident rms-power density of 1W/m2 (10% of the maximum permissible incident power density for the general public in the EU), while three parallel control colonies were not. The two groups of colonies were kept in separate rooms electromagnetically shielded from each other. The colonies were placed on digital scales and equipped with sensors continuously measuring RF electric field strengths, temperature, humidity, and CO2. The development of the eggs, larvae and pupae was monitored continuously, as well as the state of the queens.

We observed that 11% of eggs and 20% of larvae from the exposed colonies as well as 22% of eggs and 15% of larvae from control colonies were removed by bees before the capping stage (n.s. difference). We also observed a one day delay in hatching for 23% and 8% of eggs in exposed and control groups, respectively (significant difference), and one day delay in the emergence of adult bees for 19% and 4% of larvae, in exposed and control bees, respectively (n.s. difference). Total emergence percentage was not different between the exposed and the control group (ca. 100%). No differences were observed in queen status and weight of the colonies. However, brood temperature, humidity, or CO2 between the two experimental groups still need to be analysed. Further tests are currently conducted to increase data points. Field tests on honey bee colonies are also planned to determine the wellbeing of the colonies also while applying a higher frequency (e.g. 26 GHz) exposure.

Outcomes of the above and further investigations will increase our knowledge and understanding of honey bees' behaviour under these exposure patterns, explain the biological meaning of these effects and determine any mitigation measures needed.

PP-107 [Bee Health]

Pesticide exposure assessment in stingless bees

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Bees are crucial pollinators of many crops and wild plants, and pesticide exposure is one of the primary environmental stressors affecting their health. Most information regarding the impacts of pesticide exposure has been derived from studies on honey bees; however, recent research has increasingly focused on pesticide exposure and its effects on **non-*Apis* bees**, including other social bees such as **bumble bees and stingless bees.**

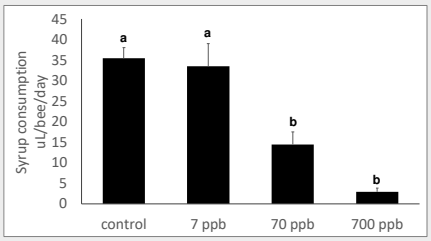
Stingless bees comprise the most diverse group of eusocial bees with more than 500 species distributed in the pantropical region.

The growing declining of insects' population due to human activities, such as **pesticides**, is also affecting the stingless bees. Differences in **life history traits** between **honey bees** and **stingless bees** are likely to influence the routes and levels of **pesticide exposure**.

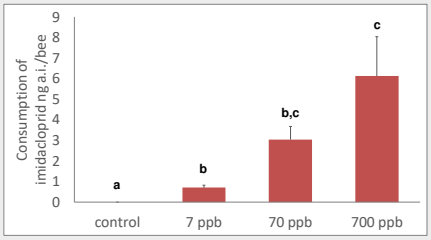
Quantifying food ingestion is a key component in estimating pesticide exposure to bees through their diet. **Foraging bees** consume the largest amounts of nectar, and artificial syrup (50% sugar in water) is a suitable medium for quantifying food intake.

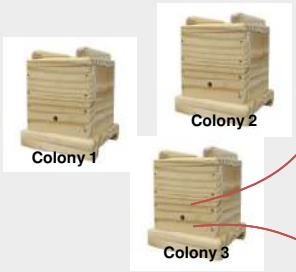
Here, we investigated the consumption of syrup contaminated with the **neonicotinoid imidacloprid, a widely used insecticide in Brazil,** by the stingless bee ***Melipona quadrifasciata***.

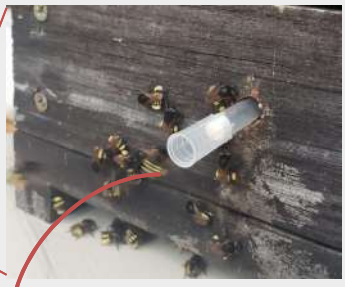
Ingestion of syrup

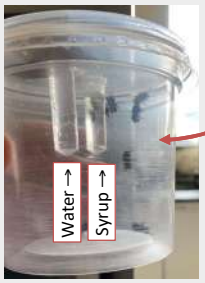


Ingestion of imidacloprid





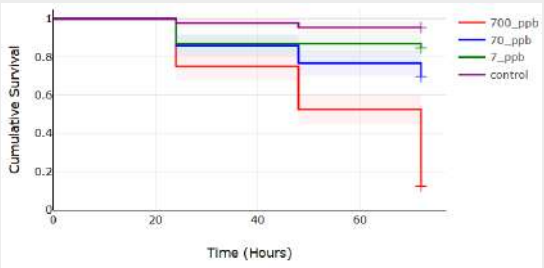




Control: syrup 50% v/v
Treatments:
Imidacloprid 7 ppb
Imidacloprid 70 ppb
Imidacloprid 700 ppb
} Realistic concentrations found in honey and nectar

Foragers were fed for 72 hours, and consumption was measured at the end of the experiment.
Dead bees were removed daily.

Foragers fed syrup containing 70 and 700 ppb of imidacloprid ingested significantly lower amounts of syrup. Nonetheless, each bee fed 700 ppb consumed more active ingredient than bees fed 70 ppb. An amount of 5-6 ng a.i. of imidacloprid per bee is extremely harmful to *M. quadrifasciata* foragers.



- Our study demonstrates that, unlike honey bees and bumble bees, stingless bees seem **to avoid feeding on syrup contaminated with imidacloprid**.
- This result may have important implications for stingless bee health.

Financial support FAPEMIG CNPq UFVJM

PP-108 [Bee Health]

Building tools for Integrated Varroa Mite Management

Grand Est region
France

Field monitoring of varroa sensitivity to miticides in the Grand Est region, France

About us

The ADA Grand Est is a professional regional organisation that works towards the development, support and promotion of modern and sustainable beekeeping. It aims at gathering beekeepers from the Grand Est region of France around issues that are relevent to them: the health and environment of bees, breeding techniques, and the promotion of beekeeping and bee products.

Key numbers

32 beekeepers involved in the project over 3 years

455 hives included in the protocols

988 phenotypic tests conducted

Methodology

Two kinds of tests were carried out:

In situ phenotypic tests

applying the molecule through direct contact of phoretic mites on living bees

- 2023 and 2024: **Pettis tests** (Pettis J, 1998), with glass jars.
- Since 2025: + **Apiarium tests** (Bahreini et *al.*; 2020 & 2023), 125ml plastic containers.

- A sample of 300 bees is collected from each hive registered in the experiment (x12/apiary).
- The bees are placed in containers maintained at approximately 25°C.
- The bees and their phoretic Varroa mites are exposed to a sized-down strip of the chosen treatment molecule (amitraz, flumethrin or tau-fluvalinate).
- The dead Varroa mites collected into the petri dish are counted after 24h for tau-fluvalinate and after 6h for amitraz and flumethrin.
- The bees are washed with a detergent to count the remaining alive mites (VP100).
- The level of varroa sensitivity is evaluated by dividing the number of dead mites by the total number of mites counted.

Ex situ phenotypic tests

sampling varroa mites from capped brood and testing the samples in petri dishes

- Samples sent and **tested in lab** by APINOV

- Samples of capped brood are cut and collected from the apiary, on hives with >3% infestation.
- The samples are sent to our partner lab (APINOV).
- The varroas collected from the samples are exposed to the chosen treatment mollecule in Petri dishes.
- The level of varroa sensitivity is evaluated by dividing the number of dead mites by the total number of mites counted.

Varroa infestation: Randy Oliver's Varroa Model was used to better understand varroa population dynamics and better estimate treatment's efficiency. Varroa population in V3 was compared to model estimated population without treatment:

JULY - V1 sampling	AUGUST - V2 sampling	SEPT. - V3 sampling
Varroa count: Nb varroa/100 bees Counts on hives that were part of the project at N-1. Counts on new hives that joined the protocol to replace winter losses.	**Varroa count: Nb varroa/100 bees | Pettis tests or Apiarium on 3 molecules (amitraz, tau-fluvalinate and flumethrin) -** 12 hives per apiary monitored to analyse phoretic varroa sensitivity. **Lab tests by APINOV -** Sampling of capped brood, picked among the most infested hives (> 3% infestation). PRE TREATMENT	**Varroa count: Nb Varroa/100 bees** Same process as V1. POST TREATMENT

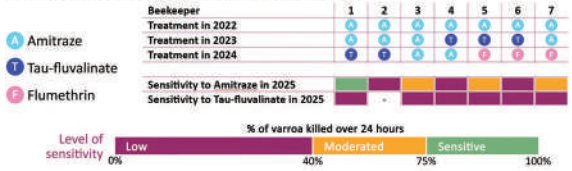
The « Alternance project »

a field-based approach geared towards beekeepers

- Initiated by the ADA Grand Est in 2023.
- 8 beekeepers involved in 2023, 13 beekeepers in 2024, and 11 beekeepers in 2025.
- Started in the Grand Est region (see map above), and is now starting to be carried out by our network partners (ADA network + ITSAP-Bee Institute).
- **MAIN GOAL**: measuring the loss of sensitivity of the varroa mite towards miticides at the scale of the apiary, allowing beekeepers to adapt their treatment strategy, and to favorise an IPM approach rather than monotherapy.
- **OBJECTIVES:**
  - Collecting initial indications of sensitivity/reversion dynamics.
  - Developping a tool and reflections based on individual beekeepers' protocols.
  - Exploring Integrated Pest Management approaches as alternatives to monotherapy (Randy Oliver, ABJ, 12/2006).
  - Going further than conventional mite monitoring.
  - Understanding apiaries' dynamics around treatments and mite development throughout the year.

Results highlights

Average sensitivity level of the apiaries monitored in 2025 (APINOV tests), in regards to the treatment previously applied:



Main analysis (for now)

- Variability of varroa sensitivity within the same apiary.
- Results overall consistent and correlated, validated over the years and follow-up of the same hives.
- Strong correlation between treatment efficiency in the field and lab sensitivity monitoring (Pettis and Apinov).
- Two main categories of treatment failure: proven resistance and/or poor timing of treatment on excessive mite infestation (Varroa Model).
- Environmental impact and diversity of events can impact results (weather, viruses and pests, hive loss over the winter and new hives entering the protocol, timing and/or quality of treatment...).

Conclusion

This on-going 3-year project shows the need to keep **integrating complementary strategies** such as winter treatment, alternation of molecules and population-based control method. Interannual monitoring also showed **an improvement for miticide sensitivity when a molecule rotation is introduced**. The ADA GE intends to collect data and monitor reversion time on a multiyear sequence; we keep **exploring ways to improve the methodology and protocol** and bring the experiment closer to bees' natural behaviour when receiving a treatment, testing types of jars (Pettis, Apiarium), sizes and time exposure with each molecule.

PP-109 [Bee Health]
Feeding drives the reproduction of Varroa destructor

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The reproduction of Varroa destructor, an ectoparasite with devastating effects on honeybees, is activated solely by freshly capped Apis mellifera brood. V. destructor mites initiate reproduction shortly after entering appropriate cells, yet the mechanisms that trigger their reproductive initiation remain poorly understood. Feeding is considered a major driving factor. To investigate how feeding affects the reproduction of V. destructor mites, we conducted artificial infestation experiments to compare reproductive-related changes between mites that invaded appropriate and inappropriate cells, and analyze the association between these changes and feeding behavior. The results showed that the changes in vitellogenin genes expression levels and gonopore size of mites introduced into freshly capped cells and therefore produced offsprings are associated with weight, i.e., feeding. All three exhibited an increased followed by a decrease during the reproductive period of mites. Weight loss occurred on day 8 after mites entered cells (when the last egg was laid), while vitellogenin genes downregulation started on day 2 (before the first egg was laid). Also, the first blood meal of the mites occurred within 1 hour after entering cells. Interestingly, mites introduced into cells 24 hours or more after capping, which did not lay offspring as a result, exhibited similar changes, albeit with less pronounced variation compared to fertile mites. Transcriptomic sequencing displayed that, compared to sterile mites, the transcriptomic profile of fertile mites underwent significant changes 6 hours after entering cells, with the activation of functions and pathways related to protein synthesis. However, proteomic sequencing revealed that there were only minimal differences in the endogenous V. destructor proteins between fertile and sterile mites. The more significant proteomic differences are attributed to exogenous host proteins, such as major royal jelly proteins, bee milk proteins, etc. Taken together, these results suggest that feeding may serve as a trigger for the initiation of reproduction in V. destructor, and the abundance of host nutrient-related proteins may promote the fertility of mites. Our research provides new insights into the interactions between V. destructor and honeybees based on feeding behavior.

PP-110 [Bee Health]
Resistance and vulnerability of honeybee (Apis mellifera) gut bacteria to commonly used pesticides

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Agricultural and apicultural practices expose honeybees to a range of pesticides that have the potential to negatively affect their physiology, neurobiology, and behavior. Accumulating evidence suggests that these effects extend to the honeybee gut microbiome, which serves important functions for honeybee health. Here we test the potential effects of the pesticides thiacloprid, acetamiprid, and oxalic acid on the gut microbiota of honeybees, first in direct in vitroinhibition assays and secondly in an in vivo caged bee experiment to test if exposure leads to gut microbiota community changes. We found that thiacloprid did not inhibit the honeybee core gut bacteria in vitro, nor did it affect overall community composition or richness in vivo. Acetamiprid did also not inhibit bacterial growth in vitro, but it did affect community structure within bees. The eight bacterial genera tested showed variable levels of susceptibility to oxalic acid in vitro. In vivo, treatment with this pesticide reduced amplicon sequence variant (ASV) richness and affected gut microbiome composition, with most marked impact on the common crop bacteria Lactobacillus kunkeei and the genus Bombella. We conducted network analyses which captured known associations between bacterial members and illustrated the sensitivity of the microbiome to environmental stressors. Our findings point to risks of honeybee exposure to oxalic acid, which has been deemed safe for use in treatment against Varroa mites in honeybee colonies, and we advocate for more extensive assessment of the long-term effects that it may have on honeybee health.

APIMONDIA SCANDINAVIA 2025
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PP-111 [Bee Health]

BEENERGIA

Pathogens on the move:

Impact of pathogen transmission between managed and wild bees

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Wild bee populations are declining in many regions[1] - and that's bad news for nature and for us. Why? Because wild bees are key to pollination and healthy ecosystems, as honey bees are.

Managed honey bees do not just share flowers with wild bees - they also share diseases[2]. Are these diseases also responsible for wild bee declines[3,4]?

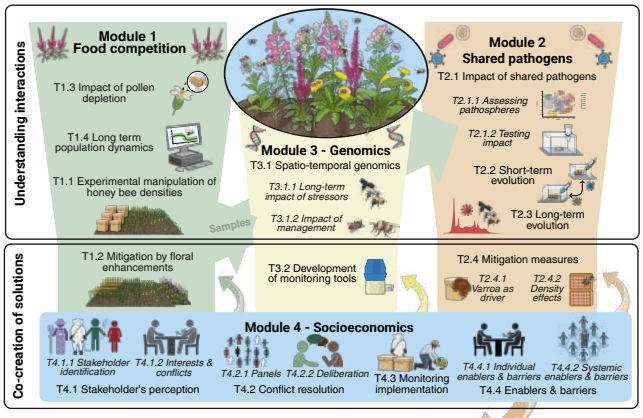
BEENERGIA aims to identify if, when, and how managed bees pose a risk to the resilience of wild bee populations.

Module 1
Explores how wild bee reproduction is affected when they must compete for nectar and pollen, especially during the flower-scarce summer months.

Module 3
Explores how managed bees shape the genetics and evolution of wild bee populations.

Module 4
Connects science with beekeepers, conservationists, and policymakers and how they perceive bee interactions

Graphical overview of the BEENERGIA project



Module 2

Can diseases of managed bees affect wild bees?

How does transmission affect the short- and long-term evolution of pathogens?

How can we mitigate potential effects of pathogen transmission?

Field survey: are pathogens shared?

High honey bee density to ensure overlap with wild bees

Collection of wild bees and honey bees

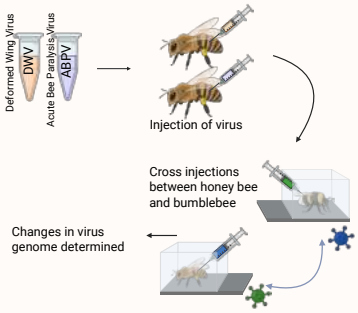
Checking what pathogens they carry

Do the shared pathogens affect wild bee reproduction and survival?

Screening wild bee females for pathogens found in the first step

Link pathogens found with the number of offspring and their sex ratio

How does pathogen transmission affect the virulence and genetics of pathogens?

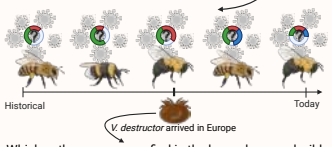


What is the long-term impact of bee management on pathogen transmission and evolution?

We screen museum samples

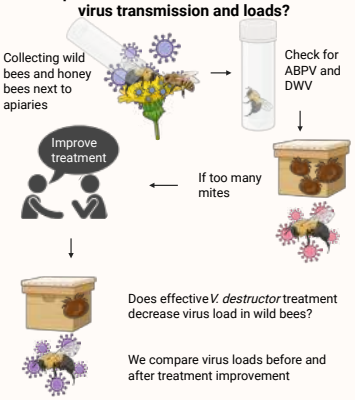
Endogenous Viral Elements (EVEs) are used. EVEs are viral genome sections integrated into the host genome.

When did the viruses start infecting the different host species?



Which pathogens can we find in the honey bees and wild bees before *V. destructor* was present in Switzerland

Does improved *Varroa destructor* control decrease virus transmission and loads?



Does effective *V. destructor* treatment decrease virus load in wild bees?

We compare virus loads before and after treatment improvement

Are big bee hotels pathogen and parasite paradises?

Compare big and small wild bee hotels and compare the virus loads

Visual inspection of brood mortality and parasites

References

1. D. Goulson, E. Nicholls, C. Botías, E. L. Rotheray, Bee declines driven by combined stress from parasites, pesticides, and lack of flowers. Science. 347 (2015).
2. O. Yañez, N. Piot, A. Dalmon, J. R. de Miranda, P. Chantawannakul, D. Panziera, E. Amiri, G. Smagghe, D. Schroeder, N. Chejanovsky, Bee viruses: routes of infection in *Hymenoptera*. Front. Microbiol. 11, 943 (2020).
3. D. Goulson, E. Nicholls, C. Botías, E. L. Rotheray, Bee declines driven by combined stress from parasites, pesticides, and lack of flowers. Science. 347 (2015).
4. J. M. Iwasaki, K. Hogendoorn, Mounting evidence that managed and introduced bees have negative impacts on wild bees: an updated review. Curr. Res. Insect Sci. 2 (2022).

The poster and most illustrations were made with BioRender

PP-112 [Bee Health]

Gut microbiome composition and hygienic behavior as indicators of varroa resistance in an Italian honey bee breeding population

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Background

Honey bee colonies face multiple threats, with *Varroa destructor* among the most serious. Selective breeding for hygienic behavior, enabling bees to detect and remove infested brood, is a key strategy to enhance resistance. Recent research also highlights the gut microbiota's role in bee health and resilience.

This study aimed to investigate the relationship between gut microbiome composition and hygienic behavior in an Italian honey bees population selected since 2015 for docility, productivity, and hygiene. By integrating microbiome profiling and behavioral testing, we explored microbial patterns associated with resistance traits.

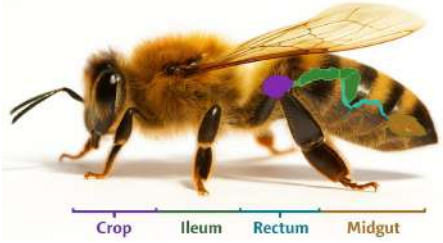


Figure 1. Honey bee gut.

Materials and Methods

Figure 2. Pin test for hygienic behavior.

Seventy-seven colonies from a breeding population were sampled three times between June and October 2021. For each colony, ten worker bee guts were dissected, pooled, and used for 16S rRNA sequencing (V3–V4 region) via Illumina technology.

Bioinformatic analyses were performed in R, with taxonomic assignment using the SILVA database.

Hygienic behavior was assessed using the Pin Test, where 50 capped brood cells were pierced with a needle and the removal rate after 24h was recorded (Figure 2). The test was repeated twice, and scores were averaged.

Results

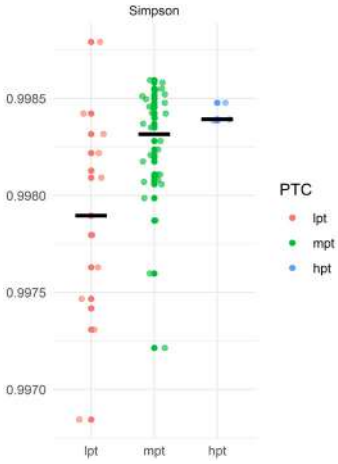


Figure 3. α-diversity by hygienic group.

A clear, season-dependent association between gut microbiota diversity and hygienic behavior was observed. Colonies classified as highly hygienic (hpt) exhibited increased α-diversity, as shown in Figure 3. This trend was particularly evident in October, when varroa destructor pressure typically peaks.

From the differential abundance analysis, 64 ASVs were identified as significantly more abundant in the high-hygiene group, as shown in yellow and red in Figure 4.

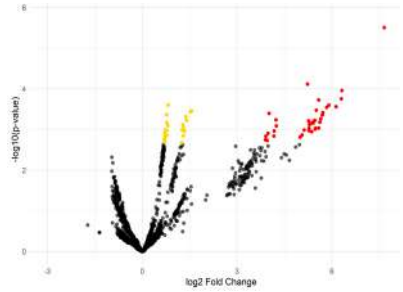


Figure 4. Differential abundance of bacterial taxa.

These ASVs belonged to beneficial bacterial genera, including *Bifidobacterium* and *Lactobacillus*, which are known for their immunomodulatory roles and may contribute to enhanced colony resilience and pathogen defense.

Conclusions

Our results suggest that a beneficial gut microbiota may support honey bee immune function and enhance hygienic behavior, contributing to greater colony resilience. Understanding microbiome–behavior interactions provides valuable insights for bee health management and highlights the potential of probiotic-based approaches to improve honey bee health and varroa resistance.

This research was funded by the BEENOMIX 2.0 and BEENOMIX 3.0 projects funded by the Lombardy Region (FEASR program), (grant number 201801057971 – G44I19001910002 and 202202375596 - E87F23000000009).

PP-113 [Bee Health]
Honey bee resistance to varroa mites: insight into the complex nature of the SMR trait

Amélie Noël, Barbara Locke
Honey Bee Research Centre, Swedish University of Agricultural Sciences, Uppsala, Sweden

Background and Purpose
The parasite Varroa destructor is a major threat to the honey bees (Apis mellifera) and to beekeeping worldwide. Specific honey bee population have developed resistance to the parasite and are able to regulate the growth of the varroa population within the colony, without the required use of mite-control pesticides. These populations can have different host traits that affect the varroa-load inside the colony but a common similar feature in many of them is the SMR trait (Suppressed Mite Reproduction). Recent studies have shown that a modification of the pheromonal bouquet of pupae could potentially be linked to the disruption of varroa reproduction. However, this pheromonal bouquet is used by brood to communicate with adult bees. The aim of this study is to observe whether adults in colonies with high SMR expression are more or less sensitive to pupal pheromones than non-SMR colonies.

Methodology
We compared how bees from SMR and non-SMR colonies react to pheromones at different concentration using simple olfactory learning tasks with the proboscis extension reflex.

Results and conclusions
This study will deepen our understanding of the communication between individuals in the colony and potentially open new perspectives on understanding how honey bee colonies develop unique traits of mite resistance.

Practical implications for beekeepers
The long-term aim of this study is to develop sustainable long-term strategies for mite control with mite-resistant honey bees. Understanding the underlying mechanisms of the SMR trait will help to develop new technology used in identifying and breeding for disease resistance.

PP-114 [Bee Health

Primal Bee®

Treatment-Free Beekeeping: case study in Negev Desert

G. Riganti, A. Gamberoni, T. Moldovan, E. Nir, Y. Melman, J.R.Graham

Symbiosis Meets Design

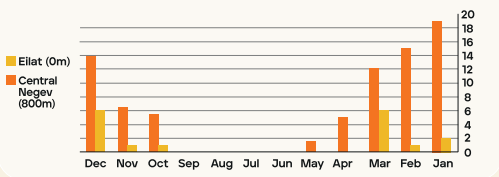
Treatment free beekeeping – managing bees without the use of artificial antibiotics or chemical pesticides, is one of the most difficult challenges and diffuse desires for many hobbyist beekeepers. The purpose of this work is to present a case study demonstrating success in treatment-free beekeeping due to ideal internal hive conditions, treatment-free stock, and a pseudoscorpion symbiosis providing biological control.

Field Study in the Negev Desert

Between 2015-2025, this study was conducted in a semi-desert climate on the border of Beer Seeva Negev desert. Attempts were made to select survivor colonies by catching feral colonies and swarms using a standard wooden Langstroth hive. Thermodynamic hive prototypes were designed and built, to ensure an ideal internal nest environment. The hive design was optimized, foundation drawn by bees and living pseudoscorpions were installed in the hive.

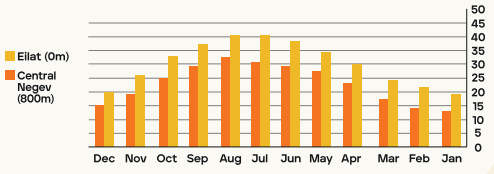
Negev Desert Average Precipitasion [mm]

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Eilat (0m)	2	1	6	0	0	0	0	0	0	1	1	6	17
Central Negev (800m)	19	15	12	5	1.5	0	0	0	0	5.5	6.5	14	78.5



Negev Desert Average day time Temperatures [c°]

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Eilat (0m)	19	21	24	30	34	38	40	40	37	33	26	20	30
Central Negev (800m)	13	14	17	23	27	29	31	32	29	25	19	15	23



Synergy in the Hive: Thermodynamics, Genetics, and Pseudoscorpions

Strong survivor colonies of Apis mellifera ligustica cultivated locally for 40y, were collected from swarms and feral colonies and maintained treatment-free for 5y. Survivor colonies were observed raising the internal hive temperature from 35°C to 45°C similar to an immune response to combat bacterial infection. This immune response was effective due to the thermal efficiency of the Primal Bee hive. The pseudoscorpions survived on the bottom board in the thermodynamic hives, and predation of Varroa was observed.
Honey was harvested also in late autumn up to winter-time where nearby professional operations in standard hives are fed up to 60L of sugar syrup to survive. This presentation will highlight for beekeepers the importance of providing an ideal internal environment in the hive and the synergistic results of thermodynamics, bee biology, biological control and survivor stock genetics.

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PP-115 [Bee Health]
Hidden in the Honeycomb: Diversity and Phylogeny of Bee Parasites

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Dragomir Damnjanović[1,2], Alena Lövy[1], Monika Burgerová1,2, Hana Pecková[1], Šimon Zeman[3], Jan Votýpka[1,3]
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Bees (Hymenoptera: Anthophila: Apoidea) are taxonomically and ecologically diverse pollinators dependent on pollen and nectar. While their ecological and economic significance is well-documented, research on their parasites has primarily focused on honey bees and bumblebees. The understudied wild bees may harbor a broader and more complex range of parasites and pathogens than managed honey bees.

Microsporidians, obligate parasites of animals and protists, pose a significant threat to honey bees and bumblebees. Monoxenous trypanosomatids colonize arthropod digestive tracts and were considered benign until recent studies suggested their negative impact on pollinator health. Bee amoebae infect Malpighian tubules and gut, causing organ damage that can lead to host death. Despite these effects, the diversity of these parasite groups in bees remains largely unexplored as is the possible parasite spillover between commercial and wild bees. Expanding research beyond domesticated bees and identifying new parasitic species is essential for understanding emerging threats contributing to pollinator declines.

Tissue metabarcoding, a powerful tool for uncovering hidden parasite diversity, has yet to be applied to bee-associated parasites. We employed metabarcoding and high-throughput sequencing (Illumina and Oxford Nanopore Technologies) to detect microsporidian, trypanosomatid, and amoebae diversity in honey bee and wild bee tissues and products in the Czech Republic.

Metabarcoding analyses of bee samples revealed a high parasite prevalence. Sequencing identified multiple microsporidian OTUs clustering within the Nosematidae clade, including Nosema ceranae and potential new microsporidian species in honey bees. Trypanosomatid-specific screening detected Crithidia mellificae, Lotmaria passim, and novel OTUs. Amoebae-specific screening revealed Malpigamoeba and Entamoeba species as distinct insect-infecting lineages. Our findings highlight the potential for bees to harbor a previously unrecognized diversity of parasites. Light and electron microscopy will be employed to confirm infections and provide additional insights into the parasite load and pathogenicity.

Our research underscores the need for further investigation into parasite diversity, transmission dynamics, and their impact on pollinator health. This is critical for maintaining ecological stability and agricultural sustainability, as healthy pollinators are essential for crop production. The outcome of our research highlights the importance for beekeepers to monitor for emerging parasites and adopt management strategies to protect their colonies.

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PP-116 [Bee Health]

Development of a metabolic preparation with high antimicrobial potential for use in the prophylaxis against *Paenibacillus larvae* causing American foulbrood in bee colonies

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Introduction and Research Problem

American foulbrood (AFB) is a bacterial, infectious, highly contagious disease of honey bee larvae (*Apis mellifera*) caused by the Gram-positive, rod-shaped bacterium called ***Paenibacillus larvae***. The earlier taxonomic name of the species of this obligate pathogen was *Bacillus larvae* (Genersch et al., 2006). This is a highly specialised pathogen with only one established host, brood with an acute and malignant course, which affects and kills larvae in the straightened form, less often in the pre-pupa or pupa stage. The disease most often occurs during warmer periods, in Poland it occurs in the second half of summer (Pohorecka et al., 2012). Transformation from spore to live, vegetative bacterial cell form occurs **when the glucose concentration in the simple intestine of the bee larva falls below 2.5%**. Bee larvae are particularly vulnerable to this infection. *Paenibacillus larvae* spreads its infectivity and pathogenicity through multiple levels via many different complex mechanisms, factors, and routes of transmission. **It takes only 10 spores to infect one larva. Infection usually occurs when 35 endospores per larva are applied to the brood**. For infection of the pupae by haemolymph, 5000 sporophores are needed. **One infected larva can contain 100 million to as many as a billion spores** and 100 million viable bacterial vegetative cells before sporulation begins. **A larva that has died may contain 2.5 billion spores** (Ebeling et al., 2016; Tsourkas, 2020). Susceptibility to infection, the course of infection and disease depend on the infectivity, virulence and spreadability of pathogens, the age and immune status of larvae, and the effects of stress factors, mainly cold, malnutrition or overheating. **Larvae aged 55-60 hours are susceptible to infection.** Older larvae are generally not susceptible to infection. The disease usually appears in strong and healthy colonies with large brood numbers when environmental conditions and the microclimate in the hive are disturbed. The susceptibility and course of the infection depends on the infectivity, virulence and dissemination of the pathogen, **but also on the age, the immune status of the larvae, the hive microbiome and stress factors such as cold, malnutrition, lack of a varied diet, overheating and the presence of concomitant diseases** (Nowotnik et al., 2024). The brood becomes infected after ingestion of contaminated food given by worker honey bees (so-called hive bees). Within the colony, the disease spreads via feeder bees, which inoculate the mouth organs and legs with bacterial ensopres and, through them, the honey (Dickel et al., 2022). Other ways of spreading the germs include, for example, hive pests, which can become infected with the endospores while foraging and then excrete the spores in their faeces, or combs contaminated with endospores of *P. larvae* that previously housed diseased and dead brood. **Spores are transmitted via the beekeeper and straw bees, robbing bees and apiary equipment including combs.** They can also be transmitted on footwear, clothing, frames, bee products or apiary equipment. Spores are also present in the environment - **in dead brood, water, pollen, nectar, honey or royal jelly and bees can also become infected with them through trophallaxis**. The source of infection is contaminated food and the route of infection is the gastrointestinal tract (Fries et. al., 2006; Lindström et. al., 2008; Šekulja et. al., 2013; Grady et al., 2016). **This disease leads to emaciation of the colony, a reduction in the number of flying bees, and productivity declines** (Evans 2004). Clinical signs depend on the particular genotype, **Eric I, Eric II, Eric III, Eric IV or Eric V**, and may be either dieback of the larvae and their remaining stretched out and rigid form, or the mucous, gelatinous head of the bees, the extra-occluded caps, scabs stuck to the hexagonal wall of the cell or the dried ovula of the future undeveloped bee (mouth organ). This is a pathognomonic trait for malignant foulbrood. The first symptom of brood die-off is a change in the colour of the cuticle from pearly white, shiny to greyish-white, dull and then, under the influence of the proliferating microflora, to yellow. There is a decrease in tissue tone while external segmentation is preserved. The larva becomes flaccid and softens (Erban et al., 2019; Beims et al., 2020; Bzová et al., 2021). **The most alarming finding from the USA is that, on a national scale, AFB resistance to tetracycline (38%) was significantly (p < 0.001) higher than resistance to tylosin (27%) (Alburaki et al., 2024).** The situation is completely different in the EU, where there are no registered antibiotics for honey bees, and over-the-counter medicines may be used in honey bees in a manner inconsistent with their intended use. There is also a risk of contamination of bee products and exceeding the maximum residue limit (MRL). **Although antibiotic therapy is formally prohibited in the EU, the degree of antibiotic contamination in honey samples ranges from 1% to 7% of honey samples produced in the EU**. In countries where antibiotics are permitted, unfortunately, relapses occur after their use and completion of treatment. There is no pharmacotherapy for the disease, and ex officio control is used in many countries (Mosca et al., 2023). Seeing such a significant imperfection in all these methods, as well as the growing resistance of individual *P. larvae* genotypes to antimicrobial substances and the increased secretion of various metabolites and proteins secreted by *P. larvae*, it was decided to respond to this growing problem with a different research approach. Since *P. larvae* owes its pathogenicity mainly to the toxins and enzymes it produces, it was decided **to respond to the research problem with the same type of weapon, using a completely new biotechnological approach. In this study it was used a synbiotic combination of metabolites and bacteriocins produced by beneficial and probiotic strains in combination with plant extracts**. This study aimed to test and compare the antimicrobial activity of metabolites of fermented extracts of **selected plant raw materials and killer probiotic strains** against *Paenibacillus larvae* Eric I, Eric II (the most popular strains in the EU) as biological agents (**as an integral preparation called ApiBiotic produced by ProBiotics Polska Company**) for the **biocontrol of American foulbrood in bee colonies**. Preventive methods are still lacking and are in the early stages of development. It has therefore become an object of scientific interest for many researchers to look into the possibility of using bacterial metabolites for biocontrol of American foulbrood as a preventive measure. We must strive to ensure that prevention is the best method of treatment.

Results – CLSI guidelines

Table 1 Data (to 3.3 - 3.5) with designated MIC and MBC parameters for ApiBiotic against the *Paenibacillus larvae* ATCC 9545 (Eric I)

ApiBiotic:	*Paenibacillus larvae* ATCC 9545 (Eric I)			
Metabolites belonging to:	**MIC [% v/v]**	**MIC [mg/cm³]**	**MBC [% v/v]**	**MBC [mg/cm³]**
ApiBiotic I (production: 07/2024)	12,5	125	25	250
ApiBiotic II (production: 10/2024)	12,5	125	25	250
ApiBiotic III (production: 12/2024)	10	100	12,5	125

Table 2 Data (to 3.3 - 3.5) with designated MIC and MBC parameters for ApiBiotic against the *Paenibacillus larvae* CCUG 50846 (Eric II)

ApiBiotic:	*Paenibacillus larvae* CCUG 50846			
Metabolites belonging to:	**MIC [% v/v]**	**MIC [mg/cm³]**	**MBC [% v/v]**	**MBC [mg/cm³]**
ApiBiotic I (production: 07/2024)	1	10	10	100
ApiBiotic II (production: 10/2024)	1	10	1	10
ApiBiotic III (production: 12/2024)	1	10	1	10

Figure 1. Killing curve showing the relationship between ApiBiotic concentration and the time of its effect on the viability of *Paenibacillus larvae* ATCC 9545 (Eric 1) bacterial cells

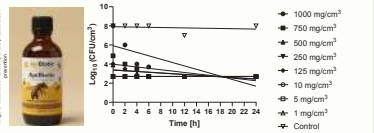


Image 1. Visualization of the ApiBiotic product used in the research

Figure 2. Killing curve showing the relationship between ApiBiotic concentration and the time of its effect on the viability of *Paenibacillus larvae* CCUG 50846 (Eric 2) bacterial cells

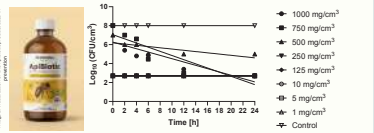
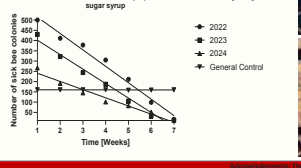


Image 2. Visualization of the ApiBiotic product used in the research

Image 3. Microdilution method (to 3.3 and 3.4) according to CLSI

Image 4. Sampling of infected larvae – as additional study, treatment trial and verification of the effectiveness of the preparation in the infected colonies

Figure 3. Decline curve of bacterial infections caused by *Paenibacillus larvae* in Polish apiaries from 2022 to 2024 after treating sick bee colonies with a 3-fold dose of 10% preparation administered every 5 days in 50% sugar syrup



Materials and methods – CLSI guidelines and methodology

1. Subject of research
Probiotic product, which is also a metabolic preparation and synbiotic with the working name ApiBiotic, and produced by ProBiotics Polska – Probiotics Manufacture in Bratuszyn, 62-720 Brudzew, Poland, www.probiotics.pl

1.1 Product composition
ApiBiotic contains: beneficial microorganisms and their metabolites as antimicrobial agents such as *Lactobacillus acidophilus, Lactiplantibacillus plantarum, Lactiocaseibacillus casei, Bifidobacterium Bifidobacterium longum, Streptococcus thermophilus, Lactobacillus bulgaricus, Limosilactobacillus fermentum, Bifidobacterium animalis, Lactococcus lactis subsp. lactis biovar diacetylactis* used for fermentation and extraction of biologically active compounds from the following plant components: yerba mate leaf , bay laurel leaf, mugwort herb, white willow leaf, walnut leaf, common pine buds, silver birch leaf, European olive leaf, English oak leaf, allspice fruit, watercress leaf, marigold flower, tall nasturtium leaf, black poplar buds, in addition, killer strains belonging to species have been added: *Parasaccharibacter apium* PBP01, *Lactobacillus kunkeei* PBP03, *Lactobacillus amylovorus* PBP04, *Lactobacillus apis* PBP05, *Lactobacillus melliventris* PBP06, *Apilactobacillus apinorum* PBP07, suspended in aqueous solution of cane molasses. The names of the strains have internal numbering and coding. The strains were deposited at the Institute of Microbiological Technology in Turek, Poland. The test strains had confirmed probiotic potential, meeting the FAO definition and the essential characteristics of a probiotic.

2. Indicator pathogens
The biological material consisted of the bacterial, pathogenic, indicator strains belonging to *Paenibacillus larvae* ATCC 9545, and *Paenibacillus larvae* CCUG 50846 (Labiol, Poland). Formerly, this is *Paenibacillus larvae subsp. sp. larvae*. The strains were deposited at the Institute of Microbiological Technology in Turek, Poland.

3. Working Methodology: Preparation of ApiBiotic samples for analysis
For the purposes of microdilution analysis, a three samples from 3 production series of ApiBiotic were subjected to mechanical filtration as part of mechanical sterilisation using 0.22 µm syringe filters with a diameter of 33 mm (Argenta, Poznań, Poland). This allowed us to test the antimicrobial activity of bacterial and plants metabolites against indicator strains belonging to *Paenibacillus larvae*. Dilutions of the filtered fluid were prepared so that the metabolite concentrations could be directed to analyses using microdilutions: 100%, 75%, 50%, 25%, 12,5%, 10%, 5%, and 1%. The dilutions were performed using sterile saline. A concentration of 100% was assumed for the liquid coming directly from the post-cultivation bioreactor.

3.1 Determination of minimum inhibitory concentration (MIC) and minimum bactericidal concentration (MBC) by the microdilution method (CLSI M02, CLSI MO7-A9, CLSI M100-S22, CLSI M11, CLSI M23, CLSI M56, Jorgensen and Ferraro 2009, CLSI-VET06)
The minimum inhibitory concentration (MIC) and minimum bactericidal concentration (MBC) of the ApiBiotic samples was tested using a serial microdilution method with certain modifications resulting from the specific nature of the microorganisms used. The obtained and sterile metabolites in the liquid after filtration using syringe filters were tested in the following percentage concentrations [% v/v]: 100; 75; 50; 25; 12,5; 10; 5; 1. In all analyses, the study was conducted using BHI liquid medium (Argenta, Poznań, Poland). The concentrations were then converted from percentage units [v/v] to units in milligrams per millilitre [mg/mL]. The density of water was assumed to be 1.000 g/mL for the calculations, justified by the fact that the bioreactors contained an aqueous solution of molasses.

3.2 Preparation of bacterial inoculum of *Paenibacillus larvae*
From a 24-hour culture (BHI agar and Columbia agar medium, Argenta, Poznań, Poland) of a specific bacterial strain belonging to the *Paenibacillus larvae* species (*Paenibacillus larvae* ATCC 9545, and *Paenibacillus larvae* CCUG 50846), a smear was made or biological material in the form of colonies was transferred using a standard loop to a flat-bottomed tube containing physiological saline. Using a densitometer, an inoculum with an optical density of 0.5 McFarland (units densitometer DEN-1B, Biosan, Poland) was prepared, which corresponded to approximately 1.0 x 10⁸ CFU/mL. If necessary, the biological material was diluted with saline solution. The prepared inoculum was not kept for more than 15 minutes before filling the 96-well plate.

3.3 Preparation of the microdilution method
The 96-well plate was gradually filled with 200 µl of the appropriate concentration of metabolites of ApiBiotic together with BHI brain and spinal fluid (100 µl of the proper concentration of metabolites and 100 µl of the BHI medium, Argenta, Poznań, Poland). The plates were filled in order from the highest to the lowest concentration of the antimicrobial agent, starting from the top rows (lines). This was done in a laminar flow chamber. The last two vertical rows of cells were designated as positive and negative controls, consisting in the first case of BHI medium, saline, and *P. larvae* inoculum without the addition of metabolites from ApiBiotic, and in the second case of BHI medium, 5% hydrogen peroxide, and *P. larvae* inoculum. After pouring the appropriate concentrations of metabolites together with BHI broth, 10 µl of *P. larvae* inoculum was added to each well using a multichannel pipette. The prepared plate was incubated at 37°C for 18-24 hours in a microaerophilic atmosphere created by Campygen Compact (Argenta, Poznań, Poland) laboratory atmosphere generators.

3.4 Determination of the minimum inhibitory concentration (MIC)
The cloudiness of the wells in the 96-well plate could suggest that the *P. larvae* bacterial cells are still alive. The absence of cloudiness and sediment, as well as the transparency of the preserved contents filling the well, could indicate a lethal effect on *P. larvae*. The MIC value for bacteria, therefore, reflects the minimum concentration of metabolites at which bacterial cells remain dead. A more reliable method was to spread the contents of the wells onto agar medium to estimate the number of cells that had grown. For the purposes of this analysis, a model was adopted in which the MIC value took the form of grown colonies on agar medium in the range of 50-100 CFU, so that the reduction in relation to the negative control was approximately 1-2 logarithmic cycles. For this purpose, 100 µl of culture was taken from each well, from the highest to the lowest concentration of the antimicrobial agent, and dripped in two replicates onto a single plate with Columbia agar (blood agar, Argenta, Poznań, Poland) and the second comparative Mueller-Hinton medium with the addition of blood (Argenta, Poznań, Poland). After the characteristic droplets had dried, the plates were placed in an incubator at 37°C in a microaerophilic atmosphere created by CampyGen Compact laboratory atmosphere generators. The reading was taken after 24-48 hours, and the grown bacterial colonies were counted. The MIC value indicated the concentration of metabolites at which less than 100 colonies and more than 50 colonies grew.

3.5 Determination of the minimum bactericidal concentration (MBC)
The next step was to collect 100 µl of culture from each well, from the highest to the lowest concentration of the ApiBiotic, and to drop it in two replicates onto a single plate with Columbia agar (blood agar) and the second comparative Mueller-Hinton medium with the addition of blood. After the characteristic droplets had dried, the plates were placed in an incubator at 37°C in a microaerophilic atmosphere created by CampyGen Compact laboratory atmosphere generators. The reading was taken after 24-48 hours, and the grown bacterial colonies were counted. If the plate has grown 3 logarithmic rows fewer bacterial colonies than in the negative control, i.e. less than 50 cells, this represents a 99.9% reduction in the cells of the initial inoculum. The MBC value indicated the concentration of metabolites at which less than 50 colonies grew.

3.6 Determination of the number of microorganisms depending on the duration of action of bacterial metabolites (NCCLS 1999)
To determine the degree of microbial reduction, 100 µl of suspension were taken from a series of dilutions and placed on sterile Petri dishes with Columbia agar (blood agar) and the second comparative Mueller-Hinton medium with the addition of blood at intervals of 0, 2, 4, 6, 12 and 24 hours of incubation of *P. larvae* inoculum mixed with the appropriate concentration of metabolites and BHI liquid medium. Metabolites in a volume of 900 µl and the prepared inoculum in a volume of 100 µl were transferred to Eppendorf tubes containing 1 mL of BHI liquid medium. The procedure was repeated for the control sample, transferring the inoculum to a tube containing 1 mL of BHI broth or, in the case of a positive control sample, to a tube containing 1 mL of BHI broth and 900 µl of 5% hydrogen peroxide. The concentration of metabolites corresponded to the MIC value obtained. The samples prepared in this way were incubated at 37°C for 0, 2, 4, 6, 12, and 24 hours. After the incubation intervals were completed, 0.1 mL was taken from each Eppendorf tube with a specific MIC concentration and transferred to tubes with saline solution (9.9 mL) in order to perform serial dilutions, transferring 1 mL from the previous tube each time. Next, surface cultures were performed on all dilutions containing inoculum presumably decreasing by one logarithmic order by pipetting 20 µl of biological material onto a Petri dish with Columbia agar (blood agar) and the second comparative Mueller-Hinton medium with the addition of blood using an automatic pipette. The same procedure was used for control samples without metabolites. The inoculated plates were incubated for 24 hours at 37°C under microaerophilic conditions using a CampyGen Compact laboratory atmosphere generator. The reading consisted of counting the grown bacterial colonies and then collecting all the data, which was used to create graphs showing the killing curves of the test bacterial strains after a specified time. The time-kill curve was constructed for each interval and concentration used, successively reducing the content of *P. larvae* bacterial cells. Bactericidal activity was defined as a 99.9% reduction (above ≥3 log10 CFU/mL) of the total amount of the original inoculum.

3.7 Data analysis (Ferro et al., 2014)
All data used to create the time-kill curves were analysed using GraphPad Prism 10.5.0 (Graph Pad Inc., San Diego, CA, USA) software. The results are presented on a semi-logarithmic scale. The time-kill curves were plotted on an o-y (log10 CFU/mL) and o-x (time expressed in hours) coordinate system. The logarithmically corresponding concentration causing a decrease in the number of microorganisms was converted to a linear regression analysis (non dose-response model). The number of microorganisms was presented as a logarithmic CFU/mL value as a function of time (0, 2, 4, 6, 12, 24 hours) for different metabolite concentrations. The use of linear regression to analyse bacterial killing curves is a widely accepted and recognised approach in microbiological research and antibiotic pharmacodynamics.

Image 5. Sampling of infected larvae / Infected open brood and capped brood before applying the ApiBiotic application

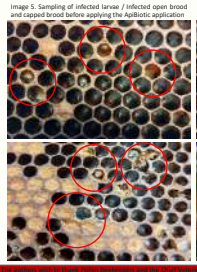


Image 6. Sampling of healthy larvae / Healthy open brood and capped brood after applying the ApiBiotic application

Materials and methods – EUCAST guidelines and methodology

4. Working Methodology: Preparation of preparation samples for analysis
For the purposes of well-diffusion method, a three samples from different production series of ApiBiotic were subjected to mechanical filtration as part of mechanical sterilisation using 0.22 µm syringe filters with a diameter of 33 mm (Argenta, Poznań, Poland). This allowed us to test the antimicrobial activity of bacterial and plants metabolites against indicator strains belonging to *Paenibacillus larvae*. Dilutions of the filtered fluid were prepared so that the metabolite concentrations could be directed to analyses (% v/v): 100%, 75%, 50%, 25%, 12,5%, 10%, 5%, 1%. The dilutions were performed using sterile saline. A concentration of 100% was assumed for the liquid coming directly from the post-cultivation bioreactor.

4.1 Agar Diffusion Assay (EUCAST)
The second stage focused exclusively on screening and the determination of antimicrobial activity against *P. larvae*. For the determination of antimicrobial activity, the well-diffusion method was used according to EUCAST standards with modifications due to the specificity of the bacteria used. For this purpose, the *P. larvae* Eric I, and Eric II strains were revived by transplanting colonies onto blood agar medium (Argenta, Poznań, Poland) and then onto agar slants, respectively, incubated at 37°C for 24-48 h (incubator BE400, Memmert, ZALMED, Poland) in a CO2 atmosphere created by CampyGen Compact laboratory atmosphere generators (Argenta, Poznań, Poland). So-called microbial wash was then performed with an optical density of OD = 0.5° McFarland (approximately 1.0 x 10⁸ CFU/mL, densitometer DEN-1B, Biosan, Poland). Additionally, samples were combined respectively with the media used in beekeeping to feed the bee colonies (sterile water and sterile sucrose solutions of 50% and 60%, Merck), and mixtures of 1:1 were obtained. The culture fluid was diluted to a concentration of 100%. Control groups were used, consisting of sterile water and sterile sucrose solutions at 50% and 60% concentrations (Merck). Subsequently, surface cultures (1 mL) of *P. larvae* were inoculated using a microbial spatula on plates with blood agar and cut wells in the medium. 20 µl of the appropriate metabolites of the product with the carrier was transferred to the wells, and media without ApiBiotic were transferred to the control plates. All Petri dishes were incubated for 48-72 hours at 37°C in a CO2 atmosphere. After the time had elapsed, readings were taken, and 'halo' zones were measured.

4.2 Statistical analysis
Statistical analysis of the results obtained was performed using one-way ANOVA (Tukey's parametric post-hoc test) at a significance level of p-value < 0.05. This analysis allows the means of any number of groups to be compared with each other, showing statistically significant similarities or statistically significant differences. The univariate scheme (one-way analysis of variance) tested whether one independent variable (factor) influenced the results of one dependent variable. The statistical analysis included results from the evaluation of antimicrobial potential (v/v concentrations of the inoculant) in four groups versus the carriers: water, sucrose 50%, and sucrose 60% in three groups. In the scientific literature, results are also analyzed using Student's t-test, Mann-Whitney U-test, Katz's approximation, Pearson's Chi-square test, or Fisher's exact test.

Results – EUCAST guidelines

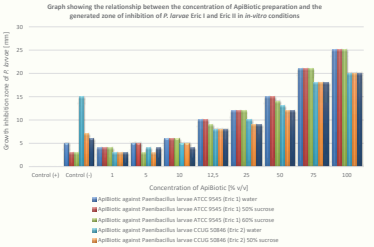
Table 3 Data with values of 'halo' effect measured by the well-diffusion method with the heat map effect

Antimicrobial activity well-diffusion method (cm)		ApiBiotic against *Paenibacillus larvae* ATCC 9545 (Eric 1)			Standard Deviation S (0 ± 1.000)	ApiBiotic against *Paenibacillus larvae* CCUG 50846 (Eric 2)			Standard Deviation S (0 ± 1.000)
Concentration of ApiBiotic (%)		water	50% sucrose	60% sucrose		water	50% sucrose	60% sucrose	
Control (+)		0	0	0	0	0	0	0	0,0000
Control (-)		5	3	3	1,1547	15	7	6	4,9329
1		4	4	4	0	3	3	3	0,0000
5		5	5	3	1,1547	4	3	4	0,5774
10		6	6	6	0	5	5	4	0,5774
12,5		10	10	9	0,5774	8	8	8	0,0000
25		12	12	12	0	10	9	9	0,5774
50		15	15	14	0,5774	13	12	12	0,5774
75		21	21	21	0	18	18	18	0,0000
100		25	25	25	0	20	20	20	0,0000

Image 7. Plate presenting well-diffusion method according to EUCAST using ApiBiotic against the ATCC 9545 (Eric 1)

Image 8. Plate presenting well-diffusion method according to EUCAST using ApiBiotic against the CCUG 50846 (Eric 2)

Figure 4. Graph presenting values from Table 3.



Highlights and conclusions for beekeepers

- The **bactericidal activity and effectiveness of ApiBiotic** have been confirmed by two independent, global protocols: EUCAST and CLSI;
- In addition to its **confirmed antimicrobial properties *in vitro*, the product also maintains its *in vivo* field** activity, conducted on bee colonies from 160 apiaries in Poland and other countries, subject to scientific secrecy;
- An attempt to inhibit the growth of *Paenibacillus larvae* bacteria in serotypes Eric I and II — a factor threatening the health of honeybee larvae—**using metabolites contained in ApiBiotic *in vitro* and *in vivo* was successfully carried out;**
- **Composition in ApiBiotic can reduce the pressure of American foulbrood in bee colonies by supporting the physiological development of the microbiome of bee colonies, competing with *P. larvae* and blocking the excessive multiplication and production of *P. larvae* endospores;**
- **ApiBiotic can be used as a biocontrol tool of American foulbrood** as an alternative to antibiotics in countries where they are legal;
- The analysis of antimicrobial activity showed differences between the indicator strains used;
- **Under in vitro conditions, ApiBiotic showed a very strong suppressive effect on indicator strains;**
- There is a statistically significant relationship and correlation between ApiBiotic concentrations used and the **subsequent antimicrobial activity of the metabolites;**
- Studies have shown that the *P. larvae* CCUG 50846 strain is more resistant to the antimicrobial substances contained in the preparation, **but when using higher concentrations of the preparation, it becomes susceptible;**
- The growing body of research demonstrating the **potential of ApiBiotic in reducing *P. larvae*;**
- Research studies offer hope for the **effective introduction of biotechnological methods in beekeeping** to prevent bee colonies from acquiring and developing infection;

Acknowledgements: The authors wish to thank Polish Beekeepers and the Chief Veterinary Officer of Poland for their research support and for providing access to apiaries
Source of funding: This research was funded by the Polish Ministry of Science and Higher Education, grant number 700/S/IMT/7157/UWD-KONF/2025, and by ProBiotics Polska Magdalena Górska

PP-117 [Bee Health]
Environmental (eDNA) detection tools for monitoring Vespa velutina

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The yellow-legged hornet (Vespa velutina) recently invaded the southeastern United States, emerging as a new threat to North American pollinators. In introduced areas, the hornet disrupts plant-pollinator networks and demonstrates a preference for the western honey bee (Apis mellifera L.) as prey, compromising bee colony health. Due to the difficulties associated with locating V. velutina populations, better tools for rapid, accurate hornet detection and monitoring are urgently needed. Here, we investigated the utility of environmental DNA (eDNA) methods to detect the yellow-legged hornet in Savannah, Georgia, USA. We targeted: 1) sentinel apiaries within the known range of the hornet (sampled monthly) and 2) "rapid response" apiaries where hornets had been observed hawking. We collected eDNA samples by swabbing various apiary-associated substrates including hive lids, entrances, and tools, as well as cement pads beneath hives and nearby hornet bait traps. Soil was also collected from the apiary environment. For all samples, DNA was extracted and screened via quantitative PCR for general invertebrate and V. velutina DNA. We found that our eDNA assay accurately detected hornet DNA from positive control swabs collected from V. velutina nests, yet infrequently detected hornet DNA from apiary materials (overall, less than 5% of samples). We detected hornet DNA most frequently from hornet bait traps with recent adult hornet captures (23% of positive traps). These results match hornet behavior, as adults catch their prey in flight and rarely, if ever, contact hive surfaces. Therefore, current eDNA approaches in apiaries do not seem to be effective at monitoring the invasion of V. velutina. Future work can investigate hornet landing behavior to determine more appropriate substrates for eDNA surveillance. Additionally, alternative methods of monitoring the yellow-legged hornet should be explored, such as harmonic radar tracking and camera traps.

PP-118 [Bee Health]

Development of a starch-vaseline formulation for controlled release of thymol as acaricide in beehives

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Thymol: antioxidant plant-derived volatile monoterpene-phenol authorized for varroosis control in organic beekeeping.

Thymol dissipates rapidly, impacting bees' behavior and requiring re-application.

Controlled-release thymol formulations are needed:

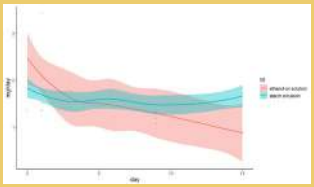
- ensure prolonged exposure to effective doses
- minimize the risks of overexposure
- reduce application frequency

Starch, particularly **amylose**, can form **inclusion complexes** with small molecules such as **thymol**

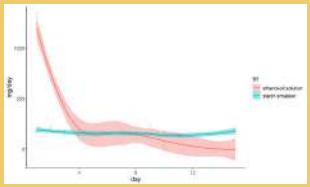
In this study we evaluated a starch-vaseline-based formulation for varroosis control

Treatments
- Thymol in oil-ethanol solution applied to cardboard strips (4 g/strip) — included for comparison purposes
- Thymol in starch-vaseline matrix applied to cardboard strips (4 g/strip)

Emission profiles characterization:
- gravimetry
- volatile collections



Volatiles collecitons



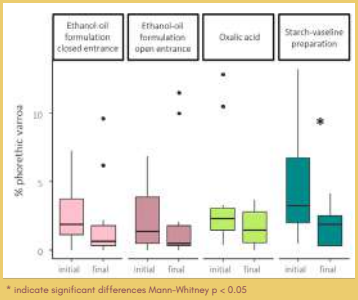
Weight loss

Apiary trial

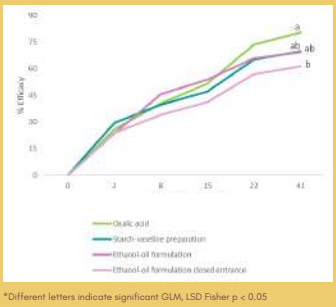
april 2024
Sarandí Grande - Uruguay

- Oxalic acid in glycerol applied on cardboard strips (12 hives)
- Thymol in oil-ethanol formulation on cardboard strips in hives with an open entrance (11 hives)
- Starch-vaseline thymol formulation on cardboard strips in hives with an open entrance (14 hives)

8g/hive in thymol treatments
all treatments re-applied after 15 days



* indicate significant differences Mann-Whitney p < 0.05



*Different letters indicate significant GLM, LSD Fisher p < 0.05

These findings suggest that starch-vaseline based thymol formulations show promise as a sustained alternative for Varroa control in beekeeping

APIMONDIA SCANDINAVIA 2025
SWEDEN | DENMARK | NORWAY

PP-119 [Bee Health]

In-person workshops increase the likelihood of beekeepers adopting best management practices that are supported by science

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Background

Best management practices (BMPs) are widely recommended in apiculture, as they can reduce honey bee (*Apis mellifera*) colony losses[1,2]. Yet, BMPs are not readily adopted by all beekeepers. For example, the alcohol wash is recommended for *Varroa destructor* monitoring, but it is lethal for honey bees. Thus, some beekeepers prefer to use the powdered sugar shake as it is non-lethal. Until recently, this was merely an assumption[3]. Beekeepers accepted it as "fact" based on hearsay. It is crucial to test longstanding assumptions that may impede adoption of BMPs. Additionally, we need to identify learning environments in which validated information are effectively transferred to beekeeper, promoting behavior changes and ultimately increased adoption of BMPs in apiculture.

Methods

We assessed the lethality of a sugar shake to honey bee workers via a mark-release-recover protocol and compared three treatment groups (TG): *Powdered Sugar Shake*, *Powdered Sugar Coat* and *Control*. In 20 colonies across three U.S. states, 300 honey bee workers per TG were colored-coded, subjected to their treatment and returned to their colony (Figure 1). Recovery rates of color-coded workers were evaluated five days later. We also determined the relative efficacy of the powdered sugar shake to dislodge *V. destructor* compared to the alcohol wash.

Fig. 1: Color-coding honey bee workers, covering them with powdered sugar and performing a powdered sugar shake. Colored boxes reflect actions performed for each TG.

To identify effective learning environments (LEs), we developed in-person and online curricula focusing on BMPs specific to *V. destructor*. Both LEs included a theoretical presentation, followed by an online recording of an alcohol wash and powdered sugar shake, or an apiary visit to directly apply the two monitoring methods (Figure 2). Beekeepers from two U.S. states took a pre- and post-survey to evaluate which LE was more effective at invoking a behavior change.

Fig. 2: Sample presentation slides, recording and hands-on application of alcohol wash and powdered sugar shake

Results

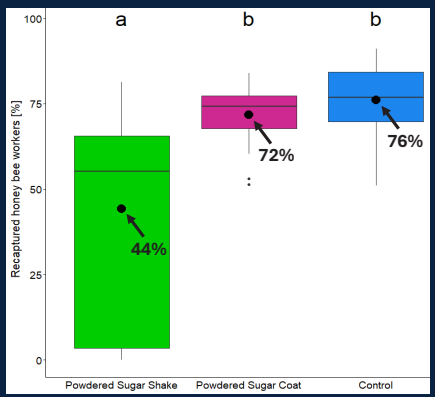

Fig. 3: Recovery rates of color-coded workers 5 days post mark release. Different letters indicate significant differences ($p \leq 0.05$).

The *Powdered Sugar Shake* TG had the lowest recovery rates (*p<0.001*) (Figure 3). The powdered sugar shake had a relative efficacy of 67% to 100% in dislodging *V. destructor* but was not different from the alcohol wash (*p>0.05*).

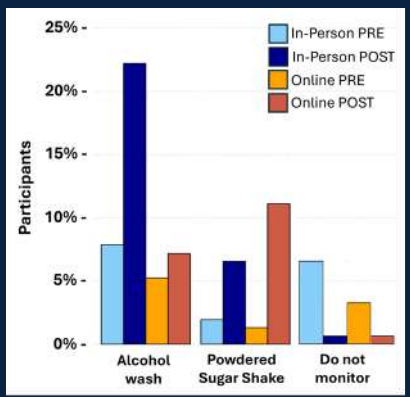

Fig. 4: Proportion of participants that selected their monitoring method of choice in a pre- and post-survey.

Participants from the in-person LE were more likely to select the alcohol wash as their monitoring method of choice (*p=0.05*), while participants from the online LE were more likely to select the powdered sugar shake (*p=0.03*) (Figure 4).

Conclusions

We showed that the powdered sugar shake can, in fact, be lethal to honey bee workers. Due to its variable efficacy and susceptibility to climate, it is a less reliable *V. destructor* monitoring method. Beekeeping educators should recommend the alcohol wash over the powdered sugar shake as a BMP. To increase adoption of BMPs, educators should hold in-person events that allow beekeepers to directly implement the presented information.

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PP-120 [Bee Health]
Understanding the molecular machinery in agrochemical detoxification

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Pollination is a vital ecosystem service as it is key for the reproduction of flowering plants, including important agricultural crops. The eusocial western honey bee, Apis mellifera, is the only honey bee in North America and is the primary managed pollinator in the world. Unfortunately, honey bees are susceptible to a wide range of interacting stressors, including chemicals used in agriculture. The use and overuse of agrochemicals present a current threat to honey bee populations. It can be difficult to disentangle and identify specific stressors that affect a particular colony. Therefore, research is needed to understand how agrochemicals operate to affect bee mortality, how honey bees detoxify the many agrochemicals found in their environment, and the degree to which genetics contributes to resistance. However, much of the literature about how honey bees metabolize toxic chemicals is founded on homology to other insects. Studies directly linking exposure to agrochemicals and the elicited changes in gene expression are needed to improve our comprehension of the honey bee detoxification system. We are presenting the largest RNA-Seq study on honey bee toxicology, including the effect of 18 different agrochemicals from 5 classes, across 3 tissue types totalling 99 experimental contrasts. Here we show that each chemical produces both common and unique patterns of gene expression. Furthermore, detox gene regulation occurred in all tissue types and was present in all chemical classes, e.g., insecticides and herbicides. Alarmingly, this trend was prominent for amitraz and oxytetracycline, both used as treatments in commercial beekeeping. Our research addresses several questions in the field and provides important knowledge that can be mobilized to improve honey bee health and potentially the health of other native pollinators. Promoting agrochemical awareness and potential breeding practices for agrochemical resistance.

PP-121 [Bee Health]

Incidence of Vairimorphosis (nosemosis) across continental Croatia over two consecutive years

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BACKGROUND

- Vairimorphosis (nosemosis) is a widespread disease in adult honey bees across Croatia.
- Many beekeepers are unaware of its presence in their hives and underestimate its impact.
- *Vairimorpha ceranae* is now the predominant species causing the disease.
- Unlike *V. apis, V. ceranae* infections do not leave visible faecal marks on hives and combs.
- This lack of visible signs leads to a misconception among beekeepers that the disease is absent from their apiaries.

AIM

- The study aimed to assess the prevalence of Vairimorphosis in honey bee colonies.
- The research focused on continental Croatia.
- It targeted large apiaries (100+ colonies) managed by experienced beekeepers.
- The assessment was conducted over two consecutive years on the same apiaries.

METHODS

- The study was conducted in 2017 and 2018.
- Samples were collected in late summer from 30 apiaries.
- At each apiary, 60 bees were sampled from 25 to 70 randomly selected colonies.
- Microscopy (OIE Terrestrial Manual. OIE; Paris, France: 2013. Nosemosis of Honey Bees. Chapter 2.2.4.)
- In total, 2,122 colonies were included in the laboratory analysis.
- R Studio, v 2025.05.1

- Data were classified by region, taking into account variations in climate and forage resources

RESULTS

Apiaries	Year	No samples	Positive samples	Spores average no
30	2017	1020	462	2.675.392
	2018	1102	392	487.976
			ns	*p<0,05*

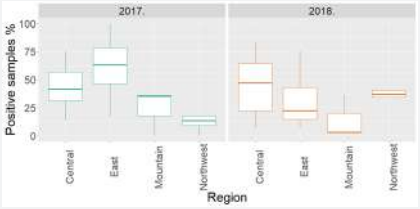

Figure 1. Percentage of samples testing positive for *Vairimorpha* sp. across regions and years

CONCLUSIONS

- Vairimorphosis detected in all apiaries
- Spore counts vary across years
- No significant difference in the proportion of positive cases between years
- High prevalence among large-scale beekeepers:
  - 45.29% and 35.57% of positive samples
- Further research needed:
  - Year-round monitoring of the same apiaries
  - Collection of additional relevant data

PP-122 [Bee Health]
Economic injury levels of Varroa destructor and pathogens associated with honey bee (Apis mellifera) colony losses in Western Canada

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Varroa destructor, a parasitic mite of honey bees (Apis mellifera), is thought to be the primary cause of winter colony mortality. To manage this mite, beekeepers must use Integrated Pest Management (IPM) strategies. An effective IPM relies on prompt monitoring of mite levels to treat colonies when they reach an economic threshold and before they develop to economic injury levels. Concerns have been raised about the possible interaction between varroa mites and other stressors that may lead to high colony mortality. Varroa mite levels were recorded in colonies from five regions of British Columbia, Canada: Lower Mainland, Kootenay, Okanagan, Cariboo, and Peace. Varroa mite levels were analyzed for associations with colony strength and mortality, as well as with other pathogens that were identified using total RNA sequencing. The Kootenay and Lower Mainland regions had the highest mite levels in the fall, followed by the Okanagan, Cariboo, and Peace regions. The Peace region had the lowest mite growth and lowest colony mortality. Varroa mite levels in the fall significantly predicted odds of colony mortality in the spring. Colonies with ≥ 1% mite infestation in the fall had a significantly higher mortality rate ($p=0.005$) compared to colonies with <1% mite levels. Therefore, treatment is recommended above that threshold. Also, deformed wing virus-B levels were 8.4 times higher than those of deformed wing virus-A variant in all the regions and were highest in the Kootenay region, which also had the highest rate of colony losses. Lastly, Malpighamoeba mellificae and Vairimorpha apis transcripts were identified along with other pathogens that deserve further investigation, including Apis mellifera filamentous virus, Lake Sinai virus, and Apis mellifera solinvivirus 1. The dynamic nature of host-pathogen interactions requires frequent pathogen surveillance to determine the prevalence and levels of parasitic mites and associated infectious diseases and their impact on honey bee health, not only in the regions of this study but globally. More studies are needed to determine the nature of the interaction between the identified pathogens and V. destructor.

PP-123 [Bee Health]

Postbiotics in beekeeping: benefits in the strength of the beehives and direct effect against *Varroa destructor*

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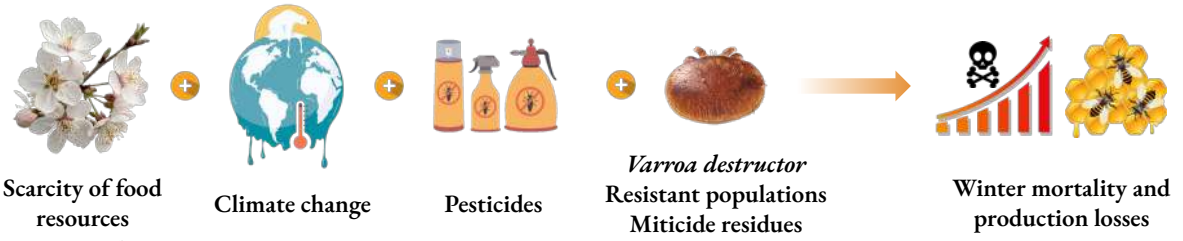
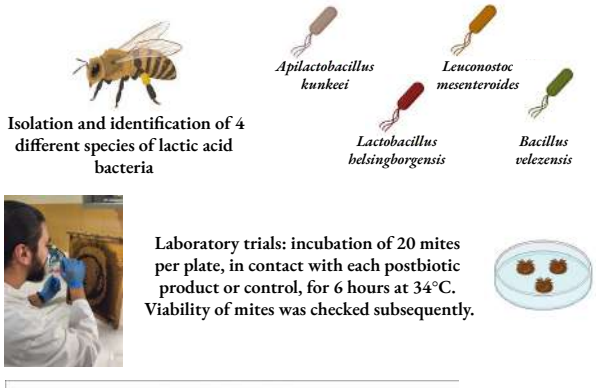


Experiment 1: feed supplement

Experiment 2: direct action against *V. destructor*



- The application of postbiotic products such as feed supplementation in the beehives could improve key factors such as adult bee population, queen egg laying - amount of brood and foraging activity; and reduce the loads of *N. ceranae*, enhancing the productivity and survival of the colonies during the cold season
- The activity of lactic acid bacteria in postbiotic format against *V. destructor* mites registered in laboratory bioassays shows that postbiotics could be a very promising tool in the fight against this pathogen in the beehives
- More studies are carrying out to a better comprehension of the mechanisms of action of postbiotics and to discover the best methods of application under field conditions

Cofinanciado por el Fondo Europeo Agrícola de Desarrollo Rural (FEADER) en un 80% dentro del Programa de Desarrollo Rural (PDR) de Extremadura 2014-2022, por la Junta de Extremadura en un 16,28%, y por el Estado, Ministerio de Agricultura, Pesca y Alimentación (MAPA), en un 3,72%.

PP-124 [Bee Health]

Hive type and genetics for improved varroa survival and resistance

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The untreated MENA population in Galicia

In Galicia (North Spain), Iberian genetic lines have been managed without treatment since 2015, following the MENA programme.

MENA hive design:
- Frames arranged "hot" (parallel to entrance)
- No artificial wax sheets
- Extra frame to reduce spacing

Management:
- Minimal interventions
- Monitor natural varroa fall
- Treat only if infestation exceeds threshold

Selection of genetic lines:
- New queens bred annually from untreated survivors

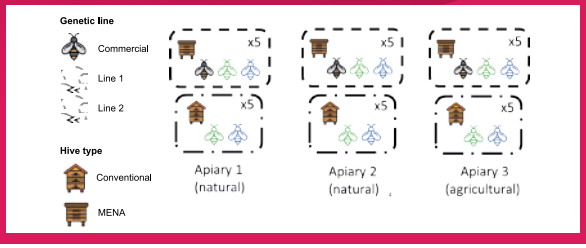
Conventional hive "MENA" hive

Hive entrance Hive entrance

Experiment (2023 – 2024)

- 3 genetic lines (MENA selected Line 1, MENA selected Line 2, unselected commercial line)
- 2 hive types (MENA, convencional)
- 3 apiaries
- 5 colonies per group = Total 75 colonies

Evaluation and monitoring of colonies over 2 years
- Natural varroa fall over 4 days (hygienic bottom board)
- Varroa infestation on adult bees (powdered sugar roll method)
- Hygienic behavior test (pin test)
- Number of brood frames
- Number of adult bee frames



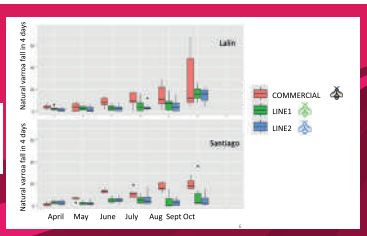
Results

Hygienic behaviour

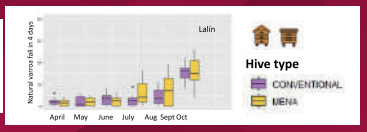
Higher hygienic behavior in lines 1 and 2 compared to the commercial line (F=68,153; p<0,001)

Natural varroa fall

Line 1 and Line 2 have significantly less varroa than the commercial line (~40% less!)

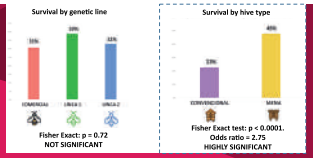


In contrast, hive type has no effect on natural varroa fall. No differences between conventional and MENA hive.



Survival

- High colony loss across all experimental groups (72%)
- No survival differences between genetic lines
- Hive type matters : Colonies in MENA-type hives are 2.75 times more likely to survive



Conclusions

Genetic Lines
Lines 1 and 2 show lower varroa loads and higher hygienic behavior than commercial lines.
Selection potential for these traits exist in the Iberian honey bee.

Hive Type
No difference in varroa load between MENA and conventional hives.
Colonies in MENA hives showed higher survival, despite similar varroa levels.

A combination of genetics, management, and hive type enhances varroa resistance and colony survival.

Proyecto de investigación TED2021-131393B-I00 financiado por MICIU/AEI/10.13039/501100011033 y por la Unión Europea NextGenerationEU/ PRTR.

PP-125 [Bee Health]
Comparative toxicity of neonicotinoid insecticides to honey bees: insights from a comprehensive network meta-analysis

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Honey bees Apis mellifera are crucial pollinators, playing a key role in the productivity of agricultural crops. However, synthetic insecticides, including herbicides, fungicides, and insecticides, are widely employed in agricultural practices to protect crops from pests and diseases. While these chemicals are effective in controlling pests, they pose several environmental challenges, especially their unintended effects on non-target organisms like bees. The widespread use of neonicotinoid insecticides has raised particular concern due to their potential harm to honey bee populations.

The impact of different neonicotinoid insecticides on honey bee mortality and their overall toxicity levels has not been thoroughly compared. Understanding the relative toxicity of these insecticides can help inform safer agricultural practices and pesticide regulations. This study seeks to compare the toxicity of six neonicotinoid pesticides: Imidacloprid, Clothianidin, Thiamethoxam, Acetamiprid, Thiacloprid, and Dinotefuran, using a network meta-analysis.

A total of 31 studies were included in the network meta-analysis. A Bayesian approach and Markov Chain Monte Carlo (MCMC) simulations were used to analyze the data, with results expressed as log odds ratios (Log ORs) for mortality and Standardized Mean Difference (SMD) for LD and LC values, alongside 95% credible intervals (CrI). The Surface Under the Cumulative Ranking Curve (SUCRA) was employed to rank the toxicity of the neonicotinoids.

The findings indicated that Dinotefuran was the most lethal neonicotinoid for honey bee mortality, with a SUCRA score of 0.76, while Clothianidin, with a score of 0.38, was the least harmful. Regarding LD values, Thiamethoxam was the most toxic (0.76), while Acetamiprid showed the lowest toxicity (0.05). For LC values, Imidacloprid ranked highest in toxicity (0.84), whereas Thiacloprid ranked lowest (0.22). The results highlight the significant variation in toxicity among neonicotinoids.

This analysis emphasizes the need for caution in the use of neonicotinoids in agricultural areas where bees are active. Dinotefuran, in particular, poses a high risk to honey bee populations, while Acetamiprid and Thiacloprid show lower toxicity levels, making them more suitable for bee-friendly pest management strategies. Beekeepers and farmers should consider the varying risks of neonicotinoids when selecting pesticides to minimize harmful effects on bee populations and support sustainable pollination services.

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PP-126 [Bee Health]

Varroa destructor management in Australia

A pre-trial of Varroa management in 55 *Apis mellifera* hives using chemical free biotechnical methods in a subtropical climate during the initial spread of Varroa

Figure 1

Introduction

Varroa destructor was first detected in Australia on 22 June 2022 at Newcastle (figure 1). Prime *Apis mellifera* breeding conditions year round and high temperatures with honey harvested winter and summer limit chemical control options for beekeepers. Varroa may quickly breed resistance to synthetic chemicals through overuse. *Aethina tumida* (Small Hive Beetle) is endemic and quickly causes the death of weak hives (figure 2).

The Varroa destructor "invasion phase" in Australia has seen extreme reinvasion numbers up to 100% infestation due to very high densities of feral (wild) hives. Near Newcastle 90% of feral hives have died within 6-12 months of varroa invasion. Some managed hives have died 6 weeks after varroa infestation.

Many Australian beekeepers are hesitant to try chemical free Varroa control methods due to a lack of knowledge and fears these methods will be ineffective or take too much time and labour. This pre-trial was undertaken to test the suitability of two frame queen isolators for autumn and winter use in subtropical Australian conditions.

Beekeeping in tropical & subtropical Australia

Figure 2

Method

55 hives on 6 stationary apiary sites near Ballina NSW (figure 3) had mite infestations counted monthly using an alcohol wash of approximately 300 bees. Hives are timber with 9 frames of brood and 1-2 super boxes of honey. Varroa first arrived in each apiary at different times between February and June 2025.

Integrated Pest Management of Varroa followed the IPM Broodcomb developed by Ballina Honey (figure 4). Hives were requeened in May 2024 using queens from Australia's fledgeling Varroa resistant breeding program run by the Australian Queen Bee Breeder's Association (AQBBA). *Dalotia coriaria* beetle were released into each apiary to control Small Hive Beetle pupae in the soil around hives. Drone brood removal was undertaken on all hives whenever the provided drone frame was capped off.

Varroa reproduction was interrupted and phoretic mites trapped out using a two frame queen isolator purchased from Lyson Australia (figure 5). In late summer and autumn an empty frame of worker brood and an empty frame for building out drone comb were used in the isolator, which was installed when a 3% mite threshold was reached. Two worker brood frames were used in the isolator over winter, installed at a 0.3% mite threshold.

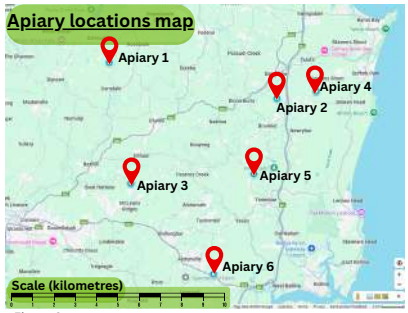


Figure 3

Figure 4. Varroa Integrated Pest Management in this trial follows the IPM Broodcomb developed by Ballina Honey for Australian beekeepers

Varroa control method used

Two frame queen isolator
Autumn: 1 frame with no foundation + 2 empty brood frames used
Winter: 3 empty worker brood frames used

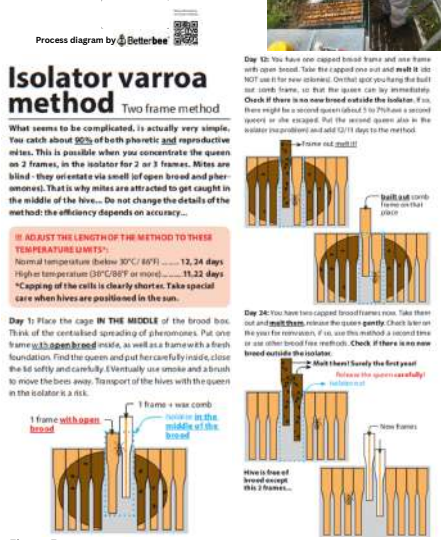


Figure 5

Result

This trial is ongoing. Hive health and production have been severely impacted by record wet weather throughout the trial period. Mite numbers have been extremely variable within and between apiaries due to the initial invasion (figure 6). There has been a loss of 16.36% of hives, with 12.73% of this loss at Apiary 1. This has included 0% deaths directly from varroa, with 12.73% absconded (bees left hive) and 3.64% death by Small Hive Beetle slime out (both at Apiary 1). 47.27% of hives superceded (replaced) their original queen (figure 7). Average mite count when installing isolators was 6.89% and when releasing the queen 11.27%. 10.91% of hives had too few bees in the hive to alcohol wash when releasing the queen, 7.27% at Apiary 1 and 3.64% at Apiary 2.

Average Varroa % infestation 1 Feb - 1 Aug 2025

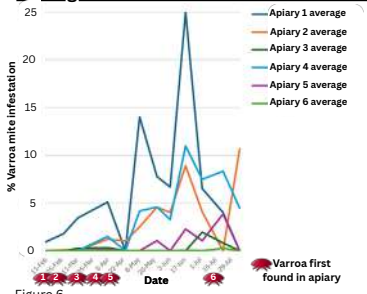


Figure 6

Conclusion

The two frame queen isolator cage method has proven convenient to use in this trial, but is struggling to keep mite numbers down under the very high reinvasion numbers seen in the initial varroa invasion phase. Higher than average rainfall and number of rain days has potentially caused more issues for the hives in the trial than varroa. However, the late arrival of varroa at Apiary 6 shows that hive death and supercedure issues can be attributed to varroa mite. Small Hive Beetle pressures have been less than expected compared to other local beekeepers. Local beekeepers were not overwhelmingly inclined to try these methods due to a reluctance to find and handle the queen as well as concerns around cutting back brood numbers.

Effects of Varroa on each apiary 1 Feb - 1 Aug 2025

Apiary	Starting number of hives	Varroa first found in apiary	Hives died	Hives queen superceded	Hives isolator cage used
1	12	11Feb	7 (5 absconded, 2 Small Hive Beetle)	11 (4 of these x2, 2 of these x3)	9 (3 of these x2)
2	9	27Feb	1 (absconded)	6	9 (2 of these x2)
3	6	13Mar	0	2	5
4	11	8April	1 (absconded)	4 (2 of these x2)	10 (3 of these x2)
5	7	9April	0	3 (1 of these x2)	3 (1 of these x2)
6	10	22Jun	0	0	4

Figure 7

Full trial starting October 2025

From October 2025 200 hives across 10 stationary apiaries will be used to trial chemical free biotechnical and low chemical use varroa control methods. All hives will be requeened using queens from the AQBBA varroa resistant queen breeding program. Drone brood removal will be used in all hives using a drone frame uncapped every 24 days. *Dalotia coriaria* beetle will be released into each apiary to control Small Hive Beetle. Oxalic Acid sponges will be used to assist in keeping mite numbers below threshold. When hives reach a threshold of 3% in a monthly alcohol wash two vertical queen excluders will be used to separate the brood into three sections without finding the queen. The same sequence as above will be used using only the section holding the queen (determined by the presence of eggs after 11 days).

Follow the QR code to www.honeyvalefarm.com.au for updates on this trial

This trial is run and funded by Jackie Morrison at Ballina Honey, NSW Australia
goodlife@honeyvalefarm.com.au
www.ballinahoney.com.au
www.honeyvalefarm.com.au

The author would like to thank: Nuffield Australia for a travel scholarship sponsored by AgriFutures Australia. Thomas Van Pelt and Dr Ralph Büchler for their introduction to biotechnical Varroa management practices.

Jackie's Nuffield report on IPM for Australian beekeepers is available free at www.nuffieldscholar.org/reports

PP-127 [Bee Health]

Novel Approach to Hive Health and Varroa Control

Carlos Perea, Justin Sanchez, Dr. Jeffery Pettis, Dr. Michael Portereiko

ABSTRACT

Annual Bee hive losses of 40-50% have become common, with recent years trending even higher. These losses are often attributed to a combination of environmental, chemical, and pathogenic components. Solutions are needed that can reduce the impacts of external stressors while simultaneously cleansing the hives of pest and pathogenic pressures to promote healthy and vigorous hives. However, current methods of treating hives can have their own toxicity to bees or their human caretakers, can be difficult to implement, and can induce resistance in the intended target. Here we show results from hive treatments conducted in Corrales, New Mexico, that suggest that **ApiVera enhances hive resilience, improves brood health, and contributes to higher survival rates, while simultaneously reducing pathogen load in the hive, including Varroa mite and total microbial counts, using an oxidative chemistry that is less likely to produce resistance, making it a promising alternative or supplement to conventional beekeeping management strategies.**

PROBLEM

Traditional beekeeping relies heavily on chemical miticides to manage colony health, but **resistance and negative impacts on bee physiology demand alternative solutions**. This study investigates whether ApiVera nutrient treatments improve hive survival and colony health compared to untreated controls. Specifically, we examine brood viability, adult bee coverage, and overall hive weight as indicators of hive resilience.

METHODOLOGY

The King Field Trials were conducted in Corrales, New Mexico (August–September 2024), utilizing a time-paired experimental design over a 3–4 week period. Twelve single hive bodies were assigned to three groups:

- Twice-weekly ApiVera treatment
- Weekly ApiVera treatment
- Untreated control

Hive Health Metrics (Recorded Weekly)

Bee coverage (%) | Brood frames (#) | Honey frames (#) | Hive Weight (kg)

ApiVera treatments were applied using a fogging system, and data collection included alcohol washes for mite assessments, brood health evaluations, and hive weight tracking.

Weekly Treated Hives	Before Treatment RLU*	After Treatment RLU*	Absolute Reduction	Log Reduction
Hive 1	15,334	450	14,884	1.53
Hive 2	6,806	0	6,806	Complete
Hive 3	17,277	0	17,277	Complete
Hive 4	927	0	927	Complete

***RLU (Relative Light Units):** A higher RLU value generally indicates a higher level of contamination or biological activity.

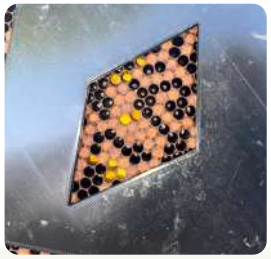
RESULTS & CONCLUSION

ApiVera-treated hives demonstrated a **fourfold increase in hive survival** compared to controls.

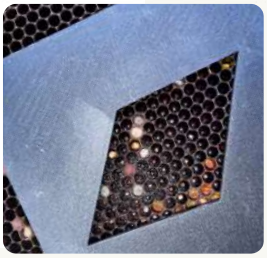
Key findings include:

- **Higher bee coverage** in treated hives (35.0% weekly, 33.9% twice-weekly) vs. controls (22.3%).
- **Increased brood frame numbers**, with twice-weekly treatments showing the highest brood viability (8.7 vs. 6.0 in controls).
- **Improved hive weight**, supporting colony productivity.

These results suggest that ApiVera enhances hive resilience, improves brood health, and contributes to higher survival rates, making it a promising alternative or supplement to conventional beekeeping management strategies.



Hive B (treated weekly with ApiVera): Stabilized mite pressure and maintained robust colony health despite challenges. This hive thrived and showed a 4x higher survival rate compared to the untreated controls.



Hive F (control): Experienced a 17.2% increase in mite pressure, colony decline, and eventual queen abandonment during Week 3.

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TERRAVERA APIVERA

PP-128 [Bee Health]

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FVET Facultad de Veterinaria Universidad de la República Uruguay

Evaluation of screen and sticky bottom boards for the control of Varroa destructor in Africanized and European honeybees

INTRODUCTION

Varroa mite is the most important biotic threat to honey bees worldwide.

Honey bees exhibit several behavioral resistance mechanisms against Varroa parasitism, with grooming being one of them. Detached mites that fall onto bottom boards may re-infest bees, reducing the effectiveness of grooming behavior.

METHODOLOGY

90 standardized hives without Varroa divided in six groups

15 Africanized colonies with conventional bottom boards

15 European colonies with conventional bottom boards

15 Africanized colonies with Screened bottom boards

15 European colonies with Screened bottom boards

15 Africanized colonies with Sticky bottom boards

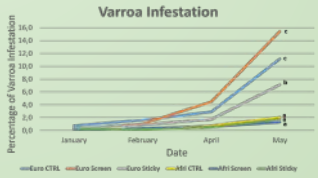
15 European colonies with Sticky bottom boards

Every 35 days – January to May – assessed:

- ✓ Adult population
- ✓ Brood
- ✓ Varroa infestation levels

RESULTS

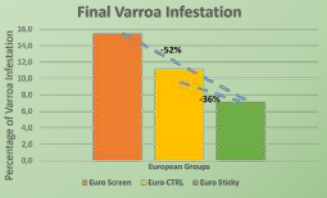
At the beginning of the experiment (January, summer in the Southern Hemisphere), all colonies had an infestation rate below 1%.



At the end of the trial, the Varroa Infestation was significantly higher in the European groups compared with Africanized Groups

By May, the infestation levels in Africanized bee colonies remained around 2% across all groups, where as European bee colonies exhibited between 4 (sticky bottom boards) and 8 times (conventional and screened bottom boards) higher than their Africanized counterparts.

In European bees, colonies with sticky bottom boards had 36% and 52% lower infestation rates than those with conventional and screened bottom boards



CONCLUSION

Our results confirmed that European honey bees are significantly more susceptible to Varroa than Africanized bees.

Sticky bottom boards proved to be a valuable tool in reducing Varroa population growth and could be effectively integrated into pest management strategies.

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Unidad Académica Animales de Granja

PP-129 [Bee Health]
Hygroregulation in honeybees: strategies for survival in the Arizona desert

Ethel M Villalobos, Scott Nikaido
Department of Plant and Environmental Protection Sciences, University of Hawaii at Manoa, Honolulu, Hawaii, USA.

The regulation of in-hive humidity is key to the development of bee brood and the overall health of the colony, nevertheless, there are still gaps in our knowledge about the delicate balance between water uptake and water loss in arid environments. Here we report how managed colonies of A.m. scutellata responded to summer weather in the Arizona desert. We tracked the daily changes of temperature and relative humidity across different areas of the hives and over three summers using temperature and humidity probes. The brood nest was kept at stable temperatures (35 °C) throughout the day, even when ambient temperatures reached over 40 °C. The average RH in brood frames was maintained within acceptable minimum levels of 50 -55%, while the RH on the honey frames was more variable. Nest humidity exhibited distinct diurnal patterns, with elevated RH levels during the daytime, when ambient humidity fell sometimes below 20%. At night, regulation of the nest humidity was limited to the resources already stored within the colony, and the occasional drop in nocturnal RH resulted in an increase in the brood temperature. Behavioral responses to drought and excessive temperatures were more obvious late in the day and at night. We confirmed a strong water foraging activity in late afternoon by adding a non-toxic fluorescent dye to a water feeder and recording how bees filled large numbers of cells across multiple frames with water. Fanning outside the hive to dissipate heat is a common thermoregulatory strategy of honeybees, however, due to the high ambient temperatures during the summer of 2020, ventilation of the hive occurred at night. Using a heat sensitive camera, we recorded the changes in temperature of fanner bees, bees passively cooling on the front of the hive, and the body of the hive. The temperature of fanner bee aggregations dropped only slightly during the night from 30.4 °C at 8 to 9 pm to 28.7 °C at 4 to 5 am, while the hive body dropped from over 43 °C to 21 °C, and the bees resting outside reduced their temperature by 4 to 5 °C.

PP-130 [Bee Health]

APIMONDIA

Living with the small hive beetle:

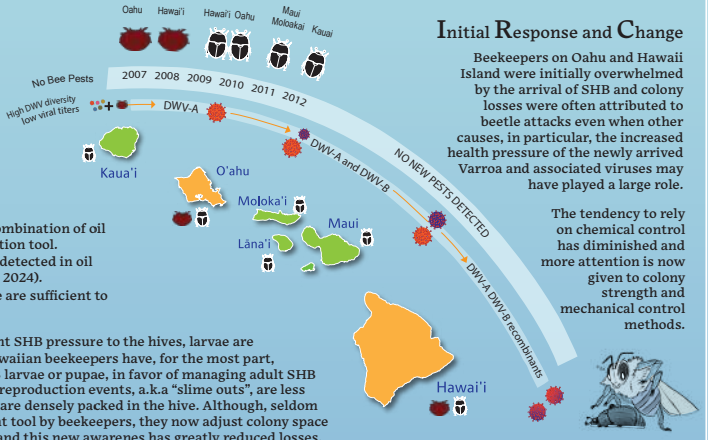
what we have learned after 15 years of continuous pest pressure in Hawaii

Ethel M. Villalobos and Scott Nikaido
Plant and Environmental Protection Sciences. Univeristy of Hawaii at Manoa

Beekeeping in Hawai'i was idyllic. Pleasant temperatures year-round, calm and productive bees. Hawai'i was once a honey industry leader and later became a queen producing center for the United States of America. The geographical isolation of the islands and the import regulations protected the health of the local honey bee populations until 2007 when Varroa was detected for the first time, followed by the arrival of ***Aethina tumida***, the Small Hive Beetle (SHB), a couple of years later.

Detection and Spread

The small hive beetle (SHB) was first detected on the Island of Hawai'i. The beetle was widely distributed across the island and no eradication measures were taken. Sadly, the SHB soon spread to all the major Hawaiian Islands within a few years.



Initial Response and Change

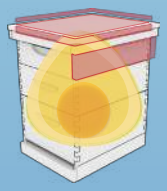
Beekeepers on Oahu and Hawaii Island were initially overwhelmed by the arrival of SHB and colony losses were often attributed to beetle attacks even when other causes, in particular, the increased health pressure of the newly arrived Varroa and associated viruses may have played a large role.

The tendency to rely on chemical control has diminished and more attention is now given to colony strength and mechanical control methods.

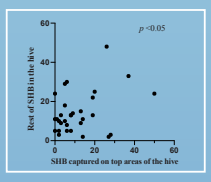
1 During the first months of the SHB invasion the combination of oil traps and visual inspection worked well as a detection tool.
In Year 1 of the Oahu invasion, 86% of the beetles were detected in oil traps and 12% via visual screening (Ref: Villalobos et al. 2024).
In Year 15, visual inspections of the top areas of the hive are sufficient to estimate beetle density.

2 In spite of the constant SHB pressure to the hives, larvae are seldom observed. Hawaiian beekeepers have, for the most part, abandoned targeting SHB larvae or pupae, in favor of managing adult SHB populations. Mass larvae reproduction events, a.k.a "slime outs", are less likely to occur when bees are densely packed in the hive. Although, seldom reported as a management tool by beekeepers, they now adjust colony space to reflect bee population and this new awarenes has greatly reduced losses.

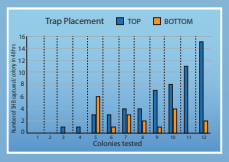
3 Worker bees chase the beetles away from valuable hive resources such as bee brood and pollen. Consequently, adult beetles are often found on the cover and side honey frames of the top box (red areas on the diagram at right). These areas of the hive can be easily screened by beekeepers during regular apiary visits faciliating monitoring. Similar results to Hawaii were obtained for Africanized bees in Latin America. (Ref: A Little Peek May Be Enough: How Small Hive Beetle Estimates Can Help Address Immediate Colony Management Needs. Villalobos et al. 2025.)



Inspection area	Percent of total SHB captured
Floor of the hive before inspection starts	2.6%
Cover	7.6%
Side frames of top box	36.8%
Center frame of top box	0.8%
Floor of the hive right after inspection	41.4%

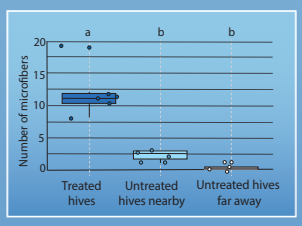


4 Corrugated plastic traps on the bottom board have been suggested as a sampling tool for SHB.
In Hawaii, corrugated traps on top of the honey frames consistently captured more beetles compared to those placed on the floor of the hive. One third of the bottom board traps failed to capture SHB in infested colonies compared to 16% of top of the frame traps. This suggests floor of the hive placement may be less effective.



5 Although worker bees can rarely hold and remove a SHB adult, however, they often chase, corral, and confine adults within the hive. Hawaii's bees frequently construct "beetle jails" and local beekeepers manually kill a large number of SHB when the beetles are released from these jails during regular colony management.

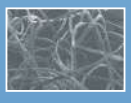
6 Microfiber sheets are one more tool suggested for SHB control. The sheets are introduced to hives where they are actively chewed on by bees in an attempt to remove them from inside their nest. It is that instinctive behavior that creates the "fuzziness" on the sheets that entraps beetles (see images of new and old sheets on the far right). The use of microfiber sheets resulted in an increase in density of plastic fibers on the cuticle and digestive tract of the worker bees, as well as in honey in the colonies under treatment. Untreated colonies in nearby apiaries had less fibers than treatment colonies. Fiber identity was confirmed via Raman analysis. The fibers were determined to be polyethylene (PET) and the blue dye was identified as PB15A (Ref: Management practice for small hive beetle as a source of microplastic contamination in honey and honeybee colonies, Buteler et al. 2024). Based on our results we would not reccomend this practice.



New sheet

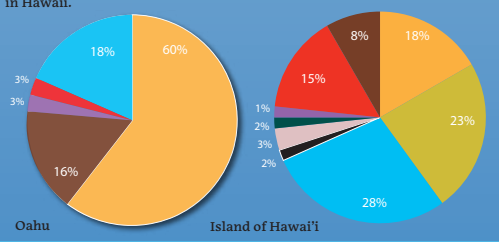
Used sheet

SEM images of microfiber sheets



Recent Surveys Results

Most small-scale beekeepers in Hawaii (>90%) actively manage SHB populations. Beekepers often use more than one strategy and the methods utilized varied between islands. Pesticide use for SHB control is minimal in Hawaii.



- Oil traps between frames
- Oil traps on bottom board
- Microfiber sheets
- CD style traps with killing agent on bottom board
- Soil treatments
- Concrete floor apiary
- Diatomecous earth or oil cans at base of hive
- Reduced hive entrance
- Control hive space (ensure high bee coverage on frames)

Colony losses due to SHB occur less frequently.

FREQUENCY OF COLONY LOSSES

Every 6 months	8%
Every year	22%
Every 2 years	13%
No losses in 3 years	57%

Over 50% of beekeepers have not had a "slime out" in the last three years.

Acknowledgments: Thanks to Dr. Micaela Buteler, Dr. Luis Medina, and Dr. Zhening Zhang for their research collaborations. Thanks to Kevin Sander, Tadd Rienstra, and Dennis Takata for their assistance in the field. Photo Credits: Tina Carvahlo SEM photos, Jasmine Joy photo of SHB jail, additional photos by E. Villalobos. Bee beetle illustration by Emma Shelly. A portion of this research was funded by WESTERN SARE.

PP-131 [Bee Health]
Evaluation of efficacy of lactic acid bacteria from Honeybee for American foulbrood and Nosemosis

Hyang Sim Lee
APQA

Honeybee gut microbiome is known to help to protect against harmful pathogens and nourish the host. Furthermore, it has been reported that honeybee probiotic administration has a positive effect on the resistance of honeybee infectious diseases, such as American and European foulbrood and Nosemosis. In this study aimed to isolate and identify lactic acid bacteria (LAB) from honeybee-gut. Seventy-one strains of lactic acid bacteria (LAB) were isolated from Apis mellifera and Apis cerana, and 6 strains (L. kullabergensis, L. apis, L. panisapium, L. mellis, L. melliventris, L. kimbladii) were finally selected through the measurement of antimicrobial against P. larvae and antioxidant activity. In addition, the efficacy of these strains in controlling Nosemosis was evaluated. Based on Real-time PCR, a significant lower level of Nosema after 7-day infection. In field application, it was confirmed that these strains decreased P. larvae and Nosema cerana. These results indicate that LAB isolated from honeybee-gut possess beneficial properties for honeybee health.

PP-132 [Bee Health]

Addition of postbiotics enhances the effectiveness of oxalic acid treatments against *Varroa destructor* under field conditions

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INTRODUCTION

Due to the emergence of varroa mite populations resistant to chemical acaricides and the residues generated in beehives, as well as the highly variable effects of organic treatments such as oxalic acid, it is necessary to find new products that are effective or that increase the effectiveness of existing products against *Varroa destructor*, such as postbiotic products, which have been shown to be effective against this mite in *in vitro* experiments. The aim of this study was to evaluate the efficacy of postbiotics from beehives, and their combinations with oxalic against *V. destructor*.

MATERIALS AND METHODS

To test the possible synergies between oxalic acid and postbiotics against Varroa, four groups were established: **Control (C)**, **Postbiotic (POS)**, **Oxalic Acid (OX),** and a **combination of both (POX).**
It was applied to the hive using cellulose strips together with glycerine and the corresponding compound, and eight strips were placed per hive in the breeding area.

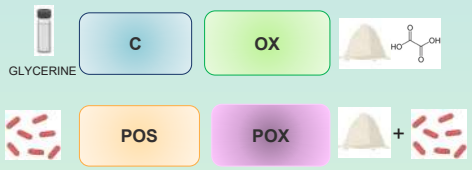


Image 1. Treatment with cellulose strips in a beehive.

To determine the effect of each treatment, the following parameters were monitored:

PHORETIC VARROA MITES PRE AND POST TREATMENT

BREEDING VARROA MITES PRE AND POST TREATMENT

VARROA MITE FALL

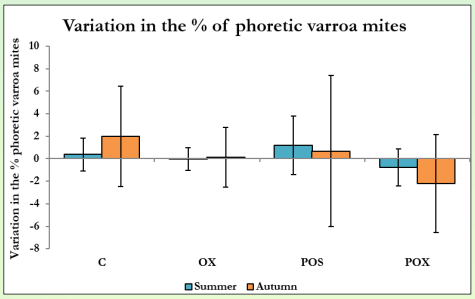
PRODUCT EFFICACY

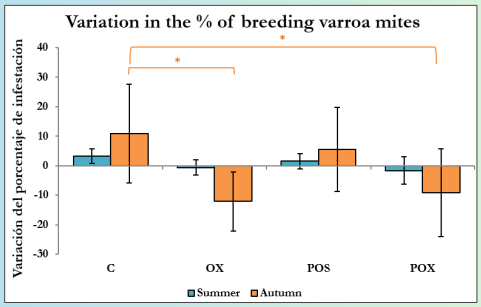
$$Efficacy(\%) = \frac{Fall\ of\ mites\ during\ treatment(FMT)}{FMT + Mite\ remaining\ after\ treatment}$$

Mite remaining after treatment=
(Nº bees× Phorectic mites) + (Nº brood cells×Breeding mites)

RESULTS

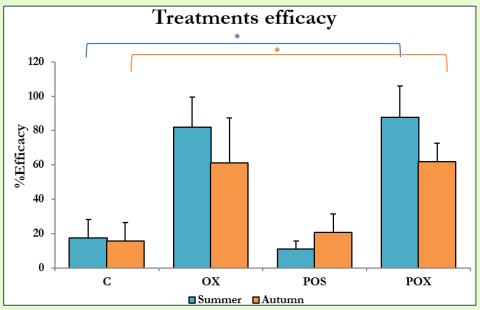
- There was not statistically significant differences between treatments groups in the variation in the percetage of **phoretic varroa mites**.





(*) Statistical significance was set at p-values<0.05, and between 0.05 and 0.1 were considered marginally significant.

- **Varroa levels in brood** increased significantly in the control group and decreased in the OX and POX groups in summer, and the same results were repeated in autumn, with a statistically significant reduction ((C-OX) (*p-value*=0.037); (C-POX) *p-value*=0.083)



(*) Statistical significance was set at p-values<0.05, and between 0.05 and 0.1 were considered marginally significant.

- Regarding the **efficacy**, in summer POX (87.59%) showed a marginally significant difference regarding C (17.54%) (*p*-value = 0.084). In autumn the POX treatment showed a significantly higher efficacy than C (*p*-value = 0.007) and POS (*p*-value = 0.002)

- The efficacy of the treatments was generally higher in the summer experiment (82% OX, 87.6% POX) than in the autumn experiment (61.1% OX, 61.8% POX).

CONCLUSIONS

Postbiotics derived from the isolation of lactic acid bacteria from the normal microbiota of bees can be a very useful tool in the fight against *V. destructor*, demonstrating an **increase in the effectiveness of oxalic acid treatments**.
Further studies will be conducted to test new methods of applying postbiotics in hives and the effect of **combining them** with other organic treatments.

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PP-133 [Bee Health]

APIMONDIA SCANDINAVIA 2025
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Honey bee nutrition as a beekeeping management practice: the first global survey by the COLOSS Bee Nutrition Task Force

Alessandra Giacomelli[1], Damien, Pierre Fèvre[2], Aygün Schiesser[3], Priyadarshini Chakrabarti[4], Alireza Arab[5], Ivana Tlak Gajger[6], Bjørn Dahle[7], Christian Pirk[8], Maja Ivana Smodiš Škerl[9], Michel Bocquet[10], Robert Chlebo[11], Mustafa N. Muz[12], Simone Tosi[2]

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INTRODUCTION

Honey bee malnutrition and starvation are current major global challenges. The pollen and nectar shortages are dramatically impacting bee health and the beekeeping sector, forcing repeated and prolonged emergency feeding interventions to ensure their well-being and their productivity. While poor nutrition has a negative impact on honeybee health and development, there is a limited understanding on the role and impact of feeding practices and perceptions among beekeepers. The COLOSS Bee Nutrition Task Force, that gathers experts in bee nutrition, has therefore developed and implemented a global nutrition survey to provide an overview of current feeding practices and the nutritional challenges faced by honey bee colonies.

Keywords: Honey bee nutrition, nutritional stressors, supplemental feeding, malnutrition, monitoring

METHODS

Data was collected through a questionnaire distributed to National Coordinators (NCs) in several countries. The NCs were responsible for translating the questionnaire into local languages to ensure accessibility and accuracy in responses. The survey was made available to beekeepers in both online and hard copy formats, allowing for broad participation across different regions and technological capabilities.

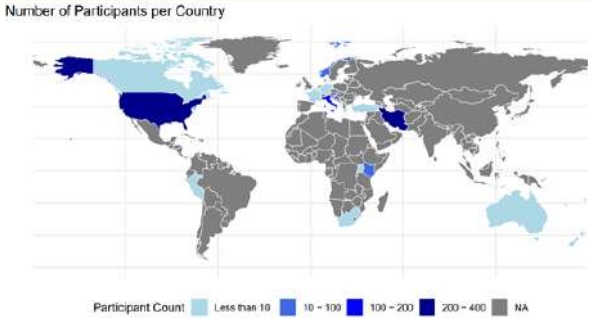

Figure 1. World map of participating countries (respondents number=1118))

Figure 2. Beekeeper feeding colonies

RESULTS

The Task Force monitored 218,768 colonies distributed across 20 countries (year: 2022) (fig. 1). This survey revealed that feeding practices (carbs) are a very common strategy used by 78.1% of the beekeepers (fig. 3). Concerningly, 40.7% of the involved beekeepers perceive negatively supplemental bee feeding products highlighting dissatisfaction with commercial products (fig. 4), mostly due to disadvantages such as cost and the contamination of food sources (fig. 5). Most beekeepers (52.4%) describe that prolonged drought periods represented the most severe cause of honey bee nutritional stress (fig 6).

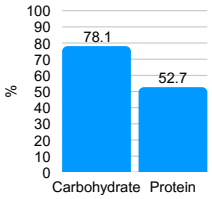

Figure 3. Supplemental feeding provided (Beekeepers%) (n=1118)

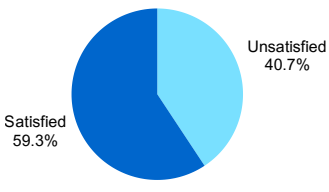

Figure 4. Satisfaction of beekeepers with the products commercially available on the market (n=818)

Figure 5. Reasons of unsatisfaction by commercial products (n=333)

CONCLUSIONS

Citizen science plays a crucial role in supporting scientific research, as demonstrated by this survey, which also helped identify beekeepers engaged in specialised activities such as pollen characterisation, systematic honey analysis, and colony monitoring with connected scales—showing how such initiatives foster mutually beneficial collaboration between researchers and practical beekeeping. Future activities involve integrating data from subsequent years and deepening knowledge of the beekeeper feeding strategies in broader areas of the world. This work highlights that, to face the dramatic increase of nutritional stress events, innovative strategies for sustainable beekeeping are needed.

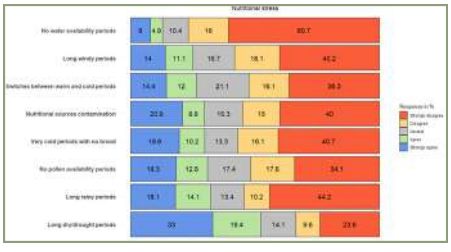

Figure 6. Causes of nutritional stress (n=1118)

Table 1. Number of monitored colonies and respondents in each countries (n=1118)

	RESPONDENTS N.	COLONIES N.
USA	385	82253
IRAN	277	100260
ITALY	180	9938
CROATIA	108	8423
NORWAY	67	1920
SLOVENIA	39	2214
KENYA	16	1249
SLOVAKIA	12	270
CANADA	8	4252
FRANCE	6	1381
TURKEY	6	400
SOUTH AFRICA	4	2568
ALBANIA	2	220
AUSTRALIA	2	200
NEW ZEALAND	1	3000
UGANDA	1	100
CZECH REPUBLIC	1	60
BELGIUM	1	20
PERU	1	20
GERMANY	1	20
TOTAL	**1118**	**218768**

PP-134 [Bee Health]
More than ten years of the bee poisoning incident diagnostics programme in Poland - experiences and conclusions

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Poland has had an official system for diagnosing bee poisoning cases since 2014. During the 11 years of its functioning, more than 500 cases of suspected bee poisoning were diagnosed. Samples of dead bees came from apiaries where it was suspected that the poisoning may have been caused by improper use of plant protection products (PPPs) in neighbouring crops. The symptom of the poisoning was a sudden and massive number of dead bees in front of the hives. The apiary was inspected by a veterinarian, who at the same time took samples of the dead bees for toxicological analyses. Investigations into the correct use of PPPs were carried out by staff of the Plant Protection Inspectorate.

Samples of dead bees were subjected to toxicological analyses to determine residues of pesticides that may be active substances of PPPs, biocidal products or veterinary medicines. The analyses were carried out using a specially developed analytical procedure[1].
Pesticide residues were detected in 96% of the dead bee samples. Up to 25 different pesticides were determined simultaneously in a sample of dead bees. In 80% of the diagnosed cases, analysis of the bees revealed the presence of residues of highly toxic pesticides. Insecticides accounted for almost half of the substances detected, often several at the same time. Residues of various fungicides, herbicides, acaricides and amitraz were also detected very frequently. The three main substances most frequently causing bee poisoning in Poland were chlorpyrifos, clothianidin and dimethoate.

With the withdrawal from use of PPPs containing chlorpyrifos or dimethoate, there has been a significant decrease in the number of reported cases of bee poisoning. This confirms the effectiveness and correctness of the system for diagnosing and recording bee poisonings in Poland. It not only provides individual assistance to beekeepers, but also enables a detailed characterisation of the problem of bee poisoning in Poland and confirmation of its causes.

[1]Kiljanek et al, 2016, Multi-residue method for the determination of pesticides and pesticide metabolites in honeybees by liquid and gas chromatography coupled with tandem mass spectrometry—Honeybee poisoning incidents, Journal of Chromatography A,1435, 100-114,https://doi.org/10.1016/j.chroma.2016.01.045

PP-135 [Bee Health]
Prevalence of pathogens and parasites in Danish honey bees

Per Kryger[1], Annette Bruun Jensen[2]
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For more than 100 years beekeepers and the Danish State have cooperated to control American foulbrood. From a peak of 888 cases in 1956, in 2024 the numbers have fallen to just 14 apiaries, the lowest number on record. Today, the arrival of new diagnostic tools has allowed us to address the prevalence of further pathogens and parasites in Danish honey bees.

In 2023 and 2024, beekeepers across Denmark have volunteered samples for a survey. Approximately 700 samples have been analysed from more than 350 colonies without clear symptoms of disease. Ideally beekeepers have provided a pair of samples, approximately 60 bees and a piece of sealed brood comb, from which 60 larvae or pupae have been collected. The samples have been freeze-dried, grinded to extract DNA and RNA for the diagnosis of 6 vira, 2 bacteria, 3 fungi, 3 protist, 2 mites and 2 insect pests. Since the majority of the samples have come from apparently healthy colonies, this provides an unbiased baseline for the prevalence of pathogens and parasites, here we will focus on virus and bacteria.

The highest prevalence is for two viruses, sacbrood and deformed wing virus type B, both above 90 %. While the former is independent of varroa, the latter is closely linked to the transmission through varroa mites. In contrast the two bacterial pathogens Paenibacillus larvae, the cause of American foulbrood, and Mellisococcus plutonius, the cause of European foulbrood, have a low prevalence of less than 2 % positve samples and or apparently absent, respectively. We attribute this disparity to the efforts of most Danish beekeepers, to exchanging all waxcombs in their colonies each year, a highly effective method against bacterial infections, while apparently not affecting viral diseases.

The purpose of this survey is to support beekeepers in avoiding disease outbreaks in the future, by focusing on the most frequent pests. Clearly, the good practise of high wax hygiene helped control bacterial diseases to a low level, but different tools like breeding may be needed for combating viral and fungal diseases.

PP-136 [Bee Health]
Microbial interaction study for biocontrol of American foulbrood (AFB) in Honeybees

Dany Yammouni[1], Ziad Rizk[1], Selma Snini[3], Florence Matieu[3], Abdo Tannouri[1], Youssef El Rayess[2]
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The western honeybee Apis mellifera plays a crucial role in agricultural production and ecosystem stability through pollination. However, in recent decades, honeybee colony losses have surged worldwide, with particularly severe declines in the Middle East, exceeding acceptable biological thresholds. American foulbrood (AFB), caused by Paenibacillus larvae, a Gram-positive spore-forming bacteria, considered one of the main virulent bacterial diseases threatening honeybees' colonies worldwide. Traditional methods of managing AFB rely primarily on the use of antibiotics and chemical treatments, but these approaches raise concerns about antimicrobial resistance, environmental impact, and the safety of bee products and are prohibited in many countries.

Faced with these challenges, a promising alternative lies in the study of microbial interactions within the hive. Indeed, many bacteria and other microorganisms present in the bees' environment can play a role in the regulation of pathogens, by competing with them or by producing natural antimicrobial substances. Therefore, the objective of this study is to test several microbial isolates from honeybee's intestine against AFB.

More than 500 samples of honeybees and comb were collected from different Mediterranean countries due to the support of PRIMA SAFEAGROBEES project. Among the potential beneficial bacteria against several honeybee diseases, four isolates showed high inhibition activity against the AFB at the laboratory level. The inhibition experiments were first realized using cell-to-cell contact test. Then, it was proven that the secondary metabolites of the potential beneficial bacteria were responsible for the inhibition. The protein nature of the secondary metabolites was verified by lifting the inhibition when treating the media with heat treatments and proteolytic enzymes such as trypsin, pepsin and papain. The releasing time of the secondary metabolites of each beneficial isolate was also determined.
These findings highlight the potential of beneficial bacteria as a biocontrol strategy against Peanibacillus larvae, offering a promising alternative to conventional treatments.

PP-137 [Bee Health]
Understanding the emergence and disease dynamics of Chronic bee paralysis in England and Wales

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Chronic bee paralysis is a serious disease of adult honey bees caused by an unclassified RNA virus known as chronic bee paralysis virus (CBPV). Individual honey bees suffering disease show characteristic shivering and shaking symptoms followed by paralysis and death. Colonies appear to transition very rapidly from being apparently healthy, to presenting with piles of thousands of dead bees outside the colony, which is contrary to conventional epidemiological understanding. Here we report an update on the patterns of emergence across England and Wales using data from a national honey bee health database known as BeeBase. We also report on field trials that monitored the build-up of disease across three apiaries over a three-month period. We demonstrate that the virus is present in dead bees up to two months before colony level symptoms are visible. Finally, we investigate virus sequence similarities within and across outbreaks, as well as highlighting which genotype is causing disease across England and Wales. Overall our findings provide new evidence to inform our epidemiological understanding of this damaging emerging disease.

PP-138 [Bee Health]

Honey Bee Colony Losses in Turkey: Winter 2022/23 and 2023/24 Findings from the COLOSS Monitoring Questionnaire

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INTRODUCTION

Honey bee colony health is essential for pollination services, agricultural sustainability, and the overall resilience of the beekeeping sector. Globally, honey bee malnutrition and starvation represent major challenges, as shortages of pollen and nectar dramatically impact bee health and productivity, often requiring repeated and prolonged emergency feeding interventions. While poor nutrition negatively affects honey bee development and colony performance, there is limited understanding of the role and impact of feeding practices and beekeepers' perceptions. In Turkey, high colony loss rates continue to raise concerns.

To address these issues, the 2023 and 2024 COLOSS Honey Bee Colony Loss Surveys aimed to assess losses and identify contributing factors, providing critical insights to improve colony management strategies. Continuous monitoring through standardized surveys is crucial to understanding loss trends and their underlying factors, while the global COLOSS Bee Nutrition Task Force survey complements this by offering an overview of current feeding practices and nutritional challenges faced by honey bee colonies.

Keywords: Honey bee colony losses, beekeeping, colony health, COLOSS Questionnaire, queen problems, natural disasters,Turkey

MATERIALS AND METHODS

The surveys were conducted online using Google Forms, based on the COLOSS standardized questionnaire. Beekeepers were invited to participate voluntarily through official newsletters, social media, phone communication with local beekeeping centers, and in-person contacts. The 2023 survey included 50 beekeepers managing 4,371 colonies, while the 2024 survey expanded to 131 beekeepers with 11,505 colonies.

Survey data recorded colony losses due to dead or empty colonies, unresolvable queen problems, and natural disasters (e.g., wildfires, floods, earthquakes). For each beekeeper, the loss rate was calculated as the sum of lost colonies (due to queen problems, natural disasters, and worker bee deaths) divided by the colonies present before winter. This approach aligns with the COLOSS methodology used internationally to enable standardized comparisons and provide robust insights into colony health and management practices.

Figure 1. Turkish version of Coloss Monitoring Questionnaire

RESULTS

In 2023, the overall colony loss rate was 34.1%, comprising 25.1% dead or empty colonies, 7.4% queen problems, and 1.6% natural disasters. In 2024, the overall loss rate slightly increased to 35.8%, with 19.8% dead or empty colonies, 7.8% queen problems, and 8.1% natural disasters.

Dead or empty colonies remained the most common cause of losses, while natural disaster-related losses showed a considerable increase in 2024. Queen problems consistently contributed a moderate proportion of losses. These findings highlight the importance of monitoring colony health and implementing effective management practices.

DISCUSSION

The high overall loss rates observed in 2023 and 2024 emphasize the need for improved colony management strategies in Turkey. Dead or empty colonies remain the primary cause of losses, indicating potential issues with colony health or wintering conditions. The moderate but consistent contribution of queen problems suggests that systematic queen management, including regular replacement, could help reduce losses.

Natural disasters had a substantial impact on Turkish beekeeping during this period. Wildfires, especially in the Mediterranean and Aegean regions, destroyed forage sources and damaged hives. The February 2023 Kahramanmaraş earthquake disrupted beekeeping infrastructure, displacing many hives and affecting honey production. Flood events in 2024 further damaged apiaries and reduced harvests.

Governmental and local interventions, including financial support, temporary hive relocation, and direct aid to affected beekeepers, partially mitigated these impacts. These events underline the vulnerability of apiculture to environmental hazards and highlight the need for climate-resilient management strategies.

Adaptive management practices, including enhanced queen care, monitoring of colony health, diversified forage sources, and mitigation of predictable environmental stresses, are essential for promoting sustainable beekeeping in Turkey. While some natural disasters, such as earthquakes or floods, cannot be prevented, certain risks—such as extreme heat, drought, or wildfire—can be anticipated and addressed through preventive measures, hive relocation, or supplementary feeding. Increased participation in surveys will improve data accuracy, aid loss prevention, and support the long-term resilience of honey bee colonies.

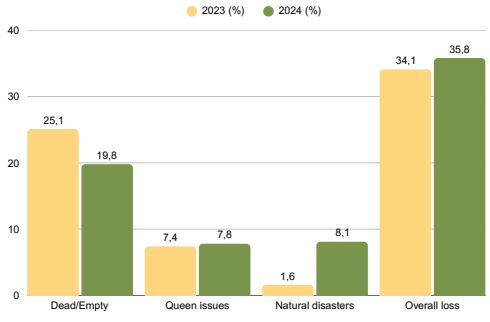

Figure 2. Overview of Honey Bee Colony Losses and Contributing Factors in Turkey (2023–2024)

PP-139 [Bee Health]
Building the BeeArc: The Nature of the Future

James Townend Fearnley
Apiceutical Research Centre, Whitby, North Yorkshire UNITED KINGDOM

BUILDNG THE BEEARC: THE NATURE OF THE FUTURE
Colony Collapse Disorder is perhaps the most stark expression of what can happen to a living organism when too much is asked of it. Over commercialisation of the honeybee has at its worst brought about critical system collapse for honeybee colonies, especially, but not exclusively in the US.

CCD involves a sudden and complete disconnection of those forces which maintain coherence, complex management and integration of the superorganism that is the honeybee. The natural multifaceted immune system of the honeybee – that which keeps it together- collapses despite the presence of food and brook back in the hive.

Whilst we may argue about measurable and specific causation the truth is obvious. The demise of the honeybee mirrors much of what is taking place in every realm of nature.

CCD illustrates the eventual impact of multiple stresses on any organism, and ultimately on the life of human beings.
Human society today faces critical challenges in all realms; to its social and community life, to its economic and environmental life and to its cultural and spiritual life. Human beings are facing community collapse disorder.
The BeeArc is community based project which will explore the challenges facing human beings and nature through the prism of the honeybee.

The £7 million project is composed of three parts.
1. BeeArc: Discovery Centre where the visitor will be taken on a journey of discovery through the cultural, social and economic life of the honeybee whilst reflecting on what human being may learn from the honeybee.

2. BeeArc: Research Centre - a university of the honeybee, where researchers will explore regenerative and transformative ideas for both human beings, nature including the honeybee.

3. BeeArc: Hives of Activity – a community regeneration programme where we can reconnect with Making, Meeting and Meaning – with reconnecting with our crafts skills, refresh and renew relationships and explore what it is that makes human life meaningful.

The BeeArc Community Benefit Society intend to build the project in a National Park in North Yorkshire United Kingdom.
www.beearc.com James.fearnley@beearc.com

PP-140 [Bee Health]
Parasites and Pathogens Affecting Honey Bees in the United Arab Emirates

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The beekeeping sector in the United Arab Emirates faces several challenges due to harsh climatic conditions and limited natural forage availability. The presence of various pests and diseases further threatens colony health, leading to increased mortality and reduced honey production. Therefore, this study aimed to examine the presence of parasites and pathogens in local bee colonies, with a focus on Varroa destructor, bee trypanosomatids, and Nosema spp.

Adult honey bees (Apis mellifera L.) were collected from different apiaries across the UAE. From each hive, samples of 60–100 worker bees were taken. Additionally, Varroa destructor mites (adult females) were dislodged from approximately 300 worker bees using the powdered sugar method and collected for further analysis. Honey bee samples were mechanically homogenized using a mortar and pestle, and the resulting homogenates were examined microscopically for Nosema spp. spores. Selected Nosema-positive samples underwent DNA extraction and PCR identification to determine the Nosema species. These samples were also screened for bee trypanosomatids using universal PCR primers. Furthermore, DNA was extracted from adult Varroa mites using a commercial DNA extraction kit, and mite haplotypes were confirmed based on the partial cytochrome oxidase 1 (cox1) gene sequence.

Microscopic examination of bee homogenates detected Nosema spp. spores in 62% of the samples, while molecular analyses confirmed the presence of Nosema ceranae in all analyzed samples. Additionally, Varroa destructor was present in 58% of hives, and all mites belonged to the Korean haplotype. Interestingly, 10% of the analyzed samples were positive for the bee trypanosomatids.

Our study highlights a significant threat to honey bee colonies in the UAE, primarily due to the high prevalence of Nosema ceranae and Varroa destructor. The detection of bee trypanosomatids needs further investigation to assess their potential impact on honey bee health.

To mitigate these threats and maintain colony health, beekeepers should implement improved Nosema and Varroa management strategies, including regular monitoring, nutritional support, and sustainable treatment approaches.

PP-141 [Bee Health]

1% FOR THE PLANET – ENVIRONMENTAL PARTNER –
Universidad del Rosario | Escuela de Ciencias e Ingeniería
Food Security – BEE POLLINATORS' PROTECTION
THE UNIVERSITY OF ARIZONA

Optimized nutrition for managed bees

A scalable solution to pesticide exposure

Andre J. Riveros[1,2], Valentina Caicedo-Garzón[1,3], Valeria Velandia[1], Sergio A. Niño-Mayorga[1], Juan P. Hernández[1]
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[3]Department of Molecular, Cellular & Developmental Biology. University of Michigan

Visual abstract

IP available

Background

Hunger is a major global problem. More than 800 million people (twice the population of South America) is undernourished.
Increasing crop yields has been a cornerstone to fight food insecurity.

Pollinators increase fruit quantity and quality.

Yet, pesticides produce lethal and multifactorial sublethal effects.

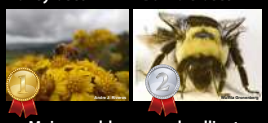
Can we protect managed pollinators while relying on a rational use of pesticides?

Technology aims

To offer a **nature based** solution for protection of managed pollinators against sublethal realistic field levels of insecticides with different mechanisms of action.

Species evaluated

Honey bees | Bumble bees



Major world managed pollinators

Metabolites administered

Rutin, Quercetin, p-coumaric acid, kaempferol.

Insecticides tested

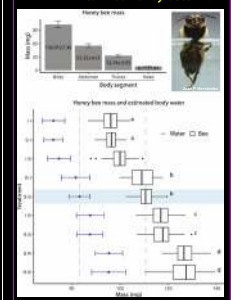
Imidacloprid, Deltamethrin, Fipronil.

Proxies evaluated

Learning, memory, decision speed, sucrose sensitivity, motor control, sting response, cellular immune response, humoral immune response, resilience to parasites, thermic resilience, osmotic equilibrium, ionic equilibrium, hive health, mortality.

Examples

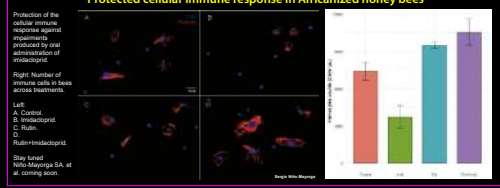
Water balance protection and recovery in Africanized honey bees



Water-balance protection and recovery of bees intoxicated with the neonicotinoid imidacloprid (and coadministered or prophylactically administered with the flavonol rutin). Top: Distribution of mass across body segments. Bottom: water content (mean±SD) and total body weight (box plots) of bees exposed to different treatments.
The order of letters (I: imidacloprid; S: sucrose; R: rutin), indicates the sequence of oral administration of a molecule. a,b,c,d: indicates significant differences among groups.

Stay tuned, Hernández et al. coming soon. See also:
Hernández et al. 2025. PeerJ 13, e19991.
Hernández et al. 2025. Int. Org. Biol. 7(1), obaf018

Protected cellular immune response in Africanized honey bees



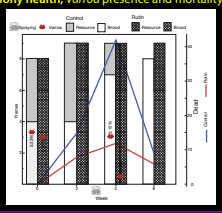
Protection of the cellular immune response against impairments produced by oral administration of imidacloprid.

Right: Number of immune cells in bees across treatments.

Left
A. Control.
B. Imidacloprid.
C. Rutin.
D. Rutin+Imidacloprid.

Stay tuned
Niño-Mayorga SA. et al. coming soon.

Monitoring of colony health, *Varroa* presence and mortality



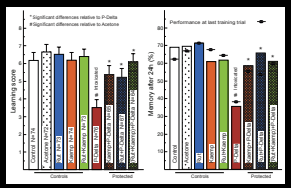
Monitoring of two hives followed by 18 weeks (treatment (six weeks)-fasting (six weeks)-reversed treatment (six weeks).

Left axis: number of frames allocated to brood or resources (pollen and nectar combined; see icons on top).

Right axis: number of dead bees removed by workers at hive entrance.
Control: sucrose syrup.
Rutin: rutin+sucrose syrup.

Stay tuned
Velandia V., & Riveros AJ. coming soon.

Cognitive protection in Africanized honey bees



Cognitive protection of bumble bees (*B. impatiens*) against impairments produced by intoxication with fipronil and imidacloprid.

*Indicates significant differences.

See Riveros AJ. & Gronenberg W. (2022). J. Exp. Biol. 225:17

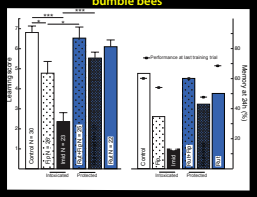
See also in honey bees and fruitflies:
Garcia LM. et al. 2024. PLoS One e0300899
Ramirez et al. 2022. J. Exp. Biol. jeb244526

Cognitive protection of Africanized honey bees (*A. mellifera*) against impairments produced by intoxication with deltamethrin.

Rut: Rutin; Kaemp: Kaempferol
P-Delta: Pure deltamethrin.

Stay tuned, coming soon
Caicedo-Garzon V. & Riveros AJ.

Cognitive protection in North American bumble bees



Overview of technology: A liquid composition based on secondary metabolites from plants (primarily flavonoids). The administration enhances resilience against insecticides as early as one day following administration.

- Easy administration in syrup or pollen patty
- Natural composition
- Enhanced immune response
- Enhanced resilience against parasites
- Resilience against low temperatures
- Supports coexistence of Agriculture & Apiculture
- Cognitive and motor protection
- Supports water and ionic balance

We are a research lab based in Bogotá (Colombia). In our country (and probably in yours too), the sociecological conflict between agriculture and beekeeping is on the raise. We strive to ameliorate this conflict through education (Highschool-Doctoral), outreach (beekeepers, communities, corporations) and research (from bioinformatics to field tests), ultimately supporting conservation and food security.

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PP-142 [Bee Health]

Simultaneously applying Darwinian selection for honey bee survival in 8 European countries

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[1]Wageningen University and Research, Biointeractions & Plant Health, Wageningen, The Netherlands, [2]Inbuzz VOF Beekeeping Company Boot and Calis, IJsbaanweg 8, 1251 VV, Laren, The Netherlands, [3]CIMO, LA SusTEC, Instituto Politécnico de Bragança, Bragança, Portugal, [4]Department of Medical Biochemistry and Microbiology, Science for Life Laboratory, Uppsala University, Uppsala, Sweden, [5]Nottingham Trent University, Physics and Mathematics, UK, [6]Ghent University, Department of Biochemistry and Microbiology, Ghent University

Introduction

A sustainable approach to bee health is to foster natural resistance to Varroa (*V. destructor)* in European honey bees *(A. mellifera)*. The Darwinian Black Box protocol propagates colonies left untreated against *Varroa* and selects for reproduction, growth, and survival. It has shown long-term persistence in the Netherlands, though its broader applicability remains to be tested.

Objectives

Testing the Darwinian Black Box protocol across different climates and subspecies.

→ evaluate its potential as a sustainable beekeeping strategy.

We focus on identifying early indicators of success (survival):

- Genetic traits
- Developmental patterns
- Behaviour

From North – South: Norges Birokterlag Forening (NB), Stichting Wageningen Research (WR),Martin-Luther-Universität Halle-Wittenberg (MLU), Universitatea de Științe Agricole și Medicină Veterinară (USAMV), Universiteit Gent (UGENT), Nothingham Trent University (TNTU), Universidade de Coimbra (UCOI), Instituto Regional de Investigación y Desarrollo Agroalimentario y Forestal de Castilla-La Mancha (IRIAF), Instituto Politécnico de Bargança (IPB).

Methods

Locally adapted *A. mellifera* subspecies (Map) are managed using the **Darwinian Black Box protocol** (see right):

- **In brief:** Genetically diverse colonies → split into 4 nukes (T1–T6) → virgin queens mated on isolated islands (T6–T8) → winter survivors (T) propagated annually (2024–2027) → selection on survival, reproduction, growth
- **Monitoring:** Automated hive weight data (BEEP, NL); annual worker genetic analyses; responsiveness to vibrational stimuli (see poster: Knocking on a honeybee hive); colony-level aggression assays.
- **Analysis:** Regional comparisons to test robustness & limits of DBB and identify early signatures of colony success.

Preliminary Results (2024-2025, 1st year of selection)

	2024				2025						
Partner	#mother colonies	#splits	#colonies autumn	#wintering	#survivors	% mortality	#surviving mother lines	# splits	#final splits	#mother lines	% success mother lines
IRIAF	32	108	54	41	3	90	2	11	11	2	8
USAMV	30	74	57	51	26	49	26	25	66	25	83
UCOI	18	72	7	2	0	100	0	40	40	40	0
IPB	23	92	57	38	21	45	21	53	53	15	65
TNTU	22	34	34	27	18	33	12	54	58	12	55
UGENT	25	100	76	47	0	100	0	69	63	44	0
NB	24	65	57	57	54	5	24	69	69	21	88
WR	25	96	80	70	11	84	8	24	20	6	24
MLU	25	100	79	66	16	76	10	50	70	10	40
			Mean mortality across partners:			64,6%			Mean success motherlines :		40,3%

Darwinian Black Box across Europe : First-Year Insights

- Low 1st-year survival in some regions
- → Regional adaptations: fewer splits (larger nukes), multiple splitting rounds, stimulation of extra queen production, broader genetic base.
- Additional challenges: Asian hornet (*Vespa velutina)* and extreme weather.

The Darwinian Black Box Protocol

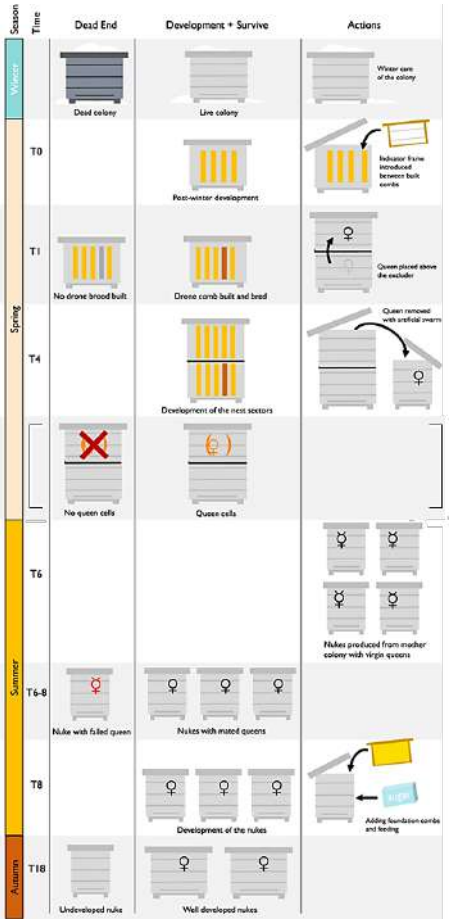

Figure from: Blacquière, T., Boot, W., Calis, J., Moro, A., Neumann, P., & Panziera, D. (2019). Darwinian black box selection for resistance to settled invasive Varroa destructor parasites in honey bees. *Biological Invasions*, *21*(8), 2519-2528.

Trudy van den Bosch (WR, NL), Emma Bossuyt (UGENT, BE), Nuno Capela (UCOI, PT), Bjørn Dahle (NB, NO), Ellen Danneels (UGENT, BE), Chloe Davis (TNTU, UK), Lina DeSmet (UGENT, BE), Daniel Severus Dezmirean (USAMV, RO), Jeroen Eerens (UGENT, BE), Klaus Felgenträger (Beekeeper, DE), Alexandru Ioan Giurgiu (USAMV, RO), Linn Fenna Groeneveld (NB, NO), Michael Hardt (Beekeeper, DE), Mariano Higes (IRIAF, ES), Paul O. Köhler (MLU, DE), Robert J. Paxton (MLU, DE), Ana Rita Lopes (IPB, PT), Raquel Martín Hernández (IRIAF, ES), Antonio Pérez Pérez (IRIAF, ES), Camilla Sundby (NB, NO), Demetris Taliadoros (SciLifeLab Uppsala, SE), Jolanda Tom (WR, NL)

PP-143 [Bee Health]

CEMIBA Laboratorio de Microbiología Básica y Aplicada | Facultad de Ciencias VETERINARIAS | UNIVERSIDAD NACIONAL DE LA PLATA | CONICET Consejo Nacional de Investigaciones Científicas y Técnicas | CIAS

Varroa Surviving Bees in Argentina (ASVA): A national project

REYNALDI FJ , MAGGI MD, ASVA Group

Dr. Francisco José Reynaldi (CONICET- CEMIBA- FCV UNLP); **Dr. Matías Maggi** (CONICET, IPROSAN CIAS UNMdP) ; **Grupo ASVA :** Galindo A , Albarracín V , Cardón W , Cisneros N , De Groot G , Junges C , Manzo MP, Melegatti P , Pellizzer N , Rizzuto S , Salgado C , Sanhueza M , Tejerina M , Maggi MD, Reynaldi FJ.

Introduction:

Global beekeeping has undergone profound changes since Varroa destructor shifted to its new host, Apis mellifera, in the late 1950s in Vladivostok, Russia. Today, except for Australia and a few African countries, Varroa-free zones are virtually nonexistent. Argentina, characterized by a broad latitudinal gradient, encompasses diverse climatic conditions that influence bee populations. Consequently, European and Africanized honey bee populations coexist within the 32°–35° latitudinal range, forming a transition zone between both ecotypes. Africanized bees predominantly inhabit the northern regions, whereas European ecotypes are more common in the south. While most Varroa-resistant bee populations in Argentina belong to Africanized ecotypes, some European-derived populations have also demonstrated long-term survival against the mite. This study aims to investigate the population dynamics of Varroa destructor and its association with honey bee pathogenic viruses in Apis mellifera colonies with varying degrees of susceptibility to the mite.

Materials and Methods:

Seventeen apiaries across different geographic regions of Argentina were sampled, all of which had remained untreated with acaricides for at least two years. The study assessed the genetic lineage of the resident bee populations, the Varroa-bee interaction, and the prevalence of honey bee viruses.

Results:

The Patagonian region exhibited the lowest proportion of bees with African lineage (A) (table 1 and 2), the lowest viral loads, and the lowest Varroa infestations. In contrast, the NOA + Cuyo region had the highest proportion of African lineage (A), the highest Varroa loads, and the highest viral loads.

Argentine regions	Bee lineages			
	A	C	M	O
NOA + Cuyo	43 %	---	---	57 %
NEA	17%	---	---	83 %
Central	24 %	29 %	10 %	37 %
Patagonia	9 %	73 %	---	18 %

TABLE 1: Percentage of bee lineages founded in the Argentine studies regions

Argentine Region,	% VA	%VCO	%VCZ	N° phoretic mites	N° mites in bee brood	N° mites in drone brood	mites/ hive
NOA + Cuyo	2,95 (0-10)	4,70 (0–50)	12,8 (0–113,09)	559 (0–1866)	1757 (0–21120)	1087 (0- 11942)	3415 (0–27306)
NEA	1,93 (0–9,2)	1,5 (0–10)	2,92 (0–46,66)	343 (0–1619)	699 (0–4928)	51 (0- 341)	1094 (0–6504)
Central	0,60 (0–5,1)	0,96 (0–10)	3,54 (0–34,21)	159 (0–843)	318 (0–3344)	173 (0–1848)	333 (0–5993)
Patagonia	0 (0–0)	0 (0–0)	0,39 (0–4,3)	0 (0–0)	0 (0–0)	13 (0- 145)	13 (0–145)

Photo 1: **%VA** percentage of mites in adults bees; **%VCO** percentage of mites in bee brood; **%VCZ** percentage of mites in drone brood

TABLE 2: Software used to defined bee lineages

Photo 1: higienic behaviour of Jujuy **(A)** and La Plata **(B)** colonies

Photo 2: Varroa collection for grooming test

Discussion:

Although honey bee populations in Patagonia displayed the lowest pathogen burdens and the lowest prevalence of African lineage, they are highly adapted to cold climates and may struggle to thrive in other regions of Argentina. Given this constraint, three apiaries from the Central region and three from the NOA region were selected for further investigation in the second phase of this study.

PP-144 [Bee Health]
Flawed generalizations: sex- and species-specific susceptibility to pesticide exposure in bees

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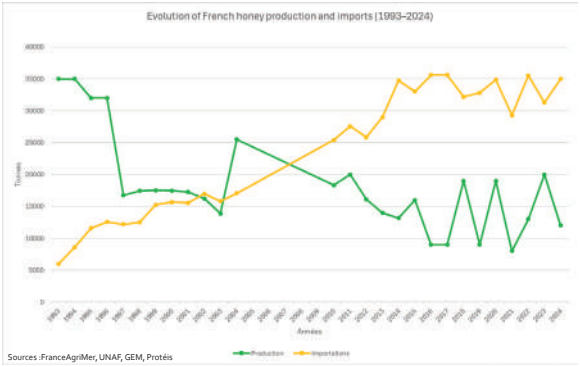
and false negatives are likely. Given that environmental risk assessments tend to focus exclusively on western honeybee (Apis mellifera) workers, they may not adequately address the environmental challenges other bee species experience. Here, we show both false positives and negatives when chronically exposing males and females of three bee species to a neonicotinoid insecticide. Using modified OECD 245 guidelines, male and female Bombus terrestris, Osmia bicornis, and A. melliferawere chronically exposed to thiamethoxam. Mortality and feeding behavior were measured daily. Irrespective of the species, the data show no significant effects of exposure on feeding. However, species-specific differences in LDD50's values were revealed. Apis mellifera demonstrated the highest susceptibility, followed by O. bicornis and then B. terrestris. Furthermore, solitary bee females and honeybee workers are less susceptible compared to their male counterparts. Our data demonstrate that environmental risk assessments using A. mellifera workers are unsuitable to derive general conclusions for other bee species. These findings underscore the need to include more models in bee ecotoxicology to ensure reliable assessments of the risks posed by chronic and acute pesticide exposure.

PP-145 [Bee Health]

French beekeepers against neonicotinoids: a 30-year struggle

French beekeeping since 1995: a dramatic situation

At the beginning of the 1990s, neonicotinoid insecticides were introduced in France. Since then, about **300 000 hives have perished each year** and have to be replaced. **Mortality has risen from 5% to 30%[1]. Honey yields per hive have significantly reduced**, halving French honey production in 20 years. At the same time,honey imports have exploded.



Strong mobilisation of beekeepers …

The scientific evidence of toxicity is accumulating

From the start, producers of these new insecticides denied their effects on bees.

But more and more studies have gradually confirmed beekeepers observations: imidacloprid is found in both pollen and nectar[2] ; the products are very persistent and toxic at infinitesimal doses both in pollen and nectar[3].

As early as 2003/2004, a scientific and technical committee setup by the French government concluded that imidacloprid and fipronil led to *'worrying risks to bees', 'in agreement with beekeepers' observations'*[4]. Ten years later, those results were confirmed by the European Food Safety Authority (EFSA)[5].

Since then, numerous scientific studies have confirmed the negative impact of neonicotinoids on bees[6].

A bitter legal battle

The French government however, failed to act on this information.Consequently, French beekeepers decided to engage in a legal fight to prohibit these products and enforce their rights.

Between 1998 and 2021,the National Union of French Beekeeping (UNAF) initiated or intervened in over 20 proceedings[7] against those toxic insecticide authorizations, either attacking their producers or the French government.

An unprecedented media mobilisation

Demonstrations were organised by beekeepers, mobilising the whole profession and involving a large coalition of environmental and farmers' organizations.

Creating connections : UNAF has engaged in **permanent exchanges with scientists.**UNAF has also established closer ties **with farmers' and citizens' organisations** working to establish fair, democratic and environmentally friendly agricultural and food policies.

Since 2005, an environmental awareness campaign called 'The bee, sentinel of the environment' has been run by UNAF. A significant number of hives have been placed on the buildings of local authorities or companies. This created real opportunities to show the role of pollinators and to evidence the causes of their vanishing.

Mobilisation of elected representatives: from 2010, UNAF initiated a **support committee for bees and beekeepers**, composed of deputies from the French and European parliaments who are committed to defending the interest of the pollinators[10] : more than **100 parliamentarians** have joined the Committee to this day.

Significant resources deployed: important legal fees (around 100 000 euros per years) and **significant human resources** (ten employees, among them a press manager and project managers).

Active involvement in European lobbying: UNAF is a founding member of **BeeLife[10]**, an European beekeeping coordination aiming at studying the impact on bees of pesticides and at questioning European policy-maker.

Over several years, the scientific, legal and media battle has achieved some victories which are constantly being challenged

1999 — **suspension of insecticide Gaucho (imidaclopride) on sunflower**[11]

2004 — suspension of Gaucho **on maize**[12]

2005 — **France bans the use of fipronil in fields**[13]

2011 — the highest administrative court **cancels the authorization of Cruiser (thiamethoxam) on maize**[14]

May 2012 — the EFSA finally admits that the **assessment guidance of pesticides impact on bees suffers from many shortcomings**[15]

June 2012 — the French ministry of Agriculture **withdraws the authorization of Cruiser on canola (rapeseed)** and initiates at European level a **procedure to reassess the impact on bees of three active substances from the neonicotinoids family**[16]

April/July 2013 — the European Union (EU) **partially bans the use of imidacloprid, thiamethoxam, clothianidine and Fipronil**[17]. Uses on crops considered to be unattractive to bees (such as straw cereals) remain authorized, despite the large areas concerned and the long persistence of these substances.

July 2013 — EFSA publishes its **new Guidance on the risk assessment of plant protection products on bees.** This new guidance took into account all routes of exposure of bees, chronic toxicity, sublethal effects or effects on wild bees[18]. **But the Member States have refused to implement these recommendations,** choosing instead to favour pesticides over the protection of pollinators[19]

August 2016 — the French legislator adopts **the Biodiversity Law and totally prohibits the agricultural use of neonicotinoids in France** from September 1st, 2018[20]. This ban is applied to 5 active substances: acetamiprid, clothianidin, imidacloprid, thiacloprid and thiamethoxam

September 2017 — France **authorizes two pesticides with a new generation neonicotinoid, the Sulfoxaflor,** for use on many crops[21]

November 2017 — **The authorization of Sulfoxaflor based pesticides is suspended** by the French administrative court[22]. The court confirmed this decision in February 2018 and and then did so again in February 2025 following an appeal

May 2018 — the EU issues a **total ban on outdoor uses of imidacloprid, thiamethoxam and clothianidin**[23]. The ban entered into force in December 2018

October 2018 — the French legislator **extends the scope of the neonicotinoid ban to molecules with the same mode of action (sulfoxaflor and flupyradifuron)**[24].

2019-2020 — Their approvals having expired, **the use of clothianidin[25], thiamethoxam[26], imidacloprid[27] and thiacloprid[28] is now prohibited in the EU.** However, many Member States, including France, are **circumventing this ban through emergency authorisations**[29]

2020 — a French law **reauthorizes the use of seeds treated with neonicotinoids for sugar beet cultivation** in the form of exemptions granted annually by the government.

2022 — **the EU bans all outdoor uses of Sulfoxaflor**

January 2023 — **the Court of Justice of the European Union declares these kinds of exemptions illegal**[30] and subsequently, France's highest administrative court followed this ruling

May 2023 — A **new Bee guidance document**, less ambitious than the 2013 version, is proposed by the EFSA in 2023. However, **for the application of this document to become a legal obligation for Member States, all the necessary regulatory changes must be finalised**[31]

June 2025 — **France's highest administrative court confirms the scientific validity of the ban on acetamiprid, sulfoxaflor and flupyradifuron** following an appeal by the French professional organisation of agrochemical companies[32]

July 2025 — **A law reauthorising the use of acetamiprid, sulfoxaflor and flupyradifuron was passed in France without debate** in the National Assembly[33]. Several elected officials filed an **appeal with the Constitutional Court.** UNAF submits an external legal opinion[34].

August 2025 — **the French Constitutional Court censured the reauthorisation of neonicotinoids** due to insufficient regulation of their uses and to protect **the constitutional right to live in a balanced and healthy environment**[35]

The battle continues in France, in Europe, and worldwide...

In France:

With attempts to reauthorise neonicotinoids, **the mobilisation of beekeepers and many other stakeholders (scientists, pesticide victims, farmers, environmental NGO, lawyers, etc.) is stronger than ever.**
A citizens' petition against the law of 8 July 2025 , posted on the National Assembly website, has gathered **more than 2 million signatures.**
Although**, the French Constitutional Court censured the reauthorisation of neonicotinoids, UNAF remains vigilant for any new legislative proposals that may arise in the future.**

In Europe:

...because there are still many gaps[36] in the methodology for assessing the risks of pesticides, which allows dangerous substances to still be authorised and leaves the door open to the authorisation of new pesticides that are just as dangerous as neonicotinoids.

In the world:

...because it is still one of the most widely used insecticide class on the planet

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PP-146 [Bee Health]
Effects of the fungicide tebuconazole and the insecticides cypermethrin and methyl chlorpyrifos on Apis mellifera carnica(Pollmann, 1879)

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Honey bees may be exposed to multiple stressors daily, with pesticide use being one of the most significant. Our study aimed to evaluate and elucidate the biological effects of commercial fungicide formulation (tebuconazole) and insecticide formulation (cypermethrin and methyl chlorpyrifos), both alone and in combination, on newly emerged and forager of Carniolan honey bees. The parameters analyzed were the survival rate and histopathological effects of pesticides on the midgut. The newly emerged and forager workers (20 bees in five replicates per treatment) were exposed orally, until the last bee dies, to a fungicide (0.250 ng/µL = 0.250 ppm) - FGD, and separately to insecticide (0.250 ng/µL = 0.250 ppm) - ISD, and to the combination of both pesticides (0.165 ng/µL = 0.165 ppm) - FGD+ISD. Untreated control (CTL) bees received only sugar syrup (1:1 sugar/water; w/w). The results showed a significant decrease ($p < 0.0001$) in the survival probability of newly emerged and forager Carniolan honey bees exposed to pesticides, both alone and in combination (FGD, ISD, and FGD+ISD). The median survival was similar for both age groups. Histopathological analyses after six days revealed that exposure to ISD in newly emerged bees increased the release of cells ($p < 0.001$), apocrine secretion ($p < 0.0001$), vacuolization ($p < 0.005$), and nest alterations ($p < 0.0001$) compared to bees from the CTL. Similarly, forager bees exposed to ISD demonstrated an increased release of cells ($p < 0.001$), vacuolization ($p < 0.05$), nest alterations ($p < 0.005$), and also appearance of atypical cell nuclei ($p < 0.05$) when compared to CTL bees. The total lesion index was significantly higher in both newly emerged bees ($p < 0.0001$) and forager bees ($p < 0.001$) exposed to ISD compared to CTL. The results for the FGD and FGD+ISD treated groups were comparable. Based on the results, bees from both age groups were adversely affected by the commercial pesticide formulations, with ISD being more harmful. Our findings highlight the potential risks of commercial pesticide formulations to bee health and survival, emphasizing the need for beekeepers to be aware of pesticide use near their apiaries.

PP-147 [Bee Health]

EUCALYPTUS HONEY FROM THE FORESTS OF PORTUGAL. WHAT IS IMPORTANT TO KNOW? WHAT REMAINS TO BE DONE!

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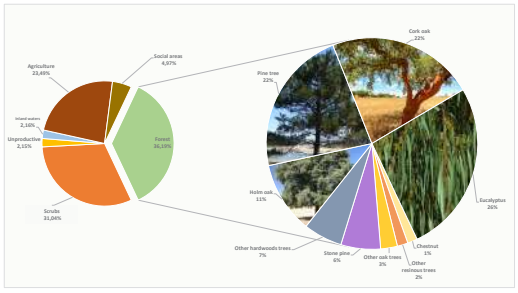
INTRODUCTION

In Portugal, *Eucalyptus* is a forest species of significant economic relevance, covering about 25% of the forest area. These forests are also a significant resource for bees, and specifically for *Apis mellifera iberiensis*, providing abundant nectar, pollen and propolis. This study aimed to evaluate the foraging patterns of *A. mellifera* in eucalyptus forests, as well as the physicochemical, microbiological, and palynological characteristics of the honey produced.



Portugal main land uses and surfaces occupied by forest species

METHODS

During 2024, pollen samples were collected biweekly from two hives in the same apiary, and capped honey samples were obtained during the eucalyptus flowering season. Samples of *eucalyptus* honey were also collected from different regions of the country. Pollen analysis was used to identify associated flora and all honeys were characterized by microbiological, physical-chemical and pollen evaluation. The results are presented and discussed in the context of forestry and beekeeping practices, the honey produced and the impacts on both species, man and *Apis mellifera iberiensis*, from the perspective of One Health and Planetary Health.

Location of sampled apiaries

Honey bee pollen loads

Honey sample collection

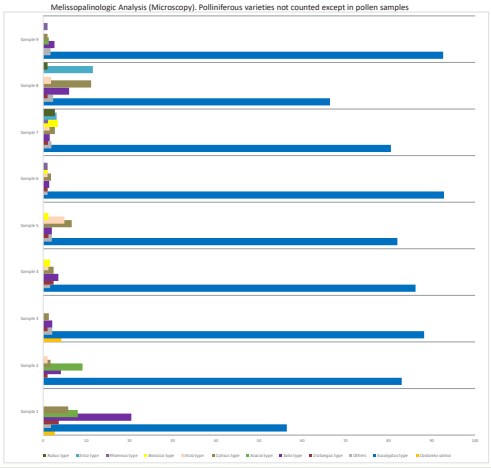
RESULTS & DISCUSSION

Characterization of 9 Eucalyptus monofloral honeys by microbiological, physicochemical and pollen evaluation

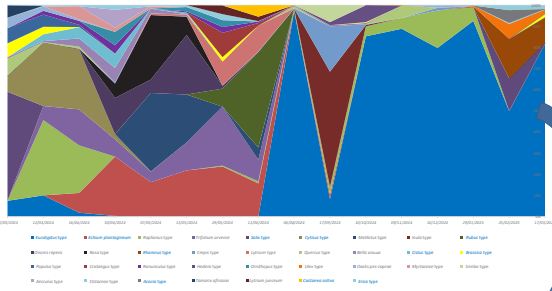
Physical - Chemical parameters	Average	±	SD	Units
Conductivity (20°C)	5,62	±	0,72	x10⁻⁴ S/cm
pH	3,99	±	0,12	UpH
Free acid	23,42	±	4,26	meq/kg
Hidroxymethylfurfural (HMF)	4,00	±	1,09	mg/kg
Moisture (20°C)	17,48	±	0,72	%
Carbohydrates	81,80	±	0,40	
Fructose	40,17	±	1,36	%
Glucose	29,67	±	1,73	%
Sucrose	1,23	±	0,85	%
Maltose	1,70	±	0,27	%
Fructose / glucose ratio	1,36	±	0,10	-
Fructose + Glucose	69,78	±	2,48	%
Diastase activity	19,48	±	1,82	U Gothe/Schade
Color	65,33	±	18,22	mmPfund
Antioxidant capacity ABTS (SC50)	208,82	±	41,82	mg/ml
Trolox equivalent antioxidant capacity (TEAC)	8,11	±	1,18	µMoITE/g
Total polyphenols	10,90	±	1,33	mgG/100g
Methylglyoxal (MGO)	32,67	±	1,09	mg/kg
Catalase Activity	38,24	±	24,60	U/g
Peroxidase activity	1,10	±	0,12	U/mg protein
Protein	0,42	±	0,07	%
Fat	<0,1			%
Saturated fatty acid	<0,1			g/100g
Salt	17,90	±	11,86	mg/100g
Energy	329,00	±	1,55	Kcal/100g
Sodium (Na)	71,40	±	47,45	mg/kg

SD standard deviation

Melissopalinologic Analysis (Microscopy). Polliniferous varieties not counted except in pollen samples

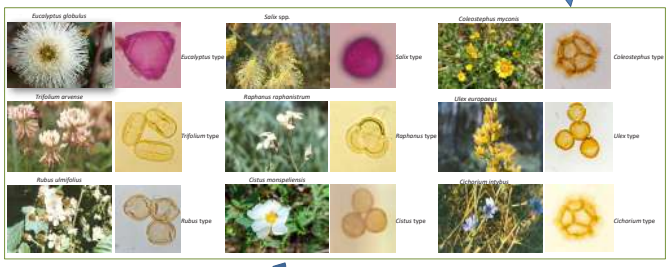


Most representative plant species foraged by honey bees, associated with the sampled pollen



67 plant species in pollen sampling, 11 of which are present in the most representative species identified in honey.
In blue, common in pollen and honey samples.

Some species observed in apiaries and types of pollen



CONCLUSION

- ✓ All honeys present values within the limits permitted by regulamentation;
- ✓ *Eucalyptus* spp. was a predominant source used by honeybees and was detected in 100% of the analysed samples;
- ✓ The relative frequency of the *eucalyptus* pollen in these honeys exceeds 45%, and therefore been considered monofloral *eucalyptus* honey (Von Der Ohe W, et al., 2004);
- ✓ Monofloral honeys contained several pollen types with a considerable percentage of pollen grains from *Eucalyptus* type, and also from *Erica* type, *Acacia* type, *Salix* type, *Cytisus* type, *Castanea sativa*, *Rubus*, and other minoritary species;
- ✓ Honeys showed significant antibacterial activ typeity, associated with low pH and low protein content;
- ✓ High-quality honeys were confirmed by low HMF content (a parameter related to freshness and food quality) and high diastase activity.;
- ✓ High value of methylglyoxal, catalase and peroxidase activity and total polyphenols gives these honeys high medicinal value;
- ✓ Monofloral honey from *Eucalyptus* spp. was characterized by its high pollen content, antimicrobial properties and high antioxidant power.

PERSPECTIVES

- ✓ Pollen and honey data provided a reliable fingerprint of the environment from which the *eucalyptus* honey originated;
- ✓ As *eucalyptus* pollen represents the majority of the detected pollens, these honeys could be further enriched with undergrowth and/or ecological corridors and still be considered monofloral;
- ✓ A greater abundance of floral species could increase honey production.

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PP-148 [Bee Health]
Laboratory and field tests to assess the efficacy of B403 against wax moth (Galleria mellonella) and safety on honeybees (Apis mellifera)

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To assess the efficacy of B403, Bacillus thuringiensis – based product, against larvae of the greater wax moth, Galleria mellonella, both laboratory and field tests were conducted in Greece, between 2023 and 2025. Two different lab tests and two different field tests were conducted. During the first lab test, a total of 96 wax moth larvae (WML) of 3rd instar stage, divided in 4 batches of 24 specimens, isolated individually in arena-boxes, were used. Doses of 5%, 10% and 20% were applied. Tested products were applied in artificial diet for each WML. The mortality as well as the repellence effect of each formulation, was tested in the arena boxes, stored in incubators at 30°C for a period of 21 days. Results indicated that B403 was very toxic for WML at tested doses and on the same time, induced a strong repellence effect. All tested larvae were found dead when 10% and 20% doses were applied. Mortality at 5% dose reached 98%.

During the second test, pieces of pre-treated wax combs were introduced in cages contained 125 honeybees and the same B403 doses were applied. All bees died within a period of 21-27 days post application and their longevity presented no differences with untreated bees.

During field test, different B403 was tested for the repellency of wax moth and the protection of stored honeybee wax combs, stored under typical beekeeping conditions. A total of 160 honeybee wax combs were used, divided in 4 batches (3 experimental, 1 control). No combs were destroyed in batches of 10% and 20% while the protection of 5% reached 99.99%. All control combs were destroyed by WML. Furthermore, impact on honeybees was examined by placing treated combs of all three tested doses, inside colonies. The mortality of honeybees presented no difference between any dose of B403 batches and the control.

Finally, olfactometry tests applied in 2025, showed a strong repellency effect of all doses tested on 96 individual WML.
All experiments, in laboratory and in field, showed a high efficacy of B403, against WML and proved the tolerance of the product by honeybees.

APIMONDIA SCANDINAVIA 2025
SWEDEN | DENMARK | NORWAY

PP-149 [Bee Health]

Thermotolerance of the honey bee: differences between three subspecies of *Apis mellifera* living in Mediterranean basin

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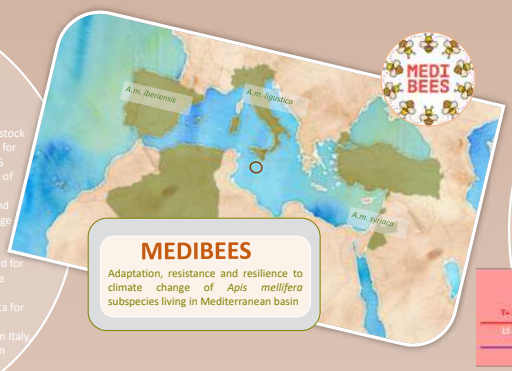
INTRODUCTION

Thermotolerance is defined as the temperature range between the coldest (critical thermal minimum, CT_{min}) and the warmest (critical thermal maximum, CT_{max}) temperatures at which an organism can maintain muscle control. The limits of heat tolerance are already known for several livestock species, but they have not yet been defined for the honeybee, *Apis mellifera*. The MEDIBEES project aims to shed light on the adaptation of the different *A. mellifera* subspecies in the Mediterranean basin and their resistance and resilience to climate change Today, knowledge of the thermal tolerance limits of *Apis mellifera* is essential for inferring the consequences of climate change on bees and for taking timely action to make the appropriate decisions in beekeeping.

This study presents thermotolerance data for three subspecies of *Apis mellifera* from the Mediterranean basin: *A. mellifera ligustica* in Italy, *A. m. syriaca* in Jordan and *A. m. iberiensis* in Spain. The data takes into account the bees' age and sex.



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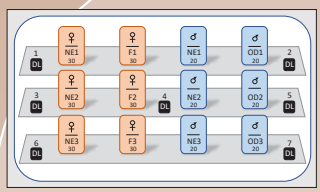
MATERIAL & METHODS



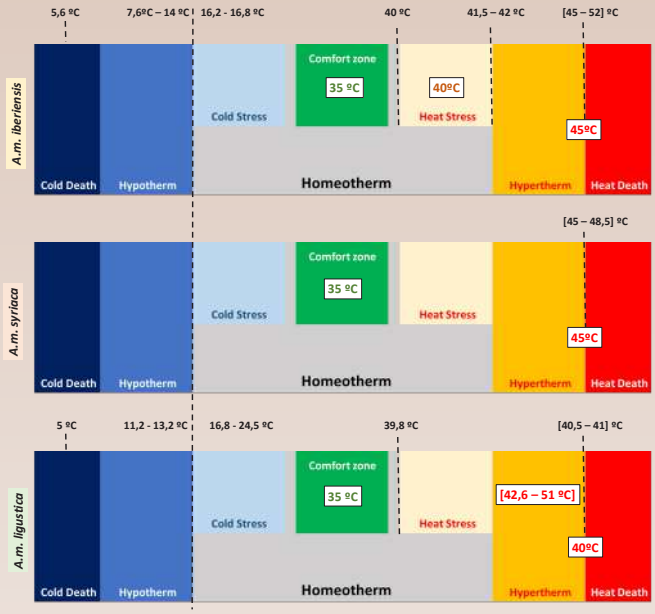
The thermotolerance experiments involved exposing the bees to controlled temperature ramps (from 30°C to 70°C for heat and from 35°C to 5°C for cold). Newly emerged and older workers collected in spring were used for the heat tolerance assay. Newly emerged and older workers collected in autumn were used for the cold tolerance assay. Drones could only be tested in autumn for *A. m. ligustica*. The observed differences in behaviour throughout the process were noted in order to create a thermotolerance graph. Mortality stabilised when the dorsal turning effect was negative.

RESULTS

Heat tolerance		Workers		Drones	
		Critical T	Final T	Critical T	Final T
A.m. iberiensis	Newly emerged	45 ºC	47,9 ºC	51,9 ºC	54 ºC
	Older	47,9 ºC	49,5 ºC	48,6 ºC	55,1 ºC
A.m. syriaca	Newly emerged	45 ºC	53,5 ºC	45,5 ºC	57 ºC
	Older	45,5 ºC	58 ºC	48,5 ºC	54,5 ºC
A.m. ligustica	Newly emerged	41 ºC	48,5 ºC	41 ºC	56 ºC
	Older	41 ºC	55,5 ºC	40,5 ºC	55,5 ºC

Cold tolerance		Workers			
		Cluster	Lethargy	Nº dead bees	% Mortality
A.m. iberiensis	Newly emerged	16,2 - 16,8 ºC	13,9 - 14,1 ºC	0	0
	Older	16,7 - 16,8 ºC	13,9 - 14,4 ºC	14	15,55 %
A.m. syriaca	Newly emerged	No signs	No signs	0	0
	Older	No signs	No signs	0	0
A.m. ligustica	Newly emerged	16,8 - 24,5 ºC	11,2 – 13,2 ºC	8	8,88 %
	Older	10,6 - 13,8 ºC	8,7 – 10,2 ºC	0	0
		Drones			
A.m. ligustica	Newly emerged	24,7 – 26,2 ºC	15,8 – 16,3 ºC	6	10 %
	Older	18,1 -18,5 ºC	15,1 – 16,8 ºC	10	16,66 %

RESULTS



CONCLUSIONS

HEAT

- **Age and sex affect to heat tolerance in the subspecies of the honey bee, *Apis mellifera*:** drones usually show higher heat tolerance than workers, and newly emerged workers show slightly lower final threshold than foragers
- **The death by heat starts at 40,5ºC in *A.m. ligustica*, and 45ºC in *A.m. iberiensis* and *A.m. syriaca***
- *A. m. ligustica* showed the lowest tolerance to heat, suggesting a lower level of adaptation to hot environments

COLD

- **The level of cold tolerance varies between subspecies:** *A. m. iberiensis* higher than *A.m ligustica*
- **In terms of age:** newly emerged workers showed higher tolerance than foragers in *A. m. iberiensis*, whereas the opposite was true in *A. m. ligustica*.
- **Drones of *A.m. ligustica* showed lower cold tolerance than workers**
- **The highest level of cold tolerance was observed in *A.m. syriaca*,** with no signs of cold stress and hypothermia

Acknowledgements

Thanks to Teresa Corrales, Virginia Albendea , Carmen Uceta, María Gajero, Jesús García, and David de la Plaza, from CIAPA´s team, for their fantastic work in the laboratory and in the hives.

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PP-150 [Bee Health]
How safe is swarm trapping in areas with a high density of bee colonies and a history of American foulbrood outbreaks: an example of swarm surveillance in the city of Ljubljana

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Background/Purpose.
The City of Ljubljana carries out numerous activities related to beekeeping and local food production for its citizens. The popularity of beekeeping also leads to a greater density of bee colonies, a more frequent occurrence of swarms and a greater risk of disease outbreaks.

Problem description
Swarms can cause unpleasant inconvenience to citizens and also pose a risk to beekeepers dealing with swarms of unknown origin. American foulbrood, the most economically important bacterial bee disease, can be spread vertically through swarms both from colonies with clinical signs of the disease and from colonies without clinical signs.

Methodology
In cooperation with the Slovenian Civil Protection and Diseaster Relief Administration and the Ljubljana Fire Department, swarms have been managed in the city of Ljubljana since 2016. A network of swarm collectors has been established. In 2023 and 2024 swarms of unknown origin were sampled before they were placed in new hives. Since qPCR quantification of Paenibacillus larvae in adult bees has a high diagnostic value for predicting disease outcome based on P. larvae spores, 69 analyses of bee samples from captured swarms were performed.

Results and conclusions
The detection of P. larvae was negative in 44 samples of bees from captured swarms. Only two samples had spore counts of more than 500 spores per bee, namely 632 and 1175. These results show that with proper management, the probability of a disease outbreak in the swarms examined is very low.

Practical implications for beekeepers
In most cases of American foulbrood outbreaks in colonies colonised as swarms, the spores originate from hives, previously used combs or contaminated food. Swarms should always be colonised with foundations and fed with sugar solution. With proper management, the risk of a disease outbreak is very low, even in areas with a high density of bee colonies.

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PP-151 [Bee Health]

Studying dehydration as an adaptive trait in honey bees: differences among nine *Apis mellifera* subspecies living in Mediterranean basin

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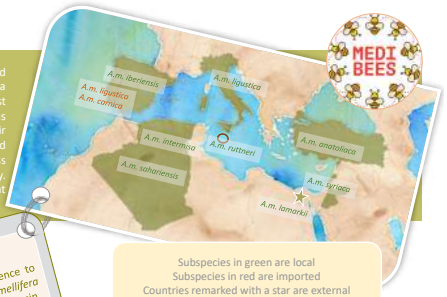
INTRODUCTION

Adaptability is defined as the ability of an organism to adapt to new situations. Nowadays, climate change is leading to hotter and drier environments, and one of the main concerns for honey bees is how they can withstand and adapt to these new conditions. In particular, the Mediterranean region is a recognised hotspot for climate change [1,2] and house several subspecies of *Apis mellifera*. The increasingly high temperatures suppose one of the most important abiotic pressures for bees, but changes in precipitation patterns are also key. Both variables are closely related and, when get combined, act as new independent stressor. Honey bees are able to regulate both temperature and humidity inside the hive in two ways: (i) fanning bees increase air exchange rates from inside to outside the hive by orienting themselves at the entrance, and (ii) bees evaporate water from nectar and regurgitate liquid droplets within the hive to restore favourable conditions [3]. The dehydration capacity of the bees has been defined as an adaptive trait under heat stress that can be study calculating the percentage of body water loss (BWL) per bee after the exposure to a specific combination of temperature and humidity. This work is part of MEDIBEES project, and studied the BWL of nine *Apis mellifera* subspecies from the Mediterranean basin, which were exposed to different temperature and humidity conditions. The results presented here aim to shed light on the different adaptability of the Mediterranean honey bees.



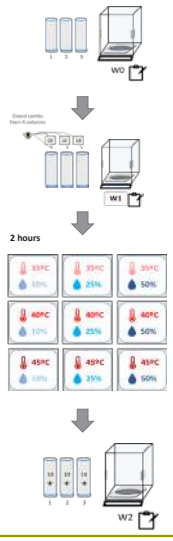
Subspecies in green are local
Subspecies in red are imported
Countries remarked with a star are external collaborators of MEDIBEES project

MEDIBEES
Adaptation, resistance and resilience to climate change of *Apis mellifera* subspecies living in Mediterranean basin

MATERIAL & METHODS

Within MEDIBEES project, BWL assays were performed with nine subspecies living in Mediterranean basin: *Apis mellifera ligustica* in Italy, *A.m. syriaca* in Jordan and Lebanon, *A.m. iberiensis* in Spain, *A.m. anatoliaca* in Turkey, *A.m. lamarkii* in Egypt, *A.m. ruttneri* in Malta, and *A.m. intermissa* and *A.m. sahariensis* in Algeria. Three cages were weighed first when empty and then when containing 10 bees each. The bees were exposed to nine different conditions (combining temperatures of 35°C, 40°C and 45°C with relative humidities of 10%, 25% and 50%) for two hours. They were then weighed again and %BWL was calculated [4]. An additional study was carried out in Spain to analyse the adaptation of 3 different subspecies in the same apiary: *A.m. iberiensis* (local subspecies) was compared with two introduced subspecies stablished during 1 year (*A.m. ligustica* and *A.m. carnica*).

Histograms were created using average data. Statistical analyses of variance (ANOVA) and means were compared by using JASP 0.95.1 program.



DISCUSSION

Several subspecies of *Apis mellifera* live in the Mediterranean basin, each adapted to specific environments. For example, to arid and dry environments in Jordan, Egypt and Algeria; temperate environment in Malta; and some live adapted to several different environments, such as in Spain, Italy, Turkey or Lebanon. *Apis mellifera ligustica* (native to Italy) as well as *A.m. carnica* (native from Balkans), are used commercially beyond their native range because of their supposed adaptability. However, this practice endangers the survival of local subspecies, as they are negatively selected in beekeeping, and the risk of hybridisation with introduced subspecies increases. Given the worrying scenario of climate change in the Mediterranean region, the value of local subspecies adapted to their specific environments is key.

This work showed different dehydration ability (% BWL) within and inter-subspecies under different warm and humid environments, supporting the different adaptation degree of all of them: subspecies in Spain, Italy, Turkey, Egypt, and Malta showed significant higher dehydration at 45ºC than 35ºC. Otherwise, humidity seems to play an interesting role at 45ºC, with significance in *A.m. anatoliaca*, but no effects are evident at 35ºC and 40ºC. Finally, Algerian and Jordanian subspecies did not show significant effect of heat on BWL. On the other hand, an experiment comparing local (*A.m. iberiensis*) and imported subspecies (*A.m. ligustica* and *A.m. carnica*) was carried out in Spain after one year of adaptation of the new subspecies. No significant differences were found between Italian bees in 2023 and *A.m. ligustica* in Spain in 2024. In the three subspecies showed a protective effect of heat stress when humidity increased, as well as no significant differences at 40ºC. *A.m. ligustica* showed significant lower % BWL at 45ºC 10% of RH.

These results support the use of local bee breeds in Mediterranean beekeeping, as rising temperatures and changing rainfall patterns are making environmental conditions harsher, being the imported subspecies even more vulnerable.

CONCLUSIONS

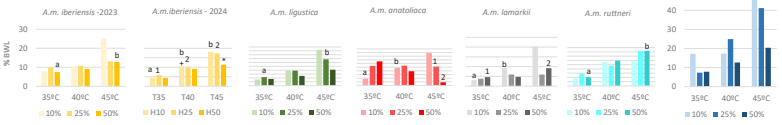
- **Significant differences within and inter- subspecies**
- **Heat and humidity seems to affect differently to subspecies depending on their local adaptation**
- **In some cases, 50% of humidity decreases the heat stress degree**
- **Comparing local and imported subspecies, significant differences in % of BWL, specially at 45ºC 10% RH**

RESULTS

Significative differences within subspecies

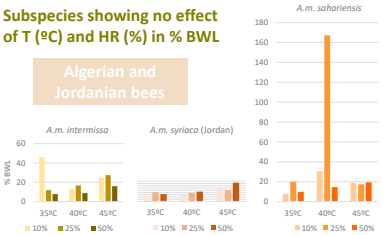
Subspecies showing increasing % BWL with higher temperature

The histograms show average data

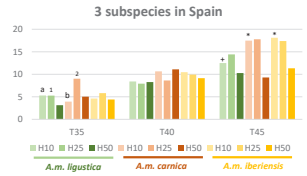


Subspecies showing no effect of T (ºC) and HR (%) in % BWL

Algerian and Jordanian bees

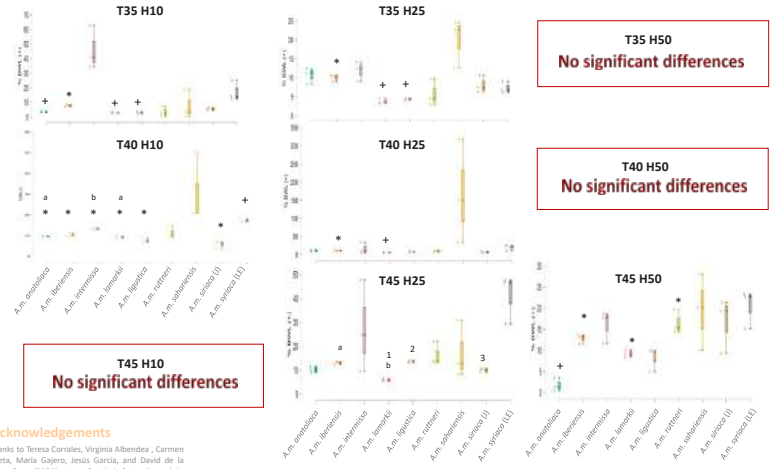


Comparative analysis of native and imported subspecies in Spain (1 year later)



Significant differences between subspecies

The raincloud plots show data from biological replicates



T35 H50
No significant differences

T40 H50
No significant differences

T45 H10
No significant differences

Acknowledgements

Thanks to Teresa Corrales, Virginia Albendea , Carmen Uceta, María Gajero, Jesús García, and David de la Plaza, from CIAPA's team, for their fantastic work in the laboratory and in the hives.

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PP-152 [Bee Health]
Toxicity of active substances used in agriculture towards bees

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The purpose of this work was to provide farmers with a tool to minimize the impact towards bee health when carrying out phytosanitary treatments with pesticides.

For this purpose, a table was produced on the toxic effects on honey bees Apis mellifera of active substances currently allowed in Italy for phytosanitary treatments and their persistence in the environment and when available, the same data were reported for other bee species (Bombus terrestris and Osmiaspp.

The toxicity class was determined on the basis of the lowest LD50 value for acute oral or contact exposure. The following reference values were used for all three species: < 2 µg/bee = high toxicity; 2-100 µg/bee = medium toxicity; > 100 µg/bee = low toxicity. In the absence of this data, that for ingestion toxicity was used. In case both results were available, the lower one was considered. In case the degree of toxicity was not among species, the value for the most sensitive species was provided.

The table is user-friendly in that the level of toxicity to bees was indicated by three colors, making it possible designedto be as to understand the data immediately.

The following databases were consulted to compile the table on toxicity: ECOTOX, TOXNET, PAN Pesticide Database, PPDB-Pesticide Properties Database, BPDB-Bioperticide DataBase, EFSA documents, Win BDF-Agrochemicals Data Bank.

In order to compile the table on sublethal effects, a literature search on the topic was conducted.
A second table was also produced showing the active substances for which sublethal effects on other bee species Apis mellifera, Bombus terrestris and Osmia spp. were found.

The tables are made available free of charge to all interested parties-farmers, technicians, beekeepers and their organizations-both via the web (in A4 format, pamphlet, for letterpress and poster) and in print.
The tables are aimed to be a valuable document to promote good agricultural practices for the protection of bees, both farmed and wild.

PP-153 [Bee Health]
Investigating Pesticide Toxicity in Apis cerana for Better Pollinator Health Management

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Pollinators, especially honey bees play a crucial role in global food security and ecological balance. However, pesticide exposure poses a serious threat to their survival, affecting foraging behavior, reproductive success, and overall colony health. Pesticides can exert both lethal and sublethal effects, leading to long-term colony declines and disruptions in pollination services. This study investigates the toxic effects of commonly used pesticides on Apis ceranathrough controlled topical bioassays. Worker bees were exposed to different pesticide concentrations and mortality was recorded at multiple time intervals after post-application. Bioassays were conducted using single-use bee rearing cups to ensure accurate exposure conditions. To assess toxicity, LC values were determined using probit analysis, with Abbott's correction applied for precise dose-response evaluation. Additionally, the hazard quotient (HQ) was calculated for each pesticide to determine its relative risk to A. cerana populations. Results indicate that insecticides, particularly broflanilide and imidacloprid, exhibited pronounced lethality, inciting substantial mortality even at infinitesimal concentrations. Conversely, chlorantraniliprole, along with the scrutinized fungicides and herbicides, manifested markedly lower toxicity. These findings highlight the heightened risk posed by certain insecticides, emphasizing the need for pollinator-friendly pest management practices. Implementing Integrated Pest Management (IPM) strategies that prioritize pollinator health can help mitigate harmful effects while maintaining agricultural productivity. Moreover, the hazard quotient analysis revealed the potential long-term risks associated with chronic pesticide exposure, even at sublethal doses, which can impair navigation, learning ability, and immune responses in honey bees.

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PP-154 [Bee Health]

APIGUARD® and Oxalic Acid three-year monitoring trial (2021 – 2023, North East Italy)

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Introduction:

Since 2003, beekeeping groups in the region of Friuli Venezia Giulia, in North Eastern Italy, have worked on plans to control Varroa, taking into account the alternating use of synthetic active ingredients.

In the last few years, organic treatments used according to an organic Integrated Pest Management (IPM) protocol, started to be introduced. For the success of this strategy, a slow release product should be used as main tool, but potentially supported by a different organic active ingredient with a flash action.

In order to extend to all the beekeepers this new tool to fight varroa mite, a large study with more than 413 hives and based on APIGUARD® was perfmoed for 3 years in a row. **APIGUARD®** is a sophisticated, patented slow release gel that ensures correct dosage of its active ingredient, thymol.

Materials and methods:

The objective of this monitoring was to verify at different times of the year the strength and vitality of bee colonies subjected to a well-defined plan of varroa control with organic treatments in North East Italy.

In 2021, 413 hives were monitored, of which 36 were managed according to an organic Integrated Pest Management (IPM) protocol, where APIGUARD® (thymol) and oxalic acid were used in different combinations and times of the year.

GROUP A
- 1 tray of APIGUARD® (2/03/2021)
- No treatment with Oxalic acid at the end of May
- Full dose of APIGUARD® (summer treatment 5/08/2021)
- 1 tray of APIGUARD® (22/09/2021)
- Oxalic acid in December

GROUP B
- 1 tray of APIGUARD® (2/03/2021)
- Treatment with Oxalic acid at the end of May (23/05/2021)
- Full dose of APIGUARD® (summer treatment 5/08/2021)
- 1 tray of APIGUARD® (22/09/2021)
- Oxalic acid in December

GROUP C
- No treatment of APIGUARD® (2/03/2021)
- Treatment with Oxalic acid at the end of May (23/05/2021)
- Full dose of APIGUARD® (summer treatment 5/08/2021)
- 1 tray of APIGUARD® (22/09/2021)
- Oxalic acid in December

In the following two years, we increased the number of hives monitored, reaching 424 in 2022 and 479 in 2023, and the protocol was adjusted in group B.

GROUP B
- 1 tray of APIGUARD® (2/03/2021)
- Treatment with Oxalic acid at the end of May (23/05/2021)
- Full dose of APIGUARD (summer treatment 5/08/2021). **5 days earlier, a treatment with Oxalic acid was performed.**
- 1 tray of (22/09/2021) **5 days earlier, a treatment with Oxalic acid was performed.**
- Oxalic acid in December

Results:

- In 2021, the group where both active ingredients were used during the year had no colony losses, and saw a smaller reduction of strength at the end of autumn compared with the control groups.
- In 2022 and 2023, colonies receiving the full IPM treatment were stronger in spring than the other 2 groups where only 1 of the treatments was used.

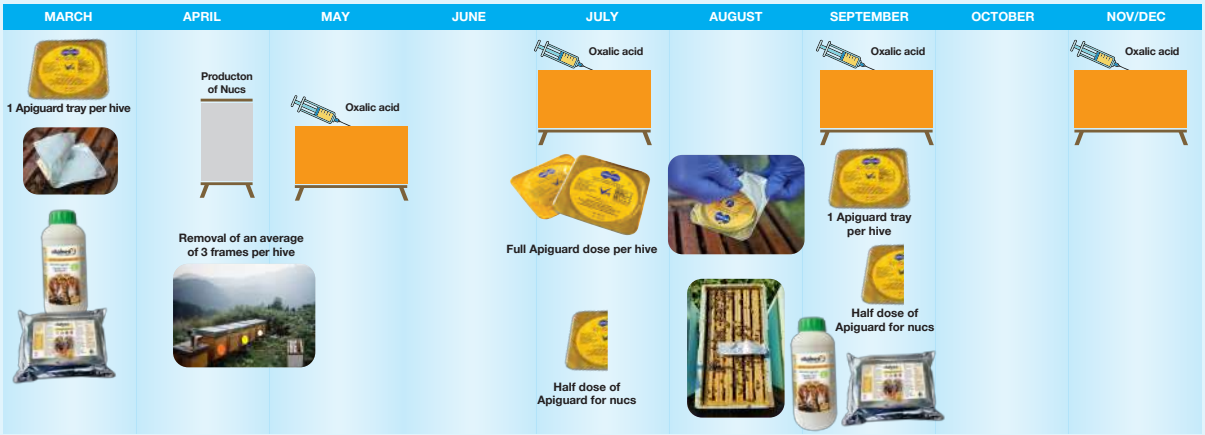
Conclusion:

After 3 years of using APIGUARD® + oxalic acid in an IPM protocol, **none of the colonies were lost.** The Varroa population was controlled over the 3 years. The colony strength was higher than the other groups.

The spring treatment and post acacia harvest are decisive to keep the varroa load low, and reduce the reinfestation in September.

An IPM programme based on an organic product like APIGUARD® in combination with Oxalic acid, can be used safely and effectively for organic and conventional beekeepers.

Outline for Varroa control plan



PP-155 [Bee Health]
Optimisation of Varroa destructor control strategies in Ukrainian apiaries

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[2]Association "Professional Pollination: Innovations, Bioresearch, Pollinator Health", Lviv, Ukraine

Varroa destructor remains a major threat to Apis mellifera globally, with chemical acaricides being the primary control method, including in Ukraine. However, excessive use, combined with pesticide exposure and climate change, has led to increasing resistance in Varroa populations (Maggi et al.2010a, 2011) and higher colony mortality. This necessitates the development of new strategies for managing Varroa mite populations in bee colonies throughout the season under Ukrainian conditions.

The study was conducted from August 7 to December 14, 2024, at a private apiary in Kazanka, Mykolaiv Region, Ukraine, involving 145 colonies of A. m. carnica (85%), A. m. ligustica (10%), and A. m. macedonica (A. m. sossimai) (5%). The effectiveness of Avatar Bi VarroaOff, an organic acaricide, was tested on two groups of A. m. carnica colonies (n=5 per group) using different application intervals: four treatments every four days vs. three treatments every six days. The remaining colonies received Varoflu (flumethrin, 3.6 mg/strip, 3–4 strips/colony). Mite infestation levels and colony strength were recorded before and after treatment, with daily mite drop assessed separately (Dietemann et al. 2015).

After 38 days from the start of treatments, all bee colonies were subjected to additional treatments with various acaricides:

- Oxalic acid (sublimation);
- Oxalic acid (aerosol vaporization);
- 60% formic acid;
- Amitraz (Apimitryn).

Treatments continued until mite drop ceased. Avatar Bi VarroaOff achieved 65% efficacy (three treatments) and 77% (four treatments). No method fully eradicated Varroa destructor in the presence of brood.

Even the combined use of different types of acaricides at specific intervals did not immediately reduce the mite infestation level to an acceptable threshold. The results confirm the low efficacy of synthetic acaricides in Ukraine, which aligns with global trends (Sammataro et al. 2005).

The high demands for the quality and safety of beekeeping products, climate changes prolonging the brood-rearing period into late autumn, and the declining efficacy of synthetic acaricides underscore the need for new strategies to control Varroa destructor populations. Continuous mite monitoring and season-long population regulation, utilizing organic acids (oxalic, formic) or complex organic acaricides like Avatar Bi VarroaOff, alongside biotechnical methods, are promising strategies for sustainable Varroa management.

PP-156 [Bee Health]
The expanding threat of Vespa orientalis: insights from Malta on microbiota, pathogens, and beekeeper perceptions

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Vespa orientalis, the Oriental hornet, is increasingly recognised as an emerging invasive threat worldwide, with populations expanding beyond its native range into Europe, South America, and beyond. While considered indigenous to Malta, its growing numbers and intensifying impact on beekeeping mirror those of an invasive species. This study combines microbiota and pathogen analysis with a three-year beekeeper survey (2022–2024) to assess V. orientalis's potential as a pathogen reservoir, and the associated risks to beekeeping.

Despite growing reports of V. orientalis predation on honey bees, its gut microbiota and potential to harbour pathogens remain understudied. Additionally, beekeeper surveys tracking hornet sightings, colony losses, intervention effectiveness, and response strategies provide valuable insight into its perceived and actual impact on apiaries.

This study analysed the gut microbiota and pathogen presence in V. orientalis specimens from four locations in Malta, comparing individuals that fed on honey bees and those that scavenged on cat food. 16S rRNA gene sequencing and qPCR were used to assess microbial diversity and detect bee pathogens presentin the hornet. In parallel, beekeeper survey responses were evaluated to track changes in hornet sightings, colony losses, and mitigation strategies.

Microbial analysis revealed a core gut microbiota dominated by Firmicutes and Proteobacteria, with diet-based differences. Arsenophonus, a genus linked to honey bee-associated bacteria, was enriched in hornets preying on honey bees, suggesting potential microbial exchange between hornets and bees. Pathogen screening identified Nosema ceranae and Crithidia bombi, both known to impact pollinators.

Survey analysis highlighted fluctuating but persistent impacts of V. orientalis. Colony losses dropped in 2023 but rose again in 2024, despite more beekeepers taking action. Intervention effectiveness also declined in 2024, with more beekeepers reporting that control measures were ineffective. Findings indicate that V. orientalis's impact on beekeeping persists and may be worsening as mitigation efforts decline in effectiveness.

With traditional control measures becoming less effective, new management strategies are urgently needed. Integrating scientific research with beekeeper-driven surveillance will be key to long-term mitigation both in Malta and globally. Additionally, insights into V. orientalis gut may open new avenues for biological control, offering targeted microbial-based strategies to regulate hornet populations.

Low *Varroa destructor* infestation and the potential of organic beekeping in Pernambuco Brazil

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STUDENT POSTER N°1092

INTRODUCTIO

Beekeeping has been consolidated as an important source of employment and income for small producers in the Brazilian Northeast, playing a fundamental role in the regional economy and in the fixation of man in the countryside. In addition, the region has ideal conditions for the production of organic honey, being one of the few in the world with this potential, due to the vast availability of native flora free of contamination by agrochemicals.

OBJECTIV

Evaluate the infestation rate by the *Varroa destructor* mite in the regions of Sertão, Agreste and Zona da Mata of Pernambuco – Brazil, in order to ensure the sustainability of organic beekeeping in the region

MATERIALS

Bee samples were collected from 85 colonies, which were transferred to a container containing 70% alcohol (Figure 1 and 2) to determine the infestation rate, using the methodology of De Jong and Mantilla (1986). The analyses were carried out at the Laboratory of Animal Genetics and Bee Breeding Prof. Dr. Warwick Estevam Kerr, in the Department of Animal Science at Federal Rural University of Pernambuco (Figure 3 and 4)

Figure 1. Collecting bee samples from the hive

Figure 2. Collected bee samples from the hive in a container with 70% alcohol

Figure 3. Collected bee samples

Figure 4. Students doing the analyses

RESULTS

Varroa destructor (figure 5 and 6) is one of the main parasites of bees of the genus Apis, and can compromise the health of the swarms and the productivity of the hives. Its control is a challenge for worldwide beekeeping, and its presence at low rates is a positive indicator for the sustainable production of organic honey.

Figure 5. *Varroa destructor*

Figure 5. *Varroa destructor* and *Apis mellifera*

The results indicated an average *Varroa destructor* infestation rate of 1.27 ± 0.025, which is considered low. (Figure 6)

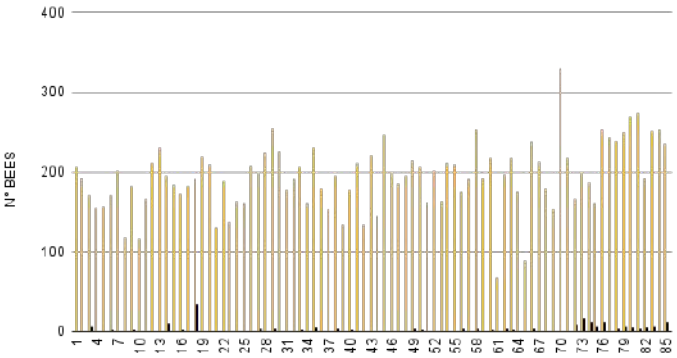

Figure 6. Comparative chart of bees and parasites (*Varroa destructor*) in the samples

CONCLUSION

It is concluded that the low mite infestation in Pernambuco favors the production of high-quality organic honey, reinforcing the viability of sustainable beekeeping in the region and its socioeconomic importance for local beekeepers.

ACKNOWLEDGMEN

UNIVERSIDADE FEDERAL RURAL DE PERNAMBUCO
PROExC
ADEPE Agência de Desenvolvimento Econômico de Pernambuco
FACEPE Fundação de Amparo à Ciência e Tecnologia do Estado de Pernambuco

APIMONDIA SCANDINAVIA 2025
SWEDEN | DENMARK | NORWAY

PP-158 [Bee Health]

Management of pests and predators of Honeybee: Control strategies for improved bee keeping in India

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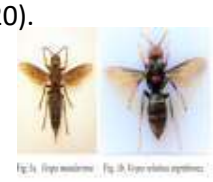
Abstract: Beekeeping supports the livelihoods of many marginalized communities in India, particularly in rural areas. While Indian honey bees are generally free from major diseases, except Thai sac brood virus, pests and predators cause significant losses, often leading to colony desertion. This study focuses on identifying common pests and their management in Maharashtra. The greater wax moth (*Galleria mellonella*) is a major pest in southern India, especially during July–October and November–December, attacking weak colonies and damaging brood, honey, and pollen. Other threats include the yellow banded hornet (*Vespa cincta*), wax beetle (*Platybolium alvearium*), robber bees, leaf cutter bee (*Megachile disjuncta*), and dragonflies. These pests, especially in unhygienic or weak colonies, impact honey production and threaten the economic stability of beekeepers. The study highlights control strategies to support improved and sustainable beekeeping in Maharashtra.

Pest : Wax Moths (Galleria mellonella & Achroia grisella) Larvae destroy combs, pollen, and brood.
Control: Maintain strong colonies, freeze infected combs, and use traps.

Predators:

Hornets (Vespa mandarinia, Vespa tropica) : Attack foraging bees and decapitate them to feed their young.
Control: Install hornet traps, reduce hive entrances, and monitor colonies during peak hornet season

- **Introduction** : Although Greater wax moth (Galleria mellonella) and lesser max moth (Achroia grisella) are known to cause threat to apiculture. But, recently the hornet pests belonging to family Vespidae have gained the upper hand and are causing direct damages to the foraging bees and are leading to reduction in colony population, making the colonies weak and finally resulting in absconding or deserting of bee colonies (Requier et al., 2020).



Green Bee eater

- Hornet pests of honey bees in the Indian Himalayas
- **Ants** Invade hives to steal honey and attack larvae. **Control**: Use physical barriers like oil moats and elevate hives

Varroa Mite (Varroa destructor) Parasitic mites that weaken bees by feeding on their bodily fluids.
• **Control**: Use screened bottom boards, drone brood removal, and organic miticides.

Varroa Mite

Birds (e.g., Bee eaters, Woodpeckers) Damage hives and stress colonies. **Control**: Use netting or scare devices around apiaries.

•Small Hive Beetle (Aethina tumida)
•Larvae feed on honey, pollen, and brood, causing fermentation.
Control: Trap beetles, maintain hive hygiene, and avoid excess space.

- **Conclusion** : Strategies would improve bee keeping : A trap developed for controlling hornets showed up to **83% efficiency**.
- Designing of the bait trap for managing the hornet menace in the apiaries Considering the severity of attack and the amount of loss incurred to the apiarists of Indian Himalayas

•Various pests and predators cause major losses in apiculture.
•These pests reduce honey bee colony strength and productivity, directly impacting the beekeeping industry.
•The resulting decline affects both rural livelihoods and the broader economy.
•Effective pest and predator management is crucial for sustainable
• beekeeping in the Indian context.

Selected References : Aizen et al., 2008, Anonymous, 2019, Uniyal et al., 2018, Shah and Shah, 1991, Requier et al., 2020).

APIMONDIA SCANDINAVIA 2025
SWEDEN | DENMARK | NORWAY

PP-159 [Bee Health]

How does combined exposure to pesticides and *Nosema ceranae* affect bee health?

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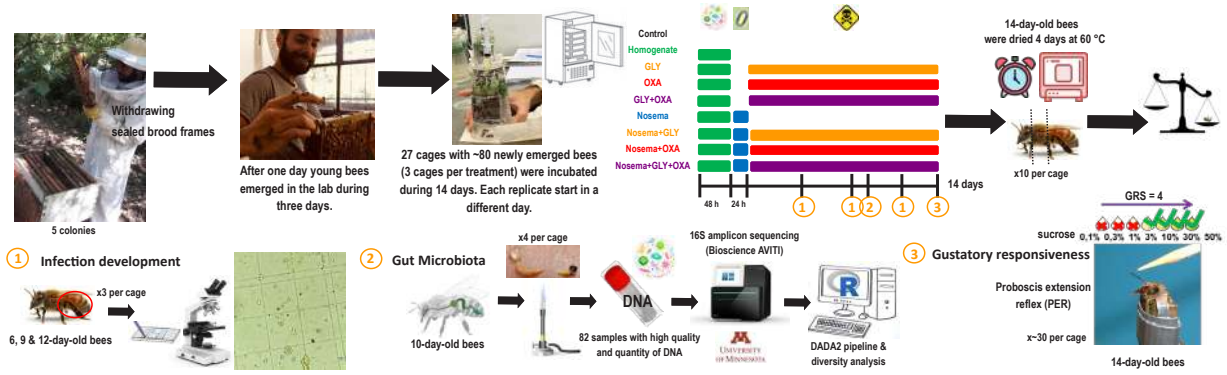
INTRODUCTION

Agricultural intensification in recent decades has led to extensive use of agrochemicals. Beekeeping is not exempt from this problem. The demand for pollination services has increased, and beekeepers must frequently apply acaricides to control *Varroa destructor.* Therefore, after pesticide applications on crops or hives, growing residues have been detected in honey and beebread[1]. Also, pests and pathogens are more probable in crowded apiaries with honey bee colonies in stressful environments. In this scenario, the honey bees are chronically exposed to mixtures of pesticide residues, which weaken colonies on a stress treadmill. The question is how the early ingestion of pesticides can alter the development of gut defensive barriers, such as the microbiota, or digestive diseases, such as nosemosis. Hence, the current study aimed to assess the interaction between *Nosema ceranae* infection and a common pesticide mixture. On the one hand, the herbicide glyphosate (GLY), the pesticide most widely applied in crops, has shown detrimental effects in both brood and adult bees[2,3,4]. On the other hand, the organic acaricide oxalic acid (OXA) is one of the most applied options in Latin America. Previous studies indicate that both pesticides have antimicrobial action on the gut microbiota of bees[5,6]. This antimicrobial action is relevant due to the potential detrimental effect that they would exert on the bee health. Adult bees have a gut microbiota consisting mainly of bacteria belonging to 9 genera such as Lactobacillus, Snodgrassella, Gilliamella and Bifidobacterium, among others[6]. These symbionts play a crucial role in nutrition and immunity, acting as barriers against pathogens and pollutants[6]. Therefore, the early disruption of the gut microbiota in young bees would affect their physiology or the physiopathogenesis of digestive diseases such as nosemosis. Moreover, the first weeks in the lifespan of adult bees are crucial for the survival of the colony because they take care of the queen and the next generations of larvae.

METHODS

We caged around 80 newly emerged bees per treatment (3 replicates with bees from 5 colonies) and reared them under lab conditions (31 °C and 60% RH). Then, we inoculated the caged bees with native gut microbiota by administering 2 mL of homogenate with gut content of nurse bees from hives and sucrose solution (5 guts : 1 mL PBS 1X : 1 mL sucrose sol. 2:1) during the first two days in all treatments, besides a control group without homogenate. Furthermore, the adult bees were chronically exposed to the herbicide glyphosate (GLY: 1.6 mg/L), the acaricide oxalic acid (OXA: 280 mg/L) or both administered in the sucrose sol. (1:1) at 3 days of age, besides a group without pesticides (homogenate). These pesticide concentrations correspond to the maximum value of residues detected in hives according to the literature[6]. The same 4 treatments were performed adding spores of *N. ceranae* (80.000 spores/bee) in 1 mL of sucrose sol. (1:1) during 24 h at 2 days of age. Therefore, we carried out 9 treatments with the different possible combinations of exposures, measuring intake and survival. Then, the infection development was monitored in 6, 9 and 12-day-old bees while the diversity of the microbiota was analysed after 10 days. Lastly, we assessed physiological alterations in 14-day-old bees, measuring dry weight and gustatory responsiveness[2,4].



RESULTS

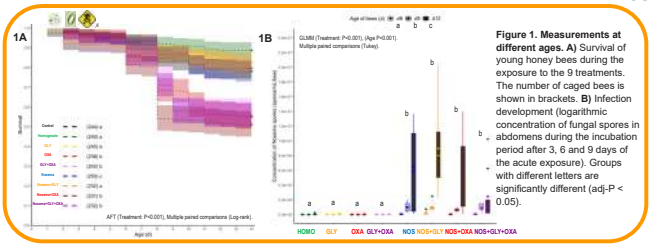


Figure 1. Measurements at different ages. A) Survival of young honey bees during the exposure to the 9 treatments. The number of caged bees is shown in brackets. **B)** Infection development (logarithmic concentration of fungal spores in abdomens during the incubation period after 3, 6 and 9 days of the acute exposure). Groups with different letters are significantly different (adj-P < 0.05).

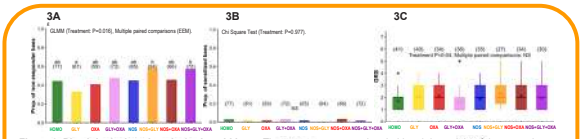


Figure 3. Physiological markers in 14-day-old bees. The sucrose response threshold and dry weight of the young honey bees were assessed after ingesting 8 different combinations of the two pesticides and spores of *Nosema ceranae*. **A)** Proportion of non-responder bees, i.e. without PER after stimulation with water or sucrose solution. Groups with different letters are significantly different (adj-P < 0.05). **B)** Proportion of sensitized bees, i.e. with non-specific PER to water or sucrose solution. **C)** Dispersion of the gustatory response score (GRS) of each bee with specific PER to sucrose solution (CLM followed by EMM). The number of assessed bee is shown in brackets. Dry weight showed no significant differences among treatments (GLMM, P=0.407).

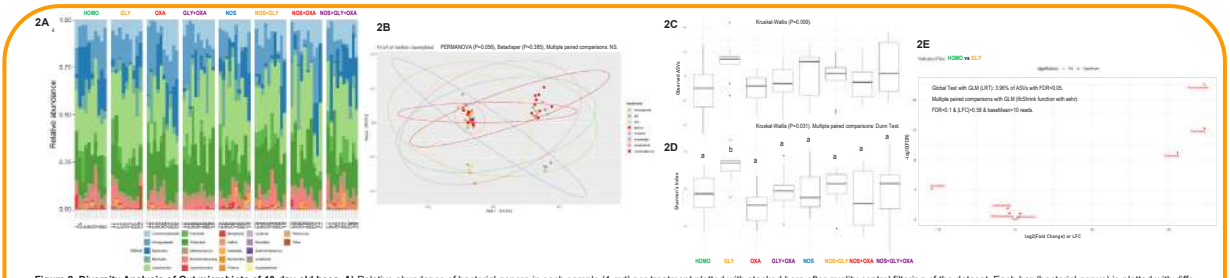


Figure 2. Diversity Analysis of Gut microbiota of 10-day-old bees. A) Relative abundance of bacterial genera in each sample (1 gut) per treatment plotted with stacked bars after quality control filtering of the dataset. Each bar (bacterial genus) is plotted with different colours (see legend). **B)** Multivariate analysis of beta diversity. PCoA plot is based on distance matrices of Unweighted Unifrac similarities. The points (each sample) are plotted with different colours per treatment (see legend). The ellipses indicate bidimensional confidence intervals (95%) for each treatment. **C&D)** Dispersion of indices of alpha diversity per treatment plotted with boxplots. C) Observed ASVs as an indicator of bacterial community richness in each simple (high index, high richness). D) Shannon´s index as an indicator of bacterial community uniformity in each sample (high index, high uniformity). Groups with different letters are significantly different (adj-P < 0.05). **E)** Differential abundance analysis with DESeq2. Volcano plot of ASVs with a significant difference in the number of reads between homogenate and GLY groups, as an example.

CONCLUSIONS

Our results indicate that exposure to field-relevant concentrations of OXA and GLY showed lethal and sublethal effects on gut microbiota diversity, respectively. Furthermore, the infection with *Nosema ceranae* reduced the survival of young honey bees. However, the pesticides did not interact synergistically with the fungal infection in survival, but the combination of GLY and *Nosema ceranae* slightly affected the sensitivity to sucrose. Therefore, a combination of stressors should not necessarily generate an expectation of a greater deleterious effect because of the complex interaction *in vivo*.

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PP-160 [Bee Health]
Diversity and distribution of honey bee viruses in the Netherlands

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Colonies of the western honey bee (Apis mellifera) are susceptible to a wide range of predators, parasites and pathogens threatening their health and often their survival. Among these, the parasitic mite Varroa destructor is considered the most important threat to honey bee health and is associated with high worldwide colony losses. While the mite weakens the colony by feeding on the brood and the adult bees, it also lowers the immune defenses of its host and transmits several viruses. In many cases, the final collapse of a honeybee colony is believed to be an effect of virus infections rather than the direct effect of parasitization by V. destructor.

While a few studies conducted in the Netherlands have investigated honey bee viruses, they mainly focused on Deformed wing virus (DWV) and were restricted to a limited geographical area. With the aim of assessing the diversity and the geographical distribution of viral species in Dutch honey bees, 300 colonies from 100 apiaries across the country were sampled at the end of the summer 2022. All samples, comprising 30 bees, were homogenised, RNA was extracted and viral loads of DWV as well as Chronic bee paralysis virus (CBPV) were measured using qPCR. In addition to this, samples were pooled and sequenced using Next Generation Sequencing (High Throughput Sequencing; HTS). Analysis of the generated NGS dataset revealed the presence of a number of recently discovered viruses such as Apis rhabdovirus-1 (Rhabdoviridae), Bee Macula-like virus (Tymoviridae), Hubei Partiti like virus 34 (Partitiviridae) and Varroa orthomyxovirus 1 (Orthomyxoviridae), the ecology of which is poorly understood.

PP-161 [Bee Health]
Chemo-whispering: A possible adaptive trait of honey bees to reduce varroa mite reproduction

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ABSTRACT
Background and Purpose
Some honey bee (Apis mellifera) populations can survive varroa mite infestation with minimal to no treatment. These populations exhibit reduced varroa reproductive success, but the mechanisms behind this remain unclear and may vary between populations around the world. This is the case for the well-studied mite-resistant honey bee population of Gotland in Sweden. The purpose of this study was to better understand host-parasite interactions between honey bees and varroa mites, focusing on how the mites reproduction may be disrupted.

Methodology
To begin we compared the reproductive success of the varroa mite exposed to adult bees, which could remove mites, versus those caged without adult bees having access. Since adult bee presence did not affect the mite reproductive success, we investigated pupal characteristics that might inhibit mite reproduction. Specifically, we examined brood pheromones (specifically fatty acid methyl and ethyl esters and (E)-beta-ocimene) released by the pupae during the early capping period (0-36 hours), when mite reproduction is triggered in both resistant and non-resistant brood. Gas chromatography was used to analyze these pheromones.

Results and conclusions
We found that varroa-resistant honey bee pupae produced lower levels of specific pheromones compared to varroa-susceptible ones. These pheromones are typically used to communicate information, such as developmental stage, from the pupae to adult worker bees, but are also intercepted by varroa mites to locate suitable hosts for feeding and synchronize reproduction. Our study suggests that varroa-resistant honey bees employ a type of chemical camouflage, which we have termed “chemo-whispering”, where the bees produce lower pheromones levels that prevent varroa mites from recognizing host signals, thus mite reproduction.

Practical implications for beekeepers
This research provides valuable insight into developing better bee health management strategies concerning varroa infestation and offering potential for more sustainable beekeeping practices.

PP-162 [Bee Health]
Detection of miticide resistance in Varroa destructor mite population in Canadian apiaries

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In the last decade, honey bee health has substantially declined with the main driver of colony losses being the parasitic mite Varroa destructor, and its associated load of viruses. In Canada, the national winter loss in 2023 was 32% with provincial losses ranging from 11% to 46% (CAPA, 2023). Control of varroa mite in beekeeping has become a tireless all season long endeavour. Amitraz acaricide has been the main alternative for controlling varroosis, and it has been used intensively in apiculture for over a decade. Resistance to amitraz in mite populations has been described in Europe and US. In Canada, there are reports of reduced amitraz efficacy, and amitraz resistance is widely discussed among beekeepers. This study aimed to screen Varroa mite populations in Canadian apiaries for genetic mutations associated with resistance to amitraz (octopamine receptor gene) and pyrethroid (voltage-gated sodium channel gene). Our results confirmed the presence of Y215H amitraz-resistance mutation in mite population in Alberta, Manitoba and British Columbia. This mutation was found in 98%(AB), 97% (MB) and 80% (BC) of the apiaries tested, with allele frequency ranging from 14-100%, 62-100%, and 5-81%, respectively. In parallel, the L925I and L925M pyrethroid-resistant mutations were found at similar prevalence in the same apiaries. Testing historical samples from the 2014-2017, the Y215H amitraz-resistant mutation was not detected in the apiaries tested; whereas the L925I and L925M pyrethroid-resistant mutation were already present in 50% of the apiaries tested. These findings support the implementation of a nationwide monitoring of miticide resistance using genotyping of mite populations. This will provide beekeepers and regulatory agencies timely information that will enable them to make decisions regarding control methods used to manage varroosis, including rotation of available treatments.

PP-163 [Bee Health]

PROFILING THE BEE GUT MICROBIOME FOR DIAGNOSING NEONICOTINOID EXPOSURE AND MODELING EFFECTS ON COLONY PRODUCTIVITY AND BEEKEEPER PROFITABILITY

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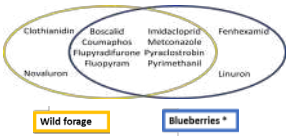
Presenter: Miriam Bixby

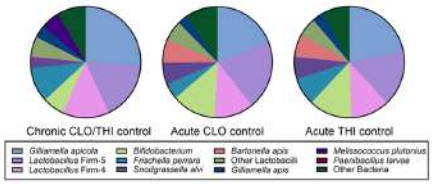
Exposure of the European honey bee (Apis mellifera) to pesticides can result in both lethal and sub-lethal effects that diminish the productivity and sustainability of beekeeping operations. Colonies situated in agriculturally rich regions are often exposed to systemic insecticides. In Western Canada, for example, our findings indicate that colonies are exposed to insecticides regardless of whether they are directly involved in crop pollination.This may be due to widespread pesticide use or dispersion beyond the original application sites. As a result, all beekeepers, including those not renting bees for pollination, may be affected by pesticide exposure to their colonies.

Pesticides found in honey bee bodies
from colonies pollinating blueberries and colonies placed far from blueberries (wild forage) indicating that colonies not involved in crop pollination are also at risk of pesticide exposure in agricultural regions



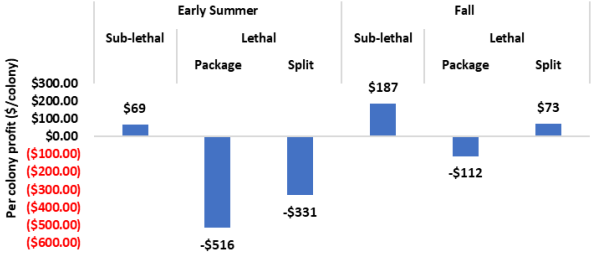
A critical component of colony health is the bee gut microbiome, which plays a vital role in digestion, immunity, and disease resistance. Disruptions in the gut microbial community, or dysbiosis, can serve as early indicators of colony stress and declining health. To better understand how pesticides influence the microbiome, we used shotgun metagenomics sequencing, which allows for deep taxonomic resolution, to assess the gut microbiome's response to two common neonicotinoid insecticides: clothianidin and *thiamethoxam* in laboratory cages and colony field conditions. Our results reveal common dysbiosis signatures, including an increase in *Bifidobacterium* spp. after chronic sublethal exposure and an increase in *Apibacter adventoris* after short-term acute exposure. Other dysbiosis signatures were unique to each insecticide exposure, such as an increase in *Snodgrassella alvi* in response to clothianidin and a decrease in Lactobacillus spp. following thiamethoxam exposure. These microbial shifts reveal the sensitivity of the bee gut microbiome to environmental stressors and highlight its potential as a diagnostic tool for monitoring colony health.

Microbial composition of the gut microbiome of controls bees in the colony experiment (CTX), and control bees in cages for the experiments testing Clothianidin (CLO) and Thiamethoxam (THI)

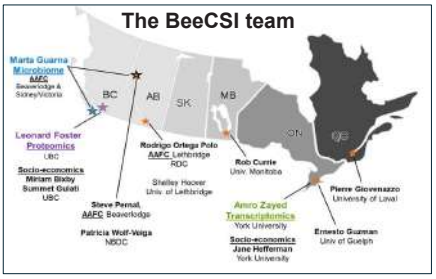


Building on this biological understanding, our research has also examined the economic implications of pesticide exposure for beekeepers. We developed a profit model which incorporates both the direct and indirect effects of neonicotinoid toxicity based on calculated risk quotients (RQs) and exposure thresholds. In this model, direct effects are expressed as a decline in honey production, while indirect toxicity is represented by a colony health variable that influences profitability. The timing of exposure plays a critical role in determining economic outcomes: impacts that occur in the summer, when honey production is highest, result in greater revenue losses compared to those that occur in the fall. While the model highlights significant risks to colony productivity and profitability, it also identifies pathways for mitigation. Practical beekeeper interventions include reducing pesticide exposure and adopting cost-effective replacement and rebuilding strategies such as making in-house colony splits.

Together, these biological and economic insights underscore the importance of integrated strategies for improving honey bee health and maintaining beekeeping profitability in pesticide-intensive agricultural landscapes. Microbiome monitoring and practical beekeeper interventions to minimize pesticide exposure and reduce recovery costs to mitigate profitability losses offer promising avenues for sustaining colony health and maintaining the profitability of beekeeping operations.



Colony profitability considering the impact on honey production from pesticide exposure with no measured adverse effect on other honey bee health or behavior



Acknowledgement: The authors acknowledge funding from the Government of Canada through Agriculture and Agri-Food Canada (AAFC) to MMG, SP, and ROP [AAFC J-002368] and from Genome Canada to LF, AZ, RC, PG, SH. We also thanks all members of the Bee Sci consortium https://beecsi.ca/beecsi-consortium/

PP-164 [Bee Health]
Plega hagenella (Neuroptera), efficient parasitoid of stingless bees (Meliponini) colonies: biology, infestation and control in stingless bees breeding sites

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Plega hagenella (Neuroptera) is a parasitoid of bees that has recently been studied in the nests of the stingless bee Melipona subnitida (Maia-Silva et al., 2012, 2015) and Scaptotrigona spp. It has been extensively investigated as a parasitoid of Melipona compressipes colonies in Amapá State, Brazil. The infestation was monitored in several smallholder meliponaries, with the first author conducting an in-depth study on its control.

The impact of Plega infestation gradually increases in meliponaries, and the parasitoid's behavior was examined through a control program that tested various strategies, primarily focusing on cleaning the breeding sites to eliminate adults that are typically not found during the day. Data regarding behavior, infestation, and control had been largely unknown until now. Infestation begins with small larvae invading the nest and searching for brood cells in the pre-pupal or pupal phase. The mantisfly larva consumes the pupa and develops within the brood cell, and its silken cocoon can be detected by the host stingless bee workers, who are unable to open them. After completing its development, the Plega larva opens its cocoon and exits the brood cell in a pharate form. It shows behavioral plasticity: pharate adults were not attacked by their hosts in M. subnitida, that remove them unharmed from the nest, as refuse; but can leave the colony undisturbed by workers in M. compressipes. Outside the nest, often on the external walls of the hives, it completes its development, emerging with its wings while leaving its exuviae attached to the hives.

It was found that brushing the external walls of the hives once a week is an effective management technique that controls the infestation or even prevents its development. Numerous exuviae can be found outside hives in infested areas, allowing for the identification of both female and male. The adult insects exhibit nocturnal activity and can be captured using light traps, which accounts for the small number of individuals in zoological collections. The exuviae likely attract females to oviposit on the hive walls, facilitating infestation. Recently, new infestations have been discovered in Scaptotrigona colonies across several Brazilian states, expanding their range distribution

APIMONDIA SCANDINAVIA 2025
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PP-165 [Bee Health]

Exploring Pyrethroid and Amitraz Resistance in *Varroa destructor* Mites from Honeybee (*Apis mellifera*) Colonies in Portugal

Maíra Costa[1], Carlos A. Yadró[1], Ana R. Lopes[1], Antonio Pérez-Pérez[2], Raquel Martín-Hernández[2], Mariano Higes[2], M. Alice Pinto[1], Dora Henriques[1].

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Introduction

Varroa destructor, an ectoparasitic mite of honey bees (*Apis mellifera*), poses a significant threat to apiculture by causing varroosis and transmitting viruses, including the deformed wing virus. This mite can be controlled by the use of synthetic or organic acaricides. However, the excessive and repeated use of acaricides has led to resistance in mite populations.

Resistance to pyrethroids, is linked to mutations at positions 925 (L925V, L925I, L925M) and 918 (M918L) of the voltage-gated sodium channel (VGSC) gene. For amitraz, resistance is linked to mutations in the Octβ2R gene, at position 87 (N87S), 215 (Y215H), 290 (F290L), and 337 (Y337F).

Objectives

- Detect the presence of resistance alleles to pyrethroids at positions 918 and 925 in Portugal
- Detect the presence of alleles associated with resistance to amitraz
- Map the national distribution of these resistance alleles

Materials & Methods

Sampling: Mites were collected across Portugal in 2024/2025.

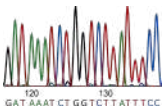
82 apiaries **(Pyrethroids)**
27 apiaries **(Amitraz)**

Varroa destructor analyzed
245 samples **(Pyrethroids)**
59 samples **(Amitraz)**

Laboratory

✓ **DNA Extraction**
- From a single *Varroa destructor*

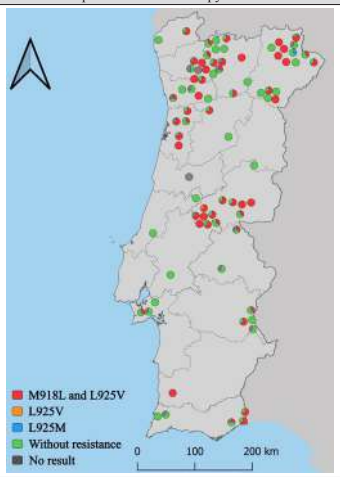
✓ **PCR**
Two **locus-specific primers** were used:
- One targeting known mutations associated with **pyrethroid resistance;**
- One targeting mutations linked to **amitraz resistance (Y215, F290 and Y337)**.



✓ **Sanger Sequencing**
- Sequencing was performed by Macrogen Europe (Madrid, Spain);
- Chromatograms were analyzed and aligned using (Bioedit and MEGA)

Results & Discussion

Apiary-level results: spatial distribution of pyrethroid resistance in Portugal.



Pyrethroids: Of the 245 samples analyzed, 20 (8%) did not yield valid results. Of the remaining samples, 107 (43.7%) showed the simultaneous presence of the L925V mutation — typical in Europe — and the M918L mutation, initially identified in the Valencian Community, Spain. Only one sample (0.4%) presented the L925V mutation alone, and another (0.4%) revealed the L925M mutation, originally described in the United States. On the other hand, 116 samples (47.3%) did not exhibit any mutation associated with pyrethroid resistance and were therefore considered susceptible, of which 3.4% were heterozygous.

Spatial distribution of apiaries and amitraz samples.

Amitraz: Remarkably, 98.3% of the 59 amitraz samples (58 samples) carried the Spanish F290L mutation, with just one sample (1.7%).
The Y215 mutation (USA) and the Turkish Y337 mutation were not detected in any of the samples. In this study, no samples were analyzed for the N87 position using a primer targeting this mutation. This mutation has been previously reported in other European countries and will require further investigation in future analyses.

Conclusion

Regarding pyrethroids, the most common mutation among the samples was the M918L + L925V combination, which is expected given Portugal proximity to Spain. Regarding amitraz, the recent Spanish F290L mutation was detected in 98.3% of the samples, and its high prevalence should be further investigated.

References: Millán-Leiva, A., Marín, Ó., De la Rúa, P., Muñoz, I., Tsagkarakou, A., Eversol, H., Christmon, K., VanEngelsdorp, D., & Gonzalez-Cabrera, J. (2021). Mutations associated with pyrethroid resistance in the honey bee parasite *Varroa destructor* evolved as a series of parallel and sequential events. Journal of Pest Science, 1–13.
Hernández-Rodríguez, C. S., Moreno-Martí, S., Emilova-Kirilova, K., & González-Cabrera, J. (2024). A new mutation in the octopamine receptor associated with amitraz resistance in *Varroa destructor*. Pest Management Science. https://doi.org/10.1002/ps.8434

Funding: This work was supported by the project "MITE- Varroa e vírus transmitidos: MonItorização de muTações e dEsenvolvimento de ferramentas moleculares inovadoras" funded by National Beekeeping Programme 2023-2027. FCT/MCTES (PIDDAC): CIMO, UIDB/00690/2020 (DOI: 10.54499/UIDB/00690/2020); and SusTEC, LA/P/0007/2020 (DOI: 10.54499/LA/P/0007/2020).

PP-166 [Bee Health]
Impact of blueberry environment on bee bread, larvae and foraging bees: An untargeted metabolomic profiling approach

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The success of blueberry fruit set relies heavily on efficient bee pollination. In Canada, there is growing concern about the health of colonies involved in this process, with nutritional deficiencies suggested as a key contributing factor. This study aimed to determine the nutritional profile of bee bread and assess its impact on the larvae and bee metabolome using an untargeted metabolomics approach. Sixteen colonies from the Lac Saint-Jean region (QC), a polyfloral area, were distributed across two control sites (polyfloral; four hives per site) and two blueberry field sites (monofloral; four hives per site). Samples were collected at time 0 (before the hives were moved for pollination) and at time 1 (when pollination was nearing completion) and were analyzed by UHPLC coupled with mass spectrometry to perform untargeted metabolite profiling. After pollination, total polyphenol content in larvae and foraging bees decreased in the blueberry group. These results suggest that plant-derived secondary metabolites from blueberries, which help maintain the antioxidant status of bees, were reduced. In contrast, after pollination, bee bread from the blueberry group showed an increase in the intensity of flavonoids (isorhamnetin 3-galactoside, isorhamnetin-3,7-di-O-glucoside, isorhamnetin-3-glucoside-4'-glucoside, and syringetin-3-O-glucoside), organic compounds (hydroxypyruvate and citrate), and nucleotides (uridine and guanosine), indicating a distinct nutritional profile. The pollination service did not influence the larvae metabolome. However, after pollination, foraging bees in both groups showed decreased flavonoid content (cyanidin, rutin, nicotiflorin) and the phospholipid phosphatidylcholine. Homovanillic acid, an important biomarker of dopamine metabolism and pheromone regulation, specifically the queen mandibular pheromone, increased in the polyfloral group compared to the blueberry group. Overall, these results reveal that the untargeted metabolomic profile of bee bread presents distinct metabolites, differentiating the polyfloral from the blueberry group and suggesting higher nutritional diversity in the polyfloral group. Moreover, foraging bees exhibited temporal variations in their metabolic profiles before and after pollination, potentially influenced by growth, development, and nutrient exposure during the pollination service. Future studies will focus on the roles of bioactive metabolites in bee bread, larvae and the bee metabolome.

PP-167 [Bee Health]

APIMONDIA SCANDINAVIA 2025 23-27 SEPTEMBER

Evaluating pesticide efficacy for the control of *Vespa velutina nigrithorax*: one more step to protect the bees

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[4]REQUIMTE/LAQV - R. D. Manuel II, Apartado, 55142 Porto, Portugal.;Centre for Functional Ecology, Department of LifeSciences, Associated Laboratory TERRA, University of Coimbra, Coimbra, 3004-504, Portugal.
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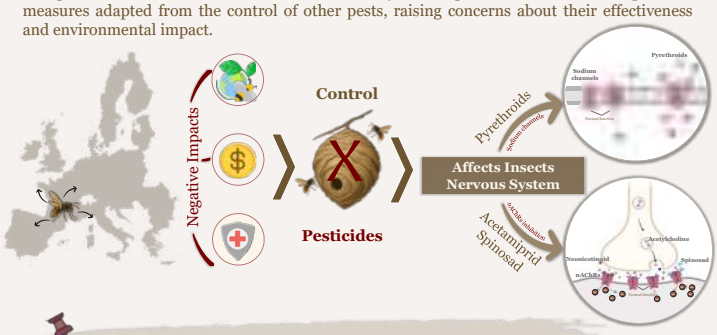
Introduction [1,2,3]

Vespa velutina nigrithorax (*Vvn*) is an invasive species rapidly spreading in Europe, with significant impacts on biodiversity, beekeeping, the economy, and human health. Current control methods rely mainly on pesticides, either injected into nests or used in baited traps. In Europe, the absence of standardized, scientifically tested protocols has led to improvised measures adapted from the control of other pests, raising concerns about their effectiveness and environmental impact.



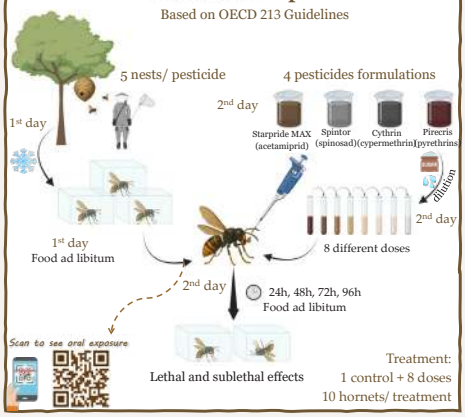
Objective

Evaluate the efficacy of four pesticides formulations: Starpride MAX® (a.s. acetamiprid), Spintor® (a.s. spinosad), Cythrin® (a.s. cypermethrin) and Pirecris® (a.s. natural pyrethrins) against *Vvn* by oral exposure.

Methodology [4]

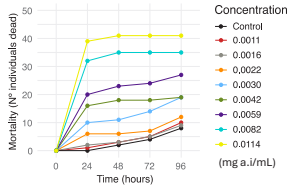
Acute Oral Exposure

Based on OECD 213 Guidelines



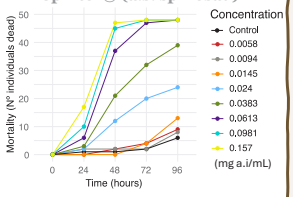
Results

Starpride MAX® (a.s. acetamiprid)



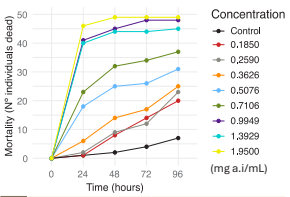
24h LC_{50}- 0.0063 mg a.i./mL LC_{90}- 0.0184 mg a.i./mL
48h LC_{50}- 0.0060 mg a.i./mL LC_{90}- 0.0155 mg a.i./mL

Spintor® (a.s. spinosad)



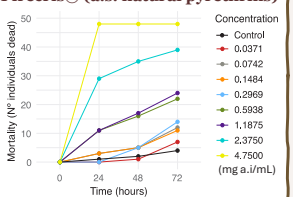
24h LC_{50}- 0.3040 mg a.i./mL LC_{90}- 1.5800 mg a.i./mL
48h LC_{50}- 0.0433 mg a.i./mL LC_{90}- 0.1090 mg a.i./mL

Cythrin 10EC® (a.s. cypermethrin)



24h LC_{50}- 0.7343 mg a.i./mL LC_{90}- 1.5900 mg a.i./mL
48h LC_{50}- 0.5224 mg a.i./mL LC_{90}- 1.3218 mg a.i./mL

Pirecris® (a.s. natural pyrethrins)



24h LC_{50}- 1.7024 mg a.i./mL LC_{90}- 7.3062 mg a.i./mL
48h LC_{50}- 1.2705 mg a.i./mL LC_{90}- 6.4458 mg a.i./mL

Conclusion [5,6]

	Starpride Max	Spintor	Cythrin 10EC	Pirecris
Effects	Rapid action; high mortality within 24h	Mortality increase over time Highest incidence of sublethal effects	High mortality; toxicity increased over time	High mortality and sublethal effects
Environment impact	Safer for pollinators Synthetic Rapid degradation	Biopesticide Rapid degradation on plant surfaces	Synthetic	More toxic to other insects (bees) Biopesticide
Limitations	-	More toxic to other pollinators (e.g. bumblebees) than *Vvn*	Strong repellency (>0.5076 mg a.i./mL)	Highest lethal doses
Promisor candidate?	✓	✓	✗	✗

- Formulations with acetamiprid and spinosad are the most promissors insecticides for the control of *Vvn*;
- Cythrin showed strong repellency effects over 0.0576 mg/mL which could reduce real-world efficacy;
- Pirecris presented the highest LD.

Acknowledgments

This work was supported by FCT - Fundação para a Ciência e Tecnologia, I.P. by project reference PTDC/CTA-AMB/2123/2020 and DOI identifier 10.54499/PTDC/CTA-AMB/2123/2020

References

PP-168 [Bee Health]

Breeding Mite Resistant Honey Bees In the U.S.

Standardized U.S. deep 10 frame and 5 frame brood boxes, frames, and foundation.

Managed using no miticides, antibiotics, or fumagillin for 15+ years.

Top producing survivors are tested using Harbo VSH assay- measuring % Suppressed Mite Reproduction.

Queens are grafted from II'd breeder Queens (Drone and maternal lines, high expressing SMR.)

Drones are caught from high expressing colonies to inseminate new breeders.

2.4% average infestation, no evidence of DWV or brood diseases in September 2024.

stevensbeeco.com

PP-169 [Bee Health]
Effects of radiofrequency electromagnetic fields (RF-EMF) on honey bees and other pollinators

Manuel Treder[1], Marcus Müller[2], Larissa Fellner[1], Michael Glück[1], Peter Rosenkranz[1], Kirsten Traynor[1]
[1]State Institute of Bee Research, University of Hohenheim, Stuttgart, Germany
[2]Communications Engineering Lab, Karlsruhe Institute of Technology, Karlsruhe, Germany

Urbanization and the increasing use of wireless technologies are contributing to elevated levels of radiofrequency electromagnetic field (RF-EMF) emissions in populated areas. Cities often have a high density of wireless devices operating on microwave frequencies, such as the commonly used 2.4 and 5.8 GHz bands of wireless technologies. This anthropogenic electromagnetic radiation is an integral part of our daily lives, but represents a form of environmental pollution and poses a potential stressor for bees and other flying insects. Debates circulate on whether this anthropogenic radiation negatively influences key fitness parameters or disrupts important habitats and refugia of pollinators, especially in highly developed areas where such fields are ubiquitous.

We aimed to study the effects of these frequencies on different pollinators, while meeting the challenge of a defined and realistic radiation exposure required for such experiments. To generate this defined radiation, we used a novel and high-quality technical setup that generates consistent and realistic electromagnetic radiation, developed for these experiments by the Communications Engineering Lab (CEL) at the Karlsruhe Institute of Technology. We tested the effects of 2.4 and 5.8 GHz on I) brood development, longevity and homing ability of free-flying honey bees, and on II) flower visitation rates of different pollinators under field conditions.

The results of this interdisciplinary work show significant effects of long-term exposure on the homing ability of foraging honey bees, but no effects on brood development and adult worker longevity. In addition, we found no effect of this radiation on honey bee visitation rates on pollinator-attractive plants, but the number of foraging bumble bees decreased significantly when plants were subjected to RF-EMF exposure. We continue to explore the effects of RF-EMF exposure on other parameters of bee health.

This work was funded by the Ministry of Food, Rural Affairs and Consumer Protection Baden-Württemberg, Germany.

PP-170 [Bee Health]

Better-B FOR RESILIENT BEEKEEPING

Europe's Vulnerability and Preparedness for New Invasive Species

Following the devastation caused by the Varroa mite, several invasive species have emerged as serious threats to honeybees. These include the yellow-legged Asian hornet, the small hive beetle, and the Tropilaelaps mite. These species disrupt colonies (e.g., predation, disease) - posing ecological risks and economic challenges for beekeeping. Twelve international experts with specialized expertise in honey bee health, management and invasive species were interviewed. They identified key gaps in administrative and beekeeper responses - particularly in prevention, detection and mitigation - and offered recommendations for action.

Key findings from expert interviews

Preparedness & Awareness

"There is always a gap between detection by researchers and confirmation by authorities. During this gap, the pest is really moving on."

🐝 Authorities across Europe are generally underprepared for invasive alien species (IAS), impacting the beekeeper sector.

🐝 Veterinary services are often responsible for bee health but lack specific training in beekeeping and invasive species.

🐝 Beekeepers' awareness increases only when directly affected. Early-stage vigilance is often lacking.

Surveillance & Monitoring

"The best strategy is prevention. And prevention goes hand in hand with monitoring."

"Be aware. Start monitoring. Prevent. Keep your own bees. Don't bring anything from outside."

Monitoring systems vary widely:

🧍 Citizen science platforms can support reporting and expert validation

📑 Periodic bee health surveys help track trends in bee populations.

⛔ Bottle traps are widely used but non-selective, harming native species (Vespa Velutina Nigrithorax).

🔎 Active monitoring (e.g., observing hive entrances) is more accurate but time demanding (*Vespa Velutina Nigrithorax*).

👓 Visual training for beekeepers and inspectors (*tropilaelaps*).

Control Measures

🔪 **Nest destruction** is the main method of control for *Vespa Velutina Nigrithorax*, but costly and unsustainable without funding.

🐿️ **The Trojan Horse method** (toxic bait on foraging hornets) shows promise but lacks regulatory approval and environmental safety validation.

🧪 **Formic acid** and possibly **oxalic acid** may be effective against, but more testing is needed (*Tropilaelaps*).

⛔ **Eradication of bee colonies** is discouraged—experts recommend isolation and study instead.

Regulatory & Funding Challenges

📓 Fragmentation across countries and lack of unified EU protocols hinder a coordinated response.

💵 Funding is project-based, often ending before long-term solutions are in place.

💵 Some compensation schemes are ineffective or absent, discouraging reporting and cooperation.

Tropilaelaps mite (*Tropilealaps spp.*)

Small hive beetle (*Aethina tumida*)

Yellow legged Asian hornet (*Vespa velutina nigrithorax*)

Expert Policy Recommendations

👉 Promote local bee stocks and restrict imports from high-risk regions.

👉 Invest in early detection, advisor training, outreach and visual tools (e.g., videos, guidelines, leaflets, apps).

👉 Incentivize reporting and cooperation (e.g. fair compensation or mutually beneficial collaborations)

👉 A European-wide network is needed to coordinate surveillance, develop flexible and adaptive protocols, and support research.

"We need proactive plans with lots of stakeholders involved because it needs to be a holistic plan, considering parts that go beyond what each individual brings to the table."

What are your thoughts? Scan the QR code and let us know!

List of authors: Line Wahlqvist, Giovanni Formato, Marco Pietropaoli, Camilla Pedrelli, Gabriele Torma, James Henty Williams
Contact: Liwa@agro.au.dk
AARHUS UNIVERSITY

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WEBSITE www.better-b.eu info@better-b.eu
Linkedin Better-B Project
Get Involved Join our Multi-Actor Forum

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PP-171 [Bee Health]

New *Nosema* multiplex qPCR reveals that 16SrRNA based PCR potentially overestimates *Nosema apis* prevalence and no correlation between viral load and *N. cer* in healthy beehives but a possible link in clinically affected colonies, in Austria

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Research Aim/INTRODUCTION

The honeybee midgut-infecting microsporidium *Nosema apis* (*N. apis*) was firstly described by Zander in 1909 in western honeybees (*Apis mellifera*), followed by *Fries* who discovered *Nosema ceranae* (*N. ceranae*) in 1996 - firstly appearing in eastern honeybee (*Apis cerana*) and in 2005 finally in *A. mellifera* (Huang, 2007). *Nosema* dates back in the last decade, but routine diagnostic detection still relies on microscopy and conventional PCR . Microscopy is time consuming and not as sensitive/specific as PCR . Conventional PCR situated in 16S ribosomal RNA (16SrRNA) represents an inadequate target for quantitative PCR because of multiple genomic copies per *Nosema* spore. The aim of this study is to **establish** a **sensitive multiplex *Nosema ssp.* qPCR** for accurate quantitation of *Nosema* spore load targeting a **single-copy genomic region** (DNA-dependent RNA Polymerase Subunit B1, RPB1). After encountering difficulties with multiplexing an already existing *Nosema ssp.* monoplex qPCR assay (Babin, 2022), we redesigned *N. ceranae* primers and probe. Additionally, we compared conventional PCR (Fries, 2013) with qPCR results. Concerning honeybee viruses, in literature knowledge on **interaction** between ***Nosema ssp.* and viral diseases** is scarce. We therefore compared honeybee viral load with *N. ceranae* spore load using our new qPCR. With this quantitative *Nosema ssp.* diagnostic tool, research on possible synergy between *Nosema* spore load and honeybee viral load is possible.

MATERIALS & METHODS

Overview of tested sample sets:

Honeybee viruses vs. *Nosema ssp.*

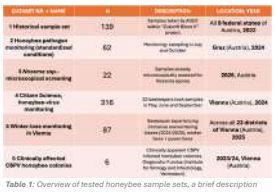


Table 1: Overview of tested honeybee sample sets, a brief description

qPCR-assay design and performance

Primers and probe used for detection of *N. apis* derive from *Babin et al.* (2022). For ***N. ceranae*, new primer and probe sequences** were designed using *DNAStrider* within same genomic region (DNA-dependent RNA-polymerase largest subunit B1, RPB1) where *N. apis* primers and probe were situated by Babin (2022).

Fig. 1: Alignment of Nosema ceranae/apis qPCR primers and probes within DNA-dependent RNA polymerase largest subunit B1 (RPB1) using Geneious®Prime®. Sequence shown in coloured bases resembles Nosema apis/ceranae RPB1 consensus extraction. Nucleotides marked in grey visualize mismatches (webbsies) between both Nosema species. Below consensus sequence, N. cer sequence is shown in upper case (NCIB Acc. No.: KF002468.1.) and N. apis sequence in lower case (NCIB Acc. no.: JX213665.1.). qPCR forward primers are highlighted in yellow and reverse primers in turquoise. qPCR probes are visualized in red. N. apis primers and probe are situated in upper row (Babin, 2022) and N. cer primers/probe in lower row.

qPCR assay was validated **in multiplex reaction**, detecting ***N. apis*** (Babin, 2022), ***N. ceranae*** (this study) and ***Apis mellifera* ß-actin** (internal control). Standard solutions (10^7 down to 10^1 copies) were tested for qPCR assay validation before testing samples. Limit of detection (**LOD**) for both *N. apis* and *N. ceranae* standards resulted in **10 copies per reaction**. For all qPCR reactions Luna® Universal Probe qPCR Master Mix Kit was applied. With each qPCR run performed, positive/negative controls, no-template-controls (NTC) as well as standard solutions ($10^5 - 10^1$ copies) were included.

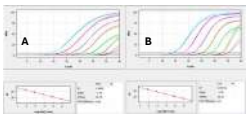
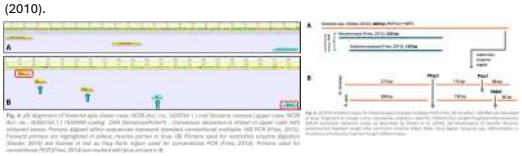


Fig. 2: N. apis (left) and N. ceranae (right) exponential standard dilution series curves and linear regression line (below each exponential standard curve diagram). Y-axis represents fluorescent dye (FAM for N. apis, Cy5 for N. ceranae) intensity and x-axis shows cycle of threshold (Ct). Validation of standard dilution series extending from 10^7 down to 10^1 copies was performed in triplicate reaction using Analytik Jena QTower3® qpcrsoft 4.1.

Conventional multiplex *Nosema ssp.* PCR (Fries, 2013) and RFLP (Gisder, 2010)

With datasets 1 - 3 conventional PCR in addition to qPCR was performed for validation. Additionally, a random sample set (n = 8) from dataset 1 was subjected to restriction enzyme analysis of *Nosema ssp.* as previously described by *Gisder et al.* (2010).



CONCLUSION

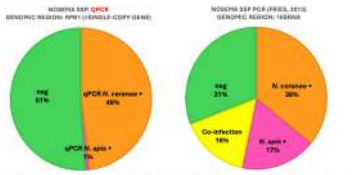
- **Validation of multiplex *Nosema ssp.* qPCR** assay targeting ***N. apis*** (Babin, 2022)**, *N. ceranae*** (this study) and ***Apis mellifera* ß-Actin.**
- ***Nosema ceranae*** is **widely spread** in Austrian apiaries while ***Nosema apis*** is **rare**
- *N. ceranae* **qPCR** (this study) is **consistent with** goldstandard **conventional PCR** (Fries, 2013)
- **One *Nosema apis* detection** via **qPCR**. Verified via **sequencing** and **RFLP** (Gisder, 2010). Multiple unverified *N. apis* conventional PCR detections.
- Sample (nr. 119) tested positive for *N. apis* via conventional PCR reveales **higher similarity to *N. bombi*** than *N. cer* and *N. apis*
- **Co-analysis** of *N. cer* spore load and **honeybee viral load**: lack on correlation in healthy honeybee colonies. **Possible link to BQCV and CBPV** in clinically affected colonies

RESULTS

Dataset 1, 2022 (n = 139)

qPCR
- 67 (**48%**) positive *for **N. cer***
- 1 (**0,7%**) positive for ***N. apis***

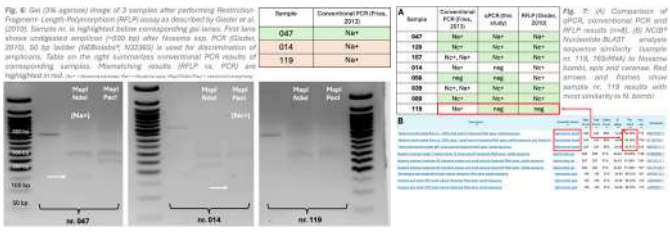
Conventional PCR (Fries, 2013)
- 50 (**36%**) positive for ***N. cer***
- 22 (**16%**) positive for ***N. apis* + *N. cer***
- 24 (**17%**) positive for ***N. apis***



N = 8

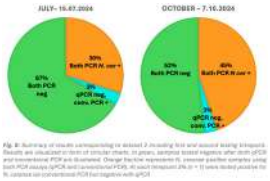
RFLP (Restriction-Fragment-Length-Polymorphism; Gisder, 2010)

Sample nr. 047 (*N. apis* positive via qPCR) was verified after restriction enzyme digest as *N. apis* positive



Dataset 2, 2024/25 (n = 62)

- 24 (39%) positive for *N. cer*, no *N. apis* detected
- prevalence: **July = 31%**, **October = 47%**
- 2 (**3,2%**) samples **undetected** via **qPCR**, detected via conventional PCR (Fries, 2013)



Dataset 3, 2024 (n = 22)

8 samples (**36%**) were tested positive for ***N. cer*** via qPCR and conventional PCR (Fries, 2013). **Both PCR** results were **congruent**. Previously performed **microscopy** resulted in **3 samples not being detected** by microscopy and **2 samples** being identified as **false positive** in comparison to molecular detection.

Dataset 4, 2024 (n = 316)

Viral load vs. *Nosema* spore-load

- 36 (11%) positive for *N. cer*
- ***N. cer*** prevalence: **May = 19%**, **June = 14%**, **September = 6,7%**
- **No significant correlation** (Spearman) for *Nosema* spore load and honeybee viral load (**ABPV**, **CBPV**, **DWV-B**, **SBV**)

Dataset 5, 2025 (n = 87)

BQCV

- 41% *N. cer* +
- 2/21 (9,5%) queens *N. cer* +
- 6 (6,9%) samples: BQCV viral load above 10^8 copies/bee
  → **5**/6 *N. cer* **co-infection**

Dataset 6, 2024 (n = 6)

CBPV

- **clinically apparent CBPV** infected honeybee colonies
- **4**/6 (66%) ***N. cer*** +
- *N. cer* spore load up to 10^4 copies/reaction

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PP-172 [Bee Health]
APISANA - "Assessing Environmental Chemical Stressors in Honeybee Colonies: A Comprehensive Analysis of Beehive Matrices and Forage Plants"

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Honeybees (Apis mellifera) are vital pollinators, well-known for their role as biomonitoring and microsamplers. This study aimed to develop a method to quantify chemical stress in honeybee colonies by analysing various hive matrices and forage plants. We focused on identifying the most effective sampling strategy to reflect colonies' chemical exposure and provide beekeepers with tools to monitor hive health and environmental quality. We defined two phases: an initial broad sampling phase (3 locations, where honey from brood nests and supers, harvested honey from the year (acacia or linden), wax, trapped pollen, bees, and forage plants tissues (sunflower) were collected and analysed, 146 samples), followed by a refined sampling strategy based on the first-phase results on areas with specific mass-flower crops (3 locations, where pooled samples from 3 colonies of honey from brood nests, beebread, wax, brood and plant tissues during rapeseed and sunflower blossom (2 periods) were collected and analysed, dividing samples in two to test the impact of freezing in residue content, 74 samples). High-resolution chemical analyses using GC-MSMS and LC-MSMS were conducted to screen for 472 agrochemical and environmental chemicals. Thirty-seven percent of the first-phase samples contained detectable chemical residues, with the most contaminated pollen and honey from the brood nest. Fluvalinate, an acaricide used as a veterinary product, was, without surprise, the most frequently detected chemical (22% of contaminated samples) in this phase. Acetamiprid and Tebuconazole were the most detected insecticide and fungicide active ingredients. Pollen and honey from the brood nest are reliable indicators of long-term chemical exposure, while honey from supers reflect short-term exposure. This study provides a practical framework for assessing chemical stressors in honeybee colonies, highlighting the importance of pollen and brood nest honey as key matrices to monitor environmental contamination. The findings underscore the need for improved monitoring and management of agrochemical use to protect honeybee health and ensure sustainable pollination services.

PP-173 [Bee Health]
Comparative study between different methods of varroa control: brood interruption and long-term application of oxalic acid

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Background/Purpose
Over the last decade, research has focused on finding approaches to varroa control based on apicultural measures and the use of active ingredients with a low risk of contamination of hive products. In recent years, two main approaches have often been mentioned: Brood interruption and the use of oxalic acid when brood is present in the colonies.
Description of the problem

Queen caging, one of the methods of brood interruption, is very labour intensive for the beekeeper, and beekeepers also fear that colonies with disrupted brood will have less chance of a successful overwintering. On the other hand, the use of oxalic acid during brood rearing, which could be a method for large-scale beekeepers, has been shown to have negative effects on open brood, the queen and the lifespan of the bees.

Methodology
We caged the queens for 24 days in a smaller (first group) and a larger (second group) cage and treated them with a single application of oxalic acid. In the third group of colonies, we applied the active ingredient oxalic acid to the strips present in the colonies for 28 days. We determined the effects of the different methods by observing the effectiveness of the treatment and the effects on colony development and honey yield. The most common bee viruses and the number of nosema spores were measured four times in each colony from fall 2023 to spring 2025.

Results and conclusions
Brood interruption has no effect on colony strength in fall and overwintering success in our study. The use of oxalic acid strips for 28 days led to a higher varroa load in late summer, comparable to groups in which the queens were confined.

Practical implications for beekeepers
According to our results, the size of the queen cage has no influence on the success of the queen cage protocol; climate and pasture conditions seem to have a very important influence on the results. The mode of action of oxalic acid is still unknown, its application according to our protocol did not lead to satisfactory results and should still be treated with caution.

PP-174 [Bee Health]
Applied mycology in beekeeping, impact of fall Ganoderma lucidum supplementation on winter survival

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Applied mycology has shown tremendous potential in various applications such as biomaterials, mycoremediation, pesticide detoxification or medicine. The impact of mushroom supplementation on mammals has been widely documented; however, few studies have explored its potential on insects. In 2018, Stamets et al. investigated the potential of polypore mushroom mycelia's extract supplementation in honeybees' sucrose syrup food diet and found large reduction of the main virus associated with Varroa destructor infestations. Since then, a handful of studies have explored the potential of several species with different mechanisms of actions on bees. Varroa could, for example, be treated directly with the use of ectoparasite fungi. While beekeepers need to actively treat mites or other parasites, a more holistic approach may even further improve colony health. The improvement of bees' nutrition can make them less prone to infestation and could potentially reduce treatment needs; we could not only prevent colony losses but also improve performance and beekeepers revenues.

We speculate that like the complex yeast and bacteria communities of natural nectar could influence bees behavior, their inner microbiota and overall colony health, reishi (Ganoderma lucidum) which properties are well known for medicinal and veterinary purposes could readily act as a beneficial immunomodulatory prebiotic in the hives. This strategy may be easily generalizable, even more effectively and at a lower cost than commercial probiotic formulae.

In order to validate the potential of reishi supplementation, we have treated 60 of the 120 hives of Miellerie Flavo's operation facility each fall for four seasons (2021-2024). Half of the colonies were mocked-supplement while the other half benefited from Cubee's G. lucidum extract proprietary composition. History of beekeeping practices, location and hive state (i.e. strength, mortality, varroa level…) were thoroughly recorded using the Nectar application in order to train a Bayesian survival model with time as covariate and our preliminary results show clear health improvement and a drastic increase in winter survival of 32% (± 7%).

PP-175 [Bee Health]
Effects of Crossbreeding on Grooming Behavior in Iranian Honey Bees (Apis mellifera meda)

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[2]Department of Apiculture, Institute of Animal Science, ELGO DIMITRA, Nea Moudania, Greece

Background/PURPOSE: Grooming behavior in honey bees plays a crucial role in colony health and defense against parasites, particularly the invasive Varroa destructor mite. This behavior is essential for maintaining cleanliness and mitigating the impact of external stressors, such as pests, pathogens, and environmental contaminants.

Problem Description: The western honey bee, Apis mellifera, is the most widespread and well-known species in Iran, with subspecies including the Iranian honey bee (Apis mellifera meda), Carniolan (Apis mellifera carnica), Italian (Apis mellifera ligustica), and their respective hybrids (Iranian × Carniolan and Iranian × Italian). Although previous studies have emphasized the importance of grooming in mite control, few have compared the grooming efficacy across different bee breeds, particularly in the context of Varroa destructor management.

METHODOLOGY: At the beginning of March 2024, marking the end of the wintering season for the colonies, 12 colonies from each of the five bee breeds were randomly selected and standardized based on honey and pollen stores, the number of brood frames, initial population size, and hive type (Langstroth hive). During the experimental period, the colonies did not receive any chemical treatments. Data on mite-grooming behavior and mite damage were collected weekly during the spring of 2024 at the Honey Bee Research Centre, University of Kurdistan, Sanandaj, Iran (35.27788°N; 46.99562°E).

RESULTS: The results indicated that Carniolan bees exhibited superior grooming behavior, performing significantly better ($p < 0.05$) compared to other groups. Italian bees, while still relatively hygienic, were generally less efficient at grooming than Carniolan bees. However, hybrid bees demonstrated greater grooming efficiency compared to the indigenous bees, indicating positive heterosis in the crosses and complementarity between the breeds.

CONCLUSION: These findings suggest that superior grooming performance of Carniolan bees and the increased efficiency of hybrid bees indicate that selective breeding for grooming behavior can enhance mite control and overall colony health.

Practical Implications for Beekeepers: Beekeepers can improve colony resistance to Varroa destructor by selecting higher-performing bee lines, whether purebred or hybrid. This approach may reduce the need for chemical treatments and improve colony health, ultimately enhancing the productivity and sustainability of beekeeping operations.

PP-176 [Bee Health]
Assessing the Impact of Total Dissolved Solids (TDS) in Water on Honey Bee Health in Northeast Louisiana, USA

Mahmoud Ramazani
Sammy's Southern Honey

INTRODUCTION: Honey bee health is crucial for ecosystem services and food production. However, bee colonies face various threats, including poor water quality. This study investigates the impact of Total Dissolved Solids (TDS) in water on honey bee health in Northeast Louisiana, USA, a region known to have compromised water quality due to agricultural runoff, industrial activities, and natural geological processes. Similar water quality issues are likely prevalent in other parts of the world, particularly in areas with intensive agricultural practices or limited water treatment infrastructure.

METHODS: We conducted a 12-month study on 20 bee colonies in Northeast Louisiana, exposing them to different TDS levels (15, 160, 300, 600 ppm). Colonies were managed according to standard beekeeping practices. We monitored colony strength, brood development, honey production, and varroa mite infestation levels. Water samples were collected monthly and analyzed for TDS and pH levels.

RESULTS: Our results show significant correlations between TDS levels and bee health metrics. Colonies exposed to higher TDS levels exhibited reduced brood development and honey production, as well as increased varroa mite infestation levels. We also found associations between TDS levels and bee mortality rates.

CONCLUSION: This study highlights the importance of monitoring TDS levels in water sources for bee colonies in Northeast Louisiana. Our findings suggest that exposure to high TDS levels can have detrimental effects on honey bee health, including impacts on brood development, honey production, and varroa mite infestation levels. These results have important implications for beekeepers and policymakers seeking to mitigate the impacts of poor water quality on honey bee health.

APIMONDIA SCANDINAVIA 2025
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PP-177 [Bee Health]

The importance of gut flora in the overwintering process for Swedish honey bees (*Apis mellifera*) - effects on bee health?

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Introduction

Winter mortality is one of the biggest challenges for beekeepers, with significant economic and ecological consequences. Most Swedish beekeepers overwinter their colonies on sugar water to maximize honey harvests. However, scientific studies on how this practice affects bee health are rare. Does the winter diet 1) influence the microbiome and 2) affect the ability to survive the long Swedish winter?

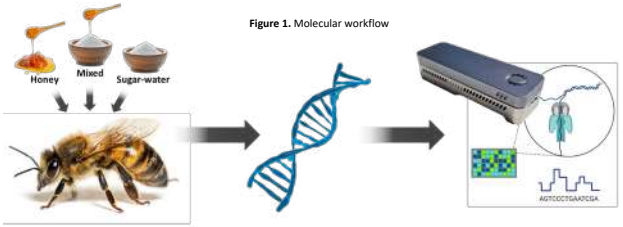

Figure 1. Molecular workflow

Samples
Collection of intestines under sterile conditions from honeybees fed on 1) honey, 2) sugar-water and 3) mixed diet

DNA extraction and PCR amplification
DNA were extracted using the ZymoBIOMICS™ DNA Miniprep kit (Zymo Research) and the 16S gene were amplified using the 16S barcoding kit 24 v14 (Oxford Nanopore Technologies)

DNA sequencing
50 ng of pooled DNA from 12 samples were run for 8 h on a Flongle flow cell in a MinION Mk1B (Oxford Nanopore Technologies) and sequence data were analyzed to the bacteria genus level using EPI2ME software (Oxford Nanopore Technologies)

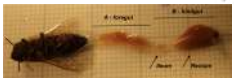

Figure 2 Dissected bee gut
A) foregut
B) hindgut divided in ileum and rectum

Material & Methods

- A bee yard in Uddevalla, Sweden was sampled on March 4, 2025, after five months of overwintering. 25 bees were collected from each colony. Three dietary groups (Fig. 1) were represented: 1) honey fed, 2) sugar-water fed and 3) mixed fed.
- In total, 9 colonies and 225 bees are under analysis. Preliminary data are presented here (n = 36).
- Each bee gut was dissected under sterile conditions (Fig. 2).
- The rectum was analyzed with molecular tools (Fig. 1).

- Gut community compositions was modeled to estimate diet-specific mean compositions 1) within-diet concentration (φ; higher = tighter) and 2) with a weakly informative prior on log φ (Normal(4.8, 0.6) (Fig. 3-5)).
- Inference via MCMC in brms/rstan.
- As an exploratory complement Bayesian model-based clustering was performed (Fig. 6).

Preliminary results (n = 36, 12 individuals per diet-group)

- ❖ The winter diet strongly influences the bacterial taxonomic composition in Swedish honeybees.
- ❖ Colonies on a sugar diet exhibit the most distinct bacterial profiles (Fig. 5), accompanied by a significant reduction in within-group variability (Fig. 4).
- ❖ The mixed diet results in a bacteria composition that is closer to a honey diet (Fig. 6), but not always (e.g., in Fig. 3 for Enterococcus).
- ❖ The honey diet has the largest variability in the gut bacterial communities (Fig. 4).

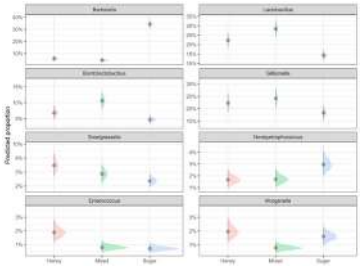

Figure 3. Posterior distributions of predicted taxon proportions (Top-8). Half-violins show posterior distributions per diet; points mark medians and bars indicate 95% credible intervals. Panels display the 8 taxa with the largest between-diet differences in posterior median proportion (remaining taxa not shown). Predictions come from a Bayesian Dirichlet regression fit to all taxa with diet as predictor and diet-specific concentration (ϕ).

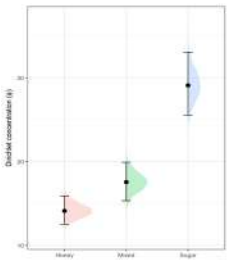

Figure 4. Dirichlet concentration (ϕ) by diet — higher = tighter communities. Half-violins show posterior distributions of ϕ from the Bayesian Dirichlet regression (fit to all taxa with diet-specific ϕ); points mark medians and bars indicate 95% credible intervals. Larger ϕ implies lower within-diet variability in community composition. Sugar shows the highest ϕ (i.e., the lowest within-diet variability).

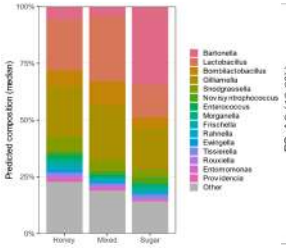

Figure 5. Predicted community composition (posterior medians). Stacked bars show median predicted proportions from the Bayesian Dirichlet regression (fit to all taxa with diet-specific concentration, ϕ). Displayed are the Top-15 taxa with the largest between-diet differences; all remaining taxa are grouped as "Other." Colors indicate taxa.

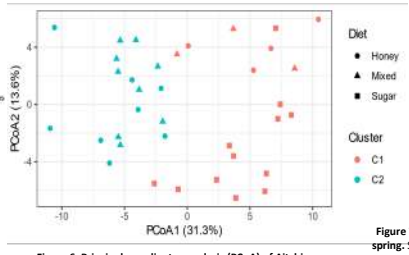

Figure 6. Principal coordinates analysis (PCoA) of Aitchison distances. Points are samples; color = model-based cluster (Gaussian mixture in ILR space; BIC-selected VVI, *K*=2), shape = diet. Axes show the variance captured by the first two principal coordinates; the plot is for visualization only—clustering was performed in the full ILR space.

Figure 7. Brood frame during spring. Spring development of analysed colonies was monitored from April-June 2025. All frames were photographed, and each brood cell marked and counted (right). Spring development will be combined with the microbiome results and tested for possible correlations.

Jordbruksverket
Co-funded by the European Union

Conclusions

Winter diet seems to strongly structure the honeybee gut community.

Two microbiome community types were identified: sugar mapped almost exclusively to Cluster 1, whereas honey/mixed predominantly fell into Cluster 2. Thus, a distinct sugar-associated community type seems to be exist, while mixed foder - an alternative for beekeepers - resembles the honey fed community.

We are currently evaluating the microbiome results of a larger data set in which we also tracked the spring development and survival of the different colonies from April-June 2025 (Fig. 7).

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PP-178 [Bee Health]
Exposome Analysis of Honeybees Using Passive Sampling followed by HRMS

María Del Mar Gómez Ramos[1], María Murcia Morales[1], Jose Antonio Martínez[1], Francisco José Díaz Galiano[1]
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Honeybee (Apis mellifera) health is increasingly compromised by multiple chemical stressors, including pesticides, environmental chemicals and in-hive produced chemicals. Assessing their impact requires holistic, non-invasive, and standardized approaches, as traditional methods often involve live colonies and suffer from limited sensitivity and comparability.

This study presents the APIStrip (Adsorb Pesticide In-hive Strip), a Tenax-TA-based passive sampler that accumulates target and non-target chemicals inside hives without disturbing bees. APIStrips are deployed for 15 days, enabling standardized, trace-level monitoring. Extraction followed by both high-resolution mass spectrometry (HRMS) provides a comprehensive chemical profile.

Preliminary validation showed high sensitivity, reproducibility, and representativeness. A non-targeted HRMS study was conducted using APIStrips in 30 apiaries across Denmark, Sweden, and Finland. Duplicate samples were collected during two (Sweden, Finland) or five (Denmark) sampling rounds. Full scan and IDA-MS/MS modes enabled tentative identification of key compounds through spectral libraries and accurate mass analysis.

Discovery-based exposomics revealed variations in hive chemical burdens across regions and time. For example, Linoleoyl ethanolamide was frequently found in Swedish hives but not in others. Seasonal variation in Denmark highlighted dynamic shifts in chemical exposures.

These results demonstrate that APIStrips combined with HRMS offer a powerful, non-invasive exposomic platform. This methodology supports hypothesis generation for follow-up studies on bee health and provides insight into regional and temporal differences in chemical exposure. The findings highlight the potential of passive samplers in environmental monitoring and contribute to a better understanding of stressor impacts on bee populations

PP-594 [Bee Health]
Post-Graduate Training in Honey Bee Health and Medicine for Veterinarians in France

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Since 2005, the National Veterinary Schools of Nantes and Alfort have proposed a post-graduate training in Honey Bee Health. The "Honey Bee Health and Medicine" program was created to develop diagnostic skills and provide expertise to veterinarians.

The certification aims to provide veterinarians the following skills: Observation and interpretation of colony disorders; Diagnosis of Honey Bee colony diseases and health troubles and collecting relevant samples; Assessment of the human, material and wildlife environment of a beekeeping farm; Prevention of the spreading of regulated diseases by implementing and supervising control measures; Prescription of appropriate veterinary drugs; Understanding relevant regulation; Acting as an official vet in the beekeeping field.
The training includes 200 hours of theoretical and practical training: Honey Bee biology and colony life; Practical handling, Sampling, and diagnosis; Health disorders and troubles; Regulations; Implementation of Honey Bee colonies health audits (and sanitary audits of the beekeeping practices and technics).

To date, 289 veterinarians have been graduated. Their diversity and nationwide distribution have created a unique Honey Bee health network. The Ministry of Agriculture officially recognized this program in 2014.

Since 2024, the diploma has been certified by all four French National Veterinary Schools. To improve accessibility and recognition, a submission will be made to the "National Authority for Regulating and Financing Vocational Training" for registration in the "specific repertory".

The graduated veterinarians (working in private practice, administration, diagnostic laboratories, and pharmaceutical industry) carry out key missions: Protecting and treating Honey Bee colonies; Implementation of studies, Field surveys, and epidemiological surveillance; Self guarding food safety and public health; Protecting the environment; Advancing research and training.

PP-595 [Bee Health]
Everything You Always Wanted to Know About Beekeeping but were afraid to ask - The COLOSS B-Rap Expert Hotline (Enhancing Beekeeping Knowledge Dissemination and Bridging Information Channels)

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Effective knowledge dissemination is essential for improving beekeeping practices and addressing key challenges like bee colony health, climate change, and regulatory updates. However, a gap often exists between the ways beekeepers seek information and how researchers, advisors, veterinarians, policymakers, and industry experts share scientific data and policies. Ensuring information flows through effective and accessible channels is crucial for maximizing its impact.

This interactive poster by the COLOSS core group B-RAP (Bridging Research and Practice) explores the alignment between information demand and supply in the beekeeping sector. It focuses on understanding beekeepers' information needs and identifying reliable resources, such as scientists, advisors, and veterinarians. By analyzing preferred communication methods—scientific journals, beekeeping magazines, online platforms, and social media-we identify potential barriers to effective dissemination.

The poster invites beekeepers to interact through a QR code, choosing the category of interest (bee health, regulatory aspects, hive management, etc.), submitting a question in the format "Is it true that...?" and choosing their preferred source for answers — scientists, beekeeping advisors, beekeeping associations, experienced beekeepers, veterinarians, governmental authorities, AI, etc. Beekeepers can also specify their preferred channels for receiving information (beekeeping magazines, internet websites/blogs, etc). This approach provides insights into their main concerns and trusted sources. As an additional interactive element, the authors will organize two events within Apimondia, in which the submitted questions are discussed with experts and interested Apimondia participants.

The goal is to improve communication strategies, ensuring research and policy guidance effectively reach beekeepers. We aim to strengthen the knowledge exchange between researchers and beekeepers, enhancing engagement and adoption of best practices. Additionally, we get valuable insights into the most pressing concerns and needs of the beekeepers, which is important for focusing research and dissemination efforts on supporting the beekeeping community.

The final objective is to emphasize the importance of adaptive communication strategies to bridge the gap between research and practice, ensuring more efficient and impactful dissemination of beekeeping knowledge.

PP-596 [Bee Health]
International Bee Research Association (IBRA) - Contributing to bee research and beekeeping by publishing books and journals since 1949

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In 1949, the Bee Research Association (BRA), initially founded in 1945, legally came into existence with Dr Eva Crane as its first Director, the 'I' for 'international' was added in 1976. The aim of the International Bee Research Association (IBRA) is the advancement of the science of apiology and, with a view to achieving that primary objectives, the promoting, financing, organising, carrying on, disseminating and encouraging bee research. IBRA promotes the value of bees by providing information on bee science and beekeeping worldwide, as well as by publishing books and two journals. IBRA is managed by a small number of trustees, working on a voluntary basis. IBRA's genuinely scientific journal is the Journal of Apicultural Research (JAR). JAR is a peer-reviewed, scientific journal dedicated to examining and publishing the latest research on bees. The Editorial Board of JAR comprises 16 members from around the world, each bringing diverse expertise and backgrounds. Five regular issues are published annually and special issues are added when timely topics arise, the latest being a Special Issue on Pests and Pathogens in 2024. Bee World is a popular journal, available free to IBRA members. It was already established in 1919 by the Apis Club in London (founder: Ahmed Zaky Abushady) but became a BRA journal in 1952. It has 4 issues per year and contains original scientific articles and reviews (peer-reviewed) as well as obituaries, book reviews, a forum section for discourse and interviews with scientists. Bee World serves as a bridge between Science and Beekeeping. IBRA also publishes the COLOSS Bee Book. In this poster, we will present the IBRA Council members, the Editorial Boards of the two journals, the most downloaded and most cited articles of the two journals as well as a list of recently published books through a collaboration with Northern Bee Books publisher.

PP-597 [Bee Health]
Healthy Bees - a serious game for improved honey bee health

Lotta Fabricius Kristiansen
Swedish University of Agricultural Sciences, Department of People and Society, Skara, Sweden

Maintaining healthy honey bee colonies is complex, as it is influenced by numerous environmental factors. Beekeepers often struggle to fully understand these factors, which can impact colony survival and productivity. To address this challenge, a serious game called "Healthy Bees" has been developed. The game aims to provide an engaging and accessible way for players to learn about the key aspects of beekeeping and colony management.

Beekeepers must navigate multiple challenges, such as ensuring sufficient pollen and nectar availability and controlling the varroa mite, a major threat to honey bee health. The complexity of these factors can be overwhelming, making it difficult for beekeepers—especially novices—to make informed management decisions. Traditional learning methods may not always be effective in conveying these intricate relationships.

To create an interactive and educational tool, a collaboration was established with master's students from the University of Skövde, specializing in Serious Games. Students with diverse competencies worked together to develop the first version of "Healthy Bees" as part of their course project. The game is designed primarily for mobile platforms and is based on scientific research on bees and pollination. In the game, players buy a bee colony, earn money by selling honey or answering knowledge questions, and reinvest in improving the landscape, winter food supply, or their beekeeping knowledge.

The initial version of "Healthy Bees" demonstrated that interactive learning can effectively simplify complex beekeeping concepts. The game allows players to experiment with honey harvesting and observe its effects on colony health, providing an engaging and hands-on approach to education. By making beekeeping knowledge more accessible, the game helps players develop a better understanding of how to maintain strong and productive colonies.

"Healthy Bees" offers a valuable educational tool for both new and experienced beekeepers. It highlights key factors affecting colony health, promotes better decision-making, and fosters an understanding of sustainable beekeeping practices. By increasing awareness of beekeeping challenges and best practices, the game contributes to improved pollination services and honey production, benefiting both agriculture and natural ecosystems.

PP-598 [Bee Health]
On-line tool for beekeepers: how to find the most appropriate Varroa treatment

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[1]Epidemiology Department, Istituto Zooprofilattico Sperimentale del Lazio e della Toscana "M.Aleandri"
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Varroa treatments are essential for sustainable management of honey bee colonies. Low environmental impact acaricides (e.g. thymol or formic acid based) offer several benefits like low risk of resistance development and high efficacy. The efficacy of medicines can vary depending on the temperature ranges at the apiary level.

Within the activities of the Horizon Europe BETTER-B project (Grant Number 10068544), an on-line tool for beekeepers has been developed. The tool, freely accessible through the BETTER-B Learning Platform (https://www.better-b.eu/learning-platform/), is an interactive map able to display areas of suitability for different temperature-dependent anti-varroa treatments. The model uses a cell-based approach, generating a raster map for every anti-varroa product, based on the temperature range indicated into the leaflets.

The primary raster dataset represents minimum and maximum average temperatures, derived through interpolation from point observations. It was acquired from major weather networks over the 30-year period spanning 1970-2000 (https://worldclim.org/). Temperature-dependent varroa treatments have been mapped at the cell level, with a spatial resolution of 584.6 m per cell, and the final output is a raster map that crosses the rasters/treatments with each cell containing a treatment profile on a monthly basis. An ArcGIS-powered web interface enables users to identify appropriate varroa treatments and their approved application periods for any location (e.g., apiary). This tool will be updated with registered varroa medicine data from all BETTER-B project partner countries providing a practical basis for the beekeeper, assisting him in choosing the best IPM strategy that fits its business model, the regional context (climate, available registered medicines, density of bee colonies, etc.) and the specific characteristics of the treatment agents.

PP-599 [Bee Health]
Analysis of the Number of Scientific Publications on the Oriental Wasp (Vespa orientalis) in Southern Spain

José Gil Gómez, Eva María Gómez Turpín
I+D Department, Bee Garden, Málaga, Spain

Background/PURPOSE: The oriental wasp (Vespa orientalis), as invasive species, has garnered growing scientific attention due to its negative impact on local ecosystems and apiculture in southern Spain. This study aims to analyze the evolution of the number of scientific publications on this issue to understand the extent of research and predominant areas of focus.

Problem Description: The expansion of the oriental wasp has raised concerns among beekeepers and ecologists due to its predation on honeybees (Apis mellifera), which are crucial for pollination and honey production. Insufficient research could hinder the implementation of effective control and mitigation measures.

METHODOLOGY:: An exhaustive review of academic databases and specialized publications was conducted to identify relevant studies on the oriental wasp in the Andalusia region. Temporal and thematic trends of the published articles were analyzed. This review allowed us to identify the main research focuses and evaluate the scientific response to the invasion of this species.

Results and CONCLUSIONS: The results reveal an increase in the number of publications in recent years, reflecting greater concern and effort by the scientific community to address this threat. However, gaps in current knowledge were identified, particularly concerning effective control methods and the long-term impact on local biodiversity. It is imperative that more research is conducted to develop sustainable management strategies. Additionally, it is crucial that local and national administrations implement more rigorous measures to control the spread of this invasive species and protect both honeybee colonies and regional biodiversity.

Practical Implications for Beekeepers: Beekeepers need to stay informed about research trends to adopt evidence-based practices and collaborate with researchers and local authorities in developing sustainable management strategies. Continued research is essential to provide effective solutions and protect honeybee colonies.

PP-599 [Bee Health]

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Analysis of the Number of Scientific Publications on the Oriental Wasp (*Vespa orientalis*) in Southern Spain

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Keywords: Oriental wasp, biological invasion, beekeeping, scientific publications, biodiversity, pest management

BACKGROUND / PURPOSE

The oriental hornet (*V. orientalis*) has become a growing threat to ecosystems and apiculture in Southern Spain. Native to warmer regions, this invasive predator targets *Apis mellifera*, contributing to colony losses and reduced pollination. This study aims to quantify and analyze the scientific response to *V. orientalis* from 2012 to 2025 through a literature review, focusing on the Andalusian region and placing it in a global context. Understanding the scientific attention devoted to this species is essential for guiding future management strategies and mitigating its impacts.

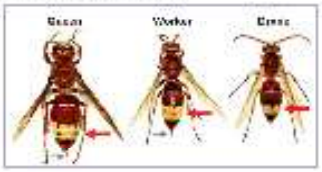
METHODOLOGY

A literature review was conducted in Google Scholar; articles were found using the keyword "*Vespa orientalis*" for the global study, whereas keywords related to southern Spain were added for the localized version. A large number of studies were manually reviewed to ensure that only those describing *V. orientalis* as a threat to public health or beekeeping were identified, mostly in its invasive role, were represented in the final data. Purely taxonomical studies and those discussing the hornet in its native ecological niche without causing harm were excluded. Publications were then classified by year and region.

PROBLEM DESCRIPTION

The first detection of *Vespa orientalis* in Spain dates back to 2012, highlighting that its presence in the Iberian Peninsula is not recent. The species poses serious risks to apiculture and agriculture by aggressively predating on honeybee colonies and damaging fruit crops. Its presence in urban areas also raises public health concerns due to the potential for allergic reactions to stings.

1



2

Figure 1. *V. orientalis* exhibits yellow abdominal bands (red arrows) that stop short of the tip of the abdomen. Coloration, body size, and structural traits vary depending on the individual's sex and caste within the colony. Only females have stingers (grey arrows). *Photos are Courtesy of Joseph Dvorak, www.biolib.cz.* Figure 2. *Vespa orientalis* attacks on one's own hives, causing stress and weakening of the bees (photograph taken by the author).

RESULTS AND CONCLUSIONS

Data shows a significant rise in global publications in 2019 and its following years, with moderate growth in Southern Spain.

3

4

Figure 3 & 4. Global frequency of articles related to *V. orientalis* threat since 2012, globally and in Southern Spain, respectively.

In both cases, a sudden spike in research interest in 2019 marks the start of a trend that continued to this day. Although moderate in Spain, the increase in scientific literature surrounding the recently introduced invasive species highlights rising concern. This increase is very likely linked to the rapid expansion and danger posed by the hornet, as its impacts start to become more noticeable in the apicultural and agricultural world.

Although the rise in scientific literature is a result of the worsening situation, it also indicates that more coordinated efforts are being carried through, bringing new knowledge that will potentially help in the application of future measures. However, gaps remain in understanding long-term impacts and management strategies. Institutional and scientific collaboration is needed, as there is limited research on effective control strategies. Early and unified action is urgently needed to mitigate its ecological and economic impact.

Advances in research into pheromones and specific traps are needed to improve the detection and control of these species. At the same time, the government must urgently strengthen port surveillance and curb massive maritime import traffic, often involving agricultural products below production costs in Spain. This uncontrolled entry of products increases the risk of invasive species entering the country. Furthermore, these food products, transported over long distances, cause pollution by having a larger carbon footprint.

PRACTICAL IMPLICATIONS FOR BEEKEEPERS

V. orientalis predation on honeybee colonies leads to reduced honey production and crop pollination. Its impact also extends to fruit agriculture, damaging crops like grapes. Beekeepers should implement evidence-based mitigation strategies such as narrowing hive entrances and deploying baited traps (including hive entrance traps and light-based funnel traps). Active collaboration with researchers and authorities is essential for outbreak monitoring and targeted control, as well as the implementation of science-based practices to reduce colony vulnerability. Engagement in public awareness and policy advocacy is also critical to ensure this threat's recognition and to promote coordinated response measures.

ACKNOWLEDGMENT

We would like to thank Leo Martos for his collaboration on this poster, as well as all those who support bees and those who continue to research solutions to the serious problems faced by beekeeping.

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PP-605 [Bee Health]

BeeNet

Monitoraggio ambientale con le api

APIMONDIA SCANDINAVIA 2025
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MONITORING THE HONEY BEE PATHOGENS IN THE AGRICULTURAL ENVIRONMENT: RESULTS FROM THE BEENET PROJECT

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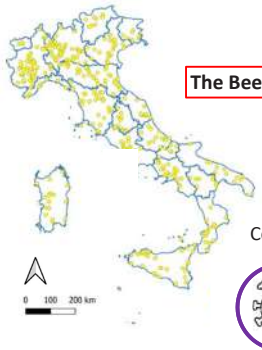


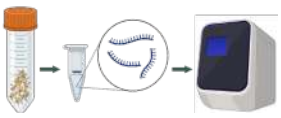
The BeeNet project aims to evaluate the quality of the Italian agroecosystem through honey bees and wild bees

The monitoring started in 2021 and will end in 2024, for a total of 3 years.
The monitoring involves all of the twenty Italian regions, using sedentary apiaries of 3 colonies
In total, a network with 360 apiaries was monitored

SAMPLING

Colony was monitored 4 times per year: March, June, September and November
Sampling forager bees

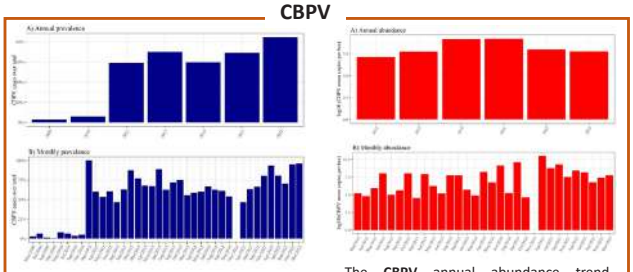
Viruses: DWV,-A, DWV-B, ABPV, CBPV, KBV, IAPV and BQCV
Microsporidia: *N. ceranae*
Trypanosomatids: *Lotmaria passim, Crithidia mellificae* and *C. bombi*



RESULTS

IAPV, *C. mellificae* and *C. bombi* were not detected in the investigated Italian apiaries across the monitoring

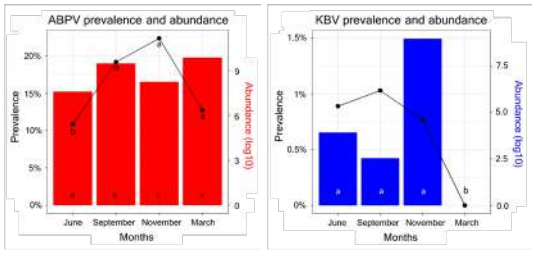
CBPV



The annual trend showed low **CBPV** values until 2012 (4.3%). From the spring of 2012, there was a steep rise in prevalence values that reached minimum values in the winter of 2014. The prevalence reached the maximum during 2024 (84.7%) from 2021 to 2023.

The **CBPV** annual abundance trend showed a rise in the average copy number of the pathogen culminating in 2014 (1.65×10^{9}) to stabilise until 2021 (1.77×10^{9}). From 2022 (1.08×10^{8}) to 2023 (6.11×10^{7}) an evident abundance decline was noted.

ABPV & KBV



ABPV was the most prevalent virus (16.7%), whereas **KBV** was detected sporadically (0.7% national prevalence).

ABPV and **KBV** had an average national abundance of 5.9×10^{6} and 2.4×10^{5} viral copies per bee, respectively.

L. passim

L. passim average national abundance was 2.2×10^{3} in the 1st year and 1.6×10^{6} in the 2nd year, with no significant variations.

L. passim prevalence was higher in June and March of the 1st year compared to the same months of the 2nd year.

A peak of ***L. passim*** prevalence occurred in November in the 2nd year.

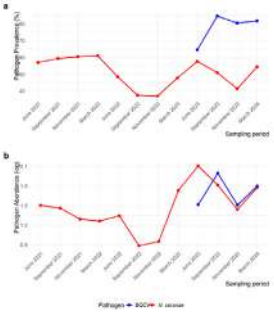
N. ceranae & BQCV

A weak positive correlation was found between ***N. ceranae*** and **BQCV** abundances.

Prevalence and abundance were higher in NorthWest: ***N. ceranae*** (58.2%; 8.7×10^{7}), **BQCV** (25.8%; 5.1×10^{4}).

The second year showed the lowest prevalence and abundance of ***N. ceranae.***

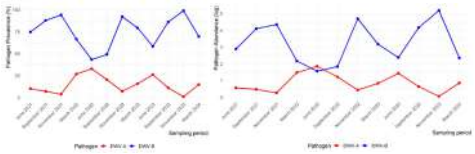
N. ceranae peak was detected in June 2023 (57.6%; 5.2×10^{8}), while BQCV in September 2023 (85.2%; 9.6×10^{4}).



DWV-A & DWV-B

DWV-B was consistently the dominant variant (73.7%) compared to **DWV-A** (14.9%).

In the second year, **DWV-B** prevalence declined (65.4%), while **DWV-A** increased (19.2%), but overall trends returned to initial levels in the third year.



Viral loads differed strongly between variants, with **DWV-A** showing a much higher mean abundance (3.37×10^{11}) than **DWV-B** (2.59×10^{8}). Over time, **DWV-B** abundance remained stable, whereas **DWV-A** declined markedly, reaching 2.88×10^{8} in the third year.

CONCLUSION

This monitoring represents the first comprehensive investigation conducted in Italy on the occurrence of main honey bee pathogens across agroecosystems.

Each investigated pathogen showed specific seasonality, linked not only to the pathogens' epidemiology but also to regional variations, beekeeping techniques and land uses.

The study emphasises the importance of ongoing monitoring and suggests future research should consider environmental and human-related factors, as well as space-time modelling, to better understand and predict the pathogens' distribution not only in the apiaries but also in the environment.

BeeNet 2019-2025 (Italian National Fund under FEASR 2014-2020 by the MASAF "Ministero dell'agricoltura, della sovranità alimentare e delle foreste" to the CREA "Consiglio per la Ricerca in agricoltura e l'analisi dell'economia agraria")

https://beenet.crea.gov.it/

APIMONDIA SCANDINAVIA 2025
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PP-606 [Bee Health]

INTERSPECIFIC TRANSMISSION OF BEE PATHOGENS IN WILD POLLINATORS IN NATIONAL PARKS

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[8]Gran Paradiso National Park, Torino, Italy

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INTRODUCTION & AIM

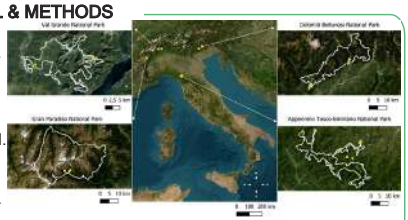
Pollinators, especially **bees** and **hoverflies**, are essential for ecosystems but are experiencing alarming declines due to habitat loss, climate change, and pathogens. While bee pathogens are well studied, their effects on hoverflies remain poorly understood.

Transmission can occur through shared flowers, contaminated food or water, or direct contact, with hoverflies acting mainly as potential mechanical vectors via floral visitation.

This study investigates 10 bee-associated pathogens in bees and hoverflies from four Italian mountain parks, evaluating environmental, seasonal, and biological factors influencing infection.

MATERIAL & METHODS

In 2024, 16 sites across four National Parks in Northern Italy were sampled from May to September. Sites included grazed pastures and ungrazed meadows, with collections performed only on spontaneous vegetation.



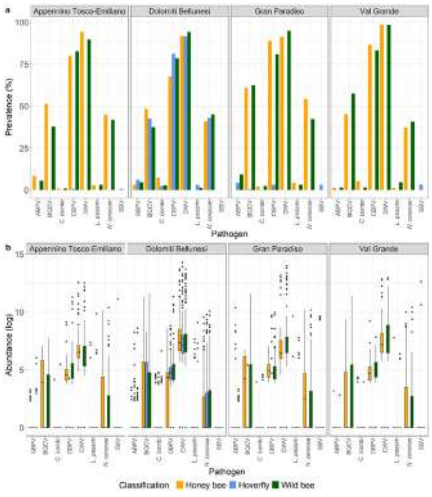
Honey bees, wild bees, and hoverflies were collected. Nucleic acids were extracted from each individual, and qPCR was used to detect and quantify 10 pathogens (viruses, microsporidia, trypanosomatids).

Normalised Difference Vegetation (NDVI) was derived from Copernicus satellite images (500 m buffer) to assess vegetation cover and habitat complexity.

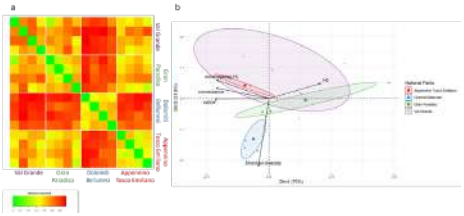
Prevalence and abundance patterns were analyzed with GLMMs. Factors included altitude, NDVI, land management, season, and host traits (diet, voltinism, sex).
Host-pathogen networks were explored with bipartite metrics.

RESULTS

A total of 1,688 specimens were collected: 388 honey bees, 632 wild bees, and 668 hoverflies.
Overall, 76.3% of individuals were positive for at least one pathogen. The most prevalent pathogens were DWV (70.4%) followed by CBPV (60.4%), BQCV (35.2%) and *N. ceranae* (32.5%). DWV showed the highest abundance (5.2×10¹¹ copies).



Prevalence patterns differed among hosts and parks: wild bees were positive for nearly all pathogens except SBV, and honey bees never carried SBV, ABPV in Gran Paradiso, or *L. passim* in Dolomiti Bellunesi. Hoverflies were particularly noteworthy, as they hosted multiple pathogens, including SBV, which appeared exclusively in Syrphidae in several parks. Notably, in Dolomiti Bellunesi, hoverflies exhibited prevalence and abundance levels comparable to those of honey bees and wild bees, underlining their potential role as overlooked pathogen reservoirs.



The network analysis revealed clear differences in pathogen-host interactions among parks. The dissimilarity matrix showed that sites within the same park were generally more similar, while Dolomiti Bellunesi stood out as the most distinct compared to all others. The PCA confirmed this pattern: Val Grande sites appeared more scattered and weakly structured. Gran Paradiso sites showed intermediate network characteristics, while Appennino Tosco-Emiliano sites were more connected, with pathogens displaying similar interaction patterns across hosts.

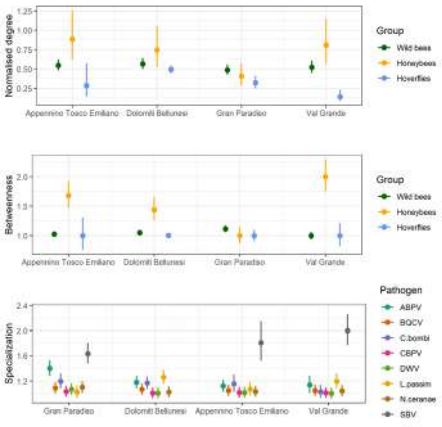
Linear models showed that honey bees were the main epidemiological "bridges," carrying the highest number of pathogens and connecting different host groups, except in Gran Paradiso where wild bees played this role.

SBV emerged as the most specialized pathogen, infecting only hoverflies and being absent in the Dolomiti Bellunesi.

Environmental factors strongly influenced pathogen risk: infection decreased with altitude but increased with NDVI and grazing, and peaked in July.

Hoverflies had lower infection risk overall compared to bees. Within hoverflies, risk was shaped by biological traits: zoophagous larvae, females, and bivoltine species were more often infected, while univoltine species showed the lowest prevalence.

At the genus level, *Melanostoma* and *Episyrphus* were the most susceptible, highlighting important intra-group variability.



CONCLUSION

This study reveals widespread pathogen circulation in mountain pollinator communities, even in protected National Parks. Pathogens were found not only in bees but also in hoverflies, highlighting their emerging role as potential hosts and mechanical carriers in pollinator pathogen networks. Environmental factors (altitude, vegetation, land use, seasonality) and host traits (species, sex, larval diet, and life cycle) significantly influence infection risk, with seasonal peaks in pathogen load observed in summer

These findings underscore the complexity of pathogen dynamics in wild pollinators, the important role of hoverflies in pathogen spread, and the need for integrated "One Health" approaches to safeguard pollination services and ecosystem health.

PP-607 [Bee Health]
Chemical and Biological Approaches Against Varroa destructor in Algeria: Effectiveness and Colony Impact (SafeAgroBee PRIMA)

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he Varroa destructor mite is responsible for varroosis, the leading disease weakening and causing the loss of honeybee colonies. With a global prevalence, this pathology significantly impacts both individual bees and entire colonies due to its association with multiple honeybee viruses. In Algeria, beekeepers use various treatment methods and products, and this study aims to assess their effectiveness and potential side effects on colonies.

The trials were conducted on 15 apiaries owned by ten beekeepers in the central region of Algeria (Blida and Boumerdès). Different chemical and natural treatments were tested. The results showed a decline in the effectiveness of chemical compounds, particularly fluvalinate and flumethrin, confirming the high resistance of the mite to these products in Algeria.

Field studies highlighted the importance of biological treatments based on thyme (Apilife Var®, Oxuvar®, and Apibioxal®) as an alternative control method. These products showed promising efficacy but also had negative effects on colonies, including desertion, queen mortality, and brood interruption. Additionally, the use of plants and essential oils produced highly variable results, with moderate effectiveness and noticeable disturbances in colony behavior.

Conversely, oxalic acid treatment in the absence of brood proved to be the most effective method, achieving a mite elimination rate of over 90%. Further laboratory studies are needed to recommend optimal natural solutions for controlling this beekeeping pathology. A combined approach integrating chemical, biological, and biotechnological control strategies appears to be the most effective solution for managing varroosis while minimizing its impact on colonies.

BEEKEEPING TECHNOLOGY AND QUALITY

PP-179 [Beekeeping Technology and Quality]
Accessing the safety and quality of Thai stingless bee honey produced in different regions

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Stingless bee honey, produced by various species of stingless bees, has garnered attention due to its unique physicochemical properties, potential health benefits, and the significant challenges associated with establishing safety and quality standards. The absence of formal norms complicates the commercialization and consumer trust in stingless bee honey products. The quality and safety of stingless bee honey in Thailand have garnered increasing attention. Research indicates that honey produced by stingless bees, particularly the Tetragonula pagdeni, exhibits distinct physicochemical characteristics contributing to its high market value and medicinal properties. In this study, 100 honey samples produced by three stingless bee species from 20 meliponaries were collected from eight provinces in five regions. Analyses were carried out under the Thai stingless bee honey standard.

The results reveal that the water content in honey was a major issue of honey quality, and it was linked to geography and species. The safety of honey, especially microbiologically data, was linked to the meliponary management and process of honey harvesting. Besides, some honey samples were contaminated with environmental and human pathogens. This study emphasizes the impact of processing among stingless bee species on honey quality and highlights the significance of understanding the quality of honey based on the geographical origin of stingless bees for consumers and producers.

PP-180 [Beekeeping Technology and Quality]

Investigating pesticide persistence in commercially available beeswax

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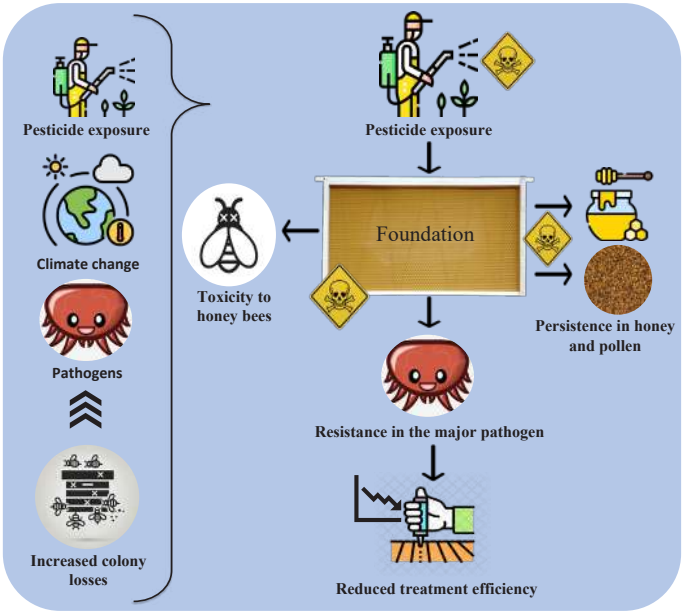
INTRODUCTION

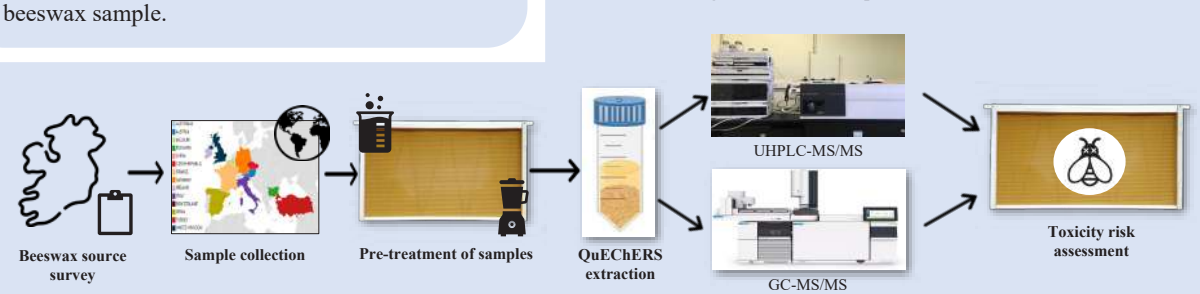
- Honey bee colony losses have increased over the past 40 years due to climate change, pathogens, and pesticide exposure.
- Beeswax is the most contaminated hive material and can be reused for decades as foundation.
- Pesticide persistence in foundation can cause toxicity for honey bees, lead to the evolution of resistance in major honey bee pathogens, and result in decreased treatment efficiency.
- Pesticides can migrate into honey and pollen, posing risks for human health.
- Pesticides banned in Europe have been reported in several countries, including in Ireland.
- This contamination may originate from foundation because the beeswax trade is not regulated globally.



METHODS

- We surveyed Irish beekeepers to determine where they buy their foundation.
- Beeswax samples were collected from suppliers across ten countries, both within and outside Europe.
- The analytical chemistry methods for pesticide screening in beeswax are currently being fine-tuned
- Next we will screen all beeswax samples for over 300 pesticides.
- The toxicity risk will be calculated for each beeswax sample.

Origin of beeswax samples from different countries



CONCLUSION

This study aims to provide data to international regulatory bodies and advocate for global policy development in the beeswax trade. This will mitigate contamination from beeswax and promote sustainable beekeeping practices with a 'One Health' approach for the future.

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PP-181 [Beekeeping Technology and Quality]

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Use of Alternative Protein Sources in the Nutrition of Honey Bees

Under Commercial Colony Management Conditions in New Zealand

Modern beekeeping and climate change place honey bees under constant stress, depleting their immune resources and reducing their recovery ability. Complete nutrition, beyond basic proteins, fats, and carbohydrates, must include amino acids, polyunsaturated fatty acids, enzymes, microelements, and phytonutrients. This approach supports colony health, productivity, and physiological resilience, particularly under intensive commercial use.

Our research investigated spirulina as a promising protein alternative under commercial queen-rearing conditions. Spirulina is notable for its high protein content, balanced amino acid profile, polyunsaturated fatty acids (linolenic acid), and antioxidants, aligning well with the biological needs of honey bees. Unlike many commercial protein substitutes with limited amino acid content and digestibility, spirulina provides comprehensive nutrition *(see figure 1)*.

Figure 1, *Stepwise optimisation of spirulina-based formulations*

Experimental diets were initially screened in colonies to assess physical characteristics and acceptance compared to commercial protein feed (control). Based on field observations, formulations were adjusted for texture and intake. Final-stage testing confirmed consistent consumption and integration into colony feeding behaviour.

METHODS

The study emphasized spirulina's effect on hypopharyngeal gland development, royal jelly production, and colony resilience during intensive queen-rearing cycles. At a concentration of 30% of the total feed, spirulina effectively met protein and amino acid requirements while enhancing hypopharyngeal gland functionality, critical for larval nutrition and queen quality. Physiologically healthy larvae for grafting were consistently available, boosting queen production efficiency *(see figure 2)*.

Figure 2, *Multi-choice feeding preference test for protein supplements*

RESULTS

Although spirulina alone demonstrated positive effects, its benefits were maximized when combined with key minerals such as magnesium, zinc, and manganese. Under laboratory conditions, this enhanced diet supported physiological resilience, as evidenced by a 30% survival rate in the spirulina-fed group compared to 28% in the commercial feed group. While the numerical difference is modest and not necessarily statistically significant, it confirms the non-toxicity and nutritional adequacy of the spirulina-based diet for sustaining longevity. Notably, royal jelly deposition in queen cells increased by approximately 12%. Nurse bees receiving this diet began filling queen cups with royal jelly as early as the egg stage - prior to larval hatching - which is rarely observed in practice and suggests an overcapacity of jelly production, likely indicating enhanced hypopharyngeal gland activity and improved physiological status under stress (see figure 3).

Figure 3, *Spirulina's complex nutrient profile*

Rich in protein, amino acids, and bioavailable trace elements such as magnesium, zinc, and manganese — provides a biologically relevant supplement for supporting physiological functions in honey bee colonies under intensive commercial use.

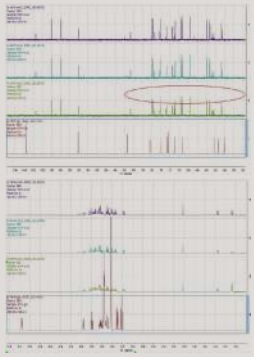
CONCLUSION

These findings highlight spirulina's potential as a superior protein source for bees, particularly in commercial operations. By improving colony nutrition, spirulina enhances productivity, supports hypopharyngeal gland health, and increases stress resilience. Combining spirulina with essential minerals ensures optimal results, offering an effective solution to address nutritional deficits and sustain bee health under modern intensive beekeeping conditions *(see figure 4)*.

Spirulina represents a viable alternative to commercial pollen substitutes, capable of significantly improving colony performance, resilience, and the production of high-quality queens.

Figure 4, *Invertase Testing*

As part of our preliminary efforts to validate the proposed hypothesis, we performed ^{13}C NMR profiling of bee head extracts. The resulting spectra indicated distinguishable features potentially linked to invertase activity. While further confirmation is needed, early patterns suggest increased enzymatic signals in forager bees from colonies receiving spirulina-based protein supplementation. These findings align with the observed positive effects on hypopharyngeal gland development.



PP-182 [Beekeeping Technology and Quality]
Characterizing Honey-Fruit Combined Fillings for Bakery Products: A Comparative Study against Commercial Products

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This study aimed to develop and optimize a novel bakery filling using honey, apple puree, and carboxymethyl cellulose (CMC) and compare its properties with commercial fruit fillings. A Box-Behnken design was employed to optimize the preparation process, considering three key independent variables: apple puree (10–30% w/w of honey weight), CMC (1–1.5% w/w of honey weight), and vacuum drying time (5–10 h). The effects of these variables were systematically evaluated in terms of baking stability index, syneresis, total phenolic content (TPC), firmness, and water activity. The optimal formulation was identified as 25.14% apple puree, 1.21% CMC, and a drying time of 7 h and 23 min. Incorporating apple puree significantly enhanced TPC, total flavonoid content (TFC), and antioxidant capacity, while CMC played a critical role in improving baking stability and viscoelastic properties. The optimized honey-fruit fillings exhibited similar thermal properties to commercial fruit fillings but demonstrated superior antioxidant activity, including higher TPC, TFC, and radical scavenging activity. Although commercial fruit fillings displayed slightly better viscoelastic properties, they had lower structural stability compared to the honey-fruit mixture. The optimized honey-fruit filling provides a promising alternative to commercial options, offering superior nutritional value, enhanced rheological stability, and comparable thermal characteristics. This innovation highlights the potential for developing bakery fillings with improved health benefits and functional properties.

PP-183 [Beekeeping Technology and Quality]

"Abstract Ref no. 0101"

PRODUCTION, PROCESSING AND QUALITY OF INDIAN HONEY FROM APIS DORSATA

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ABSTRACT

"Madhu" i.e. Honey in Sanskrit the original Indian language, is collected by Rock bees or Giant bees Apis dorsata honeybees are well known and used since ancient times. The Indian traditional medicine system – Ayurveda, describe several formulations and its health benefits, still continued and practiced. Honey is an important item in Indian religious rituals. It has been estimated that out of total production of honey in India (133,000 MT) about 60 – 65 % honey is contributed by Apis dorsata.bee colonies alone, besides Indian native Apis cerana, Apis florea and exotic Apis mellifera bees. This dorsata honey is most commonly marketed and used in India and else where.

The huge sized Apis dorsata bee colonies found on trees and rocks in forests and mountains in large numbers and not easily accessible. As also found in urban areas on tall concrete buildings, galleries, bridges, water tanks. Honey produced in forests originated from the nectars of several medicinal plants and trees, almost free from chemicals in best natural environment. The size of the dorsata bee-colonies or comb is about 0.5-1.5 M and quantity of honey stored is larger than A.mellifera and A.cerana bees hence it need different management and techniques. It yields about 10 – 40 kg honey from single colony.

Methods for collection, extraction, production and handling of honey by safe and hygienic techniques being developed and standardized.

Assessment of quality of dorsata honey showed that it contain moisture (water) as high as 24.5 %, HMF 110ppm (Maximum), Diastase activity (DN) 8.20 (Maximum) besides other characteristics. The quality of honey including reduction of excess moisture (almost 5%) from 24.5% reduced to 19.5 %. Turbidity / Optical Density improved to 0.45, besides organoleptic testes and other vital natural medicinal properties could be maintained. Beekeeping technology and quality of honey from dorsata bee colonies improved besides conservation of bees and welfare of local honey collectors. The proper scientific handling, processing and storage etc. of honey benefitted to over 6000 beneficiaries by the CBRTI programme. It has great scope as "Organic honey", if proper certification is done. This will help to cover even 40-50% of almost 90 % untapped potential of dorsata honey

Figure-1- NATURAL APIS DORSATA COLONY

Figure-2- Manual/Motorized Centrifugal Honey Extractor with Filter Bag

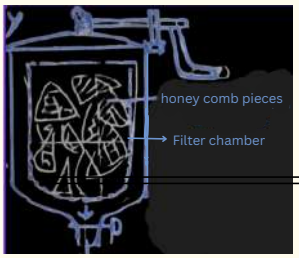


Figure-3

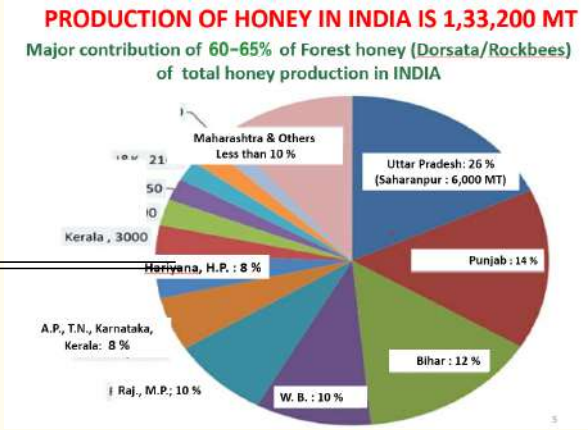
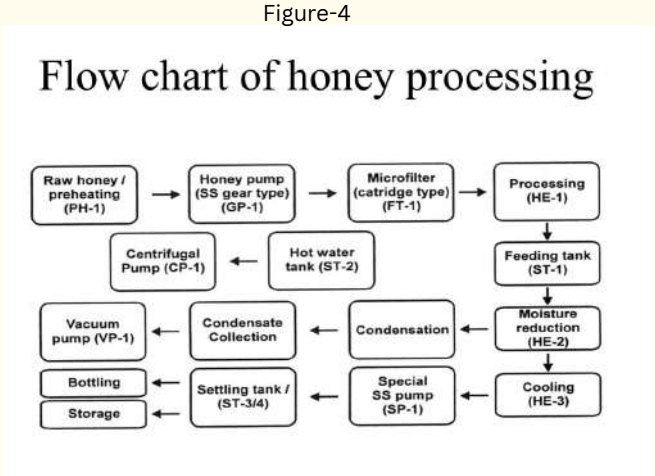


Figure-4



QUALITY ASSESSMENT OF DORSATA HONEY

Table 1. Quality of raw honey Vs Processed honey from *Apis Dorsata* (Av.68 samples)

Sl.No	Characteristics / Quality	Raw Honey	Processed Honey	FSSAI - 2020
1.	Colour / Clarity	Light to Amber / Turbid	Light to Amber / Clear	----
2.	Flavour	Unpleasant	Characteristic	----
3.	Taste	Sweetish sour	Characteristic sweetish	----
4.	Fermentation	6 – 12 Months	No, Even after 12 Months	----
5.	Granulation	Within 12 months	After 12 months at Room Temp	----
5.	Specific gravity 27°C	1.38 – 1.41	1.36 – 1.40	1.35
6.	Moisture (Water) %	21.75 – 24.50	18.50 – 20.00	20 Max.
7.	Total Reddoicing Sugars %	70.6 – 76.8	74.00 - 80. 20	60
8.	Fructose (Levulose) %	36.50 – 36.80	38.20 – 41.50	---
9.	Glucose (Dextrose) %	34.00 – 36.80	33.00 – 38.50	---
10	Ratio F/G OR L/D	1.00 – 1.20	1.00 – 1.20	0.95 – 1.5
11.	Sucrose %	1.10 – 2.40	1.00 – 1.50	5 Max.
12	Acidity as formic acid %	0.12 – 0.22	0.10 – 0.20	0.2 Max.
13	Ash (Minerals) %	0.25 – 0.35	0.18 – 0.30	0.50 Max.
14	Water insoluble matters % ,Max Pressed honey % Max	1.20 – 3.50	0.20 – 0.35	0.10 Max. 0.5 Max.
15	Pollen count (per g) Max	9000 – 14000	500 – 1200	5000 Max
16	Hydroxy Methyl Furfural (HMF) mg / kg (ppm)	08 – 78	20 – 80	80 Max
17	Diastase No. (DN)	10 – 15	2 – 12	3 Min.
18	Yiest count (millions / g)	Numerous	Nill	----

Figure-5

CONCLUSION

Above studies showed huge quantity of honey from A. dorsata in India need organised and modern scientific methods for collection, processing and quality control need to improve to meet vast increased demand for marketing and export.

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PP-184 [Beekeeping Technology and Quality]

Three Digital Beekeeping Tools in Taiwan: *Varroa* Mite Monitoring System, Nectar Source Geographic Information System and Apicultural Traceability System

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Abstract

Beekeeping is labor intensive. This study has developed the following three applications to support the advancement of apiculture in Taiwan.
(1) *Varroa* mite monitoring system: Monitoring *Varroa* mite population is essential for integrated pest management, but the small body size makes visual identification difficult. This system is able to calculate the infestation level of the *Varroa* mite in a beehive by using mobile device to take photos of live honeybees on frames. The algorithm based on deep learning analysis of the photos counted the number of honeybees and mites. Trained on a dataset of 3,987 images, the algorithm reaches a precision of 84% for honeybee counting and 91% for mite counting. This non-destructive method provides a fast and effective alternative to traditional approaches.
(2) Nectar source geographic information system: In the past, there was a lack of comprehensive information on nectar and pollen sources for beekeepers, and no system existed to connect farmers in need of pollination with beekeepers. Traditionally, beekeepers search for apiaries independently with limited exchange of experiences. Making it difficult for newcomers to identify suitable locations. To address this, we developed a cloud-based platform using ArcGIS to manage geographical data on nectar and pollen crops. The system includes orthophotos, electronic maps, and 13 major crop distribution layers. Users can select crop layers to identify suitable locations, enhancing pollination services and apiculture development.
(3) Apicultural traceability system: Beekeepers typically used branches, stones, bricks, or markings to track hive status, with most records kept on paper. This made data difficult to utilize or analyze effectively. To improve apiary management, this study designed a database format tailored to Taiwanese apiculture. The user interface adopts a calendar format, recording key parameters such as personnel, tasks, time, location, and equipment involved in beekeeping. Data is uploaded to a public cloud-based platform, only providing necessary information to certification companies and consumers to comply with Taiwan Good Agricultural Practice standards. Additionally, the system includes predefined expert guidelines for pest control and queen rearing, along with a report export function for assessment and analysis.
Keywords: artificial intelligence, *Varroa*, monitoring, geographic information system, traceability

(1) Varroa mite monitoring system

This study developed an automated *Varroa* mite monitoring system using deep learning algorithms combined with mobile devices and cloud computing. The dataset consisted of images captured using cameras or smartphones with a resolution of 12 megapixels, taken at fixed distances toward the frame (Figure 1). The dataset includes 3,987 labeled images, with a total of 416 mite annotations and 46,110 honey bee annotations. We employed the YOLOv4 architecture for object detection, training the model to distinguish between large objects (honey bees) and small objects (mites). After evaluating various image cropping dimensions (192×192, 416×416, 608×608, 960×960, and 1280×1280 pixels), the 608×608 size yielded the best performance. Data augmentation and image enhancement techniques, such as brightness and saturation adjustment, were applied during training. The trained model achieved a precision reached 84% for honey bees and 91% for mites (Figure 2). Each image is analyzed in less than 15 seconds, enabling real-time estimation of mite infestation rate (Figure 3).

Figure 1. Beekeepers can simply upload smartphone photos for cloud analysis.

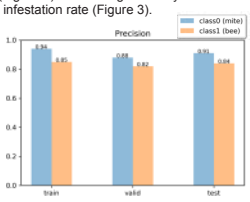

Figure 2. The model precision for honey bees and *Varroa* mite.

Figure 3. Output of image recognition.

(2) Nectar source geographic information system

There are many plant species in Taiwan that can be used as nectar and pollen sources. However, plant species that can produce honey or bee pollen with commercial value are mainly fruit trees cultivated in large areas, with longan (*Dimocarpus longan*) honey, *lychee(Litchi chinensis*) honey and tea (*Camellia sinensis*) pollen comprising the majority in the domestic market. Additionally, nectar source fruit trees also include citrus fruit (*Citrus* spp.), Indian jujube (*Ziziphus mauritiana*), persimmon (*Diospyros* spp.), coconut (*Cocos nucifera*), avocado (*Persea americana*), loquat (*Eriobotrya japonica*), and carambola (*Averrhoa carambola*). Pollen source fruit trees also include plum (*Prunus mume*), pear (*Pyrus pyrifolia*), and pitaya (*Hylocereus* spp.) (Figure 4). The Taiwan Agricultural Research Institute, Ministry of Agriculture has conducted surveys and released the maps of a variety of perennial crops, including the crops above. This system framework adopts ArcGIS software to draw maps and manage geographical information data and release produced map platform service on the Internet (Figure 5). The system map platform base maps are provided by the National Land Surveying and Mapping Center in Taiwan, including orthophotos with clear landscape and universal electronic maps with administrative boundaries and road markings.

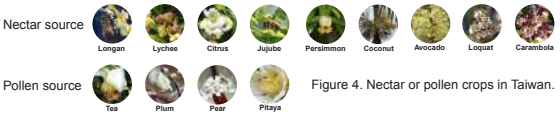

Figure 4. Nectar or pollen crops in Taiwan.

Figure 5. One dimension of the system main screen. Demonstrating 8 crop layers overlaying on landscape orthophotos.

Figure 6. Apicultural traceability system function flowchart.

(3) Apicultural traceability system

To enhance data management and streamline certification in apiculture, we developed this system capable of recording a wide range of operational events and producer data (Figure 6). The records are divided into 4 functional modules: **Apiary**, **Material**, **Feed**, and **Harvest**, according to the nature of the task. Among them, the **Apiary Management** module is the most complex, with hierarchical structures that allow for detailed recording of hive conditions, queen characteristics, and colony status—including data such as colony strength, number of frames, occurrence of pests and diseases, and queen loss. The **Harvest Management** module supports traceability from collection through packaging to shipment, and enables users to upload relevant documents to designated authorities for swift application for Taiwan Good Agricultural Practice (TGAP) or Taiwan Beekeeping Association certification.

To simplify the data input process, we designed a **Calendar-based user interface**, allowing users to assign and track tasks via clickable event scheduling (Figure 7). This includes not only single tasks, but also task kits (e.g., weekly pest control routines). Furthermore, we integrated an expert-driven schedule (e.g., queen rearing) as a reference template, which users can customize to fit their individual beekeeping practices. This system aims to reduce manual labor, support certification processes, and enhance digital transformation in modern beekeeping management.

Figure 7. User interface of beekeeping calendar.

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PP-185 [Beekeeping Technology and Quality]

Finding drone congregation areas with mechanical drones

And data collection of DCA locations

JULIA MAHOOD
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MAP MY DCA

Background

- *Apis mellifera* honey bees mate while flying in discrete leks called drone congregation areas (DCAs)
- The locations of DCAs are known to remain constant year after year[1]

Problem

- It is not fully understood how drones find these static locations, or what it is about them that leads to the creation of a DCA
- In the past, researchers have found DCAs using helium balloons or poles with pheromone lures attached, however this is limiting because areas over tree canopy, water, and tall structures are not easily accessible

Methodology

Using a mechanical drone, or unmanned aerial vehicle (UAV) to look for DCAs is a method that allows the user to survey a greater variety of areas

UAV Requirements

- Equipped with a camera that can be monitored in real time
- Must be able to tow the lightweight lure

Equipping a UAV for DCA hunting

- Lure can be either a live queen or QMP lure (TempQueen) attached to something weighing around 11g and large enough to easily spot from the UAV camera (hair roller, pill bottle with holes drilled in it, or Hopkins queen cage)
- Lure should hang ~6 meters below the UAV
- Attach lure with thin thread to allow it to break if caught
- Attach thread to thick paracord to avoid thread getting caught in propellers during takeoff
- Outfitting UAV with drop kit allows for attachment of paracord without interference with sensors

Screenshot of the Maven application showing a spiral flight path around an apiary

Where to Look for DCAs

- DCAs are found around apiaries, often within a few hundred meters[2, 3, 4]
- While some common characteristics of DCAs have been observed (landscape depressions, over creeks) looking only in those areas creates the possibility of biased results
- Flying in an outward spiral is an effective method to cover the area
- Using waypoints software, flights can be programmed to fly a route set up in advance that covers the entire area equally not just in expected places, allowing the pilot to focus on looking for drones

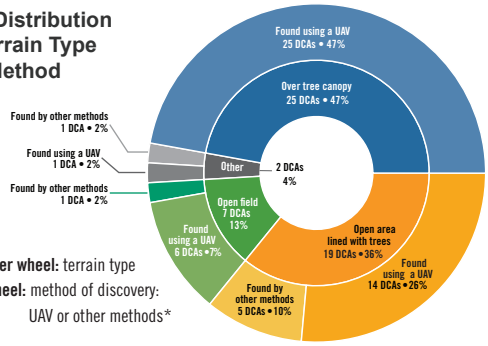
Citizen Science

- The citizen science project MapMyDCA.com is a free online tool that offers instructional information about looking for DCAs using mechanical drones
- The website's main feature is a map where users can pin DCA sites that they have located
- Anyone visiting the site can view pinned DCA locations
- All data are easily downloadable for study
- The sharing of DCA locations will help researchers gain insights about DCAs
- Since the mapmydca.com website launched in December 2019, 177 users have registered
- 53 DCAs have been pinned in 9 countries

Rolling over a pin reveals a pop up window with a button to click where more information can be found

Results and Conclusions

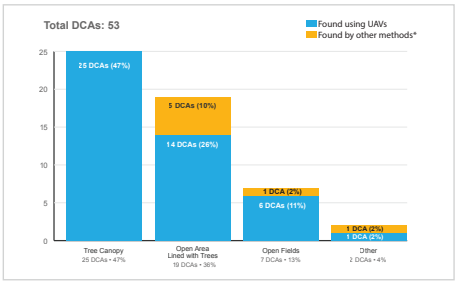
DCA Distribution by Terrain Type and Method



Inner wheel: terrain type
Outer wheel: method of discovery: UAV or other methods*

**Other methods include helium filled balloons, poles, by ear, by finding everted drones on the ground*

- An interesting finding is that 47% of the posted DCAs found occur over tree canopy, contradicting earlier research employing more limiting surveying methods stating that DCAs typically occur in an open area surrounded by a windbreak[5]
- Looking only at the DCAs found using a mechanical drone, (where it's possible to survey areas over tree canopy) 54% of DCAs were found over tree canopy



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mapmydca.com

Drone congregation area videos:

Georgia, USA | Massachusetts, USA | Connecticut, USA

PP-186 [Beekeeping Technology and Quality]

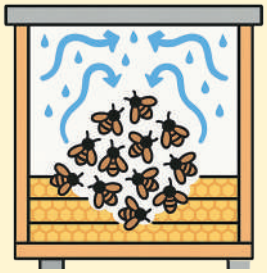
Climate Hive „BEELIVE“ – Reducing Humidity in the Beehive

Hive without Climate Cover

Observations show that with the Beelive climate cover, the bees cluster more loosely, and the hive experiences less moisture and mold.

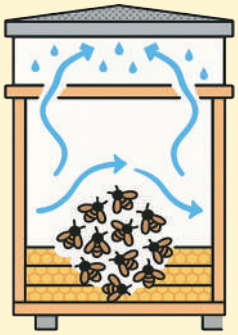
Hive with Climate Cover after 48 Hours

NORMAL LOOT

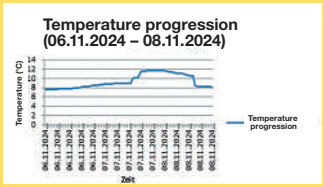


Better Hive Climate – Beelive Cover

- Bees sit more loosely
- Lower risk of feed interruption
- Improved hive hygiene
- Reduced chalkbrood risk
- Lower feed consumption
- Supports strong spring development



CLIMATE COVER



Temperature Pattern – Climate Cover Test

- Climate cover was placed for 6 hours, then removed
- Temperature rose after removal
- Cause: evaporation cooling effect was gone
- Similar to feeling warmer after leaving the swimming pool in summer

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Appalachian Multi-purpose Apiary Informatics System (AppMAIS)

Rahman Tashakkori, PhD

Lowe's Distinguished Professor of Computer Science

APPALACHIAN STATE UNIVERSITY
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Computer Science

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PP-188 [Beekeeping Technology and Quality]
Mercury Contamination in Honey from Different Bee Species in Ecuador: Health Risks and Environmental Quality

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BACKGROUND: Honey quality is influenced by various factors, including botanical origin, bee species, and environmental contaminants such as heavy metals. Mercury contamination, a major environmental concern, can affect the quality and safety of honey, posing potential health risks. This study aims to assess the mercury content in honey produced by different bee species in Ecuador and to evaluate the potential health risks associated with its consumption.

Problem Description: Despite the global concerns regarding heavy metals in food products, little research has been conducted on the presence of mercury in honey, particularly in the diverse ecosystems of Ecuador. This study addresses the knowledge gap by evaluating honey samples from the coastal, highland, and Amazonian regions of Ecuador, with a focus on mercury contamination as a marker of environmental quality.

METHODOLOGY: A total of 50 honey samples were collected from different regions of continental Ecuador in 2024. The samples, representing honey produced by Apis mellifera L., Geotrigona, and Melipona mimetica, were analyzed using Flame Atomic Absorption Spectrometry (FAAS) to determine the mercury content. The botanical origin of the honey was identified, and the sampling locations were recorded with precise geographic coordinates. The study also investigated the potential relationship between the presence of mercury in honey and the environmental conditions around the beehives, including the floristic sources used by bees.

RESULTS: The results revealed varying levels of mercury contamination in honey samples from different regions. Additionally, differences in the floral sources and bee species were observed to influence the mercury uptake in honey. The study also determined the percentage of provisional tolerable intake (%PTWI) and target hazard quotient (THQ) for the honey samples, providing an indication of the potential health risks associated with their consumption.

CONCLUSIONS: This study emphasizes the importance of monitoring heavy metals in honey as a bioindicator of environmental health and food safety. It highlights the need for ongoing research into the safety of honey produced in Ecuador, as well as products containing honey as an ingredient. Furthermore, it suggests that implementing strategies to reduce mercury contamination is crucial to ensure honey is safe for human consumption.

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PP-189 [Beekeeping Technology and Quality]

Heather Honey Proteins

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Introduction

Honey derived from the nectar of heather (*Calluna vulgaris*) differs in many respects from most other floral honeys. Heather honey has distinct taste and flavor, as well as high commercial value. The protein content of heather honey can reach up to 2%, which is high compared to most honeys (usually < 0.5%). Mineral concentration is also high and can be up to 0,5 %. Its characteristic jelly-like consistency is thought to result from the presence of glycoproteins.

Nectar of heather presents a challenge for honeybees (*Apis mellifera*), and some bee strains are not able to produce ripe honey from it. Due to the high protein and mineral contents, heather honey can be unsuitable as winter food causing stress, dysentery, and even death of the colony, if the bees are not able to make cleansing flights early in the Spring. Heather honey can be identified organoleptically (taste, flavor, color, jelly-like consistency), as well as by measuring electric conductivity and detecting heather pollen in honey. In this study, we investigated the protein content of heather honey compared with other floral honeys, using samples provided by two beekeepers from Southwest Finland and commercially available products from Norway.

Results

The Finnish heather honey samples (samples 1-3) contained less heather pollen than the Norwegian samples (samples 7-9). Electric conductivities in the Finnish samples were also lower than in the Norwegian samples. Highest electric conductivities were measured in samples containing honey dew honey (samples 4 and 10), and these samples had low protein concentrations compared to heather honey. Highest protein concentrations were measured in Norwegian heather honey samples. We observed a strong correlation between heather pollen counts, protein concentration, and electric conductivity (with the exception of honey dew honey; **Fig. 1**)

Honey proteomes were analysed by liquid chromatography-tandem mass spectrometry (LC-MS/MS; **Fig. 2**). The data were searched for bee and all green plant (*Viridiplantae*) proteins annotated in TrEMBL database. Majority of the soluble protein in the measured samples were secreted by bees. Despite the higher protein concentration, fewer proteins were identified in heather honey than in other floral honeys (**Fig. 3A**). The proteomes of the Finnish and Norwegian heather honeys exhibited similar features (**Fig. 3B**)

Sample	All nectariferous	Apiaceae	Brassicaceae	*Calluna vulgaris*	Cirsium/ Carduus	Impatiens	Mycosotis	Pyrus / Malus / Aronia	Rosacea e	Salix	Taraxacum / Sonchus	Trifolium hybridum	Trifolium pratense/ incarnatum / medium	Vaccinium	Others	Nectarless
1	358	41	91	40	1	25	1	2	65	10	1	26	x	25	30	69
2	408	13	14	55	1	26	4	x	167	25	1	48	1	20	31	9
3	422	12	9	13	15	15		33	99	177	x	19		11	19	7
6	423	17	2	x		x	300	2	37	24		24		9	8	19
8	362	2	x	205	4	1		1	42	27	8	7	3	1	61	66
9	367	2	57	134	2	x		1	79	15	2	32	10	2	31	63
10	403	1					300	1	64	12	3	5		14	3	14
11	422	4		1		x	350	1	26	19		x		12	9	4

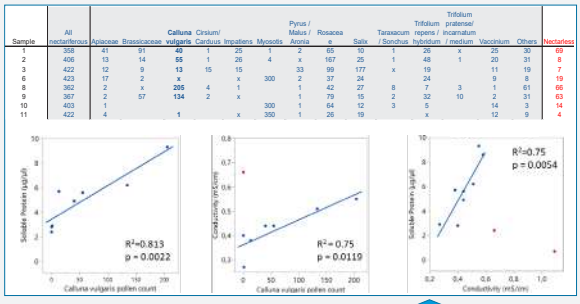
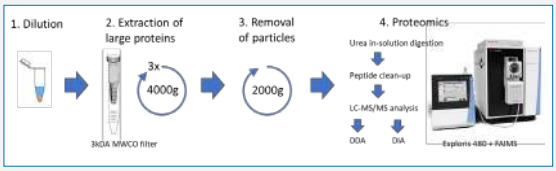


Figure 1. Pollen analysis. Top: Pollen counts by species or genus of plants identified in selected samples Bottom: correlations between protein concentration and heather pollen counts (left), electric conductivity and heather pollen counts (middle), and protein concentration and electric conductivity (right). Samples containing honey dew honey (red dots) were excluded from calculations involving electric conductivity

Figure 2. Proteomics workflow. Honey samples were diluted with water and proteins were extracted with 3 kDa molecular weight cut off centrifugal filter. Large particles, such as pollen, were then pelleted from the remaining sample, and soluble protein was prepared for LC-MS/MS analysis with a routine urea in-solution digestion method. The purified peptides were analysed with 2h gradients both with data-dependent acquisition method (DDA) for species identification and data-independent acquisition method (DIA) for quantitative comparisons.



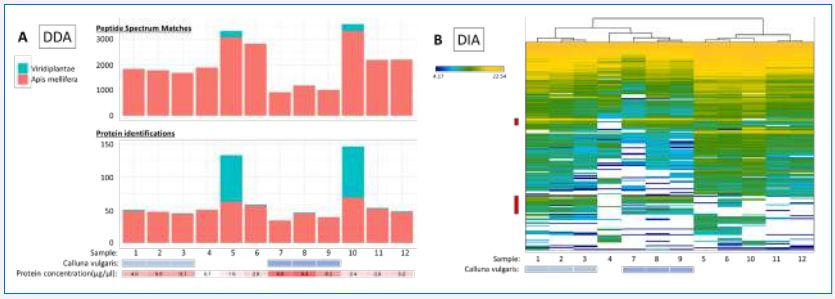


Figure 3. Honey proteome. A) Peptide spectrum matches (top) and protein identifications (bottom) for each sample in the DDA data searched against all sequences of the species *A.mellifera* and clade *Viridiplantae* in TrEMBL database. **B)** Hierarchical clustering of the samples based on DIA data shows similarities between Finnish and Norwegian heather honey samples. Hierarchical clustering of the proteins found two clusters that are to some degree specific to heather honey (indicated with red bars).

Table 1. Proteins predominantly found in heather honey. Proteins associated with DNA damage repair are shown with red color.

Uniprot ID	Protein Descriptions	Log2 Fold Change
A0A7M7G0D4	Transferrin	only in heather honey
A0A7M7GKH7	P-type Ca(+) transporter	only in heather honey
A0A7M7MNL5	Protein TAPT1 homolog isoform X2	only in heather honey
A0A7M7HQN6	**Breast cancer type 2 susceptibility protein**	**only in heather honey**
A0A7M7MR67	Myeloperoxidase	only in heather honey
A0A7M7MTQ0	Hybrid signal transduction histidine kinase M	only in heather honey
A0A7M7RPK0	NAD-dependent protein deacetylase sirtuin-1 isoform X2	only in heather honey
A0A7M7GBF5	Uncharacterized serine-rich protein C25S.13	10.24
A0A7M7GW34	Uncharacterized protein LOC102653840	9.04
A0A7M7GU48	Tetratricopeptide repeat protein 39 homolog, mitochondrial-like	7.59
A0A7M7GPF3	Uncharacterized protein LOC611955 isoform X2	5.87
A0A7M7GUP4	Disks large-associated protein 5 isoform X3	5.78
A0A7M7TFF5	**Enhancer of mRNA-decapping protein 4**	**4.25**
A0A7M7FZV4	Multiple inositol polyphosphate phosphatase 1	3.88
A0A7M7MH65	DnaJ homolog subfamily C member 7 isoform X4	3.76
A0A7M7UKP7	Glycerate kinase-like	3.70
A0A7M7D9H6	**DNA repair protein XRCC1**	**3.58**
A0A7M7GBG4	Uncharacterized protein C30orf47 homolog	3.19
A0A7M7MT71	**Transcriptional regulator ATRX homolog isoform X3**	**2.96**
A0A7M7LUF5	U6 snRNA-associated Sm-like protein LSm6	2.24

Discussion

The electric conductivity measurements were performed with a method described by Sancho et al. (1991). These values need to be multiplied by a factor of 1.5 to obtain values comparable with the standard method. The honey directive defines the upper limit of electric conductivity in floral honeys to 0.80 mS/cm. Two of the Norwegian heather honey samples (7 and 8) measured in this study had conductivities higher than limit in the honey directive. Given the high commercial value of heather honey, adjusting the limit set in the directive should be considered.

The soluble proteins in heather honey are mostly secretions of the hypopharyngeal glands, such as proteins belonging to the Major royal jelly protein family. However, the amount of protein secreted by bees is much higher in heather honey than in most other floral honeys, which may indicate that ripening of heather honey is more demanding for the bees. Some of the identified bee proteins exhibited a degree of specificity towards heather honey. As an interesting observation, several of these proteins have been associated with DNA damage repair.

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PP-190 [Beekeeping Technology and Quality]

Automated entrance monitoring to investigate honey bee foraging trips using an open-source wireless platform and fiducial tags

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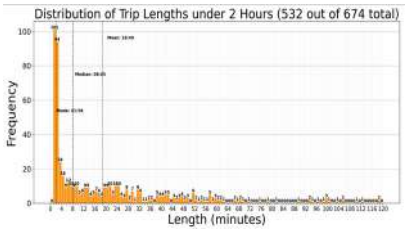
[1]The Pennsylvania State University, [2]Cornell University

Abstract
Honey bee foraging involves tens of thousands of organisms making decisions about where to collect needed resources. Studying this is possible through direct observation, but the large number of individuals makes the implementation of technologies ideal to scale up this type of study. Consequently, there is a need for instruments that can facilitate accurate assessments of honey bee foraging at the colony level. To address this need, we developed an automated imaging system for monitoring the in-and-out activity of honey bee foragers as they walk through a customized entrance with a camera sensor at the hive entrance. We used AprilTags attached to each bees' thoraces to provide unique identification numbers that allowed the system to track in-and-out events throughout the foraging season of the colony. Our design relies on low-cost Raspberry Pi computers and cameras with commercially-available off-the-shelf components, making it easily reproducible with the open-source documentation provided. We successfully deployed and evaluated our system, demonstrating consistent results. Our results highlight the system's effectiveness in monitoring honey bee trips, which lays the groundwork for future estimations of foraging distances.

Read the entire article at:
Penaloza-Aponte, Diego et al. 2024. Automated entrance monitoring to investigate honey bee foraging trips using open-source wireless platform and fiducial tags. HardwareX, Volume 20, e00609.

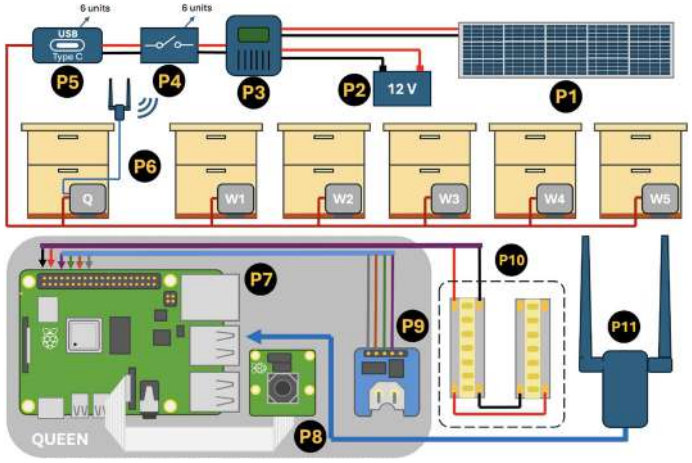
The BeeCam-AprilTag system:

- A real-time detection system capable of identifying individual bees, retrieving their position and orientation using inexpensive tags.
- A system composed of multiple devices able to collect and share data via a local wireless network that users can access wirelessly for monitoring and data transfer.
- A portable system deployable outdoors that runs 24/7 for long periods.
- Built entirely with commercially available off-the-shelf components.
- An architecture and interface that is simple to install and operate by people with limited knowledge in electronics and programming.



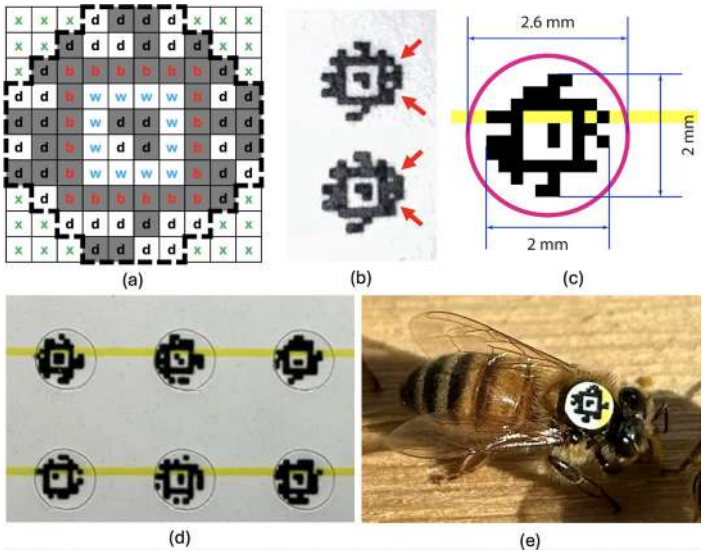
Sample data showing trip lengths of tracked worker bees.

Funding and Acknowledgments
We would like to acknowledge Mark Gingrich, Steve Berner, Nils Napp, Margaret J. Couvillon, and Lindsay Johnson. The Penn State Drawdown Scholar Program in collaboration with the Penn State College of Engineering and the Institute of Energy and the Environment funded the contributions made by Erin Dent as a summer 2023 research assistant. We thank the farmers who hosted the honey bee colonies; Glenn Rex, Levi Fisher, David Blank, Ryan Murray, Eric Peck, and James Phillips and those who helped with the fieldwork: A. Pantaleone, C. Darnell, M. Woolford, W. Towne, L. Watson, J. Eckhart, L. Collins, M. Bodamer, J. Gowin, E. Rubio, S. Feldman, N. Bhattarai, E. D. Sossa, C. Crosier, E. O'Neil, D. Sorokin, K. Jakhmola, P. Hafker, E. Ralph, E. Carroll, A. Curry, M. Dahlberg. This work was supported by the U.S. Department of Agriculture NIFA Award 2022-51300-37884.



General system schematic describing the main hardware components. Labels P1 to P5 indicate the power module components, label P6 refers to the enclosures containing the electronics for each colony, and labels P7 to P11 denote the electronic components within the enclosure of the "queen" computer.

Hardware. (a) IP65 enclosure modifications. (b) Electronics inside enclosure. (c) Enclosure, 3-D printed entrance and landing board installed at colony entrance.



AprilTags: (a) Pixel-bit structure for the 44h12 circular tag family. (b) Printing quality comparison, with arrows indicating white pixels obscured by ink smearing. (c) Printed tag dimensions, showing the magenta circle for the cutting area and the yellow strip for tag orientation. (d) Tags printed and cut, ready for use. (e) Tag mounted on the thorax of a honey bee.

PP-191 [Beekeeping Technology and Quality]

Abs Ref: 0145

CHEMOMETRIC CLASSIFICATION OF PERUVIAN HONEYS FROM BAJO MAYO, SAN MARTÍN, PERU: MULTIVARIATE AND FACTORIAL MODELING APPROACHES

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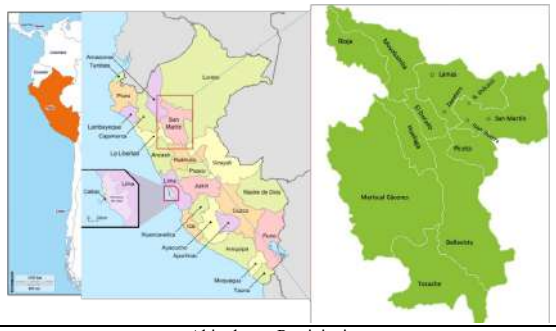
REMARKS

Determining the botanical and geographical origin of honey remains challenging, making it increasingly important to standardize analytical protocols that verify its quality and identify its floral source, thereby reducing the market for fraudulent and adulterated products. Since honey inherits its color, aroma, flavor, and physicochemical properties from flowering plants, pedoclimatic conditions also influence its composition. Interest in honey analysis has grown to meet regulatory requirements, particularly for monofloral honeys. The objective of the study was to determine the physicochemical and sensorial characteristics of honeys from the Mayo river basin.

MATERIALS AND METHODS

The study was conducted on honey samples collected from the Mayo River basin, located in the northwest of the San Martín region and the northeast of the Amazonas, making it a bi-regional basin. Covering an area of 9,774.25 km², the basin has an elongated biogeographic shape that gradually widens toward the lower reaches of the Gera River. Topographic variations range from 200 to 2,000 meters above sea level, and four distinct climatic environments have been identified. The area experiences rainfall deficits in autumn, winter, and spring, along with high relative humidity.



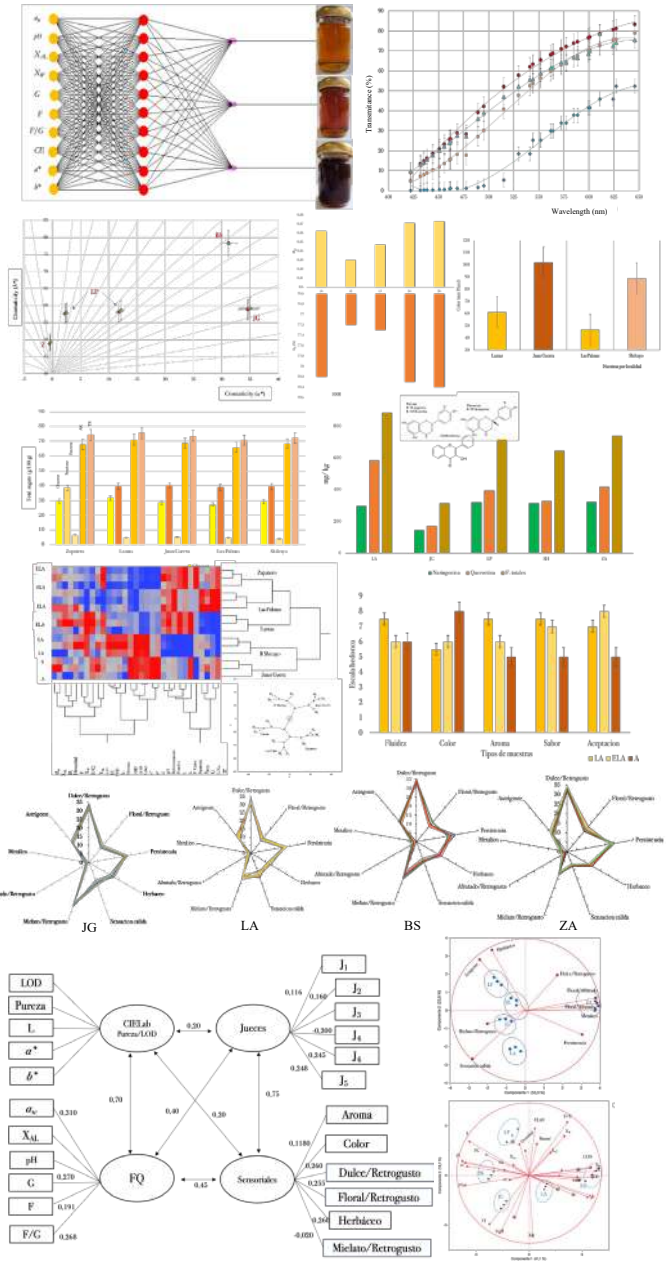
Samples	Place	Altitude (msnmm)	Precipitation (mm/año)	Latitude	Longitude
ZA	Zapatero	286	1200	06° 30' 00"	76° 30" 00"
LM	Lamas	596	1300	06° 29' 05"	76° 22' 23"
JG	Juan Guerra	230	1100	06° 35' 28"	76° 18' 47"
LP	Lamas/Palmas	814	1200	06º 27' 10''	76º 32' 00"
BS	Banda/Shilcayo	350	1243	06º 32' 56''	76º 21' 45"

Honey evaluation was performed using Harmonized methods for the following parameters: moisture (X_W)); total sugars (X_T), reducing sugars (X_{RE}); free acidity (X_{AL}); glucose (G) and fructose (F)); fructose/glucose ratio (F/G) and glucose/moisture ratio (G/H); Tabouret index (IT); color (Pfund); CIELab parameters, color purity (PC), and dominant wavelength (LOD); water activity (a_w); pH; electrical conductivity (EC), diastase index (ID); ash content (XC; total dissolved solids (TCD), Baumé; refractive index (RI) and specific rotation (POR).

Sensory attributes and intrinsic characteristics of the samples were analyzed in relation to their classification using a Probabilistic Neural Network, cluster analysis, discriminant analysis, multiple factor analysis, and PLS-PATH modeling, allowing clear differentiation and classification of the honeys.

RESULTS AND DISCUSSION

The geographic portion of the Mayo River basin is characterized as an Amazonian environment with tropical dry forest (BS-T) in the San Martín region. It features mountainous physiogeographic conditions and hosts a wide range of ecosystems. Flowering occurs throughout the year, with both short and long flowering periods, often presenting dense floral blooms. The melissopalynological profile of the honey harvested in LA, LP, and ZA revealed them to be multifloral honeys, containing both dominant and significant accompanying pollen grains.



Sensory attributes of honeys from Juan Guerra, Zapatero, Lamas, Banda de Shilcayo, and Las Palmas were analyzed through Quantitative Descriptive Analysis, allowing classification of samples with similar profiles regardless of geographic origin. Probabilistic neural networks, cluster analysis, and PLS-PATH modeling confirmed these groupings and quantified the influence of honey attributes in relation to geographic origin.

PP-192 [Beekeeping Technology and Quality]

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MULTIVARIATE TECHNIQUES AND FACTORIAL MULTIPLE MODELS IN CLASSIFICATION OF HONEYS FROM STATES OF LARA AND YARACUY (VENEZUELA)

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REMARKS

Honey is a natural product made mainly from the nectar of flowers; its final quality depends on its botanical and geographical origin. The variability is wide even for honey from the same region. The botanical and geographical origin of honey is still difficult to determine, so it is increasingly necessary to standardize analysis protocols that contribute to the verification of the quality of this important product of the beehive.

This study addresses the physicochemical properties and sensory attributes of tropical honeys from the Venezuelan states of Lara and Yaracuy. The research applies modern multivariate classification techniques, including cluster analysis, neural networks, discriminant methods, multiple factor modeling, and PLS-PATH methods.

MATERIALS AND METHODS

Venezuelan honeys from the states of Lara and Yaracuy were classified based on physicochemical and sensory parameters. Samples were collected from apiaries in the central-western region of the country, comprising a total of 30 honeys from nine localities: Lara (13 samples) and Yaracuy (17 samples), specifically from Crespo, Simón Planas, Palavecino, Jiménez, Morán, Andrés Eloy Blanco, Iribarren (west of Barquisimeto), Peña, and Urachiche. Analyses included color, CIELab chromaticity, pH, free acidity, total sugars, moisture, ash content, electrical conductivity, density, and water activity, combined with sensory evaluation and multivariate statistical methods.

Estate	Place	Altitude o.s.l.	Precicinitation mm/year	Termal sensation °C
Lara	Crespo	1220	500-800	23,5
	Simón Planas	283	1600	24,0
	Palavecino	1000	400-500	24,5
	Jiménez	500	400-500	22,0
	Morán	620	400	22,0
	A. E. Blanco	300	1680	21,0
	Iribarren	765	800	24,5
Yaracuy	J. A. Páez	340	1370	27,0
	Peña	675	1900	26,0
	Urachiche	477	1800-1900	25,0

Discriminant function analysis, seven predictor variables reflecting the overall quality of the honey types were considered: L, a*/b*, pH, moisture content (Xh), electrical conductivity (EC), and Pfund scale color (mm). Results associated with sample groups that generated classification functions with p-values below 0.05 were considered statistically significant. For cluster classification analysis, the parameters a*/b*, EC, moisture content (Xh), pH, dominant wavelength, and color purity were used.

In neural network system, the variables free acidity (X_{AL}), moisture content (Xh), total sugars (Xs), ash content, and pH were applied.

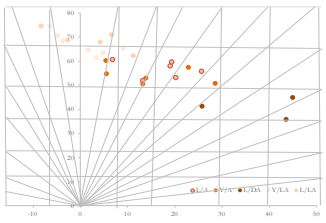
RESULTS AND DISCUSSION

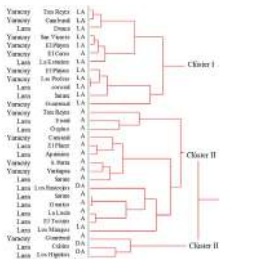
Honeys from Lara and Yaracuy consisted of 50% amber, 40% light amber, and 10% dark amber multifloral types, with distinctive properties that allow differentiation by geographical origin. This region hosts diverse vegetation types, including xerophytic communities, deciduous and semi-deciduous forests, as well as areas dominated by thorny shrubs and *cardonales*. Deciduous forests are comparatively less diverse than humid forests.

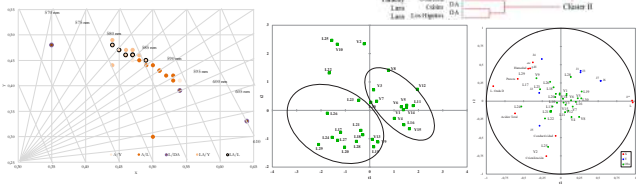
	A (ds)	DA (ds)	LA (ds)	Total (ds)
%	50	10	40	100
n	15	3	12	30
*a**	16,1 (7,24)	38,0 (1,07)	1,26 (0,63)	12,3 (1,30)
*b**	54,8 (3,60)	40,7 (4,55)	67,8 (4,44)	58,6 (9,50)
CE (mS. cm^{-1})	0,773 (0,130)	0,672 (0,306)	0,616 (0,180)	0,700 (0,321)
Xw	20,4 (4,04)	21,3 (1,10)	19,9 (1,28)	20,3 (1,30)
pH	3,47 (0,11)	3,64 (0,12)	3,41 (0,16)	3,47 (0,15)
Pfund (mm)	98,8 (7,70)	128 (7,70)	71,3 (8,36)	90,7 (20,1)
L	47,3 (4,64)	29,8 (8,36)	64,0 (5,72)	52,3 (12,0)

The flora is mainly composed of species from the families *Mimosaceae*, *Caesalpiniaceae*, and *Capparidaceae*, represented by the genera *Prosopis*, *Acacia*, *Cercidium*, and *Capparis*. Emergent columnar cacti, particularly those of the genera *Stenocereus*, *Subpilocereus*, and *Pilosocereus*, are characteristic elements of the landscape. Other noteworthy taxa include *Croton*, *Opuntia*, *Jatropha*, and *Cnidoscolus*, together with herbaceous species from the genera *Lantana*, *Digitaria*, *Evolvulus*, *Sida*, and *Sporobolus*, complemented by cacti of the genera *Opuntia*, *Mammillaria*, and *Melocactus.*

The physicochemical and sensory analyses, combined with multivariate statistical methods, allowed for the classification and differentiation of Venezuelan honeys from Lara and Yaracuy according to their quality attributes and geographical origin.







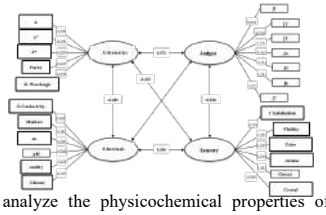
Physicochemical, sensory, and hedonic parameters of Venezuelan honeys.

Samples	VEB.	VEB...	VE12	VE16.	VE28.	VE29
Physicochemicals	Yaracuy			Lara		
L	72,9	41,1	51,3	56,4	63,8	32,3
a*	-6,50	28,5	5,50	11,2	4,20	45,0
b*	74,6	50,9	54,7	62,2	68,9	45,0
D. Wavelent (mm)	577	590	580	583	577	605
Xc	0,23	0,28	0,23	0,24	0,23	0,64
CE (mS. cm^{-1})	0,528	0,816	0,525	0,737	0,533	1,290
Moisture	20,0	20,7	20,0	20,7	21,5	21,5
a_w	0,50	0,60	0,60	0,60	0,60	0,60
pH	3,40	3,60	3,50	3,50	3,90	3,50
AT (meq. kg^{-1})	25,8	28,9	32,2	30,8	29,6	31,4
Glucose/water	1,60	1,60	1,40	1,60	1,60	1,40
Sensory						
Fluidez	5,90	4,40	8,30	5,30	4,40	6,50
Color	3,60	5,30	5,10	3,90	6,00	7,70
Aroma	4,50	5,40	7,30	4,40	6,60	6,50
Cristal	0	0	4,00	1,30	0	0
Taste	6,10	7,60	6,70	6,30	7,10	6,20
Hedonic						
J1	7	8	8	3	8	9
...	...	...	...	...	...	...
J3	9	8	7	5	9	5

Eigenvalues associated with principal component analysis

	Physicochemicals		Sesnsoy		Judges	
	EV	%Inercia	EV	%Inercia	EV	%Inercia
1	4,19	42,0	2,10	34,0	3,00	43,0
2	1,59	16,0	1,78	30,0	1,28	18,0
3	1,17	12,0	0,69	12,0	0,98	14,0
4	1,10	10,0	0,65	11,0	0,74	11,0

PLS-PATH relationships in the classification of honeys from the states of Lara and Yaracuy based on multiple factor analysis



The present study made it possible analyze the physicochemical properties of honeys, whose results allowed the formulation of classification criteria through the application of multivariate analysis techniques. This approach enabled the construction of a framework interrelating the intrinsic properties of Venezuelan honeys

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PP-193 [Beekeeping Technology and Quality]

REFRACTIVE, CODOUNIS, KIRKWOOD AND TABOURET INDICES IN THE EVALUATION OF SELECTED COLOMBIAN HONEYS

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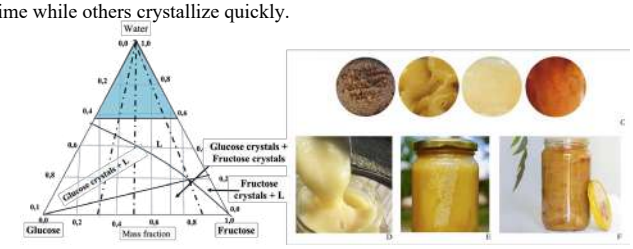
Abs Ref: 0157

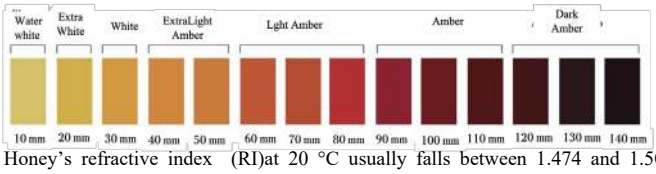
REMARKS

Honey is essentially a solution of reducing sugars, usually in a state of supersaturation with respect to glucose at room temperature, since glucosa-being one of its major constituents has relatively low solubility. Crystallization in Honey represent a supersaturated compounds containing glucose and fructose. Glucose has lower solubility than fructose, so it tends to precipitate out of solution and form crystals. Not all honeys crystallize at the same rate: some remain liquid for a long time while others crystallize quickly.

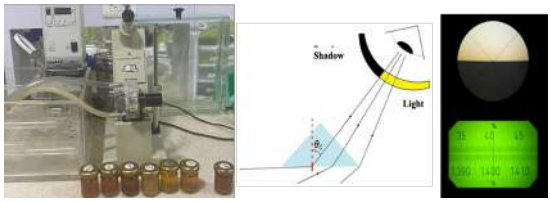


Glucose (91 g/100 mL) crystallizes easily in honey, while the higher solubility of fructose (380 g/100 mL) helps it remain liquid. Sucrose (~200 g/100 mL) and maltose (165 g/100 mL) show intermediate behavior. Honey's botanical origin defines its composition, sensory profile, and therapeutic value, making thorough characterization essential. During storage, honey may crystallize fully, partially, or remain in a metastable state. The Codounis Index is an early metric developed to quantify the crystallization tendency of honey, providing one of the first attempts to express crystallization risk as a single numerical

Color, expressed on Pfund scale, is nly used as a discriminant parameter for the classification of honey categorizing honey into white, extra light amber, light amber, amber, and dark amber. Color is strongly influenced by botanical origin, mineral content, and phenolic compounds, making it a valuable indicator in honey differentiation and quality control.



Honey's refractive index (RI)at 20 °C usually falls between 1.474 and 1.504, depending on water content. As water increases, (RI) decreases, parameter is temperature dependent: $n_{20} = n_T + 0.00023 \cdot (T-20)$, here n_{20} is refractive index corrected to 20 °C; nT RI measured at temperature T(°C).

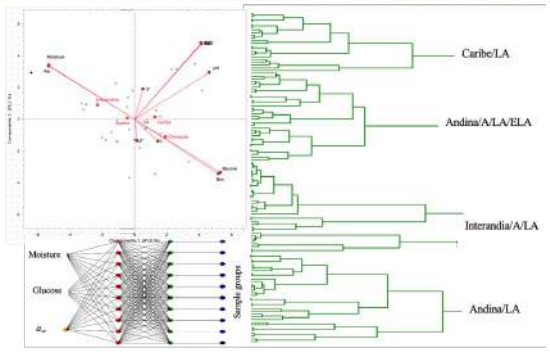


Kirkwood's Index relates honey's botanical origin to electrical conductivity, pH, and color. EC reflects mineral content and correlates with polyphenols and antioxidant activity. Differentiation relies mainly on dissolved solids (Xs), reducing sugars (Xr), and pH. (KI) values below 73.1 is required for a sample to be classified as honeydew honey: IK = 1,4Xr- 8,3pH - 12,3X.

METHODS

Honey samples from various Colombian biogeographical regions and altitudes were analyzed. Color was classified using the Pfund scale and supported by refractive index, Tabouret, and Kirkwood indices. Differentiation was based mainly on fixed solids (Xs), reducing sugars (Xr), and pH.

RESULTS

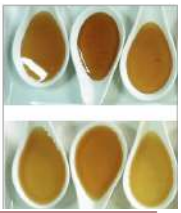


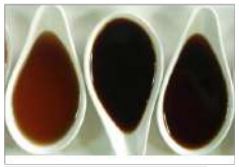
Color	Pfund (mm)	RI (n_D, 20 °C)
Water White	10	1.4830-1.4835
Extra White	8-17	1.4835-1.4838
White	17-34	1.4838-1.4842
Extra Light Amber	34-50	1.4842-1.4845
Light Amber	50-85	1.4845-1.4850
Amber	85-114	1.4850-1.4855
Dark Amber	> 114	1.4855-1.486

The refractive index of amber honeys is around 1.4845, while white honeys show values of 1.4838. The highest values correspond to light amber (LA), and the lowest were found in samples from the lower montane very humid forest (*lm-VHF*) 1.4923) and tropical dry forest (*td-F*): 1.4831.

Honey crystallization is mainly influenced by its glucose and water content. When glucose levels are lower, the higher water availability enhances fructose dissolution but limits glucose incorporation into the solution, accelerating crystal formation. Conversely, high glucose combined with reduced moisture increases the granulation index. Crystal formation begins in a section of the honey, which may cover part of it, and in some cases, the process is accompanied

Tabouret's Index (n =2)	Color honey				
Zona de vida	A	W	DA	ELA	LA
lm-HF	9,10		9,65		9,38
pm-HF					9,42
th-F	8,70		8,35	7,5	9,25
lm-VHF				11,2	
pm-VH	10,3		9,51		7,97
td-VDF	7,98		9,32		8,13
lm-DF	8,70			10,0	10,2
td-F	8,50	11,1		8,97	8,90





Wild life Z.	n	IK
lm-HF	12	65,1 *
pm-HF	11	76,3
th-F	22	74,5
lm-VHF	4	59,7 *
pm-VH	25	64,6 *
lm-DF	12	73,4 **
td-F	48	76,8

Color	n	IK
A	31	71,0
DA	17	61,9
ELA	26	76,5
LA	58	75,8
W	4	79,9

The Index (IK), used as a classification parameter for honeydew, establishes a threshold value of 73.1 to identify honeydew honeys. Samples exceeding this limit are classified as honeydew. Typically, amber (A) and dark amber (DA) honeys exhibit these characteristics.

In tropical regions, honeys generally present higher moisture content due to the prevailing humid climate, a factor that directly affects viscosity and increases susceptibility to fermentation, thereby emphasizing the need for careful post-harvest handling and storage practices.

PP-194 [Beekeeping Technology and Quality]
Development of a Geographic Identity for Mieles Ecuador: Creation of Designation of Origin and Protection

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BACKGROUND: Honey is a natural product of great value both in gastronomy and medicine, and its quality varies depending on the region of origin. In Ecuador, the geographical and ecological diversity allows the production of honeys with unique characteristics in flavor, texture and properties, reflecting the essence of the flowers and plants native to each area. However, honey production faces challenges, mainly the lack of differentiation compared to products from other regions, which limits its commercialization and favors unfair competition. Furthermore, many consumers are unaware of the distinctive properties of Ecuadorian honey, which makes its expansion into international markets difficult.

To address this problem, the development of a designation of origin is proposed that guarantees the authenticity, quality and traceability of Ecuadorian honey, promoting its commercialization and protecting local producers.

The methodology includes descriptive and exploratory research, documentary review, interviews with experts and field studies, such as surveys and direct observation. A comparative analysis will be carried out with other designations of origin.

It is expected that the results of this research will allow us to better understand the unique characteristics of Ecuadorian honey, develop a certification system and marketing strategies to position it in global markets.

RESULTS: The implementation of a designation of origin will strengthen the competitiveness of the beekeeping sector, promoting its sustainability and economic development.

PP-195 [Beekeeping Technology and Quality]

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CHEMOMETRIC ANALYSIS IN CLASSIFICATION OF COLOMBIAN HONEYS ACCORDING TO PHENOLIC, REDUCTIVE CAPACITY AND ANTIRADICAL POTENTIAL

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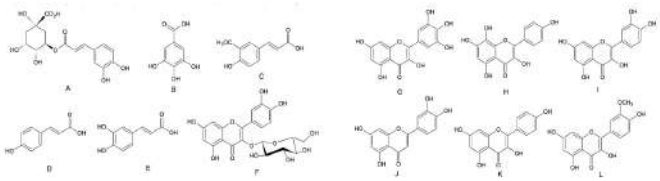
REMARKS

Honey is a complex natural product produced by bees from floral nectar and other extrafloral secretions, which they collect, transport, dehydrate, and store in the hive. Its composition includes more than 180 compounds, such as sugars, amino acids, vitamins, enzymes, and, most notably, polyphenols. Among these, phenolic acids and flavonoids stand out for their strong antioxidant capacity and their role in modulating diverse biological processes.

The quality and physicochemical characteristics of honey, as well as sensory attributes such as color, aroma, texture, and flavor, are closely influenced by its botanical origin, climatic conditions, and processing practices. The antioxidant activity refers to the analytical measurement of concentrations of radicals of different natures in a controlled oxidative system (Gallic, Caffeic, Ferulic, Chlorogenic, p-Coumaric, Protocatechuic, Sinapic and Vanillic acids; Quercetin, Kaempferol, Luteolin, Apigenin, Pinocembrin, Galangin, Naringenin, Chrysin and Isorhamnetin).



METHODS

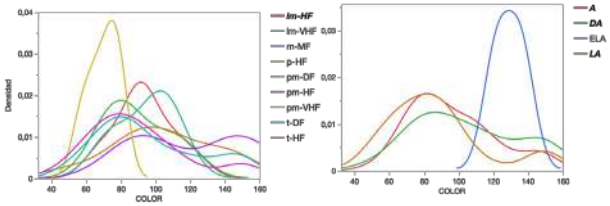
This study aimed to quantify the total phenolic content (using the Folin-Ciocalteu assay) and flavonoid content (using the aluminum chloride assay) via UV-Vis spectrophotometry at 765 nm and 415 nm, respectively. The reducing power was evaluated through the FRAP assay (2,4,6-tripyridyl-s-triazine), while antioxidant capacity was determined using the ABTS assay (2,2′-azinobis(3-ethylbenzothiazoline-6-sulfonic acid)) in Colombian honeys from diverse geographic origins.

All measurements were performed using the Microwe 96-well microplate system. Ethanol extracts of honey were prepared by leaching, followed by filtration, centrifugation, and storage at 4°C until análisis. In Colombia, progress in the phenolic profiling of floral and monofloral honeys is still limited, and studies on this topic remain in the early stages.

RESULTS

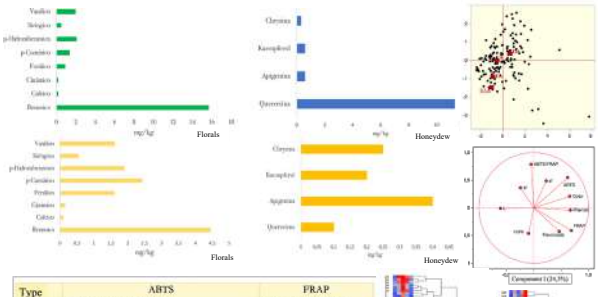
Four types of honey were identified across different ecological zones and classified by the Pfund scale as Type A (38%), Type DA (19.6%), Type ELA (1.4%), and Type LA (40.6%). Color, a key quality attribute influenced by floral source and processing, was further assessed using the CIELab system, which measures lightness (L), red–green (a^*), and yellow–blue (b^*) coordinates.

The pigment and soluble compound fraction present in honeys exhibits yellow to yellow-orange tones, which indicate the presence of chlorogenic acid (A), gallic acid (B), ferulic acid (C), p-coumaric acid (D), and caffeic acid (E). Isoquercetin (F), myricetin (G), herbacetin (H), quercetin (I), luteolin (J), kaempferol (K), and isorhamnetin (L), among others, are also found depending on the botanical origin, in addition to compounds generated through browning reactions.

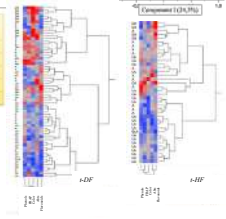


The phenolic and flavonoid content in tropical honeys is closely related to their color. It is a good indicator of their bioactive compounds. Darker honeys tend to be richer in these compounds, with higher antioxidant capacity, nutritional value, and greater resistance to oxidative degradation. Pfund < 50 mm: Total phenols: 20–40 mg GAE/100 g with flavonoids: 5–15 mg QE/100 g; 50–85 mm ≈ 40–80 mg GAE/100 g with 15–30 mg QE/100 g; > 85 mm ≈ 80–120 mg GAE/100 g with 30–50+ mg QE/100 g

Type		Phenols (mg/100 g)		Flavonoids (mg/100 g)		Flavonoids/Phenols	
	n	Media	EEM	Media	EEM	Media	EEM
A	55	94,5 ± 47,6	6,42	8,71 ± 5,90	0,80	0,11 ± 0,08	0,011
DA	28	96,5 ± 79,5	15,0	9,40 ± 7,00	1,30	0,13 ± 0,09	0,016
ELA	2	64,7 ± 25,2	17,8	5,78 ± 3,48	2,46	0,09 ± 0,021	0,014
LA	58	81,1 ± 50,8	6,64	8,14 ± 4,50	0,60	0,13 ± 0,09	0,012



Type		ABTS (mgE. Trolox/100 g)		FRAP (mgE. Trolox/100 g)	
	n	Media	EEM	Media	EEM
A	55	13,1 ± 3,60	0,48	29,1 ± 9,52	1,28
DA	28	14,6 ± 4,20	0,79	35,1 ± 13,5	2,55
ELA	2	9,70 ± 0,02	0,02	17,6 ± 0,30	0,21
LA	58	11,2 ± 3,50	0,45	27,2 ± 9,00	1,18



Total phenolic and flavonoid content in Colombian samples is known for some honeys, such as those from *Weinmannia tomentosa* L.f. (Encenillo), with values of 157 ± 1.40 mg GAE/100 g and 12.9 ± 0.12 mg QE/100 g, respectively, and from *Eucalyptus* sp., with 76.6 ± 1.47 mg GAE/100 g and 5.96 ± 0.17 mg QE/100 g.

PP-196 [Beekeeping Technology and Quality]

Ref No.: 0194

Is what you see what you get?

Pollen composition and labeling of Greater Cape Floristic Region honey

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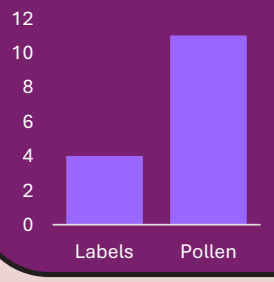
An important aspect of honey authenticity is whether the label accurately describes the product (origin authenticity). [1] Melissopalynology, the study of pollen and spores in honey, is a reliable method for identifying the type of honey and potentially where it was harvested from. [2]

South African honeys are poorly studied due to the lack of expertise and resources. [3] Here, we provide one of the first pollen snapshots of ±70 honeys from the Greater Cape Floristic Region (GCFR). The goal was to see what types of honeys are produced and whether their labels accurately reflect their composition.

Labels and pollen don't agree!

	Mono	Misidentified mono	Multi
Mono	40.0%	10.0%	50.0%

We have more types of monofloral honey than collection says!



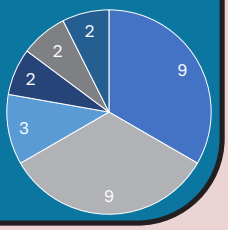
Pollen fingerprint successfully distinguishes GCFR honey from others....

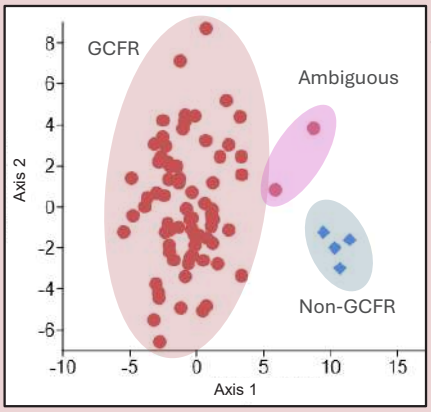
Lost opportunities?

	Mono	Multi
Multi	1.5%	8.8%
Neutral	20.6%	69.1%

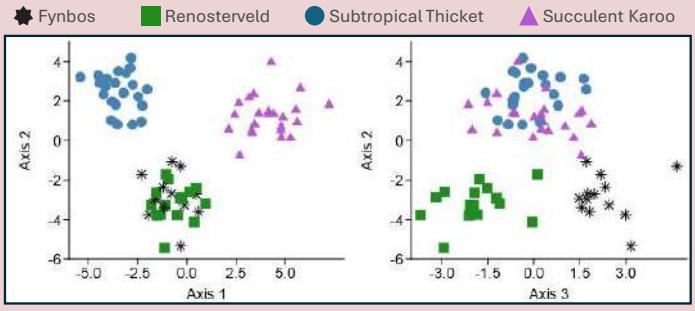
Beekeepers prefer neutral labels e.g. "raw honey" or "pure honey" to avoid misleading consumers.

Bees visited over 70 plants! These were the most common:





...and within the region! A true reflection of the uniqueness of Greater Cape Floristic Region.



Important literature:
1 Bogdanov and Martin (2001). Honey authenticity: a review. https://www.researchgate.net/publication/228505284_Honey_Authenticity_a_Review.
2 Von der Ohe *et al.* (2004). Harmonized methods of melissopalynology. Apidologie 35, S18–S25.
3 Delport et al. (2022). A new conceptual framework for the development of international melissopalynological research: Africa as a case study. Review of Palaeobotany and Palynology. https://doi.org/10.1016/j.revpalbo.2022.104695

PP-197 [Beekeeping Technology and Quality]

Fig.1 Conversion cell (orig.)

A new type of cells built by bees

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The most important capacity of the bee colony is the building up of the honey-combs.
Honeycombs are built up by the worker bees with wax secreted from the wax mirror glands. The wax secretion is a natural physiological phenomenon manifesting the moment when there is nectar and pollen in nature.
The honeycomb building capacity signifies the colony's ongoing renewal, and provides it with vitality and good health.
A bee colony always develops according to a certain pattern.
The life of the bee colony cannot exist without honeycombs, for honeycombs, owing to the way they are built up, provide us with the identification elements of the pattern according to which the colony is organized.
The colony does the building following a matrix pattern – the invisible framework. This matrix can be perceived as an invisible higher level or pattern that leaves its permanent print on the colony's activity. The visible performance of the bee colony life, accessible to our physical senses, is governed by the matrix.
Fully understanding that the matrix is the essential element in the bee colony's life, I have tried to emphasize it and to integrate it in my working system.
As the matrix is an impalpable, abstract element belong-ing to subtle levels and plans, I have tried to find its correspondence in organic levels. Starting from the premise that honeycombs are at the very basis of the colony life performance, depending on their specific building modality in nature, I have identified the five elements of the matrix as their links between the material level, and the subtle levels. These elements help us know and understand the pattern governing the colony activity, for they represent the extension of the matrix into our material universe. I have used specific names fit for each element, for the sake of an easier and better understanding.

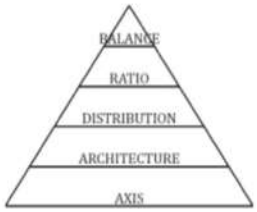


Fig. 1 Matrix and its elements(orig.)

The five elements of the matrix are: AXIS, ARCHITEC-TURE, DISTRIBUTION, RATIO, and BALANCE.
First element: AXIS.
• The axis stands for the colony's capacity to develop from top to bottom through the construction of honeycombs, and not from bottom upwards.

Second element: ARCHITECTURE.
• The architecture refers to the types of cells that make up the honeycombs and their position.
• The architecture is fully depending on the axis. No axis, no architecture.

Here are this element's characteristics:
-The drone brood cells are located at the periphery of the worker bee cells, laterally or at the very base of the nest;
-The cells for the depositing of the honey are located in the upper part, above the worker brood.
• There are at least five types of cells. **Besides the known ones, I have identified a new type of cells that I call "conversion cells."**

Third element: DISTRIBUTION.
Distribution is in direct connection with architecture, for architecture determines distribution.
Distribution is the way in which the colony uses cells, depositing nectar, pollen, and eggs in them.
We notice that architecture refers to the construction of cells, and distribution, to the way in which these cells are used.
Thus, architecture generates distribution.

Characteristics:
-The capped honey is located above the brood, in the upper part of the honeycomb;
-The worker bee brood is under the maturated nectar, whether capped or uncapped;
-The drone brood is under the worker bee brood;
-The bee bread is around the brood, in the upper part or laterally.

Fourth element: RATIO.
Ratio refers to the organization per ages and specializations of the colony population;
Ratio is the basic element in assessing queen bees and directly influences swarming, productivity, and the good health of the bee colony. In this respect, a good quality queen bee that is placed in a system having a faulty ratio may send a wrong message to the beekeeper.
Ratio relies directly on distribution.
Examples:
-A high number of worker bees – increased productivity;
-A small number of worker bees and a high number of "nurse" bees – "meat" colony, low productivity;
-A high number of "nurse" bees – increased tendency for swarming;
-A low number of drones – stress, lack of vitality, average productivity.

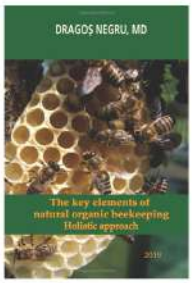
Conclusions:
We notice the synergy of the matrix elements, and their existence in interdependence.
These 4 names are specifically chosen, to make them easier to understand, and to make it easier to understand the colony's development in relation to each of these elements.

The fifth element is the BALANCE.
• Nothing in the colony life occurs at random; it is all governed by the law of balance.
• A holistic, appropriate maintenance system must comprise all of its elements in synergy one with another.

The last element governing all the other ones, balance, is on top of the pyramid. Thus we notice something extremely interesting: the matrix elements generate one another starting from the base (AXIS) going up to the top (BALANCE).

The matrix can be identified and approached through these five elements.

The synergy of these five elements relies on the performance of all the physical, chemical, and biological processes, in the form of its relation to the matrix.



Conversion cells are the cells resulting from the reduction of the drone cells' diameter until they reach specific dimensions. They represent a particular type of cells that reflect certain changes in the colony. Their peculiarity resides in the fact that only the upper part of the drone cell is modified, but not the interior. Actually, these are drone cells whose outside diameter has been reduced by the addition of wax.
The main characteristic of these cells: they are thick and round, a noticeable difference from the other types that are hexagonal (worker bee cells, drone cells), or linking cells, which are irregular in shape.

Beyond the things we can see, such as cells built up by bees, it is important for us to understand the link between the matrix and the phenomena that occur in the colony.
On this very basis, I have determined my own method of assessing the presence and status of the queen bee in the colony at any given point, emphasizing the existing status by means of one of the matrix elements: architecture. Architecture emphasizes different types of cells built by the worker bees, depending on the specific needs of the colony at the moment. In this way, knowing the matrix and its elements thoroughly, we can evaluate the colony's dynamic development without having to open the nest and analyze the brood frames, or looking for the queen bee or the freshly laid eggs.

The holistic approach that I now advocate relies on the principles of holism, which we find completely in the method which assesses the presence of the queen bee by analyzing one single element of the matrix: the architecture. By evaluating this one component, we access at once the whole, which then reveals to us each of its peculiarities and dynamics in its entirety.
Inserting one single empty frame into the active area of the nest and the next day examining the types of built-up cells, we learn with just one look the status of the colony and what its needs are without disturbing the bees by other operations such as lifting the frames and searching for the brood or the queen bee. I call this method "the eloquent honeycomb method" because the "speech" of the colony is present in the construction modality of the honeycomb.

More information about holistic maintenance of bee colonies on natural combs can be found in the book: The key elements of natural organic beekeeping. Holistic approach

The book can be ordered at the following link:
Amazon.com: The key elements of natural organic beekeeping: Holistic approach: 9781693774393: Negru, Dragos

PP-198 [Beekeeping Technology and Quality]

APIMONDIA SCANDINAVIA 2025 23-27 SEPTEMBER
Abs Ref: 0216

PHYSICOCHEMICAL CHARACTERIZATION AND DETERMINATION OF THE BIOLOGICAL ACTIVITY OF MONOFLORAL ENCENILLO HONEY FROM THE HIGH ANDEAN ZONE OF COLOMBIA

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REMARKS

The botanical and geographical origin of honey remains difficult to determine; therefore, it is increasingly necessary to standardize analytical protocols that contribute to verifying the quality of this important hive product, to establish its floral origin, and to reduce the market of fraudulent honeys adulterated with glucose syrups, which, by their lower prices, undermine its consumption. In Colombia, studies related to the quality of *Apis mellifera* honeys, according to their nature, have not been extensive, despite the country being considered a honey producer. Given Colombia's location in the intertropical convergence zone, honey can be harvested at different times of the year depending on local climatic conditions and microclimates.

The Encenillo (*Weinmannia tomentosa* Don) is an endemic tree species, associated with cliserie forests in páramo and subpáramo ecosystems of Colombia and Venezuela, growing between 2600 and 3700 m a.s.l. Its inflorescences, arranged in spikes of creamy to white tones, are a source of nectar, pollen, and resinous materials collected by *Apis mellifera* to meet brood requirements and colony protection. This forest species is of apicultural interest due to its nectar flows, which allow the production of monofloral honey as a result of the

MATERIALS AND METHODS

The objective of this study has focused on the analysis of the physicochemical, viscoelastic, and volatile components of Encenillo honey obtained from cliserie forest ecosystems in the high Andean zone of Boyacá. Fifteen samples of freshly centrifuged honey were collected in the high Andean cloud forests of Sotaquirá, Boyacá (5°46´25.5"N; 73°15´24.8"). The site corresponds to the biogeographic association of lower montane humid forest (*lm-HF*)-MB: 2800–3000 m a.s.l.; rainfall 1000–2000 mm/year; 12–16 ºC), following the intense flowering and nectar flow periods of the species. Analytical parametres: Moisture. Soluble solids (°Brix). pH and Acidity. Electrical conductivity. Reducing sugars. HMF. Diastase index. Color. Viscosity. Thermal properties: Cp and k.Optical rotation. GC/MS

RESULTS

Encenillo honey is a light amber, floral honey with: Good maturity indicators (high proline, adequate diastase activity, moderate HMF). High sugar concentration with a balanced fructose/glucose ratio, suggesting a moderate crystallization tendency. Notable antioxidant potential due to high phenolic and flavonoid contents. Stable physicochemical profile comparable to other premium unifloral honeys such as Manuka or Ulmo. The honey exhibited Newtonian behavior.

Compound	Peak	Retention Time (RT)	Kovats Index (KI)	µg kg⁻¹ (± SD)	Identification
Alcohols					
Ethanol	12	5.04–6.62	878–926	185.3 (1.91)	St; MS; KI
1-Butanol	19	7.90–9.40	990–1020	201 (0.40)	MS; KI
2-Butanol	15	7.84–9.36	990–1020	450 (0.73)	St; MS; KI
2-Methyl-1-propanol	18	10.3–11.9	1067–1120	17.1 (1.90)	St; MS; KI
2-Methyl-2-propanol	10	3.33–5.59	1124–1240	12.3 (0.23)	MS; KI
2-Methyl-1-butanol / 3-Methyl-1-butanol	21	13.4–15.4	1175–1268	22.9 (4.03)	MS; KI
2-Propanol	11	4.76–6.40	862–916	5.10 (0.24)	St; MS; KI
Aldehydes					
Acetaldehyde	2	5.90–5.94	715–761	450 (30.1)	MS; KI
2-Methylpropanal	5	1.50–2.20	752–794	0.47 (0.10)	MS; KI
Benzaldehyde	25	20.8–22.7	1450–1516	12.1 (0.23)	MS; KI
Benzeneacetaldehyde	26	24.5–25.7	1570–1630	0.80 (0.05)	MS; KI
Ketones					
2-Butanone	9	4.31–5.72	836–891	20.5 (0.40)	MS; KI
2-Propanone (Acetone)	6	1.72–2.41	755–797	38.1 (10.6)	MS; KI
3-Hydroxy-2-butanone	22	14.1–15.8	1244–1271	15.8 (0.77)	St; MS; KI
2-Pentanone	13	6.41–7.92	937–975	3.20 (0.50)	MS; KI
Hydrocarbons					
n-Heptane	1	1.23–2.42	736–757	0.91 (0.06)	St; MS; KI
n-Octane	4	1.38–3.36	737–757	0.46 (0.08)	St; MS; KI
Toluene	17	8.65–10.0	1017–1042	7.40 (1.16)	MS; KI
Esters					
Ethyl acetate	7	3.53–5.29	796–868	3.35 (0.06)	MS; KI
Furans					
Furfural	4	20.2–22.0	1379–1436	67.3 (1.28)	St; MS; KI
2-Methylfuran	8	3.72–5.49	802–8979	86.7 (1.65)	St; MS; KI
Nitriles					
2-Methylpropanenitrile	14	7.35–8.30	976–1002	0.08 (0.02)	MS; KI
Sulfur compounds					
Dimethyl disulfide	3	0.80–1.30	727–772	3.75 (1.60)	MS; KI
Terpenes					
D-Limonene	20	12.3–13.9	1156–1201	4.87 (0.35)	MS; KI
Linalool oxide	23	16.8–18.5	1497–1563	0.57 (0.07)	MS; KI

Parameter	Units	Mean ± SD
Refractive Index	–	1.4864 ± 0.0010
°Brix	g 100 g⁻¹	78.3 ± 0.44
Density	g mL⁻¹	1.4129 ± 0.0020
Specific Rotation	–	−20.8 ± 0.16
E. Conductivity (EC)	mS cm⁻¹	0.525 ± 0.004
Ash	g 100 g⁻¹	0.198 ± 0.002
Total C. (TCD)	ppm	0.261 ± 0.003
Thermal Conductivity (k)	W m⁻¹ °C⁻¹	0.349 ± 0.007
Heat Capacity (Cp)	kJ kg⁻¹ °C⁻¹	2.10 ± 0.05
Water Activity (aw)	–	0.604 ± 0.050
Moisture	g 100 g⁻¹	20.1 ± 0.43
pH	units	3.87 ± 0.04
Free Acidity	meq kg⁻¹	29.7 ± 1.30
Lactonic Acidity	meq kg⁻¹	2.20 ± 0.15
Total Acidity	meq kg⁻¹	31.8 ± 1.40
Viscosity (25 °C)	Pa·s	5.61 ± 0.50
Thixotropy	Pa/s	11,410 ± 1,671
Reducing Sugars	g 100 g⁻¹	69.7 ± 0.17
Fructose	g 100 g⁻¹	40.1 ± 0.30
Glucose	g 100 g⁻¹	29.6 ± 0.34
Fructose/Glucose		1.35 ± 0.03
Phenols	mg kg⁻¹ (Gallic Acid equiv.)	1570 ± 14
Flavonoids	mg kg⁻¹ (Quercetin equiv.)	129.4 ± 1.20
Proline	mg kg⁻¹	368 ± 37.2
HMF	mg kg⁻¹	43.8 ± 0.67
Diastase Index	Shade	11.8 ± 0.30
Optical Density (420 nm)	Absorbance	0.597 ± 0.025
Optical Density (635 nm)	Absorbance	0.117 ± 0.015
Tuboure Index	–	3.75 ± 0.06
Pfund Color	mm	69.0 ± 1.00
Luminance (L)	–	59.6 ± 1.48
Chromaticity a*	–	17.4 ± 0.94
Chromaticity b*	–	79.8 ± 1.90
Chroma (C)	–	81.7 ± 2.10

Encenillo honey shows a strongly viscous and temperature-dependent rheological profile, dominated by G″ over G′, with little elastic response. This honey can be classified as a viscous-dominant Newtonian fluid under the tested conditions, with minimal elastic contributions. Its flow properties make it comparable to other unifloral honeys of tropical origin, which generally show similar Newtonian behavior at moderate temperatures.

Its antimicrobial potential is attributed to multiple factors: High osmotic pressure (≈78% sugars, aw ≈0.60) → inhibits microbial growth by dehydration. Low pH (≈3.9) and acidity creates unfavorable conditions for microorganisms. Phenolic and flavonoid compounds (≈1570 mg/kg GAE, 129 mg/kg QE) provide antioxidant and antimicrobial effects by damaging bacterial membranes and proteins. Enzymatic activity (diastase, H_2O_2 production) contributes to oxidative stress in bacteria. Volatile compounds (furfural, benzaldehyde, limonene, linalool oxide) → act as additional antibacterial agents.

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PP-199 [Beekeeping Technology and Quality]

Effect of collection month on the freezability of drone semen of *Apis mellifera iberiensis* reared under field conditions

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Introduction

Honey bees are vital pollinators, playing a crucial role in enhancing fruit and seed production while maintaining ecological balance. The health and reproductive quality of the queen are essential for ensuring colony stability.

As the sole fertile female in the colony, the queen's reproductive capacity directly affects the productivity and resilience of the hive. To produce strong and viable offspring, the queen must mate with a sufficient number of drones, which promotes greater genetic diversity and reduces the risk of inbreeding within the colony. However, the queen's reproductive success largely depends on the quality of the sperm she receives. Poor sperm quality can impair egg fertilization, reduce brood viability, and ultimately disrupt colony population dynamics.

During Spain's spring reproductive season, colonies produce numerous drones whose primary role is to mate with virgin queens. As the season progresses, drone numbers decline due to factors such as resource availability and colony size. Despite the critical importance of drone quality for colony viability, this aspect has been understudied, underscoring the need for further research.

Our goal

To analyze the effect of the month of semen collection from drones reared under field conditions on sperm quality and sperm survival to the cryopreservation procedure.

Results

① Drone capture

Drones of *A. m. iberiensis* were collected from 10 hives (56/month) on warm, sunny days during their return from unsuccessful mating flights.

② Semen extraction

Drones were immobilized with chloroform, and semen was extracted via manual eversion of the endophallus using a capillary tube.

③ Sample preparation

Semen from 224 drones was pooled in groups of 8, diluted in Kiev medium with 10 % egg yolk plasma and 10 % DMSO for cryoprotection.

④ Cryopreservation

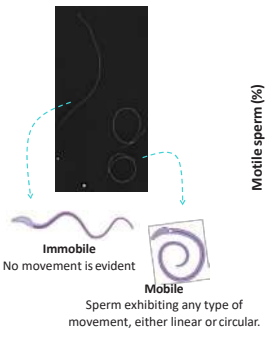
Cooling stages:
- From 20 °C to 5 °C at 0.5 °C/min.
- From 5 °C to -40 °C at 3 °C/min.
- Immersion in liquid nitrogen (-196 °C).

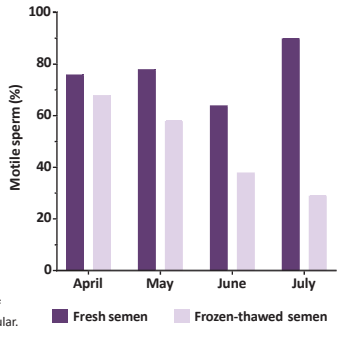
Storage:
- Minimum 24 h before post-thaw analysis.

⑤ Sperm quality analysis

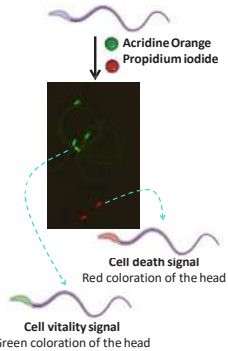
Motility and viability were assessed before and after thawing to evaluate cryopreservation success and suitability for queen insemination.

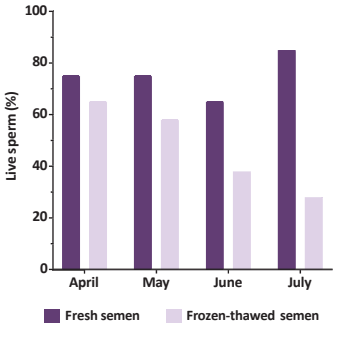
Effect of the month of semen collection on sperm motility in drone fresh and frozen-thawed semen





Effect of the month of semen collection on sperm viability in drone fresh and frozen-thawed semen





No significant differences in sperm quality of fresh samples were observed between months. Cryopreservation reduced sperm quality in all groups ($p<0.01$), with a sharper decline in samples from June and July: post-thaw motility and viability ranged from 58–66% in April–May, and dropped to 31–38% in the following months.

Conclusion

Sperm freezability may be reduced in the drones reared under field conditions collected after the reproductive season, although these results should be confirmed in different years and conditions.

Acknowledgement

This work was supported by the Spanish AEI-MICIN (grant PID2023-148475OB-I00), the EU Horizon Europe (grant 101082073) and the DGA-FSE (grant A07_23R).

Funded by the European Union

PLAY & LEARN

PP-200 [Beekeeping Technology and Quality]

Poster 0228

The Consumer as the Harvester: Disrupting Honey's Supply Chain

Author: Simon Mildren
Affiliation: HiveKeepers, Australia

Background & Purpose

At HiveKeepers we set out to challenge one of the long-standing norms in the honey industry: the distance between the person who harvests the honey and the person who enjoys it.

While much innovation in beekeeping has focused on hive monitoring and bee health, we realised the actual process of extracting honey and getting it into the hands of consumers had remained largely unchanged. It's a model filled with unnecessary steps, added costs and too many opportunities for contamination or adulteration.

We asked ourselves:

What if the person enjoying the honey could also be the one harvesting it?

Simplicity without compromise

Consumer connected harvesting

New model for honey sales and distribution

The Problem

- Traditional supply chains rely on multiple intermediaries, adding cost and reducing transparency
- Extraction methods can be time-consuming, messy and inefficient for small-scale producers
- Consumers are completely disconnected from the source of their honey
- Quality honey producers have limited ways to differentiate their honey or reach their customers directly

Methodology

We set about creating a system that could bring honey harvesting closer to the consumer without compromising quality, safety or the wellbeing of the bees.

The result is HiveKeepers' patent-protected harvesting system, developed through extensive testing, collaboration with beekeepers and feedback from early users. The system was designed around three key principles:

- **Simplicity** – Make harvesting intuitive and fast for anyone, whether you are a beekeeper or honey consumer
- **Purity** – Minimise handling and eliminate common contamination risks
- **Connection** – Create a direct line between producer and consumer that enhances trust and story-sharing

Results & Findings

- Honey harvesting is drastically simplified – Beekeepers can extract small amounts of honey on the spot without the need for bulky equipment
- Intermediaries are removed – Consumers can harvest and enjoy honey straight from the source
- Purity is preserved – With no filtering or processing required, the honey stays clean and true to its original form
- Trust is increased – Consumers can witness or participate in the harvest, deepening their connection to the beekeeper and the bees

Opportunities for Beekeepers

- **New revenue opportunities** – Supports direct-to-consumer models and small-batch premium offerings
- **Market differentiation** – Beekeepers can offer harvest-as-you-go experiences or sell honey still sealed in its original cassette
- **Lower barriers to entry** – Reduces the need for expensive extraction infrastructure
- **Better storytelling** – Enables provenance-driven marketing and stronger customer engagement

Challenges Ahead

Shifting the industry mindset from bulk production to small-batch, consumer-connected harvesting comes with challenges:

- **Changing habits takes time** – Beekeepers and consumers alike need education and reassurance
- **Regulations are designed for traditional systems** – There are hurdles around labelling, processing and sale of unprocessed honey
- **Scaling requires coordination** – Adoption depends on accessible tools, consistent support and proof that this model works at different scales

Conclusion

HiveKeepers is rethinking what it means to harvest honey. By putting the power of extraction into the hands of the beekeeper and even the consumer, we're helping build a new model for honey production.
It's one that values simplicity, transparency and the joy of real, fresh honey.

HiveKeepers
www.hivekeepers.com

PP-201 [Beekeeping Technology and Quality]

Poster 0229

From Hive to Honesty: How Technology is Combating Honey Fraud and Restoring Trust

Author: Simon Mildren
Affiliation: HiveKeepers, Australia

Background & Purpose

At HiveKeepers, we set out to address one of the biggest challenges in the honey industry: how to ensure that honey remains pure and unadulterated from the hive all the way to the consumer.

While advances in hive monitoring and laboratory testing have made important strides, we noticed that most of these solutions still leave the harvested honey vulnerable, especially once it leaves the beekeeper's hands. Too often, bulk processing, blending, and storage introduce risks that even the most rigorous testing can't fully prevent.

We wanted to create a system that secures the integrity of honey at the source, one that not only preserves its natural quality but also restores trust for consumers and opens new opportunities for beekeepers.

What if the solution to honey fraud started inside the hive?

Secures purity at the source

Enables end to end traceability

Designed for a modern honey supply chain

The Problem

- Key vulnerabilities in extraction, storage and distribution are still being exploited
- Current technologies don't ensure honey remains untouched through to the point of sale
- Consumer confidence in honey purity continues to decline
- Beekeepers producing genuine, high-quality honey are disadvantaged by low-cost adulterated alternatives

Methodology

We set about creating a system that could protect honey from adulteration by securing its purity at the very start, inside the hive itself.

Our development process combined industrial design, beekeeper workshops and iterative prototyping. We conducted early-stage trials with both recreational and small-scale commercial beekeepers to test the usability, extraction process and honey integrity. We also reviewed emerging traceability technologies to evaluate how they might integrate into our closed-system harvesting format.

Results & Findings

- Adulteration is significantly reduced – Preliminary trials show that honey harvested via HiveKeepers remains unaltered from hive to consumer
- Handling is minimised – Commercial producers no longer need to process honey from the HiveKeepers cassette, reducing labour and post-harvest equipment use
- Purity is preserved until consumption – Honey remains sealed until the moment of use, avoiding oxidation and maintaining flavour and quality
- Traceability is enabled – The system avoids bulk mixing, making it possible to trace each honey cassette back to its original hive source

Opportunities for Beekeepers

- **Protects honey integrity** – Reduces contamination risks and ensures natural honey reaches the customer
- **Supports premium positioning** – Gives beekeepers a way to confidently market high-quality, pure honey
- **Simplifies direct-to-consumer models** – Harvest-ready cassettes create a new category of packaged honey, ideal for boutique and farm-gate sales
- **Encourages industry evolution** – Presents a new framework for verifying authenticity and rebuilding consumer trust

Challenges Ahead

Introducing a new honey harvesting format comes with real challenges.

- Adoption takes time – Traditional workflows and mindsets are well-entrenched in commercial honey production
- Infrastructure change is needed – Retail and export systems built around bulk honey require adaptation
- Education is essential – Producers, regulators and consumers must all understand the value of source-protected honey
- Scalability must be proven – Large-scale deployment requires coordinated testing, feedback and manufacturing capacity

Despite these hurdles, early results show strong potential to shift the industry toward more transparent and fraud-resistant practices.

Conclusion

Our goal at HiveKeepers has always been to reimagine how honey is harvested, protected and delivered, with integrity and trust at the centre.
While traditional supply chains remain vulnerable, our early work shows that closed-system harvesting can offer a viable and scalable alternative. It's a shift that empowers beekeepers, reassures consumers and encourages transparency across the entire industry.

HiveKeepers

www.hivekeepers.com

APIMONDIA SCANDINAVIA 2025
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PP-202 [Beekeeping Technology and Quality]

IoT-Based Hive Monitoring for Assessing Colony Strength and Honeybee Pollination Efficiency

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Objectives

- Assess honeybee colony strength using **smart hives** during agricultural pollination.
- Evaluate pollination based on **real-time weight/activity data**.
- Generate high-quality data for **AI-based predictions**.
- Integrate IoT monitoring into **precision agriculture**.

Introduction

- **Pollination efficiency** is key to crop yield, especially in sunflower production.
- Traditional evaluation of colony strength and pollination efficiency is often **invasive and subjective**.
- The absence of **objective daily assessment** of forager bee activity limits development of global pollination services.
- This study **uses IoT-based smart hives** (AmoHive) to non-invasively monitor colony activity via **hourly weight tracking.**

Materials and Methods

Six **AmoHive** hives were used:
- 4 deployed to **sunflower fields** (2 with attractant, 2 without).
- 2 remained at a stationary site (~15 km away).
- Each hive transmitted **hourly data**: weight, internal/external temperature, internal/external humidity, GPS and solar panel voltage (a proxy for solar irradiance), and more.
- On July 10, an **eco-attractant** was sprayed via XAG P100 Pro **drone**.
- Colony strength and pollination effort were assessed by daily *'Breakfast Canyon'* depth — the weight loss due to morning forager departure.

Figure 1. AmoHive smart hives and smartphone application. Online monitoring of hive weight, temperature, humidity, and solar activity.

Figure 3. GPS locations of smart hives in the sunflower field.

Innovation

- Eco-attractants applied by drone stimulate nectar foraging.
- **Real-time hive data** enables **transparent pollination** service **assessment**.
- Individual colony contribution becomes measurable and controllable.
- **Data-driven pollination** improves precision and yield.
- AmoHive's solar-based power management enables long-term autonomous operation **with minimal energy use**, synchronized with environmental conditions and bee behavior.
- Adaptive sleep/wake cycles significantly **reduce** the frequency of data transmission**, minimizing** cumulative **electromagnetic exposure** and its potential **negative effects** on **bee health and behavior**.

Figure 4. An agricultural drone spraying an environmentally friendly attractant over a sunflower field.

Figure 5. Visualization of the uniform spraying process.

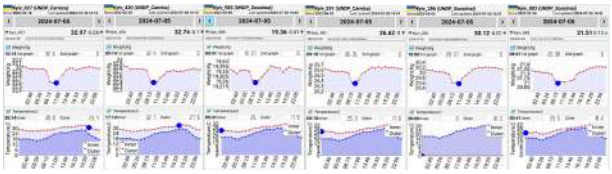

Figure 2. Daily Hive Weight Trends During Calibration (July 5).

This figure shows 24-hour weight and temperature data from all six smart hives on the day before the pollination experiment began (July 5). Each graph reflects a typical daily weight curve with a distinct morning drop — the *'Breakfast Canyon'* — followed by a gradual weight gain throughout the day. The depth of the *'Breakfast Canyon'* was comparable across all colonies, indicating similar forager populations and colony strength under identical environmental conditions. These **calibration** measurements were used as the reference **baseline** for interpreting colony-specific responses during the pollination experiment.

Further details on the construction and capabilities of the smart hive are available in the scientific article : Kurdin, I.; Kurdina, A. Internet of Things Smart Beehive Network: Homogeneous Data, Modeling, and Forecasting the Honey Robbing Phenomenon. Inventions 2025, 10(2), 23. https://doi.org/10.3390/inventions10020023

Results

- Colonies near the attractant area showed **higher** nectar collection.
- Hive 027 peaked **at +4.91 kg/day**; total gain **34.8 kg** vs. 14.5 kg (Hive 591, no attractant).
- Attractant-treated area showed **+250 kg/ha yield increase**.
- Online hive data captured the impact of **invasive inspection** (July 14), with **a drop** in pollination activity and nectar intake.
- Pollination Ability Estimation via '*Breakfast Canyon*' Metrics

Figure 6. Daily Weight Dynamics of AmoHive-027

Detailed hourly weight and temperature data for Hive 027 from July 7 to 13 illustrate a clear pattern: sharp morning drops ('*Breakfast Canyon*') followed by steady daily weight gains. A notable increase in **foraging activity** and **nectar collection** occurred after **attractant spray**ing on July 10. This supports the hypothesis of attractant-induced enhancement in foraging behavior.

Figure 2 confirms that all colonies had similar forager strength prior to the experiment.
Table 1 and **Figure 6** demonstrate that colonies near the **attractant-treated area** (Hives 027 and 430) collected significantly **more nectar than the others**, with Hive 027 peaking at 4.91 kg/day. A sharp decline in activity on July 14 across all hives, visible in the **weight dynamics**, reflects the impact of beekeeper intervention.

№ Hive	Name of Honey Bees	Initial depth of 'Breakfast Canyon'	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Total
027		430gr	0.77	3.31	3.49	4.15	4.91	3.29	2.95	-6.3	1.25	3.25	2.2	0.7	1.77	0.86	0.46	0.4	0	34.77 kg
430		440gr	0.51	2.77	2.72	3.24	3.08	2.73	2.66	-1.0	2.43	4.05	2.15	1.28	1.71	1.03	0.6	0.07	-0.1	33.30 kg
985		120gr	0	0	0	0.05	0.2	0.17	0.19	0.35	0.2	0.4	0.32	0.09	0.22	0.05	0.06	0	0	2.0 kg
591		270gr	0.16	1.07	1.4	1.78	1.9	1.85	1.85	-2.6	1.64	2.03	1.29	0.45	1.11	0.5	0.4	0.13	0.03	14.50 kg
286		570gr	0.04	0.88	0.26	0.61	0.91	1.25	1		0.95	1.26	1.41	1.73	-0.6	0.42	0.24	0.34	0.38	0.06	11.10 kg
883		410gr	-0/2	0.71	0.24	0.43	0.37	0.49	0.5		0.39	0.8	0.8	1.47	-0.4	0.18	0.23	0.21	0.25	0.04	6.82 kg

Table 1. Hive Weight Changes, July 7-23, 2024

This table summarizes **daily weight gains** (kg) across six hives during the 17-day pollination period. Hives 027 and 430 near the attractant-treated field showed significantly higher gains — peaking at 4.91 kg/day (Hive 027) — compared to untreated and control hives. The disruption on July 14 (highlighted blue) followed emergency beekeeper intervention. The final column shows cumulative nectar collection. These values were used to assess colony performance and pollination engagement.

Conclusions

- **IoT-based hive monitoring**, combined with analysis of the **depth and dynamics** of the *'Breakfast Canyon'* (maximum morning hive weight drop due to forager departure), enables **real-time, non-invasive assessment** of colony **strength** and **pollination engagement** — both individually and in comparison with other colonies within the smart apiary.
- Drone-sprayed eco-attractants can boost **nectar collection** and enhance colony performance.
- **Minimizing colony stress** (e.g., avoiding mid-pollination period inspections) improves pollination efficiency.
- **Real-time data** supports **transparent service evaluation** between beekeepers and farmers.
- This work demonstrates the successful integration of **precision beekeeping** and **agriculture** for **sustainable, data-driven crop management**.

Acknowledgements: The authors gratefully acknowledge the support of SUMMIT-AGRO UKRAINE and DroneUA in organizing and conducting the experiment.

APIMONDIA SCANDINAVIA 2025
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PP-203 [Beekeeping Technology and Quality]

Solar-Powered Smart Hives Network for Beekeeping and Long-Term Research

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Objectives

- Develop autonomous, **solar-powered IoT-based smart hives** capable of year-round operation in regions with long winters, snow, and harsh climates.
- Build a Smart Hives Network capable of continuous multi-year operation, with **a standardized frequency** of digitization and data transmission.
- Create a continuously growing, homogeneous database suitable for machine learning and AI-based colony behavior modeling.
- Design a system for **non-invasive monitoring** to support long-term scientific research and practical beekeeping, with a focus on sustainability, data-driven decision-making, and **early risk prediction**.

Introduction

- The lack of homogeneous, high-quality, and comparable data from beehives limits the application of machine learning (ML) and artificial intelligence (AI) in both honeybee research and precision beekeeping.
- **Without real-time hive data**, beekeepers cannot promptly respond to rapid and critical threats such as autumn or spring **honey robbing**, or **overwintering failure** — for example, dangerously **high humidity inside** the hive during winter — nor can they efficiently optimize logistical and operational efforts.
- Furthermore, traditional monitoring methods are invasive, episodic, and unsuitable for **long-term or winter** analysis.
- The absence of multi-year, standardized datasets from diverse regions makes it difficult to assess the long-term impacts of **climate change** on colony health and behavior.
- This project introduces a solar-powered, field-tested smart hive network that addresses these gaps by enabling autonomous, non-invasive, regularly timed data collection under natural conditions across varied climates in **Europe and North America.**

Materials and Methods

- A standardized network **of ~25 AmoHive smart hives (Langstroth type)** was deployed across multiple regions **(43–54°N latitude)** including Poland, Ukraine, Canada, and Germany.
- Each hive operates autonomously, powered exclusively by solar energy, and is equipped with internal sensors for weight, internal/external temperature, humidity, and solar voltage.
- All devices use **adaptive sleep/wake cycles** based on solar irradiance:
  - In spring/summer — activation occurs hourly;
  - In autumn/winter — activation is reduced to every 2+ hours.
- The smart hives have been operating continuously **since 2019,** even under extreme natural conditions such as **–35 °C** in Canada and prolonged **high humidity** in northern Poland.
- Collected data are wirelessly transmitted and stored in a centralized, growing database, forming **a multi-year, homogeneous time series** suitable for machine learning and AI-based modeling.
- The adaptive activation mode of the IoT system — with time-regular cycles driven by available solar irradiance — aligns with the seasonal dynamics of the colony. This approach ensures long-term **autonomous functionality**, **conserves energy**, and **minimizes interference with the bees' natural behavior**.

Innovation

- A continuously operating smart hive network powered exclusively by solar energy for **over 7 years** — validated across diverse climates in Canada and Europe.
- **Energy-efficient sleep mode** minimizes electromagnetic emissions and prolongs device functionality, reducing potential negative impacts on bee health and behavior.
- **Ultra-low data traffic**: hourly transmission of compact data packets (just a few kB) sufficient for real-time colony assessment and predictive modeling.
- **Mobile application** for intuitive, real-time visualization of key hive metrics, supporting both researchers and beekeepers in field conditions.

Smart Hives Network

Smart hives deployed across a latitudinal range from 43°N (Toronto, Canada) to 54°N (Masuria, Poland)

Smart Hive

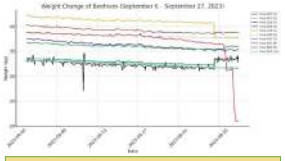
Core unit of the network: AmoHive smart hive based on the Langstroth design.
Patent UA133650, 10 April 2019

Figure 1. Smart Hive AmoHive

Results

- Over **20,000 days** of monitoring across a standardized network of solar-powered smart hives deployed in Europe and North America, generating nearly **one million synchronized records** of colony behavior and environmental hive conditions.
- The IoT system remained functional under extreme climates: from –35 °C winters in Ontario to high humidity in the Masurian Lake District, operating autonomously year-round.
- A wide range of **cyclic and non-cyclic behavioral patterns** was detected and visualized. In addition to typical daily activity curves (varieties of the *'Breakfast Canyon'*), more complex seasonal and rare patterns were documented.
- Examples include:
  - Honey robbing prediction (spring/autumn)
  - Wintering success and failure patterns
  - **Solar irradiance impact** on nectar flow (e.g., Taraxacum officinale)
  - Colony queenlessness and drone-laying symptoms detection
- **Solar irradiance** values were **calibrated and synchronized** using **real-time panel voltage** and cross-referenced with NASA POWER, Copernicus, and Open-Meteo (by hive **GPS coordinates**).

Pattern: **Honey Robbing**



Forecasting:
Prediction horizon: **up to 7 days**
Method: **Weight + Moving Window Anomaly Detector**

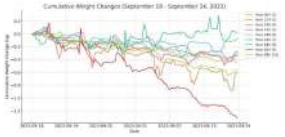
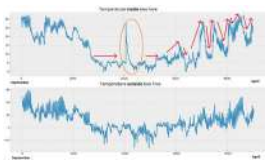


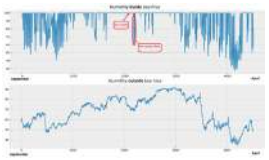
Figure 2. Smart Apiary in Ukraine

Further details on honey robbing prediction are available in the scientific article: Kurdin, I.; Kurdina, A. Internet of Things Smart Beehive Network: Homogeneous Data, Modeling, and Forecasting the Honey Robbing Phenomenon. Inventions 2025, 10(2), 23. https://doi.org/10.3390/inventions10020023

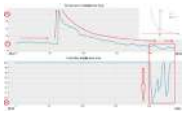
Pattern: **Overwintering, Fondant & Temperature**
Internal temperature dynamics after winter fondant feeding, compared with external temperature conditions.



Pattern: **Overwintering, Fondant & Humidity**
Internal humidity dynamics after winter fondant feeding, compared with external humidity levels.



Pattern: **Overwintering, Fondant (Detailed)**
Fourteen-day dynamics of internal temperature and humidity following winter fondant feeding.



Summary: Fondant, Microclimate, and Spring Forecasting
During overwintering, when internal humidity approaches critical levels (up to 100%), the application of winter fondant improves both colony condition and hive microclimate.
It triggers a sharp internal temperature increase of 10–20 °C, followed by a gradual exponential decline over 7–14 days, accompanied by a decrease in humidity.
The amplitude, duration, and internal/external temperature and humidity differentials provide insight into colony strength and enable forecasting of early spring development.
This adaptive response enhances winter survival under cold and humid conditions.

Pattern: **Nectar Flow & Solar Irradiance**
Pattern showing the relationship between nectar collection activity and solar irradiance dynamics.

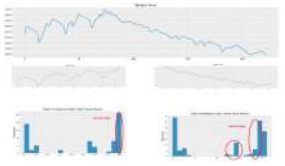


Figure 3. Smart Apiary in Poland

Conclusions

- Multi-year data collected from identical solar-powered smart hives provide a robust foundation for developing **an adaptive predictive model** of honeybee colony dynamics with **integrated anomaly detection**. This model is based on historical and **real-time** hive parameters, **solar irradiance** data, a **library of behavioral patterns**.
- The standardized and time-synchronized dataset is well-suited for ML applications, diagnostics, and early warning systems.
- Digitized, non-invasive overwintering data offer practical value for improving **overwintering practices** in traditional beekeeping.
- **GPS-tagged honey flow records** increase consumer **trust** and help **verify honey** authenticity.
- Solar irradiance data obtained from hive-mounted panels, synchronized with global datasets (e.g., NASA POWER, Copernicus), provide a novel source of information for studying bee orientation, foraging behavior, and activity under natural conditions.

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PP-204 [Beekeeping Technology and Quality]

An armed concrete langstroth hive: a prototype to popularize on bail of a patent

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In modern beekeeping, the langstroth is both the most used hive and one of the models against which many tools and technologies are designed. The objective is to use reinforced concrete instead of the board for the body of such a hive. In fact, obtaining a board only occurs after you have cut down a tree. An action which either reduces the capacity of the flora to provide bees with food and medicinal substances, destroys the key factor of the ecosystem that the trees represent or in certain particular cases causes the disappearance of valuable plant varieties.The use of concrete is therefore designed to overcome this waste. This work required an original mold of my own design, a trowel, a tray then the following materials: gravel, sand, cement, water, 6mm reinforcing iron for respective quantities of 5478136 cubic millimeter, 3652091 cubic millimeter, 4 kilograms, 2 liters, 4420 millimeters for a whole body. The iron bar is cut into rewelded pieces to form a skeleton approximately reminiscent of the arrangement of the edges of a rectangular parallelepiped measuring 505 x 415 x 210 cubic millimeter. The concrete ingredients are mixed in the tank, then sprinkled well with water to be poured into the mold after the iron skeleton has been placed there. Ten hours later, the stripped formwork reveals a rectangular parallelepiped box with a cavity of 466 x 376 x 240 cubic millimeter and a wall thickness of 22 millimeters.

This box takes ten frames with useful dimensions of 415 x 198 square millimeter and a span of 475 millimeters each. Two holes drilled in front of one of the small facades of the structure allow you to hang the pollen trap. Economically, it costs 4 euros. It weights twenty kilograms compared to seven for the wooden specimen. This model therefore combines ecology with economics and also helps to resolve other problems such as the deterioration of hive by termites, other organisms, vegetation fires and weather. For these reasons, we call for any form of partnership aimed at quickly obtaining intellectual property with a view to wide dissemination.

Keywords: Langstroth, concrete, economy, ecology,patent, dissemination

PP-205 [Beekeeping Technology and Quality]

EVALUATION OF THE EFFECT OF FRUCTOOLIGOSACCHARIDES (FOS) ON THE HONEY BEE MICROBIOTA AND MYCOBIOTA

zukán R&D&I CHAIR IN BEE NUTRITION

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Honey bees play a vital role in pollination and ecosystem health. In Spain, beekeeping supports biodiversity and the agriculture, but climate change and drought threaten natural forage availability, leading to increased use of artificial feed. Fructooligosaccharides (FOS) are prebiotic compounds derived from sucrose that enhance gut health by promoting beneficial microbes and organic acid production. This study investigates the impact of FOS supplementation on the gut microbiota and fungal communities in the Iberian honey bee *Apis mellifera iberiensis*.

Thirty *Apis mellifera iberiensis* hives were assigned to three groups:

- **Control** (standard syrup)
- **1 % FOS** supplementation
- **5 % FOS** supplementation

Colony productivity was assessed by comparing hive weights before and after treatment.

Worker honey bee DNA was extracted for metagenomic analysis to profile bacterial and fungal communities based on operational taxonomic units (OTUs).

- **Alpha diversity** metrics assessed species richness.
- **Beta diversity** (Bray-Curtis distance) evaluated shifts in microbial community structure across treatments.

- Hive weights increased significantly in the **5 % FOS** group, indicating enhanced colony productivity. However, **FOS supplementation did not significantly alter** bacterial gut populations.
- **Alpha and beta diversity** analyses showed that microbiota composition varied **naturally over time**, not due to FOS.
- **Fungal communities** (mycobiota) also showed no significant differences between control and treated groups.
- Notably, **mycobiota diversity decreased over time in FOS-treated bees**, but remained stable in control suggesting a possible long-term effect.

CONCLUSION

FOS improves hive productivity without major short-term impacts on gut microbial composition, though potential long-term effects on fungal diversity merit continued research.

PP-206 [Beekeeping Technology and Quality]

Where Do Swarms Prefer to Bivouac?

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Abstract

Swarms from the same apiary tend to bivouac on the same site, year after year. Why?

Method

Method: Survey research

Respondents: Members of 5 local beekeeping associations in the eastern US

Number of respondents: 36

Topic: Preferred bivouac site of the swarms they observe

Results

Features of Preferred Bivouac Sites

- Percentage of swarms from the same apiary bivouacking in the same site: 60%
- Average distance from the mother hive: 14 m
- Number of swarms bypassing closer potential sites: 50%
- Average height of the bivouac site: 5 m
- The predominant site is: On the branch of a tree: 86%
- Location on the branch: Near the outer edge of the tree: 71%
- Size of the branch at the bivouac site is: 2-5 cm: 53%
- Location is:
  lightly shaded: 66%
  with little wind: 51%

Discussion

Escaped swarms cause several problems:

1. Loss of desirable queen
2. Loss of honey crop
3. Injury to beekeeper
4. Irritated neighbors
5. Mite bomb

Bivouac traps may reduce escaped swarms

- Used widely in Russia
- Potential bivouac trap design
  - Attracts swarms
  - Easily placed
  - Easily retrieved

Further Research:

- Do scouts evaluate potential bvouac sites?
- How do scouts evaluate potential bivouac sites?
- How do scouts, and early arrivers, communicate the quality/desirability of potential bivouac sites?
- Evaluate potential bivouac trap designs

Testable Hypotheses

- *Distance:* Allows colony to sort itself, collect bees & queen
- *Height:* Safe, out of easy reach from ground
- *Position:* Accessible & secure; near end of a sturdy branch
- *Location:* Sheltered; little exposure to sun and wind

References

Linton, F. Bivouac Traps: Catch Swarms before They Depart. American Bee Journal, April 2025. Pages: 405-7.

Seeley, T. Bait Hives for Honey Bees. https://ecommons.cornell.edu/server/api/core/bitstreams/6a183063-f398-4552-b4dd-f14a9488faed/content

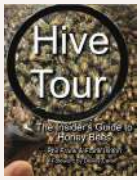
Tammy Horn Potter's Tree Branch method: https://forestry.ca.uky.edu/episode/woods-today-bees-and-swarms. The description of the tree branch bivouac trap starts 16 minutes into the video.

Russian text on Bivouac Traps (one of several): https://www.medovik.info/osnovy/roenie/ur.php From the website: "The site Medovik "Beekeeping and Bees" exists to help people who decide to study the science of beekeeping."

Note: For internet searches use the term "Russian scion" or "Привой и роевня"

Poster Design by: Grey Boyce

Read Frank's Books:



PP-207 [Beekeeping Technology and Quality]

STUDY OF GEOGRAPHICAL INDICATIONS OF ORIGIN FOR THE PRODUCTION OF HONEY FROM *Myracrodruon urundeuva*, CHACO REGION, CHUQUISAQUEÑO, BOLIVIA 2024

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INTRODUCTION

In 2021, the Bolivian state created a national program to strengthen and support beekeeping production based on climate change resilience criteria. The goal is to strengthen and consolidate the national beekeeping sector, emphasizing added value at source, diversification, and differentiation of honeys based on their geographic and botanical origin.

METHODOLOGY

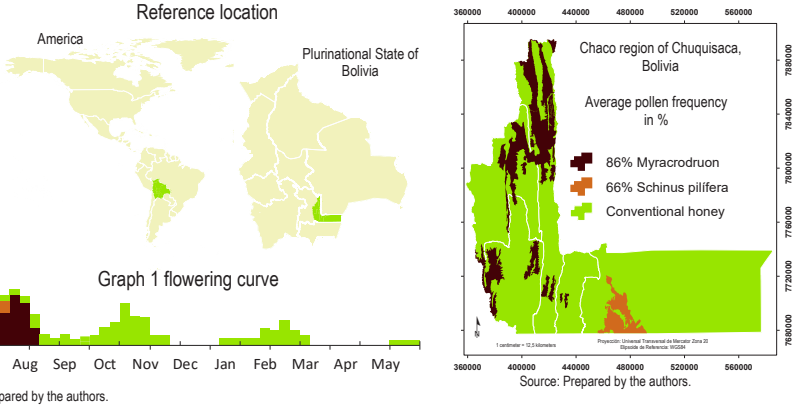
The study is based on the survey of beekeeping flora, on the spatial distribution of apiaries and its correlation with the altitudinal, bioclimatic, geomorphological and edaphic variables defined by (Navarro, G. and W. Ferreira. 2007). Throughout the territory, 28 apiaries with 340 monitoring hives were identified, with 56 permanent sampling plots PPMs, where all individuals were recorded from seedlings with (dbh<5 cm, h ≤ 1.30 m) to know the density of each species, observe the phenology and evaluate the natural regeneration per vegetation unit.

Floristic comparison for the location of sampling points within the 1 km libation area was performed by pixel-level mapping of chlorophyll content values and intervals of -1 and 1 from the NDVI=(Band5-Band4) / (Band5+Band4) analysis of the "LANDSAT_8" product SCENE_ID = LC08_L1TP_231074_20240818_20240823_02_T1. For the calculation of honey yields (kg/hive) data were collected from probability samples of hives during the season. For the estimation of pollen grain frequencies samples were sent for melissopalynological analysis according to Louveaux *et al*. (1978).

RESULTS

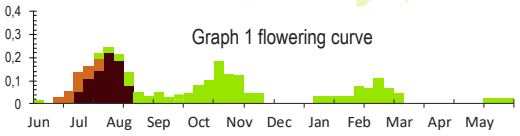
Figure 1 shows the reference geographic coverage with the highest density indices of Myracrodruon urundeuva of 80 trees/ha with an average dbh of 27.4 with 86% predominant pollen of the species, a yield of 8-16 kg of honey per hive, with an area of 2,500 km². The second vegetation unit of Schinus pilífera with an average density of 40 trees/ha with an average dbh of 32.1 and a honey yield of 9-14 kg/col with an area of 545 km².

Figure 1. Honey with geographical and botanical origin



Source: Prepared by the authors.

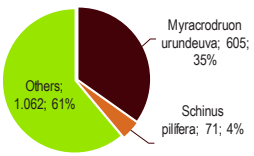
Graph 1 shows some predictive value for the timing of nectar and pollen flow of the species studied in the Chaco region.



Source: Prepared by the authors.

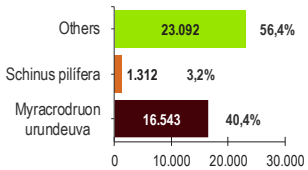
Graph 2 shows the percentage participation of producers by differentiated production zones, graph 3 describes the number of hives managed in the area and graph 4 refers to the production volume of monofloral honey from Myracrodruon urundeuva, which reaches 132 tons recorded in the season according to geographical area.

Graph 2. Number of Producers



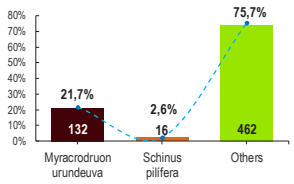
Source: Prepared by the authors.

Graph 3. Number of Beehives



Source: Prepared by the authors.

Graph 4. Differentiated honey in tons



Source: Prepared by the authors.

CONCLUSIONS

The geographic origin can be established by the presence of pollen characteristic of the recorded species, limited to the libation area for each apiary and vegetation unit. The botanical origin can be deduced from the predominant pollen frequencies, with more than 46% from one species (monofloral honey) of Myracrodruon urundeuva.

Keywords: Honey, geographical identity, botany Bolivia

Acknowledgments:

To the Bolivian Food and Derivatives Company (EBA) for allowing the development of research within the framework of the national beekeeping program, as well as the cooperation of the producers of the Regional Association of Beekeepers of the Chuquisaca Chaco (ARACH). Whatsapp +591 71163213

PP-208 [Beekeeping Technology and Quality]

APIMONDIA SCANDINAVIA 2025 23-27 SEPTEMBER
Abs Ref: 0278

CHARACTERIZATION OF COLOMBIAN PROPOLIS: FINGERPRINTING BY ELECTROSPRAY IONIZATION MASS SPECTROMETRY (ESI-MS)

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REMARKS

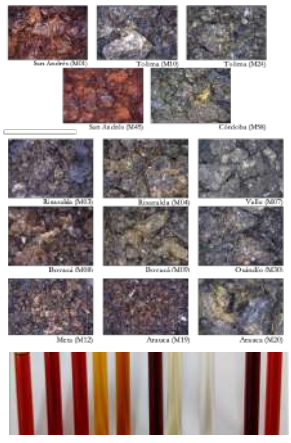
Propolis is recognized worldwide and has been registered in the Chemical Abstracts Service (CAS) 9009-62-5, as a natural product elaborated by different genera of bees, from mucilaginous exudations, gums, lipophilic materials, latex and resinous plant material, which they bring to their hives and mix with glandular secretions from the hypopharynx and wax glands.

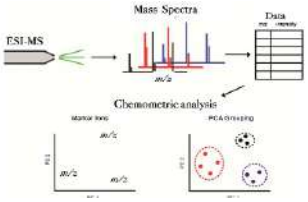
Mass spectrometry has been used in con-junction with gas chromatography (GC/MS) for many years for the analysis of the main volatile and semi-volatile components of propolis. Electrospray ionization (ESI) is a technique used in mass spectrometry to produce ions using an electrospray in which a high voltage is applied to a liquid to create an aerosol. It is especially useful in producing ions from macromolecules because it overcomes the propensity of these molecules to fragment when ionized. ESI(-)-MS fingerprinting focuses on the more polar and acidic components of the sample, which is of special importance for the study of propolis.

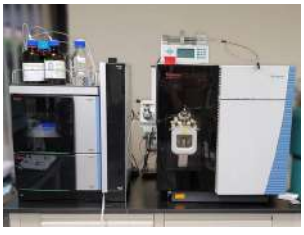
MATERIALS AND METHODS

A total of 45 Colombian bee propolis were collected from different biogeographical zones of Holdrige´s wild life: montan lower wet forest (*ml-WF*), premontanean wet forest (*pm-WF*), Tropical rainforest (*t-RF*), Very humid low montane forest (*vh-LMF*), Premontane very humid forest (*pm-VHF*), Low montane dry forest (*lm-DF*) and Tropical dry forest (*t-DF*) in Caribbean, Andean and Inter-Andean Region.

Ethanolic extract were obtained by cavitation process y mixing 5 g of raw propolis sample, with 25 mL of ethanol (96%/1 h/25ºC). The dry propolis extracts were dissolved in a solution of 70% (v/v) chromatographic grade methanol (Tedia, Fairfield, OH, USA), 30%. (v/v) deionized water and 0.1% ammonium hydroxide. The solutions of propolis were infused directly into the ESI source by means of a syringe pump (Harvard Apparatus) at a flow rate of 10 µl min^{-1}. ESI(-)-MS fingerprints were obtained on a hybrid Micromass Q-TOF mass spectrometer under the following conditions: capillary and cone voltages were set to -3000 V and -40 V, respectively, with a de-solvation temperature of 100ºC. Although fingerprints were acquired in the m/z 100 – 1000 range, no important ions were observed below m/z 0 or above m/z 700, therefore ESI(-)-MS data is shown in this range.

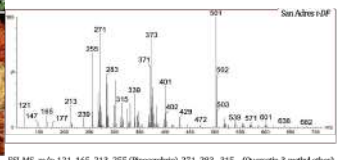




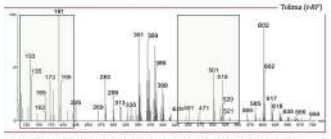


RESULTS AND DISCUSION

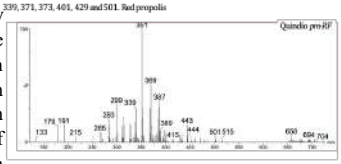
Electrospray ionization mass spectrometry (ESI-MS), in either negative or positive mode, offers significant analytical potential. Ionization is achieved by applying a high electrical charge to the sample. Phenolic compounds generally exhibit higher sensitivity and better fragmentation in the negative ion mode. Since phenolic fingerprint compounds are predominantly detected in this mode, it becomes essential to apply discrimination processes that reveal associations within Colombian propolis samples. The observed fragmentation patterns are consistent with those previously reported in the literature.



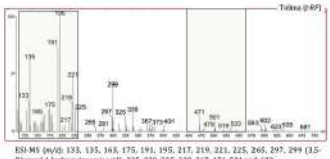
ESI-MS m/z: 121, 165, 213, 255 (Pinocembrin), 271, 283, 315 (Quercetin-3-methyl-ether), 339, 371, 373, 401, 429 and 501. Red propolis



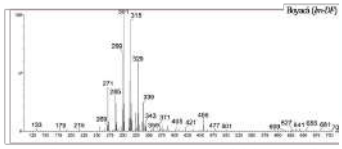
ESI-MS (m/z): 133, 135, 163, 165, 173, 191, 195, 225, 269, 283, 299, 313, 335, 351 369, 385, 399, 429, 451, 471, 501, 519, 520, 569, 585, 602, 617, and 635



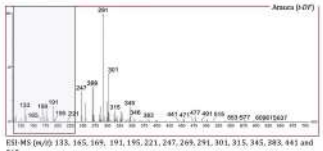
ESI-MS (m/z): 133, 179, 191, 215, 265, 283, 299 (3,5-Diprenyl-4-hydroxycinnamic acid), 339, 351, 369, 387, 443, 515, 658, 694 and 704. Yellow propolis



ESI-MS (m/z): 133, 135, 163, 175, 191, 195, 217, 219, 221, 225, 265, 297, 299 (3,5-Diprenyl-4-hydroxycinnamic acid), 325, 339, 525, 339, 367, 471, 581 and 602.

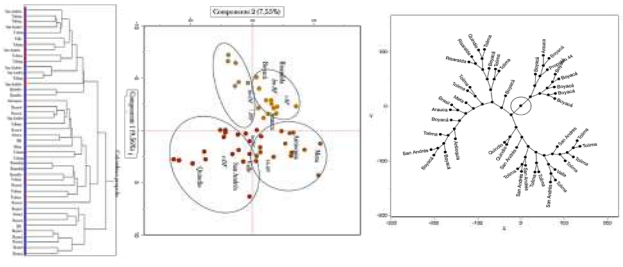


ESI-MS (m/z): 133, 179, 215, 269, 271, 285, 299 (3,5-Diprenyl-4-hydroxycinnamic acid), 301 (Quercetin), 315, 329, 339, 343, 371, 405, 455, and 627.



ESI-MS (m/z): 133, 165, 169, 191, 195, 221, 247, 269, 291, 301, 315, 345, 383, 445 and 515.

Phenolic acids	m/z ESI (-)	Flavonols	m/z ESI (-)
Chlorogenic acid	353	Quercetin	301
Caffeic acid	179	Quercetin-3-methyl-ether	315
Dicaffeoylquinic acid	515	Kaempferol	285
Ellagic acid	301	Isorhamnetin	315
p-Coumaric acid	163	Kaempferol-methyl-ether	299
Ferulic acid	193	Kaempferol-methoxy-methyl-et	329
Isoferulic acid	193	Pinobanksin-5-methyl-ether-3-O-pentanoate	289
Tricaffeoylquinic acid	677	Pinobanksin-7-methyl-ether-5-O-phydroxyphenylpropionate	292
Benzoic acid	121	Quercetin-dimethyl-ether	329
3,4-Dimethyl-caffeic acid	207	Quercetin-tetramethyl-ether	359
Ellagic acid	301	Galangin-5-methyl-ether	283
Cinnamic acid	147	Rhamnetin	315
Cinnamylideneacetic acid	173	Quercetin-dimethyl-ether	329
3-prenyl-p-coumaric acid	232	Galangin	269
Caffeic acid isopenyl ester	247	Kaempferide	299
Caffeic acid benzyl ester	269	Flavonol glycosides	m/z ESI (-)
Caffeic acid phenylethyl ester	283	Quercetin-3-O-rutinoside	609
p-Coumaric acid isopenyl ester	231	Quercetin-3-O-glucuronide	477
p-Coumaric acid benzyl ester	253	Quercetin-3-O-glucoside	463
Caffeic acid cinnamyl ester	295	Kaempferol-3-O-rutinoside	593
p-Coumaric acid cinnamyl ester	279	Isorhamnetin-3-O-rutinoside	623
Artepillin C	299	Isorhamnetin-O-pentoside	447
3-Prenyl-4-(2-methylpropionyl-oxy)-cinnamic acid	315	Quercetin-3-O-rhamnoside	447
3-Prenyl-4-(dihydrocinnamoyloxy)-cinnamic acid	363	Isorhamnetin-O-glucuronide	491
Methoxi cinnamic acid cinnamyl ester	293	Kaempferol-methyl-ether-O-glucoside	461
p-Coumaric acid-4-hydroxyphenylethyl ester dimer	565	Isorhamnetin-O-acetylrutinoside	665
Di-hidroflavonols	m/z ESI (-)	Rhamnetin-O-glucuronide	491
Pinobanksin-5-methyl-ether	285	Quercetin-dimethyl-ether-O-rutinoside	637
Pinobanksin-5-methyl-ether-3-O-acetate	327	Quercetin-dimethyl-ether-O-glucuronide	505
Pinobanksin	271	Kaempferol-O-p-coumaroylrhamnoside	577
Pinobanksin-5,7-dimethyl-ether	299	Pinobanksin-3-O-acetate-5-O-phydroxyphenylpropionate	292
Pinobanksin-3-O-acetate	292	Pinobanksin-5-methyl-ether-3-O-pentanoate	289
Flavanones	m/z ESI (-)	Pinobanksin-7-methyl-ether-5-O-phydroxyphenylpropionate	292
Pinocembrin-5-methyl-ether	269	Flavonas	m/z ESI (-)
Pinocembrin	255	Luteolin	285
3-Hydroxy-5-methoxyflavanone	289	Apigenin	269
		Luteolin-5-methyl-ether	299
Polyisoprenylated benzophenones	m/z ESI (-)	Chrysin	313
Nemorosone	501	Acacetin	331



PP-209 [Beekeeping Technology and Quality]

Abs Ref: 0279

A CHEMOMETRIC APPROACH: CHARACTERIZATION AND CLASSIFICATION OF COLOMBIAN PROPOLIS BASED ON INFRARED SPECTROSCOPY

Anderson Guarnizo Franco, Julian Eduardo Lozano Ipus, Mónica Patricia Osorio Tangarife, Guillermo Salamanca-Grosso, Universidad del Tolima, 730006299, Ibagué, Tolima, Colombia. Grupo de Investigaciones Mellitopalinológicas y Propiedades Fisicoquímicas de alimentos. E-mail: gsalaman@ut.edu.co

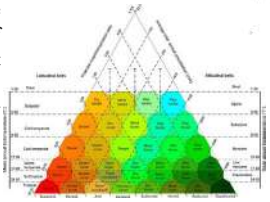
REMARKS

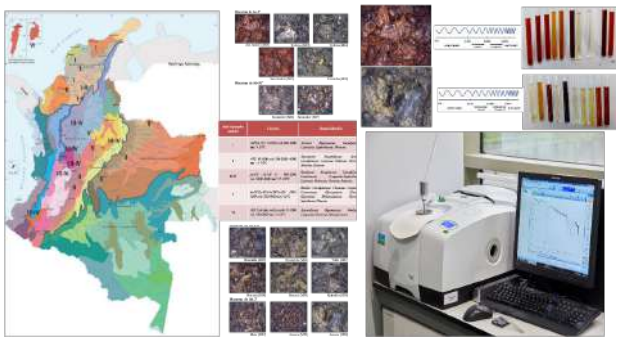
Propolis is a complex material of resinous consistency produced by bees which has a highly variable physical appearance, color, and consistency, depending on many factors such as geographic origin, types of vegetable sources, time of collection, and season of the year. Bees use propolis to seal openings in the hive to avoid the entrance of intruders, to maintain a constant inner temperature, to contribute to the attainment of an internal aseptic environment, and overall to protect the hive from widespread bacterial infection. Chemical composition is extremely complex and variable, showing the presence of beeswax, resin, essential oils, and pollen. Its composition is highly variable because of the richness and versatility of tropical flora. Therapeutical properties of propolis are well known, with antimicrobial, anti-inflammatory, anti- oxidative and cytotoxic qualities.

IR spectroscopy provides a global chemical "fingerprint" that captures information about all major classes of compounds. Also allows the study of the variability in the chemical composition, making it essential to use rapid, non-destructive, and reproducible techniques for its characterization. This approach provides molecular fingerprints that reveal the presence of functional groups associated with bioactive compounds, supporting authentication, quality control, and the correlation of chemical profiles with biological activities. The aim of this study is to apply FT-IR spectroscopy for the characterization of Colombian propolis through its ethanolic extracts, considering their relevance in tincture preparation.

MATERIALS AND METHODS

A total of 45 Colombian bee propolis were collected from different biogeographical zones of Holdrige´s wild life: montan lower wet forest (*ml- WF*), premontanean wet forest (*pm-WF*), Tropical rainforest (*t-RF*), Very humid low montane forest (*vh-LMF*), Premontane very humid forest (*pm- VHF*), Low montane dry forest (*lm-DF*) and Tropical dry forest (*t-DF*) in Caribbean, Andean and Inter-Andean Region.



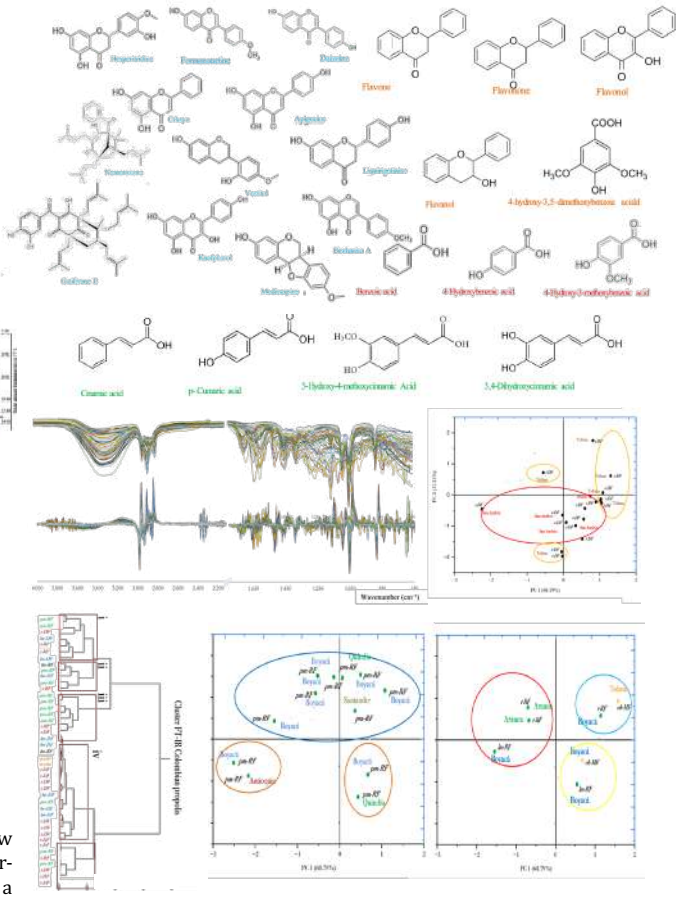


Ethanolic extract were obtained by cavitation process y mixing 5 g of raw propolis sample, with 25 mL of ethanol (96%/1 h/25ºC). Fourier-transform infrared spectroscopy (FTIR) analyses were performed by using a Perkin Elmer Spectrum One spectrometer (Perkin Elmer, USA), in range from 4000 to 650 cm^{-1}/ resolution of 4 cm^{-1} In each spectrum, 16 scans were co-added. The data were analyzed by FT-IR Spectrum software (Perkin Elmer). Once the spectra were registred, baseline correction treatment was applied to minimize the difference between the spectra during the baseline change, smoothed and normalized to reduce noise in spectral data and regularization. Chemometric evaluations were performed using OriginPro 2024™ and JMP Pro17 software

RESULTS AND DISCUSION

The FT-IR spectra of the ethanolic propolis extracts showed characteristic bands associated with major secondary metabolites, mainly phenols and polyphenols. The main signals included aliphatic –CH_2 and –HCH_2 vibrations (2930, 2876 cm^{-1}), carbonyl C=O (1660–1720 cm^{-1}), hydroxyl –OH (3200–3650 cm^{-1}), and substituted aromatic rings (1500–1600 cm^{-1}). Additional bands were observed at 3300–3600 cm^{-1} (–OH groups of flavones and isoflavonoids), 1215 cm^{-1} (C–O ester stretching), 1440–1231 cm^{-1} (C=C–H aromatic vibrations), and 758 cm^{-1} (CH_2 stretching of aliphatic chains).

Band flavanones	cm^{-1}	Banda flavonols	cm^{-1}	Bands flavanols	cm^{-1}
ν(C-H)	3287-3060	ν(C-H)	3090-3070	ν(C-H)	3135-2910 cm^{-1}
ν(C=O)	1670-1625	ν(C=O) de anillo B	1702-1654	ν(AR-C=O)	1670-1625 cm^{-1}
ν(C=C)	1620-1560	ν(C=C) de anillo	1616-1611	ν(C=C) de anillo B	1620-1560 cm^{-1}
ν(C=C)	1510-1480	δ(C–H) + ν(C=C) de anillo B	1520-1516	ν(C=C) de anillo A	1530-1510 cm^{-1}
				δ(HCC) de anillo C	
ν(C=C) + ν(C=O)		ν(C=C)	1362-1354	δ(HCC) de anillo C	
				ν(C=C) de anillo A y B	1300-1235 cm^{-1}
ν(C=C) + ν(C=O)	1380-1350	ν(C=O) + ν(C=C)	1260-1252	τ(HCCC) de anillo C	
				τ(HCCC) de anillo C	975-960 cm^{-1}
ν(C=C)	1250-1200	ν(C=C)	1184-1180	τ(HCCC) de anillo B	880-845 cm^{-1}
ν(C=C)	740-700	ν(C=O) + ν(C=C)	1046-1043	τ(HCCC) de anillo A	780-770 cm^{-1}
δ(CCC) de anillo	635-610	ν(C=C)		δ(CCC) de anillo A	545-515 cm^{-1}



Chemometric analysis using PCA and HCA successfully discriminated Colombian propolis ethanolic extracts. PCA showed that the main variance was explained by wavenumbers related to phenolic and flavonoid vibrations, while HCA grouped the samples into five consistent clusters. These results confirm that FT-IR spectroscopy, combined with multivariate tools, provides reliable spectral fingerprints for differentiating propolis according to biogeographical origin.

Abs Ref: 0280

PROFILE OF PHYSICOCHEMICAL PARAMETERS IN THE DETERMINATION OF AUTHENTICITY AND DIAGNOSIS OF COLOMBIAN HONEYS: DSC AS A COMPLEMENTARY DIGNOSTIC TOOL

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REMARKS

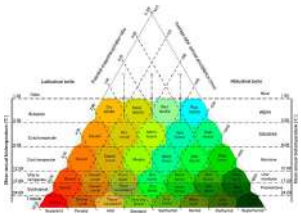
Honey is a complex biological product, its composition is a function of botanical origin. The glucose, fructose and sucrose fractions account for 90% of the total solids. The product can be marketed as a viscous liquid, in combs, or in crystallized form, depending on the nature and type of honey.

Fraud in commercial honeys is a criminal and intentional act committed to obtain unfair economic benefit and there are different types of honey adulteration. The quality criteria of honeys in general, have to be evaluated according to national or international legislation, to verify three concepts: 1. Authenticity, 2. Freshness and 3. Safety.

METHODS

Differential scanning calorimetry (DSC) techniques are establishing themselves as a rapid and simple diagnostic tool that does not require complex sample preparation operations for diagnosis. For this reason, their use has been evaluated in the characterization of Colombian honeys.

A total of 33 Colombian honeys were collected from different biogeographical zones of Holdrige´s wild life: (*ml-WF*), (*pm-WF*), (*t-RF*), (vh-LMF), (*pm-VHF*), (*lm-DF*) and (*t-DF*) in Caribbean, Andean and Inter-Andean Region.


Holdridge´s life zones system

Colombia life zones system

The phase transition properties of the honeys were studied using a differential scanning calorimeter (DSC, TA Instruments, USA, model TA 2010, with controlling module Thermal Advantage Version 1.1A) and cooling accessory, all samples were weighed (~ 10mg) in analytical scale (± 0.01mg) inside hermetically sealed aluminum pans. Then were heated from -100 to 100ºC, at 10/ºC.min. An empty aluminum pan was used as reference. The results were analyzed using the Universal Analysis 2000 software version 4.2E (TA Instruments). Reported data are the average of tripicate determination. Samples were analyzed for color (Pfund scale), water activity and sugar composition (fructose-to-glucose ratio by HPLC).

For HPLC analysis, 5 g of honey were dissolved in water, diluted to 100 mL with methanol and water, and filtered through a 0.45 µm PTFE membrane. Samples were analyzed using a Shimadzu system with a RID-10A refractive index detector and a Phenomenex Luna® Omega 3 µm Sugar 100 Å LC column (150 × 4.6 mm) at 30 °C. Isocratic elution (acetonitrile:water, 80:20) was performed at 1.3 mL/min, and sugars were quantified using calibration curves with standard solutions. The glass transition (Tg) and weak endothermic phenomenon (WEP) of Colombian honeys were compared with those of agave, maple, and invert sugar syrups. Specific rotation was also measured after dissolution and clarification using a ZUZI™ polarimeter (data not shown).

RESULTS

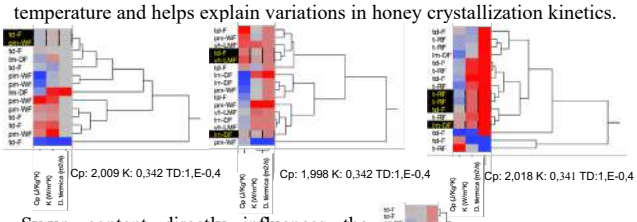
According to their physicochemical properties, honey can be considered as a complex high concentrated sugar solution. The significant effects of water on the physical state of sugars can be explained by state diagrams that relate the phase and state transition temperatures to water content. Water-sensitive amorphous systems may exhibit several changes in their physicochemical properties.

Color	WLZ	a_w	F	G	F/G	TI	TII
A	*lm-DF*	0,604	37,2	25,8	1,44	-45,6	45,8
	pm-WF	0,606	42,7	27,9	1,53	-45,8	48,4
	t-RF	-	-	-	-	-	-
	ml-F	0,602	41,8	27,9	1,50	-45,5	45,6
	vh-LMF	-					
	WLZ	a_w	F	G	F/G	TI	TII
DA	*lm-DF*	0,581	35,5	28,1	1,27	-40,9	49,6
	pm-WF	0,599	37,1	26,7	1,39	-45,3	47,1
	t-RF	-	-	-	-	-	-
	ml-F	0,615	37,0	29,6	1,25	-48,1	52,5
	vh-LMF	0,645	32,5	28,4	1,15	-46,1	44,9
	WLZ	a_w	F	G	F/G	TI	TII
ELA	*lm-DF*	0,563	40,1	29,0	1,38	-41,5	42,7
	pm-WF	-	-	-	-	-	-
	t-RF	0,594	45,5	25,2	1,82	-44,1	53,7
	ml-F	0,615	38,2	30,2	1,27	-46,3	50,0
	vh-LMF	-	-	-	-	-	-
	WLZ	a_w	F	G	F/G	TI	TII
	lm-DF	0,608	35,4	35,3	1,00	-48,0	48,2
	pm-WF	0,582	41,2	28,5	1,45	-43,3	49,9
	t-RF	-	-	-	-	-	-
	ml-F	0,588	42,1	27,5	1,54	-45,3	50,8
	vh-LMF	0,563	41,3	31,4	1,32	-41,3	55,6

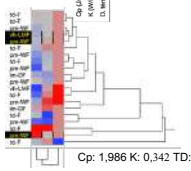
The use of DSC techniques in the detection of honeys adulterated with various types of syrups and hydrolysates in different percentages is well known. The determination of parameters such as pH, electrical conductivity, water and ash in the characterization of honey takes a back seat when thermal analysis is used as a quality criterion.

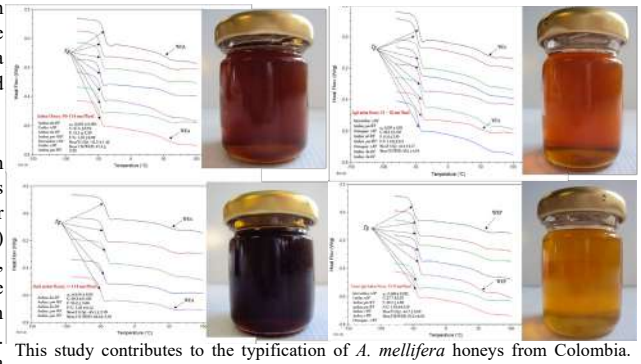
Adulterant potential	TI (Tg)	TII (WEP)
Agave syrup	-33,4 ± 0,90	45,1 ± 1,28
Maple syrup	-42,7 ± 1,27	50,3 ± 1,30
Inverted sugar syrup	-24,3 ± 0,70	57,5 ± 1,60

The heat flow curves obtained by DSC showed typical honey behavior with two main thermal events. First, a glass transition (-45 to -39°C) associated with a relaxation effect, the amplitude of which depends on the sample's thermal history. This transition reflects the amorphous nature of honey, as materials lacking sufficient order to crystallize generally exhibit Tg at low temperatures. Second, a weak endothermic phenomenon (WEP) between 40.6 and 59.0°C was observed, likely related to melting of water-sugar complexes or polymorphic sugar forms. This transition is reproducible within a narrow temperature range but disappears after a heating/cooling/heating cycle. The WEP region is strongly influenced by temperature and helps explain variations in honey crystallization kinetics.



Syrup content directly influences the observed values of Tg and WEP, showing a linear relationship: higher syrup levels result in higher values (data not shown). Thermophysical properties therefore provide a useful classification method.





This study contributes to the typification of *A. mellifera* honeys from Colombia. Variations in DSC thermal properties, optical rotation, and reducing sugars proved to be effective markers for honey characterization, while thermal parameters enabled the classification of honey groups. Moreover, principal component analysis (PCA) of DSC data demonstrated strong potential for detecting fraudulent honeys.

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PP-211 [Beekeeping Technology and Quality]

Environment, Social and Governance(ESG) realization considering safe bee venom production and animal welfare through a Korean bee venom collector.

B02

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ABSTRACT

The bee venom extraction process is directly related to the welfare of bees, and by using the Korean bee venom extractor you can safely obtain bee venom while minimizing stress and risks to bees. The Korean bee venom extractor is an innovative technology that simultaneously considers the welfare of bees and safe bee venom production with the following advantages: It consistently extracts high quality bee venom without killing bees (bee safety). Also it does not significantly affect the physiological ecology of bees (improved animal welfare). High-quality bee venom is produced through high-quality bee venom extraction and purification technology (high-quality bee venom production). This animal-friendly bee venom production environment contributes to the future-oriented development direction and realization that is in line with global ESG (Environment, Social and Governance) management.

INTRODUCTION

Chungjin Biotech Co. Ltd. is a comprehensive Korean and worldwide renown bee venom research company capable of bee venom collection, bee venom raw material production and product development.
There has been a worldwide trend regarding bee venom research and bee venom therapy. Korea has been actively involved in bee venom research and has published the most bee venom-related papers over the past 20 years.(*A Bibliometric Analysis of Bee Venom Research over the Past 20 Years, Korean journal of Acupuncture, 2020)

Table 1. Top 25 countries publishing the highest number of articles about bee venom

Countries/Regions	Records (n)	% (of 1,547)
SOUTH KOREA	340	22.50
USA	271	17.52
PEOPLES R. CHINA	184	11.89
GERMANY	104	6.72
SWITZERLAND	100	6.46
ENGLAND	72	4.65
BRAZIL	62	4.01
AUSTRALIA	61	3.94
FRANCE	58	3.75
ITALY	58	3.75
JAPAN	49	3.17
DENMARK	41	2.65
POLAND	40	2.59
AUSTRIA	39	2.52
IRAN	38	2.46
TURKEY	38	2.46
EGYPT	35	2.26
INDIA	35	2.26
NETHERLANDS	31	2.00
SPAIN	31	2.00
BELGIUM	20	1.29
CANADA	19	1.23
CROATIA	16	1.03
CZECH REPUBLIC	18	1.16
ISRAEL	17	1.10

MATERIALS AND METHODS

Proposing measures for realizing ESG

(Environmental)

To ensure a sustainable beekeeping industry, we harvest bee venom in a way that protects the ecosystem and maintains the health of bees.

(Social)

We respect animal rights by improving the welfare of bees and secure consumer trust through safe and ethical bee venom production.

(Governance)

Chung Jin bee venom production and quality control processes are transparent and fully traceable.

Animal Welfare Livestock Farm Certification System

Our bee venom collection system follows the Korean "Animal Welfare Livestock Farm Certification System" in principle. This system certifies cattle, pig, chicken, and duck farms that raise animals humanely maintaining their natural way of living according to high standards of animal welfare. Although honeybee beekeeping farms are not currently included in the certification target, the basic principles of this system can be applied to our bee venom production.

[Other methods of bee venom production] 1.Chemical stimulation by administering alcohol : There is a chemical stimulation method that administers alcohol to live bees. This method has been shown to cause excessive stress to the bees and a reduction of secretion efficiency. 2.Bee venom collection by artificially pressing the chest and abdomen of a bee to secrete bee venom. This method is very slow labor intensive and inefficient and sacrifices the bee. 3. Electric/Mechanical bee venom collection.

The bee venom collection plate is located under the electric stimulating device, so only the liquid bee venom remains and dries, the unrefined bee venom powder is collected by scraping. It is the most effective method of extracting bee venom by performing electric stimulation using a bee venom collection device. it is a method widely used in countries with advanced beekeeping technology because it protects bees and allows economical bee venom extraction.
Honeybees have the characteristic that when one worker bee secretes venom, the other worker bees also secrete venom. Bee venom extraction using the electric stimulation method can obtain bee venom without sacrificing bees,

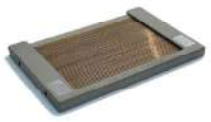
RESULTS

Unethical bee venom collection methods and their problems

-Direct bee killing: It is extremely unethical to kill bees and extract venom from their venom sacs.
- Excessive electric stimulation: Using too strong an electric stimulation can cause serious stress and harm to bees.
- Frequent collection: Collecting venom too frequently can harm the health of bees and colonies.
Problems
- Decrease in bee population: Unethical methods can drastically reduce bee populations.
- Ecosystem imbalance: Bees are important pollinators, and their decline affects the entire ecosystem.
- Decrease in bee venom quality: Bee venom collected from stressed bees may be of poor quality.
- Unsustainability: These methods can threaten the bee venom industry itself in the long term.

Advantages of Chungjin Biotech's bee venom extractor

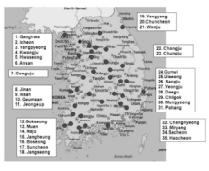
1. Effectively produces bee venom while protecting the lives and health of bees
2. Ethically extracting bee venom without killing bees, and it ensures the sustainability of the bee venom in dustry in the long term



This world class technology extracts bee venom by giving electric stimulation to live bees. It has patents, utility models, and new technology certifications (NEP-2005-069), and guarantees world-class quality.

1. Safety: Prevents injury to workers that occur during the bee venom extraction process.
2. Compatibility & Animal Welfare: Animal welfare is realized because bee venom is extracted while giving minimal stress to bees and considering their physiology and ecology. Therefore, high-purity bee venom can be obtained.
3. Efficiency: Increases productivity by extracting bee venom faster and more efficiently than conventional methods. Controls the extraction frequency and amount to prevent excessive stress on bees.
4. Quality: High-quality bee venom is produced because the purification process is performed using only pure water and fermented alcohol to improve the quality of the collected bee venom.
5. Sustainability: Bee venom is collected while maintaining the health of the bee colony. Controls the extraction frequency and amount to prevent excessive stress on bees. Bee venom can be produced in a sustainable way without harming the environment.

Excellence of Chungjin Biotech



Production history system

"BEE VENOM" dosage and injection method

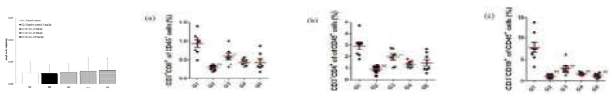
-The outstanding effects of bee venom therapy on breeding pigs
-The remarkable effects of bee venom therapy in piglets/growing pigs

Existing bee venom collection methods either stimulate bees to kill each other or kill the bees during the collection process. This can cause injury to the workers and cause stress to the bees.

Granules of bee venom and lactose mixture, coated prototype (BVLS) - enteric bee venom complex Optimized weight ratio of bee venom and excipient lactose with various concentration combinations.

Patent : Enteric-coated granular composition comprising ingredients derived from bee venom and lactic acid bacteria, 10-2413030, KR

The immune-enhancing effect of bee venom was evaluated and confirmed by orally administering enteric granules (BVLS) containing bee venom-derived components and lactose to male immunosuppressed mic.



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Sang Mi Han, HyungJoo Yoon and HaJu Baek (2012) Components According to Different Collecting Time and Location in Bee Venom. The Korean Society of Applied Entomology 51(3): 299~303

PP-212 [Beekeeping Technology and Quality]

BEE-GUARDS
for resilient beekeeping

Comparing colony performance under standard and innovative Varroa management in a European experiment

Marina Meixner & Marin Kovačić, Sergio Albertazzi, Athanasios Antonopoulos, Małgorzata Bieńkowska, Maria Bouga, Robert Brodschneider, Matias Casalongue, Leonidas Charistos, Raffaele Dall'Olio, Gennaro Di Prisco, Dylan Elen, Martin Gabel, Egoitz Galartza, Dariusz Geruła, Fani Hatjina, Magdalena Jovanovska, Ioannis Manthos, Angelina Fathia Osabutey, Melanie Parejo, Janez Prešern, Zlatko Puškadija, Konstantinos Rekkas, Pilar Santolaria, Georg Schaunitzer, Victoria Soroker, Josipa Stavalj, Antonios Tsagkarakis, Aleksandar Uzunov, Viviana Valenzano, Jerzy Wilde, Jesús Yániz & Cecilia Costa
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Investigating Resilience in European Beekeeping

The BEE-GUARDS project compares an innovative Varroa management concept to commonly used conventional treatment standards (overview on the right). This concept aims for increased honey bee health, reduced need for synthetic acaricide application and an overall improvement of natural selection mechanisms. Performance and resilience of colonies is measured using a standardized field protocol and digital monitoring tools. 17 partners across 12 countries are conducting a large-scale field experiment involving nearly 500 colonies to assess this approach.

BEE-GUARDS Workpackage 1
21 apiaries
(15- 35 colonies each)
with innovative/conventional groups respectively

Innovative	Conventional
Summer treatment: brood interruption by queen caging + oxalic acid trickling	**Summer treatment:** Locally used treatment standard (e.g., formic acid or amitraz).
Winter treatment: Only if infestation thresholds are reached (e.g. oxalic acid). Preferrably no chemical treatment.	**Winter treatment:** Default treatment (irrespective of the infestation level) according to local standards.

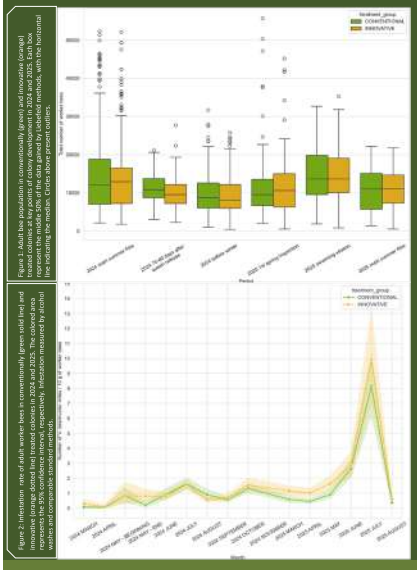

Figure 1: Adult bee population in conventionally (green) and innovative (orange) treated colonies at key points of colony development in 2024 and 2025. Each box represents the middle 50% of the data gained by (identified methods, with the horizontal line indicating the median. Circles display outliers.

Figure 2: Infestation rate of adult worker bees in conventionally (green) and innovative (orange) treated colonies in 2024 and 2025. The colored area represents the 95% confidence interval, respectively. Infestation measured by alcohol washes and comparable sample intervals.

Fostering natural selection

The innovative management approach aims to foster natural selection and to reduce acaricide treatment whenever possible. Therefore, chemical winter treatments are omitted whenever possible to ensure a higher Varroa load in the following drone rearing season (selective pressure) and brood interruptions with oxalic acid application are used as a highly efficient summer treatment. Thereby we are testing the hypothesis that this well-timed treatment will ensure healthy winter bees and an accordingly good wintering of the colony.

Initial Results

- Despite lower varroacide application in the innovative group, data from the first study season indicate no meaningful differences between both groups in terms of colony strength (Fig. 1), brood production, pollen stores, and varroa infestation (Fig. 2).
- Notably, no negative effects of brood interruption in summer (innovative management) on colony strength were observed.
- Varroa infestation followed an expected seasonal pattern with slightly higher infestation during drone production in the innovative group (Fig. 2).

Internet of Apiaries

A digital pan-European apiary network was created by equipping approximately half of the colonies with digital monitoring devices (e.g., for temperature, flight activity & weight, Fig. 3). This allows continuous monitoring and additional in-depth analyses of colony development.

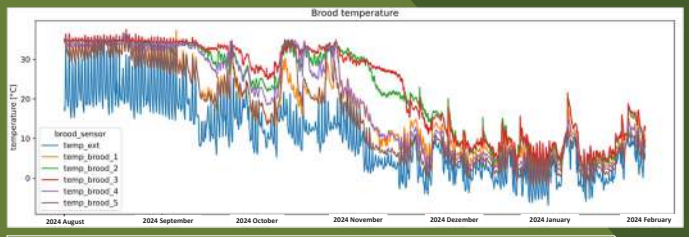

Figure 3: Average temperature measured by 5 in-hive temperature sensors in a colony in an apiary in Slovenia (Partner KIS, orange, green, red, purple and brown line) and external temperature of the apiary (blue line). Between November and December 2024, a gradually temperature drop (from 35 °C to 15 °C) in the hive is visible, indicating a stop of brood rearing.

Conclusion & Outlook

- The innovative management approach seems to meet the expectations of reduced varroacide demand and increased Varroa pressure on drones despite proper colony development. This is closely connected to BEE-GUARDS Workpackage 2 (oral presentation; Abstract 0788) focusing on sustainable breeding strategies.
- It thus seems to suit the aim of resilient beekeeping under various climatic conditions.
- The remaining field data collection for 2025 is still ongoing and will be evaluated and presented in the future.

Funded by the European Union

Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or European Commission. Neither the European Union nor the granting authority can be held responsible for them

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PP-213 [Beekeeping Technology and Quality]

Apisense

AGH

UNIWERSYTET PRZYRODNICZY w Lublinie

APISENSE: AI-ENHANCED SENSORS FOR DETECTING BEE PHEROMONES AND VOCS TO MONITOR COLONY HEALTH AND PREDICT VARROA, NOSEMA, AND FOULBROOD INFESTATIONS

Michał Lupa[1,2*] Dagmara Stasiowska[1,2] Aneta Strachecka[3] Michał Wierzbiński[2] Krzysztof Olszewski[3] Bartosz Kądziołka[2] Sebastian Cibor[2]

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BACKGROUND

Bee Disease Detection Methods

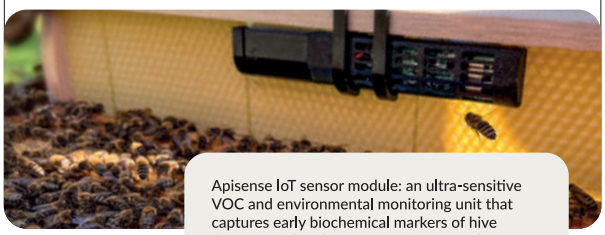
Early detection of diseases is crucial for protecting bee colonies, yet current methods in most cases enable to identify the disease once it is advanced.

Method	Scalability	Accuracy	Non-invasive	Status
Visual inspection	x	x	x	Widely used
In-vitro test	x	√	x	Commercial
Scent-detecting dogs	x	√	√	Limited use
Vaccine	√	x	√	Emerging
Bacteriphagae therapy	?	?	√	Experimental

APISENSE SOLUTION

In-hive Sensor

Apisense delivers the first AI-powered, non-invasive bee disease prediction system, combining ultra-sensitive IoT sensors with satellite data to enable early identification of AFB, EFB, Varroa, and Nosema



Apisense IoT sensor module: an ultra-sensitive VOC and environmental monitoring unit that captures early biochemical markers of hive diseases with ppb-level precision — enabling non-invasive, real-time diagnostics.

EFFICIENCY

Disease detection

Current system's efficiency for various bee disease detection:

- American Foulbrood: 97%
- Nosemosis: 87%
- Varrosis: 84%

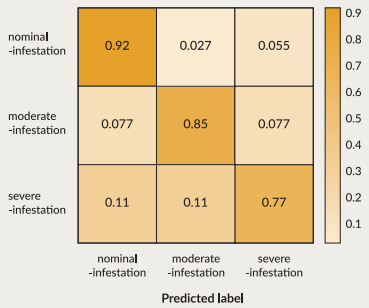
The system maintains high accuracy with low error probability.

Early Identification Accuracy

>90%

Powered ba AI anomaly detection on multimodal time-series data

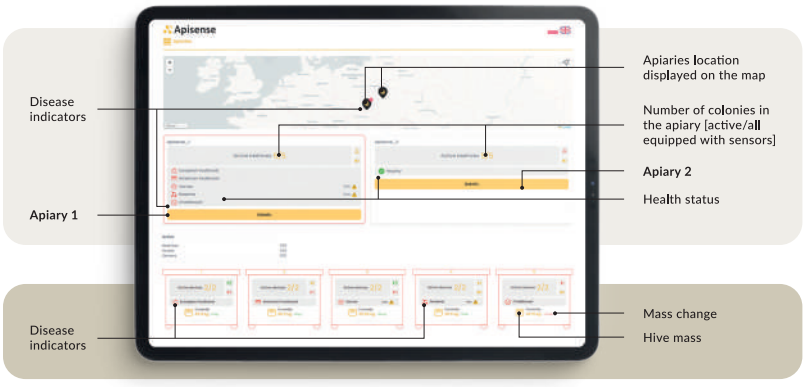
Varossis Normalized Confusion Matrix



Disease spreading prediction

Sufficient sensor coverage allows the system to integrate on-site measurements with satellite data to predict disease spread direction.
Want to learn more? See our talk on Saturday, 27th Sept, at 9:45 in HALL A2.

APISENSE MOBILE APP



METHODOLOGY

Academic trial experiments: 2024

Preliminary validation of sensor and AI model for bee disease detection
Number of tested colonies: 70

European validation studies: 2025

Cross-European validation under different beekeeping conditions.
Number of tested colonies >200

Global validation studies: 2026 (planned)

Efficiency validation across various climate conditions worldwide
Aimed number of tested colonies: 2000

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PP-214 [Beekeeping Technology and Quality]

EFFICIENCY IMPROVEMENTS IN HONEY EXTRACTION ROOMS: SHIFT MANAGEMENT AUTOMATED THROUGH GENETIC ALGORITHMS

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d. Comisión de Investigaciones Científicas (CIC), Buenos Aires, Argentina

ABSTRACT

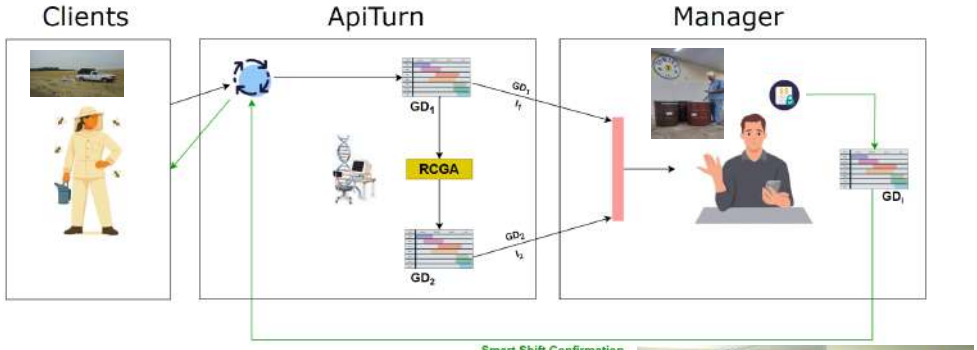
ApiTurn: A general shift management system is presented.

- **ApiTurn** is an accessible online planning tool
- It aims at maximizing productivity.
- It is an **INTELLIGENT DECISION-SUPPORT SYSTEM**: The manager can always make the final scheduling decisions.
- It supports the decisions that concern creating and managing shifts:
  - Minimization of the amount of equipment washings
  - Optimization of the use of the extraction room in a working week.
- It was implemented for mobile phones.
- Flexible, user-friendly application both for clients and managers of honey extraction rooms
- **ARTIFICIAL INTELLIGENCE (AI) APPROACH**: Ad hoc design of a specialized Genetic Algorithm (GA)
- **RETUNING OF GANNT's DIAGRAM**: More profitable scheduling is proposed thanks to RCGA

OPTIMIZATION METHODOLOGY

- The optimizer **RCGA** is methodologically inspired from population genetics.
- Every possible solution is represented by a "digital individual".
- After the generation of an initial set of feasible solutions, individuals are randomly recombined or mutated.
- The resulting individuals undergo a process of natural selection, which favors the survival of the fittest (the best solutions).
- The evaluation is done by a fitness value, which scores some characterizing aspects, thus yielding the scheduling benefits.
- The model was built by addressing the hierarchical structuring of the requests:
  - It allows an easy effective identification of a client´s relevance through a file that helps to prioritize urgencies and key clients.

SHIFT MANAGEMENT SYSTEM



GD_1 = Gantt's diagram in order of request
GD_2 = proposed Gantt's diagram
I_i = fitness (GD_i): income

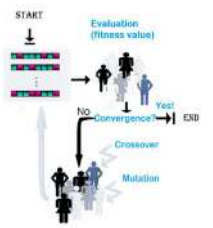
CLIENT CLASSIFICATION FOR THE OPTIMIZER

APP IMPACT METRICS

IMPACT METRIC	UNIT OF MEASUREMENT	VALUES IN TRADITIONAL PRACTICE *Without ApiTurn*	IDEAL VALUES *When supported by ApiTurn*
Efficiency in production	$\frac{\text{Real production}}{\text{Standard production}} \times 100\ \%$	72	100
Quantity of extracted honey	kg/day	5400	7500
Overturns	Weekly frequency	3	0
Idle time	Hours/week	4	1
Extraction room utilization rate	$\frac{\text{Available hours} - \text{idle times}}{\text{Available hours}} \times 100\ \%$	84	100

IMPACT METRIC	UNIT OF MEASUREMENT	VALUES IN TRADITIONAL PRACTICE *Without ApiTurn*	IDEAL VALUES *When supported by ApiTurn*
Product quality *Contamination of the color by mixing different honeys must be avoided*	Tonality (% change)	20	0
Distractions of the manager by paying attention to customers who request turns. *This causes a costly interruption of his activity in the production system.*	Number of interruptions/ week	25	5

RCGA: REAL-CODED GENETIC ALGORITHM



CONCLUSIONS

- **ApiTurn** strategy is innovative as a modelling/ diagnostic tool .
- **ApiTurn** supports beekeeping decisions on changing problems that are not easily diagnosed in advance.
- An adequate ad-hoc implementation of this approach may enrich the shift platforms of any honey-extraction room.

FUTURE WORK

- **ApiTurn**'s modules can straightforwardly be adapted to local issues, thus contemplating significant cost savings in shift management.
- Further testing is vital to complete thoroughly the computational design.
  - General verification should be conducted to check whether this approach is always both rigorous, efficient and effective.
  - **REALISTIC TESTING**: to be conducted during next summer season for Tomiel®'s scheduling.
- It is advisable to explore efficient implementation alternatives for the optimizer to tackle with computing time-demanding problems, so that the AI solver helps to find improved solutions even faster.

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APIMONDIA SCANDINAVIA 2025
SWEDEN | DENMARK | NORWAY

PP-215 [Beekeeping Technology and Quality]

49th APIMONDIA Congress, 23th - 27th September 2025, Copenhagen, Denmark

Tracing the geographical origin of honey using contemporary analytical methods and chemometric approach

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INTRODUCTION

Honey is recognized from the past as high-quality food which is why it is more and more often target of different types of adulteration. Assessing the authenticity of honey is the goal of many scientists worldwide for which simple analytical methods have not been sufficient for a long time. One of the promising analytical approaches in determination of honey authenticity is usage the combination of stable isotopes and mineral composition together with chemometrics.
In Croatia, production of multifloral and different unifloral honey types is possible because of its diverse vegetation and climate. One of the well-known honey types, not only in Croatia but also more widely, are black locust (*Robinia pseudoacacia* L.) and lime (*Tilia* spp.) honey. Both of these plants could be found in continental and coastal region of Croatia.
The aim of this work was to achieve distinction of honey samples of the same botanical origin produced in different geographical regions of Croatia by using stable carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) isotope ratio and mineral composition.

MATERIALS AND METHODS

❑ **Honey samples**
29 black locust (*Robinia pseudoacacia* L.) honey samples
- 9 Istria County (coastal region)
- 20 in the area extending from Krapina-Zagorje County to Vukovar-Srijem County (continental region)

12 lime (*Tilia* spp.) honey samples
- 4 Primorje-Gorski Kotar County (coastal region)
- 8 in the area extending from Bjelovar-Bilogora County to Vukovar-Srijem County (continental region)

❑ **Botanical origin confirmation**
- melissopalynological and physico-chemical analyses (water content, electrical conductivity, HMF content, diastase activity, carbohydrate content by HPLC)

❑ **EA-IRMS analysis of stable carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) isotope ratio**
- isolation of proteins from honey samples according to AOAC method 998.12 (AOAC, 2000)
- weighted the samples of honey and honey proteins into tin containers placed in solids autosampler (MAS 200R, Thermo Scientific, UK) connected with EA-IRMS (FlashEA 2000 HT with NoBlank device–Thermo-Electron Delta V Advantage Isotope Mass Spectrometer, Thermo Scientific, UK) device via ConFlow IV Interface
- reference standards PeeDee Belemnite (PDB) for carbon and IAEA-N1 and IAEA-N2 for nitrogen

❑ **ICP-OES analysis**
- digestion of honey samples in microwave digestion system (ETHOS 1 Advanced Microwave Digestion System; Milestone, Sorisole, Italy)
- quantification of 20 elements (Fe, Mg, Al, Cr, Mn, Zn, Cu, B, Cd, Ba, Ni, Co, As, Pb, Ca, K, Na, P, S, and Hg) was carried out in triplicate by ICP-OES (iCAP 6500 Duo; Thermo Scientific, Loughborough, United Kingdom)

❑ **Data analysis**
- Principal Component Analysis (PCA) used for potential classification of honey according to geographical origin
- statistical analysis was conducted in Statistica 13 (Stat. Soft. Inc., USA), Microsoft Office Excel and R-3.5.2 software.

RESULTS AND DISCUSSION

Figure 1 shows the classification of black locust honey samples according to two regions. For this PCA analysis, the main components PC1 and PC2 were functions of all three IRMS variables ($\delta^{13}C_{honey}$, $\delta^{13}C_{protein}$ and $\delta^{15}N_{protein}$), and obtained PCA model explain 86.47% of the total variability among the data, and the classification success of the model was 88.89% (Table 1). The two samples of black locust honey overlapped due to similar isotope ratio values (Figure 1). Sample from Virovitica - Podravina County overlapped with the area of the coastal region, and its values of $\delta^{13}C_{honey}$, $\delta^{13}C_{protein}$ and $\delta^{15}N_{protein}$ were -24.99‰; -24.75‰ and 3.99‰. Similar values were found in the black locust honey sample from the coastal region (-25.01‰, -24.76‰, 3.82‰). In order to determine the botanical and geographical origin, in addition to the stable isotope ratio, many authors have used a larger number of parameters, especially mineral composition of honey. The success of the correct classification of black locust honey according to the region of origin increased when the principal components PC2 and PC3 were a function of the IRMS ($\delta^{13}C_{honey}$, $\delta^{13}C_{protein}$ and $\delta^{15}N_{protein}$) and ICP (Mn, Mg, Zn, Pb, P, K) (Figure 2) variables and amounted 100% (Table 1). The model successfully managed to group the samples according to the region, and PC2 and PC3 explain 35.97% of the total variability of the dana.
The same was done for linden honey (Figure 3) where a successful 100% classification (Table 1) with respect to the region of origin of the honey was obtained using only the IRMS variables ($\delta^{13}C_{honey}$, $\delta^{13}C_{protein}$ and $\delta^{15}N_{protein}$). The first two principal components explain 91.07% of the total variability among the data.

CONCLUSION

PCA analysis showed that only IRMS parameters were not sufficient for discrimination of black locust honey according to geographical origin due to data overlapping. Despite the separation of lime honey from the coastal and continental regions was achieved only by IRMS parameters, the separation of black locust honey samples was successfull after inclusion of ICP parameters.
The obtained results of differentiating the geographical origin of honey samples within one botanical species are encouraging, but considering that a narrow geographical area was encompassed, it would be interesting to expand the further research to more botanical species of honey comming from more distant geographical regions.

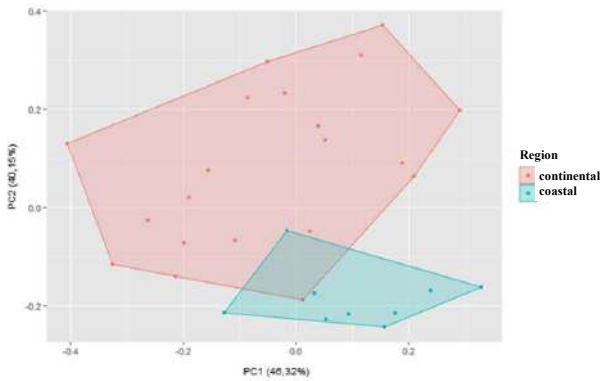

Figure 1 Classification of black locust (*Robinia pseudoacacia* L.) honey by regions using PC1 and PC2 as functions of IRMS variables

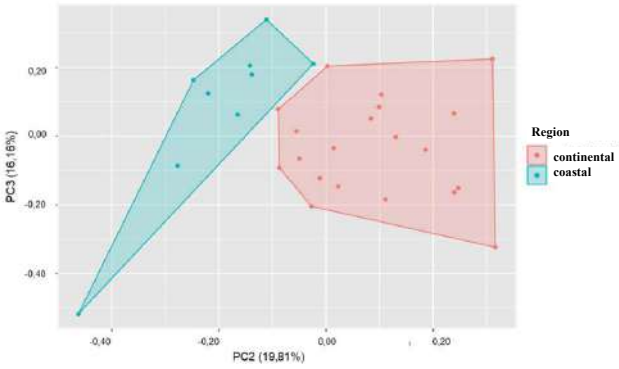

Figure 2 Classification of black locust (*Robinia pseudoacacia* L.) honey by regions using PC2 and PC3 as functions of IRMS and ICP variables

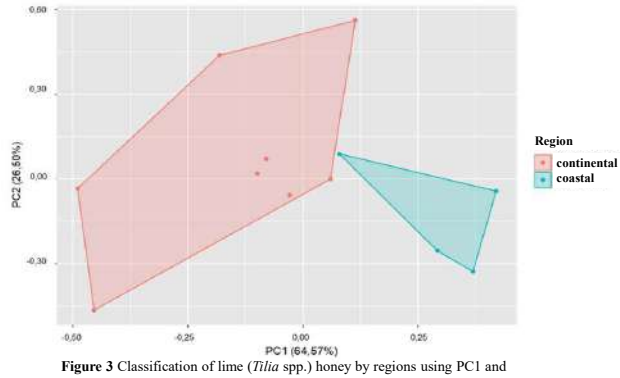

Figure 3 Classification of lime (*Tilia* spp.) honey by regions using PC1 and PC2 as functions of IRMS

Table 1 PCA model classification success (cutoff=0.6)

Figure	Total percentage of correct classification of the model (%)	Accurate classification of honey from the continental region (%)	Accurate classification of honey from the coastal region (%)
Figure 1	93.10	95.00	88.89
Figure 2	100.00	100.00	100.00
Figure 3	100.00	100.00	100.00

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PP-216 [Beekeeping Technology and Quality]

SYSTEMATIC EVALUATION OF A PROCESS FOR THE PRODUCTION OF MEADS BASED ON COLOMBIAN MONOFLORALS HONEYS

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Abs Ref: 0354

INTRODUCTION

Mead is a fermented alcoholic product made with yeasts (Sacharomices cereviciae). It is made from honey must with or without blends of other inputs. The objective of this work was the elaboration of meads with monofloral honeys of Eucalyptus, Encenillo and Matarratón, optimizing water, honey and yeast, in a discontinuous system (Batch) at a temperature of 32ºC. Some meads can have between 7% and 15% ethanol and a wide range of compounds such as sugars, acids, vitamins, antioxidants and minerals among others.

MATERIALS AND METHODS

Figure 1. Transformation of ethanol and CO2 during the fermentation process into monofloral mead musts

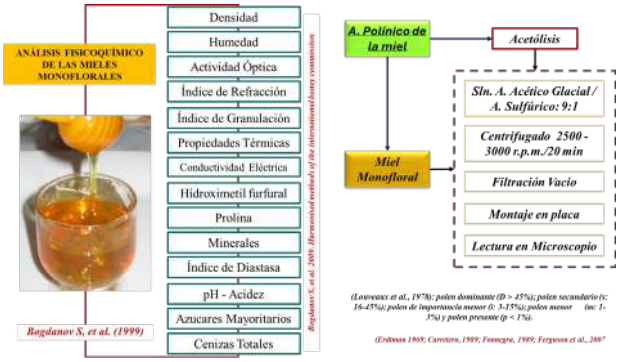
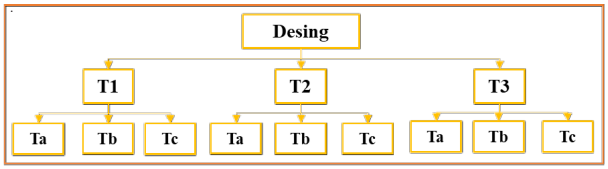


Figure 2. Determination of the Botanical Origin and Physicochemical Analyses of Colombian Monofloral Honeys

During fermentation, 27 reactors were used with musts inoculated with 0.30, 0.40 and 0.60 g/l of yeast. The transformation of sugars, volatile and total acids was evaluated using the Sigmoidal-Logistic mathematical model. The measurement of OH- and CO2 was adjusted to the Sigmoidal-Slogistic1 mathematical model with logarithmic interaction of Levenberg Marquart.

Table 1. Raw material and experimental design for meads



T1: Encenillo; T2: Eucalipto y T3: Matarratón (Ta-0,30; Tb-0,40; Tc-0,60)

RESULTS AND DISCUSSION

The results showed a decrease in soluble solids during the fermentation process, from 22.2 ± 0.40 to 9.10 ± 0.05 ºBrix. The ethanol fraction in the musts evolved with the increase of yeast; for the meads it was in the range of 8.34 ± 0.22 to 11.2 ± 0.33 g.L-1. For the evaluation of the kinetics, the statistical package OriginPro2016 was used. Carbon dioxide evolution showed a higher reaction rate in musts with higher yeast levels, from 17.4 ± 0.06 to 20.8 ± 0.70 g.L-1 accumulated during the 11 days of fermentation. The final product was evaluated in terms of ethanol fraction, soluble solids, total acidity, volatile acidity and carbon dioxide.

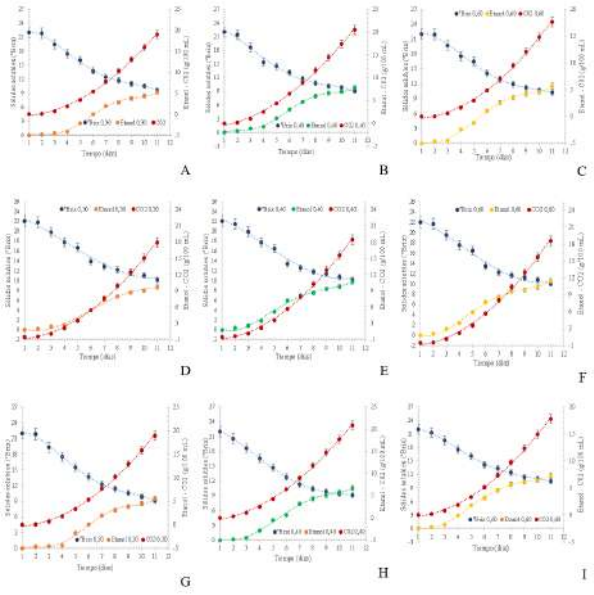


Figure 7. Transformation of ethanol and CO2 during the fermentation process into monofloral mead musts

CONCLUSIONS

Research has shown that the greater the number of microorganisms, the greater the efficiency of the process. However, high concentrations of yeast cannot be used during the beginning of the process because it generates unpleasant conditions in the final product

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APIMONDIA SCANDINAVIA 2025
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PP-217 [Beekeeping Technology and Quality]

From to : the promise of shotgun metagenomic to trace the honeys' journey

Julie Birgel, Kamila Canale-Tabet, Thibault Leroy

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Background

- Due to their high commercial value, honeys are among the most counterfeited food products in the world (falsification of origins, addition of syrups).
- To address these issues, our goal is to use the overall DNA content of honeys (shotgun metagenomics) to identify species (plants, bees, microorganisms, etc.) that could serve as biomarkers of origins and quality.

Aims

1) Extract DNA from honeys.
2) Estimate honey bee DNA content in honeys.
3) Explore the bee genetics with respect to the declared origins of honeys.

Materials & Methods

- Sequencing data from 442 honeys (4,902,178,137 reads in total)
  - 4 projects (including ours)
  - 32 countries
  - 14 honeydews

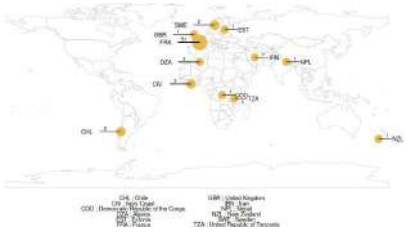


Figure 1: Geographical origins of honeys including in our project.

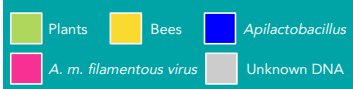
- Mapping reads with BWA-MEM2 to the honey bee reference genome (HAv3.1).

From hive…

Environmental DNA

Tracing honeys' origins ?

Identification of frauds ?



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Preliminary results

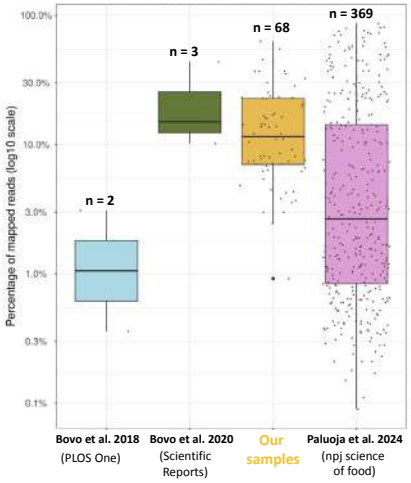


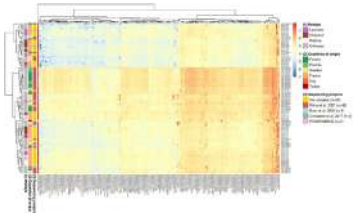
Figure 2: Per-sample percentage of reads mapped to the honey bee genome (log_{10} scale) for the four different projects.

Interpretations

- Presence of bee DNA in all the samples analyzed.
- Proportion can vary considerably (from 0.09% to 86.55% of all sequenced reads).

Perspectives

- Infer the population genetic structure of the bees from honeys.
- Explore the taxonomic diversity of honeys' samples (microorganisms, plants…).



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PP-218 [Beekeeping Technology and Quality]

TRAZAPI: Optimizing Beekeeping Operations and Ensuring Traceability"

Emanuel A. Miranda and Reymond E. Rojas, Corona Dorada SA

TrazAPI is an all-in-one platform designed to optimize the management of apiaries in tropical regions. With advanced tools TrazAPI improves productivity, ensures honey traceability, and helps beekeepers face challenges such as honey adulteration and climate change.

Traceability needs

Problem: producers and consumers face difficulties verifying honey processes and lots.

Solution: TRAZAPI, a SaaS and open-source platform, designed to manage apiaries, inventories, and work orders while showing consumers a verifiable history of each lot through a QR code.

How it Works

Scan: Consumers or inspectors scan the QR code from the package or poster.

Verify: Origin, processes, dates, and activities are displayed.

Trust & Share: Each lot has a unique public URL to share its story.

Purpose

Digitize field activities.

Ensure transparency across the value chain.

Support decision-making with real-time data.

Empower producers, organizations, and consumers.

Benefits for Beekeepers

Empowerment through data: Beekeepers gain control over their own production records, with transparent and verifiable information.

Simplified management: Daily tasks, hive monitoring, and treatments are digitized, reducing paperwork and human error.

Market access: Full traceability increases trust with consumers and opens doors to national and international markets.

Fair recognition: Producers can demonstrate the quality of their honey with scientific traceability, adding value to their brand.

Sustainability & resilience: By tracking inputs, treatments, and harvest cycles, beekeepers strengthen both productivity and environmental responsibility.

Key Features

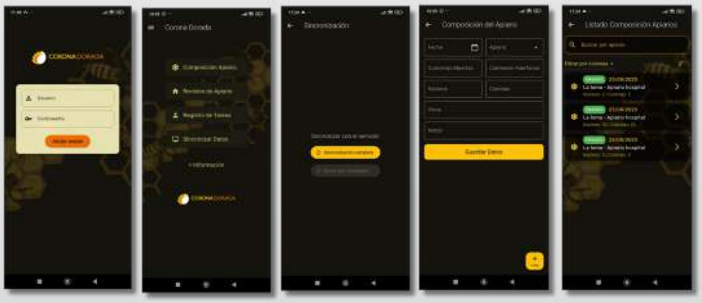
QR per lot: Unique and secure public page for each honey lot.

Integrated management :Work orders, inventory, purchasing/sales, and reports.

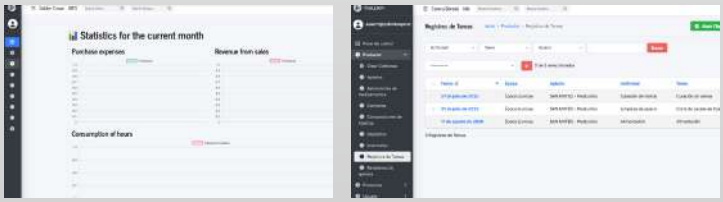
Open Source – Open architecture for audits, improvements, and integrations.
O

Offline ready – Field logging possible with limited connectivity.

App interface (Android version)



Web Interface (Desktop version)



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Scan the code and discover how TRAZAPI can transform your beekeeping operations, ensuring efficiency, traceability, and honey quality. Contact us today for a personalized demo.

CORONADORADA
BIENESTAR PARA TODOS

PP-219 [Beekeeping Technology and Quality]

Trapping queen swarms upon landing to overcome bottlenecks in royal jelly and queen production programs

Author : **Kodjo Logou** Agossou (agossoumartine@gmail.com)
STATION AGRO-APICOLE DE RECHERCHE ET PRODUCTION (SAAR-P) Guerin-Kouka**/ Togo**

The in-vitro production of queen and royal jelly imitates the domestic bee ethology. However, finding larvae under seventy-two hours old at the right time is a real bottleneck, as is the transfer of these larvae. This document presents the simultaneous research carried out in our station to alleviate these difficulties. Indeed, when it comes to obtaining this age range of larva, the popular process using the insertion of an old comb between two brood frames suffers from many problems, including technical, biological and even meteorological. As for their transfer, problems of eyesight and dexterity of the handler are the common pitfalls. The larvae production equipment consists of a hive body acting as a swarm trap, a single-frame hive equipped to pick the queen, a piece of old brown comb with a worker cells mounted on a frame, an articulated light magnifying glass, a plastic laying matrix with removable cell bottoms. The latter will additionally serve alone to investigate transfer problems. At the honey flow, the traps are placed adjacently so that access to the hive body is subject to passage through the hive.

The two adjacent doors of these traps are separated by a queen excluder. Also, when a swarm decides to adopt the hive body, the workers access it and the queen is retained. The latter will be completely caged there a few moments later. With regard to the first concern, the frame filled with empty comb is introduced into the hive after having lightly painted the comb with honey. In the case of both concerns, at the same time, the swarm is transferred to another hive after having introduced the queen into the laying matrix previously put in operating condition. Five days later, the two devices display tiny larvae at the bottom of the cells under magnifying glass. Additionally, the plastic cell bottoms come off, taking these larvae with them easily. Both protocols are conclusive.They appear to be real sure shortcuts of these phases of existing methods. It is unfortunate that we didn't have the optimal conditions in our langstroth hives the one which could capitalizing such achievement.

Keywords: Queen, in-vitro,larvae,swarm, comb, matrix

PP-220 [Beekeeping Technology and Quality]

Sensory profile of Portuguese honeys with Protected Designations of Origin

Guedes, H. I. [1,2]; Furtado, C.[3]; Beirão da Costa, S.[4]

[1] Federação Nacional dos Apicultores de Portugal, [2] CCAB - Centro de Competências da Apicultura e Biodiversidade; [3] Instituto Superior de Agronomia; [4] Prosense, Lda

INTRODUCTION

Honey and Protected Designation of Origin (PDO)

High Value: Strong commercial relevance (Portugal & global)
Market Trend: Rising demand for quality and authenticity
PDO Role: Increases consumer confidence in the origin and ensures protection for beekeepers
Gap: Lack of precise, or not updated, organoleptic data in Portuguese PDO specifications
Need: Organoleptic info vital for product evaluation and compliance
Approach: Sensory analysis complements physicochemical & pollen tests
Outcome: Stronger categorization. Validates if product features match the PDO designation

Portugal: 8 PDO in Mainland and 1 in Azores

AIM

1. **Establish** an honey expert **sensory** analysis **panel**

2. **Define sensory profiles** of five Portuguese honeys with PDO:

Terra Quente PDO
1 Unifloral butterfly lavender (*Lavandula* sp.)

Ribatejo Norte PDO - 4 subregions
3 Multifloral: **Albufeira de Castelo de Bode**; **Alto Nabão** and **Bairro**
1 Unifloral rosemary (*Rosmarinus officinalis*): **Serra de Aire**

METHODOLOGY

Constitution of the sensory panel
Selection and training of assessor layed on ISO 8586 guidelines

Sensory profiles establishment
Honey profiles were established according Consensus Profile (ISO 13299) regarding colour (intensity and tone), odour (intensity and description) and taste (intensity and description)

Samples preparation
Honey samples (20 cl) were placed in a closed containers (30 cl) and left to stabilize at room temperature at least 12h

Honey Tasting procedure - 3 Steps
1. Colour assessment with the container sealed and after rotation to spread honey along the walls and assess tonal variations
2. Odour assessment smelling the sample after removing the lid, taking long and short inhalations to assess the aromas.
3. Taste assessment diluting the honey in the mouth to identify flavours, their intensity, and persistence.

MAIN RESULTS

SENSORY PANEL

Initial recruitment – 61 Naïve sensory assessors
- Beekeeping technicians, consumers, producers and academics

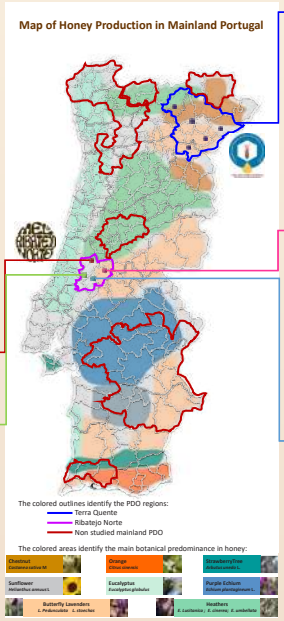
Selection – 54 Initiated sensory assessors
- Impairment screening [not qualified (- 5)]
- Sensory acuity screening
- Potential for describing sensory perceptions [not qualified (- 4)]
- Personal unavailability [withdrawals (- 21)]

24 Selected sensory assessors

Training – 20 selected sensory assessors
- Detection and recognition tastes and odours
- Development and use of descriptors
- Use of scales
- Specific training for honey analysis
- Personal unavailability [withdrawals (-2)]

18 Expert sensory assessors

HONEY SENSORY PROFILES



TERRA QUENTE

Unifloral from Butterfly lavenders

Sampling	Collection points (7) from different areas (5) 2014 – 2021
Colour	Very light amber to light amber
Odour	Predominantly floral. Low intensity and persistence. Possible fruity and fresh notes
Taste	Very sweet. Persistent acidic notes on aftertaste

ALBUFEIRA CASTELO DE BODE

Multifloral with Eucalytpus, Chestnut and Heather (Erica sp.)

Sampling	2013 - 2021
Colour	Light amber to amber, with greenish tones (occasionally may appear as dark amber)
Odour	Predominantly woody, floral (*Ericaceae*), with moderate intensity
Taste	Slightly sweet with. Salty notes and slight acidity, with occasional bitter notes

BAIRRO

Multifloral with Purple echium and Thistle (*Carlina hispanica* Lam.)

Sampling	2013 - 2020
Colour	Light amber to amber
Odour	Floral and fruity (fresh fruits). Low to moderately intense, with low persistence
Taste	Sweet to very sweet. Slightly acidic. Salty notes

ALTO NABÃO

Multifloral with Eucalytpus, Purple echium and Heather

Sampling	2012 - 2021
Colour	Amber to dark amber, with reddish tones
Odour	Floral (*Ericaceae*), woody. Intense but with low persistence
Taste	Slightly sweet to sweet. Slightly acidic. Some salty notes and occasionally slight bitter hints

SERRA DE AIRE

Unifloral from Rosemary (*Rosmarinus officinalis*)

Sampling	2017 - 2021
Colour	Very light amber
Odour	Floral. Moderately intense, with low persistence
Taste	Sweet to very sweet. Slightly acidic.

CONCLUSION

- The establishment of a **sensory analysis panel** for honey evaluation was successfully **achieved**.
- A sensory analysis panel is a dynamic tool, and the results of evaluations depend on its members. Regular activity and training are needed to ensure reliable performance.
- The validation sessions showed that the group of experts **is able to qualify compliance** in Portuguese butterfly lavander honeys with the profile defined for **Mel da Terra Quente PDO**, as well as in multifloral honeys for the profiles of the **Alto Nabão**, **Serra de Aire** and **Bairro** from **Ribatejo Norte PDO sub-regions**.
- Performance testing also demonstrated that the **Albufeira de Castelo de Bode** honey sensory profile seemed too broad, making it difficult to differentiate samples. Therefore, more honey samples from this subregion are needed for the validation or reformulation of the profile.
- This will also be an analytical tool that can be useful in **combating fraud** or detecting natural responses to **landscape evolution** due to **climate change** or catastrophic events such as wildfires and droughts.

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- Caderno de Especificações da Denominação de Origem do Mel da Terra Quente, CAAF (1994)

ACKNOWLEDGMENTS

We are grateful for the collection and provision of samples of Honey with PDO from the beekeepers of the following entities:
- AALBA – Cooperativa de Produtores de Mel, CRL
- Associação dos Apicultores da Região de Leiria, Ribatejo e Oeste
- AAN – Associação dos Apicultores do Nordeste
- Cooperativa de Produtores de Mel da Terra Quente e Frutos Secos, CRL

AFFILIATION

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POSTER PRESENTED AT 49TH APIMONDIA CONGRESS, COPENHAGEN 2025

PP-221 [Beekeeping Technology and Quality]
The Effect of Essential Oils on the Population of "Varroa destructor" Mites

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Vytautas Magnus University Agriculture Academy, Faculty of Agronomy

This study investigates the impact of essential oils from thyme (Thymus vulgaris L.), clove (Syzygium aromaticum L.), and peppermint (Mentha piperita L.) on the population dynamics of Varroa destructor, a major ectoparasite of honeybees (Apis mellifera L.). The experiment was conducted in three stages: two laboratory experiments aimed at determining the concentrations and toxicity of essential oils to both bees and mites, followed by a field experiment to assess the effects of these oils on mite infestation in beehives. Mites and bees were collected using the carbon dioxide method and subsequently placed in Petri dishes treated with essential oils at various concentrations. In the field phase, essential oil-impregnated wooden sticks were placed in the hives to assess their long-term impact on mite populations.

The results indicated that the highest concentration of essential oils (2 mg/ml) was the most effective in reducing Varroa destructor populations, with the greatest mite mortality observed both after 2 and 4 hours of exposure. Essential oils from clove, thyme, and peppermint caused significant mite mortality within the first 24 hours. However, bee mortality remained low, with clove oil resulting in the highest bee mortality. When assessing the treatment effectiveness, thyme essential oil proved to be the most potent, with an average of 12.7 dead mites per hive, compared to 3.7 with peppermint and 31.3 with the control. Additionally, data from the double control oxalic acid treatment showed that thyme oil significantly reduced mite numbers, with an average of 9.3 mites per hive, compared to 26.3 for peppermint and 31.3 for the control.

In conclusion, thyme essential oil demonstrated a 70% effectiveness in controlling Varroa destructor, suggesting its potential as a viable alternative treatment for mite infestations in honeybee colonies.

APIMONDIA SCANDINAVIA 2025
SWEDEN | DENMARK | NORWAY

PP-222 [Beekeeping Technology and Quality]

DETERMINATION OF MINERAL CONTENT IN COLOMBIAN PROPOLIS SAMPLES FROM THREE REGIONS: BOYACÁ, CAUCA AND SAN ANDRÉS INSULAR

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Abs Ref: 0440

INTRODUCTION

Bees of the *Apis mellifera* genus play a crucial role in forest ecosystems through pollination and the maintenance of biodiversity [1]. Among the products derived from bees is propolis, which is produced by mixing their saliva with resins from various plant sources, such as plant tissues, buds, and exudates, for the purpose of hive construction and environmental protection [2]. Propolis has been reported to exhibit multiple biological activities, including antioxidant, antibacterial, anti-inflammatory, and potential anticancer effects [2a, 3]. These activities are associated with its diverse phytochemical composition, comprising more than 180 constituents, such as flavonoids, phenolic acids, diterpenes, aromatic compounds, vitamins, essential fatty acids, minerals, among others [3b, 4]. This composition is influenced by several factors, including bee species, geographic region, environmental conditions, and local flora [4]. In the case of propolis extracts, their composition may vary depending on the extraction method, solvent, temperature, and duration [5].

MATERIALS AND METHODS

Study area:

Samples were collected from apiaries located in three regions of the country: San Andrés Island, Boyacá, and Cauca.

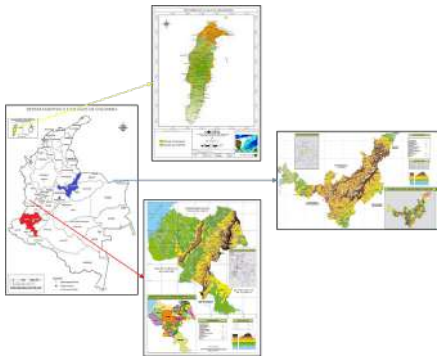
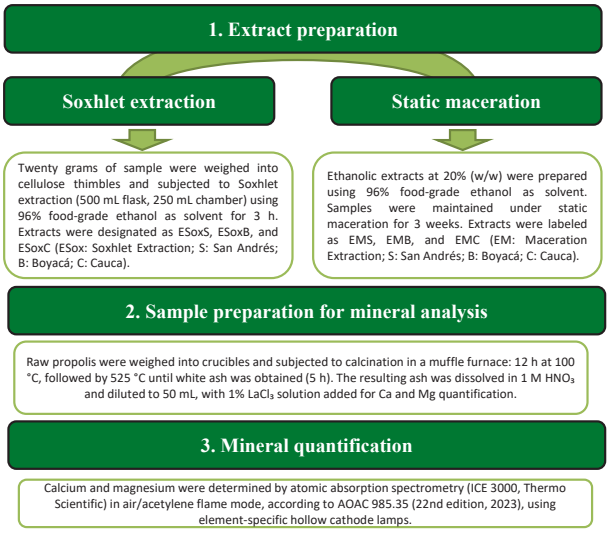


Figure 1. San Andres Island, Boyacá and Cauca Colombia.



RESULTS AND DISCUSSION

The concentrations of the minerals analyzed in different regions of Colombia are presented in Table 1.

Concentration (µg/g)								
Sample	Mg	Fe	Zn	Ca	Se	Mn	Cu	Total
Raw propolis San Andrés	59.27	86.11	26.64	115.00	66.91	5.46	1.08	360.47
Raw propolis Boyacá	12.15	64.60	22.78	61.61	<LOQ	53.30	<LOQ	214.44
Raw propolis Cauca	15.04	40.86	10.86	57.74	<LOQ	4.86	<LOQ	122.83
Soxhlet extract San Andrés	14.02	<LOQ	6.40	21.84	<LOQ	<LOQ	<LOQ	42.26
Soxhlet extract Boyacá	2.63	<LOQ	6.84	10.89	<LOQ	<LOQ	<LOQ	20.36
Soxhlet extract Cauca	1.65	<LOQ	6.33	4.28	<LOQ	<LOQ	<LOQ	12.26
Maceration extract San Andrés	6.00	3.70	7.32	10.11	<LOQ	<LOQ	<LOQ	27.13
Maceration extract Boyacá	1.51	<LOQ	6.56	3.09	<LOQ	<LOQ	<LOQ	11.16
Maceration extract Cauca	3.31	<LOQ	7.21	8.36	<LOQ	<LOQ	<LOQ	18.88
Note: <LOQ = below the Limit of Quantification.								

Table 1. Concentrations (µg/g) of Mg, Fe, Zn, Ca, Se, Mn, Cu, together with the total mineral content assessed.

The mineral results in raw propolis of *Apis mellifera* (see Table 3) differ from those reported by Matuszewska et al. (2021), who found calcium contents ranging from 220 to 560 µg/g, magnesium from 64 to 140 µg/g, iron from 76 to 160 µg/g, zinc from 11 to 19 µg/g, manganese from 5.00 to 9.70 µg/g, and copper from 0.98 to 3.00 µg/g in raw propolis of *Apis mellifera*.

The predominant mineral in the three regions is calcium, followed by iron and zinc. Notably, only in the propolis from San Andrés were copper (1.08 µg/g) and selenium (66.91 µg/g) detected.

The Tukey test (see Table 2) revealed that the mineral content of raw propolis is significantly higher compared to ethanolic extracts. Furthermore, no significant differences were observed between the two extraction methods (see Figure 2).

Method	N	Mean	Grouping
Raw	6	232.6	A
Soxhlet	6	24.96	B
Maceration	6	19.06	B

Table 1. Concentrations (µg/g) of Mg, Fe, Zn, Ca, Se, Mn, Cu, together with the total mineral content assessed.

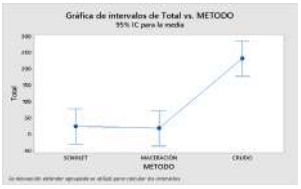


Figure 2. *Interval plot for total mineral content by method.*

Mineral content in propolis varied among San Andrés, Boyacá, and Cauca, likely reflecting regional environmental conditions and flora. The high selenium levels in San Andrés samples may be linked to *Cocos nucifera* and *Rhizophora mangle*, identified as relevant sources of this trace element.

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PP-223 [Beekeeping Technology and Quality]
The Significance of the Intelligent Bee Larval Transfer Machine

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BACKGROUND: Beekeeping plays a vital role in sustainable agricultural development, yet it faces challenges such as labor shortages, low productivity, and an aging workforce. The intelligent larval transfer machine, integrating artificial intelligence and innovative technologies, aims to optimize traditional manual larval transfer processes and drive industrial upgrading.

Issues: Conventional larval relocation relies on manual labor, characterized by inefficiency, high physical demands, unstable larval survival rates, and elevated production costs for royal jelly, hindering large-scale operations:high physical demands on beekeepers, who suffer from presbyopia, cervical, and lumbar diseases;low productivity in royal jelly production due to manual larva transfer reliant on visual precision and skill; severe aging of practitioners; unstable survival rates and non-sterile conditions in manual larva transfer processes. High production costs result in elevated royal jelly prices, hindering market expansion and scaling. Traditional beekeeping methods, characterized by inefficiency and labor intensity, further constrain industry development. The aging workforce further restricts industry growth.

Solution: The intelligent machine combines AI-powered visual recognition, bionic robotic arms, and multi-motor collaborative control. It identifies larval positions with precision, mimics human movements for gentle transfer, and ensures sterile operations, thereby enhancing efficiency and reducing damage.

Outcomes: The device significantly improves production efficiency (shortening cycles), larval survival rates (minimizing injury), and product quality (meeting organic standards). It accelerates the transition toward mechanized and intelligent beekeeping, injecting momentum into sustainable industry development.

Practical Impact: Beekeepers benefit from reduced physical strain, enabling a focus on colony management. The technology attracts younger professionals, alleviating talent shortages, while enhancing market competitiveness of bee products, boosting incomes, and supporting industry scalability.

PP-224 [Beekeeping Technology and Quality]

Installation applicable in organic control and testing the actual level of Varroa mite (Varroa destructor) infestation in a honeybee colony

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Varroa mite is one of the leading causes of honeybee colonies losses. In order to apply an effective treatment strategy, it is important to know the level of infestation with phoretic mites throughout the season, but also the effectiveness of new or existing treatments, including testing the resistance of mite to various treatment substances under standardized experimental conditions. Currently, the tools for assessing the mite population in a honeybee colony are based on estimation methods, mainly on powdered sugar or alcohol washing, starting from samples of several hundred bees. In order to increase the assessments accuracy regarding the phoretic mites' number at colony level and monitoring the infestation level in apiaries according to international recommendations, we developed a programmable installation for entire population sampling.

Installation is presented in detail on: https://www.youtube.com/@adriansiceanu5301

The new installation is provided with a swinging drum in two cycles of two minutes each, for the homogeneous powdering of bees collected from a colony with 100 g of powdered sugar/kg of bees (first cycle), followed by separation by sieving and collection of the almost entirely mite population (second cycle) in order to count the parasites, but also to eliminate them.

METHODOLOGY

- To test and optimize this installation an experiment was organized on **10 colonies;**
- **The effectiveness** of instalation was evaluated by quantifying the number of parasites collected **immediately after installation use** as well **after 2 and 24 hours**, on mites fallen on the antivarroa bottom board.
- The effectiveness was checked out by applying the classic **alcohol washing method** on 50g samples of bees collected from tested colonies.

RESULTS

- **The installation effectiveness** in monitoring the real level of infestation in colonies is between **80–93.6%, with the mean – 88%**;
- **The infestation level** with phoretic mites in the experiment was between **1–3.14 %/colony, with the mean – 2.32%.**

Exp. n =10	Qantity of bees in installation	Number of mites collected by installation (T0)	Infestation level (%) T0	Mites out of total collected by using the installation (%) T0	Number of mites fallen on the bottom board (T1÷2h)	Infestation level (%) T1	Mites out of total collected by using the installation (%) T1	Number of mites fallen on the bottom board (T2÷24h)	Infestation level (%) T2	Mites out of total collected by using the installation (%) T2	Total number of mites collected by using the new installation	Total infestation using installation (%) T0+T1+T2	Total mites collected by using the installation (%) T0+T1+T2	Quantity of bees for washing method	Number of residual mites - washing method	Total number of residual mites/colony	Total number of mites/ colony = residual + collected by installation	Infestation level per colony (%)	The effectiveness of installation
Min	12400	127	0.70	82.38	8	0.05	4.12	3	0.02	1.01	146	0.80	100.00	500	1	25	182	1.00	80.04
Max	18200	381	2.68	91.25	48	0.28	10.57	27	0.16	9.52	454	2.94	100.00	500	2	69	488	3.14	93.62
Mean	15300	267.2	1.75	86.70	23.7	0.15	7.69	17.3	0.11	5.61	308.2	2.01	100.00	500	1.3	39.85	348	2.32	87.98

CONCLUSIONS

- A very high efficacy in counting/control of infestation level;
- The factors that influence the effectiveness of the installation are:
  - the swinging speed in the two cycles and
  - the size of the powdered sugar particles
- This installation allows the organic control which could be applied to any biological unit, during specific works when deemed necessary;
- The procedure allows testing the effectiveness of treatments used and to monitor the real infestation level;
- The procedure helps the detection of other parasites (e.g. *Tropilaelaps* spp.).

PP-225 [Beekeeping Technology and Quality]
A New Hive Architecture for Improved Stability and Efficiency, patent reference FA675216 and FR0600618

Rabah Benali
personal research

Since learning that the internal temperature of a hive should be close to that of the human body and the humidity level should resemble a tropical climate, every visit to the apiary became a lesson.

The transition from cold or after adding or removing supers to examine the brood requires significant effort from the bees to restore balance within the hive. A single failure can weaken the hive for the entire season, affecting its productivity and health.

After observing the behavior of bees over several years, I developed this bipyramidal hive architecture. It introduces a new design that is more resistant to temperature variations and provides a more stable internal environment for the bees.
The flight floor, located at the top of the lower pyramid, enables multidirectional airflow, reducing wind impact on the hive's entrance and helping maintain a constant temperature inside.

The honey supers are placed on the four sides rather than on top, which helps maintain optimal temperature and humidity levels in the main part of the hive. This design allows interventions without disturbing the brood or removing the supers, ensuring minimal disruption.

Even during severe cold spells, the brood, located at the center of the hive instead of the bottom, will be better protected from temperature fluctuations.
The hive's base connects the two pyramids by their bases, providing greater stability against vibrations and minimizing disturbances.

The frames are composed of small sections connected with hooks, increasing flexibility in creating smaller hives, managing swarms, and adjusting the internal layout. The hooks come in various sizes, allowing precise adjustments of the frame spacing, making the hive adaptable to changing conditions.

Access between the hive body and supers is easier to control, whether by the bees or the beekeeper, compared to traditional hives.

This new concept also facilitates the integration of smart accessories for hive management, allowing more efficient monitoring and development.

This hive design is particularly suited to urban beekeeping and regions difficult to access for transhumance, offering a sustainable and adaptable solution for modern beekeeping.

PP-226 [Beekeeping Technology and Quality]

AN INSTANT RELEASE ROYAL JELLY-CYCLODEXTRIN INCLUSION COMPLEX FOR SOFT SKIN AND HAIR APPLICATIONS

APIVITA

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Background & Summary

Royal jelly (RJ) is a yellowish-white, gel-like substance produced by the hypopharyngeal and mandibular glands of young worker bees. RJ offers numerous health benefits, including antimicrobial, anti-inflammatory, anticancer, antioxidant, antidiabetic, immunomodulatory and anti-aging properties. Moreover, RJ has gained attention for its potential to combat skin aging as it is rich in key bioactive compounds such as 10-hydroxy-2-decenoic acid (10-HDA) and polyphenols that confer antioxidant and photoprotective activities on skin [1,2]. However, their extraction and use are challenging due to their stability, as they degrade when exposed to elevated temperatures, light and oxygen.

How can the stability limitations of RJ be overcome to enhance its use in cosmetic formulations?

The present study intends to eliminate the stability disadvantages of RJ, offering protection and instant release of the 10-HDA and the polyphenols that it contains aiming to enhance its bioactivity in cosmetic applications.

We performed extraction and inclusion of bioactive components from fresh, untreated RJ into a β-hydroxylpropyl cyclodextrin (HPβCD) system, composed solely of natural and safe ingredients, which results in the instant release (IR) of the incorporated polyphenols and 10-HDA.

This RJ-IR formulation was further incorporated in cosmetic formulas to evaluate the benefits of an instant activity.

We show that:

- **RJ-IR modulates the expression of stress factors *in vitro* in hair follicle dermal papilla cells (HFDPCs)**
- **RJ-IR incorporation in shampoo and hair conditioner reduces hair porosity of hair shaft, upon urban pollution stress or baseline conditions and restores hair integrity**
- **RJ-IR incorporation in a face cream effectively repairs skin barrier function**

Materials & Methods

RJ-IR preparation

RJ (≥1.6% 10-HDA) was dissolved to 5.5% w/w in deionized water and 1,3-propanediol under stirring. HPβCD (20% w/w) is pre-dissolved in water and mixed in. The mixture was sealed and stored at 5–7 °C for 8 h, then cold-filtered (5–0.45 μm). pH is adjusted (3.5–7.5) if needed. Subsequently, total polyphenols and 10-HDA are then quantified.

Gene expression analysis

Total RNA (500 ng) was extracted and reverse-transcribed using standard kits. Gene expression was analyzed by qPCR using the ΔΔCt method, with GAPDH as the reference gene.

In Vivo and Ex Vivo Application Studies

Hair Care Application:

0.5% w/w in shampoo and hair care mask as a routine treatment:

- applied on hair shafts. The shafts were further exposed to urban dust and UV-A, stained with a fluorophore, cryosectioned (5 μm), and imaged using an epifluorescence microscope (Evos M5000). Images were analyzed with ImageJ
- used by 5 volunteers. Fibers were collected and observed using scanning electron microscopy (SEM)

Skin Application:

A 0.5% w/w RJ-IR face cream was applied by 10 volunteers, and transepidermal water loss (TEWL) was measured using a Tewameter® TM HEX.

Results &Discussion

- **Upregulation of Nrf2 gene expression in HFDPCs was observed after 24-hour exposure to RJ-IR, indicating activation of cellular antioxidant pathways**

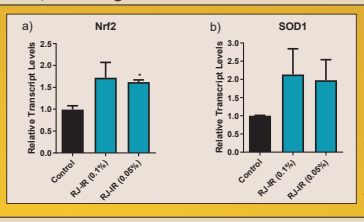

Figure 1. Gene expression of Nrf2 (a) and SOD1 (b) after exposure of HFDPCs to RJ-IR 0.05% v/v. Non-parametric t-test, comparison with the control. * p-value <0.05"

- **The RJ-IR routine (shampoo + hair conditioner) showed significant repair efficacy against urban pollution induced alterations on hair fiber integrity and porosity *ex vivo***

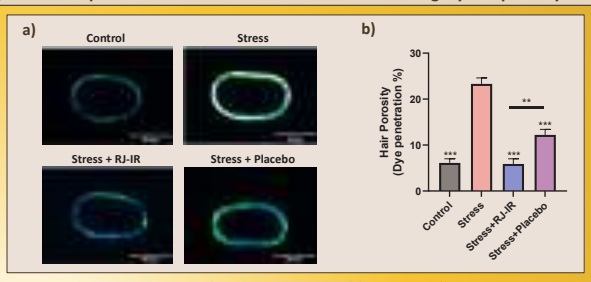

Figure 2: Hair integrity and porosity. a) in situ visualization of fluorescein diffusion on cross-section of hair. The fluorescence emission signal for fluorescein was obtained by using specific excitation and emission wavelengths (498/517 nm). Fluorescein is visualized in a color range (low levels in dark, high levels in bright colors). b) The quantification of fluorescein diffusion on hair is reported for each experimental group and expressed as % values of fluorophore penetration in the hair shaft and shown as mean ± S.D. ***, p < 0,001; **, p < 0.01, one-way ANOVA and Dunnett's post-hoc test for multi-comparisons analyses vs stress group or Unpaired t test with Welch's correction for binary comparison.

- **The RJ-IR routine (shampoo + hair conditioner) improves hair uniformity, smooths the surface, and restores cuticle integrity *in vivo***

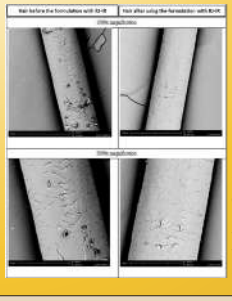

Figure 3: Imaging of hair strand samples isolated from volunteers using scanning electron microscopy, before (left) and after (right) the use of shampoo enriched with 0.5% w/w RJ-IR and the use of a hair cream enriched with 0.5% w/w RJ-IR. Magnification 1000X and 2000X.

- Cream with 0.5% RJ-IR leaves a protective layer on the skin which contributes to the reduction of water evaporation from the horny layer of the epidermis

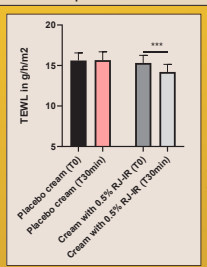

Figure 4: TEWL measurements before (T0) and 30 minutes (T30) after application of cream with 0.5% RJ-IR or placebo. A reduction in TEWL was observed 30 minutes after application of the RJ-IR cream. Data are mean ± SEM; n = 10 per group. p < 0.001, paired t-test.

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[2] Rizki, P. A., Krisnamurti, D. G. B., Reksodiputro, M. H., Farida, S., Koento, T., Rachmadi, L., Wuyung, P. E., Wibowo, H., & Boesoirie, S. F. (2023). STABILITY EVALUATION OF ROYAL JELLY GEL. *Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis*, *71*(2), 89–96

PP-227 [Beekeeping Technology and Quality]

Intervention of modern movable frames in traditional wall hives and for sustainable ecosystem.

Shivilak Natural Products

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Introduction

Indigenous honey bee Apis cerana beehives are a part of the architecture of mountain regions of Ghadwal, India. Shivalik's mission is to support village communities conserve their natural resources and biological diversity while utilizing forest products and resources in an equitable, economically and environmentally sustainable manner.

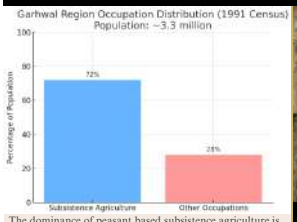
Apis cerana

Geographical Loaction

Geographical location of Uttarakhand

Geographical location of Uttarakhand

Traditional Method



The dominance of peasant based subsistence agriculture is generally perceived in negative terms in its relation with poverty due to declining and low levels of productivity. Earlier strategies to alleviate poverty through a diversified economic structure have not yielded desired results possibly due to reasons of ecological fragility and to an extent the problems posed by inaccessibility.

Located at the height of about 150 cm from the floor

During current study efforts were made to design low cost, eco-friendly movable frames. Provision was made with wooden frames in Khadras. Natural fixed combs prepared by the bees are replaced to the movable frame. Inside the wall, frames are vertically hung parallel to each other. Extra frames are filled with sheets of wax foundation on which the combs are built by the bees. Scientific intervention in the indigenous method makes convenient for inspection of the colonies, pest management, swarm control and division of bee colonies.

Wall Hive

Methodology

Traditional wall Hive

Empty Wall Space

Improve Wall Hive

Improved wall hive with Bee column

4Kg-8kg of harvest is improved to 10Kg-15Kg

Wall hive with frames Incorporation

From such hived Apis cerana families the yield is about 4 to 8 kg of honey per year. A lot of specialists have noticed the problems with proper examinations of such hive construction, and introducing some modern management methods accordingly. On the other hand it is known fact that A. cerana families abscond and swarm much more often from the modern hives than from the traditional ones. 4500 bee keepers adapt to the mobile frame technology in Uttarakhand Garhwal regiom

CONCLUSION

- Shivalik's mission is to support village communities conserve their natural resources and biological diversity while utilizing forest products and resources in an equitable, economically and environmentally sustainable manner.
- Shivalik Natural Products working in the Uttarakhand Trai Bhabar and Garhwal Himalayas with the mission of supporting Beekeepers to Organic Honey Production from Apiary, wall hive, log hive and forest in an equitable, economically and environmentally sustainable manner.

PP-228 [Beekeeping Technology and Quality]
PHYSICOCHEMICAL PROPERTIES AND VOLATILE COMPONENTS OF Apis mellifera HONEYS COLLECTED IN THE COLOMBIAN MACIZO MOUNTAIN COMPLEX

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Honey is a natural product with sweetening properties that is well known worldwide, produced by bees from flower nectar and plant secretions. Its physicochemical properties depend on the time of collection, environmental and agroclimatic factors of the biogeographical zones at the time of collection. The objective of this work was to evaluate sixteen samples of honeys produced in the mountainous area of the Colombian massif in the department of Cauca, which were characterized in terms of melisopalynology, nutritional composition, physicochemical properties and volatile compounds. Analyses of the volatile components collected by the Trap and Purge extraction technique and analyzed by GC/MS were performed. Pollen grains for some of the samples were higher than 45%, conferring a monofloral quality. The pfund color of the honeys ranged between 73.0 ± 0.90 and 150.0 ± 0.01 pH between 3.86± 0.01 and 5.09± 0.01 total acidity 7.37 ± 0.04 and 25.82 ± 1.40 meq kg-1, still within standard limits, electrical conductivity 0.525 ± 0.004 mS cm-1, moisture 18.9 ± 0.43 g 100 g-1 and 23.6 ± 0.24 g 100 g-1, ash 0.198 ± 0.004, reducing sugars 65.3 ± 0.36 g 100g-1, total phenols 1586 ± 24 mg kg-1 A. Ga, flavonoids 137.4 ± 1.26 mg kg-1. Tabouret index 3.82 ± 0.05 based on 1.35 ± 0.03 fructose/glucose ratio and 0.638 ± 0.045 water activity. The honeys show Newtonian behavior. GC/MS analysis allowed the identification of 27 volatile compounds, including alcohols, ketones, aldehydes, acids, terpenes, hydrocarbons, benzenes and furan derivatives. 2-Methyl-1-propanol, D-Limonene and 2-Furanmethanol, Acetaldehyde, 2-Propanol and 2-Butanol are the most commonly identified, as well as others such as Acetone, Toluene, 2-Butanone, 2-Methyl pentane, Ethanol, 2, 3-Pentadione, n-Octane, 2-Methoxy-1-propene, Nonanal, 4-Methyl-1,3-pentadiene, Ethyl acetate, Propanedioic acid, 3-Methyl-1-butanol, Furfural, Butyrolactone, 1-Pentanol and 1-Butanol among others.

PP-229 [Beekeeping Technology and Quality]
Update and Future Plans for the Honeybee Mortality Risk Map in Honey Plant Distribution Areas

WONKI CHUNG
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With climate change and environmental degradation increasingly threatening honeybee populations and contributing to Colony Collapse Disorder (CCD), scientific research has become essential to ensuring the sustainability of the beekeeping industry. This study aims to analyze honeybee mortality risk factors in honey plant distribution areas and propose strategies to strengthen the sustainability of apiculture by identifying safe and high-risk zones.

To achieve this, we utilized the nationwide honey plant distribution map established in 2023, incorporating nectar yield grading information and smart beekeeping data to examine the correlations between various factors contributing to honeybee mortality. Our analysis identified the lowest winter temperature—when honeybee activity is at its lowest—as a key variable. Additionally, we selected areas within 100 meters of nectarous trees, based on forest big data exchange records concerning road proximity and mountainous area usage. High-risk zones were further refined by incorporating pest monitoring indices.

Furthermore, the impact of pesticides used in agricultural crop cultivation, a critical issue in bee mortality, was considered. To assess this, we extracted paddy field and orchard data from the Ministry of Environment's 2023 land cover map, analyzing areas within 100 meters of these agricultural zones. Based on these findings, we will update the real-time honeybee mortality monitoring system and implement early warning alerts to inform beekeepers and policymakers of high-risk areas.

Looking ahead, we plan to integrate high-resolution predictive meteorological data to generate an enhanced risk forecast map. These efforts are expected to contribute to increased productivity in the beekeeping industry and the advancement of climate-smart apiculture management.

PP-230 [Beekeeping Technology and Quality]

ERBEL BEE TEST APP:
New Data Collection Software For Performance Testing In Honey Bee Queen Selection And Breeding

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maristak erbel BeeBreed.eu

HONEY BEE SELECTION PROGRAMS

The genetic improvement of honey bee populations is a promising way to achieve more efficient and sustainable beekeeping, because:

1) Allows for increased colony productivity

2) Improves livestock manageability

3) Helps bee populations adapt to changing environmental conditions

4) Enhances disease resistance

5) And plays a key role in conserving different Apis mellifera populations

The web platform for genetic value estimation BeeBreed (Länderinstitut für Bienenkunde) is the largest public database containing data on more than 200,000 queens of different subspecies. Taking into account pedigree and performance data of the queens and using the BLUP system, they calculate the genetic values of each queen in order to carry out a genetic selection.

PERFORMANCE TESTING

The basis of all selection programmes is the data collected through performance testing. This is a phase that involves many people, breeders and testers above all, but also mating station managers, inseminators, selection programme coordinators, etc.
Most breeders participating in breeding and genetic improvement programs still use paper forms for recording performance data. This procedure leads to a certain percentage of data corruption through misread handwriting, loss of cards, transmission errors and loss of time when entering data into BeeBreed.
It is crucial that all the data collected by the queen testers in the selection programme is made available to BeeBreed managers in the easiest, quickest and most efficient way, without generating errors or too much extra work.

ERBEL BEE TEST

To avoid these issues and improve certain aspects of breeding programs, we developed an app called **ERBEL Bee Test** for recording queen testing data during selection. This app enables users to:

a) Collect data in an organized and clear manner,

b) Instantly upload data to the BeeBreed platform, avoiding errors,

c) Store historical data and download it when needed,

d) Validate the accuracy of recorded data and alert testers if any testing is being conducted incorrectly, as it allows real-time tracking of who is conducting the tests and how,

e) Perform a pre-selection of queens halfway through the testing process.

By using this app, the collection of performance data is immediately improved, as testers' work can be monitored and they can be notified if an operation is not done correctly so that they can correct it. In this way, the breeding program itself also benefits immediately, with increased quantity and quality of the collected data.

HOW TO USE ERBEL BEETEST?

More info https://erbel.eus/erbel-bee-test-app/

PP-231 [Beekeeping Technology and Quality]

NEW POTENTIAL FRESHNESS MARKERS FOR ROYAL JELLY: GLUCOSE OXIDASE AND CARBOXYPEPTIDASE-A-LIKE

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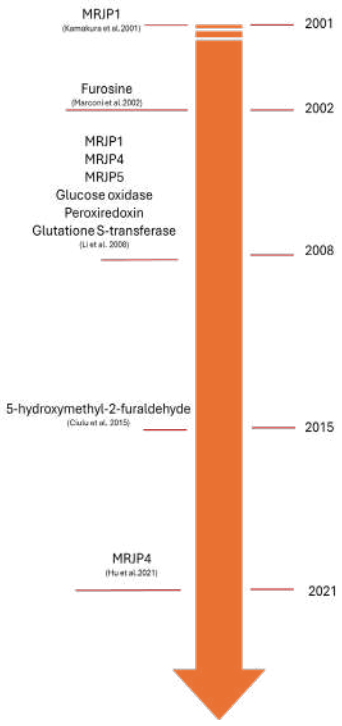
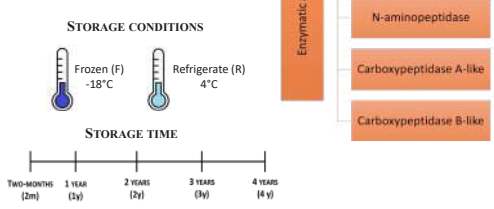
Several potential markers for freshness assessment have been tested and suggested in the last decades. However, implication of enzymatic activity involvement in RJ quality assessment during shelf life has been poorly investigated despite it can have potential affect on antimicrobial and antioxidant properties as well as in proteins degradation resulting in a loss of product quality



Enzyme	RJ Storage Time – Refrigetation condition 2m	1y	2y	3y	4y	*p-Value*
Glucose oxidase (U/mg proteins)	274 ± 70 [a] (279)	62 ± 21 [b] (45)	91 ± 6 [b] (91)	129 ± 24 [b] (130)	93 ± 30 [b] (98)	*0.015*
Carboxypeptidase-like A (U/mg proteins)	33.7 ± 10.5 [a] (22.8)	3.9 ± 1.3 [c] (5.2)	13.3 ± 2.3 [b] (13.1)	4.5 ± 1.4 [c] (4.3)	6.2 ± 3.2 [bc] (1.6)	*0.007*
Trypsin-like (U/mg proteins)	0.40 ± 0.02 (0.40)	0.50 ± 0.03 (0.48)	0.45 ± 0.03 (0.41)	0.47 ± 0.02 (0.47)	0.49 ± 0.05 (0.49)	*0.136*
Chymotrypsin-like (U/mg proteins)	0.07 ± 0.02 (0.06)	0.03 ± 0.01 (0.01)	0.08 ± 0.02 (0.06)	0.09 ± 0.02 (0.10)	0.07 ± 0.02 (0.06)	*0.271*
N-aminopeptidase-like (U/mg proteins)	0.58 ± 0.19 (0.44)	0.35 ± 0.06 (0.34)	0.30 ± 0.03 (0.32)	0.33 ± 0.03 (0.30)	0.32 ± 0.04 (0.31)	*0.692*
Carboxypeptidase-like B (U/mg proteins)	0.29 ± 0.21 (0.04)	0.20 ± 0.12 (0.04)	0.37 ± 0.30 (0.02)	0.19 ± 0.15 (0.00)	0.77 ± 0.22 (0.59)	*0.206*

Scan me!

Enzyme	2mR *vs.* 1yR	2mF *vs.* 1yF	2mR *vs.* 2mF	1yR *vs.* 1yF
Glucose oxidase (U/mg proteins)	274 ± 70(279) *vs.* 62 ± 21(45) ***p = 0.009;***	772 ± 436(272) *vs.* 433 ± 140(392) *p = 0.754;*	274 ± 70(279) *vs.* 772 ± 436(272) *p = 0.754;*	62 ± 21(45) *vs.* 433 ± 140(392) ***p = 0.047;***
Carboxypeptidase A-like (U/mg proteins)	33.7 ± 10.5(22.8) *vs.* 3.9 ± 1.3(5.2) ***p = 0.006;***	9.4 ± 5.1(4.0) *vs.* 9.7 ± 3.4(7.5) *p = 0.584;*	33.7 ± 10.5(22.8) *vs.* 9.4 ± 5.1(4.0) ***p = 0.025;***	3.9 ± 1.3(5.2) *vs.* 9.7 ± 3.4(7.5) ***p = 0.047;***
Trypsin-like (U/ mg proteins)	0.40 ± 0.02(0.40) *vs.* 0.50 ± 0.03(0.48) ***p = 0.018;***	0.49 ± 0.04(0.46) *vs.* 0.50 ± 0.03(0.48) *p = 0.718;*	0.40 ± 0.02(0.40) *vs.* 0.49 ± 0.04(0.46) *p = 0.109;*	0.50 ± 0.03(0.48) *vs.* 0.50 ± 0.03(0.48) *p = 0.917;*
Chymotrypsin-like (U/mg proteins)	0.07 ± 0.02(0.06) *vs.* 0.03 ± 0.01(0.01) *p – 0.120;*	0.11 ± 0.02(0.11) *vs.* 0.05 ± 0.02(0.06) *p – 0.133;*	0.07 ± 0.02(0.06) *vs.* 0.11 ± 0.02(0.11) *p – 244;*	0.03 ± 0.01(0.01) *vs.* 0.05 ± 0.02(0.06) *p – 0.348;*
N-aminopeptidase-like (U/mg proteins)	0.58 ± 0.19(0.44) *vs.* 0.35 ± 0.06(0.34) *p – 0.361;*	0.43 ± 0.06(0.47) *vs.* 0.38 ± 0.08(0.28) *p – 0.465;*	0.58 ± 0.19(0.44) *vs.* 0.43 ± 0.06(0.47) *p – 0.749;*	0.35 ± 0.06(0.34) *vs.* 0.38 ± 0.08(0.28) *p – 0.917;*
Carboxypeptidase B-like (U/mg proteins)	0.29 ± 0.21(0.04) *vs.* 0.20 ± 0.12(0.04) *p = 0.848;*	0.13 ± 0.13(0.00) *vs.* 0.69 ± 0.65(0.00) *p = 0.416;*	0.29 ± 0.21(0.04) *vs.* 0.13 ± 0.13(0.00) *p = 0.295;*	0.20 ± 0.12(0.04) *vs.* 0.69 ± 0.65(0.00) *p = 0.738;*



Glucose oxidase and carboxypeptidase-A-like activity may be suitable markers of RJ freshness within one year at refrigeration condition
Freezing may be a valid alternative storage method to improve preservation of the activity of these enzymes.

DIPARTIMENTO DI SCIENZE VETERINARIE

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APIMONDIA SCANDINAVIA 2025
SWEDEN | DENMARK | NORWAY

PP-232 [Beekeeping Technology and Quality]

APIMONDIA SCANDINAVIA 2025
SWEDEN | DENMARK | NORWAY
23-27 SEPTEMBER
COPENHAGEN

BEES' ACTIVITY THROUGH THE LENS: A NEW MONITORING TOOL

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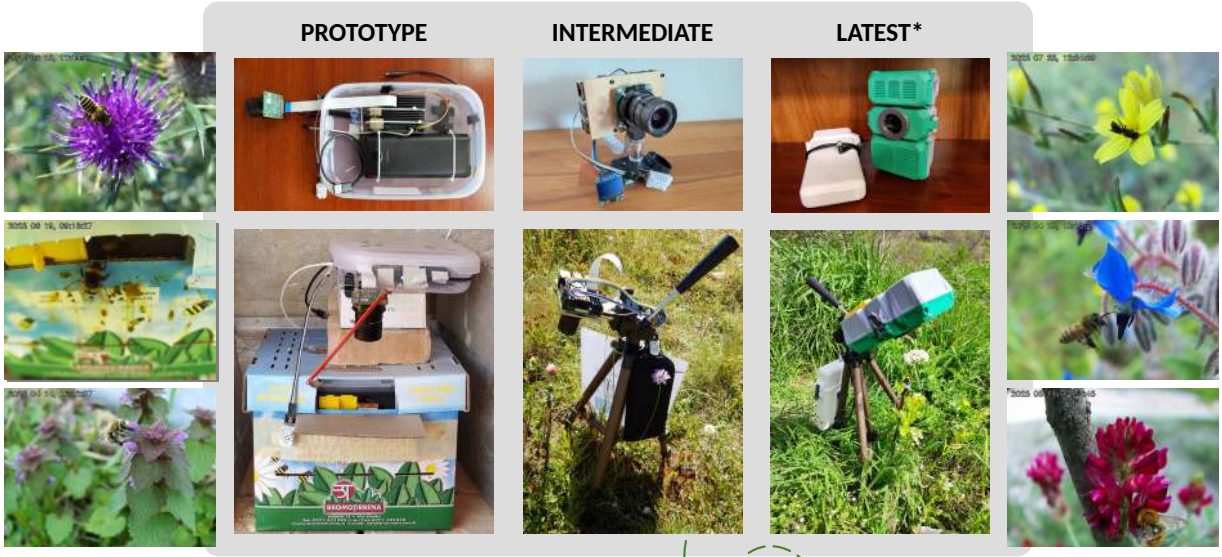
INTRODUCTION

The worldwide decline of bees' populations, the overall lack of data concerning many species, and the intrinsic downsides of classic monitoring techniques (e.g. time-consuming, indiscriminately lethal) call for an intensification of monitoring efforts and novel solutions.
We present a new, portable device running an *ad hoc* software that allows to capture pollinators' activity in different contexts, only detecting instances of movement, so that video processing time, storage and battery are saved.

MATERIALS & METHODS

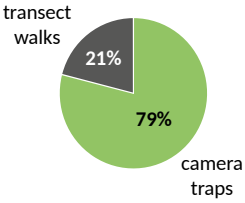
The tool has been tested to monitor bees' activity on flowers, and its efficacy has been determined in terms of Precision and Negative Predictive Value (NPV). Assessed aspects also include monitored time cut by the software and number of records obtained (against number of records from transects).



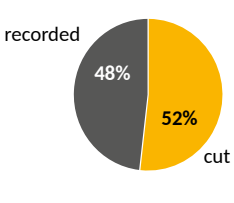
RESULTS

PERFORMANCE NO false negatives, precision = 0.19

NUMBER OF RECORDS



MONITORED TIME



CONCLUSIONS

The proposed tool was proved to be useful in aiding in bee monitoring, providing a huge amount of additional data and significantly cutting down such data's processing time.
Given its versatility, the device could easily be repurposed to aid in honeybees' management.

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* Latest case design by Davide Palusci (INTAEL S.N.C., Pescara (PE), Italy).

PP-233 [Beekeeping Technology and Quality]
Pollen Spectrum of Elazig/Turkiye Honey: A Study on Floral Diversity and Botanical Authentication

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Melissopalynology, the study of pollen identification present in honey, is an essential tool for determining the botanical and geographical origin of honey. Elazig, located in eastern Turkiye, hosts a rich floral diversity, contributing to the unique characteristics of its honey. This study aimed to analyze the pollen composition of honey samples obtained from Sivrice province of Elazig to assess their floral sources and botanical authenticity.

A total of 17 honey samples were collected from local beekeepers during the 2023 harvest. Pollen identification was conducted using standard melissopalynological protocol without acetolysis. The frequency classes of pollen types were determined, and the dominant and secondary floral sources were classified. Results indicated that the most prevalent pollen types belonged to Astragalus sp., Trifolium sp. and Xeranthemum sp., followed by Rosaceae, Lathyrus sp., Brassicaceae, Apiaceae, Paliurus spina-christi, Melilotus sp., Centaurea sp. and Pimpinella sp.. The presence of nectariferous plants such as Astragalus and Trifolium highlights the floral richness of the region and supports the classification of Elazıg honey as monofloral or multifloral.

The findings contribute to the characterization of Sivrice/Elazig honey, providing valuable insights for beekeepers, consumers, and quality control authorities. This study underscores the importance of regional honey authentication and promotes the recognition of Elazig honey in the global market.

APIMONDIA SCANDINAVIA 2025
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PP-234 [Beekeeping Technology and Quality]

APIMONDIA SCANDINAVIA 2025 23-27 SEPTEMBER

COMAPIS APICULTURA

COPENHAGEN

Uso de cámara térmica para diagnóstico de ubicación de colonias de Abejas *Apis mellifera mellifera* en diversas estructuras urbanas

Parrado, Mario; Calle, Sara. **COMAPIS APICULTURA**. Bogota DC, Colombia. 2024. contacto@comapis.com
www.comapis.com

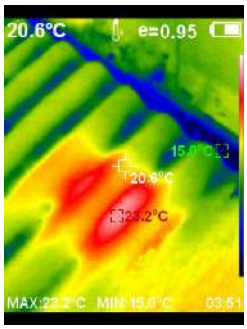


Image 1 of 4. Case 1. Top view with thermal camera. Combs are held in place by Eternit tiles. The colony is large, two years old. Red color indicates a breeding temperature of 23.2°C.

- Bogota has more than 8 million inhabitants.
- Altitude of 2,640 MSL and temperatures between 14 and 25°C.
- Bogota, DC, has more than 10,000 bee colonies per year.
- Bogota has large green areas that are a food source for bees.
- These colonies are located on false facades, roofs of houses, manhole covers, trees, poles, among other places.
- Bees in Colombia already have a law that protects them, and several companies and homeowners are aware of this and pay for the proper removal of bee colonies.
- COMAPIS APICULTURA is the first company to implement the use of a thermal camera and a vacuum cleaner exclusively for bee swarm removal.

Image 2 of 4. Case 1. Interior view. Internal view of the ceiling of a room, the size of the bee colony is unknown.

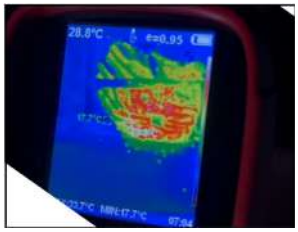
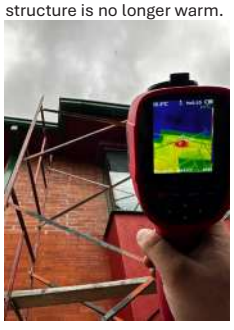


Image 3 of 4. Case 1. Thermal camera view. Image with the exact location of the bee colony.

Image 4 of 4. Case 1. Discovery of the bee colony and validation of the technique. We confirmed that the thermal camera was able to detect the honeycombs.

Image 5. Recommended for use in cold environments. Newly established colonies (≤5 days) are not detected because the surrounding structure is no longer warm.



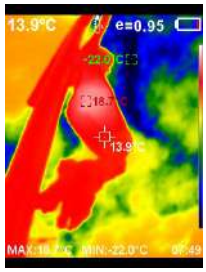
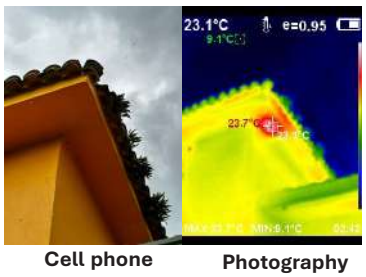


Image 6. On sunny days, there are detection biases. For this camera model, it is important not to base it on color, but on temperature.

Image 7. Comparison of the location of a bee colony after 6 months of establishment.



Cell phone photography **Photography thermal camera**

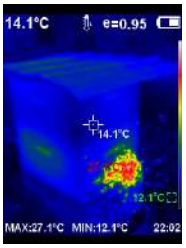
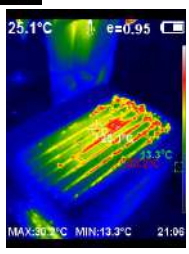


Image 8. Use in hives, external view.

Image 9. Use in hives, internal view.



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PP-235 [Beekeeping Technology and Quality]

Monitoring the response of honeybee colonies to external stressors
WITH INTELLIGENT SENSORS

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Background

The biological characteristics of honeybees date back to antiquity, a fact that is often overlooked in modern beekeeping. Beekeeper intervention in the colony, inadequate food sources, environmental pollutants, climate change, high colony density, pathogens and pests all cause stress in bees. To improve the well-being of bee colonies in the future, a newly developed intelligent multi-sensory system has been developed that monitors the bees' response to various stress factors and provides insights into the colony without the need for manual intervention.

Methods

Twenty Carniolan honeybee colonies (*Apis mellifera carnica*) were placed at four sites with different impact of stressors, five at each site. Newly developed multi-sensors were installed in the colonies to measure **temperature, relative humidity, air pressure and VOC, beehive mass, sound inside the beehive and to detect rainfall**. The health status of the colonies were monitored and various bee-related samples for chemical analysis of pesticides and toxic metals were collected and analyzed.

Results

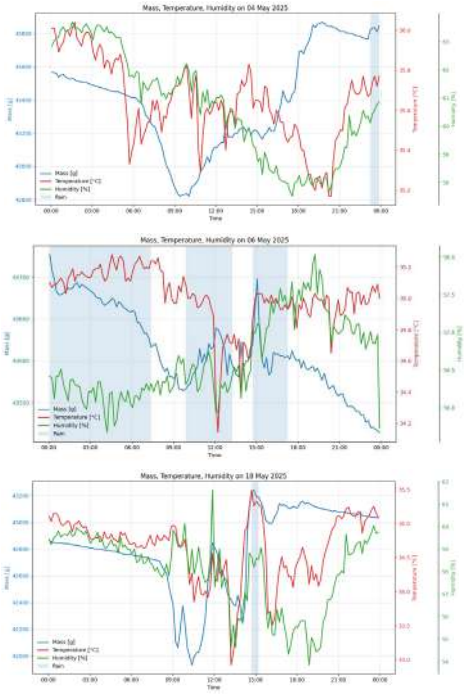

Figure 4: Results of measurements with intelligent sensors: mass, temperature, humidity and rain on 4, 6 and 18 May 2025

Figure 1: Multi-sensory system installed in a honeycomb

Figure 2: Beehives with installed sensors and pollen traps

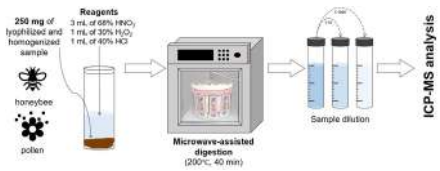

Figure 3: The analytical procedure for determining total element concentrations

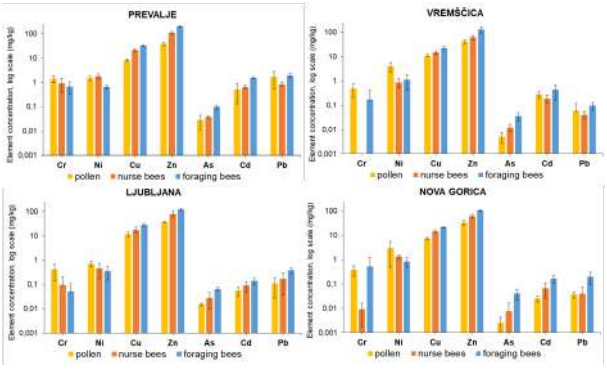

Figure 5: Concentrations of elements in pollen, nurse honeybees and foraging honeybees sampled at four locations in Slovenia in June and July 2025. Data are presented as mean ± standard deviation of five colonies at each location, expressed on a dry weight basis.

At all sites, foraging honeybees generally accumulated higher concentrations of most metals (especially Cu, Zn, As, Cd, Pb) compared to nurse honeybees and pollen, reflecting their exposure during foraging. Pollen showed relatively high Cr and Ni concentrations, but generally lower concentrations of other metals, suggesting selective accumulation of certain elements.Depending on the sampling location, there were remarkable variation in the element concentrations of foraging honeybees. Prevalje (industrial and mining area) consistently showed elevated concentrations of Cr, Cu, Zn, As, Cd and Pb, while Nova Gorica (intensive agricultural area), Ljubljana (urban environment) and Vremščica (pristine site) generally exhibited lower concentrations.

Conclusions

With the current analysis of the sensor readings with artificial intelligence methods, we can determine the degree of stress to which the bees are exposed due to various external factors. Through further measurements and analyses of the measured data, we will try to determine the correlations with the identified stress factors that have affected the bee colonies. By analysing the sensor data, beekeepers will be able to track and predict various colony activities more accurately than with a single investigation. At the same time, the bees will be less exposed to certain stress factors, which will have an impact on their well-being, health and productivity.The results of the chemical analyses show that honeybees and hive products, such as pollen, serve as both bioindicators and passive bioaccumulators of heavy metals, making them effective tools for monitoring environmental pollution.

This research was funded by the Slovenian Agency for Research and Innovation; research project J7-50040 WellBEEing: IoT monitoring of bee colonies in the presence of external stressors

PP-236 [Beekeeping Technology and Quality]
Validation of the Organic Beekeeping Sites by the Support of the GIS

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Organic beekeeping is a sustainable and ecological approach to apiculture that prioritizes the health of honeybee colonies by minimizing chemical interventions and supporting natural behaviors. By maintaining ecological balance and promoting biodiversity, organic beekeeping enhances pollinator health, improves honey quality, and contributes to sustainable agriculture. It integrates organic management practices, natural hive designs, and selective breeding for disease resistance.

The European Union's organic regulation defines specific principles for organic beekeeping, including requirements for beekeeping practices, hygiene, bee breeds, disease prevention, and the location of the apiary itself. This research focuses on the latter - apiary location and its validation using Geographic Information System (GIS). According to organic beekeeping regulations, hives must be located within a 3 km radius of organically cultivated plants, wild plants, or non-organically managed crops and forests that are maintained using methods with a low environmental impact.
Manually validating apiary sites can be challenging, making ICT-based solutions highly valuable. This research demonstrates the application of spatial data from the Rural Support Service of Latvia to analyze the areas surrounding actual and potential apiary locations. Agricultural fields can be considered as organic based on specific spatial data parameters within the database.

In this study, a GIS-based system prototype has been developed to visually assess agricultural fields within the honeybee flight range around an apiary. The system identifies organic and non-organic fields and visualizes the potential foraging fields.

The developed approach and system prototype can be beneficial for regional authorities and policymakers responsible for evaluating beekeepers and granting organic certifications. Additionally, beekeepers and consumers can use this system to verify whether an apiary is located in an organic environment, ensuring that bee products meet organic standards.

PP-237 [Beekeeping Technology and Quality]
“Mixed hive systems to enhance stocking and management of bee colonies in different forest landscapes of Tanzania”

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"In Tanzania, hive systems in use include logs, top bars and frames, each with pros and cons regarding management and production. It is evident that honey and beeswax available in the country's market chains are collected from log and top bar hives. The challenges faced the beekeeping industry at production level include low occupancy rates, durability of the hives less than five years, and a lack of interchangeability. This study was conducted to establish a mixed system of top bars and frames within a box hive, as well as to design a standard octagon shape hive. Three carpentry workshops were utilized at different times: one at Sao Hill Forest Plantation in Iringa, and two in Dar es Salaam - Fine wood works limited and individual carpenter. The designed mixed hive systems consist of sized frames and top bars that fit both top and frame hives, a catcher box combining of top bars and frames, and cylindrical octagonal hives with respective catchers. The systems were tested in three different areas: Mufindi, Iringa, and Mwanga districts, demonstrating the advantage of interchangeable and the ability to transfer swarm of bees from catcher to the top or frame hive. The octagon hive demonstrated movable combs compare to log hive, easy to be made by local Carpenter and adopting forest environment. Additionally, the mixed hive systems have standard measurements that can be replicated to carpenters and interested beekeepers. It is recommended to introduce mixed hive systems to small holder beekeepers in various foraging habitats to test the acceptance of good beekeeping practices and production efficiency."

PP-238 [Beekeeping Technology and Quality]
Chemometric data and physicochemical pattern of Chilean honeys derived from native endemic species of Southern Chile

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Chile boasts a diverse array of native endemic melliferous flora, distributed throughout the country from north to south. The quality of Chilean honeys is recognized internationally, primarily for their excellent taste and beneficial biological properties attributed to their botanical origins.

Honey production in Chile occurs across several regions; however, the southern areas contain numerous native rainforests that offer natural conditions protected from human impact. Honeys sourced from these regions are highly valued, yet they still lack comprehensive analytical characterization.

In this study, we selected seven apiaries located near Lake Ranco (Los Ríos Region) and eight apiaries close to Lake Llanquihue (Los Lagos Region). Honeys from each location were collected over three consecutive harvesting seasons at the end of summer, resulting in a total of 21 honey samples. The samples were analyzed for botanical origin, percentage of humidity, pH, ash content, protein content, total carbohydrates, HMF content, diastase activity, and total phenolic compounds. Additionally, we calculated the ratio of antioxidant activity to phenolic compound content (AA/PCC) based on the obtained data.

The results indicate a significant influence of two native species on antioxidant activity: Caldcluvia paniculata and Weinmannia trichosperma. However, the most noteworthy findings relate to the combination of these species in the final botanical composition of honeys. Data and correlations among the parameters are presented, considering the distribution of the apiaries in the study area.

APIMONDIA SCANDINAVIA 2025
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PP-239 [Beekeeping Technology and Quality]

APIMONDIA SCANDINAVIA 2025
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Physicochemical Characterization of *Apis cerana* F. Honey from Thailand: Implications for Quality Standards

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ABSTRACT ►►►

This study provides a comprehensive physicochemical analysis of the honey produced by the Eastern honey bee (*Apis cerana* F.), obtained from local beekeepers in Southern Thailand during 2023-2024. A total of thirty-five honey samples were assessed for several key quality parameters essential for standardization. The moisture content ranged from 19.7% to 28.3%, while the ash content varied between 0.12% and 0.40%. Electrical conductivity was recorded between 0.28 mS/cm and 0.55 mS/cm. The color ranged from 14.0 to 108.3 mm Pfund, indicating a spectrum from white to amber. pH values were between 3.6 and 4.8, and free acidity ranged from 33.0 to 72.0 mEq/kg. Diastase activity varied from 1.16 to 12.15 DN. Sugar analyses revealed fructose levels from 33.83 to 48.54 g/100 g and glucose from 35.13 to 51.54 g/100 g, with sucrose detected in five samples. Notably, there is a lack of existing data on the physicochemical properties of *A. cerana* honey in Thailand, with only one prior study reporting a moisture content range of 18.5% to 24.5%, which aligns with our findings. These results offer valuable insights into the unique physicochemical characteristics of *A. cerana* honey in this region, contributing to the development of quality standards and the growth of the local honey industry. Further research is warranted to establish specific standards for *A. cerana* honey that align with international benchmarks.

INTRODUCTION

Honey is a natural substance composed of a complex mixture of sugars, organic acids, enzymes, amino acids, minerals, and pollen, which reflects its botanical and geographical origin. It is typically viscous, ranging in color from pale yellow to dark amber, and is known for its distinctive sweetness and therapeutic properties (Crane, 2009). The production of honey involves repeated digestion and regurgitation by honey bees, during which nectar is transformed through enzymatic activity primarily diastase, amylase, and invertase under acidic conditions in the bee's stomach (Cornara et al., 2017).

Among of various honey bee species, *Apis cerana*, commonly known as the Eastern honey bee, is a native species widely distributed across southern and southeastern Asia. It is well known for its remarkable adaptability to diverse ecological conditions, ranging from tropical lowland to mountainous regions and for resilience to environmental stressors and pests. This adaptability is attributed to its genetic diversity and behavioral plasticity, enabling it to survive under varying climatic conditions and floral availabilities (Hepburn & Radloff, 2011).

In agricultural ecosystems, *A. cerana* plays a crucial role in the pollination of a wide variety of crops, including fruits, vegetables, and oilseeds. Studies have shown that its foraging behavior is well-suited to small flowers and native plant species, making it an efficient pollinator in both natural and cultivated landscapes (Partap, 2011).

In Thailand, *A. cerana* has been traditionally managed by local beekeepers, especially in rural and forested areas to produce honey, that is valued for its unique flavor profile and potential medicinal properties, which are influenced by the diverse floral sources in the region. However, there is a notable lack of scientific data on the physicochemical properties of *A. cerana* honey in Thailand. Therefore, this study aims to address this gap by providing a comprehensive physicochemical characterization of *A. cerana* honey collected from local beekeepers in Southern Thailand during 2023–2024. By analyzing key quality parameters, the findings offer valuable insights for the development of specific quality standards for *A. cerana* honey. Establishing such standards is essential not only for ensuring product quality and consumer safety but also for supporting the sustainable growth of the local honey industry and aligning with international benchmarks.

MATERIALS AND METHODS

35 samples were collected from a mixed deciduous forest area within Pathio district, Chumphon province, southern Thailand

Honey physicochemical analysis

- Ash content (AOAC Method 920.181, 2000)
- Diastase activity (AOAC Method 958.09, 2000)
- Electrical conductivity (IHC Method (2009)
- Moisture (AOAC Method 963.38, 2000)
- pH and free acidity (AOAC Method 962.19, 2000)
- Color (Hanna Honey Color HI 96785 colorimeter)
- Sugar content (AOAC Method 977.20 (1977), HPLC with Refractive Index Detector HPLC)

RESULTS AND DISCUSSION

Table 1 Physicochemical Characteristics of *Apis cerana* (AC) honey compare with *Apis dorsata* (AD) and *Apis mellifera* (AM) Honey (TAS 8003-2013 Standard)

Sample	Ash (%)	Diastase (DN)	EC (mS/cm)	Moisture (%)	Free acidity (meq/kg)	pH	Color (Pfund)
AC_PT01	0.28	1.16	0.33	22.20	73.17	3.58	45.00
AC_PT02	0.29	5.29	0.40	20.23	34.67	4.10	26.67
AC_PT03	0.40	3.77	0.50	21.27	48.33	4.05	56.33
AC_PT04	0.19	1.89	0.33	19.17	56.50	3.68	87.00
AC_PT05	0.29	3.64	0.44	21.33	50.33	4.12	41.00
AC_PT06	0.37	3.50	0.55	22.03	40.50	3.97	52.00
AC_PT07	0.25	2.40	0.54	23.67	58.17	3.69	108.33
AC_PT08	0.31	3.15	0.36	25.17	33.33	3.87	14.00
AC_PT09	0.36	4.68	0.46	28.10	44.50	4.06	45.67
AC_PT10	0.36	5.14	0.51	19.20	38.00	4.14	36.67
AC_PT11	0.31	2.53	0.55	20.33	62.83	3.66	88.33
AC_PT12	0.32	3.17	0.54	20.40	56.00	3.81	73.00
AC_PT13	0.23	3.97	0.44	21.90	50.83	4.10	38.00
AC_PT14	0.33	2.82	0.44	23.60	51.00	3.79	76.00
AC_PT15	0.26	4.51	0.44	20.77	48.33	4.12	45.00
AC_PT16	0.25	2.94	0.54	21.07	51.00	3.75	75.00
AC_PT17	0.24	4.25	0.44	24.17	44.00	3.78	48.00
AC_PT18	0.29	5.26	0.46	19.97	43.50	3.81	50.33
AC_PT19	0.31	6.59	0.46	21.17	43.33	3.74	71.67
AC_PT20	0.33	6.70	0.53	22.90	53.00	3.69	107.33
AC_PT21	0.23	3.86	0.50	22.13	52.67	3.68	59.00
AC_PT22	0.30	3.15	0.50	22.73	52.00	3.75	94.33
AC_PT23	0.21	5.52	0.28	21.70	43.67	3.85	50.33
AC_PT24	0.30	5.47	0.44	25.13	46.00	4.14	46.67
AC_PT25	0.16	5.67	0.39	28.30	41.83	4.09	41.67
AC_PT26	0.38	5.06	0.45	25.43	45.67	4.21	45.00
AC_PT27	0.21	6.01	0.41	24.33	47.17	4.01	37.00
AC_PT28	0.30	3.63	0.50	22.40	49.00	4.00	75.33
AC_PT29	0.22	12.15	0.39	25.00	51.33	3.94	41.00
AC_PT30	0.20	5.85	0.50	22.63	61.00	3.91	89.67
AC_PT31	0.25	5.60	0.43	25.00	58.33	3.84	70.67
AC_PT32	0.27	6.00	0.43	22.87	49.33	4.03	44.00
AD_01	0.35	1.99	0.45	26.80	40.33	4.13	35.67
AD_02	0.29	3.70	0.42	27.53	48.00	4.09	30.67
AD_03	0.12	3.47	0.44	27.33	54.67	3.87	42.67
AM Honey TAS 8003-2013 Standard	< 0.6	> 3.0	< 0.8	< 21.0	< 50	Not specified	Not specified

Remark: Color of honey; ■ White, ■ Extra Light Amber, ■ Light Amber, ■ Amber

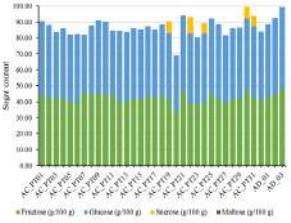

Figure 1 The Sugar Profile of *Apis cerana* Honey Samples from Southern Thailand

The moisture content of *A. cerana* honey ranged from 19.7% to 28.3%, with a mean of 24.0%. However, according to *Apis mellifera* L. honey standards, moisture content typically should not exceed 20% to prevent fermentation.. (Bogdanov et al., 2004).

The ash content (0.12–0.40%) and electrical conductivity (0.28–0.55 mS/cm) reflect moderate mineral levels typical of floral honey (Terrab et al., 2003). Color varied widely (14.0–108.3 mm Pfund), indicating diverse nectar sources (Partap, 2011). pH values (3.6–4.8) and free acidity (33.0–72.0 mEq/kg) suggest good acidity and antimicrobial potential. Diastase activity (1.16–12.15 DN) demonstrate enzymatic variability that may be influenced by heat exposure or floral origin (White, 1978). Compared to standards for *A. mellifera* honey, the fructose (33.83–48.54 g/100 g) and glucose (35.13–51.54 g/100 g) contents of *A. cerana* honey are generally lower. Typical *A. mellifera* honey exhibits total reducing sugars often exceeding 60 g/100 g, indicating *A. cerana* honey may have a comparatively lower sugar concentration, potentially influenced by regional floral sources and bee species.

CONCLUSION

The physicochemical analysis of *A. cerana* honey from Southern Thailand reveals distinct characteristics, including high moisture variability, moderate mineral content, and diverse sugar profiles. These findings highlight the need for species-specific quality standards. Establishing such standards will enhance product reliability and support sustainable development of the local honey industry.

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PP-240 [Beekeeping Technology and Quality]

EUCALYPTUS HONEY FROM THE FORESTS OF PORTUGAL. WHAT IS IMPORTANT TO KNOW? WHAT REMAINS TO BE DONE!

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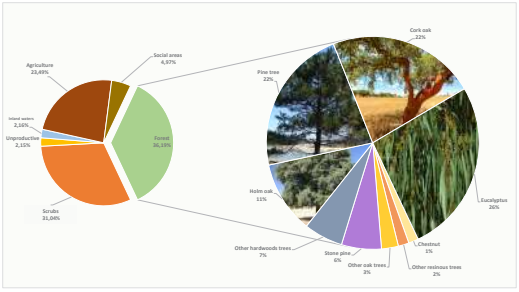
INTRODUCTION

In Portugal, *Eucalyptus* is a forest species of significant economic relevance, covering about 25% of the forest area. These forests are also a significant resource for bees, and specifically for *Apis mellifera iberiensis*, providing abundant nectar, pollen and propolis. This study aimed to evaluate the foraging patterns of *A. mellifera* in eucalyptus forests, as well as the physicochemical, microbiological, and palynological characteristics of the honey produced.



Portugal main land uses and surfaces occupied by forest species

METHODS

During 2024, pollen samples were collected biweekly from two hives in the same apiary, and capped honey samples were obtained during the eucalyptus flowering season. Samples of *eucalyptus* honey were also collected from different regions of the country. Pollen analysis was used to identify associated flora and all honeys were characterized by microbiological, physical-chemical and pollen evaluation. The results are presented and discussed in the context of forestry and beekeeping practices, the honey produced and the impacts on both species, man and *Apis mellifera iberiensis*, from the perspective of One Health and Planetary Health.

Location of sampled apiaries

Honey bee pollen loads

Honey sample collection

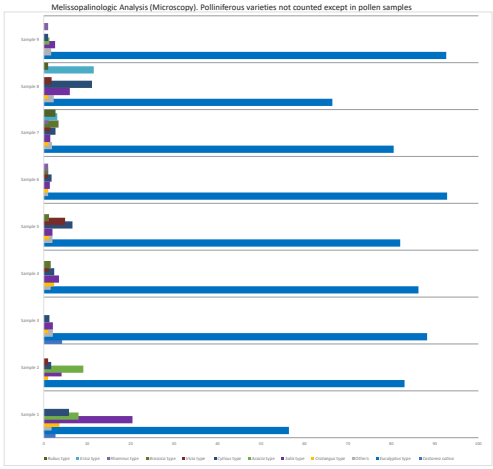
RESULTS & DISCUSSION

Characterization of 9 Eucalyptus monofloral honeys by microbiological, physicochemical and pollen evaluation

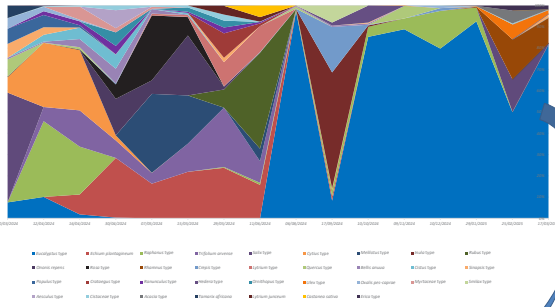
Physical - Chemical parameters	Average	±	SD	Units
Conductivity (20°C)	5,62	±	0,72	x10⁻³ S/cm
pH	3,99	±	0,12	UpH
Free acid	23,42	±	4,26	meq/kg
Hidroxymethylfurfural (HMF)	4,00	±	1,09	mg/kg
Moisture (20°C)	17,48	±	0,72	%
Carbohydrates	81,80	±	0,40	
Fructose	40,17	±	1,36	%
Glucose	29,67	±	1,73	%
Sucrose	1,23	±	0,85	%
Maltose	1,70	±	0,27	%
Fructose / glucose ratio	1,36	±	0,10	-
Fructose + Glucose	69,78	±	2,48	%
Diastase activity	19,48	±	1,82	U Gothe/Schade
Color	65,33	±	18,22	mmPfund
Antioxidant capacity ABTS (SC50)	208,82	±	41,82	mg/ml
Trolox equivalent antioxidant capacity (TEAC)	8,11	±	1,18	µMolTE/g
Total polyphenols	10,90	±	1,33	mgEi/100g
Methylglyoxal (MGO)	32,67	±	3,09	mg/kg
Catalase Activity	38,24	±	24,60	U/g
Peroxidase activity	1,10	±	0,12	U/mg protein
Protein	0,42	±	0,07	%
Fat	<0,1			%
Saturated fatty acid	<0,1			g/100g
Salt	17,90	±	11,86	mg/100g
Energy	329,00	±	1,55	Kcal/100g
Sodium (Na)	71,40	±	47,45	mg/kg

SD standard deviation

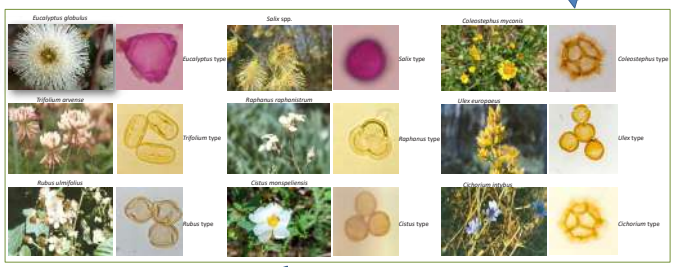
Melissopalinologic Analysis (Microscopy). Polliniferous varieties not counted except in pollen samples



Plant species foraged by honey bees - associated with the sampled pollen



Some species observed in apiaries and types of pollen



CONCLUSION

- ✓ All honeys present values within the limits permitted by regulamentation;
- ✓ *Eucalyptus* spp. was a predominant source used by honeybees, and was detected in 100% of the analysed samples;
- ✓ The relative frequency of the *eucalyptus* pollen in these honeys exceeds 45%, and therefore been considered monofloral *eucalyptus* honey (Von Der Ohe W, et al., 2004);
- ✓ Monofloral honeys contained several pollen types with a considerable percentage of pollen grains from *Eucalyptus* type, and also from *Erica* type, *Acacia* type, *Salix* type, *Cytisus* type, *Castanea sativa*, *Rubus*, and other minoritary species;
- ✓ Honeys showed significant antibacterial activ typeity, associated with low pH and low protein content;
- ✓ High-quality honeys were confirmed by low HMF content (a parameter related to freshness and food quality) and high diastase activity.;
- ✓ High value of methylglyoxal, catalase and peroxidase activity and total polyphenols gives these honeys high medicinal value;
- ✓ Monofloral honey from *Eucalyptus* spp. was characterized by its high pollen content, antimicrobial properties and high antioxidant power.

PERSPECTIVES

- ✓ Pollen and honey data provided a reliable fingerprint of the environment from which the *eucalyptus* honey originated;
- ✓ As *eucalyptus* pollen represents the majority of the detected pollens, these honeys could be further enriched with undergrowth and/or ecological corridors and still be considered monofloral;
- ✓ A greater abundance of floral species could increase honey production.

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APIMONDIA SCANDINAVIA 2025
SWEDEN | DENMARK | NORWAY

PP-241 [Beekeeping Technology and Quality]

Analysis of nectar production characteristics and quality of Buckwheat honey in Taiwan

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Abstract
Buckwheat honey is rich in protein and phenolic compounds, has high nutritional value and excellent antibacterial and antioxidant capacities, and is a functional food. In Taiwan, bee colonies lack nectar sources in winter, and beekeepers must feed them sugar to help them survive the winter. As a winter crop in Taiwan, buckwheat can provide a supplementary nectar source for bee colonies. This study compared the total flavonoid content and antioxidant capacity of Taiwan buckwheat honey with other nectar source of honey and explored the weekly changes in the number of flowers and nectar production during the flowering period of buckwheat, as well as the daily changes in nectar production, to evaluate the potential of producing buckwheat honey in Taiwan. The results showed that the total flavonoid content of buckwheat honey was significantly higher than that of lychee honey and Chinese tallow honey, and the antioxidant capacity was also better than that of longan honey, lychee honey, Chinese tallow honey, and Chinese chaste tree (Vitex negundo) honey. Buckwheat reached its blooming stage on the 50th day after planting, and the highest nectar production per plant was 35.71 μL on the 43rd day after planting. The average nectar production per flower was highest during the pre-blooming stage, and the morning period was usually higher than the afternoon, with nectar production varying with the flowering period and time. This study confirms that Taiwan buckwheat honey has nutritional value and commercial production potential, which can provide a reference for future beekeepers to utilize the buckwheat as a supplementary nectar source and produce buckwheat honey.

Introduction
Buckwheat (*Fagopyrum esculentum* Moench), as an important nectar plant in Taiwan during winter, has garnered significant attention due to the distinctive flavor and potential health benefits of its honey. To gain a comprehensive understanding of the quality characteristics and nectar production potential of Taiwanese buckwheat honey, this study aims to investigate the flowering characteristics and nectar yield variation of buckwheat in Taiwan. Additionally, two key bioactivity indicators of buckwheat honey—total flavonoid content and DPPH radical scavenging capacity were evaluated.

Materials and Methods
Weekly Flowering Quantity and Nectar Yield during Buckwheat Blooming Period:
Buckwheat was cultivated in a greenhouse trial plot using common buckwheat (*Fagopyrum esculentum* Moench). Six plants were randomly selected, and surveys were conducted once a week during the flowering stage at three time points: 7:30 a.m., 11:30 a.m., and 15:30 p.m., over five weeks. For each survey, the number of flowers and total nectar volume per plant were recorded. Nectar was collected using 5-μL micro-capillary tubes (Figure 1), and the volume was measured to calculate the nectar yield per plant. This was further converted into nectar yield per unit area.

Honey Bioactivity Indicators:
Samples included five types of honey from Taiwan: buckwheat, longan, Chinese chaste tree (*Vitex negundo*), Chinese tallow, and lychee, one sample per type. Total flavonoid content and DPPH radical scavenging activity were measured three times per sample, and the average values were recorded.

1. Total Flavonoid Content (TFC): The aluminum chloride colorimetric method was used. A standard curve was established using quercetin dissolved in methanol (MeOH) at concentrations of 0, 25, 50, 75, 100, and 150 ppm. Each honey sample was diluted 1:1 (v/v) with ddH_2O. For each test, 250 μL of diluted sample or standard solution was mixed with 50 μL of 10% aluminum nitrate, 50 μL of 1 M potassium acetate, and 1.3 mL of ddH_2O. After mixing, the solution was incubated in the dark at room temperature for 40 minutes. Absorbance was measured at 415 nm using a spectrophotometer to calculate total flavonoid content.
2. DPPH Radical Scavenging Capacity: The DPPH colorimetric assay was conducted. DPPH solution was prepared by dissolving 2 mg of DPPH in methanol (MeOH) and bringing the volume to 50 mL (0.1 mM), stored protected from light. Each honey sample was diluted 1:1 (v/v) with ddH_2O. The assay was divided into three groups: Control group (A): 150 μL ddH_2O + 1.35 mL 0.1 mM DPPH solution; absorbance measured at 528 nm. Sample group (B): 150 μL diluted honey sample + 1.35 mL 0.1 mM DPPH solution; incubated at room temperature for 5 minutes; absorbance measured at 528 nm. Sample background group (C): 150 μL diluted honey + 1.35 mL methanol; absorbance measured at 528 nm. Scavenging rate was calculated as Scavenging Rate = [A - (B - C)] / A × 100%

Results
Weekly Flowering Quantity and Nectar Yield:
Flowering of buckwheat began on day 23 after sowing. Flower surveys were conducted once a week on days 28, 36, 43, 50, and 58 after sowing. The average number of open flowers per plant on these days was 17.3, 180.5, 537.0, 695.8, and 128.7, respectively. The number of flowers increased weekly, reaching a peak of 695.8 flowers per plant on day 50 (Figure 2). The peak nectar yield per plant occurred on 43 days after sowing, reaching 35.71 μL., Due to potential interference by dew or residual nectar at 7:30, only data from 7:30–11:30 and 11:30–15:30 time periods were used to calculate cumulative nectar yield. After adjustment, the highest corrected nectar yield per plant was 7.19 μL on 43 days after sowing (Table 1). With an average plant density of 162 plants/m², the total nectar yield per square meter also peaked on 43 days after sowing, reaching 1,165 μL/m² (Figure 3).

Honey Bioactivity Indicators:
1. Total Flavonoid Content: The average total flavonoid content of buckwheat, longan, Chinese chaste tree, Chinese tallow, and lychee honey was 132.6, 110.0, 71.9, 26.4, and 35.1 ppm, respectively. Buckwheat honey exhibited higher flavonoid content than the other honey types, particularly compared to Chinese tallow and lychee honey (Figure 4).
2. DPPH Radical Scavenging Capacity: The average DPPH radical scavenging rates of buckwheat, longan, Chinese chaste tree, Chinese tallow, and lychee honey were 96.7%, 22.7%, 32.1%, 15.8%, and 14.4%, respectively. Buckwheat honey showed significantly higher scavenging activity compared to the other honey samples (Figure 5).

Discussion
Weekly Flowering Quantity and Nectar Yield:
Total nectar production peaked on day 43, while the highest flower count occurred on day 50, one week apart. This suggests that although the number of open flowers was highest on day 50, the number of newly opened flowers had begun to decline. Since new flowers tend to produce more nectar, the higher nectar yield on day 43 is likely due to a greater number of freshly opened flowers. Therefore, for bee colonies, the optimal time to collect buckwheat nectar may be before the peak bloom, rather than during blooming. In terms of diurnal nectar variation, more nectar was observed in the afternoon (11:30–15:30) on days 28 and 36, whereas more nectar was found in the morning (7:30–11:30) after day 43. This could result in the peak foraging time of bees shifting earlier than the actual full bloom period. This study provides valuable data on nectar production during buckwheat blooming, offering practical references for beekeepers considering buckwheat as a supplementary nectar source or for buckwheat honey productivity.

Honey Bioactivity Indicators:
Longan, lychee, and Chinese tallow kinds of honey are commonly found in Taiwan, while Chinese chaste tree honey is a specialty from southern Taiwan. This preliminary comparison shows that buckwheat honey exhibits higher total flavonoid content and DPPH radical scavenging activity than the other samples, indicating its potential as a distinctive honey rich in antioxidants. These advantages in flavonoid content and antioxidant activity may be attributed to the accumulation of specific secondary metabolites in buckwheat plants. As only one sample per honey type was tested in this study, future studies involving a larger number of samples are needed to further assess the nutritional and health potential of buckwheat honey, providing strong support for its market promotion.

Table 1. Weekly nectar production per plant at 7:30, 11:30 and 15:30 by buckwheat.

Days from sowing	Nectar volume (μL)			
	7:30	11:30	15:30	Total
28	1.04 ± 0.60[z]	0.10 ± 0.04	0.34 ± 0.15	1.47 ± 0.74
36	0.82 ± 0.23	0.54 ± 0.14	1.07 ± 0.33	2.43 ± 0.60
43	28.52 ± 10.23	4.52 ± 2.69	2.67 ± 1.04	35.71 ± 13.73
50	4.53 ± 3.07	1.23 ± 0.41	0.61 ± 0.20	6.37 ± 3.41
58	6.47 ± 4.00	0.66 ± 0.21	0.24 ± 0.10	7.38 ± 4.07

[z]Mean ± standard error (n = 6).

Figure 1. Buckwheat nectar was collected using a 5 μL capillary tube.

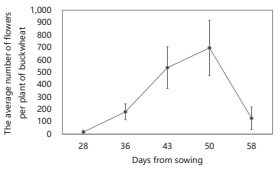

Figure 2. The average number of flowers per plant of buckwheat per week. Error bars represent ±SD (n = 6).

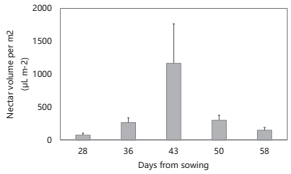

Figure 3. Corrected weekly nectar production per m² at 11:30 and 15:30 by buckwheat. Error bars represent ±SE (n = 6).

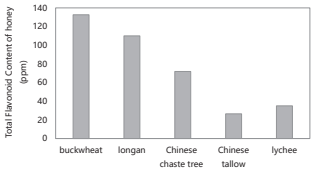

Figure 4. The total flavonoid content of honeys.

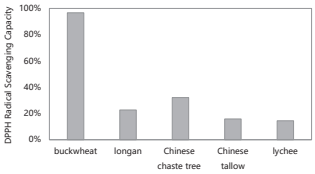

Figure 5. DPPH radical scavenging capacity of honeys.

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PP-242 [Beekeeping Technology and Quality]

CHEMICAL MARKERS IN ITALIAN PROPOLIS: CHRYSIN, GALANGIN AND CAPE AS INDICATORS OF GEOGRAPHIC ORIGIN

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Bee propolis, a natural resinous material, is widely known for its medicinal and biological benefits. Despite variations in its botanical and geographical origin, propolis consistently shows antioxidant, immunomodulatory, and antimicrobial properties [1]. However, these general properties are insufficient for its rational application in modern medicine, highlighting the need for further research.

A comprehensive research is essential to explore the chemical and pharmacological properties of propolis, focusing on its mechanisms of action, specific targets, and the unique phytocomplexes that vary with its geographical origin.

The aim of this work, focused on Italian propolis (generally poplar-type), is to better investigate and to clarify the chemical composition of samples collected in different geographical areas, providing an update and deeper insight into the current literature.

METHODS

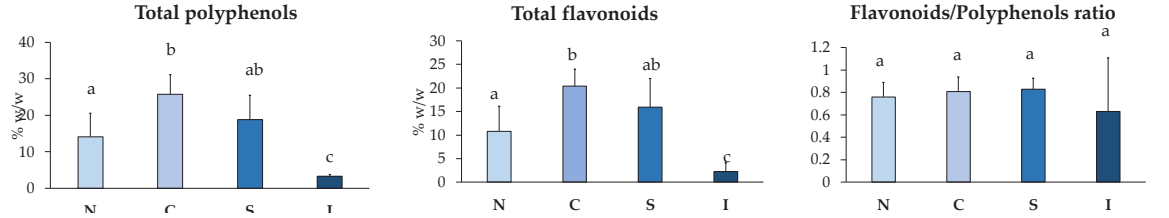
Twenty-seven propolis samples were collected in the same year (2020) throughout Italy and were grouped by geographical areas: Northern (N), Central (C), Southern regions (S) and Islands (I). The cleaned and dewaxed samples were solubilized in EtOH 75% (v/v) at a concentration of 10 mg/mL.

TPs analysis was perfomed following the Folin-Ciocâlteu assay, measuring absorbance at 700 nm. Gallic acid was used as standard and results were expressed as % w/w gallic acid equivalent.

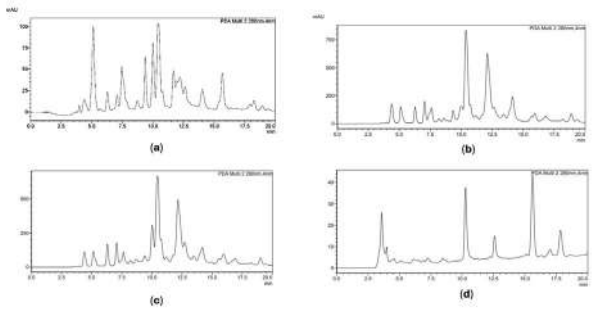
For **TFs analysis**, samples were diluted 1:200 in 75% ethanol and absorbance was recorded at 353 nm. Galangin was used as the standard and results expressed as % w/w galangin equivalent [2;3].

For the HPLC analysis, a gradient elution mode was employed using water and methanol, both acidified with 0.1% FA, as mobile phases. Chromatographic detection was performed at 280 nm. Samples were diluted at a 1:10 ratio, filtered (0.44 µm) and injected (10 µL). Peak identification was carried out by comparing retention times and UV spectra with reference standards: pinocembrin (PIN), chrysin and galangin (CHR and GAL), caffeic acid phenethyl ester (CAPE).

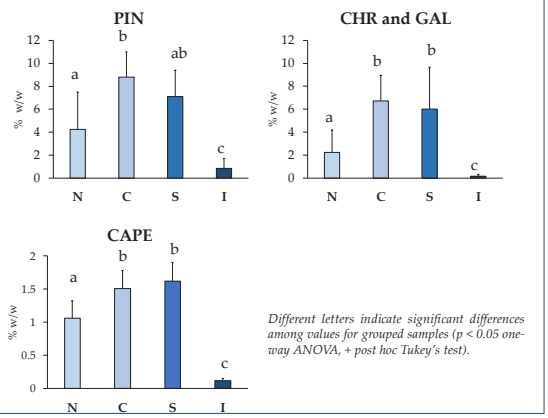
RESULTS



Different letters indicate significant differences among values for grouped samples ($p < 0.05$ one-way ANOVA, + post hoc Tukey's test).



Chromatograms recorded at 280 nm. Representative samples from North (a), Central (b), South (c) and Islands (d). PIN retention time (RT) = 10.4 min, CAPE at RT = 11.2 min, CHR at RT = 12.1 min, GAL at RT = 12.5 min.



Different letters indicate significant differences among values for grouped samples ($p < 0.05$ one-way ANOVA, + post hoc Tukey's test).

CONCLUSION

This study demonstrates that simple and rapid UV methods, such as total polyphenol (TPs) and total flavonoid (TFs) analysis, can effectively distinguish propolis from different geographical regions. Poplar-type propolis is primarily characterized by a high polyphenol content, particularly flavonoids, with significant regional variations. Despite these differences, flavonoids consistently represented the main phenolic subclass, maintaining a similar TF/TPs ratio across samples grouped by geographical area. Furthermore, HPLC-DAD analysis of key markers enabled a more precise determination of propolis origin.

In conclusion, while this research provides a solid foundation for developing more advanced methods to assess and authenticate the geographical origin of propolis, it remains a preliminary study. Further investigations are required to explore specific subregions and refine the analysis beyond the major constituents.

[1] Burlando et al., 2013
[2] Governa et al., 2020
[3] Sberna et al., 2022
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PP-243 [Beekeeping Technology and Quality]
New insights in the thermal properties of the Dadant bee hives to make them less sensitive to weather condition

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Temperature in the hives is a factor influencing bees behavior, health and the beekeeper's productivity. Various interviews of beekeepers in their apiaries, throughout Europe, provide information on their initiatives to modify their hives for the health of their bees (varroa control, mitigation of climate change). These modifications influence internal hive hygrothermal conditions and raise scientific questions to the researchers: what changes affect hive temperature ? and to what extent ? The hive acts as an "intermediary object", as hive modification practices require discussions and create relationships between beekeepers and others. Scientists, too, are involved to discuss beekeepers' percetion of the effectiveness of their innovation on bees, through their beehive instrumentation work. The variations of hive temperatures depend on many factors. As this study focuses on environmental factors, only empty hives are instrumented to assess their thermal properties. Long-term and short-term summer/winter temperature sensor data from various modified Dadant hives provide quantitative information on the amount of energy exchanged with the external environment, e.g. when a roof is painted white, or when an empty, overturned feeder is under the roof (with or without polystyrene), as well as on the reaction time of the hive fitted with aluminium partitions. The results show that the thermal properties of hives, and thus hive temperatures, can be changed in a large extent with minor modifications of the hive. Depending on materials, paints, structures, the sensitivity of the hive temperatures to the solar irradiance and/or external air temperature can be made higher or lower, depending on the beekeeper wish. This knowledge of the changes made to the hives and the control of their internal temperature should enable beekeepers to identify and reduce any thermal stress before it occurs - while minimizing the number of interventions on the apiaries, and move towards more sustainable beekeeping through greater care for the bees, helping them to adapt to climate change.

PP-244 [Beekeeping Technology and Quality]

BEESWAX ESSENTIALS

Dr. Nancy Simpson
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RENDER

Turkey pot very fast render

Double boiler so traditional

Baking cooks low and slow

Solar melter uses sunshine

RE-FORM

Outdoor wax cooling

Wax cake with debris

Golden melt

Cooling wax cake

REVEAL

Beeswax one ounce bars

Light wax sculpture

Pine candles for show

Candle variety - added color

APIMONDIA SCANDINAVIA 2025
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PP-245 [Beekeeping Technology and Quality]

Synergistic Effects of Protein Diets and Management Practices on Health and Productivity of Apis mellifera Colonies

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INTRODUCTION

Bees are key pollinators essential to ecological balance and global agriculture (Grozinger & Flenniken, 2019). Their primary energy source is carbohydrates from floral nectar, stored as honey, while nutrient deficiencies impair colony development, increase stress, and reduce productivity (Bryś & Strachecka, 2024). In tropical regions such as Brazil, seasonal fluctuations and drought frequently induce nutritional stress, particularly in Africanized populations. Under these conditions, artificial protein supplementation enhances colony performance and brood production, mitigating field losses and improving individual health (Morais et al., 2013; Paiva et al., 2019a; Kim et al., 2024). Colony health and nutrition also depend on management practices, with measures such as replacing old combs and requeening contributing to improved welfare (Goulson et al., 2015).

METHODS

The study was conducted in the city of Bambuí (20° 00′ 21″ S, 45° 58′ 37″ O), located in the state of Minas Gerais (Fig 1), within the Cerrado biome in Southeast Brazil.

The three experimental apiaries were located approximately 6 kilometers apart in a straight line, ensuring similar climatic exposure while maintaining spatial independence. The artificial food supplements artificial supplementation consisted of a protein diet (Table 1) developed from mixtures of low-cost ingredients easily accessible to beekeepers. All ingredients were subjected to nutritional analysis before being used in the formulations. The diet was formulated so that the final crude protein percentage was 25%, a value established based on our previous experience (Morais, Turcatto, Francoy, et al., 2013; Morais, Turcatto, Pereira, et al., 2013) and similar studies conducted by international research groups (Li et al., 2012).

Table 1:	Composition of the protein feed used.
	Ingredients
Control (C-)	Treatment (T)
Sugar Syrup 50%	10% Egg powder 34% Wet grain 36% Sugarcane yeast 20% Sugar Enough 70% syrup to give a pasty consistency

RESULTS

The results demonstrated that the combination of protein supplementation and proper management practices significantly improved colony performance, particularly in apiaries with recommended conditions.

In Apiary 2, which included queen replacement and comb renewal, brood production increased significantly, reaching 70% of frames occupied in September, reflecting a stronger potential workforce. Apiaries under intermediate management also showed benefits, albeit less pronounced. In contrast, Apiary 1, under poor management, exhibited only modest improvements even with protein supplementation, underscoring the necessity of integrating nutritional interventions with management practices to achieve optimal results. The protein diet was highly accepted, with over 90% consumed by all treated colonies, corroborating previous studies that emphasize the efficacy of nutritional supplements in supporting colonies during resource scarcity. Management practices, such as comb and queen replacement, were critical in improving key indicators, including food storage and reducing empty cells, mitigating the impact of stressors like parasites and diseases.

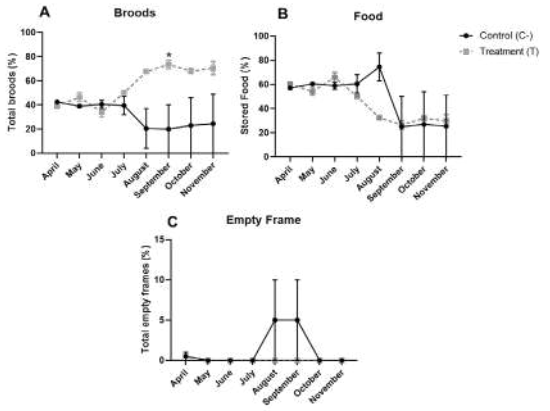


Figure 1 - A: Percentage of total brood; B: Percentage of stored food; C: Total number of empty frames in Apiary 2, from April to November. Results are shown as mean ± SEM. $p < 0.05$ is indicated by "*". The comparison between the control (C-) and treatment group (T), carried out using the Sidak test.

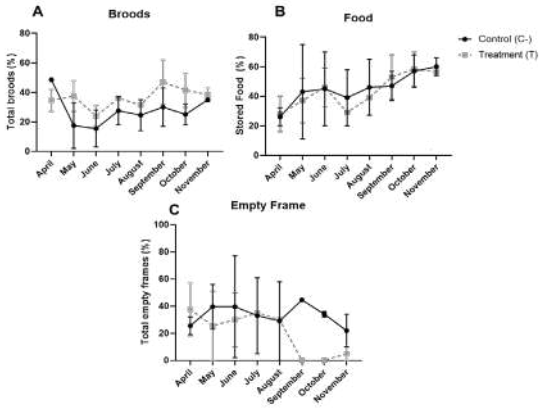


Figure 2 - A: Percentage of total brood; B: Percentage of stored food; C: Total number of empty frames in Apiary 1, from April to November. Results are shown as mean ± SEM. $p < 0.05$ is indicated by "*". The comparison between the control (C-) and treatment group (T), carried out using the Sidak test.

CONCLUSIONS

The study concludes that combining protein supplementation with proper colony management significantly strengthens colony resilience and productivity during critical periods of resource scarcity. These findings emphasize the importance of integrated approaches to promote bee colony health and resilience, essential for pollinator conservation and global food security. Moreover, they underscore the need to train beekeepers in sustainable practices to ensure effective implementation and foster the sustainable development of apiculture in ecologically and economically vulnerable contexts.

FUNDING

2025/09823-7 FAPESP

PP-246 [Beekeeping Technology and Quality]

Primal Bee®

Primal Bee: A sustainable beekeeping solution for climate challenges

G. Riganti, A. Gamberoni, T. Moldovan, E. Nir, Y. Melman, J.R.Graham

Thermal Balance: The Key to Colony Survival

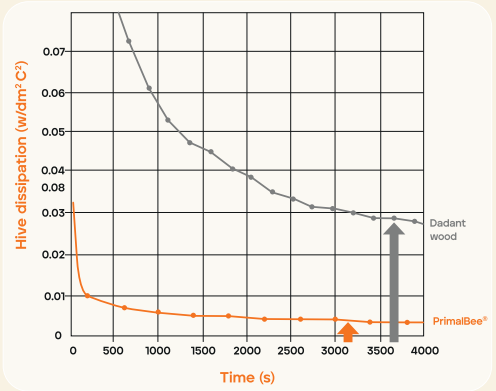
Honey bees' ability to thermoregulate their hive is a key adaptation for honey bee survival, especially in challenging climates. The ideal internal hive temperature is ~36°C (96°F). Hotter or colder temperatures can negatively impact the queen's egg-laying production and the brood (eggs, larvae, and pupae). The honey bee has several behavioral adaptations to maintain this equilibrium including clustering and vibrating to warm the colony and fanning, ventilating and evaporating water to cool the colony.

Energy Drain in Traditional Hives

Thermoregulation costs energy needed to fuel water collection flights, fan wings, and thoracic muscles to cluster, vibrate and ventilate within the hive. The efforts of thermoregulation can be lost through dissipation of heat through cracks, seams or thin walls of the standard wooden hive. This can be very energetically expensive for the bees to heat, cool and maintain their hive. Many improvements can be made to the hive design to reduce this energetic cost through thermodynamic engineering and design.

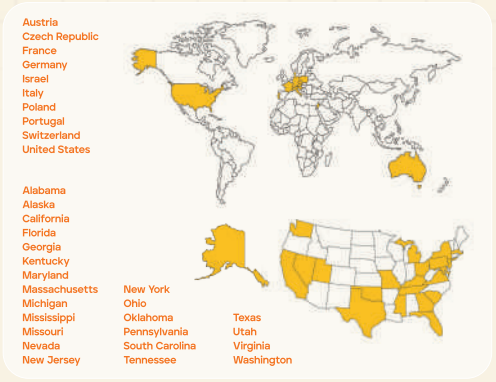
Thermodynamic Advantage: Engineering for the Bees

Since 2015, thermodynamics were compared through quantitative and qualitative measures in the Primal Bee Hive project. Innovative engineering provided an unexplored competitive advantage for honey bees. In a thermodynamic hive, bees expressed increased productivity due to perfect thermoregulation. This advantage created a better incubation process: better temperature control at lower energetic cost. Hive design is fully integrated with the biological needs of honey bees and it is a fully natural solution.



Thermodynamics in the Real World

The PrimalBee nest design was evaluated through extensive research and field testing in diverse climates —including Alaska, Australia, and the Israeli desert— the Primal Bee hive provides a solution to climatic challenges. Its insulative qualities and geometric design reduces heat loss and optimizes heat efficiency. The thermodynamic hive helps mitigate extreme weather impacts on colony health resulting in less honey consumption and larger, healthier honey bee populations.



Quantifying the PrimalBee Advantage

Field results have demonstrated significant improvements, including a 500% increase in thermodynamic efficiency in thermodynamic hives compared to standard wooden Landstroth hives (insulated wooden Langstroth hives only increased thermodynamic efficiency by 35%), doubled bee populations and honey production, and reduced colony loss. The Primal Bee hive enhances colony resilience against climate-related stressors while promoting sustainability in apiculture and by bridging scientific innovation with practical beekeeping needs.

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PP-247 [Beekeeping Technology and Quality]

Health properties of black honeybee honey: impact of harvesting and storage procedures on the product's antioxidant properties

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[3]Head of the Slow Food Presidium for the Sicilian Black Bee, Queen Bee Breeder - CREA Bologna Registry, Honorary President of the Apis mellifera siciliana Breeders Association

Background
Honey contains phytochemicals, as polyphenols, that give the product antioxidant properties and, consequently, health benefits. The content of phytochemicals is directly related to the floral origin, species of bee, environmental conditions and nature of the soil.

Problem description
We investigated how the length of time honey stays in the hive before harvesting may impact its polyphenol content and how the moisture level in honey affects the stability of these phytochemicals.

Metodology
About ten hives of Sicilian black honeybee (Apis mellifera ssp. sicula) were placed in a field of Sulla at the beginning of the flowering period (April). The honey from half super of each hive was collected after one week (rapid harvest), while the honey from the remaining ones was collected at the end of the plant's flowering (traditional harvest). Both the honeys were subjected to a dehumidification process to reduce the water content to 14%, 16%, or 18%. The Folin–Ciocalteu reaction, was used to determine total phenol content (TPC). Quantitation was by reference to gallic acid (5–100 µg/mL), and results expressed as gallic acid equivalents (GAE, milligrams/100 g. Antioxidant capacity of honeys was evaluated by ABTS•+ decoloration assays in comparison with Trolox.

Results and Discussion
The TPC content in the honey obtained through rapid harvest was 35.58 ± 2.6 mg GAE/100g (n=5), while that measured in the honey obtained from the same hive through traditional harvest was 19.8 ± 0.92 mg GAE/100g (n=5). This data shows that the honey left in the hive for about two months before harvesting, loses approximately 45% of its polyphenol content. Furthermore, while the TPC content of honey with 14% and 16% moisture did not change after 90 days of storage at room temperature, the polyphenols level decreased by about 15% in honey with 18% moisture.

Practical iimplication for beekeepers
Rapid honey extraction preserves the antioxidant capacity of honey compared to the traditional procedure. Moreover, reducing the product's moisture content to 16% limits the loss of polyphenols over time and it increases health value of the honey.

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PP-248 [Beekeeping Technology and Quality]

EUROHONIG®
Innovative Beekeeping solutions

PATENT PENDING

MAGNETTO

validation of a novel, easy-to-use and reliable tool for fast and stress-free capturing of queens

M.Eng. Constantin Dobrescu[1]; Dr. Martin Hintersteiner[1,2]

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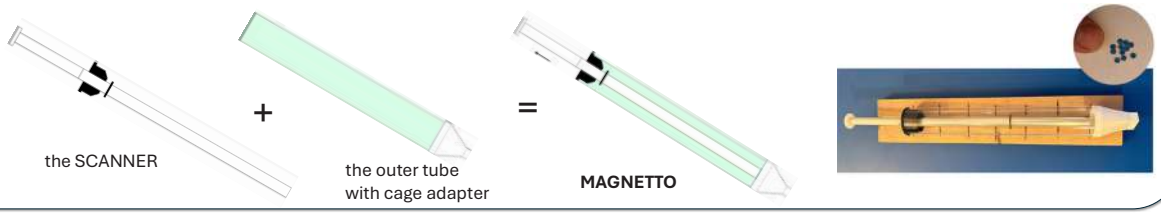
Keywords: beekeeping technology, practical beekeeping technologies, improvement of beekeeping practices, queen caging, requeening.

Background
The queen is arguably the most important individual in the honeybee colony: a vital young queen will lead to a strong and healthy population, her pheromone production will keep the colony together, and her genetics will shape the behaviour of the colony. Queens are also the only perennial animal of the colony, and as such more sensitive to intoxication from e.g. acaricides. Hence there are many situations and instances where it is desirable to be able to quickly find, capture and remove the queen from a colony in order to perform certain beekeeping practices, such as re-queening, swarm control, or varroa treatment.

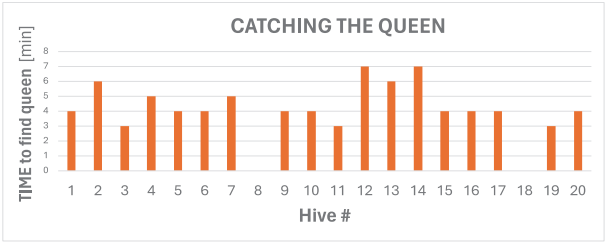
Problem Description
We therefore set out to develop a tool based on magentism, which allow to easily find the queen even in strong colonies without the need for lengthy inspection of individual frames.

Magnetto – the new tool
It consists of 2 components: the scanner & the outer tube. In addition, ferromagnetic plates are needed for marking the queen



How to find and capture the queen from a hive using MAGNETTO

Validation of MAGNETTO in a field test



Magnetto allows to find and capture a queen from a strong hive within 5 minutes on average with a success rate of 90%.

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PP-249 [Beekeeping Technology and Quality]

CHARACTERIZATION OF BOLIVIAN HONEYS FROM HONEYBEES AND STINGLESS BEES

Cristian Del Bo'[1], Claudia Picozzi[1], Erica Holzer[1], Claudio Gardana[1], Marco Perego[2], Daniela Lupi[1]

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[2] ASPEm, Emerging Countries Solidarity Association. Cantù - Italy

INTRODUCTION

Bolivia is renowned for its remarkable diversity of bee species hich play a significant role in honey production. *Apis mellifera*, the Western honeybee, is the most widespread species, producing honeys that are extensively studied and regulated worldwide. These honeys typically show consistent nutritional profiles and meet well-established quality standards.

In contrast, stingless bees (Meliponini), which inhabit tropical and subtropical regions, produce smaller volumes of honey with distinctive characteristics, including higher moisture content, greater acidity, and unique bioactive compounds. Despite their cultural and ecological importance, Meliponini honeys have received limited scientific attention, and their composition is still not fully documented. Whitin the SANAPI project, we analysed honey samples collected by beekepers of rural communities across the country in order to provide valuable data on their nutritional and microbiological properties, improve their valorization, and contribute to the conservation of traditional beekeeping practices in Bolivia.

MICROBIOLOGICAL ANALYSIS

Due to the absence of specific European or international regulations regarding the microbiological parameters of honey, the *Guidelines for Risk Analysis in the Field of Food Microbiology* issued by the Piedmont Region, Italy (CeIRSA, 2013) were adopted. For yeasts and molds that are not listed in the guidelines, the same threshold values applied to sulfite-reducing anaerobes were considered (Table 1).

Therefore, to verify the hygiene of product processing, samples received by our laboratories were subjected to the following tests: aerobic mesophilic count, sulfite reducing anaerobes, yeast and molds.

Table 1 : Reccomended guidelines for microbiological analyses

Microorganism	Method	Reccomended guidlines (CFU/g)		
		Satisfactory	Acceptable	Unacceptable
Aerobic mesophilic microorganisms	ISO4833	$<10^2$	$10^2 \leq x < 10^3$	$\geq 10^3$
Sulfite-reducing anaerobes	ISO15213	<10	$10 \leq x < 10^2$	$\geq 10^2$
Yeast and molds	ISO21527-2	<10	$10 \leq x < 10^2$	$\geq 10^2$

NUTRITIONAL ANALYSIS

Sugars, total aminoacids, proline, 5-(hydroxymethyl)furfural (5-HMF) were analysed by UHPLC-HR-MS. Minerals were analysed by ICP-MS, while total polyphenols (TP) by Folin-Ciocalteu method.

In Table 2 are reported the results on sugars content. Overall, *Apis mellifera* honey contained higher amount of fructose and glucose (above 64%) compared to Meliponini honey which content was often below the quality criteria (at least 60%) reported in the Directive 2001/110/EC.

Table 2 : Sugar content of different honey types

Honey type	BRIX %	Fructose + Glucose %	Sucrose %	Total Sugars %
Apis mellifera	80.8 ± 2.3	64.0 ± 6.6	0.33 ± 0.17	68.9 ± 6.8
Meliponini	74.6 ± 1.2	60.5 ± 5.0	0.31 ± 0.09	66.4 ± 5.55
	p < 0.001	**p = 0.037**	p = 0.614	p = 0.161

Data are reported as mean ± standard deviation
P< 0.05 significantly different betweent honey type

NUTRITIONAL ANALYSIS

In table 3 are reported the content of aminoacids and minerals of honeys. Compared to Meliponini, *Apis mellifera* honey showed a higher content of aminoacids (mainly proline) and minerals. The main differences were related to the content of potassium, magnesium and zinc.

Table 3 : Content of aminoacids and minerals in the different honey types

Variables	*Apis mellifera*	Meliponini	P values
Total Aminoacids (mg/kg)	1653 ± 823	1102 ± 332	**p = 0.012**
Proline (mg/kg)	1156 ± 470	827 ± 274	**p = 0.003**
Total Mineral (%)	0.13 ± 0.09	0.06 ± 0.03	**p = 0.001**
Potassium (mg/Kg)	56.5 ± 46.1	28.9 ± 20.1	**p = 0.009**
Magnesium (mg/Kg)	4.7 ± 0.6	4.3 ± 0.4	**p = 0.006**
Zinc (mg/Kg)	1.10 ± 0.81	0.39 ± 0.25	**p < 0.0001**

Data are reported as mean ± standard deviation
P< 0.05 significantly different betweent honey type

NUTRITIONAL ANALYSIS

No difference was observed for the levels of 5-HMF that resulted below the legal limits (< 40 mg/kg; Directive 2001/110/EC and 2024/1438) (Table 4).

Table 4 : Content of 5-HMF and related range in the different honey types

	Apis mellifera	Meliponini	P value
5-HMF (mg/100g)	7.05 ± 11.1	2.42 ± 3.8	p = 0.089
Range 5-HMF (mg/100g)	0-43.7	0-11.5	-

Data are reported as mean ± standard deviation

No significant difference was reported in the total polyphenol (TP) content between bee species (Table 5) while a wide variability was documented (range 50-2200 mg/kg).

Table 5 : Content of total polyphenols and related range in the different honey types

	Apis mellifera	Meliponini	P value
TP (mg/100g)	464 ± 461	473 ± 192	p = 0.928
Range TP (mg/100g)	50-2200	70-900	-

Data are reported as mean ± standard deviation

RESULTS & DISCUSSION

Honey is considered a microbiologically stable food. This stability is primarily due to its high sugar concentration and therefore the low availability of free water for microbial growth. However, the environment (soil, flowers, air, honeycombs, etc.) and humans can lead to contamination, especially from yeasts and spore-forming bacteria.

Among the 26 *Apis mellifera* and 31 Meliponini honeys, only one sample (from *Scaptotrigona)*, revealed values above the acceptability level for the European marketing of this product.

Regarding the nutritional composition, *Apis mellifera* honey contained higher amount of fructose and glucose as well as aminoacids (mainly proline), and minerals (potassium, magnesium and zinc), while no significant difference was observed for the levels of 5-HMF and total polyphenols. This latter showed a wide variability in line with the data of the literature.

CONCLUSIONS

The preliminary findings documented several differences in the nutritional content between bee honeys. The completion of the analysis will be fundamental for acquiring data useful for a better characterization of the different Bolivian honeys and towards the creation of a honey library.

FUNDINGS

FMAECI23DLUPI_01- Progetto SANAPI

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PP-250 [Beekeeping Technology and Quality]
Primal bee: An innovative hive solution for beekeepers by beekeepers

Jason Graham, Gianmario Riganti, Alex Gamberoni, Tomer Moldovan, Assaf Shachar, Yotam Melman, Eitan Nir
Primal Bee

Primal Bee founders, mechanical engineer Gianmario Riganti and his childhood friend and technical expert Alex Gamberoni had trouble when first embarking on their beekeeping journey together. They purchased bees, installed them into their wooden Langstroth hives and followed the recommendations offered by beekeeping books, blogs and beekeeper associations. Unfortunately, each year they were faced with a problem which plagues most beekeepers, their colonies collapsed despite their best efforts as beekeepers. Ironically, while their colonies were having difficulty surviving they were called to collect a colony in a hollow tree that was thriving. This feral colony of honey bees had a strong, healthy population with long combs of brood and stores of honey within the protected cavity of a thick-walled tree.

This inspired the beekeeping duo to develop an insulated and geometric hive that would help honey bees maintain their ideal temperature of 36 (96). Through innovative engineering they modelled many different hive types comparing each for thermal efficiency. Through this study they discovered the design that would become the Primal Bee hive. The Primal Bee hive presents an innovative approach to sustainable beekeeping by leveraging thermodynamic efficiency, superior insulation, and optimized hive design to enhance colony survival, productivity, and adaptability.

With the engineering research results, Primal Bee founders applied to a Swiss start-up competition and won. These grants were used to build the first prototype, proof of concept and an international patent application. The hive was studied through extensive research and field testing in diverse climates including the Swiss Alps, Alaska, Australia, and the Israeli desert. As hypothesized, the insulative qualities and geometric design helped to optimize heat efficiency enabling the bees to mitigate weather impacts. Field results demonstrated significant improvements, including a 500% increase in thermodynamic efficiency, doubled bee populations and honey production, and reduced colony loss. This presentation details the Primal Bee journey from concept to product, testing to market fulfillment. We hope our story serves as an inspiration for beekeepers to generate innovative solutions that go beyond their own hives to support the beekeeping community and honey and pollination industry.

PP-251 [Beekeeping Technology and Quality]
Environmental Stressors Impacts on Honeybee and Beekeeping Products

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[1]CIMO, LA SusTEC, Instituto Politécnico de Bragança, Bragança, Portugal
[2]LabApis, Departamento de Zootecnia, Universidade de Trás-os-Montes e Alto Douro, Vila Real, Portugal, CITAB, Universidade de Trás-os-Montes e Alto Douro, Vila Real, Portugal,

Honeybees (Apis mellifera) are crucial in sustaining global biodiversity and food security by facilitating plant pollination, with over 100 million colonies worldwide contributing to ecosystem stability. Additionally, beekeeping yields high-value products such as honey, bee pollen, bee bread, and propolis. Nevertheless, honeybee populations are increasingly threatened by environmental stressors, including pathogens, pesticide exposure, and industrial pollution. Among these, climate change is a significant factor negatively impacting honeybee health, colony development, and longevity. Extreme weather events such as heatwaves, wildfires, prolonged droughts, and heavy rainfall disrupt natural ecosystems, leading to malnutrition, increased susceptibility to diseases and pests of honeybees, and fluctuations in the quantity and quality of beekeeping products. Pesticide exposure further exacerbates these challenges, as honeybees encounter agrochemicals both through nectar and pollen collection, and miticides such as fluvalinate, flumethrin and amitraz used to control Varroa destructor infestations. In response to environmental stressors, honeybees exhibit physiological and biochemical adaptations, including alterations in lifespan, body size, protein composition, hormone levels, and fat reserves. Moreover, stressors can modify the chemical composition of beekeeping products, potentially affecting their nutritional and commercial value. Monitoring honeybee populations and their products by addressing the stress factors that threaten them is a critical priority for conserving sustainability. This study aims to enhance the resilience of honeybee colonies against climate change and pesticide exposure while improving production quality and yield. To achieve this, honeybee and bee bread samples were collected from apiaries across different climatic conditions, and the fatty tissues and pesticide content of honeybees, together with the nutritional value and pesticide contents of bee bread samples were evaluated to assess these stressors on beekeeping activities. The findings will provide insights into the impact of environmental stressors on honeybee health and beekeeping productivity, contributing to the development of sustainable management strategies.

Acknowledgments: The authors are grateful to the Foundation for Science and Technology (FCT, Portugal) for financial support by national funds FCT/MCTES to CIMO (UIDB/00690/2020 and UIDP/00690/2020) and SusTEC (LA/P/0007/2021). Thanks to the program Promove from Fundação “La Caixa”, in collaboration with BPI and FCT, Portugal, within the scope of project BeeSustain, PD23-00019.

PP-252 [Beekeeping Technology and Quality]
Purification, standardization and biological studies of propolis extracts from Mt Olympus

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[2]Laboratory of Applied Apiculture, Department of Animal Science, University of Thessaly. Geopolis 41334, Larissa, Greece

Propolis has been extensively studied for its diverse biological properties. This study focuses on the unique benefits and chemical composition of propolis sourced from Mount Olympus, renowned for its rich biodiversity. The propolis from this region is characterized by a high concentration of flavonoids, phenolic acids, and terpenes, contributing to its potent antioxidant, anti-inflammatory, and antimicrobial properties. Especially in this study we focus on a Billion Bees apiary in a nature reserve area of Mt Olympus.

Several purification methods were developed to effectively separate propolis from waxes and other impurities such as centrifugation with and without cooling, specific pore-size filters and vacuum filtration.

The purified propolis was subjected to standardization of its chemical content using 1. Freeze drying methods to provide a pure solid raw material of propolis 2. Production of inclusion complexes in cyclodextrins. The target is the diminishing of the variability of the chemical content of propolis that leads to discrepancies in its biological efficacy.

Accelerated aging studies reveal the stable nature of produced propolis derivatives and non-cellular antioxidant assays (DPPH, ABTS) demonstrate significant radical scavenging activity. Initial antimicrobial and in vitro efficacy studies on human dermal keratinocytes reveal promising application in the field of pharmacy and cosmetology.

In conclusion, the propolis from Mount Olympus, with its unique chemical profile and potent biological activities, holds significant promise for developing new therapeutic and cosmetic applications. Further research and development, as well as scale up of selected formulations could lead to innovative products that harness the full potential of this natural substance.

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PP-253 [Beekeeping Technology and Quality]

Target Group-specific Learning Success Optimization of Beekeeping Learning Materials using Eye-Tracking

Tido Specht, Ines Oldenburg and Oliver Theel

Motivation – Objective – Research Questions

Motivation

- learning material for novice beekeepers can often be improved in terms of didactic and methodological design

Objective

- analysis of visual attention distribution using eye-tracking (heatmaps) on subjects working with digitally presented basic beekeeping learning material for beginners where subjects have no prior beekeeping knowledge

Research Questions

- What visual focus points do experienced readers without prior beekeeping knowledge show on the learning material (eye-tracking)?
- How successful are the participants in answering test questions provided in the learning material (number of questions answered correctly)?
- How did the participants experience the learning material in terms of its suitability for learning (free questionnaire answers)?

Method – State of Research – Learning Material

Method

- eye-tracking analyses in detail eye movements when observing learning material and, thus, the visual information intake at the beginning of the information processing process [2,3]
- eye-tracking data shows the focus of visual attention (fixations) and its movements (saccades) in the stimuli [4,5]

State of Research

- learning is effectively supported by high-quality learning material [1]
- eye-tracking studies examine the visual attention of test subjects [3]
- eye-tracking data can provide insights into the viewing behavior of learners. This provides information about their visual perception of the stimuli presented [6]
- "multimedia principle:" individuals better learn from combinations of text and images/illustrations than from text alone. [7]

Learning Material

- established training material in Germany [8]
- according to "Deutsches Bienenjournal" and "Bienen und Natur:" material for beginner courses and advanced courses
- material combines text and illustrations (graphics, tables, and photos) with contents-related test questions at the end (see Fig. 1)

Figure 1: Page 1 of the learning unit analyzed

Approach & Samples

Approach

- presentation of the digitized learning material on a screen (4 A4 pages in total)
- participants are asked to read the material and finally answer questions
- continuous eye-tracking

Samples

- 12 indiv., no prior beekeeping knowledge
- competent readers

Analysis

- aggregation of eye-tracking data collected
- result: heatmaps of visual attention
- heatmap: visual representation of attention distribution across a screen surface based on eye-tracking data
- color scale: red (high), yellow (medium), and blue (low) intensity of gaze
- advantage of heatmap: quick assessment of focus areas, prioritization of contents

Results & Interpretation (1/2)

Eye-Tracking Results

Figure 2: Heatmap while reading (left), heatmap while working on tasks (right)

→ text viewed with varying intensity

→ images & illustrations hardly viewed at all

Results & Interpretation (2/2)

Test Question Results on the Contents

- 39.7 % correct answers
- 60.3 % incorrect answers

→ poor learning success

Results of Free-text Answers

- 7 participants criticize: too many foreign words not explained; too many figures in the text, illustrations not clear enough, texts do not always refer to illustrations, photos only used as decoration, too much information, too many details, facts cannot really be understood without prior knowledge
- 5 participants are mostly satisfied; they perceive text and illustrations as mostly helpful

→ learning material was largely unhelpful

Conclusion

1. only include meaningful, targeted (not purely decorative) illustrations to support the text; avoid unnecessary illustrations
2. text must refer to illustrations
3. reduce eye movement by ensuring that illustrations and text match (this reduces cognitive load!)
4. reduce text and illustrations to essential information: no unnecessary digressions or outdated, technically incorrect or folkloric representations
5. only use technical terms after they have been introduced & explained
6. initially, clearly state the goal of the learning unit
7. use simple language; observe the principles of accessible learning

Limitations – Outlook – References

Limitations & Outlook

- here: exploratory study; not representative
- conduct scanpath analyses; they allow for more qualified and detailed insight into the visual perception of learning materials
- increase number of samples
- analyze additional training and learning material

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PP-254 [Beekeeping Technology and Quality]

Carl von Ossietzky Universität Oldenburg
system software & verteilte systeme

A flexible, responsive and low-cost IT-based DIY apiary and honey flow surveillance system for your local beekeeper association

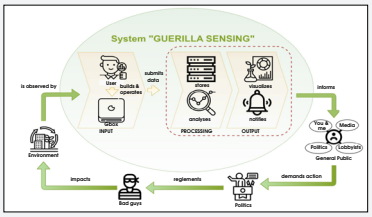
Thore Rump und Oliver Theel

A DIY Apiary and Honey Flow Surveillance System – Why?

- Provides answers to questions like:
  - Is there a honey flow to the hive?
  - How much honey flow occurs when?
  - Is the apiary location favorable?
  - Where does honey flow occur and where not?
  - Which apiary location is more favorable?
  - What is the course of the season?
  - Does a colony (still) have enough food supplies?
- Additional benefits:
  - Is there a swarming event?
  - Are there unusual activities potentially related to theft and vandalism?
- Legacy honey flow information system [1]:
  - TrachtNet, approx. 800 beehive scales, most of them in S & W Germany (see right figure)
  - uneasy access (costs & administration)

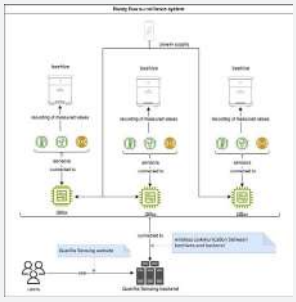
Architecture of the DIY Apiary and Honey Flow Surveillance System

1) Base system: Guerilla Sensing [2]

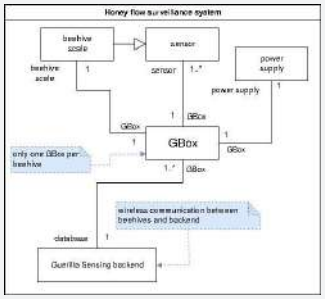


for live data visit
`bees-gs.informatik.uni-oldenburg.de`

2) Beehives with GBox

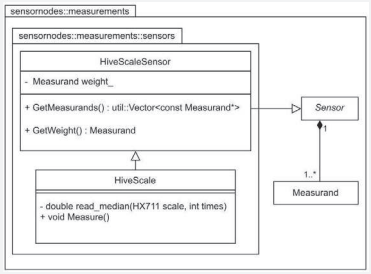


3) GBox with beehive scale

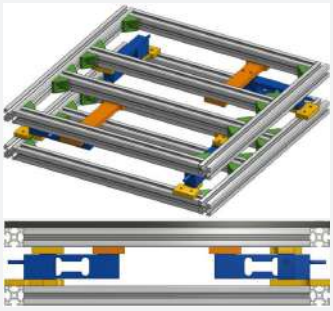


Implementation of the DIY Apiary and Honey Flow Surveillance System

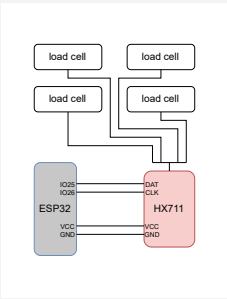
1) Software component: beehive weight sensor



2) Hardware component: beehive scale



3) Wiring diagram



Honey Flow Monitoring

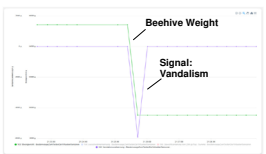
- 200g-corrected
- accumulated over 24 hours
- automated notification

Swarming Event Detection

- sudden weight drop between 250g and 3500g within 60 min
- automated notification

Vandalism Detection

- sudden weight drop
- limit adjustable
- automated notification



Costs and References

Frame	100,00 €
Wooden plates	5,00 €
Metal adapters	15,00 €
4 load cells	200,00 €
Load cell amplifier	15,00 €
Esp32	10,00 €
Housing	15,00 €
Overall costs	**360,00 €**

[1] `www.bienenkunde.rlp.de/Bienenkunde`
[2] `www.guerilla-sensing.de`

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PP-255 [Beekeeping Technology and Quality]

European Honey Contest in Koper, Slovenia 2024

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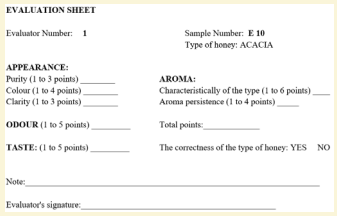
Introduction

When consumers want to buy honey, they are faced with a wide choice. A study conducted by the EU Commission, published in 2023, revealed that 46% of imported honey is suspected of being adulterated. Beekeepers must find new ways to guarantee high quality and authenticity to sell their premium products at a fair price. International honey competitions, such as the European Honey Contest, offer an opportunity to verify and showcase the excellence of their honey.

Methodology

To ensure an objective and professional sensory evaluation of honeys from different European countries, an expert 10-member international panel of honey assessors was assembled. The sensory assessment was based on scoring of the following criteria in accordance with the Rules of the Board of the Slovenian Beekeepers' Association for the sensory evaluation of honey: **appearance**, **odour**, **taste**, and **aroma correspondence to declared botanical origin**; with a maximum total score of 30 points.



EVALUATION SHEET

Evaluator Number: 1 Sample Number: E 10
Type of honey: ACACIA

APPEARANCE:
Purity (1 to 3 points) _____
Colour (1 to 4 points) _____
Clarity (1 to 3 points) _____

AROMA:
Characteristically of the type (1 to 6 points) ____
Aroma persistence (1 to 4 points) ____

ODOUR (1 to 5 points) _____ Total points:_____

TASTE: (1 to 5 points) _____ The correctness of the type of honey: YES NO

Note:_____

Evaluator's signature:_____

The evaluation sheet showing point allocations for different criteria.

Honey categories were not predefined; for a category to be evaluated, it had to include at least seven samples. If there were fewer than seven, the committee for sample preparation categorized them as either forest (honeydew) or multifloral honey based on electrical conductivity. All samples had to meet strict quality criteria, including a **water content of less than 18.6%** and a **hydroxymethylfurfural (HMF) content of no more than 15 mg/kg**.

Results and Conclusions

A total of 114 samples from 11 European countries were submitted for evaluation. Five categories of honey were defined:

Acacia (Black Locust) honey

Multifloral honey

Forest honey

Linden honey

Chestnut honey

To highlight the best honeys, only the three best samples in each category were awarded gold, silver and bronze medals. Prior to the award ceremony, the honeys were also tested for **authenticity** and the **presence of acaricides**.

The owners of the award-winning honey samples and their respective countries:

Acacia honey
1. Josip Pintar, Croatia
2. Peter Kolar, Slovenia
3. dr. Balázs Kolics, Hungary

Multifloral honey
1. Franc Hočevar, Slovenia
2. Vesna Komac, Slovenia
3. Gyula Ács, Hungary

Forest honey
1. Beekeeping Jelenc, Slovenia
2. Jozef Volansky, Slovakia
3. Jernej Benedičič, Slovenia

Linden honey
1. Zvonko Sedmak, Slovenia
2. Róbert Hanzel, Hungary
3. Marjan Lapanja, Slovenia

Chestnut honey
1. Tilen Velkovrh, Slovenia
2. Luka Jurečič, Slovenia
3. Simon Korošec, Slovenia

All 15 award-winning honeys were presented at an event in the European Parliament on World Bee Day, 20 May 2025.

https://www.honey-contest.eu/

PP-256 [Beekeeping Technology and Quality]

The Flex Hive Adapter

Bridging Langstroth and Horizontal Top-Bar Hives for Accessibility, Ergonomy and Sustainability

by Nathalie B. @ Bee-Mindful.com

APIMONDIA SCANDINAVIA 2025 23-27 SEPTEMBER COPENHAGEN

BEE MINDFUL
Horizontal, Natural Beekeeping

A scalable, accessible design empowering beekeepers to adopt ergonomic, budget-friendly practices while enabling dual style NUC and comb honey production.

LANGSTROTH

BEE MINDFUL HORIZONTAL TOP-BAR

FLEX HIVE

PROBLEM: Langstroth beekeeping is costly, heavy, and complex.

Langstroth hives dominate the industry, but frequent heavy lifting, high equipment costs, and complex and invasive management are daunting to many small-scale and hobbyist beekeepers.

OPPORTUNITY: Horizontal Top-Bar hives are simpler, but adoption has been slow and challenging.

Horizontal Top-Bar Hives (HTBHs) are budget friendly, ergonomic and accessible, yet Top-Bar NUCs are hard to find, often incompatible, and colony transfers from Langs are often invasive or disruptive , creating a barrier to adoption for users.

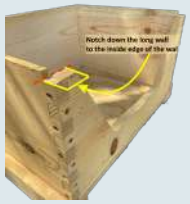
SOLUTION: The Flex Hive seamlessly bridges the gap between systems.

This quick and easy adapter enables seamless, non-invasive integration of Langstroth frames into Standardized Bee Mindful Horizontal Top-Bar Hives, letting beekeepers reuse Lang equipment, manage both styles in one hive, simplify management, increase revenue, and offer both Langstroth and HTBH NUCs while making comb honey production easier.

IMPACT: Empowering beekeepers, creating niche markets, and promoting sustainability

The Flex Hive Adapter reduces labor and expenses, increases accessibility, and makes sustainable, bee-centered practices easier to adopt worldwide. It also opens up niche market opportunities for NUC and honey producers, educators, and small-scale beekeepers.

HOW TO SET UP:

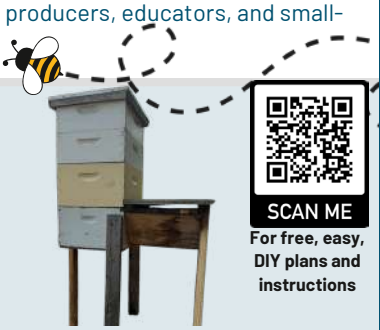


- Notch to Bar depth and Lang wall thickness
- Cut to Top-Bar Hive Opening shape
- Add a solid Bottom Board

- Attach Langstroth adapter to Top-Bar Hive or NUC
- Drill the only entrance at bottom of Top-Bar Hive or NUC

- Tuck Lang frames against the opening, always keeping brood facing the Top-Bar Hive, food and honey set away from the adapter
- Tuck blank Top-Bars against the frame shoulders *(no guides needed)*

- Watch bees build perfect Top-Bar brood and honey combs during a nectar flow.
- Keep both Lang and TBH, split and harvest from either, or phase Lang frames out.
- Use Lang feeders or honey to encourage bees into the HTBH.



SCAN ME
For free, easy, DIY plans and instructions

- Use with 5F, 8F, 10F deeps
- Use with full size HTBHs or Top-Bar NUC boxes
- We prefer 5F Lang NUC with 10 Bar Top-Bar NUC with no supers for simpler, lighter waist level management

- **Accessible to all**
- **No heavy lifting**
- **Top-Bar NUC production**
- **Comb honey production**
- **Easy & fast bridging**
- **Niche market**

TOTAL PHENOLICS AND ANTIRADICAL ACTIVITIES IN HONEY POWDERS OBTAINED BY TWO DIFFERENT DRYING PROCEDURES

UNIVERSIDAD DE BURGOS

Fernández-Muiño MA*; Cantero L, Sancho MT, Puertas G, and Osés SM
School of Sciences. Universidad de Burgos - Castilla y León. Spain.

BACKGROUND /PROBLEM DESCRIPTION

•Numerous studies support the existence of compounds in honey responsible for diverse biological activities that make it interesting compared to other natural or artificial sweeteners.

•Powdered honey has many advantages in terms of handling, transport, storage and use compared to raw honey; however, the production process and properties of powdered honeys are still little studied.

PURPOUSE

The aim of this work is to evaluate total phenols and antiradical activities against different free radicals in powdered honeys obtained using maltodextrin as Carrier by two drying techniques (vacuum drying and freeze drying) from 9 samples of honeys from 4 different botanical origins (multifloral, lavender honey, thyme honey and vetch honey).

METHODOLOGY

Total phenolics content was determined using the Folin–Ciocalteau reagent. The antiradical activities were evaluated against four radicals (ABTS•+, ROO•, •OH and O2•-) by the following procedures: TEAC, ORAC, AOA and SRS methods.

RESULTS AND CONCLUSION

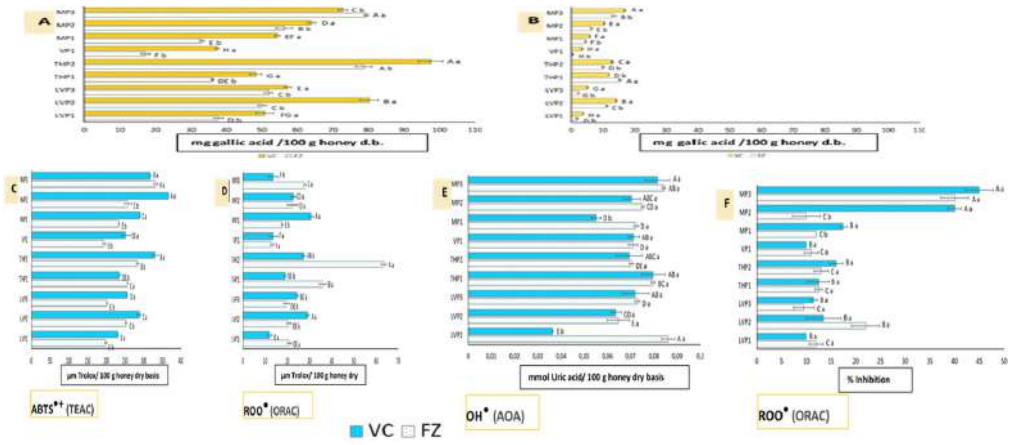


Figure 1: Total phenolics in of honey powders obtained with freeze (FZ) and vacuum (VC) drying (A) and in their methanolic extracts (B). Antioxidant activity of honey powders obtained with freeze (FZ) and vacuum (VC) drying, against different radicals (ABTS.+ (C), ROO. (D), .OH (E) and O2.-(F). Error bars represent the standard deviation for each data point. Different capital letters (A–H) indicate significant differences ($p < 0.05$) between the different botanical origins. Different lowercase letters (a,b) indicate significant differences ($p < 0.05$) between drying procedures.. LVP lavender honey powder. THP Thymus honey powder. VP Vetch honey powder. MP Multifloral honey powder..

Most of the powdered honeys showed lower values for total phenols and antiradical activities against ROO• and O2•- radicals than the raw honeys, while the values for antiradical activity against ABTS•+ radical were higher in the powdered honeys.

Both the drying method and the botanical origin of the samples influenced the total phenolics content as well as the antiradical activities against ABTS•+ and ROO• radicals. The antiradical activity against the O2•- radical depended only on the botanical origin of the honey while neither the botanical origin nor the drying procedure significantly influenced the antiradical activity against the •OH radical.

These results show that the antiradical activities of powdered honeys against different radicals are also different and depend on several compounds, which may vary quantitatively or qualitatively from one honey to another and which may or may not be modified by the drying process.

AKNOWLEDGEMENTS

The authors acknowledge Junta de Castilla y León for the financial support. BU028G24.

PP-258 [Beekeeping Technology and Quality]
Geographical Origin Authentication of Slovenian Honey

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Background/purpose
Starting in 2026, origin labelling regulations will require the exact country or countries of origin and the respective percentages of honey from each country to be indicated in descending order. This will likely lead to increased inspection controls. Our preliminary research aimed to examine the Slovenian honey market and evaluate the effectiveness of pollen analysis – one of the methods currently used in official controls for determining botanical and geographical origin.

Problem description
Slovenia, a small country with diverse vegetation, shares botanical similarities with neighbouring regions, which could present a challenge in the precise determination of geographical origin. Our objective was to simulate official honey inspections in Slovenian markets and use the preliminary findings to identify the advantages and limitations of this method.

Methodology
We collected 51 honey samples from different Slovenian regions and two control samples from non-EU countries from six different markets in autumn 2024. The pollen analysis was carried out in an accredited laboratory, which is also used for official controls. In case of deviation from the expected pollen spectrum or other anomalies, additional analyses were conducted; measurement of physico-chemical parameters and hydroxymethylfurfural (HMF) content as well as sensory analysis.

Results and conclusions
In 28 samples, some deviations were found and in case of 14 samples, interviews and consultations with beekeepers were conducted. Our findings confirmed that pollen analysis effectively identifies samples with pollen spectra atypical for our vegetation region, making it a valuable tool for verifying honey's geographical origin and detecting potential fraud. However, due to similarities in vegetation with neighbouring countries, the method has limitations in determining exact geographical origin with high accuracy. In addition, pollen analyses can establish suspicion of other forms of honey fraud (relating to botanical origin or foreign sugars). The study highlights the need for a larger database on local honey types and honey from different countries, and the importance of a correct interpretation of pollen analysis results.

Practical implications for beekeepers
These findings will enable Public Advisory Service in Beekeeping to advise local beekeepers in the case of official inspections.

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PP-259 [Beekeeping Technology and Quality]

APIMONDIA SCANDINAVIA 2025
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Bioactive compounds of honey from the Jaguari Valley region, Rio Grande do Sul, Brazil

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0836

INTRODUCTION

Honey is considered a natural food, with superior quality, presenting nutritional and therapeutic properties, originating from bioactive compounds.
The Jaguari Valley, in the state of Rio Grande do Sul, is a national and international reference in the production of high-quality honey, being the third largest Brazilian producer.

OBJECTIVE

Thus, the work in question aimed to analyze sixty samples of honey from the Jaguari Valley Region, which comprises nine municipalities in the interior of the state, regarding the levels of total phenolic compounds and total flavonoids, through analysis in a spectrophotometer.

MATERIALS AND METHODS

✓ 60 samples of honey from the Jaguari Valley

✓ **Total phenolic compounds:**

- 1.0 mL of the sample diluted in water + 1.0 mL of 1N Folin Ciocalteau reagent,
- After 5 minutes, add 2.0 mL of 20% sodium carbonate solution,
- Absorbance reading performed on a spectrophotometer at 730 nm.

✓ **Total flavonoids:**

- 1.0 mL of the honey sample diluted in ethanol + 1.0 mL of the 2% aluminum chloride solution,
- After 15 minutes the absorbance reading was taken on a spectrophotometer at 420 nm.

RESULTS

Table 1 – Total phenolic compound and total flavonoid content.

Total phenolic compounds (μg EAG mL^{-1} of honey)	Total flavonoids (μg quercetin mL^{-1} of honey)	
182.6	24.7	Average ± standard deviation
814.2	74.3	minimum
518.7	43.1	maximum

EAG: gallic acid equivalente.

- The variation of these compounds can be justified due to the fact that they were passed from plants to honey, thus, each honey presents a profile due to its floral origin used by bees in the elaboration of the honey compound, indicating differences between the honeys of the nine municipalities in the region, being considered as seasonal and environmental factors.

CONCLUSIONS

Although, due to the high presence of bioactive compounds in honey, its functional potential stands out, not just as an energy product.

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URI SANTIAGO
GOVERNO DO ESTADO RIO GRANDE DO SUL

PP-260 [Beekeeping Technology and Quality]
Spatiotemporal analysis of pollen assemblages in “”Apis cerana indica”” (Fab.) honey: A melissopalynological perspective from Kodagu, Karnataka, India

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Honey, a natural sweetener produced by honeybees plays a vital role in nutrition, medicine, and biodiversity conservation. Melissopalynology, the study of pollen in honey, helps identify floral sources, assess honey quality, and understand bee foraging patterns. Since honey composition varies with floral availability, analyzing pollen diversity is crucial for sustainable beekeeping and ecosystem management. Despite the significance of beekeeping in Kodagu region of Western Ghats, Karnataka,India research on the spatiotemporal dynamics of pollen in the native “”Apis cerana indica”” (Fab.) honey remains scarce. Here we show that honey samples from different forest ecosystems during major and minor honey flow periods exhibit distinct pollen compositions, reflecting seasonal shifts in floral resource availability. Analysis of eight honey samples, following Erdtman's (1953) methodology, identified five unifloral and three multifloral samples. During the minor honey flow period (November–December), “”Tabebuia””sp., “”Sapindus laurifolius””, and “”Alternanthera sessilis”” were dominant in semi-evergreen, moist deciduous, and dry deciduous forests, respectively. In the major honey flow period (March–April), “”Cocos nucifera”” and “”Taraxacum”” sp. were predominant in semi-evergreen and dry deciduous forests. Absolute Pollen Concentration (APC) classified the honey samples as moderately high (Louveaux classes III and IV). Pollen diversity was highest in evergreen forests during the minor honey flow period and in semi-evergreen forests during the major honey flow period. These findings will also through light in understanding the pollen dynamics for sustenance of bees and for their development. These findings provide insights into floral resource dynamics, support conservation strategies, and promote sustainable beekeeping in the Kodagu region of the Western Ghats, Karnataka,India.

PP-261 [Beekeeping Technology and Quality]

Fast, Simple, and Affordable: A Better Way to Analyse HMF in Honey

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Overview & Importance of Testing for HMF

Hydroxymethylfurfural (HMF) is a recognised indicator of honey freshness and quality forming when honey is overheated or stored for extended periods. Elevated levels can signal heat damage, poor storage or adulteration making HMF monitoring essential for both quality assurance and regulatory compliance. Under Directive (EC) 110/2001, honey placed on the European market must meet strict compositional standards and contain no additives, with HMF limits set at 40 mg/kg for most honey (except bakers honey) and 80 mg/kg with an origin from tropical climate region or blend containing these honeys.

Traditional testing methods such as HPLC are accurate but costly, time-consuming, and require specialist expertise. This new test kit, based on AOAC Official Method 980.23, provides a rapid, affordable and easy-to-use alternative, delivering high precision, excellent sensitivity, and strong agreement with reference laboratory values. By enabling fast, reliable in-house testing, producers can verify compliance, detect quality issues before distribution and avoid the delays and expenses of outsourcing to third-party laboratories. Ultimately protecting product integrity, reputation, and market access.

Sample Preparation Summary:

Step 1 - Extraction of HMF from Honey Sample:

Honey samples are prepared by diluting 5 g of honey in 25 mL deionised water, vortexing to dissolve followed by the addition of 0.5 mL each of reagents R1 and R2. The sample mixture is topped up with deionised water to 50 mL, inverted to mix, and then filtered through folded Whatman paper. An initial 10 mL portion is discarded to waste, and the remaining 40 mL filtrate was collected for analysis on the PRISM analyser.

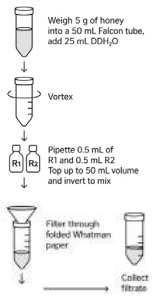

Figure 1: HMF Extraction Method

Step 2 - Sample Dilution for PRISM Analyser:

- Pipette 5 ml of filtrated honey into each of two 15 ml tubes.
- In Sample A, add 5 ml of distilled water.
- In Reference B, add 5 ml of 0.2% sodium bisulfite solution.
- Vortex both tubes for 30 seconds.

Step 2 - Sample Dilution for PRISM Analyser:

- Pipette 5 ml of filtrated honey into each of two 15 ml tubes.
- In Sample A, add 5 ml of distilled water.
- In Reference B, add 5 ml of 0.2% sodium bisulfite solution.
- Vortex both tubes for 30 seconds.

Step 3 - Running the HMF Test on the PRISM Analyser:

Step	Absorbance (nm)
1. Power On	Switch on PRISM analyser. Warm up 20 min for internal calibration.
2. Select Test	Press Quantitation -> menu button -> Open. Select HMF Test -> Open. Press Measure to load program. (If previous program was run: press Return, then Measure.)
3. Blank Measurement	- Pipette 1 ml Reference B into quartz cuvette (no bubbles). - Place in Position 1 with opaque sides forward, clear sides parallel to lamp. - Push pull rod fully in. - Close lid -> press Zero (should read 0.0000 mg/kg).
4. Sample Measurement	- Pipette 1 ml Sample A into second quartz cuvette (no bubbles). - Place in Position 2, align with beam, push pull rod in. - Close lid -> press measurement button
5. Results	Reading appears on screen (mg/kg). Optional: connect BIOXBFD49 printer to print results.

Figure 2: PRISM Analyser

Results

Intra-Precision

Intra-assay precision was assessed using two FAPAS honey reference samples containing low and high concentrations of HMF, along with a negative control sample. Each sample was tested twenty times to evaluate the precision of the HMF assay. The coefficient of variation (CV) for all test lines was found to be below 10%.

	Level 1 FAPAS T2850QC	Level 2 FAPAS T2851QC	Level 3 Honey Sample
Mean (mg/kg)	27.23	96.44	2.0
S.D	0.556	0.477	0.104
C.V (%)	2.04	0.5	5.1
N	20	20	20

Table 1: PRECISION: Intra assay precision.

Inter-Precision

Inter-assay precision was assessed using two FAPAS honey reference samples containing low and high concentrations of HMF. Each sample was tested ten times to evaluate the precision of the HMF assay. The coefficient of variation (CV) for all test lines was found to be below 10%.

	Level 1	Level 2
Mean (mg/kg)	26.47	95.75
S.D	0.058	0.131
C.V (%)	0.22	0.14
N	10	10

Table 2: PRECISION: Inter assay precision

Recovery

To evaluate assay recovery across the full measuring range, five different honey samples were each spiked at six concentration levels. The assay demonstrated excellent recovery and linearity, with values ranging from 98% to 106%.

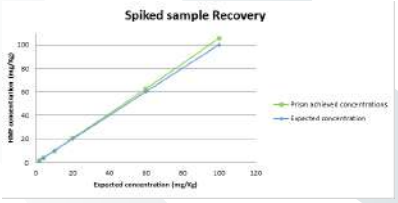

Figure 3: Spiked Recovery of HMF

Correlation with Confirmatory Methods of Analysis

To evaluate accuracy and establish correlation with confirmatory methods, ten honey samples spanning a range of HMF concentrations were analysed using the HMF assay. Results were compared directly with those obtained from the reference confirmatory method, demonstrating strong agreement across the full concentration range.

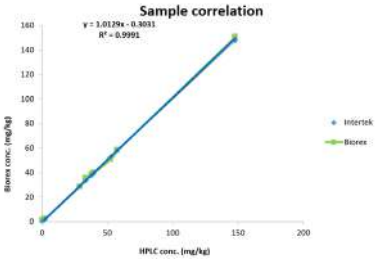

Figure 4: Correlation with Confirmatory Analysis

Limit of Detection

The Limit of Detection (LOD) was determined following standard validation procedures. Twenty independent honey samples were obtained from various supermarkets and local beekeepers and were confirmed to be freshly harvested with low HMF levels. These samples were analysed using the assay, and the LOD was calculated as the mean response of the negative samples plus three times the standard deviation (Mean + 3SD). The resulting LOD was 2 mg/kg, well below the lowest regulatory tolerance limits.

Replicate	Concentration mg/kg
1	2.12
2	2.1
3	1.96
4	1.98
5	2.3
6	2.21
7	1.99
8	2.15
9	2.22
10	1.94
11	2.09
12	1.94
13	2.05
14	2.06
15	2.05
16	1.96
17	1.95
18	2.01
19	1.98
20	1.99
MEAN	2.05
SD	0.104
%CV	5.06%
Mean +3SDs	2.4
Target	<10%
Min Acc	<20%
PASS or FAIL	PASS

Table 3: Limit of Detection

Conclusion

This developed HMF test kit offers precise (<2% variation), highly sensitive (2 mg/kg LOD), and accurate (98%-106% recovery) results using a simple process that can be performed on-site in minutes. By eliminating the need to send samples to third-party laboratories, producers can avoid high testing costs and long wait times for results. This test allows beekeepers, cooperatives, and honey processors to identify quality issues before shipping, reduce the risk of rejected consignments, and make rapid decisions to protect both product integrity and market reputation. Fast, accurate, and affordable, this kit puts quality control directly in the hands of those who need it most, supporting regulatory compliance, profitability, and customer trust.

Contact Us

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PP-262 [Beekeeping Technology and Quality]

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Smart Hive for the Preservation of Native Stingless Bees in the Face of Climate Change: Innovative Solutions for Enhancing Meliponiculture Sustainability

Authors:
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Introduction

Stingless bees are vital pollinators for biodiversity, agriculture, and food security, while also providing nutritional and medicinal products. Threatened by habitat loss, chemicals, and climate change, their conservation supports UN SDGs, making monitoring and preservation essential for sustainability and ecosystem resilience.

Problem/Objective

Maintaining optimal hive conditions outside natural habitats is a challenge. Traditional methods often lack proper environmental control, highlighting the need for innovative, technology-integrated solutions in meliponiculture.

Materials and Methods

To optimize hive conditions, two strategies were applied:

- Monitoring: Sensors (DHT11) measured temperature, humidity, and bee flow in three areas – hive interior, enclosure, and external environment.
- Thermal Control: A thermoelectric module (Peltier plate, heat sink, dual-fan cooler) regulated hive temperature, managed by an ESP32 microcontroller.

Maintaining ~34°C is vital for bee activity, ensuring their well-being, efficiency in nectar/pollen collection, and supporting sustainable meliponiculture.

Results

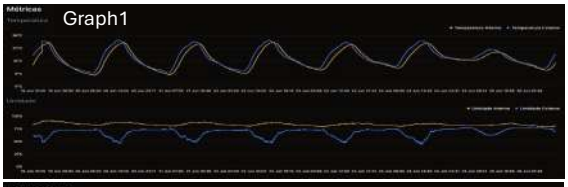
1 Awareness & Monitoring

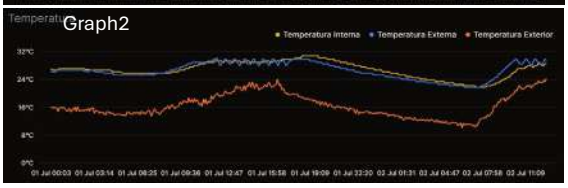
An awareness campaign highlighted the importance of proper management and technology for stingless bee preservation.

2 Results

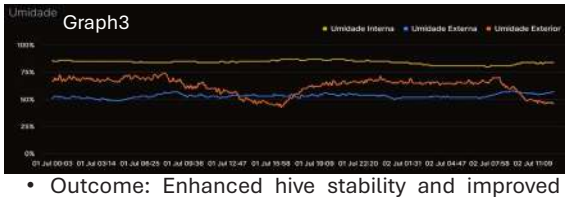
Before thermal control (until June 29, 2024): Hive showed sharp fluctuations in temperature and humidity, often below ideal conditions.

- After Peltier module installation:
  - Graph 1 & 2: Stable internal temperature, compensating for external drops.





  - Graph 3: Improved humidity regulation, reducing fluctuations.



  - Outcome: Enhanced hive stability and improved well-being of the bees.

Conclusion

Temperature control stabilized hive conditions, ensuring the survival and activity of Melipona quadrifasciata anthidioides. The Peltier module created a favorable environment by reducing temperature fluctuations, while humidity monitoring improved colony well-being, biodiversity, and sustainable meliponiculture through innovation in hive management.

ONU SDGs Addressed:

- SDG 2: Zero Hunger
- SDG 11: Sustainable Cities and Communities
- SDG 13: Climate Action
- SDG 15: Life on Land

Recognition: 1st place, Scientific Papers, CONBRAPI 2024.

APIMONDIA SCANDINAVIA 2025
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PP-263 [Beekeeping Technology and Quality]

49th APIMONDIA CONGRESS, 23-27 September 2025, Copenhagen, Denmark

Evaluation of traps for collecting propolis by honeybees

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INTRODUCTION

Propolis (bee glue) is the resinous substance produced by the honeybees after the collection and enzymatic processing of plant resins and gums. It is considered a valuable beekeeping product due to its antibacterial, antifungal, antiviral and antioxidant activity. Raw propolis consists of about 50% plant resins and gums, 30% beeswax, 10% essential and aromatic oils, 5 % pollen and 5% other organic compounds, although its exact chemical composition may vary significantly depending on the plant origin of resins and gums. There are commercial **traps** for collecting propolis by beehives but there is a lack of evaluation studies about the quantitative collection and the qualitative composition of the collected propolis by alternative type of traps.

The **aim** of the current study was the quantitative and qualitative comparison of propolis collected by two low-cost, alternative traps applied on **Langstroth beehives** in comparison with a commercial trap.

MATERIALS AND METHODS

Three different types of **propolis collection traps** were applied on Langstroth beehives, a **commercial** one and two hand-cut screens with smaller squared openings (**4 x 4 mm** and **1 x 1 mm**). Each trap was applied on three beehive colonies, equal in adult and brood population, at the same apiary. The experiment took place in **two different apiaries**, in the apiary of the Laboratory of Sericulture and Apiculture of Agricultural University of Athens and in a productive apiary in Evia island, during the spring and fall of 2024.

The applied traps were compared for their quantity and quality of the collected propolis. All the screens were placed on the beehives at the same day and were removed when one of them was filled with propolis. The **quantity** of the collected propolis was determined by freezing the screens (-18ºC for 24h), flexing them above a clean paper sheet and **weighing the removed propolis**. The **quality** of propolis samples was evaluated by performing several **spectrophotometric tests** in the Laboratory of Food Chemistry and Biochemistry of Aristotle University of Thessaloniki. Total phenolics were determined using the Folin-Ciocalteu method, and in vitro antioxidant activity was evaluated using the DPPH, CUPRAC, and ABTS methods.

For the statistical analysis, **ANOVA analysis** was performed with a percentage of significance **a=0.05** using Tukey-Kramer HSD after logarithmic transformation of the data (JMP software).

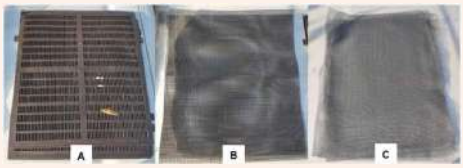

FIGURE 1: The propolis collection screens that were tested. **A.** commercial screen **B.** hand-cut screen with 4 x 4 mm openings **C.** hand-cut screen with 1 x 1 mm openings

FIGURE 2: Screens in Langstroth beehives during filling with propolis. **A.** commercial screen **B.** hand-cut screen with 4 x 4 mm openings **C.** hand-cut screen with 1 x 1 mm openings

RESULTS

Statistical analysis showed **significant differences in the amount of collected propolis** between the tested traps. Hand-cut screens with **1 x 1 mm** openings proved **more efficient** in collecting propolis (average **26.12 gr**) than the one with 4 x 4 mm openings (average 14.13 gr) (p-value = 0.0401 < 0.05), both having no significant differences with the commercial screen (average 21.13 gr) (p-value = 0.8722 and 0.0984 > 0.05, respectively).

Regarding the **quality** of the collected propolis, **no statistically significant difference** was detected between the traps tested.

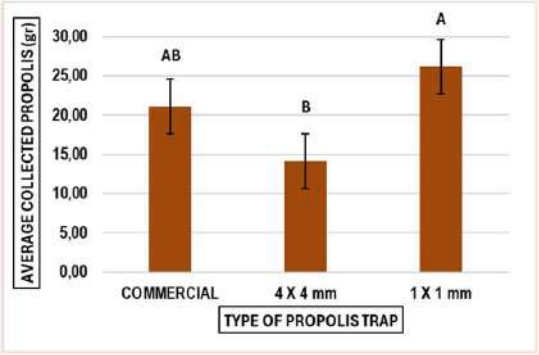

FIGURE 3: Average collected propolis for the three different propolis traps that were tested. Hand-cut screen with 1 X 1 mm openings collected the most propolis (26.12 gr) without statistically significant differences from the commercial one (21.13 gr).

DISCUSSION AND CONCLUSIONS

The study highlights the necessity of improving the existing commercial traps to optimize the amount of propolis collected.

The efficacy of the **hand-cut screen with 1 x 1 mm openings** indicates its successful use as an **alternative trap** for collecting propolis from beehives, having the **same results in the amount and quality of the collected propolis** as the commercial trap but **with decreased production cost** for the beekeepers. The results agree with the study of Tsagkarakis *et al.* (2017), in which top screens with 1 X 1 mm were more effective than the ones with larger openings. Lebedev (1979) refers that honeybees tend to fill smaller cracks than the larger ones and this is probably why 1 X 1 mm screens were also filled faster.

Due to the gap in the research related to the propolis collection traps, more alternative traps should be studied for optimizing the amount of the collected propolis.

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PP-264 [Beekeeping Technology and Quality]
Characterization of honeys from four natural parks of Calabria (Southern Italy) based on melissopalynology and volatile profile

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Background/Purpose. The plants visited by bees influence honey composition and sensory properties, linking honey to its production area. The conventional method for determining honey's geographical origin relies on melissopalynology; additionally, differences in volatile profiles provide valuable markers for geographical discrimination (Musci, Cirlini, & Caligiani, 2024). This study aims to characterize honeys from four natural parks of Calabria (a wide region in Southern Italy): Pollino National Park, Sila National Park, Aspromonte National Park, and Serre Regional Park, protected areas with unique pedoclimatic and botanical features. The characterization was based on melissopalynological and volatile profile analysis using multivariate statistical tools to evaluate possible correlations among pollen profile, volatile composition, and production areas.

Problem description. Calabria has been recognized as an area with a strong potential for beekeeping, with 47.76% of its land rated as highly suitable for honey production (Zoccali et al., 2017), supported by climate and rich floristic biodiversity. However, the composition of Calabrian honeys, in terms of pollen content and volatile profile, has not yet been described. Methodology. 44 honey samples of different botanical origins (mainly declared as wildflower and chestnut) were collected from the 2023 beekeeping season. Pollen analysis (Louveaux et al., 1978) was performed to identify typical pollen associations. The chestnut honey samples have undergone volatile profile analysis using Headspace Solid Phase Microextraction, followed by Gas Chromatography-Mass Spectrometry analysis (Musci, Cirlini, & Caligiani, 2024).

Results and conclusions. One hundred different pollen types belonging to 41 botanical families have been identified. The pollen spectrum of the analyzed honeys, regardless of their local origin, has characteristics that marked the region: the presence of Castanea is constant across all samples, along with Sulla, Echium, and species belonging to the Oleaceae family. Although the volatile profile of the chestnut honeys appears to consist of compounds which are typical of this honey, minor differences were observed depending on the production area.

Practical implications for beekeepers. The obtained data could be useful for distinguishing honey produced in Calabria from similar products of different geographic origins and serve as a groundwork for developing enhancement strategies in the studied areas.

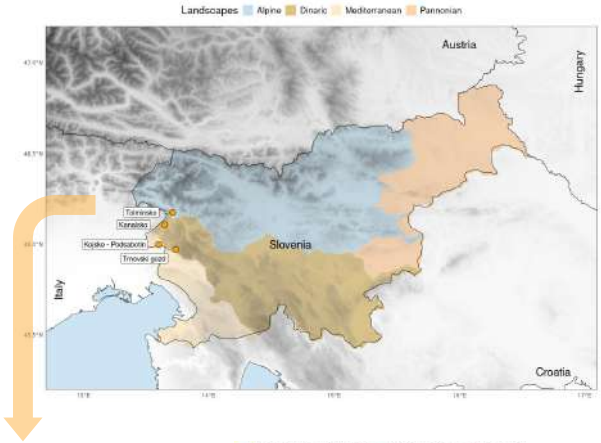
PP-265 [Beekeeping Technology and Quality]

METHODOLOGY FOR ESTIMATING HONEY YIELD

Kmetijski inštitut Slovenije
Agricultural Institute of Slovenia

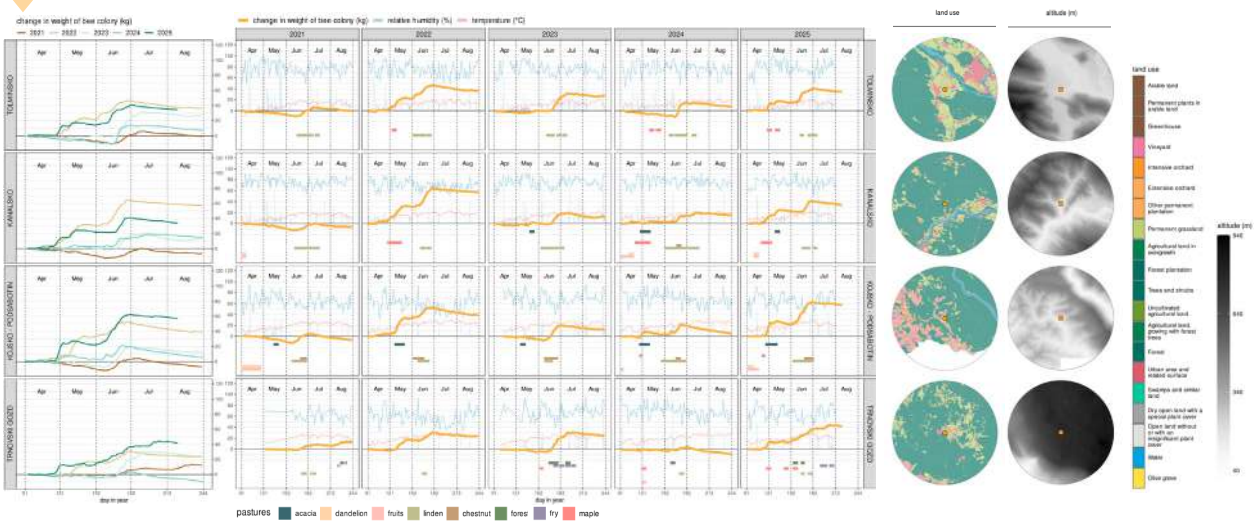
Anja **Pavlin**[1] & Janez **Prešern**[1]
[1]Agricultural Institute of Slovenia

The current methodology for assessing national honey yield relies solely on the number of registered colonies and the average yields (including negative yields) from the hives in the observational network. We assume that these estimates are underestimated.



Numerous studies highlight the critical role of weather conditions in honey production, with weather factors explaining 50-80% of yield variability. Climate and weather conditions – especially temperature, relative humidity, rainfall, and solar radiation – are among the most important environmental factors affecting bees and beekeeping and consequently honey yields. Together with other environmental factors such as topography, nectar source availability and land use, they create microlocations with distinct microclimates that vary in resilience to the increasing impacts of climate change which drive the intensification of extreme environmental conditions.

Therefore, considering these environmental factors is essential when assessing honey yields, especially in countries with high phytogeographical diversity, such as Slovenia, which lies at the intersection of the Alps, Dinaric Alps, Pannonian Basin, and Adriatic Sea Basin.



To obtain a more accurate estimation of honey yield, we propose an approach based on:

i) data on hive migrations and stationary hives[2],
ii) data on pastures and honey yield from hives in the observation network[1,3], and
iii) data on landforms[4], biodiversity[5–7], and weather[2].

The data are spatio-temporal in nature; therefore, models such as ST-SARIMA (Spatio-Temporal Seasonal Autoregressive Integrated Moving Average) and STK (Spatio-Temporal Kriging) will be tested. These methods incorporate environmental data, including meteorological factors (e.g., temperature, air pressure, solar radiation, relative humidity, precipitation, wind), land use (agricultural, forest, urban areas, water), terrain (e.g., altitude, aspect, landforms), soil type, and the density of bee colonies through time and space.

[2]The Slovenian Environment Agency [3]Beekeeping Association of Slovenia [4]Ministry of Natural Resources and Spatial Planning [5]Ministry of Agriculture, Forestry and Food [6]Centre for Cartography of Fauna and Flora [7]Slovenian Forestry Services

This research was supported through ARIS Research Program P4-0431 - young researcher grant.

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PP-266 [Beekeeping Technology and Quality]

The influence of Varroa mite treatments on the quality of propolis in Greece

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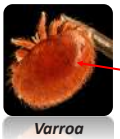
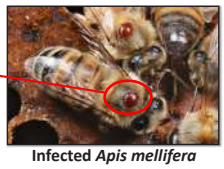
INTRODUCTION

As part of our ongoing research on beekeeping products [1,2], this study examines the chemical composition of **15 propolis** samples collected from the Department of Apiculture in Chalkidiki (Northern Greece), along with an assessment of the potential glycerol residue percentage resulting from different treatments used to control the ectoparasitic honey bee mite ***Varroa destructor***. In Greece, *Varroa* represents a major threat to apiculture, with its management relying on insecticides and acaricides approved by the European Medicines Agency (EMA). These treatments include **amitraz-impregnated strips**, **glycerin-impregnated strips with oxalic or formic acid**, and **oxalic acid** applied via **instillation** or **sublimation** [3]. The increasing use of non-toxic, organic acaricides has emerged as a crucial approach, driven by the need to address mite resistance to synthetic treatments and minimize residue contamination in beekeeping products.



Varroa destructor

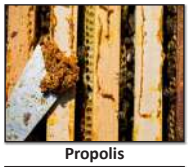


Infected *Apis mellifera*

MATERIALS AND METHODS

Extraction and Silylation: Propolis samples were obtained from five different beehives at the Department of Apiculture, Institute of Animal Science, in Chalkidiki, Greece. Each beehive was subjected to a distinct treatment method for the control of *Varroa destructor*.

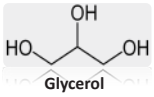
Samples were collected on days 7, 21, and 65 following treatment application (Table 1). The collected propolis was extracted using an ethanol/water solution (70:30), and the extract was subsequently evaporated to dryness. Each dried extract (5 mg) was silylated and analyzed using GC-MS [1]. Compound identification was conducted through mass spectral comparison with reference libraries (Wiley Registry of Mass Spectral Data) and bibliographic sources.



Propolis

Sublimation of oxalic acid

Oxalic/glycerin strips



Glycerol

Table 1: Propolis samples according to the treatment used against to *Varroa*.

Beehives	Propolis Samples	Anti-*Varroa* treatments
Beehive A	A-1 / A-2 / A-3	4 Strips with oxalic acid & glycerin (500 g/L glycerin)
Beehive B	B-1 / B-2 / B-3	Instillation of oxalic acid (80 g oxalic acid in a 1:1 solution of sugar: water)
Beehive C	C-1 / C-2 / C-3	2 Strips with amitraz (500 mg/ strip)
Beehive D	D-1 / D-2 / D-3	Sublimation of oxalic acid (2.5 g/beehive)
Beehive E	E-1 / E-2 / E-3	4 Strips with formic acid & glycerin (50% formic acid: 40% water: 10% glycerin)
Beehive F	CON1/CON2/CON3	No treatment

1/2/3: samples collected at days **7, 21** and **65** after the application of treatment

RESULTS AND CONCLUSIONS

Impact of Varroa Treatments on Glycerol Residues in Propolis

- **Glycerin-Impregnated Strips**
  Caused **increased glycerol residues**:
  From **20.51% to 24.30% (A)** or minor drop (from **9.25% to 8.91% for sample E**)
  -Negative effects on propolis quality:
  Alters **organoleptic** properties
  Possible **physiological effects** (e.g., laxative action)
- **Instillation (B)**
  Moderate decrease in glycerol: **14.48% → 12.60%**
- **Amitraz (C)**
  Glycerol levels ranged: **5.09%–9.19%**
  -Not recommended due to:
  Risk of **mite resistance**
  Unfavorable **chemical profile**
- **Oxalic Acid Sublimation (D)**
  Significantly minimized glycerol residues:
  Day 7: 9.98%
  Day 21: 6.07%
  Day 65: 5.12%
  -Considered safe and effective.

❖ **Seasonal variation** affected chemical composition: **fall** samples showing similar profiles and higher resin collection, while early **winter** samples exhibit increased sugars, reduced diterpenes, and altered glycerol levels due to reduced foraging and reliance on stored food.

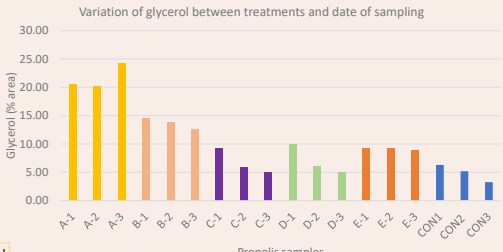


Figure 1. Variation of glycerol percentage between different treatments and date of sampling.

➢ Careful *Varroa* management is essential to preserve propolis quality; **avoid glycerin-based treatments and prefer oxalic acid sublimation**.
➢ Beekeepers and authorities should **promote residue-free practices** to ensure the chemical integrity of propolis.

Table 2: Categorization of components detected by GC-MS in propolis samples.

	Area %																	
Chemical category	**A-1**	**A-2**	**A-3**	**B-1**	**B-2**	**B-3**	**C-1**	**C-2**	**C-3**	**D-1**	**D-2**	**D-3**	**E-1**	**E-2**	**E-3**	**CON1**	**CON2**	**CON3**
Aliphatic acids	3.05	3.15	3.38	3.38	3.88	1.67	4.48	3.57	3.22	4.56	4.23	3.60	3.59	3.41	3.04	3.22	2.84	5.25
Aromatic acids	1.78	1.36	0.27	1.33	1.28	0.16	3.01	0.88	1.02	0.97	0.73	<0.1	1.02	1.04	1.35	1.54	1.21	0.56
Aromatic acid esters	2.17	2.06	0.95	2.72	2.11	0.81	3.94	2.25	1.48	2.16	1.48	<0.1	2.19	2.61	1.86	1.72	1.77	2.53
Diterpenes	31.41	32.27	18.07	23.59	22.16	11.50	34.04	38.02	22.32	32.13	25.34	5.21	31.09	35.12	27.00	41.65	41.87	30.24
Sesquiterpenes	0.26	0.21	0.23	0.27	0.28	0.30	0.38	0.39	0.49	0.26	0.32	0.77	0.38	0.31	0.40	0.25	0.24	-
Flavonoid & Chalcones	2.19	2.25	1.66	3.10	3.66	2.64	7.27	3.39	3.02	3.46	2.99	0.98	3.21	4.23	4.41	1.30	1.26	2.16
Glycerol	**20.51**	**20.23**	**24.30**	**14.48**	**13.78**	**12.60**	**9.19**	**5.95**	**5.09**	**9.98**	**6.07**	**5.12**	**9.25**	**9.30**	**8.91**	**6.30**	**5.18**	**3.27**
Unidentified Sugars	37.72	37.63	47.70	49.23	50.59	63.89	36.19	44.41	58.36	45.17	55.51	66.39	48.21	42.69	50.06	41.28	44.10	52.86
Unidentified compounds	0.51	1.16	3.69	2.28	2.51	3.46	1.03	1.39	5.29	1.92	3.80	14.22	1.41	1.70	3.26	2.30	2.47	1.69

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PP-267 [Beekeeping Technology and Quality]

Chemical analyses of selected propolis samples from Latvia

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INTRODUCTION

What is Propolis?
A resinous material collected by honeybees from plant sources, rich in bioactive compounds. Its chemical profile depends on vegetation, climate, geology, and soil

Current Knowledge in Latvia?
- Analysis by GC–MS: Only propolis from Tirza (northeast) [1,2]
- Analysis by HPLC: Phenolic acids in Riga's propolis [3]
- No nationwide chemical profile exists

Why Latvia is Unique?
- 8 geobotanical regions [4]
- Diverse vegetation types
- Influenced by climate, geology, soil and landscape
- Likely to yield region-specific propolis chemistry

Aim of This Study?
- Conduct first comprehensive chemical analysis of Latvian propolis
- Sample multiple regions
- Isolate & identify the most abundant metabolites

Significance
Provides **the first nationwide overview** of Latvian propolis composition, highlighting its chemical diversity and potential applications

Table 1. Propolis collection areas

Sample	Collection area
LV01	Jelgava, Central Latvia
LV02	Riga, North-coastal Latvia
LV03	Daugavpils, Southeast Latvia
LV04	Rujiena, Northern Latvia
LV05	Balvi, Eastern Latvia
LV06	Aizpute, Western Latvia
LV07	Svete, Southern Latvia
LV08	Ragana, North-Central Latvia
LV09	Talsi, Northwest Latvia
LV010	Cesis, Northeastern-Central Latvia

Figure 1. Latvia map

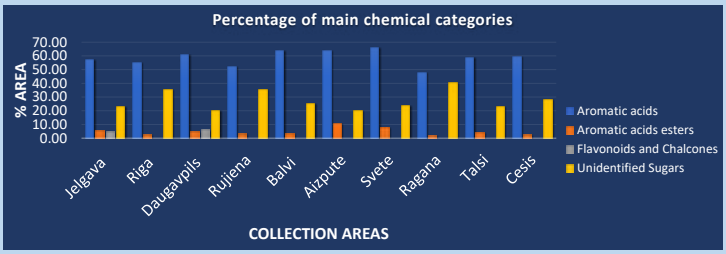

Figure 2. Main chemical category composition (%) of propolis by region.

Table 2. Chemical categories of compounds from various regions of Latvia

	Area %									
Chemical category	LV01	LV02	LV03	LV04	LV05	LV06	LV07	LV08	LV09	LV010
Aliphatic acids	4.75	3.18	3.12	1.31	1.41	3.05	1.46	3.34	1.18	4.98
Aromatic acids	57.09	55.35	61.20	52.39	63.58	63.68	66.33	47.75	58.41	59.74
Aromatic acids esters	5.85	2.91	4.47	3.03	3.57	10.60	7.95	2.05	4.04	2.91
Diterpenes	-	-	-	-	-	0.28	-	-	-	-
Sesquiterpenes	3.36	1.52	2.94	0.48	2.53	-	-	0.31	1.15	-
Flavonoids / Chalcones	4.81	0.17	5.87	-	-	-	-	-	-	-
Sugars	22.73	35.18	20.45	35.40	25.06	20.04	23.48	40.35	22.97	27.86

RESULTS

From 10 propolis samples collected from different regions of Latvia **49** compounds were identified. The **main chemical classes of propolis compounds** are listed in Table 2.

Aromatic acids are present in all samples (benzoic, p-coumaric, isoferulic, caffeic acids and derivatives).

Flavonoids & chalcones (pinocembrin, pinobanksin, pinostrobin chalcone) were found only in LV01, LV02 & LV03.

LV03 selected for further study due to high flavonoid content (5.87%) & phenolic acids (61.20%).

LV03 → 12 metabolites isolated via chromatography and identified by NMR in comparison with literature data: 2',4',6'-trihydroxy-4-methoxy dihydrochalcone, 2',6',4-trihydroxy-4'-methoxy dihydrochalcone, 2',6'-dihydroxy-4,4'-dimethoxy dihydrochalcone, 2',6'-dihydroxy-4'-methoxy dihydrochalcone, 2',4',6'-trihydroxydihydrochalcone, palmitic acid, benzyl benzoate, cinnamyl cinnamate, pinostrobin, pinostrobin chalcone, pinocembrin and pinobanksin.

CONCLUSIONS

Latvian propolis predominantly reflect the **European-type chemical profile**, rich in **aromatic acids** and **phenolic** compounds. Two distinct subtypes were identified: **poplar-type** propolis (Jelgava and Daugavpils) containing flavonoids indicative of *Populus nigra*, and **aspen-type** propolis (other regions) lacking flavonoids, but rich in phenolics linked to *Populus tremula* and surrounding flora [5]. These findings emphasize the importance of plant source identification for standardizing propolis quality and reveal regional chemical variability even within well-studied European propolis types.

MATERIALS AND METHODS

Sample Collection
10 propolis samples were collected in July 2022 from different regions of Latvia (Figure 1, Table 1).

Extraction & GC–MS
- Each sample (3 g) was extracted with **70:30 ethanol/water** and the extracts were evaporated to dryness
- Each dried sample (5 mg) was **silylated** and analyzed by **GC–MS**
- Compounds identified using Wiley database, literature, and internal data

Chromatography & NMR
- Sample LV03 purified by column chromatography
- Structure determined by **^{1}H-NMR**, **^{13}C-NMR**, **COSY**, **HSQC**, **HMBC** (Bruker Avance III 400 MHz)

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APIMONDIA SCANDINAVIA 2025
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PP-268 [Beekeeping Technology and Quality]

EUROHONIG®
Innovative Beekeeping Solutions

SyrupMaster

INVERTO FIX

A practical, simple and cost-effective methodology for preparing inverted syrup from table sugar

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Keywords: practical beekeeping technologies, sustainable beekeeping, improved invert sugar preparation, efficient feeding

Background
Sustainability and economic profitability are key challenges for beekeepers worldwide due to environmental and market challenges. Prices of honey are under increasing pressure from other sweeteners while factors like global warming, reduced biodiversity and intensive agriculture have led to a significant decline of natural forage and less resilient honeybee colonies. Therefore, efficient feeding is exceptionally important for smaller to medium sized beekeepers. Inverted sugar syrup in many ways would be an ideal feed. However, the readymade solutions offered on the market are often expensive, require large storage capabilities and transport of large volumes of liquid.

Problem Description
We set out to develop a methodology which allows beekeepers to produce their own invert syrup in a reproducible, simple and cost-effective manner from table sugar.

SyrupMaster – A semiautomatic system for producing your (Invert) syrup to feed your bees

- Clean-no mess in the production area
- No other equipment required
- Works while you sleep
- Use your own recipe
- Produce syrup for others
- Cost efficient !

INVERTOFIX is the first ready-to-use product for beekeepers for inversion of table sugar into invert syrup.

- Fresh syrup, HMF free
- No crystallization in combs over winter. No danger of colony loss
- Better control over feed quality - no impurities or low quality sugar
- No crystallization in combs over winter. No danger of colony loss
- Ideal pH for bees Maintains gut health
- Flexibility to make invert feed when you need it

How SyrupMaster and INVERTOFIX work together

3 models for producing 3:2 syrup from 50 kg, 200 kg and 400 kg sugar

Pannel for control Of dissolving and inversion process: optimal temperature and flow of water.

Submersible pump for powerful water circulation in the tank, ensuring rapid sugar dissolution.

The tank is filled with tap water up to the recommended level to obtain the desired syrup concentration.

The heating phase of the fabrication process ends when the water reaches 45 °C.

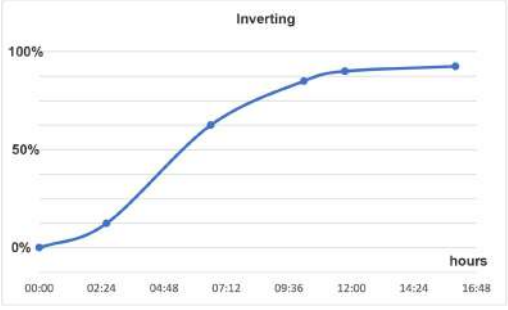
During the dissolution phase, sugar is gradually added into the tank.

At the end of this phase, a viscous syrup solution is obtained with a composition of 3 kg of sugar to 2 l of water.

When the sugar is completely dissolved, add the required amount of INVERTOFIX (5 ml/l syrup).

The controlled inverting phase lasts less than 10 hours.

The use of SyrupMaster decreased significantly the inverting time with INVERTOFIX of the 3:2 sugar syrup from 24 hours to 10 hours



SyrupMaster is the first automated system which allows beekeepers and/or associations to produce their own (inverted) feed, in a clean, convenient, reproducible and economic way.

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PP-269 [Beekeeping Technology and Quality]
Analysis of flavonoid glycosides in honey

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Monofloral honeys must have corresponding organoleptic and physicochemical properties as well as a specific pollen profile. With the analysis parameters currently defined in the Codex Alimentarius, it is not possible to prove falsifications by adding a pollen-free or a honey low in phenolic content. Alternative methods are required. In recent years, secondary plant compounds of a honey have gained importance (Oelschlägel; Speer). While specific markers such as free flavonoids could already be postulated for phenolic-rich monofloral honeys like manuka, chestnut and cornflower honey, these are largely absent for honeys with low phenolic content, such as acacia.

Based on promising studies by Tomás-Barberán and later by Truchado, the analysis of flavonoid glycosides, even though they occur in smaller quantities than the free flavonoids, is promising for the authentication of monofloral honeys. Nonetheless, the so far published data are difficult to compare as different methods were used.

A routine method for the detection of flavonoid glycosides is presented, consisting of an automated solid phase extraction (Rapid Trace®, Zymark) followed by HPLC-PDA-MS/MS analysis. Flavonoids with O-glycosidically bound sugar components were identified. The monosaccharides were β-D glucose, β-D-galactose and α-L-rhamnose, which were linked to the flavonoids at the positions 3, 7 and 4'. A total of 20 known flavonoid glycosides could be detected in different honeys by using a single method. By applying the discrimination analysis, numerous monofloral honeys could be assigned to individual clusters due to their glycoside patterns and thus clearly distinguished from each other.

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Tomás-Barberán, F. et al. (2001) HPLC flavonoid profiles as markers for the botanical origin of European unifloral honeys. J. Sci. Food Agric. 81 (5), 485–496

Truchado, P. et al (2015) Determination of interglycosidic linkages in O-glycosyl flavones by high-performance liquid chromatography. Australia. Rapid Commun. Mass Spectrom. 29 (10), 948–954

PP-270 [Beekeeping Technology and Quality]

Honey from a protected area in Uruguay: potential discriminatory parameters for geographical origin

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INTRODUCTION

***Apis mellifera* honey** is a concentrated aqueous mixture composed of many organic and inorganic compounds such as carbohydrates, water, polyphenols, volatiles compounds, minerals, enzymes, amino acids, vitamins. These bioactive compounds not only enhance the nutritional quality of honey and contribute to its aroma and flavor, but also increase its functional value by providing antioxidant, anti-inflammatory, and antimicrobial properties. The honey composition also varies according to geographical origin, floral resources, area of collection, climate and harvesting season.

Montes del Queguay (Uruguay) is a protected area of 20,000 hectares located to the east of the department of Paysandú, where different ecosystems are observed: bath, grassland, lagoons and gallery forest. (Figure 1). This region is the largest natural forested area in Uruguay, making it favorable place for beekeeping activities to produce honeys from native flora. This work presents the results of the combined effects (multivariable analysis) of melissopalynological analysis, physicochemical analyses, and mineral content on honey samples from native flora produced in the study area. Uruguay is among the top main 20 honey exporters in the world, with a production of nearly 12,000 tons, of which 90% is destined for the international market. Almost all exports are made in bulk and without differentiation, which has generated a considerable gap in prices when compared to other exporting countries. This protected area hosts a diverse range of ecosystems that influence the composition and quality of honey, enhancing its unique botanical and geographic identity.

Fig 1. "Montes del Queguay, Uruguay" Photo: EFE/Javier Revetria

MATERIALS AND METHODS

Thirty honey samples (N=30) collected during the summers of 2022 and 2023 were analyzed. Pollen content was assessed using conventional melissopalynological methods described by Louveaux et al. (1978) (1), which are internationally accepted. Physicochemical parameters were determined according to the official methods of the AOAC (2) and the harmonized technical standards of the MERCOSUR countries for honey identity and quality (3). Mineral content was quantified using a microwave plasma–atomic emission spectrometer (Agilent 4210 MP-AES) (4). Statistical evaluation was performed by one-way ANOVA considering year as factor ($p < 0.05$), followed by Tukey's test ($p < 0.05$). Principal component analysis (PCA) was applied to the 30 georeferenced honey samples from apiaries located in Montes del Queguay (Uruguay) to explore potential associations between physicochemical parameters (ash content and electrical conductivity) and mineral composition across the two sampling years. Data analyses were conducted in R version 4.5.1.

RESULTS AND DISCUSSION

A total of 84 pollen grain types from 32 species were identified, with a predominance of the families *Rhamnaceae, Myrtaceae, and Combretaceae*. In more than 60% of the analyzed samples, the native species *Scutia buxifolia* ("Coronilla"), *Blepharocalyx salicifolius* ("Arrayán"), and *Terminalia australis* ("Palo amarillo") (Fig 2) accounted for over 70% of the pollen spectrum. Figure 3 illustrate the distribution of the dominant pollen types recorded over two years, which together account for 70% of the pollen assemblage that could define the honeys of the study area.

Fig 2 . Dominant flora

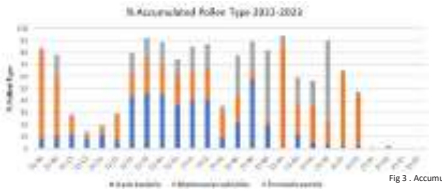

Fig 3 . Accumulated pollen type

Table 1 summarizes the yearly mean values of the parameters studied. Most of the honeys analyzed were characterized by high electrical conductivity (>800 µS/cm), representing a potential marker of their regional origin. Potassium was the most abundant mineral (representing 90% of the minerals studied), followed by calcium, magnesium and sodium. Trace element analysis revealed the presence of copper, while zinc concentrations fell below the detection limit (Fig. 4). The PCA showed that 82% of the data variability is explained by the first two dimensions (Dim1 + Dim 2). Quadrant I grouped together the variables: % ash, conductivity, potassium and copper, indicating a strong positive correlation between them. This reflects that the mineral content of honey, particularly potassium, is closely associated with conductivity and % ash. Thus, these variables provide essential information for the characterization of these honeys.

	Conductivity (uS/cm)	Ash (%)	K (ppm)	Ca (ppm)	Mg (ppm)	Na (ppm)	Cu (ppm)	Zn (ppb)
2022	876,90 ± 4,36 a	0,543 ± 0,018 a	2694,02 ± 19,15 a	114,95 ± 7,03 a	73,27 ± 0,33 a	25,11 ± 0,88 a	0,8338 ± 0,0003 a	≤ 0,4 a
2023	992,69 ± 6,98 b	0,519 ± 0,027 a	2711,10 ± 15,14 a	150,76 ± 6,89 a	96,46 ± 0,54 a	46,76 ± 0,60 b	0,7202 ± 0,0038 a	≤ 0,4 a

mean ± SD, different letters indicate stat.differences p<0,05

Table 1 . Parameters per year

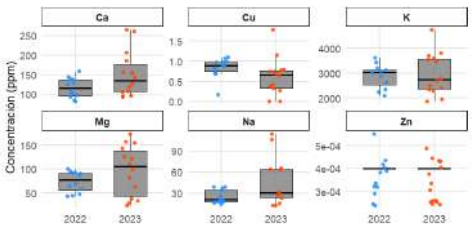

Fig 4 . Boxplot Minerals per year

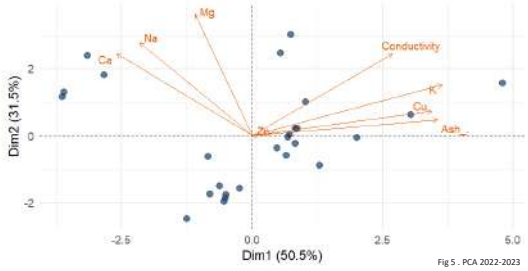

Fig 5 . PCA 2022-2023

CONCLUSIONS

The high potassium (K) and calcium (Ca) content, together with the low sodium (Na) concentration and consistently high conductivity values, can be considered discriminatory parameters for the honeys analyzed. These findings contribute to the characterization of honeys derived from native species of the Montes del Queguay, providing valuable indicators of geographical origin and supporting the potential to enhance the international market value of Uruguayan honeys. Continuous sampling during 2024 and 2025 will provide data from consecutive harvests, allowing for a more robust assessment of the viability of a geographical designation of origin

Acknowledgments:
I+D UTEC, CSIC-UdelaR, Pedeciba, Solatina

References

PP-271 [Beekeeping Technology and Quality]
Robinin as a marker for the addition of filtered acacia honey to heather honey

Janine Schlafke, Isabelle Kölling Speer, Karl Speer
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Expensive monofloral honeys, such as heather honey, are often adulterated by stretching them with sugar syrup or with inexpensive, often filtered, low-phenolic honey. Beckmann et al. were able to demonstrate this adulteration for the first time. After isolating the saccharase, it was separated into several bands by electrophoresis. All honeys studied contained the bands typical for the saccharase in almost the same intensity, while in filtered honeys one band was missing. In tests, it was possible to reliably detect the addition of about 15% of filtered honey to an unfiltered honey.

However, since the published method is quite laboriously and time-consuming, it should be examined whether the flavonoids, specifically the glycosides, can also be used to detect an addition of filtered honey, especially of a low-phenolic such as acacia honey. For this honey, the flavonoid glycoside robinin is known (Truchado et al).

Robinin and other flavonoid glycosides were analyzed by automated solid-phase extraction using HPLC-PDA/MS and quantified via external calibration in SRM mode.

In seven acacia honeys, the glycoside robinin was detected in levels ranging from 560 µg/kg to 970 µg/kg, and also in the nectar itself. In 18 other types of monofloral honeys studied (in a total of 100 samples), robinin could not be detected at all, or only in traces, so robinin can be postulated as a marker for acacia honey.

In model experiments, different proportions of a typically low-phenolic acacia honey were added to a phenolic-rich heather honey. Even at an addition of less than 10% acacia honey, robinin was detectable in the PDA chromatogram. Using MS detection adulteration with about 5% acacia honey can still be detected.

Literature:
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Truchado, P.; Ferreres, F.; Sabatini, A. G.; Tomás-Barberán, F. A. (2008): Nectar Flavonol rhamnosides are floral markers of acacia (Robinia pseudacacia) honey. J. Agric. Food Chem. 56 (19), 8815–8824

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PP-272 [Beekeeping Technology and Quality]

Regional characteristics and food safety of honey collected in Japan

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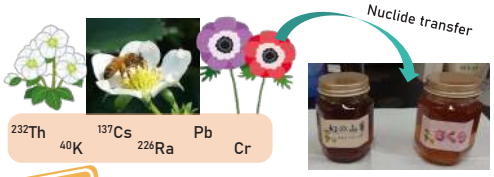
Conclusion

- Japanese Honey is safe in terms of both radioactivity and elemental analysis.
- Honey contains information that reflects the collection area.

Radionuclides and Elements

- The elements in honey are useful as tracers for assessing the environment around the honey-harvesting area.
- Evaluation of potential health effects associated with honey consumption is important.
- In Japan, the TEPCO Fukushima Daiichi Nuclear Power Plant (FDNPP) accident has occurred in 2011.



Purpose

We analyzed honey samples collected across Japan to investigated their regional characteristics and food safety.

Material and Methods

Commercial honey samples

Radioactivity analysis

Filling

The samples were placed in stainless steel containers and sealed.

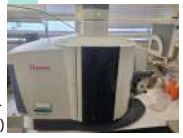
Gamma-ray spectrometry

High-purity germanium semiconductor detector (PGT, Inc. IGC-10200NPR)

Elemental analysis

Acid decomposition

Two to 4 g of honey samples were decomposed by the HNO_3 in Teflon beaker.



Inductively Coupled Plasma Atomic Emission Spectrometry

(iCAP6500 Duo, Thermo Scientific Inc.)

Calculated annual effective dose[1)]

$$E_{eff} = A_c \times A_{ig} \times D_{cf}$$

E_{eff}: Annual effective dose [Sv/y]
A_c : Activity concentration [Bq/kg]
A_{ig} : Annual ingestion of honey [kg/y]
D_{cf} : Effective dose coefficient [Sv/Bq]

Value of effective dose coefficient
2.2×10^{-7} for ^{232}Th 2.8×10^{-7} for ^{226}Ra
1.3×10^{-8} for ^{137}Cs 6.2×10^{-9} for ^{40}K

Concentration distribution of radionuclides in Honey

- We detected natural radionuclides: ^{40}K, ^{226}Ra and ^{232}Th.
  Artificial radionuclides ^{137}Cs in honey by radioactivity analysis.

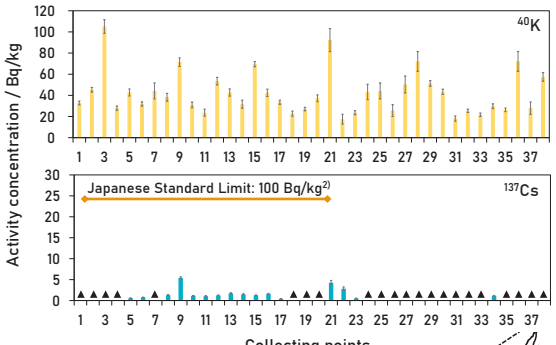


Fig. 2 Activity concentration of ^{40}K and ^{137}Cs in honey collected in Japan (▲ : N.d.).

Regional variations were observed in the concentrations of radionuclides in honey.

<Standard limits for Caesium-137>[6)]
USA : 1200 Bq/ kg
CODEX : 1000 Bq/kg
EU : 1250 Bq/kg

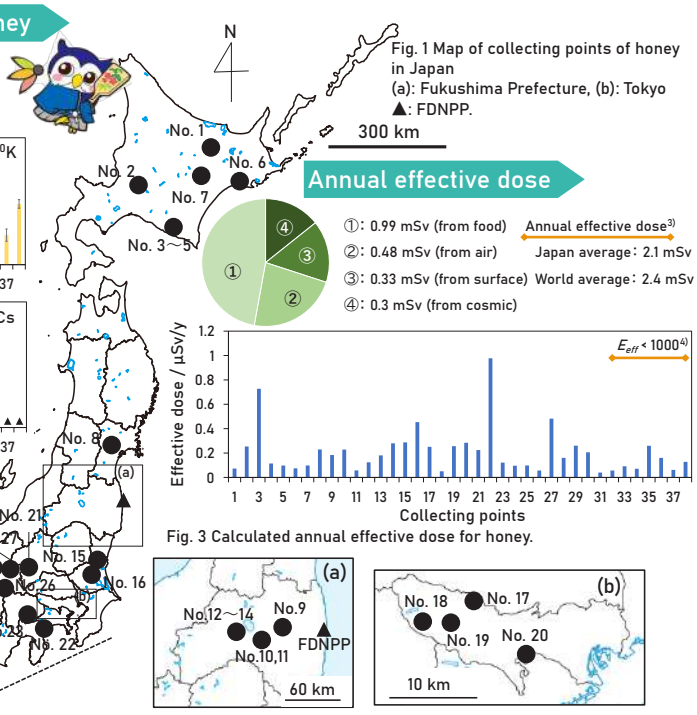


Fig. 1 Map of collecting points of honey in Japan
(a): Fukushima Prefecture, (b): Tokyo
▲: FDNPP.

Annual effective dose

①: 0.99 mSv (from food)
②: 0.48 mSv (from air)
③: 0.33 mSv (from surface)
④: 0.3 mSv (from cosmic)

Annual effective dose[3)]
Japan average: 2.1 mSv
World average: 2.4 mSv

Fig. 3 Calculated annual effective dose for honey.

Heavy metal contents in Honey

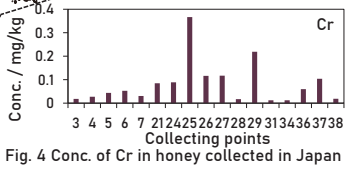


Fig. 4 Conc. of Cr in honey collected in Japan

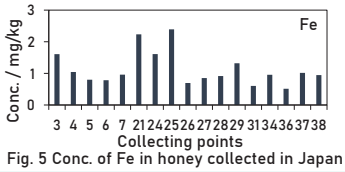


Fig. 5 Conc. of Fe in honey collected in Japan

Some research reported conc. of Cr between 0.01-1.07 ppm and value of Fe recommended under 15ppm[5)].

Japanese honey is a good quality.

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PP-273 [Beekeeping Technology and Quality]

Antimicrobial activity of honeydew honey that caused larvae mortality (River Disease) in Uruguay

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INTRODUCTION

The "River Disease" (RD) is a disorder that kills newly hatched larvae in honeybee colonies located closed to fresh waterways with abundant riparian vegetation. It usually appears at the end of spring and can lead to massive larval losses in Uruguay [1] .

Newly hatched larvae

It was observed that bees are highly active on *Sebastiania schottiana* trees (**Image 1**) , in which there are reports of biologically active compounds [2]. It is on these trees *that Epormenis cestri*, a hemiptera that secretes a sugar-rich substance on which the bees feed in the absence of flowering, is often found [1] (**Image 2**).

Image 1. *Sebastiania schottiana* trees [1].

Image 2. *Epormenis cestri* secretions[1].

The planthopper honeydew collected by the honeybees is then turned into honeydew honey within the colony. Larvae fed with this honeydew die in their first days of life [1].
The affected colonies produce honeydew honey which has no commercial outlet.

RD was first described in 1951 close to Santa Lucia River in Uruguay and appeared sporadically until the 2000s. However, in recent years there has been an increase in the number of cases and, in turn, a spread of the disease along other rivers of Uruguay.

The aim of this work is to study and characterise the biological properties of this type of hive product and to generate strategies to valorize it, which to date not only has no commercial outlet but also represents an economic loss for beekeepers.

METHODOLOGY

To perform the characterization, 10 samples of honeydew honeys were taken from different parts of Uruguay where RD was reported, and the following workflow was carried out (**Figure 1**)

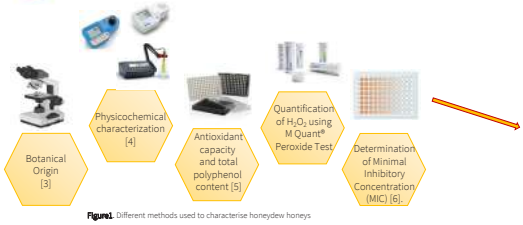


Figure1. Different methods used to characterise honeydew honeys

A battery of basic physicochemical analyses are performed, including conductivity, moisture, colour, pH, acidity, ash, diastase index and hydroxymethylfurural (HMF) [3]. Total polyphenol content was studied by Folin & Ciocalteu and their antioxidant capacity by ABTS and ORAC methods as reported by Baez et al [4].

Determination of Minimum Inhibitory Concentration (MIC) was performed as reported by Raffaelli et al [6] with some modifications. 50 %p/v honey solutions were evaluated against *Staphylococcus aureus* ATCC6538P, *Klebsiella pneumoniae* CCMG12716 and *Pseudomona aeruginosa* ATCC 15442.

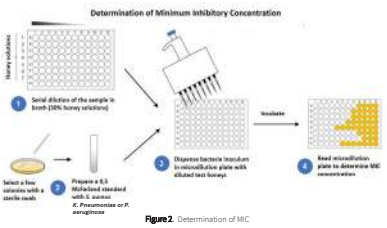


Figure 2. Determination of MIC

MIC analyses were carried out in a microdilution plate with 96 wells containing Mueller–Hinton broth. (**Figure 2**).
The MIC was determined as the lowest honey concentration (antimicrobial agent) that inhibited the visible growth of a microorganism after incubation.
Monofloral and polyfloral honeys from Uruguay were also analyzed, as well as honeys recognized worldwide for their nutraceutical properties and biological activity, such as Ulmo honey from Chile and Manuka honey from New Zealand (Manuka MGO > 500).

RESULTS

Physicochemical Analysis:

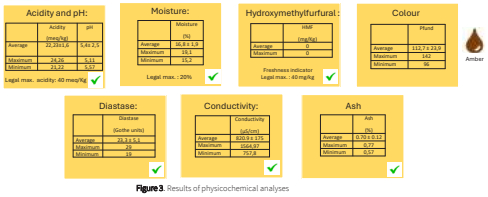
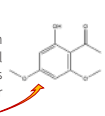


Figure 3. Results of physicochemical analyses

Figure 3 shows the results of the physicochemical analyses. The values of moisture, acidity, ash, HMF and diastase complied with the reference values established for honeydew honey in the National Bromatological Regulations.
Conductivity is an indirect measure of ash content and from a nutritional point of view it is an indicator of the mineral composition of the honeys, in this case all the samples presented a conductivity greater than 800 mS/cm, characteristic of Honeydew honeys. Also, the samples showed colors in the darker side of Pfund scale.

Peroxide Content

Peroxide determination indicated that all samples did not contain significant amounts of peroxide. This indicates that the antimicrobial activity observed in the samples is non-peroxide activity, which is not common in honeys and may be due to the presence of other biologically active compounds, such as xanthoxylin.



Nutraceutical Properties:

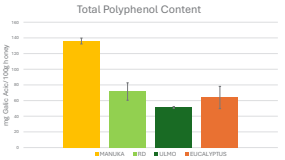


Figure 4. Results of total polyphenol content in RD samples compared to other honeys

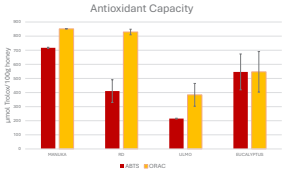


Figure 5. Results of antioxidant capacity (using ABTS and ORAC) in RD samples compared to other honeys.

A high total polyphenol content and antioxidant capacity was observed in RD samples, higher than the values observed for honeys internationally known for their polyphenol content, such as Ulmo honey (**Figure 4-5**).

Antimicrobial Activity

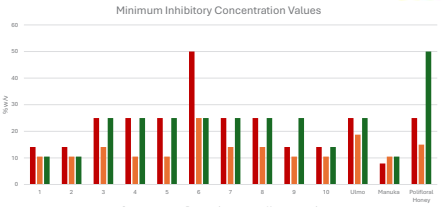


Figure 6. MIC values of RD samples and other honeys against different pathogens of interest

Honeydew honeys from colonies with River Disease showed antimicrobial activity against the three strains studied, mainly against *P. aeruginosa*, at concentrations of 10.5% w/v in most cases. This is comparable to the activity observed for Manuka honeys with more than 500 mg of methylglyoxal/kg honey (MGO>500), widely recognized for its antimicrobial activity. Also, the samples showed activity against *S. aureus* and *K. pneumoniae*, the latter being less commonly reported. The MIC values obtained for *K. pneumoniae* are lower than those observed in polyfloral honeys from Uruguay, indicating high antimicrobial activity (**Figure 6**).
This activity could be due to the presence of biologically active compounds, such as xanthoxylin, which has been reported for its biological activity in some trees.

CONCLUSIONS

Honeydew honey from hives affected by River Disease have remarkable nutraceutical properties and high antimicrobial activity.
These results represent advances in the characterization and valorization of a product that tends not to have a commercial use and is associated with economic losses for beekeepers. These results show a way to valorize this product, which is generally considered waste.
Future work will focus on evaluating the correlation between the antimicrobial activity and the presence of compounds already reported in these honeys, such as xanthoxylin.

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ACKNOWLEDGMENTS:
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PP-274 [Beekeeping Technology and Quality]
Validation of an UHPLC method for the determination of hydroxymethylfurfural in honey

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Background/PURPOSE: The increasing global demand for honey has intensified concerns about its quality and authenticity. One of the primary indicators of honey adulteration and deterioration is hydroxymethylfurfural (HMF), a compound formed during excessive heating or prolonged storage. In Panama, the lack of validated analytical methods for HMF quantification has limited the ability to assess honey quality reliably. This study aimed to validate an Ultra High-Performance Liquid Chromatography (UHPLC) method for the accurate determination of HMF in commercial honey.

Problem Description: Honey adulteration compromises consumer health and market integrity, affecting both local beekeepers and regulatory agencies. The absence of a validated method in Panama has made it difficult to monitor HMF levels effectively, thus hindering quality control efforts.

METHODOLOGY: A UHPLC method with diode-array detection (UHPLC-DAD) was validated following the International Council for Harmonisation (ICH) guidelines. The method employed solid-phase extraction (SPE) for sample cleanup, followed by chromatographic analysis using a C18 column and a water-methanol mobile phase. Linearity, specificity, precision, accuracy, limit of detection (LOD), and limit of quantification (LOQ) were assessed to ensure method reliability.

Results and CONCLUSION: The method demonstrated excellent specificity, with no matrix interferences detected. It showed robust linearity (R^2 = 0.9995) within the analytical range of 0.50–15.23 µg/mL. The precision tests confirmed repeatability and intermediate precision within acceptable limits. Accuracy was verified through recovery assays (96.7%–101.7%), and the method achieved an LOD of 0.15 µg/mL and an LOQ of 0.45 µg/mL. The validated UHPLC-DAD method was successfully applied to analyze commercial and artisanal honey samples, confirming its suitability for routine quality control and regulatory applications.

Practical Implications for Beekeepers: This validated method provides beekeepers and regulatory agencies with a robust analytical tool to assess honey quality, ensuring compliance with international standards. By identifying adulteration and improper storage conditions, beekeepers can enhance product quality, maintain consumer trust, and access broader markets with higher confidence.

PP-275 [Beekeeping Technology and Quality]

HONEYBEES AS BIOMONITORS - VARIABILITY IN THE OCCURRENCE OF HEAVY METALS, A SYSTEMATIC REVIEW

Student's Poster
Ref Number 0941

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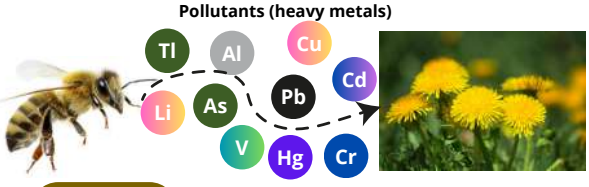
BACKGROUND AND OBJECTIVE

Honey bees (*Apis mellifera*) have been widely used as biomonitors due to their ability to accumulate environmental pollutants from air, soil and water within their foraging range.

This systematic review examines their role in detecting **heavy metal (HM) contamination** by quantifying and comparing HM levels reported in the **scientific literature (1996–2024)** across different environments: **urban, rural, and forest** (used as a control).



METHODS

- **Databases searched:** PubMed, Scopus, and others
- **Search terms:** (bees OR pollinators OR honey bees) AND (biomonitor OR bioindicator) AND (contamination OR pollution) AND (heavy metals OR minerals)
- **Studies included:** 18 peer-reviewed articles (1996–2024)
- **Statistical parameters calculated:** Mean (parts per billion, ppb), median (ppb), minimum, maximum, standard deviation (SD), and coefficient of variation (CV%).
- **Data categorization:** Results were grouped into three environmental areas — urban, rural, and forest (used as a control).

RESULTS

Heavy metal	Mean (ppb)	SD	CV%
Cr (Chromium)	0.140	±0.103	73.88
Al (Aluminum)	**7.170**	**±.3.5**	**48.80**
Li (Lithium)	0.020	±0.0	—
V (Vanadium)	0.050	±. 0.058	116
As (Arsenic)	0.536	± 0.307	57.30
Cd (Cadmium)	0.265	±0.296	112
Tl (Thallium)	0.317	±0.026	8.29
Cu (Copper)	**7.950**	**±7.36**	**92.50**
Hg (Mercury)	**590**	**±0.0**	**—**
Pb (Lead)	1.130	±0.495	43.80

Table 1. Concentrations of heavy metals in honey bees.
Values are expressed as mean ± standard deviation (ppb). CV%: coefficient of variation. The symbol "—" indicates that the CV was not calculated due to lack of variability (SD = 0).

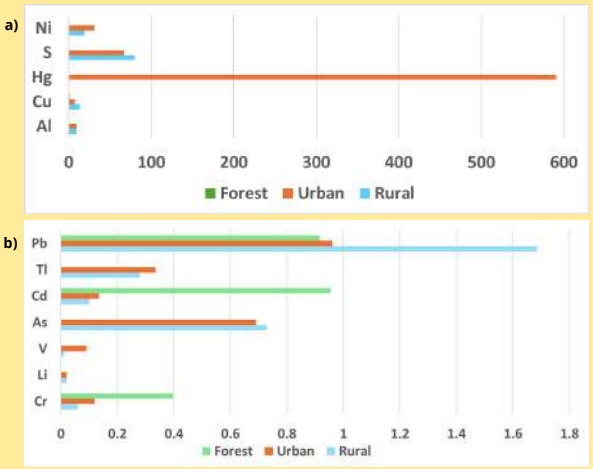


Figure 1a,b. Median concentration (ppb) of principal heavy metals present in honeybees around the world.

Only one study reported concentrations of Cr, Cd, Cu, Pb, and Zn in forest areas.

In general, heavy metal concentrations were lower in rural areas than in urban areas.

CONCLUSIONS AND RECOMMENDATIONS

- Honey bees are **effective biomonitors** of heavy metal pollution, with levels increasing from forest to rural and urban areas.
- To improve monitoring, **standardized sampling and broader global datasets** are needed.
- **Beekeepers** can play a vital role in environmental surveillance by supporting local monitoring and long-term data collection. Pollutants can harm bee health, reduce honey quality, and potentially impact human health.

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Online version and contact

PP-276 [Beekeeping Technology and Quality]
Increase Propolis extraction via High hydrostatic-assisted ultrasonic Extraction

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Propolis is a natural substance known for its potential health and medical benefits. Derived from bees, it has been the focus of extensive research due to its antimicrobial, anti-inflammatory, and antioxidant properties. In this study, we have explored the effectiveness of using high hydrostatic pressure to assist ultrasonic extraction of bee gel, through the changes in extraction rate, total phenol, ketone content, antibacterial activity, survival rate and anti-inflammatory activity of cancer cells. The research results show that the extraction rate of bee gel increased with the increase in pressure time during high pressure treatment, and the best effect was 71.16±1.05% in 600MPa treatment for 30 minutes, while the non-high-pressure treatment was 42.89±1.11%. The content measured by high static water pressure combined ultrasonic treatment at 300MPa for 20 minutes (23.29±0.04 mg of GAE/g, 17.09±0.79 mg of QEAC/g) was the best, and the single-purpose one was purified. Ultrasonic treatment was (14.36±0.09 mg of QEAC/g, 11.26±0.18 mg of QEAC/g). In the analysis of antibacterial activity and anti-inflammatory activity, the antibacterial and anti-inflammatory ability of high static water pressure treatment and high static water pressure combined with ultrasonic treatment did not significantly reduce or improve, and the effect remained unchanged, indicating that high static water pressure technology has not been effective for bedevil. The ingredients cause damage and the biological activity remains stable during the treatment process. The above results show that high static water pressure assists ultrasonic extraction of bee gel, which can provide higher extraction efficiency than traditional extraction. The application of high static water pressure technology can help improve production and active materials such as polyphenols and ketones in the extraction of bee gel products.

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PP-277 [Beekeeping Technology and Quality]

Enhance the Bioactivity of Royal Jelly via High Hydrostatic Pressure

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ABSTRACT

Royal jelly has been proven to have multiple benefits, such as enhancing immunity, promoting tissue regeneration, protecting cardiovascular health, and having anti-aging effects. It contains antioxidants like phenols and flavonoids, which can provide antioxidant effects, delay aging, reduce inflammation, accelerate wound healing, inhibit bacteria, and control blood sugar levels. High pressure processing (HPP) is an advanced food processing method that treats food by placing it in a high-pressure environment. In this process, food is submerged in water and subjected to pressures ranging from thousands to hundreds of thousands of pounds per square inch. This high-pressure treatment significantly reduces the number of microorganisms in the food, thereby extending its shelf life. Additionally, the pressure can alter the activity of enzymes in the food, making it more suitable for specific uses or processes. High pressure can also cause starch gelatinization and protein denaturation, changing the texture and taste of the food. This study investigates whether the beneficial components of royal jelly, such as total phenols, flavonoids, and antioxidant capacity, are enhanced after being treated with HPP. The study also analyzes the characteristics of royal jelly from different pollen sources after various pressure durations, comparing their differences. The results show that HPP increases the content of 10-HDA (10-hydroxy-2-decenoic acid) and total phenolic flavonoids in royal jelly. After HPP treatment, the antibacterial ability of royal jelly is significantly enhanced, and it effectively kills cancer cells, reducing their survival rate.

MATERIALS AND METHODS

Preparation of different floral source Royal Jelly Samples Include maize, rape, tea blossom (*Camellia sinensis*) and Roxburgh Sumac.

Royal jelly samples were treated with different High-Pressure Processing (100, 300 and 600 MPa) for different times (5, 10 and 20 min).

Physical and Chemical analysis of acidic, 10-HDA, total phenols and flavonoids.

Bioactivity analysis of antioxidant, anti-bacterial and cancer cell survival rate

RESULTs

Physical and Chemical analysis

Table 1. The acidic of royal jelly treat with different HPP conditions

Pressure	Times	tea blossom (meq/kg)	Roxburgh Sumac (meq/kg)	Rape (meq/kg)	Maize (meq/kg)
	Non-treat	341.05±34.34^{b}	362.14±2.83^{a}	387.59±9.01^{a}	363.22±47.02^{a}
100Mpa	5min	379.71±53.43^{ab}	443.10±19.35^{a}	439.11±59.12^{a}	387.18±5.58^{a}
	10min	398.39±6.03^{a}	466.15±14.71^{abc}	410.46±6.75^{abc}	381.55±22.06^{ab}
	20min	395.52±5.13^{a}	450.10±9.69^{ab}	425.58±4.67^{ab}	418.81±83.55^{abc}
300Mpa	5min	376.74±28.77^{abc}	459.56±38.83^{ab}	422.64±17.51^{ab}	366.51±3.96^{ab}
	10min	370.42±18.73^{abc}	468.96±10.90^{abc}	438.15±15.01^{abc}	395.22±10.16^{abc}
	20min	375.93±16.15^{abc}	465.77±6.22^{abc}	452.78±9.58^{abc}	381.51±9.94^{ab}
600Mpa	5min	401.90±2.35^{a}	483.52±17.69^{abc}	447.33±11.21^{abc}	380.89±28.39^{ab}
	10min	411.26±12.83^{a}	498.53±11.23^{bc}	448.63±21.71^{abc}	410.71±43.41^{ab}
	20min	376.05±18.04^{abc}	449.81±30.12^{abc}	470.51±11.80^{c}	455.77±11.89^{c}

**Means in a column with different superscripts are significantly different ($p < 0.05$).

Table 2. The 10-HDA contain of royal jelly treat with different HPP conditions

Pressure	Times	tea blossom (%)	Roxburgh Sumac (%)	Rape (%g)	Maize (%)
	Non	1.73±0.01^{a}	2.00±0.01^{c}	2.13±0.01^{f}	1.78±0.00^{f}
	5min	2.22±0.01^{c}	2.39±0.01^{e}	1.80±0.01^{b}	2.29±0.03^{g}
100Mpa	10min	2.32±0.03^{d}	2.50±0.05^{g}	2.29±0.03^{e}	2.36±0.00^{gh}
	20min	1.97±0.00^{b}	2.27±0.03^{e}	2.26±0.04^{e}	1.89±0.04^{c}
	5min	1.96±0.03^{b}	2.21±0.00^{e}	1.66±0.01^{a}	2.44±0.12^{h}
300Mpa	10min	2.42±0.01^{e}	2.60±0.01^{g}	2.55±0.01^{g}	2.88±0.01^{j}
	20min	2.45±0.01^{e}	3.25±0.03^{h}	2.71±0.02^{h}	2.57±0.02^{h}
	5min	1.98±0.03^{b}	2.43±0.02^{f}	1.84±0.03^{a}	2.91±0.03^{j}
600Mpa	10min	2.77±0.01^{h}	2.67±0.05^{g}	2.91±0.02^{i}	2.95±0.06^{j}
	20min	2.76±0.04^{h}	1.53±0.01^{a}	2.81±0.02^{h}	2.55±0.01^{h}

**Means in a column with different superscripts are significantly different ($p < 0.05$).

Table 3. The total phenols contain of royal jelly treat with different HPP conditions

Pressure	Times	tea blossom (mg of GAE/g)	Roxburgh Sumac (mg of GAE/g)	Rape (mg of GAE/g)	Maize (mg of GAE/g)
	Non	66.61±0.33 ^{cd}	66.95±1.38 ^{cd}	56.69±9.96 ^{a}	53.11±1.04 ^{a}
	5min	63.76±0.88^{a}	67.62±1.09 ^{bcd}	66.91±1.82 ^{c}	55.52±0.67 ^{a}
100Mpa	10min	68.64±0.36 ^{e}	64.65±0.83 ^{a}	66.40±0.67 ^{c}	57.74±1.18 ^{d}
	20min	67.47±1.54^{cd}	66.23±1.33 ^{bc}	60.65±0.61 ^{b}	66.94±1.11 ^{e}
	5min	71.75±0.10 ^{h}	67.00±1.33 ^{cd}	61.85±0.42 ^{b}	65.19±1.33 ^{e}
300Mpa	10min	71.91±0.69^{h}	71.81±1.10 ^{e}	60.66±0.23 ^{b}	60.77±1.04 ^{c}
	20min	74.91±2.01^{i}	68.91±1.45 ^{de}	76.94±2.19 ^{e}	59.61±0.39 ^{c}
	5min	66.37±0.65^{cd}	64.84±1.31 ^{a}	71.43±5.20 ^{d}	61.48±1.58 ^{cd}
600Mpa	10min	66.19±0.36^{c}	64.83±0.30 ^{a}	61.61±0.65 ^{b}	63.11±0.88 ^{e}
	20min	71.30±2.11^{h}	69.56±0.30 ^{b}	67.46±1.62 ^{c}	59.89±0.66 ^{c}

**Means in a column with different superscripts are significantly different ($p < 0.05$).

Table 4. The total flavonoids contain of royal jelly treat with different HPP conditions

Pressure	Times	tea blossom (mg of QEAC/g)	Roxburgh Sumac (mg of QEAC/g)	Rape (mg of QEAC/g)	Maize (mg of QEAC/g)
	Non	4.34±0.09^{a}	4.90±0.16^{c}	1.53±0.03^{a}	1.20±0.03^{a}
	5min	4.41±0.03^{a}	5.71±0.23^{h}	1.99±0.06^{e}	1.06±0.02^{a}
100Mpa	10min	4.49±0.21^{a}	4.97±0.07^{c}	1.81±0.02^{c}	1.40±0.03^{c}
	20min	4.92±0.21^{b}	8.45±0.27^{n}	3.18±0.06^{n}	2.08±0.03^{h}
	5min	5.59±0.01^{d}	5.59±0.03^{h}	2.01±0.03^{e}	1.25±0.00^{b}
300Mpa	10min	4.47±0.38^{a}	5.52±0.13^{h}	1.59±0.04^{d}	1.57±0.02^{d}
	20min	4.86±0.12^{b}	4.02±0.05^{b}	0.74±0.01^{b}	2.19±0.04^{h}
	5min	4.45±0.16^{a}	4.99±0.18^{c}	2.30±0.03^{g}	0.81±0.02^{a}
600Mpa	10min	3.42±0.01^{a}	3.97±0.04^{b}	2.23±0.04^{f}	2.10±0.03^{h}
	20min	3.72±0.15^{a}	1.87±0.01^{a}	2.37±0.04^{g}	1.60±0.03^{d}

**Means in a column with different superscripts are significantly different ($p < 0.05$).

RESULTs

Anti-bacterial activity

Table 8. The anti-bacterial activity of tea blossom royal jelly that treat with different HPP conditions

		Streptococcus alactolyticus	*Staphylococcus aureus*	*Staphylococcus xylosus*	*Streptococcus intermedius B*	*Vibrio parahaemolyticus*
	Non	15.67±2.08^{a}	12.33±0.58^{a}	20.00±0.00^{cd}	20.00±0.00^{cd}	13.67±1.15^{a}
	5min	18.67±2.08^{a}	12.33±0.58^{a}	21.33±0.58^{cde}	23.00±1.00^{e}	16.33±0.58^{b}
100Mpa	10min	17.00±0.00^{a}	23.00±0.00^{e}	21.67±2.08^{cde}	23.33±0.58^{e}	16.33±0.58^{b}
	20min	17.00±0.00^{a}	15.00±1.00^{d}	22.00±1.73^{de}	21.33±1.53^{cde}	21.33±1.53^{e}
	5min	20.67±0.58^{c}	15.00±1.00^{d}	21.67±1.15^{cde}	20.67±0.58^{cde}	20.33±0.58^{e}
300Mpa	10min	25.00±0.00^{e}	21.33±0.58^{e}	23.33±1.15^{de}	22.33±1.15^{de}	20.67±0.58^{e}
	20min	23.33±0.58^{de}	15.00±1.00^{d}	24.67±0.58^{e}	21.00±2.00^{cde}	20.33±0.58^{e}
	5min	22.67±0.58^{d}	15.00±1.00^{d}	18.33±0.58^{bc}	21.33±0.58^{cde}	20.00±1.00^{e}
600Mpa	10min	23.33±0.58^{de}	17.33±1.15^{c}	21.00±1.00^{c}	19.00±1.00^{c}	20.00±1.00^{e}
	20min	21.67±0.58^{de}	14.00±0.00^{d}	21.00±1.00^{c}	21.00±1.00^{cde}	21.00±1.00^{e}

Table 9. The anti-bacterial activity of Roxburgh Sumac royal jelly that treat with different HPP conditions

		Streptococcus alactolyticus	*Staphylococcus aureus*	*Staphylococcus xylosus*	*Streptococcus intermedius B*	*Vibrio parahaemolyticus*
	Non	17.67±0.58^{d}	15.00±1.00^{ab}	13.67±0.58^{a}	16.33±1.15^{c}	16.33±1.53^{bc}
	5min	17.33±0.58^{d}	25.33±0.58^{e}	13.67±0.58^{a}	21.00±1.00^{ab}	18.33±1.53^{de}
100Mpa	10min	21.33±1.53^{b}	23.67±0.58^{b}	19.67±0.58^{bc}	20.67±0.58^{ab}	15.67±1.15^{b}
	20min	20.00±0.00^{c}	15.00±1.00^{ab}	19.67±0.58^{bc}	20.67±0.58^{ab}	17.67±0.58^{cd}
	5min	20.00±0.00^{c}	15.00±1.00^{ab}	19.67±0.58^{bc}	17.00±1.00^{a}	21.00±0.00^{fe}
300Mpa	10min	20.00±0.00^{c}	18.33±1.15^{c}	20.00±1.00^{bc}	20.33±1.53^{ab}	20.33±0.58^{e}
	20min	23.00±1.00^{e}	19.00±1.00^{c}	24.00±1.73^{e}	21.33±1.15^{ab}	25.67±1.15^{g}
	5min	21.33±0.58^{b}	14.00±0.00^{a}	21.00±0.00^{b}	22.00±1.00^{a}	22.33±1.15^{e}
600Mpa	10min	21.67±0.58^{b}	15.00±0.00^{ab}	19.00±1.73^{a}	20.00±0.00^{a}	20.00±0.00^{cd}
	20min	20.00±0.00^{c}	16.00±0.00^{d}	19.67±0.58^{bc}	20.00±0.00^{b}	21.33±0.58^{e}

Table 10. The anti-bacterial activity of rape royal jelly that treat with different HPP conditions

		Streptococcus alactolyticus	*Staphylococcus aureus*	*Staphylococcus xylosus*	*Streptococcus intermedius B*	*Vibrio parahaemolyticus*
	Non	15.67±1.15^{a}	14.00±1.00^{a}	15.67±1.53^{d}	16.67±1.53^{d}	22.67±2.52^{ab}
	5min	16.33±1.53^{a}	18.67±1.15^{b}	15.67±1.53^{d}	21.33±1.15^{ab}	18.00±0.00^{a}
100Mpa	10min	16.33±1.53^{a}	14.00±1.00^{a}	22.00±0.00^{ab}	19.33±2.08^{bc}	17.00±1.00^{a}
	20min	19.33±0.58^{d}	14.00±1.00^{a}	18.33±0.58^{c}	20.00±0.00^{bc}	21.00±0.00^{b}
	5min	21.00±1.00^{cd}	14.00±1.00^{a}	21.33±2.31^{a}	18.67±1.15^{cd}	17.33±1.53^{a}
300Mpa	10min	21.00±0.00^{cd}	14.00±1.00^{a}	16.67±0.58^{c}	21.00±1.00^{abc}	23.33±0.58^{b}
	20min	24.33±1.15^{e}	16.00±0.00^{b}	20.00±1.00^{ab}	19.67±1.53^{bc}	23.33±1.15^{b}
	5min	22.00±0.00^{bc}	12.00±0.00^{d}	21.33±1.15^{a}	21.33±1.15^{ab}	15.67±0.58^{d}
600Mpa	10min	23.33±1.15^{ab}	14.67±1.15^{bc}	18.67±1.15^{c}	23.33±1.15^{a}	16.00±0.00^{cd}
	20min	24.00±0.00^{a}	16.00±0.00^{b}	24.00±0.00^{a}	23.33±1.15^{a}	16.67±0.58^{cd}

Table 11. The anti-bacterial activity of maize royal jelly that treat with different HPP conditions

		Streptococcus alactolyticus	*Staphylococcus aureus*	*Staphylococcus xylosus*	*Streptococcus intermedius B*	*Vibrio parahaemolyticus*
	Non	16.00±0.00^{c}	15.33±0.58^{cd}	16.33±0.58^{g}	16.00±1.00^{f}	20.67±2.08^{a}
	5min	16.67±1.15^{bc}	18.67±2.52^{b}	23.00±2.00^{a}	22.33±1.15^{ab}	16.00±1.00^{b}
100Mpa	10min	17.67±0.58^{b}	16.67±1.15^{bc}	21.67±1.15^{abc}	23.33±1.15^{a}	15.33±0.58^{b}
	20min	15.67±0.58^{c}	17.33±1.15^{bc}	18.67±1.15^{cf}	18.33±0.58^{c}	19.33±1.15^{a}
	5min	15.67±0.58^{c}	17.33±1.15^{bc}	20.00±1.00^{ade}	20.00±0.00^{cd}	20.67±0.58^{a}
300Mpa	10min	15.67±0.58^{c}	17.33±1.15^{bc}	21.00±1.00^{bcd}	18.67±0.58^{de}	20.33±0.58^{a}
	20min	21.67±0.58^{a}	20.67±0.58^{a}	17.67±0.58^{fg}	20.33±0.58^{c}	21.33±1.15^{a}
	5min	22.00±0.00^{a}	14.00±0.00^{d}	20.00±0.00^{ade}	21.33±1.15^{bc}	20.00±0.00^{a}
600Mpa	10min	21.33±1.15^{a}	16.00±0.00^{c}	22.00±0.00^{ab}	22.67±1.15^{ab}	20.67±1.15^{a}
	20min	22.00±0.00^{a}	22.00±0.00^{a}	19.33±1.15^{def}	21.33±1.15^{bc}	20.67±1.15^{a}

RESULTs

Anti-oxidant activity

Table 5. DPPH radical-scavenging activity of royal jelly treat with different HPP conditions

Pressure	Times	tea blossom (%)	Roxburgh Sumac (%)	Rape (%g)	Maize (%)
	Non	63.95±0.26^{ab}	66.44±0.10^{c}	67.31±3.25^{a}	71.18±0.80^{a}
	5min	63.05±0.19^{a}	67.64±0.62^{de}	68.62±0.21^{b}	70.13±0.11^{a}
100Mpa	10min	62.25±0.08^{a}	67.91±0.71^{e}	66.71±0.20^{a}	70.82±0.06^{a}
	20min	62.43±0.27^{a}	67.66±0.77^{de}	63.95±0.00^{a}	67.57±0.40^{a}
	5min	62.42±0.12^{ab}	67.87±0.73^{e}	66.97±0.11^{ab}	68.62±0.06^{a}
300Mpa	10min	62.12±0.21^{a}	67.66±0.71^{de}	67.86±0.21^{a}	66.41±0.10^{a}
	20min	62.78±0.03^{ab}	67.81±0.70^{e}	63.49±0.25^{a}	71.05±0.17^{a}
	5min	62.24±0.06^{a}	67.91±0.65^{e}	56.32±0.11^{b}	62.80±0.37^{c}
600Mpa	10min	61.97±0.42^{a}	68.48±0.71^{e}	63.82±0.06^{a}	61.64±0.15^{b}
	20min	63.44±0.09^{ab}	67.52±0.73^{de}	67.17±0.06^{a}	69.05±0.11^{a}

Table 6. Reducing power of royal jelly treat with different HPP conditions

Pressure	Times	tea blossom (mg/g)	Roxburgh Sumac (mg/g)	Rape (mg/g)	Maize (mg/g)
	Non	336.51±19.28^{ab}	245.50±5.73^{ab}	150.92±1.91^{a}	137.58±0.72^{ab}
	5min	340.07±7.54^{ab}	253.42±2.60^{abc}	130.92±1.91^{a}	120.92±0.72^{a}
100Mpa	10min	322.36±9.56^{a}	264.67±3.15^{bc}	155.50±0.00^{a}	142.58±1.91^{b}
	20min	336.51±27.14^{ab}	242.17±20.82^{ab}	166.75±1.25^{c}	165.92±6.17^{c}
	5min	345.38±1.79^{b}	261.75±10.00^{abc}	173.42±3.82^{cd}	187.17±3.47^{e}
300Mpa	10min	339.72±17.85^{ab}	241.13±11.49^{ab}	176.75±0.00^{d}	187.58±3.82^{e}
	20min	356.36±17.49^{b}	240.50±15.66^{a}	380.08±1.44^{e}	202.17±2.89^{f}
	5min	318.82±10.21^{ab}	278.42±5.91^{bc}	185.92±3.82^{b}	185.08±1.44^{e}
600Mpa	10min	295.08±21.38^{a}	261.33±12.15^{abc}	188.42±5.64^{b}	188.42±1.44^{e}
	20min	298.63±24.54^{ab}	266.31±5.05^{abc}	170.08±0.72^{bc}	136.33±2.89^{a}

Table 7. FRAP of royal jelly treat with different HPP conditions

Pressure	Times	tea blossom (mg/g)	Roxburgh Sumac (mg/g)	Rape (mg/g)	Maize (mg/g)
	Non	16.67±0.28^{ab}	36.23±0.21^{e}	16.50±0.21^{ab}	28.77±0.02^{de}
	5min	26.33±0.23^{de}	30.90±0.12^{b}	15.25±0.23^{a}	40.10±0.35^{i}
100Mpa	10min	25.50±0.02^{de}	27.75±0.05^{a}	12.00±0.14^{a}	36.10±0.35^{gh}
	20min	24.33±0.19^{de}	26.57±0.12^{a}	18.75±0.11^{b}	27.43±0.35^{de}
	5min	12.22±0.02^{a}	22.73±0.12^{a}	12.25±0.18^{ab}	28.10±0.07^{de}
300Mpa	10min	14.44±0.30^{ab}	19.57±0.12^{a}	15.50±0.14^{ab}	30.77±0.26^{e}
	20min	23.50±0.12^{de}	18.40±0.19^{a}	14.00±0.18^{ab}	18.27±0.24^{b}
	5min	17.11±0.40^{b}	20.73±0.13^{a}	17.00±0.10^{ab}	28.49±0.05^{de}
600Mpa	10min	10.17±0.12^{a}	20.57±0.07^{a}	12.50±0.00^{ab}	24.43±0.12^{cd}
	20min	7.17±0.02^{a}	19.07±0.19^{a}	5.00±0.00^{a}	26.93±0.09^{de}

SUMMARY

This study explores the effect of high-pressure treatment technology applied to royal jelly. The results show that high-pressure treatment technology has no significant impact on royal jelly quality and nutritional characteristics. In terms of biological activity, the water solubility of 10-HDA after high pressure treatment has been improved, and the antioxidant and antibacterial activities have also increased. This study points out that the application of high-pressure treatment technology in royal jelly processing can maintain nutrients and improve safety, but enzyme activity will be affected to a certain extent, so it has potential application value for food processing.

ACKNOWLEDGMENTS

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PP-278 [Beekeeping Technology and Quality]
Sugar profile and phenolic content of Portuguese honey with Protect Denomination Origin

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Honeybees play a crucial role in maintaining plant diversity through pollination, thereby supporting ecosystem stability. However, the adverse effects of climate change on bee populations and the quality of honeybee products are an increasing global concern.

Portugal possesses significant potential for beekeeping due to its favorable climatic conditions and diverse vegetation. However, according to data from the National Institute of Statistics, honey production in Portugal has declined by more than 20% since 2022, which is caused by climatic shifts. A key step in formulating effective mitigation strategies of environmental impact is closely monitoring the compositional changes in honey in response to environmental variations, which is particularly relevant in regions where honey is certified as a product with a protected denomination of origin (PDO). This study aims to analyze honey samples from five different regions of Portugal with honey certified as PDO, “Mel do Parque de Montesinho”, “Mel de Barroso”, “Mel da Terra Quente”, “Mel da Serra da Lousã” and “Mel do Ribatejo Norte” and evaluate their potential for distinguishing regional variations. The findings indicate that the botanical origin of the samples was mostly polyfloral, while the monofloral honeys were Castanea sp., Echium sp., Erica sp., Lavandula sp., Rubus sp., and Stachys sp. The total phenolic and flavonoid contents were 17-136 mg GAE/100g and 1.5-7.7 mg QE/100g, respectively. The fructose, glucose and maltose contents varied between 35-44 g/100mL, 22-31 g/100mL, and 3.0-6.5 g/100mL, respectively. Additionally, some honey samples contained low concentrations of rare sugars, including turanose, kojibiose, melibiose, and raffinose. The findings of this study contribute to the development of methodologies for assessing honey based on regional and climatic characteristics and will serve as the scientific information required to update the certification parameters for those PDOs.

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APIMONDIA SCANDINAVIA 2025
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PP-279 [Beekeeping Technology and Quality]

Characterization of Slovenian bee venom

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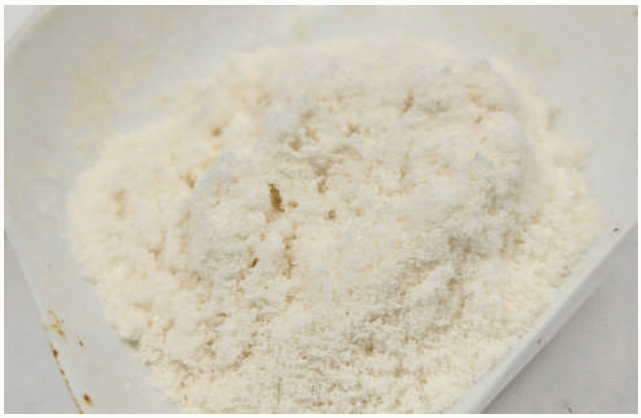
Bee venom is certainly one of the lesser-known and less-researched bee products, but it is a product with great potential. In recent years, the Slovenian Beekeepers' Association has carried out several in-house trials and researches on the production of bee venom. Between 2020 and 2022, we conducted a research project on the optimization of bee venom production technology in typical Slovenian AŽ hives and LR hives. In 2023, we launched the Characterization of Bee Products study, which also investigated the composition of Slovenian bee venom.



Materials and Methods

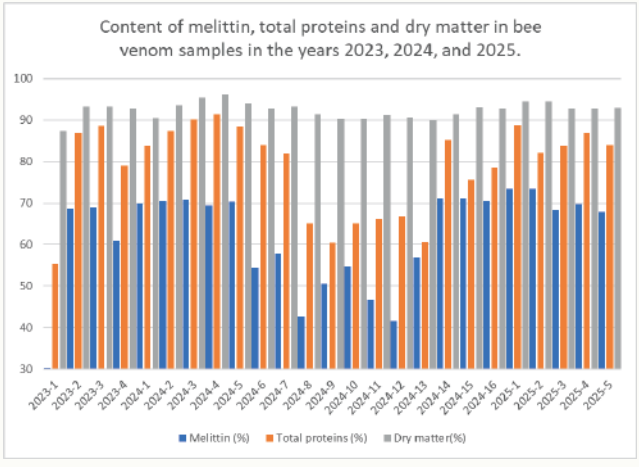
As part of the Characterization of Bee Products and bee venom study, 25 samples of Slovenian bee venom were collected in 2023, 2024, and 2025. The samples were collected by 11 Slovenian beekeepers from 7 different regions of Slovenia. Upon arrival at our laboratory, the samples were weighed, visually inspected and evaluated based on the presence of larger impurity particles and the color of the bee venom. The evaluation was performed visually and scored on a scale of 1–4 for each parameter.

Further analyses of bee venom for melittin, total protein, and dry matter were carried out by subcontractors of the Dr. Andrija Štampar Institute of Public Health in Zagreb. To determine melittin content, total protein content and dry matter content.

Results

The collected bee venom samples varied in color and appearance. Some samples were predominantly bright white, while others showed shades of grey and brown. In certain samples visible impurities were also present. Despite these differences, the samples were on average evaluated quite well. For purity, the average score was 3.8 out of 4 points, with the lowest-rated samples receiving 3 points and the majority receiving all 4 points. The samples were rated somewhat lower with regard to color, where the average score was 3.5 out of 4 points. The lowest-rated sample received only 1 point, while the majority received all 4 points.

In terms of composition, the smallest differences between the bee venom samples were observed in the proportion of dry matter, which averaged 92.4%, ranging from 87.3% to 96.3%. The average total protein content in the bee venom samples was 78.6%, ranging from 55.4% to 91.4%.



The average melittin content, considered the main quality parameter, in the bee venom samples was 62%. The lowest melittin content was found in a sample with 30.4%, while the highest was in a sample with 73.5%. Across all three years, it was observed that melittin content was higher in samples that were visually rated as good—that is, in samples where no traces of impurities were detected. Sixteen out of the twenty-five samples included in the study received full points for the visual assessment of color and impurity content. These samples also had the highest melittin content, averaging 69.67%. Within this group, the lowest melittin content was 60.8%, and the highest was 73.5%.

Based on the obtained data, it can be concluded that Slovenian bee venom is of high quality and contains a high proportion of melittin.

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PP-280 [Beekeeping Technology and Quality]

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Volatile Organic Compounds Profile of Spanish Chestnut (*Castanea*) Honey

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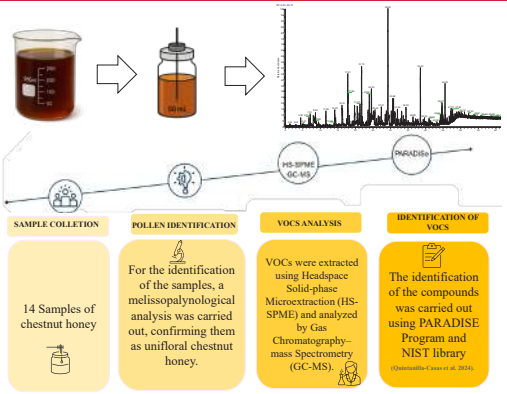
INTRODUCTION

Honey has long been regarded as the most important food product derived from honey bees. Spain is the fourth largest producer of honey in Europe and this product has a great economic impact on the primary sector in some regions.

Castanea is the taxon of interest to beekeepers, especially in inland areas from the north of the Iberian Peninsula. It produces unifloral chestnut honey of great value. This honey has very well-defined organoleptic characteristics, due to its high *Castanea* content (over 70%), with only differences due to its geographical origin and the accompanying flora. There is limited information in Spain regarding the volatile organic compounds (VOCs) that contribute to the characteristic aroma and quality of honeys.

For this reason, the present study analyzed the volatile profiles of 14 chestnut honey samples from three regions of Spain, aiming to contribute to the typification and characterization of their quality attributes.

METHODOLOGY



RESULTS

POLLEN ANALYSIS revealed a clear dominance of *Castanea* pollen (mean 78.1%, range 68.5–94.9%, present in 100% of samples), confirming the unifloral character of chestnut honey. The most frequent accompanying pollen types were *Cytisus* type (3.8%, 100%) and *Rubus* (12.9%, 92.9% of samples) (Fig. 1).

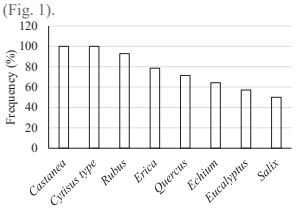


Fig. 1. Most Frequent Pollen Types in Chestnut Honey

- *Erica*, *Quercus*, *Echium*, *Eucalyptus*, and *Salix*, were presented in more than 50% of the samples.
- Their occurrence varied depending on the geographic origin of the honey.

AS A RESULT, a total of 39 volatile compounds were successfully identified. The compounds fall into 8 chemical families:

1. Terpenoids (monoterpenes & oxygenated derivatives)
- Linalool oxide (fr.1)
- Hotrienol
- Thymol
- Carvacrol
- Borneol
- Safranal
- 2,5,5-Trimethylcyclohex-2-enone
- 2,6,6-Trimethyl-2-cyclohexene-1,4-dione

2. Alcohols
- Phenylethyl alcohol
- Benzyl alcohol
- 3-Cyclohexene-1-methanol, α,α,4-trimethyl-, (S)-
- Cinnamyl alcohol

3. Aldehydes
- Cinnamaldehyde, (*E*)-
- Benzaldehyde
- *p*-Anisaldehyde
- Benzeneacetaldehyde
- 1H-Indene-4-carboxaldehyde, 2,3-dihydro-

4. Phenols
- Phenol, 3,4,5-trimethyl-
- Phenol, 2,4-bis(1,1-dimethylethyl)-
- Phenol, 3-methyl-5-(1-methylethyl)-, methylcarbamate
- Eugenol
- 7-Methyl-1-naphthol

5. Acids and Esters
- Nonanoic acid
- Benzoic acid, ethyl ester
- Methyl salicylate

6. Furans and Lactones
- Furan, 3-phenyl-
- 2(3H)-Furanone, 5-butyldihydro-4-methyl-, *cis*-
- 2-Furanmethanol, 5-methyl-
- Benzofuran, 2-methyl-

7. Aromatic Hydrocarbons
- Benzene, pentamethyl-
- Benzene, 4-ethenyl-1,2-dimethyl-
- Naphthalene, 1,2-dihydro-1,1,6-trimethyl-
- 1-Naphthalenol, 1,2,3,4-tetrahydro-2,5,8-trimethyl-

8. Nitrogen-containing compounds
- 2′-Aminoacetophenone
- Benzyl nitrile
- 6-Cyanoquinoline

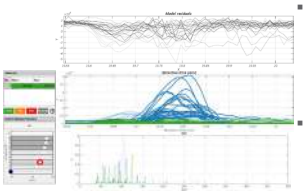


Fig. 2. PARADISe software application

- PARADISe software applied interval deconvolution combined with FIT models, which allowed a more accurate separation of overlapping chromatographic peaks
- Each compound was assigned based on its mass spectral similarity, expressed as Match Quality, together with its RI, ensuring reliable identification.

Chestnut honey was characterized by high relative concentrations of phenylethyl alcohol ($C_8H_{10}O$) and (*E*)-cinnamaldehyde (C_9H_8O) as its most abundant compounds. Other abundant compounds identified are presented in the Fig. 3).

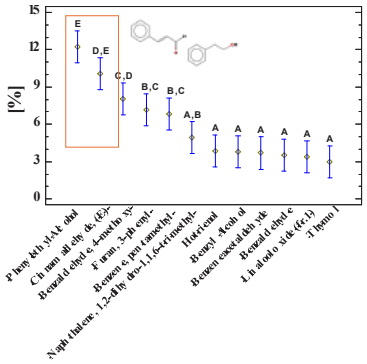


Fig. 3. Major Volatile Organic Compounds in Chestnut Honey: Mean Values with 95% Fisher LSD. Different letters denote statistically significant differences.

CONCLUSIONS:
- These compounds can be considered as key markers defining the volatile profile of unifloral chestnut honeys from Spain, supporting their typification and quality characterization.

PRACTICAL IMPLICATIONS FOR BEEKEEPERS:
- Highlights the high value of Spanish chestnut honey as one of the most appreciated unifloral honeys.Provides insights into its volatile composition, useful for product differentiation and market promotion.

Acknowledgements: This study was funded by the VASBEEP project (PID2022-141679OR). Rodríguez-Flores, MS. thanks UVigo for recruiting her as a postdoctoral researcher under the UVigo Research Talent Retention Programme. Falcão, S., thanks the national funding of the FCT (Foundation for Science and Technology) for a contract through the Institutional Scientific Employment Programme.

References. Quintanilla-Casas, B., Bro, R., Hinrich, J. L., & Davie-Martin, C. L. (2024). Tutorial on PARADISe: PARAFAC2-based Deconvolution and Identification System for processing GC–MS data.

PP-281 [Beekeeping Technology and Quality]
Developing sustainable beekeeping through new technologies and local bee conservation

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Background/purpose. Galicia has a remarkable tradition in beekeeping activity. The existence of a large, forested area and diverse melliferous flora favored this activity providing a source of income for farmers in rural areas. The aim of this project was to find out the current situation of beekeeping in Galicia and to propose management alternatives for apiaries. Problem description. Galician beekeeping is facing different challenges, such as climate change, the presence of the invasive species Vespa velutina nigrithorax, resistance to disease control treatments and the introduction of non-native honey bees not adapted to the territory. To achieve the survival of honey bee colonies, it is necessary to innovate in the methodology of colony management, allowing beekeepers to face the current and future challenges of the sector.

Methodology. 77 apiaries were selected, distributed throughout Galicia, with a total of 245 beehives selected. Each of the selected beekeepers was surveyed about their beehive management and the characteristics of their honey bees. Sanitary, morphometric and genetic analyses were carried out on the selected hives. Different types of precision beekeeping systems were used.

Results and conclusion. Continuous records of internal and external data were obtained from the apiaries and the main disadvantages, including the difficulty of interpreting the data, and advantages such as obtaining data in real time, were identified. An overview of the morphometric and molecular variability of bees in Galicia was compiled together with behavioral data. In conclusion, the description of current Galician beekeeping highlighted the variability of management among beekeepers, the concern of beekeepers about Vespa velutina and Varroa mite and the introduction of other subspecies of honey bees in Galician territory.

Practical implications for beekeepers. Good practice guidelines for the use of new technologies and other key factors in beekeeping management were elaborated.

PP-282 [Beekeeping Technology and Quality]

Melissopalynological properties of Ivy (*Hedera helix* L.) honey

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Keywords: *Hedera helix, honey, melissopalynology, pollen spectrum*

Introduction

Common ivy (*Hedera helix* L.) is a widely distributed evergreen climber in Croatia, thriving in both sunlit and shaded habitats. It's yellow-green, nectar-rich flowers are highly attractive to honey bees (Fig. 1), making it an important late-season pollen and nectar source. Melissopalynological analysis, based on the identification and quantification of pollen grains, is essential for determining the botanical origin and authenticity of honey, as well as for identifying secondary nectar sources contributing to it's composition. Recent studies have indicated the presence of rare or underexplored unifloral honeys in Croatia, underscoring the need for further investigation. This study therefore focuses on the melissopalynological properties of ivy honey to support it's recognition and classification.

Fig. 1. *H. helix* flowers during flowering time in September

Materials and methods

Twenty ivy honey samples (n=19) were collected directly from beekeepers across Croatia during the autumn of 2023 (Fig. 2a). Samples were stored in glass jars under cool and dark conditions, and all analyses were conducted within three months.

Melissopalynological analysis (Fig. 2c) followed the method of Von der Ohe et al. (2004). Pollen grains were identified and quantified using a Carl Zeiss Axio light microscope (400×–1000×), referencing a curated internal pollen collection and relevant literature. Pollen morphology was evaluated based on shape, color, size, exine structure, and germination pores (Fig. 2b).

Figure 2.a) *H. helix* honey samples; 2.b) Morphology of some pollen types in ivy honey samples; 2.c) Melissopalynological analysis

Results

Melissopalynological analysis confirmed the dominance of *H. helix* pollen (>45%) in all examined samples, with a pollen spectrum reflecting plant species flowering during the summer and early autumn period (Fig. 3). The percentage of *H. helix* pollen varied between 51% and 96%, depending on geographical location, climatic conditions, and foraging behavior of honey bees. The accompanying pollen group included asparagus (Asparagus spp.) pollen (24%) and alder buckthorn (*Frangula alnus*) pollen (20%). In half of the samples, pollen from the secondary pollen group was identified, with the most prevalent originating from the Asteraceae family, followed by Apiaceae, Rosaceae, Rhamnaceae and Poaceae. Additionally, pollen from asparagus (Asparagus spp.), sweet chestnut (*Castanea sativa*), buckthorn (Rhamnus spp.), linden (Tillia sp.) as well as clover (Trifolium sp.), was also identified. In the rare pollen group, were presented: Poaceae, Lamiaceae, *Helianthus annuus*, Fabaceae, Ericaceae, Boraginaceae, Brassicaceae and *Amorpha fructicosa*.

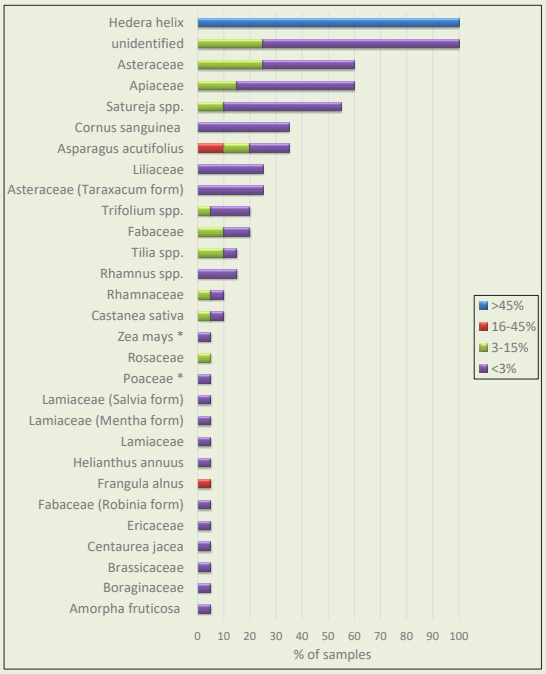

Figure 3. Results of melissopalynological analysis of ivy honey (n=19)

Conclusions

The study on ivy honey revealed uniflorality (>45% of ivy pollen) between 51% and 96%, along with pollen from other plant families. The variability in pollen composition suggests that ivy honey can incorporate nectar from a wide range of late flowering plants, depending on local vegetation. A well-defined pollen spectrum is crucial for honey authentication in terms of uniflorality confirmation, quality control, and the assessment of potential bioactive compounds derived from different botanical sources.

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PP-283 [Beekeeping Technology and Quality]

Ensuring Honey Safety: Rapid Testing for Antibiotic Residues

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Overview

Antibiotic contamination in honey can arise from hive treatments or environmental exposure, posing health risks, driving antimicrobial resistance and risking regulatory non-compliance. Residues threaten consumer safety and may lead to rejected shipments, financial losses, and reputational damage.

To safeguard public health and maintain market access, strict residue limits are enforced globally, with the EU regularly updating maximum residue levels (MRLs) for antibiotics in honey. While confirmatory methods such as LC-MS or HPLC offer high accuracy, they are costly, time consuming and require specialised facilities, making routine or on-site monitoring impractical for many producers.

Using lateral flow immunoassay technology and freeze-dried conjugates the product "FlowSense" delivers high sensitivity, specificity and accuracy in under 10 minutes. This product addresses these challenges by providing a rapid, portable and cost-effective screening solution for up to 49 antibiotics. This enables producers, exporters and regulators to perform continuous quality control, detect issues early and take corrective action, helping ensure compliance, safeguard supply chains, and protect consumer trust.

Testing Principle

Step 1: Sample Preparation

All sample preparations, except for Chloramphenicol and Nitrofurans (which require solvent extraction and evaporation), involve simple dilute-and-shoot methods.

Method

Weigh 1g Honey

↓

Add appropriate volume sample diluent

↓

Shake 3 minutes

↓

Add appropriate volume into micro well

↓

Follow incubation steps

↓

Results

Step 2: Rehydration of Freeze-Dried Conjugates

After sample preparation, which is designed to release the target antibiotic, the user applies the liquid sample into a well containing freeze-dried conjugate (biomolecule-labelled gold particles). The sample buffer rehydrates the freeze-dried conjugates, which then binds to the target antibiotic if it is present.

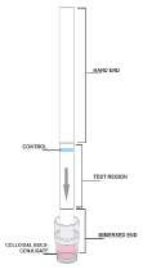

Figure 1: Orientation of Lateral Flow Test

Step 3: Detection

The prepared sample moves along the strip. If the antibiotic is present, the conjugate-analyte complex competes for binding to the antibodies immobilised at the test line. If the antibiotic is absent, no competition occurs, and a control line will appear to confirm that the test is functioning properly.

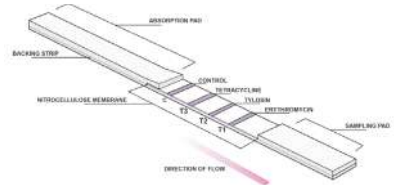

Figure 2: Example of 3 in 1 Test Strip (BXEFB58A)

Step 4: Interpretation

After a few minutes, the result can be interpreted.

A. Visually - If the analyte is present, it binds to the antibodies at the test line, blocking the labelled analyte from binding, resulting in no visible line or a faint line. If the analyte is absent, the labelled analyte binds freely to the antibodies at the test line, forming a visible line.

OR

B. FlowSense Reader- Using the same principles as visual detection, but with an enhanced sensitivity.

The FlowSense Reader has been designed to provide an accessible and effective method for food quality testing, offering numerous advantages to end-users. With a low initial investment, it is financially viable for a wide array of businesses and organisations. Its user-friendly design eliminates the need for prior experience or specialised technical skills, ensuring that anyone can operate it with ease.

Thanks to its portability, the FlowSense Reader can be used effortlessly in various environments, from field operations to different areas within food production facilities. This convenience allows for seamless integration into any workflow, ensuring that testing can be conducted without interruptions.

Key Benefits

- Easy user accessibility with minimal training needed.
- Portable for on-site testing.
- Provides semi-quantitative results to reduce visual interpretation errors.
- Multiple target analysis capability.
- Export via USB drive.
- High data storage capacity.
- Easy printing facilities via USB.

Figure 3: Accesible user interface.

Figure 4: FlowSense Reader (Portable on-site testing)

Figure 5: Example of test output using FlowSense Reader

Results

Description	Cat No.	Assay Time	Antibiotic	FlowSense Reader Detection (ppb)	Visual Detection (ppb)
Streptomycin Honey Flowsense Rapid Test	BXEFB55A-Q	10mins	*Streptomycin Dihydrostreptomycin	2 3	N/A
Multi-Sulfonamides Flowsense Rapid Test (High Sensitivity)	BXEFB56A	8mins	*Sulfadimidine (Sulfamethazine) Sulfametoxydiazine Sulfadiazine Sulfamonomethoxine Sulfisomidine Sulfadimethoxine Sulphaquinoxaline Sulfamerazine Sulfadiazine Sulfachloropyridazine Sulfamoxole Sulfamethizole Sulfamethoxypyridazine Sulphormethoxine Sulfapyridine Sulfamethoxazole Sulfisoxazole Sulfathiazole	1 1 1.5 1.5 1.5 1.5 2 1.5 2 2 3 4 9 20 20 25 45 60	1.5 1.5 2 2 3 3 3 4 4 6 8 10 40 40 60 90 100
Multi-Antibiotic Honey (Quinolones/ Thiamphenicol/ Spectinomycin) Flowsense Rapid Test	BXEFB57A	10mins	*Enrofloxacin Norfloxacin Ciprofloxacin Oxolinic acid Danofloxacin Pefloxacin Flumequine Lomefloxacin Fleroxacin Difloxacin Ofloxacin Enoxacin Sarafloxacin Nalidixic acid Marbofloxacin Thiamphenicol Spectinomycin	0.75 0.75 1 1 1 1 2 2 2 2 2 2 2.5 4 10 2 10	1.5 1.5 1.5 1.5 1.5 1.5 3 3 3 4 4 4 4 6 15 5 15
Multi-Antibiotic Honey (Erythromycin/ Tylosin/Tetracyclines) Flowsense Rapid Test	BXEFB58A	10mins	*Erythromycin *Tylosin Tilmicosin *Tetracycline Oxytetracycline Doxycycline Chlortetracycline	10 10 12 8 12 20 15	15 10 15 15 15 40 30
Chloramphenicol Honey Flowsense Rapid Test	BXEFB59A**	8mins	*Chloramphenicol	0.2	0.5
Multi-Nitrofuran Honey (AHD/AOZ/ SEM/AMOZ)	BXEFB60A**	10mins	*Nitrofurantoin (AHD) *Furazolidone (AOZ) *Nitrofurazone (SEM) *Furaltadone (AMOZ)	0.25 0.25 0.25 0.5	0.5 0.5 0.5 0.5

Δ *Reporting target
Δ **Solvent use required.

Figure 6: Honey Testing Panel

Intra-Precision

Intra-assay precision was evaluated using the control line ILU (Intensity Ligh Unit) of each FlowSense test with a negative honey sample and a spiked honey sample containing a defined concentration of the target antibiotics.

Each sample was analysed twenty times to assess test precision. The coefficient of variation (CV) for all test lines was below 10%.

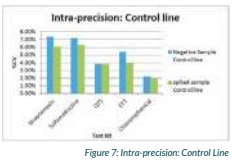

Figure 7: Intra-precision: Control Line

Detection Capability

CCβ is a validation process used to confirm a method's ability to reliably detect the target analytes. It involves testing 20 different honey samples, both blank and spiked with a known concentration of target analyte. The criteria is considered acceptable if there is no overlap between the blank and spiked results. All the FlowSense test kits complies with EU regulatory limits for all the required antibiotic.

Detection Capability ETT (BXEFB58A)

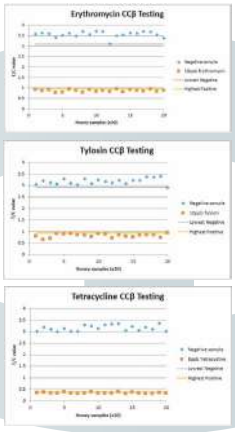

Figure 8-10: Detection Capability (3 in 1) of Erythromycin, Tylosin, Tetracycline

Detection Capability QTS (BXEFB57A)

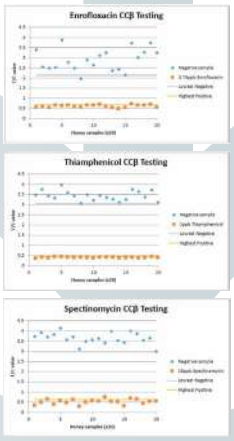

Figure 11-13: Detection Capability (3 in 1) of Enrofloxacin, Thiamphenicol, Spectinomycin

Conclusion

FlowSense offers a rapid and straightforward diagnostic tool that can be used with minimal expertise by users at any stage of the product workflow. Each test kit demonstrates high levels of precision and sensitivity, ensuring compliance with government legislation. As a platform, FlowSense provides the following testing benefits:

- Affordable in-house testing
- Multiple target analysis
- Not restricted to laboratory settings
- Short assay time of 10 minutes
- High levels of precision
- Simple sample preparation
- Excellent Correlation with FAPAS material

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PP-284 [Beekeeping Technology and Quality]

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LIVE

SVÄRMKARTAN

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Swarm Map (Svärmkartan)

The Swarm Map displays all incoming calls to the Swarm Line (Svärmtelefonen) in real time. It also shows swarm catchers the protection and surveillance zones for American foulbrood, enabling them to take specific actions within designated zones to manage the situation efficiently and safely.

SINCE 2020

direct links between the public and swarm catchers in sweden

Swarm Line (Svärmtelefonen) is a free telephone service open to the public

SVERIGES BIODLARES RIKSFÖRBUND BIODLARNA

PP-285 [Beekeeping Technology and Quality]

Developing an Objective Scoring System for Evaluation of Sustainability of Best Beekeeping Practices

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Abstract

The sustainability value of Best Beekeeping Practices can guide beekeepers towards practices that improve the resilience and profitability of their operations. A consortium of experts from 13 EU countries participated in creating an objective scoring system based on three main criteria: (1) sustainability (including cost-benefit analysis, and scoring of the impact on honey bee health, human health, and impact on environment), (2) scientific validity, and (3) readiness for practical implementation. A total of 50 Best Beekeeping Practices (BBPs) covering the themes of Apiary and colony set up and management/maintenance (category "Good Beekeeping Practices - GBPs"), Varroosis, and American Foulbrood ("Biosecurity Measures in Beekeeping - BMBs") were analysed. The practices with the highest sustainability score in each criterion were: "Expanding the colony to give the colony space" and "Only transfer disease-free bees and/or frames to other colonies" from the GBPs category, and "Identification of the best moment for Varroa treatments according to the national climatic areas" and "Queen caging" for BMBs. A significant correlation was found between the scientific value of a practice and its reduced environmental impact. Interestingly, sustainability parameters such as "Human Health", "Scientific Value," and "Environmental Impact" varied across countries.

Introduction

The implementation of Best Practices in animal production is essential for optimising economic outcomes, improving health management, ensuring high welfare standards, and reducing environmental impact. In the context of the Horizon Europe Thematic Network B-THENET, Best Beekeeping Practices were formally defined. To support beekeepers and strengthen the EU beekeeping sector, a method was developed to assess the sustainability of these practices. Such methodology may enable cross-comparison of sustainability metrics across different countries and farmed animal sectors, particularly where theoretical frameworks are needed before practical application. This tool holds promise for integration into larger initiatives, such as the EU Farm Book project, to establish uniform sustainability benchmarks for the European agricultural sector.

Materials & Methods

The sustainability analysis was based on three criteria, assessed through seven parameters, each scored from 0 to 3 (Table 1). The median total score across all parameters determined each BBP's overall sustainability rating, classified as low (0–7), medium (8–14), or high (15–21).

Table 1. Structure of the Objective Scoring System for evaluating the sustainability of BBPs.

Criteria	Parameters	Scoring
Sustainability	Cost/Benefit analysis	0 – 3
	Bee Health	0 – 3
	Human Health	0 – 3
	Environmental impact	0 – 3
Scientific value	Assessment of scientific validity	0 – 3
Readiness to use	Required beekeepers' knowledge	0 – 3
	Availability of required tools	0 – 3

50 BBPs formally identified by the Horizon Europe Thematic Network B-THENET, were scored by experts from 13 EU countries (Austria, Belgium, Croatia, Denmark, Germany, Greece, Hungary, Italy, Poland, Slovakia, Slovenia, Spain, and Sweden). Sustainability scores of BBPs were compared across countries, with further analysis of trends between categories (GBPs vs. BMBs) and correlations among the assessment parameters.

Results

All Best Practices evaluated were rated as having medium to high sustainability values across the 13 participating EU countries. The median sustainability values derived from the analysis of best practices in each country (n = 645) are presented in Figure 1.

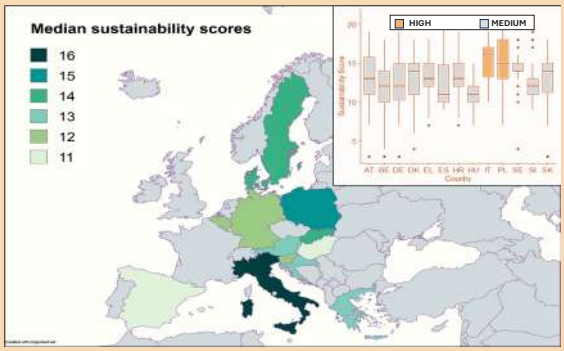

Figure 1. Map showing countries where national experts applied the Objective Scoring System for BBPs. The top-left of the figure displays median sustainability scores, with countries shaded accordingly. Boxplots at the top-right illustrate score distributions across countries, highlighting high sustainability ranges in gold and medium ranges in light grey.

The highest-scoring practices for sustainability were: "Expanding the colony to provide space" and "Transferring only disease-free bees or frames" from the GBPs category, and "Timing Varroa treatments by national climate" and "Queen caging" from the BMBs category. When comparing categories, BMBs received higher sustainability scores than GBPs. Fig. 2A shows the differences in median sustainability values between GBPs and BMBs. A significant correlation was found between the scientific value of a practice and its reduced environmental impact (Fig. 2B).

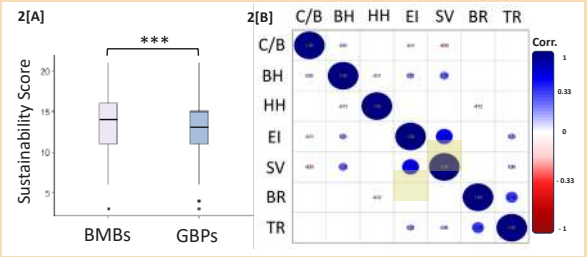

Figure 2. [A] Sustainability scores of Best Practices by category: BMBs (n=219) and GBPs (n=426). BMBs received higher scores than GBPs. (N.B. * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$). **[B]** Correlation between the parameters of the sustainability analysis: C/B (Cost–Benefit), BH (Bee Health), HH (Human Health), EI (Environmental Impact), SV (Scientific Value), BR (Beekeepers' Readiness), and TR (Tools Readiness). The colour gradient indicates the strength and direction of correlations between parameters. Significant correlations are highlighted in yellow.

Conclusions

This study presents the first structured assessment of the sustainability of BBPs across 13 EU countries, applying a standardised, expert-driven Objective Scoring System. All 50 BBPs achieved medium-to-high sustainability ratings, with significant variation among countries, reflecting the diverse realities of beekeeping across the EU. BMBs scored significantly higher than GBPs. Disease prevention strategies may have a greater impact on the overall sustainability of a beekeeping operation. Scientific value and environmental impact of BBPs were significantly correlated, reflecting the prevalence of well-documented research on low-impact techniques among the practices analysed. Future assessments should broaden practice range and include more in depth evaluation concerning One Welfare (Honey Bee, Human and Environment). The scoring system shows potential as a tool to develop sustainable BBPs. This framework could also be adapted to establish uniform sustainability benchmarks for Best Practices in other agricultural and animal production sectors.

Funded by the European Union

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PP-286 [Beekeeping Technology and Quality]
Pesticide residues in honey samples tested under veterinary official control in Poland in 2024

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In 2024, as part of the National Plan for the control of pesticide residues in food of animal origin, the Veterinary Inspection took 50 samples of honeys from all over the country for testing. Among them, 27 honey samples were analysed by a multi-residue method for the determination of 122 pesticide residues in them. The remaining 23 samples were tested for residues of glyphosate, AMPA and glufosinate. The analyses were carried out according to published analytical procedures[1],[2].

The multi-residue analyses carried out showed that 19 of the 27 honey samples tested contained pesticide residues. The majority were acetamiprid residues. In one sample, acetamiprid concentration exceeded the maximum residue limit (MRL) laid down in Regulation (EC) No 396/2005 of the European Parliament and of the Council. It is noteworthy that apart from acetamiprid, residues of only four other pesticides were determined:: azoxystrobin, DMF (amitraz metabolite), pyraclostrobin and thiacloprid.

Glyphosate residues were determined in only 2 of the 23 honey samples tested. None of the samples had glyphosate residues above the MRL set in Regulation (EC) No 396/2005. In addition, no residues of glufosinate or AMPA were detected in the samples tested.

Although glyphosate is one of the most widely used pesticides in the world, the frequency of its residues in honey has been shown to be very low. Recently, the European Commission approved an extension of its use in the EU, but with restrictions on its conditions of use. Glyphosate should not be used during crop flowering, control of flowering weeds and during high pollinator insect activity. However, it is necessary to review the conditions of use of plant protection products containing acetamiprid, especially in the context of their use during crop flowering.

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[2] Małysiak and Kiljanek, 2022, Method of Glyphosate, AMPA, and Glufosinate Ammonium Determination in Beebread by Liquid Chromatography—Tandem Mass Spectrometry after Molecularly Imprinted Solid-Phase Extraction, Molecules 27(17), 5741; https://doi.org/10.3390/molecules27175741

PP-287 [Beekeeping Technology and Quality]
Unifloral or multifloral? An evaluation of the botanical characteristics of chestnut honeys from Emilia-Romagna (Italy)

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Background/Purpose. Unifloral honey is predominantly derived from a single plant species and is often considered more valuable than multifloral honey. Due to its high added value, botanical labeling is widely used in the European market; therefore, monoflorality must be checked before labeling and marketing to protect consumers and producers.

Problem description. The natural variability in honey composition complicates the classification of unifloral honeys. Currently, classification relies on UNI standards and characterization sheets for Italian (Persano Oddo et al., 2000) and European unifloral honeys (Persano Oddo et al., 2004).

This study characterizes 14 Chestnut honeys from the Tuscan-Emilian Apennines (Emilia-Romagna, Italy) using volatile fingerprinting, physicochemical parameters, and total polyphenol content (TPC) to evaluate their compliance with botanical classification.

Methodology. Volatile profiles of Chestnut honey samples (CHER01 to CHER14) were analysed using Headspace Solid-phase Microextraction (HS-SPME) coupled with Gas Chromatography-Mass Spectrometry (GC-MS). Electrical conductivity and color were measured as physicochemical parameters, while TPC was determined using the Folin-Ciocalteu method. Additionally, selected samples with distinctive features were submitted to melissopalynological analysis. Principal component analysis (PCA) was performed to assess possible sample groupings based on volatile profiles, physicochemical parameters, and TPC.

Results and conclusions. All samples met Directive 2001/110/EC standards for electrical conductivity (>0.8 mS/cm) and exhibited similar colors (reddish to dark amber), except CHER03 and CHER04, which showed darker yellowish tones. TPC results aligned with literature data (Castiglioni et al., 2017) for chestnut honey. Major volatile compounds identified in all the analyzed samples included 2-aminoacetophenone, phenylethanol, benzyl alcohol, nonanal, decanal, and benzaldehyde. PCA revealed CHER03 as distinct from the main clusters along PC1 and PC2.

Melissopalynological analysis of CHER03 confirmed its classification as chestnut honey. However, a minor presence of pollen of Erica carnea was observed (also detected in the sensory analysis performed by the same analyst), suggesting its significant role in the nectar composition.

Practical implications for beekeepers. The study highlights the challenges in verifying honey's botanical origin due to its inherent variability. Accurate uniflorality assessment requires a comprehensive approach, combining volatile and polyphenol analyses with morphological methods, as no single compound currently serves as a definitive unifloral marker.

PP-288 [Beekeeping Technology and Quality]

Navigating the beekeeping information environment

LATEST NEWS

Mara Golob Meserko, Editor of the Slovenian Beekeeper magazine

The emergence of the Internet and social networks is a process of mediatization of the beekeeper's everyday life, that requires caution in identifying the right information. Bees and beekeepers are all over the world and do not always face the same problems, which means that one information cannot be a universal solution to all problems, so beekeepers should be careful when implementing information in practice.

Social networks such as Twitter, Facebook, and TikTok provide users with a dynamic and interactive environment where information can be quickly shared, discussed, and spread.

Why not Facebook, Instagram, TikTok, X?

Beekeepers on social media can find a whole range of different information, which is not always accurate, even less often verified, or sometimes even misleading. These pieces of information are often subject to various opinions, interests, and biases of individual users.

The rise of new authorities

On social media today, we encounter so-called new authorities. These are individuals who, through their activity on social networks, have gained a large number of followers. As the number of followers grows, so does the influencer's impact on these platforms. Beekeeping influencers exist as well, and this is useful for quickly informing beekeepers in situations that require rapid reactions. However, it is essential to keep in mind that the main goal of a person acting as an influencer is, in fact, to build their own persona on social media. Everything is therefore subordinated to influence and the acquisition of an ever-larger audience. The content of messages in different formats thus becomes of secondary importance. This means that the information obtained on social networks can be very incomplete.

Scientific articles and their importance

In contrast, academic articles are the product of precise professional research and therefore provide reliable information. In the professional journal ***Slovenski čebelar*** (*Slovenian Beekeeper*), published monthly, we combine both academic and popular articles on current problems beekeepers face in the field. Despite the professional complexity, we strive to present the articles in a generally understandable way, which we achieve through long-term and consistent use of terminology in accordance with the ***Slovenian Beekeeping Terminological Dictionary***.

Although information on social networks often spreads faster than in ***Slovenski čebelar***, professional texts prove to be crucial, as they frequently undermine potentially incorrect interpretations of information found on social media.

Fast distribution of information

Some problems require quick action by beekeepers, so sometimes printed trade journals are too slow to keep up with fast information due to their periodicity, in which case social media platforms seem to be the only effective ones. Solving beekeeping problems often requires fast, professional, and effective solutions, which means that beekeeping trade magazines and information on social media platforms should be going side by side.

Keywords: beekeeping journal, new authorities, beekeeping academic articles, social media informations

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PP-289 [Beekeeping Technology and Quality]

Innovative 4-in-1 Rapid Test for Screening Residues of Nitrofurans (AOZ, AMOZ, AHD, SEM) in Honey

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Overview

Nitrofurans are banned antibiotics that leave toxic metabolites in the form of SEM, AOZ, AHD, and AMOZ that are linked to cancer and genetic damage. Though prohibited in many regions, residues can persist through illegal use, cross-contamination, or environmental exposure. Therefore Governing bodies have established regulatory Reference Points for Action (RPA) of 0.5ppb.

Detecting Nitrofurans in honey has always been challenging, traditional methods like LC-MS/MS and ELISA while accurate, are costly, slow and require specialist expertise. Existing screening options are impractical for beekeepers and small producers with multiplex systems demanding expensive analysers and ELISA needing 1 kit for each individual antibiotic (4 in total). As a result, many producers and suppliers are unable to carry out testing at all or cannot test at the frequency and scale that is truly needed.

Cost-Effective Nitrofuran Monitoring:

To address this issue Biorex Food Diagnostics have developed an innovative multiplex lateral flow device, capable of detecting four key Nitrofuran metabolites in one simple rapid test. Cost-effective, highly sensitive and simple to use, the test enables producers to uphold quality standards, comply with regulations and prevent contaminated honey from reaching the market.

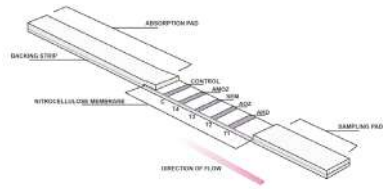

Figure 1: Design of Nitrofuran 4-in-1 lateral flow device

Honey exporters face strict regulations, with many markets requiring each batch sold to be tested for banned nitrofurans. LC-MS/MS testing can cost up to €150 per sample and take days to deliver results, meaning annual testing can reach tens of thousands of euros for high-volume producers.

With results available in just 10 minutes, this lateral flow device enables on-site screening of all batches, sending only positives for lab confirmation, cutting costs by up to 90% while ensuring compliance.

Honey Sample Preparation

Weigh 2g honey

↓

Add 4ml distilled water, 0.5ml 1M HCL and 200µl derivatisation reagent

↓

Vortex 3 minutes

↓

Incubate 15 minutes at 60-C

↓

Cool samples, add 5ml 0.1M K2HPO4, 400µl 1M NaOH and 6ml ethyl acetate

↓

Vortex 2 minutes

↓

Centrifuge 10 minutes at 3,000RCF

↓

Transfer 3ml from top layer into glass vial

↓

Evaporate to dryness at 60-C under stream of Nitrogen

↓

Dissolve with 0.5ml n-Hexane and vortex 1 minute

↓

Add 0.5ml 1X Sample Diluent and vortex 1 minute

↓

Centrifuge 2 minutes at 4,000RCF

Innovative Derivatisation reagent

In order to detect nitrofuran metabolites, a derivatisation step is required due to its chemical composition. Traditionally, this is time consuming, with the reaction taking 1 -2 hours. As part of the Flowsense test a lyophilised derivatisation agent has been developed that enables full detection from 15 minute incubation saving significant labour time and reducing time to result.

FlowSense Test Method

Test protocol

Apply 200µl to test microwell and mix 5-8 times

↓

Incubate well for 5 minutes at 25-C

↓

Place Test strip directly into microwell

↓

Incubate well for 5 minutes at 25-C

↓

Read test strip visually or Flowsense reader

Results

Detection limit/CCβ testing

Target Antibiotic	FlowSense Reader LOD (ppb)	Visual Detection LOD (ppb)	CCB achieved (ppb)
Nitrofurantoin (AHD)	0.25	0.5	0.25
Furazolidone (AOZ)	0.25	0.5	0.25
Nitrofurazone (SEM)	0.25	0.5	0.25
Furaltadone (AMOZ)	0.5	0.5	0.5

Table 1: CCβ performance summary of Nitrofuran 4-in-1 test

Figure 2: Flowsense test result screen for AHD

CCβ is a validation process used to confirm a method's ability to reliably detect the target analytes. It involves testing 20 different honey samples, both blank and spiked.

A level is considered acceptable if there is no overlap between the blank and spiked results. This test kit complies with EU regulatory limits for nitrofurans.

Precision

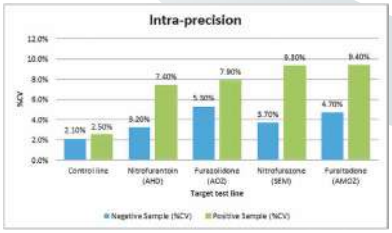

Figure 3: Precision data (%CV) of Nitrofuran 4-in-1 test kit.

Intra-assay precision was evaluated by analysing a single honey sample (blank and spiked) across 20 test strips. The coefficient of variation (CV) for all test lines was below 10%.

FAPAS (Certified Reference Honey)

	Fapas sample 02496	
Target	FAPAS Assigned Concentration/ expected diluted (ppb)	Flowsense Result
AHD	2.1	Positive
	1.05	Positive
	0.53	Positive
	0.26	Positive
	0.13	Negative
	0.07	Negative
AMOZ	4.2	Positive
	2.1	Positive
	1.05	Positive
	0.52	Positive
	0.26	Positive
	0.13	Negative

Table 2: FAPAS test results obtained from Nitrofuran 4-in-1 test

A reference honey sample from FAPAS containing quantified levels of AMOZ and AHD was examined as part of our test validation. This material was serially diluted with a confirmed negative honey sample to evaluate assay performance at very low concentrations.

As expected, the AMOZ and AHD test lines produced positive and negative results at the corresponding dilution points, while SEM and AOZ remained negative since they were absent from the reference material. These results demonstrate excellent correlation of the test with the FAPAS reference sample.

Chloramphenicol FlowSense

Chloramphenicol is a banned antibiotic with zero tolerance limits worldwide, yet it continues to be detected in honey making routine monitoring also essential. Globally, chloramphenicol is often tested alongside nitrofurans due to their shared regulatory importance in export markets. With a limit of detection of 0.1 ppb using the Flowsense reader (0.5 ppb visual), excellent precision (<5% CV) and a rapid result time of 8 minutes, the Chloramphenicol Flowsense provides a complementary solution to the Nitrofuran Flowsense for comprehensive honey safety screening.

Conclusion

The FlowSense 4-in-1 multiplex test provides a rapid, sensitive and dependable method for detecting all four banned nitrofuran metabolites in honey. With a streamlined 15-minute sample Derivatisation and 10-minute assay, it delivers visual results at the EU MRPL of 0.5 ppb and enhanced sensitivity down to 0.25 ppb with the FlowSense reader. High precision and semi-quantitative analysis make it an effective tool for beekeepers, exporters, and regulators to ensure compliance.

Utilising both Chloramphenicol and Nitrofuran Flowsense kits enables rapid on detection of two key banned antibiotic groups in honey, through just 2 tests compared to 5 separate ELISA's.

5 ELISA kits can be replaced by only 2 FlowSense kits

Figure 4: Chloramphenicol Test Strip (BXEFB59A) *Figure 5: Nitrofuran 4 in 1 Test Strip (BXEFB60A)*

Contact Us

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PP-290 [Beekeeping Technology and Quality]

B-THENET: Advancing Sustainable Beekeeping through Knowledge Exchange and Best Practices

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Abstract

The B-THENET project (https://www.bthenet.eu/) aims to promote sustainable beekeeping by collecting, defining and providing training on Best Beekeeping Practices in Europe. The development of practices is based on a bottom-up approach, and the methodology involves three phases. In the initial phase practices are collected and prioritised with the help of beekeepers. In the second phase practices are analysed to understand if they are suitable for discussion by researchers, advisors, and beekeeping associations. The final phase involves development, validation and dissemination of selected practices through the joint efforts of beekeepers, advisors and researchers. Here we present the results of the collection and prioritisation of practices carried out in the first three years of the B-THENET project.

4,776 beekeepers and advisors from 13 European countries (Austria, Belgium, Croatia, Denmark, Germany, Greece, Hungary, Italy, Poland, Slovakia, Slovenia, Spain and Sweden) were asked by means of surveys to identify the most relevant Good Beekeeping Practices (GBPs) and Biosecurity Measures in Beekeeping (BMBs). The themes discussed include: "Apiary set-up and management/maintenance", "Colony set-up and management/maintenance", "Bee feeding and watering" and "Record keeping" for the GBPs category, whereas BMBs comprise "Varroosis", "American Foulbrood" and "European Foulbrood". In the final year of the project practices on "Routine (preventive) hygiene practices" for GBPs and "Nosemosis, Small Hive Beetle and *Vespa velutina*" for BMBs will be discussed.

In the first year, 22 practices were identified as priority, of which, 13 were GBPs relative to "Apiary set-up and management/maintenance", and 9 BMBs relative to "Varroosis". In the second year, 28 practices were selected: 20 GBPs referring to "Colony set-up and management/maintenance" and 8 BMBs to "American Foulbrood". In the third year, European beekeepers identified as most important 25 practices, including 19 GBPs relative to "Bee feeding and watering" and "Record keeping", and 6 BMBs relative to "European Foulbrood". The identified practices were developed and validated through collaboration with researchers, national beekeeping associations, and local beekeepers and advisors. The outcome is a comprehensive repository of GBPs and BMBs (https://www.bthenet.eu/repository-platform/), translated and tailored to the local conditions of 13 European countries.

Introduction

B-THENET "Best Practices and Innovations for a Sustainable Beekeeping" is the first European Thematic Network funded under Horizon Europe dedicated to Best Beekeeping Practices and Innovations. The project started on 1 September 2022 and will run for four years, ending on 31 August 2026.

B-THENET involves 18 partners across 15 EU countries (Fig. 1A) including research organizations, universities, international and national beekeepers' associations, centres for advisors training, centres for social sciences and humanities, and agencies for communication and dissemination. The project collects, analyses, develops and validates Best Beekeeping Practices (BBPs) in close collaboration with EU beekeepers, advisors, researchers, and other stakeholders in the apiculture sector. This joint effort is coordinated through 13 National B-THENET Centres (Austria, Belgium, Croatia, Denmark, Germany, Greece, Hungary, Italy, Poland, Slovakia, Slovenia, Spain and Sweden) and 3 International B-THENET Centres (in 4 countries: for beekeepers in Italy; for advisors in Sweden and Spain; for other stakeholders in Belgium) (Fig. 1B).

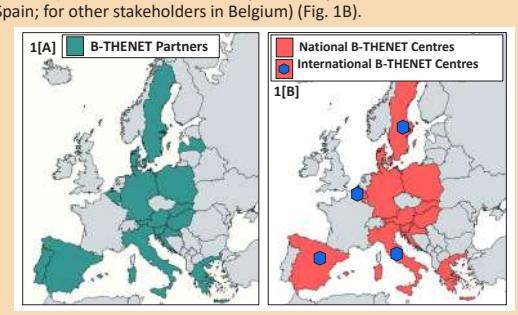

Figure 1. [A] The Project brings together 18 Partners from across 15 EU countries. **[B]** The National and International B-THENET Centres established at the beginning of the project.

Funded by the European Union

Methodology

The project formally defined **Best Beekeeping Practices** as: "Best Practices adapted to a specific geographical context (e.g., different climatic and environmental conditions), and a specific beekeeping context (e.g., different bee genetics, beekeeping equipment, and diseases), therefore representing the state of the art of beekeeping for a given area.

The methodological approach adopted by B-THENET to develop BBPs across different EU countries is illustrated in **Fig. 2**.

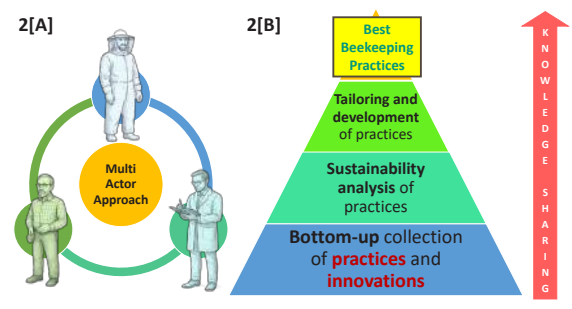

Figure 2. B-THENET Methodology. **[A]** The Multi-Actor Approach engages beekeepers, advisors, and researchers in close collaboration. **[B]** Best Beekeeping Practices are collected from beekeepers using a bottom-up approach, analysed by researchers and advisors for sustainability, and finally developed and adapted to the national context of the 13 National B-THENET Centres.

Results

Scan the QR codes to explore the main outputs and results of the project, via the **Platforms of B-THENET**.

Scan me to see **Good Beekeeping Practices** developed in 13 EU countries.

Scan me to see **Biosecurity Measures** developed in 13 EU countries.

Scan me to access **booklets & infographics** of Best Practice in the **Repository Platform**

Scan me to see **Best Practices videos** on YouTube.

Scan me to see the **Guidelines for** beekeeping **Advisors**.

Scan me to view the **Co-creation** of Best Practices **Factsheet**

Conclusions

In its first three years, the B-THENET project has delivered valuable outputs for EU beekeepers and advisors. Among its practical resources is an interactive digital platform that enables beekeepers from 13 EU countries to contribute to the development of Best Beekeeping Practices. It has also produced a wide range of digital learning and training tools dedicated to Best Beekeeping Practices, including videos, booklets, guidelines, infographics and factsheets. Furthermore, through its 13 National and 3 International Centres, the project is fostering a physical space for collaboration, and knowledge exchange and uptake in Europe.

In its final year, B-THENET will focus on developing Best Beekeeping Practices on Invasive vespid management, Small Hive Beetle, Nosemosis, and Routine (preventive) hygiene practices. In addition, it will produce related dissemination materials and a comprehensive final Manual of Best Practices for EU beekeepers, bringing together all the work carried out on best practices throughout the project.

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PP-291 [Beekeeping Technology and Quality]

UNIVERSIDAD DE LA REPÚBLICA URUGUAY

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Analysis of apitoxin yield and melliting percentage according to the use of three types of traps

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INTRODUCTION

Apitoxin is produced through the evaporation of volatile compounds from bee venom. In addition to peptides, enzymes, and dozens of other bioactive substances, its main component is melittin, which can reach concentrations of 60–70%.
The properties of melittin are important for its therapeutic applications. In worker bees, venom synthesis begins when the adult bee emerges and continues until the venom sac is fully developed three weeks later. The location of the trap in the hive is one of the factors influencing the quantity and quality of apitoxin, as it allows differential access by bees according to their age.

The objective of this study was to evaluate the performance of three types of traps, external trap (ET), internal trap (IT) and rooftop trap (RT), regarding the amount of harvested apitoxin and melittin concentration.

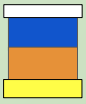
METHODOLOGY

20 standardized hives with same strength

Time of extraction: 11am

Bee venom was extracted through electric stimulation for 30 minutes

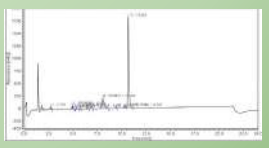
10 colonie with rooftop trap (RT)



10 colonies with external trap (ET)

10 colonies with internal trap (IT)

The apitoxin was dried and storage for each sample



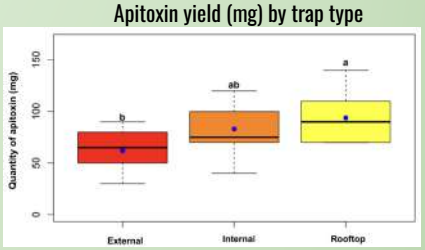
An HPLC analysis was performed to determine the [ ] of melittin

RESULTS

Apitoxin yield (mg) by trap type

Significant differences in the average apitoxin weight among the groups ($p<0.005$).

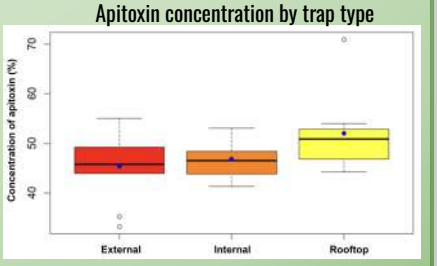
IT: 83 mg
ET: 62 mg
RT: 107 mg



Apitoxin concentration by trap type

No significant differences in the average concentration of melittin ($p>0.005$).

ET: 45,4%
IT: 46,9%
RT: 51,6%



A completely randomized design was used and the results were analyzed using an analysis of variance with an α of 0.05.

CONCLUSION

Regarding the amount of apitoxin, the top trap produced significantly more than the other two, followed by the internal trap and, finally, the external one. With respect to melittin concentration, no differences were observed among the three traps; however, the top trap yielded slightly higher values than the other two.

For beekeepers, the use of the top trap could be more convenient, not only because of the higher amount of apitoxin obtained but also due to its practicality, as it can be used both during the day and at night. In addition, the external trap could be placed vertically, which helps reduce contaminants introduced during extraction, such as bee parts or excretions.

Nevertheless, studies on apitoxin production are still scarce, and there is a need for protocols and standardized extraction methods to meet the growing market demand.

PP-292 [Beekeeping Technology and Quality]

UNIVERSIDAD DE LA REPÚBLICA URUGUAY

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Differential melittin concentrations in apitoxin harvested from young versus mature honeybees

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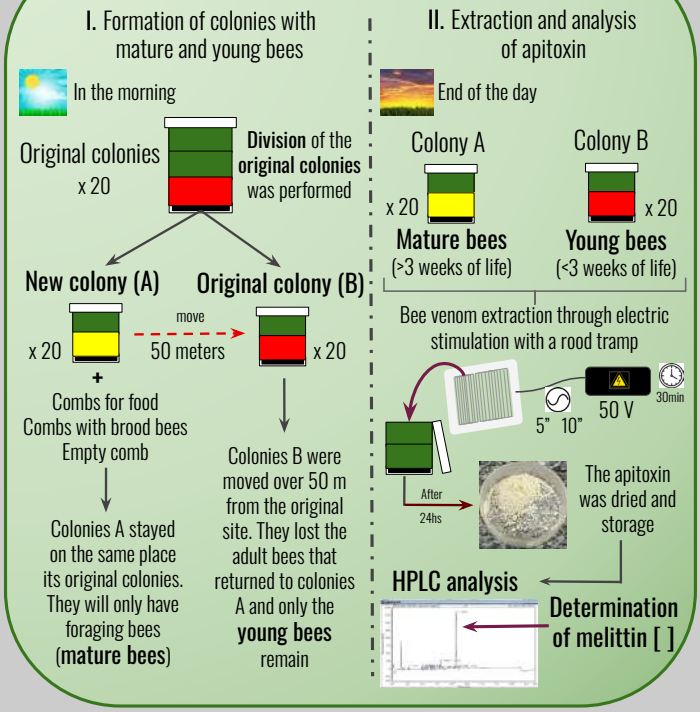
INTRODUCTION

Bee venom is a complex mixture of **bioactive substances** in an aqueous solution. It is referred to as **apitoxin** once its volatile compounds evaporate upon contact with air. This apitoxin **retains** the **complex composition,** with **melittin** as its **main component**, representing **40–60%,** although values above 70% have been reported.

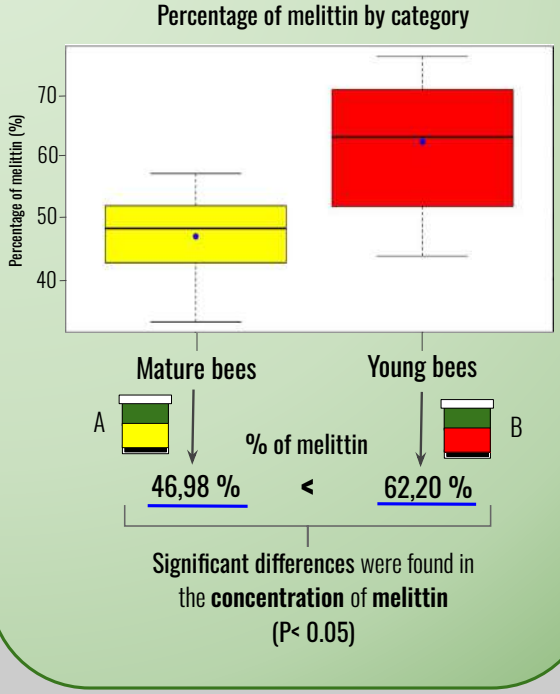
Biological, environmental and other **factors** can **influence venom composition. Bee age** at the time of extraction is one of them, as the **trap's location conditions** which bees can access it. **This leads to age variation among collected bees, which could impact the proportion of venom components.**

The aim of this study was to evaluate how bee age affects melittin concentration in venom collected from individuals within the same colony.

METHODOLOGY



RESULTS



Significant differences were found in the **concentration** of **melittin** (P< 0.05)

CONCLUSION

The **higher melittin** concentration observed in **young bees** may be explained by the fact that **melittin is one of the first components synthesized** shortly of adult life, followed by a **decrease as the venom sac fills.** Since **young bees remain inside the hive while adult (forager) bees** are outside searching for resources, **the placement of the venom trap** and the **timing of collection** can **influence the melittin content,** which is why, if these **factors are controlled, it would be possible** to **obtain apitoxin** with a **higher** or **lower melittin** content.

PP-293 [Beekeeping Technology and Quality]
Hobbyist Beekeepers' Challenges In The United States

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Department of Research & Development, Dr. Karen Avetisyan, Bee & Comb, LLC

Hobbyist beekeeping in the United States has seen a significant rise in popularity and is driven by increased awareness of the essential role bees play in pollination, environmental sustainability, and local food production. However, hobbyist beekeepers face a range of challenges that can hinder the health and success of their colonies.

One major challenge is the lack of proper education. Many new beekeepers enter the practice with limited knowledge and often treat beekeeping as a "play" or casual hobby, not fully understanding the time and commitment required. This lack of education can lead to poor management practices such as irregular hive inspections, inadequate seasonal management, and insufficient attention to pest control, which ultimately affects colony health.

A particularly pressing issue is the management of Parasitic Mite Syndrome (PMS). While there are effective treatment schemes, many hobbyist beekeepers struggle to implement them consistently. This can be due to a lack of understanding of integrated pest management or failure to adhere to regular treatment schedules. Varroa infestations can lead to colony collapse if not managed properly.

In addition to pest management, pesticide exposure is a growing concern. Many backyard beekeepers face challenges with pesticide drift from nearby agricultural areas, which can contaminate hives and harm bee populations. Pesticides, particularly neonicotinoids, have been linked to bee mortality, and even trace amounts can impact colony health. Hobbyists often lack the knowledge or resources to prevent or mitigate pesticide exposure, putting their colonies at risk.

Another significant issue faced by hobbyist beekeepers is swarm management. Swarming is a natural part of a bee colony's reproductive cycle, but it can be disruptive for beekeepers, especially those managing small-scale apiaries. Without proper management practices, swarming can lead to lost colonies and a decrease in honey production. Many hobbyists are unprepared for swarm prevention and may lack the expertise to handle it effectively.

Finally, time management remains a crucial factor. Beekeeping requires consistent attention, particularly during peak seasons. Many hobbyists fail to dedicate enough time for routine inspections, pest management, and swarm prevention, leading to poor colony management and diminished success rates.

PP-294 [Beekeeping Technology and Quality]
Multiple-metabarcoding assays provides botanical and entomological DNA fingerprints that can reveal the geographic origin of Turkish honey

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Honey is one of the most frauded animal-derived food products. Fraudulent practices often involve dilution with cheap syrups and mislabelling of the botanical, entomological and geographical origins. Turkey is a major player in the global honey market, ranking as the second-largest producer worldwide with an annual production exceeding 100,000 metric tons. Determining and monitoring the geographic origin of Turkish honey is a crucial to ensure its authenticity. To address this issue, we developed multiple metabarcoding assays using a next generation sequencing (NGS) approach to analyse 48 Turkish honey samples. This method provided botanical and entomological information to establish their geographic fingerprinting. The honey samples were collected from various regions of Turkey, each accompanied by detailed geographical and ecological information. Additionally, each sample came with a botanical declaration specifying whether it was monofloral or polyfloral, as well as indications of honeydew presence. The botanical composition was assessed through DNA metabarcoding of informative regions of chloroplast DNA, along with a bioinformatic pipeline that queried a database with over 150,000 plant species. This approach identified the predominant plant taxa in each honey sample, totalling over 1000 different plant groups or species, providing insights into their botanical and geographical origins. The entomological metabarcoding was based on two hemipteran mitochondrial DNA targets that captured information on plant-sucking insects present in the agricultural and forest landscapes where the honey samples were produced. Honeydew-associated insects exhibit host-plant specializations that correlate with different ecosystems. By integrating these metabarcoding assays, we developed a comprehensive system that combines botanical and entomological signatures to verify the geographical origin of Turkish honey. This approach offers valuable information for honey authentication.

PP-295 [Beekeeping Technology and Quality]
Capturing the larvae of the Small Hive Beetle (SHB) using a modified beehive stand as a tool for apiary bee pests management -The case of adopting an innovative multi-functional beehive stand

Esther Kimberly Yeboah
PRO,GHANA BEEKEEPERS ASSOCIATION

BACKGROUND:
Beehive stands keep the hive off the grounds and prevent pests like ant from entering to disrupt the bees and to cause absconding. Considering the fact that the larvae of the Small Hive Beetles (SHB) crawl out of the hive to pupate in the soil, a capture mechanism is being developed within the beehive stand to capture as many of the larval

Problem Description
SHB and beeswax moth are indigenous to Africa and they cause a lot of losses to the beekeepers. To do commercial beekeeping in Africa these pests must be controlled as for many recycled extracted combs sent to the hive it is only one which is protected and worked on by the bees at a time whilst the rest are left at the mercy of these pest to build. As the larvae of SHB escape it is the weak link in their developmental stages which is an advantage to be captured as a least control measure cost

OBJECTIVE: To modified the beehive stand to additionally capture the SHB larvae to reduce SHB pest infestation in the apiary

Materials and METHODS: Metal beehive stand of dimension 200 x 200 x 30cm with extension for shade formation.
A bag of soil.
A deep tray to capture SHB larval-
Ant guard-

Methods Trays are filled with moist soil and inserted under the beehive stand location to capture any escaping SHB larvae. The edge of the tray is such that the larvae upon dropping on the tray with sand cannot craw out of the tray.

Results and CONCLUSION: Escaping SHB larvae are captured into the tray with sand which are later spread for household fowls to feed on. The tray with soil acted like a trap to capture the SHB Larvae to reduce their prominence in the apiary area hence reduce their infestation level of the hives.

PP-296 [Beekeeping Technology and Quality]
A fire resistant and Honey Badger(HB)-controlled beehive for fire prone and honey badger prevalent areas

Maxwell Agyekum
MARKETING,GHANA BEEKEEPERS ASSOCIATION

BACKGROUND: Most of the dry areas of Africa are very suitable for beekeeping as the long dry periods with flora from the vegetation create the enabling environment for the thriving beekeeping industry however threats of wildfire and human-wild animal conflicts cannot be avoided

Problem Description: Wildfire,elephants and Honey Badgers are a threat to the beekeeping industry in Africa with respect to life, investments in beekeeping, biodiversity etc. As some of these activities are not within the control of the beekeeper, the beekeeper has to adopt strategies to overcome these threats. The only possible means is to produce a wild animal and fire -resistant hives that will keep the bees intact in case of any attack.

OBJECTIVES: To develop a fire resistant and honey badger - cum – elephant tolerant beehives.
Methodology
- A cuboid metal framework, and mesh screened hive
- Floor tiles
- Burnt clay tiles of floor tiles dimensions
- Fiber glass sandwiched between 0.7 mm thick stainless steel metal plates.
- Bamboo, rattan, raffia

METHODS: These beehives could be knocked down or completely framed. It will have framed work with 3 of 1.25cm U – channels long its width, length, under and top sides for which fire-resistant materials will be slidded into place to block the effect of the fire on the bees. The screened and lock ones prevent the HB from getting access to the combs.
Results and conclusions

The fire intensity has to pass through 3 layers of fire-resistant materials with air pockets which are bad conductors of heat. Thus, the bees in the inner chambers are preserved and our investments are protected. Similarly with the hives at the honey badger prone areas as the hives are locked up the turning up and down of the hives by the HB may not open the hives for the HB to get access to the honey and will not be able to destroy the hives and its content hence could be frustrated to leave as they even able to manage with the stings of bees

PP-297 [Beekeeping Technology and Quality]
Exploring bee products on the preservation of artisanal cheeses: the perspective of BEE4CHEESE project

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Honey, bee pollen, and propolis are among the primary products derived from beekeeping, with globally recognized commercial value. While honey remains the most prominent hive product in the Portuguese market, there is a need for a paradigm shift to enhance the dynamism and socio-economic value of other bee products by developing innovative applications. Portugal has a strong tradition of producing artisanal cheeses, which are distinguished by their cultural significance and unique flavor, serving as both a national and international reference. The BEE4CHEESE project addresses the need to maintain these traditions by combining natural products such as bee pollen and propolis to preserve artisanal cheeses from Portugal's inland regions, enhancing and adding value to all those products. Within the project, propolis will be extracted through more efficient techniques such as ultrasound and subcritical water procedures. Afterward, bee pollen biocapsules will be produced and loaded with propolis extracts to develop protective coatings and incorporate them into traditional cheese-making. The evaluation of the antifungal and antibacterial activity of the bee pollen biocapsules incorporated with propolis and the functional coating, as well as their effectiveness as preservative agents in food, particularly in cheese, will be evaluated. The application of artificial intelligence will be a valuable tool to assess the impact of propolis compositional heterogeneity on its biological activity, particularly its antifungal and antibacterial effects. This innovative application of bee products in biocapsules and edible coatings may promote sustainability through the use of novel, low-cost, and environmentally friendly processes, representing a significant strategy to reduce the use of synthetic additives for cheese preservation and the dependence on plastic coatings while promoting beekeeping economy.

Acknowledgments: This work received financial suport from Promove program, financed by Fundação La Caixa, BPI, and FCT, through the project BEE4CHEESE (PL24-00071). National funding by FCT- Foundation for Science and Technology, through the institutional scientific employment program contract with Soraia I. Falcão and through the Individual Call to Scientific Employment Stimulus with Andreia F. Peixoto (2021.00771.CEECIND/CP1662/CT0007).

PP-298 [Beekeeping Technology and Quality]
Protecting Honey Quality and Bee Health with Rapid Glyphosate Detection

Suzanne Ramage, Mark Squance, Nicola Kane, Morteza Afrasiabi
Biorex Food Diagnostics, Antrim, Northern Ireland

The honey industry is vital to the biodiversity of our ecosystems playing a key role in agricultural production. For producers, ensuring sustainability is fundamental, balancing the demand for high crop yields with the need to protect bee health and maintain the safety of the honey produced. This balancing act has led to a critical need for effective testing of contaminants resulting from agricultural practices within the honey industry.

One such contaminant is glyphosate, a widely used herbicide that has been detected in honey, raising issues about food safety and environmental contamination risks. As beekeepers face increased regulatory pressures and growing consumer demand for residue-free products, the need for reliable testing methods becomes essential.

Both HPLC and LC-MS are established methods for testing glyphosate, but these techniques are time-consuming, costly, and often inaccessible for small-scale beekeepers. While ELISA methods are available for glyphosate detection, the options are limited, with few kits specifically tailored for the honey industry. These methods all require specialised expertise, and the analysis process can be lengthy, making them impractical for frequent or large-scale testing. As a result, there is a clear need for a more cost-effective, and rapid testing solution that is readily accessible to the industry and ensures compliance with regulatory standards.

As part of our innovative FlowSense range, Biorex Food Diagnostics has developed a commercially available rapid test kit using lateral flow immunoassay technology to detect glyphosate residues in honey samples within just 10 minutes. The simple dilution method ensures high sensitivity and specificity, meeting the European Union's industry standard limit of 50 µg/kg for glyphosate residue in honey. Results are interpreted qualitatively or semi-quantitatively with our portable, user-friendly FlowSense reader, enabling field-based monitoring

The availability of an affordable and user-friendly glyphosate test kit enables beekeepers to proactively monitor honey quality, reducing the risk of regulatory non-compliance. Regular testing can help identify contamination sources, allowing for strategic hive placement and mitigation efforts to minimize glyphosate exposure. This solution enhances the credibility of honey products in domestic and international markets, supporting sustainable and profitable beekeeping practices.

PP-299 [Beekeeping Technology and Quality]

VARROMETER

Customise Your Varroa Control Strategy

Authors

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Why VARROMETER?

Varroa destructor is the most challenging biotic stressor for honey bee health.

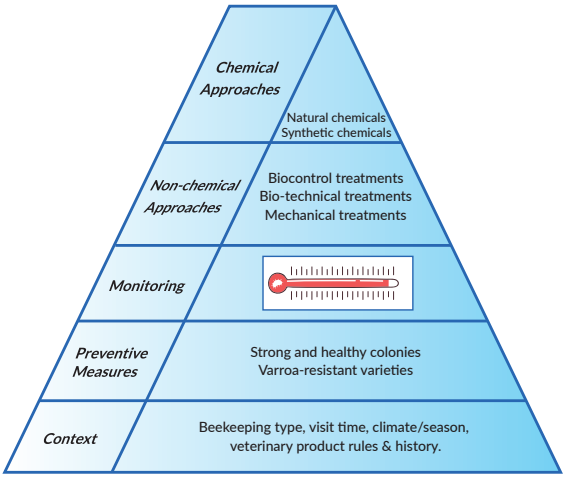
Despite abundant scientific and technical knowledge, many beekeepers find it difficult to:

- **Select strategies** tailored to their specific conditions.
- **Stay up-to-date** with the latest veterinary products and legislation.

VARROMETER was created to bridge this gap, offering a customised, up-to-date tool, based on Integrated Pest Management (IPM) of varroa.

What is VARROMETER?

Novel Interactive digital tool for beekeepers and honey bee veterinarians. It provides tailored recommendations for varroa control.



Results & Innovation

- Computes **3,840** strategy combinations
- Rotates methods to reduce resistance
- Adapts to beekeeping styles & laws
- Practical tool for vets & advisors

Next steps: Broader testing, international adaptation, and integration into digital platforms.

Acknowledgements

We thank the BeeLife network members and collaborating beekeepers for their feedback and support in the development of the **VARROMETER** tool.

BeeLife European Beekeeping Coordination

PP-300 [Beekeeping Technology and Quality]
Evaluation of the antibacterial properties and polyphenol content of commercial propolis available in Polish dietary supplements

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Propolis extract has antibacterial, anti-inflammatory, and antioxidant properties, which is mainly attributed to polyphenols (such as ferulic acid, gallic acid, caffeic acid) in its composition. However, its composition varies depending on the geographical location of the raw material. This may be important for patients consuming dietary supplements as interest in natural treatment methods is constantly increasing.

The quality of the raw material used to produce the Polish dietary supplement for the throat available in pharmacies is not controlled with the same level of precision as medicinal products. This raises doubts about the effectiveness of the dietary supplement containing propolis extract. The presented studies were conducted to verify the composition and antibacterial properties of the propolis extract commonly available on the Polish market.

Microbiological examination was performed using the disk diffusion method using a reference bacterial strain Streptococcus salivarius (ATCC 13419) that naturally inhabits the human oral cavity. The composition of the extract was determined using the GC-MS and solid phase microextraction (SPME) methods. The total polyphenol content of both the propolis extract and the dietary supplement was determined using the Folin–Ciocâlteu method. Additionally, the dry propolis extract was analyzed using thermogravimetric analysis (TGA) and scanning electron microscopy (SEM).

No growth inhibition zones were observed for the reference strain in the selected sample containing propolis found in the dietary supplement. The total polyphenol content determined in the propolis studied was significantly lower than the average total polyphenol content in European propolis described in the available scientific literature.

It is suggested that the propolis extract of well-documented composition can be degraded during the production process of dietary supplements or industrial processing of the raw material. First, the inappropriate storage of the propolis extract, both at the stage of transport and technological production can be the most probably reason, requires further investigation.

PP-301 [Beekeeping Technology and Quality]

Student Poster

MACHINE LEARNING–BASED BIOACOUSTIC DETECTION OF ROBBER BEES

Alex Otesbelgue[1]*, Eduardo Rigodanzo Korkiewicz[2], Charles Fernando dos Santos[2], Duncan Dubugras Alcoba Ruiz[1]

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WHAT?

Lestrimelitta sulina

• **Cleptobiotic bees** •
Robbers of food from other colonies.

• **A threat to meliponiculture** •
Reducing productivity and weakening hives.

Melipona quadrifasciata

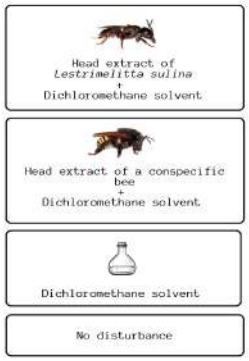
• **Defensive behavior** •
Some stingless bee species (such as *Melipona quadrifasciata*) respond aggressively to robber bee incursions.

• **The *Melipona quadrifasciata* tactic** •
Sheltered alongside other species due to its defensive responsive when robber bees are around.

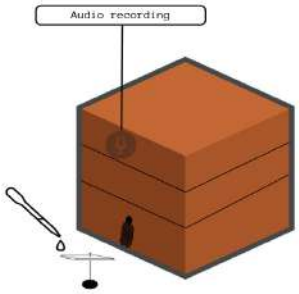
• **This tactic isn't always enough** •
Attacks can still break through.

What if we could **detect** the presence of robber bees **rapidly** to **prevent damages**?

HOW?



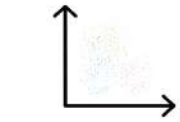
1 TREATMENT SETUP: Control and test stimuli.



2 HIVE EXPOSURE AND RECORDING: Presenting treatments and capturing bee responses.

12 Mel Frequency Cepstral Coefficients

3 ACOUSTIC FEATURE EXTRACTION: Deriving MFCCs from audio samples.

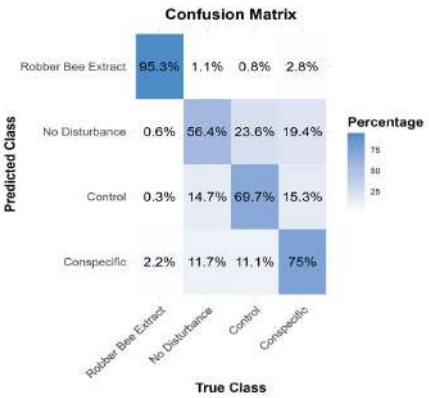


K-nearest neighbors (KNN)

4 MACHINE LEARNING CLASSIFICATION: Training and testing the model.

THEN?

Highest classification performance:
Robber bee exposure (F1 score = 0.96)
Moderate detection:
Conspecific exposure (F1 score = 0.71)
Lower detection:
No-disturbance (F1 score = 0.61) and positive control (F1 = 0.67)



- The KNN model achieved high performance in identifying the exposure of the hive to robber bee extract, with minimal misclassification.
- The model distinguished the Conspecific stimulus, revealing a different, though less pronounced, sound modification compared to the other classes.
- The rate of confusion between the Control and No Disturbance classes, along with their individual accuracy rates, indicates that the solvent does not have a very prominent discernible acoustic effect on *M. quadrifasciata* bees.

NEXT?

Increase the number of monitored hives and develop a device for rapid alerts, enabling beekeepers to take protective measures (e.g., closing hives) to prevent damage.

Watch a short video about some aspects of our research:

PP-302 [Beekeeping Technology and Quality]

The Pollinator

Metadata Standard (PMS)

A **FAIR** way to harmonise pollinator & beekeeping data

What Is PMS

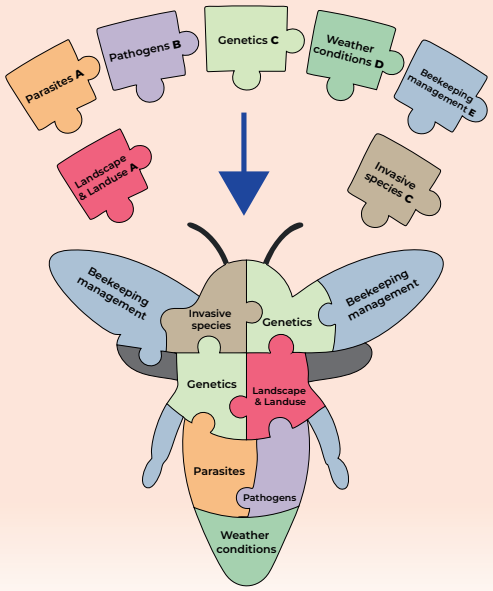
- A harmonised metadata schema
- Built on global standards + pollinator vocab
- Findable, Accesible, Interoperable, Reusable (FAIR)

Why It Matters

- Pollinator data is scattered
- Inconsistent & hard to reuse

How It Works

- Standardised descriptors & vocabulary
- Modular: public + private elements



Where It Helps

- Research & environmental monitoring
- EU reporting & risk assessment
- Tools for beekeepers & vets

Why It's Unique

- First pollinator-focused metadata standard
- Open-source & community-driven
- Embedded in the EU Pollinator Hub

PMS is the outcome of the Apimondia WG12 on Bee Data

Join us & make pollinator data FAIR

pollinatorhub.eu simon@bee-life.eu

BeeLife European Beekeeping Coordination + Partners

efsa European Food Safety Authority Co-funded project

Authors: Rubinigg M., Sušanj G., San Martin G., Benrezkallah J., Hassan A., Simon Delso N.

APIMONDIA SCANDINAVIA 2025
SWEDEN | DENMARK | NORWAY

PP-303 [Beekeeping Technology and Quality]

APIMONDIA SCANDINAVIA 2025
SWEDEN | DENMARK | NORWAY
23-27 SEPTEMBER
COPENHAGEN

Honey Quality from the Caatinga of Pernambuco: Physicochemical Analysis and the Importance of Good Beekeeping Practices

Yasmim Veras Luna de Carvalho[1]; Renata Valéria Regis de Sousa Gomes[1]; Tatiane Amaral de Barros[1]; Katya Maria Oliveira de Souza[2] ; Emilany Borges[3]

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STUDENT POSTER N°1108

INTRODUCTIO

The Caatinga biome covers approximately 80% of the territory of the state of Pernambuco and stands out as one of the few regions in the world suitable for the production of organic honey, due to the presence of extensive areas free of the use of pesticides.

Beekeeping activity has significant socioeconomic relevance in the region, with about 2,000 beekeepers involved in production, positioning Pernambuco as the fifth largest honey producer in the Brazilian Northeast, contributing with 5.5% of national production.

However, challenges related to hive management, harvesting and honey processing directly impact the quality of the final product.

OBJECTIV

Evaluate the quality of the honey produced in the Caatinga, in order to ensure the sustainability of organic beekeeping in the region

MATERIALS

Honey samples were collected from 62 from 27 municipalities in Pernambuco were analyzed. The physicochemical analyses followed internationally recognized methodologies, including the protocols of the Adolfo Lutz Institute, the National Animal Reference Laboratory and the Association of Official Analytical Chemists (AOAC). Parameters such as color, moisture, reducing sugars, apparent sucrose, acidity, hydroxymethylfurfural (HMF), insoluble solids and ash were evaluated. The tests were carried out at the Laboratory of Analysis of Bees and Honey Products of the Federal Rural University of Pernambuco (LAMEL/CENAPESQ/UFRPE). (Figure 1, 2, 3 and 4)

Figure 1 and 2. Students doing the HMF and reducing sugars analyses

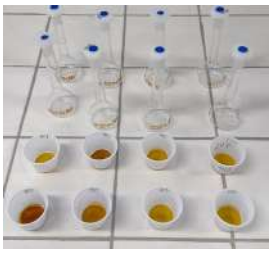


Figure 4 and 5. HMF analysis

RESULTS AND DISCUSION

The results showed variation in the Pfund scale between the shades of white, extra clear amber, amber and dark amber. (figure 6 and 7).

Of the samples analyzed, 44 were in compliance with the standards required by Normative Instruction N°. 11/2000 (Brasil, 2000) and Codex Alimentarius (2001), while 18 presented values outside the limits established by current legislation.

Figure 6 and 7. Amber honey and dark amber

CONCLUSION

It is concluded that the findings reinforce the need to implement and strengthen good beekeeping practices, aiming to ensure the quality and appreciation of Caatinga honey, a product of high added value and potential for certification as organic honey.

ACKNOWLEDGMEN

UNIVERSIDADE FEDERAL RURAL DE PERNAMBUCO
PROExC
ADEPE Agência de Desenvolvimento Econômico de Pernambuco
FACEPE Fundação de Amparo à Ciência e Tecnologia do Estado de Pernambuco

PP-304 [Beekeeping Technology and Quality]
More than doubling the honeybee pollination capability using an innovative hive design: experiment on the field and results

Gianmario Riganti, Alex Gamberoni, Jason Graham, Assaf Shachar, Deborah Briccola
Primal Bee, Pollegio (Switzerland)

Pollination is a critical environmental service provided by bees that helps to insure food security by increasing the bounty and genetic diversity of plants that we and our livestock depend upon.

Many beekeeping operations rely on income generated from locating hives of bees onto farmland in order to pollinate crops. Unfortunately, beekeepers also need to manage increased operational costs, and contend with high colony mortality. The decreased profitability and unpredictable high risks has become a barrier to beekeepers, leading to a potential shortage in agriculture pollination services and threat to food security.

This research explores the use of innovative hive design and related methodology to double pollination capability, while reducing operational costs.
Fifty (50) honey bee colonies were installed into two types of hives: 25 high thermodynamic efficiency Primal Bee hives and 25 standard wooden Langstroth hives in a commercial operation in Israel. The two groups of colonies were managed in the same way, overwintered and then used to measure and compare survivability and spring pollination activity through the metrics of brood area and forager timing and frequency of bee flights.

The colonies managed in thermodynamic Primal Bee hives resulted in larger brood areas, larger forager populations which began foraging flights earlier and ended foraging later in the day, resulting in increased flight activity by quantity and frequency compared to colonies managed in standard Langstroth hives. The increase in population dynamics resulted in increased pollination services. Data collected on the field show a remarkable difference between the two groups, with Primal Bee hives providing even more than double the pollination capability.

The data collected were used in a comparative analysis of the economics of pollination services. The results demonstrated a margin within which commercial beekeeping operations can reduce the risk of high colony mortality, and increase profitability while providing pollination services to insure our food supply.

PP-305 [Beekeeping Technology and Quality]

Translating bee-collected signals into ecosystem indicators

Christophe Brod, Manuel Dujardin, Julien Goumard, Raphaël Saint-Laurent

INTRODUCTION

Biodiversity loss, climate change, and pollution are accelerating ecosystem decline, yet monitoring remains sparse and expensive. Honeybees (Apis mellifera) naturally sample their environment through foraging, making each hive a potential ecological sensor. Advances in AI, edge computing, and low-cost connectivity now enable real-time audio and video analysis at hives, transforming them into scalable biodiversity observatories. This approach extends beyond colony management: it provides a novel tool to detect ecosystem stressors, guide restoration, and support biodiversity recovery.

OBJECTIVES

Develop science-based indicators that translate bee-derived observations into quantitative measures of biodiversity, habitat quality, and environmental stress. While digital monitoring cannot fully capture biological complexity, it can generate efficient and interpretable proxies. The goal is to build a digital platform that reliably identifies these indicators, communicates them in a stakeholder-relevant format, and ultimately triggers informed ecological action.

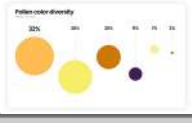
METHODS

Beehives (Apis mellifera) were equipped with multi-modal sensors (weight, temperature, humidity, audio, video). Core sensors recorded every 1–5 minutes, while audio/video were summarized at 15–60 minute intervals. Continuous data were evaluated against literature-based thresholds and indices, translating bee-derived signals into standardized environmental indicators. Metrics were aggregated across hives at the apiary level and organized from specific measures to broader ecological themes. To contextualize trends, indicators were complemented with beekeeper/farmer observations and external datasets (e.g., weather, registries).

RESULTS 1: Beehive data to environmental indicators

Pollen diversity

Foragers collect pollen across 500–700 ha daily, serving as natural botanical samplers. Computer vision classifies pollen pellet colours into groups, and the Shannon Index is applied to these groups to measure diversity. Colour variety has been validated as a proxy for floral species richness (Conti et al., 2016). In diverse landscapes, ~6 pollen types are detected per day (Brodschneider et al., 2021). Lower values indicate dominance by few floral sources (e.g., monocultures), while higher values reflect species-rich, balanced communities.

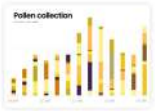


Bird diversity

Birds are attracted to hives, where their calls are recorded and classified by automated recognition. Weekly species detections are used to calculate a Shannon diversity index as an indicator of bird diversity. As established bioindicators, birds reflect habitat structure, pollution, and resource availability (Gregory & van Strien, 2010). Increasing scores signal recovery of ecological complexity and complement pollen-based diversity.

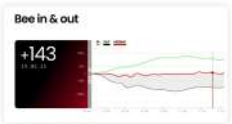
Food access

Continuity of nectar and pollen supply is tracked through hive weight (nectar, corrected for non-nectar changes) and pollen inflow. Signals are normalized to colony activity, ensuring declines reflect true environmental shortages. A benchmark-based score indicates food access: stable values mean sufficient resources, while drops point to flowering gaps or habitat degradation. Reduced food access weakens colonies, limits pollinators, and lowers plant reproduction, with cascading effects on yields and ecosystem stability (Maggi et al., 2023; Potts et al., 2016).



Toxicity

AI counters track abnormal forager losses by comparing outgoing and returning bees. EFSA (2013) defines >10% daily mortality at the colony level as acute toxicity, with smaller but persistent deviations indicating chronic effects. Adapting these thresholds to forager mortality allows daily rates to indicate area toxicity risk. Because bees transport contaminants in nectar, pollen, and water, forager mortality serves as a sensitive bioassay for detecting pesticide or pollution events in real time (Girotti et al., 2020; Mair et al., 2023).



Invasive species and diseases

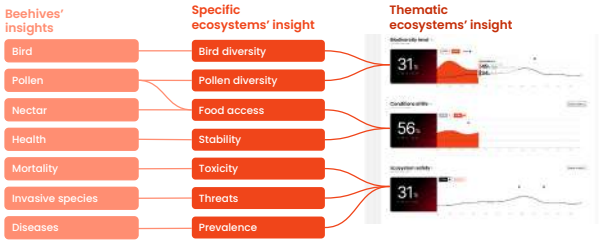
This indicator captures emerging biological threats to pollinators by combining automated detections (e.g. Asian hornet, Nosema, Deformed wing virus) with manual field inputs. Risk is scored along two axes: richness (number of different stressors) and persistence (duration of detection). These dimensions were chosen because both breadth and continuity of pressure shape ecological impact. Invasive species and diseases are well-documented drivers of pollinator decline and ecosystem instability (Helen E. et al., 2024). Persistent or rising scores denote escalating ecological risk.

Environmental stability

Colonies maintain brood areas at 33–36 °C with < ±1 °C daily variance (Stabentheiner et al., 2010; Minaud et al., 2024). Continuous temperature data are expressed as a thermoregulation score, where deviations may result from climate extremes, human activity, colony health, or poor management. Chronic deficits observed despite good beekeeping are strong indicators of environmental stress. This metric links colony health with the environment's capacity to sustain stable life processes.

RESULTS 2: Specific to thematic indicators

Standardised indicators targeting specific environmental aspects were combined into broader categories to improve monitoring and interpretation. Pollen and bird diversity were aggregated into a biodiversity indicator reflecting species presence. Food access and stability metrics were merged into a habitat quality indicator that assesses resource continuity and species viability. Invasive species, diseases, and toxicity were integrated into a safety score highlighting environmental threats. Together, these composite indicators provide continuous insights into ecosystem dynamics. Although they do not capture all species, drivers, or stressors, they deliver actionable signals that support rapid responses to major challenges, allow progress to be tracked, and guide restoration efforts.



DISCUSSION & CONCLUSION

Bee-derived indicators offer quantitative, literature-anchored measures of ecosystem state. They support:

- Standardised assessment of diversity, resource continuity, stability, and stress.
- Detection of abrupt events (e.g., toxicity spikes) and sustained pressures.
- Cross-site and temporal comparison using defined thresholds and normalization.
- Aggregation of specific insights into thematic summaries for broader interpretation and higher-level monitoring.

These results can complement existing ecological monitoring and reporting practices.

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Book a conversation

PP-306 [Beekeeping Technology and Quality]
Allergenic Evaluation of Bee Pollen and Its Derived Sporopollenin Microcapsules for Food and Biomedical Applications

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Pollen grains are emerging as innovative biomaterials for applications ranging from oral drug delivery to the encapsulation of food ingredients and the development of pollen-based building blocks, owing to their robust, chemically inert, and mechanically durable sporopollenin walls. However, concerns persist regarding the safety and application of sporopollenin microcapsules (SMCs) or derivatized sporopollenin materials purified from pollen grains traditionally associated with allergies. Herein, we address the critical question of whether bee pollen and sporopollenin shells purified from bee pollen cause allergic reactions by evaluating their interaction with human immunoglobulin E (IgE) antibodies in sera from patients with and without allergic sensitization to pollen from specific species.

SMCs from Castanea sativa, Amaranthaceae, and Olea europaea pollen types were successfully fabricated using a species-independent chemical treatment. Nitrogen-based total protein analysis revealed that the protein content in raw bee pollen samples, initially ranging from 14% to 24%, was reduced to 2.8%–3.2% after chemical treatment. Scanning electron and confocal laser scanning microscopy confirmed the successful production of hollow and clean SMCs. The Covaris Adaptive Focused Acoustics™ technology was employed for protein extraction from raw pollen and SMCs, yielding 0.7 ng – 1.2 ng and 0.026 ng – 0.028 ng of protein per pollen grain, respectively. SDS-PAGE, followed by immunoblotting analysis, showed that proteins extracted from raw bee pollen strongly reacted with IgE antibodies in human sera, whereas SMCs did not trigger allergic sensitization.

Overall, our findings suggest that while raw bee pollen proteins could elicit allergic reactions, SMCs derived from them do not, highlighting their potential as safe biomaterials for various applications and offering valuable insights into the allergenic potential of bee pollen.

Acknowledgements: The authors are grateful to the Foundation for Science and Technology (FCT, Portugal) for financial support by national funds FCT/MCTES to CIMO (UIDB/00690/2020 and UIDP/00690/2020) and SusTEC (LA/P/0007/2021). Thanks to national funding, FCT for the Ph.D. research grant for Volkan Aylanc (2021.07764.BD) and Seymanur Ertosun (2021.08361.BD). Thanks to the NextGenerationEU recovery funds through the scope of Project BeeLand 10/C05-i03/2021. PPRR-C05-i03-I-000081.

PP-307 [Beekeeping Technology and Quality]
Is it advisable to protect glass with latex when harvesting bee venom?

Enrique Nogueira[1], Valentina Rodríguez Batista[1], Agustín Pérez Graña[2], Yamandu Mendoza[3], Jose Anzola[1], Pablo Juri[1]
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Commercial apitoxin is obtained by electrostimulation using a current emitter connected to traps consisting of a grid and an attached glass. When the bee comes into contact with the grid, it receives the stimulus, stings and the apitoxin is deposited on the glass. This process can add pollutants; to avoid them, materials have been used that cover the glass and allow the passage of the stinger. Currently, it is common to use latex even though there is no scientific literature to support its use. The objective of this work was to evaluate the quantity of apitoxin obtained and the % of melittin according to the use or not of latex in the glass. Three groups of 20 hives with similar development and genetics were used, from which apitoxin was harvested for 20 minutes with an external trap: A) without protection, B) latex (with talc), C) latex (without talc). The apitoxin obtained was weighed and the melittin quantified by HPLC. A classification model was fitted and an ANOVA test was performed to analyze the amount of apitoxin and the % of melittin, finding significant differences ($p = 1.4x10-14$ and $p = 1.3x10-4$, respectively). The Tukey test determined that the amount of apitoxin in groups A and B is superior to C. For melittin, group A had a higher % than B and C. These results are possibly due to the fact that latex prevents the normal deposit of apitoxin, especially when there is no talc between the glass and the latex. This type of handling increases costs and it is more time consuming, without generating a significant advantage either in the amount of apitoxin or in the % of melittin. Moreover, it can also add pollutants to the apitoxin such as talc or latex particles –a major allergen -, so we understand its use is not recommended.

PP-308 [Beekeeping Technology and Quality]
Development and performance evaluation of a ceiling trap for harvesting apitoxin

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Apitoxin is obtained using traps that consist of a metal grid with an attached glass that is connected to an electrical current emitting device. The bees receive the stimulus by stinging the glass and the apitoxin is deposited on it. The performance of internal (IT) and external (ET) traps was evaluated for 2 years, concluding that in no situation did they exceed 100 mg/harvest/hive. The ET have limitations regarding time and weather conditions and in order to install the IT the hives must be opened and visualizing the movement of the bees is not possible. To improve performance and have fewer limitations, a ceiling trap (CT) was developed, which consists of a 51.5 x 42.5 cm plastic frame with a metal grid placed towards the inside of the hive and completely covered by 3 removable glass panels of 15 x 36 cm each. To install it, the roof of the hive is removed and the CT is laid on its place, the bees tend to climb up and come into contact with the grid. Regarding its advantages compared to the IT, there is no need to move supers and/or remove frames and it is possible to view the bees movement, which allows modulating the emitted current (voltage, frequency and duration of the pulses and of the intervals without current). Furthermore, its main advantage over the ET is how it allows working at any time or weather condition since it does not depend on the foraging activity. The quantity of apitoxin produced by the CT was evaluated during 3 years at different times (morning, evening and night) and in the four seasons. In all cases the yield was higher than 100 mg/harvest/hive, far exceeding 200 mg/harvest/hive in favorable conditions, so we consider the CT to be a versatile and efficient option for the production of apitoxin.

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PP-309 [Beekeeping Technology and Quality]

APIMONDIA SCANDINAVIA 2025 23-27 SEPTEMBER COPENHAGEN

Preliminary results of the VASBEEP project: insights into Spanish honey production

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4. IRIAF. Centro de Investigación Apícola y Agroambiental – CIAPA. C/ Camino San Martín s/n, 19180 Marchamalo (Guadalajara), Spain.

Background and problem description

Spain has a highly biodiverse natural environment offering optimal conditions for apiculture, being one of the main producers in the European Union. The marked contrasts between Atlantic and Mediterranean beekeeping practices enable the production of a wide variety of honey types, many of them remaining undervalued. The VASBEEP project aims to enhance the value of Spanish apicultural products through differentiation strategies and promoting the knowledge into nutritional and functional properties of honey and pollen.

VASBEEP

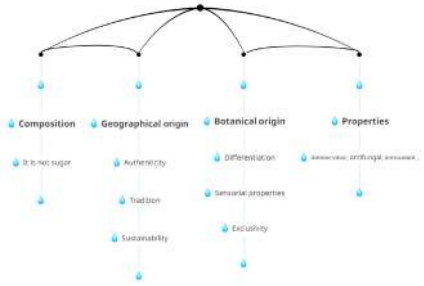
PROJECT PID2022-141679OR

Spanish beekeeping overview
Statistical data (European Commission, 2023)

BEEKEEPERS
37.000

PROFESSIONALIZATION
20%

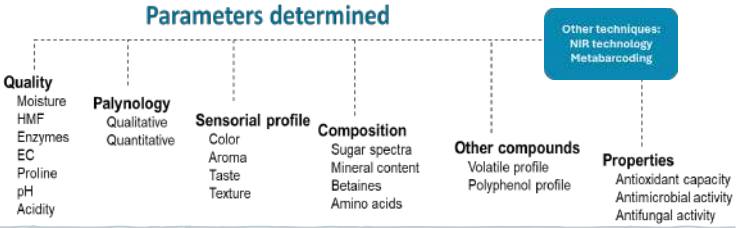
Opportunities to valorize local honey



Quality, identity, safety, consumer trust, heritage, reputation

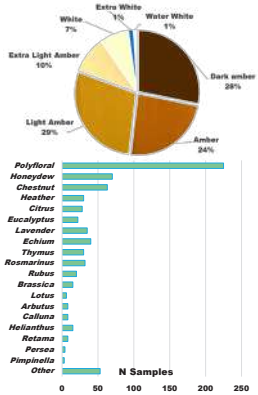
Methodology

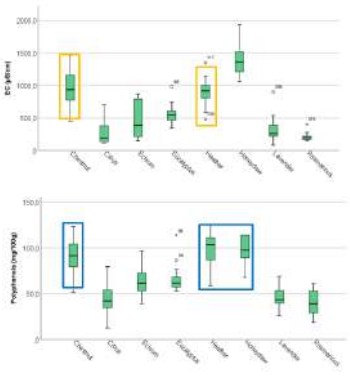
Beekeepers, technicians, vet services and researches are collaborating to perform a representative sampling around the country. Essential quality parameters, palynological studies and sensorial analysis are the first steps in samples characterization. Composition including sugar spectra, mineral content, amino acids and betaines together other relevant compounds such as polyphenols are being analyzed. Some honey properties are also the objective of this project.



Results and conclusions

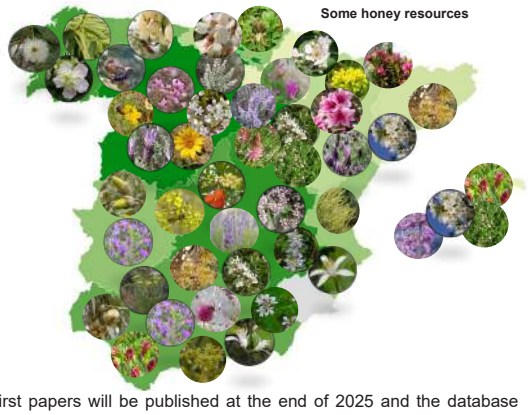
More than 700 honey samples from 2023 and 2024 harvests have been analyzed for now, and more samples from 2025 and 2026 harvest will be included. The results are being informatized and statistically treated, but a wide variety of multifloral, monofloral honey and honeydew honey samples were studied.





Main honey types were honeydew, chestnut, heather, lavender, rosemary, eucalyptus, vipers' bugloss, thyme, *Calluna*, *Citrus*, among others. Color was from extra white to dark amber, varying electrical conductivity accordingly. Antioxidant activity showed significant variation being the highest in darker honey samples.

Some honey resources



First papers will be published at the end of 2025 and the database about Spanish honey production will be accessible in Zenodo.

- ***Linking honey properties and geographical origin is vital for protecting local markets and ensuring food security.***
- ***Legislative changes are needed to define the specific qualities of honey types, preserving authenticity and preventing frauds.***
- ***Further research on honey functional properties is essential to promote consumption and enhance the value.***

Acknowledgements

Activities funded under VASBEEP project: *Valorization and authentication of Spanish apicultural products based on their composition*. Project PID2022-141679OR

The authors express their gratitude for the strong cooperation of the beekeepers, technicians and vet services. For further details, please email: apicultura@uvigo.gal or contact to the authors directly.

PP-310 [Beekeeping Technology and Quality]
Developing a simple fire- resistant brood and super beehive for fire prone areas using used oil drum and ceramic cloth/ fiber glass mat

Akwasi Apraku, Collins Mintah Benyin
research,ghanabeekeepers association

Background/PURPOSE:
The dry transitional belts of Africa are very suitable for beekeeping as it has the long dry periods and flora beekeeping industry to thrive however wildfire threats are a menace for the industry

Problem Description
Developing low-cost fire-resistant beehives for fire prone area is very costly and beyond the reach of the farmers in those area hence they are not able to take advantage of their environment to developing a decent living from nature given bee products due to the incidence of wildfire which is very intense during the dry periods
There is the need to develop a low-the but effective beehives for such environment

OBJECTIVES: To develop a fire resistant low -tech efficient brood and super beehive from used oil drum and ceramic cloth/ fiber glass mat
Methodology
Materials
Ceramic cloth/fiber glass mat
Used oil drum with lid
5cm angle iron

METHODS: The oil drum is equally cut through its mid portion horizontally and each half further cut through vertically to have four equal parts. The angle is wielded to the edges of the cut line such the quarter of the drum becomes the brood and other the super. However, two lids are needed to be cut through equally to cover the open ends of the now two set of beehives. Angle iron are internally placed in each quarter as top bar rest whilst the outside angle iron is drilled to bolt the brood and super hives in place. A queen excluder is placed between the brood and the super. The top bars in the super slides through two angle iron which acts a rail Double layer sacks of the ceramic cloths or the fiber glass mats are sown to fit each set of the hives with entrance holes internally lined with the fire-resistant materials and so hidden and covered from fire

Results
The fire-resistant material offers much protection to the bee against any emergence fires hence investment is protected however precautions are taken with respect to fire belt formation and education the herders and farmers who set fir during the dry season to clear agricultural land

PP-311 [Beekeeping Technology and Quality]

HiveTracks
know your bees!

Honey Story: A Data-Driven and Blockchain-Backed Approach to Honey Authentication

Author: Dr James Wilkes, Max Rünzel; HiveTracks, Inc. Creston, North Carolina, United States of America

Keywords: Honey traceability · Adulteration · Hive location · Nectar sources · Digital documentation · Blockchain

The Problem
Honey adulteration and mislabeling undermine consumer trust. Current lab tests are costly, sometimes inaccurate, and insufficient to guarantee authenticity.

Our Approach
HiveTracks proposes a "Honey Story":
- A digital identity for honey traceable from hive to consumer.
- Accessible through QR codes for transparency.

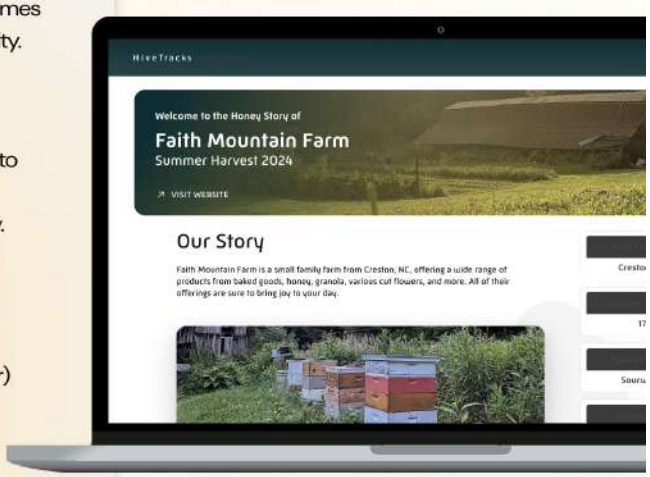
How it Works
- Record hive location and production timelines.
- Map nectar sources within foraging radius.
- Correlate flowering data (date, climate, weather)
- with honey produced.

Digital Documentation
Integrated data sources include:
- Photos + metadata
- Hive scales (weight & yield)
- Apiary management software
- Weather, land use, satellite imagery
- Crowdsourced observations

Verification Layers
- DNA & NMR testing
- Pollen & sensory analysis
- Third-party blockchain authentication (HoneyTrail)

Benefits
- Beekeepers: product differentiation, premium pricing
- Consumers: transparent, verifiable information
- Industry: stronger trust and fraud prevention

Impact
A tamper-proof, multi-dimensional record of honey's journey enhances transparency, safeguards beekeepers, and restores confidence in the honey market.



From Honey Story to Jar

Explore the free app!

GET IT ON Google Play
Download on the App Store

Connect with us www.hivetracks.com

Contact James: James@hivetracks.com **Contact Max:** Max@hivetracks.com

PP-312 [Beekeeping Technology and Quality]
Harnessing Artificial Intelligence for Smarter Beekeeping: Innovations in HiveTracks

James Wilkes, Max Runzel
HiveTracks

As AI technology rapidly advances and becomes integrated into beekeeping, HiveTracks is at the forefront of incorporating these elements into its platform. Building on over a decade of experience providing global technology solutions for beekeepers, this integration further enhances HiveTracks' ability to optimize hive management and improve decision-making for beekeepers around the world. Three new AI-driven features under development will be presented: plant and pollinator identification, brood image analysis, and customized recommendations.

The AI-powered plant and pollinator identification feature allows beekeepers to identify and document the variety and abundance of pollinators and pollinator-friendly plants in their local environment. This information helps beekeepers ensure their hives have access to diverse and plentiful food sources and validate the nectar sources of their honey. Additionally, the ability to track other pollinators in the area provides valuable insights into the local pollinator dynamics, enabling beekeepers to manage their hives in a way that promotes biodiversity and supports the broader ecosystem.

HiveTracks utilizes AI and advanced image analysis to evaluate bee populations, brood patterns and diseases, and to identify signs of pests or other hive issues. This technology not only standardizes hive health assessments, making data analysis easier and providing guidance for inexperienced beekeepers, but also enables early detection and proactive measures to improve colony health and reduce colony loss.

An AI-powered recommendation engine can provide beekeepers with customized guidance based on hive conditions, local environment, and seasonal changes. This is an improvement on hard-coded recommendation tools that are based on beekeeper assessments, which can be difficult to maintain and lack nuance. AI tools can incorporate multiple, dynamic data sources to provide relevant and actionable advice that optimizes hive management, including suggestions for space, feeding, disease and pest control. While all beekeepers can benefit from this type of advice, it would be especially helpful for inexperienced beekeepers.

HiveTracks' AI-powered tools provide beekeepers with valuable insights and actionable recommendations, promoting sustainable and resilient beekeeping practices. This data-driven decision-making not only supports beekeepers but also contributes to the overall health of the bee population and the environment.

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PP-313 [Beekeeping Technology and Quality]

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Beekeeping Flora in the "Bee Garden" Melliferous Flora Garden, Yunquera, (Málaga, Spain), in the Sierra de las Nieves National Park.

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Keywords: beekeeping flora, pollinators, conservation, biodiversity, environmental education, sustainable beekeeping, ecotourism

BACKGROUND / PURPOSE

The "Bee Garden" Melliferous Flora Garden, located in Yunquera (Málaga, Andalusia, Spain) within the Sierra de las Nieves National Park, is dedicated to the conservation and promotion of melliferous plants essential for pollinators. This study aims to characterize the beekeeping flora of the garden and highlight its importance for environmental awareness and education, as well as for raising awareness among tourists in the region.

METHODOLOGY

An inventory of the plant species present in the garden was conducted, evaluating their contribution to the bees' life cycle. Methods included direct observation and sample analysis to identify and classify the plants. Additionally, most visitors increased their knowledge of honey flora and recognized the need to protect pollinators after their visit to the garden.

PROBLEM DESCRIPTION

The decline of bee populations and other pollinators is a global concern affecting biodiversity and food production. Habitat loss and the reduction of food resources are key factors in this problem, compounded by the lack of public awareness about the importance of these insects.

Adopted beehives in the Melliferous Flora Garden and Information Point of the Sierra de las Nieves National Park near of *Abies pinsapo* (photos taken by the author).

RESULTS AND CONCLUSIONS

The results reveal a rich diversity of melliferous species in the garden, each providing vital resources at different times of the year. Key species such as rosemary, thyme and lavender are highlighted. This garden is not only a refuge for pollinators but also an educational tool for public and tourist awareness on the importance of conserving these spaces. Most visitors increased their knowledge of melliferous flora and recognized the need to protect pollinators after visiting the garden.

In addition, for this project, a herbarium and a plant seed collection have been created for educational and research purposes. The herbarium allows for the conservation and cataloging of samples of the main honey-producing and forest species in the area, facilitating the study of their morphology and their role in beekeeping and biodiversity conservation. The plant seed collection contributes to the propagation of native and honey-producing plants, ensuring the availability of resources for pollinators and supporting reforestation and environmental restoration projects. These initiatives strengthen the educational value of the space and consolidate the garden as a reference center for scientific outreach and environmental education. Photos taken by the author of the herbarium and plants from the Melliferous Flora Garden are shown, as well as the herbarium and plant seed collection websites:

https://beegardenmalaga.com/plantas-forestales/
https://beegardenmalaga.com/semillero/

Herbarium

Cistus albidus

Chestnut forest

Castanea sativa

Arbutus unedo and Plant Inventory of a Melliferous Flora Garden

Prunus avium

Salvia rosmarinus

Lavandula angustifolia

PRACTICAL IMPLICATIONS FOR BEEKEEPERS

Beekeepers can benefit from implementing similar gardens, fostering biodiversity and ensuring continuous food resources for their hives. Creating such spaces can help mitigate the effects of climate change and habitat loss, promoting the sustainability of bee populations and apicultural production. Moreover, melliferous flora gardens can attract ecotourism, providing an additional source of income and raising visitor awareness about the importance of pollinators.

ACKNOWLEDGMENT

We would like to thank everyone who supports this Honey Flora Garden project, whether by adopting a hive or tree or by visiting the Garden. We also thank those who collaborate in the "Pollinators in Málaga" Contest, a citizen science project that contributes to furthering our understanding of Málaga's biodiversity. In addition, we express our gratitude to all those who are working to combat the spread of the invasive *Vespa orientalis* in Andalusia and, more recently, the *Vespa velutina* detected in Alhaurín de la Torre (Málaga).

Adopted *Arbutus unedo*. (photograph taken by the author).

Scan and download this poster

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Hive Optimization: Using Designed Frames to Maximize Population and Production

Arthur Reis Martins - CEO, InovaApi
Center for Engineering, Modeling, and Applied Social Sciences, Federal University of ABC, Santo André, Brazil

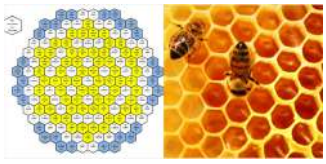
Introduction

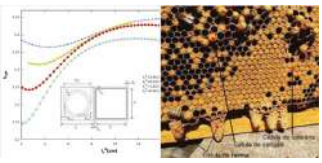
The productivity of a beehive is a direct function of its internal resource economy. Two of the most metabolically costly activities are wax biosynthesis, which consumes approximately 8 kg of honey to produce 1 kg of wax, and the rearing of a non-productive drone caste. This paper introduces a system of precision-engineered frames that eliminates these two primary metabolic costs, redirecting the colony's entire energy budget toward expanding the worker bee workforce and, consequently, to an exponentially greater honey production.

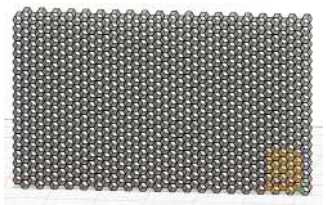
Methodology

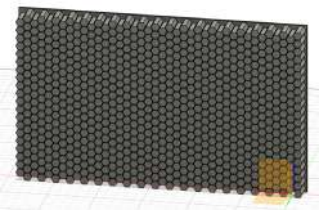
The system utilizes frames injection-molded from food-grade polymer, featuring fully drawn combs that eliminate the metabolic cost of wax. The core innovation is the demographic control achieved through cell geometry:

- **5.0 mm Worker Cells:** This fixed diameter serves as a constant tactile stimulus for the queen to lay only fertilized (diploid) eggs, which develop into workers.
- **Drone Control:** The queen is physically prevented from laying unfertilized (haploid) eggs, as the larger 6.5 mm drone cells are absent.
- **Result:** A 17.6% net gain in the worker bee workforce by converting the 15% of comb area that would be dedicated to drones.


Dimensional comparison of worker and drone cells.


Comparative model of brood area optimization.


Plastic honeycomb model for honey production.


Device for honey extraction from the engineered comb.

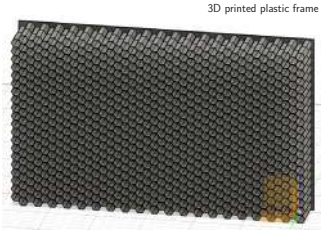
Results

The analysis projects a 123.5% increase in productivity. The table below details the comparative production model, based on a 20 kg baseline for a standard hive.

Analyzed Parameter	Control Hive	Optimized Hive
Baseline Production	20 kg	20 kg
Honey Cost for Wax	15.2 kg	0 kg
Honey Cost for Drones	∼6 kg	0 kg
Additional Workforce	N/A	+17.6%
Additional Production	0 kg	+3.5 kg
Est. Total Production	**20 kg**	**44.7 kg**
Percentage Increase	–	**+123.5%**

The total estimated production (44.7 kg) is the sum of the baseline (20 kg) plus the gains from eliminating metabolic costs (21.2 kg) and the additional production from the larger workforce (3.5 kg).

3D printed plastic frame with an exclusive design.


Engineered frame and honey extraction device.

Engineered frame with the extraction device fitted.

Discussion

The projected 123.5% productivity increase represents a paradigm shift, moving from managing external factors to optimizing the hive's internal bio-economy. A crucial secondary benefit is the biomechanical control of the *Varroa destructor* mite, the greatest health threat to *Apis mellifera* worldwide. By eliminating drone cells—the mite's preferential reproductive site—we break its life cycle, drastically reducing infestation pressure and the need for chemical acaricides.

Conclusion

This technology is not just a new type of frame, but a strategic platform for managing hive demographics, health, and productivity. By reallocating the colony's energy from metabolic costs to value-generating activities, the system enables a transformative increase in honey yield and workforce size, fostering a more profitable, resilient, and sustainable beekeeping practice.

Acknowledgements Intellectual Property

We gratefully acknowledge the financial support from FAPESP (Process No. 2023/10607-1). For scientific inquiries, please contact: **contato@inovaapi.com**.
The technology presented is the intellectual property of InovaApi, protected by patents filed with INPI (Brazil) and extended via WIPO.

InovaApi

PP-315 [Beekeeping Technology and Quality]
Microbiological quality of honey bee in Panama

Yuliana Christopher Herrera[1], Andrey Millán De León[2], Kiria Casas Calderón[2], Mauro González Zarco[2], Cecilio Puga Ramos[2], Rito Herrera[4], Martha Chaves De Von Chong[2], Hermógenes Fernández Marín[3], Ruth Del Cid Alvarado[4], Andrés Rivera Mondragón[5]
[1]Universidad Especializada de Las Américas, Facultad de Biociencias y Salud Pública
[2]Universidad de Panamá, Facultad de Ciencias Naturales, Exactas y Tecnología
[3]Instituto de Investigaciones Científicas y Servicios de Alta Tecnología, Centro de Biodiversidad y Descubrimiento de Drogas
[4]Instituto de Innovación Agropecuaria de Panamá
[5]Instituto Especializado de Análisis

Honey bee as any product of natural origin, has its own microbial flora with a characteristic microbiological behaviour. It is a food whose main competitive advantage in the market, beyond its intrinsic properties, lies in the image that consumers have regarding its purity. Although the microbial load of honey is considered low, despite its high concentration of sugars and low water activity, the presence and proliferation of certain microorganisms that could act to the detriment of the quality of the product, or could cause significant harm to the consumer, cannot be ruled out. In this study, a total of 76 honey samples were analysed, divided into two groups: 59 samples with a health registration and 17 samples without a health registration, with the aim of checking whether they complied with the microbiological limits established in the national honey quality regulations. The microbiological analyses for each sample were carried out in duplicate. The results obtained were analyzed, observing that some samples corresponding to both group exceeded the established microbiological limits. In five samples (7%), “the bacteria Escherichia coli was detected”. The microbiological quality was not met by 18% of samples without sanitary registration because they exceeded the permitted number of yeasts and molds. Microorganisms were found within the acceptable limits, but 5% of samples with sanitary registration exceeded the permitted number of Enterobacteriaceae. The mesophilic aerobic bacteria were quantified below the detection limit. “Furthermore, Salmonella and Shigella were not isolated in all samples”.

APIMONDIA SCANDINAVIA 2025
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PP-316 [Beekeeping Technology and Quality]
APIMONDIA SCANDINAVIA 2025
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Nuclear Physics and Beekeeping: Innovations Transforming Rational Management

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Introduction

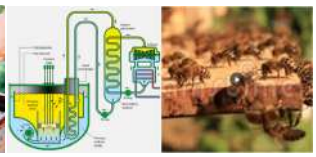
The pursuit of efficiency in complex, self-sustaining systems is a challenge shared by both nuclear engineering and modern apiculture. Both fields depend on the optimal management of internal resources and energy flux to maximize productivity—be it electrical power or honey. This work posits that the principles of nuclear reactor physics provide a surprisingly robust conceptual framework for analyzing and optimizing the bio-economy of a honeybee colony. By modeling the hive as a "biological reactor," we can move beyond traditional, descriptive beekeeping and establish a predictable, science-driven practice based on concepts like criticality, energy spectrum, and reactivity control.

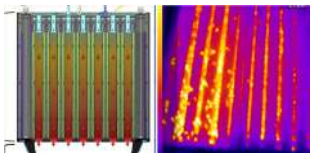
The Hive as a Biological Reactor

The colony is modeled as a biological reactor where its components and processes directly mirror those of a nuclear system. This analogy, detailed in the table below, forms the quantitative basis for our analysis.

Nuclear Component	Apicultural Analogue	Function in the System
Proton	**Queen Bee**	Defines identity and stability; central cohesive force.
Neutron	**Worker Bee**	Agent of the production "chain reaction" (foraging, care).
Neutron Poison	**Drone / Varroa Mite**	Parasitic; absorbs resources without contributing to production.
Fuel (U-235)	**Nectar / Pollen**	Raw material consumed to generate energy/products.
Control Rod	**Drone Frame Mgmt.**	Regulates the "reactivity" by removing neutron poisons.
Reactivity (k-eff)	**Productivity Index**	Ratio of production to consumption; defines system state.

Nuclear Reactor Core and Beehive


Sodium-Cooled Fast Reactor and Bees on Honeycomb


Reactor Coolant Flow and Beehive Thermal Image

Hazmat Suit and Beekeeper Suit

Radiation Monitoring and Pollen-Covered Bee

The Sun and a Swarm of Bees

Reactor Principles in Hive Management

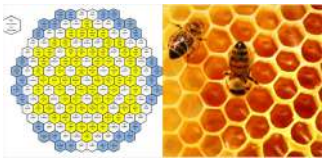
Applying reactor dynamics allows for hive classification and strategic optimization. A hive can be managed in different operational modes, analogous to thermal and fast reactors, with distinct outcomes.

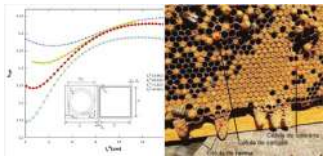
Parameter	"Thermal" Hive (Reproductive)	"Fast" Hive (Productive)
Primary Goal	Colony Reproduction (Swarming)	Honey Production
State	Subcritical / Critical (k-eff ≤ 1)	Supercritical (k-eff > 1)
Drone Population	High (Natural Ratio)	Minimized (Frame Control)
Energy Spectrum	Broad (Wax, Drones, Honey)	Focused (Honey, Workers)
Varroa Impact	High (Drone brood is a vector)	Low (Vector is removed)
Productivity	Baseline / Maintenance	Maximized / Surplus
Control Method	Passive Observation	Active Management

By managing the hive as a "Fast Reactor"—actively minimizing drone production (neutron poisons) using specialized frames—the colony's energy is channeled directly into honey production. This shifts the "energy spectrum" away from reproduction and toward resource accumulation, drastically increasing yield and creating a supercritical state of productivity.

Radiopharmaceutical and Bee Stinger

Fundamental Particles and Bee Castes


Reactor Core Map and Honeycomb Structure


Core Reactivity Graph and Specialized Honeycomb Cells

Discussion

This model extends to control systems. The Queen's Mandibular Pheromone (QMP) acts as a natural "moderator," regulating colony growth. A strong QMP signal suppresses queen rearing, maintaining stability. A weak signal initiates swarming, a "programmed power reduction." A crucial secondary benefit emerges from managing the hive as a "Fast Reactor." The *Varroa destructor* mite, the primary parasite in apiculture, preferentially reproduces in drone brood due to its longer gestation period. By systematically removing drone frames, we not only eliminate "neutron poisons" but also implement a highly effective biomechanical control against the parasite. This breaks the Varroa's reproductive cycle without chemicals, reducing infestation and creating healthier, more resilient colonies.

Conclusion

The nuclear physics framework is more than a metaphor; it is a predictive and quantitative tool for innovation. By viewing the hive as a biological reactor, we can design management strategies that precisely control its "reactivity" and "energy spectrum." This approach transforms beekeeping from a reactive art into a precision science, paving the way for technologies that maximize productivity, improve colony health, and ensure the long-term sustainability of the practice.

Intellectual Property

For scientific inquiries, please contact: **contato@inovaapi.com**. The technology presented is the intellectual property of InovaApi, protected by patents filed with INPI (Brazil) and extended via WIPO.

InovaApi

PP-317 [Beekeeping Technology and Quality]
Glyposate in honey: determination of contaminating vectors

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Honey produced by honeybees in environments where the herbicide glyphosate is widely used may contain this molecule, causing trade problems for honey-exporting countries. This herbicide is widely used in extensive agriculture worldwide. However, the mechanisms by which glyphosate is contaminated in honey are unknown. A semi-field trial was conducted with hives in 12 m2 tents, where they were cross-contaminated, with three replicates and compared with a control: pollen, water, and nectar, with known doses of glyphosate. In an effort to conduct the test with actual concentrations of glyphosate reported in the literature, nectar was supplied at 0.3 mg glyphosate acid equivalent/L; pollen at 6 mg/L; and water at 3 mg/L. The bees produced their honey in these enclosures. At the end of the trial, the honey produced exclusively with the supplied substrates was analyzed following a validated methodology according to the European guideline SANTE/11312/2021 using coupled ion chromatography-tandem mass spectrometry (IC-MS/MS). The glyphosate concentration ranges in the honey obtained in the 3 replicates of each treatment were: when contaminated pollen was fed: <LOQ - 0.011 mg/kg (LOQ = 0.010 mg/kg), when contaminated water was fed: 0.072–0.085 mg/kg, when contaminated nectar (syrup) was fed: 0.69–0.89 mg/kg. Control: Not detected in any replicate. It was found that pollen, water, and nectar can be vectors of contamination in honey. Water is a more important vector than pollen in carrying this molecule into honey. Measurements were also taken directly on soybean flowers: on nectar obtained with microcapillaries and on nectar expelled from the honey crop of bees. They found that soybean nectar may contain the incorporated molecule glyphosate, which is the most significant vector of contamination in honey. With these results, recommendations can be made to the productive sector to avoid incorporating this molecule into honey.

PP-600 [Beekeeping Technology and Quality]
Strengthening beekeeping through B-THENET qualification and certification of advisors in beekeeping

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In an era of growing challenges for beekeeping, reliable qualifications for beekeepers and advisors are essential to maintain high quality standards, sustainability, and consumer trust. As global markets demand greater transparency in honey production, a structured qualification system ensures best practices in bee colony management, disease control, and ethical beekeeping.

This research, part of the Horizon Europe-funded B-THENET project, examines two qualification levels: micro-credentials for national advisors through B-THENET Center trainings and a B-THENET certification for highly trained advisors on international level.

Micro-credentials provide targeted, modular learning in bee colony management, disease prevention, sustainability, and honey quality assurance. They promote continuous learning, allowing advisors and beekeepers to stay up to date on scientific advancements. A standardized B-THENET micro-credential certification strengthens the credibility of advisors in beekeeping. This will in a long-term perspective strengthen the beekeepers' credibility on local and global markets, increasing the consumer confidence, improving honey quality, and creating better economic opportunities.

At a higher level, the international B-THENET certification equips advisors with science-based expertise to enhance bee colony resilience against climate change, pathogens, and habitat loss. This certification includes training in communication, group dynamics, behavioral change, advisory tools, process management, and coaching in beekeeping. With up-to-date knowledge, B-THENET-certified advisors improve communication strategies, strengthen disease management, and drive sustainability in the sector.

Additionally, credentialed advisors play a key role in bridging the gap between research and practice, ensuring that beekeepers adopt the latest innovations and best practices. By fostering a network of highly trained professionals, the B-THENET framework contributes to a more adaptive and future-proof beekeeping sector.

This presentation offers key recommendations for policymakers, educators, and industry stakeholders to establish globally recognized B-THENET micro-credentials and certification frameworks. B-THENET explores if these systems could be the way forward to create a resilient, professional, and sustainable beekeeping sector, ensuring beekeepers and advisors as essential stewards of sustainable landscapes for pollinators and food security.

PP-601 [Beekeeping Technology and Quality]
Bringing your beekeeping invention to market

Stuart Ralph Anderson
Beeinventive Pty Ltd

Beekeepers as a group are particularly innovative. Every beekeeper's situation is unique, requiring each beekeeper to adapt existing equipment and processes to suit their situation. Often this adaptation involves developing new and creative solutions. From bee research laboratories to a beehive on a balcony, surprisingly clever solutions to problems have been developed. Beekeepers and bee researchers are inventors.

Some beekeeper's inventions do more than solve just their own particular problem in their apiary, laboratory or hive. The innovation has broader potential. It could make a difference, could help other beekeepers, could improve bee health, perhaps world-wide.

If an invention will help other beekeepers and, indeed, support healthy colonies of bees, it should be commercialised so that beekeepers and researchers around the world can use it. How does the inventor bring their invention to market? What are the opportunities? What are the hurdles? What help might the beekeeper/researcher/inventor need?

In this presentation Stuart will draw from his experience of co-inventing the Flow Hive and the Flow Super Lifter. He will detail what is involved in bringing those inventions to market. He will describe ways in which the creative process can be enhanced, ethical considerations, how to protect the ideas from being stolen, the options in raising finance, and possibilities in marketing.

To illustrate the bringing of an invention to market, Stuart will use anecdotes from other inventors as well as his own experience. He will describe mistakes and failures as well as successes, as each failure, while being difficult, is a learning experience.

This presentation discusses the fraught area between research, development, innovation and the marketplace. Stuart will outline the Learning Cycle developed by David Kolb (1984) and Action Research as promoted by Kurt Lewin (1944). These research approaches differ significantly from traditional research, but fit well in the area of innovating for improved beekeeping.

PP-602 [Beekeeping Technology and Quality]
A Perspective on the Status and Future of Technology and Knowledge Transfer Programs in Apiculture: The Case of Canadian Beekeeping

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The beekeeping industry in Canada plays a significant role in agricultural sustainability and economic stability, contributing approximately CAD$7 billion annually through pollination. However, beekeepers constantly face challenges trying to keep operations profitable and ultimately provide pollination services. High annual colony losses are economically untenable; e.g., 45.5% winter mortality was reported in 2021. The multifactorial contributors to poor bee health outcomes are shared by beekeepers globally, including highly virulent and emerging pathogens, exposure to agrochemicals in agricultural landscapes, and changing climate. To address these types of challenges, the Ontario Beekeepers' Association established a technology transfer program (TTP) in the 1990s. The success of this initiative led to the adoption of the TTP model in other provinces: Quebec (2006), Saskatchewan (2010), the Atlantic Provinces (2016), Alberta (2019), Manitoba (2020), and British Columbia (2021). These seven programs facilitate applied research and extension activities and support the commercialization of new technologies, effectively bridging the gap between academia and industry. Unlike conventional technology transfer offices that are often within academia or research institutions, Canadian TTPs are embedded within non-profit industry-led organizations, providing a direct and responsive approach to industry needs. However, Canadian TTPs work collaboratively with existing government extensionists and academic research initiative. This TTP model has proven to be an essential mechanism for knowledge dissemination, adaptive research, and industry-research partnerships. Education and active pathogen surveillance have been shown to be crucial in reducing colony mortality, underlining the potential impact of TTPs in promoting best practices and facilitating inter-institutional and nationwide collaborations that directly impact practitioners. Despite their successes and value to industry stakeholders, the future of these programs in Canada remains uncertain. Here we discuss the strengths and weaknesses of the programs and possible ways to effectively support the beekeeping industry in Canada through extension programs, such as the TTPs, and the potential of adopting this model in other countries.

POLLINATION AND BEE FLORA

PP-535 [Pollination and Bee Flora]
MELISSOPALYNOLOGY OF HONEYS PRODUCED IN THE NEVADOS PROVINCE OF THE DEPARTMENT OF TOLIMA, COLOMBIA BY Apis mellifera L. (Hymenoptera: Apidae)

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Honey is a sweet substance produced by bees from nectar or plant secretions, containing glucose, fructose, organic acids, enzymes, solid particles, and pollen grains. The pollen found in honey results from the foraging and pollination activities of bees on the vegetation surrounding the hive. Mellisopalynological analysis allows for the identification of the specific plants visited by bees, as pollen grains are carried by them from the flowers. In Colombia, this type of analysis has not yet been fully established, despite its significance from the perspective of plant-insect interactions. This study investigates the floral composition of honeys collected from the Nevados Province in the Tolima Department of Colombia. The region, located in the central Andes, features a variety of ecosystems ranging from tropical to montane forests, which influence the diversity of floral sources available to local honeybees. Different honey samples from the study area were processed using the standard acetolysis technique, followed by pollen grain counts per sample, and the determination of pollen type frequencies. Nearly 90 pollen types from 35 plant families were identified. The families with the highest representation were Leguminosae (17.3%), Compositae (11.9%), Anacardiaceae (5.43%), and Poaceae (5.43%). The pollen types of Attalea sp., Mimosa somnias, Triumfetta lappula, Psidium guajava, and Poaceaesp. were found in all samples, while the most represented pollen types in the samples included Attalea sp., Mimosa somnias, M. pudica, Poaceae sp., P. guajava, and Cecropia peltata. The diversity and occurrence of pollen types in the samples allow them to be classified as multifloral honeys, as no sample contained pollen types with a frequency higher than 50%. This study holds significant relevance for both the scientific community and the agricultural and beekeeping sectors in Colombia, not only in terms of beekeeping and honey production but also for biodiversity conservation.

PP-536 [Pollination and Bee Flora]

Honey bee Pollination beyond of the products

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Abstract

Pollination are the most important factors that increase biodiversity and contributes to one-third of global crop production, but comprehensive and detailed benefits are still unknown. Hence, pollination is underestimated by international policies, which is particularly alarming in times of agricultural intensification and diminishing pollination services. In this study, the effect of pollination by *Apis mellifera meda* and *Bumbus terrestris* on two almond cultivars was investigated. In this study, length, width, thickness and weight of fruit, percentage of fruit formation, percentage of empty and shriveled almonds, percentage of fat and vitamin E content were investigated. In this study, the fauna of pollinating insects in the orchard was also identified and also, the effect of pollination by *A. mellifera meda* and *B. terrestris* on the nutritional. The results showed that the highest fruiting percentage was related to bumble bee with 89.44, which was significantly greater than other treatments. No significant difference was observed between honey bee treatments (56.12) and positive control (59.82). Negative control treatment (9.62) was significantly lower than other treatments.

Materials and methods

This project was carried out in a research orchard containing two almond varieties in Iran. 3 cages containing 6 almond trees were placed in the orchard before flowering to evaluate the effect of *Apis mellifera meda* and *Bumbus terrestris* pollination. In this study, length, width, thickness and weight of fruit, percentage of fruit formation, percentage of empty and shriveled almonds, percentage of fat and vitamin E content were investigated.

Fig 1. Treatments containing *A. mellifera meda* and *B. terrestris* and positive and negative controls

Results

According to the results the highest fruiting percentage was related to bumble bee with 89.44, which was significantly greater than other treatments. No significant difference was observed between honey bee treatments (56.12) and positive control (59.82). Negative control treatment (9.62) was significantly lower than other treatments. According to the results the highest average length, width and weight of fruit was related to honey bee treatment, which was not significantly different from positive control treatment, but was significantly greater than bumble and negative control treatments. The percentage of empty and wrinkled almonds in negative control was significantly lower than other treatments.

Fig 2. The effect of *A. mellifera meda* and *B. terrestris* on almond yield

Acknowledgement

Agricultural Jihad of Bushehr Province

Pollinators Protectors Association

National Union of Iranian Beekeepers

PP-537 [Pollination and Bee Flora]
Blue berries polinization with apiaries moviles inovation in Peru

Ulises Stevens Aldea
Company ICOALCHA SAC, Department I+D, Perú, Ulises Stevens Aldea Chávez

Peru is one of the most important blue berries´ producer around the world. Peruvian´s blue berries are polinized by honey bees almost all year long. Since honey bees have been in danger for the all the blue berries´ sanitary treatments; ICOALCHA SAC has developed an innovation in order to protect them while they are polinizating blue berries´ fields. The apiaries moviles mean is to create a secure space for hives where honey bees are protected from the sanitary treatments of blue berries fields. This innovation comes with a set of tools on how to mesure the activity of honey bees in blue berries´field. As an example, now it is posible mesure polinizatin eficiency on blue berries´ fields without open the hives; base on temperature and the amount of flowers on the blue berries plants. This innovation has proben that blue berries´ polinization has a direct relationship with amount of seeds, size, weight, in general quality of the fruit after harvest. This innovation is a solucition for the masive polinization in Peru. This innovation has been proved in 50 hectareas on Agrovision´s filds which is one of the top five companies producers of the blue berries in Peru.

PP-538 [Pollination and Bee Flora]
Flowering times of the plants of Khartoum State with reference to their importance for honeybees

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The survey and evaluation of Khartoum State area for flowering plants lasted for 18 successive months. A list of 85 such plants is provided; bee plants abundance and dearth were clearly indicated. The various length of flowering periods of the various plant species, flowering density per plant and bees (Apis mellifera L.) and (Apis florea F.) preference for some of them were recorded.

Indigenous plant species are mostly blooming during autumn and winter seasons. Exotic plants which are utilized in the area as shade and ornamental plants, many of them bloom during summer, therefore, they compensate for the lack of flowers in the dearth period.

About a dozen plant species can be referred to as good foraging plants (key plants) in the area: Grewia tenax, Zizyphus spina-christi, Balanites aegyptiaca, Acacia nilotica, Acacia seyal, Capparis decidua, Tamarindus indica, Mangifera indica, Albizia lebbek, Plumeria spp., Eucalyptus spp. and Acacia mellifera. Guddeim (Grewia tenax) planting in the area is recommended on a large scale. The important factor affecting flowering in the area was the availability of water (irrigation water, high under ground watertable and rains).

Khartoum State is rich in flowering plants, with more human efforts for green surroundings will have ample foraging sources for bees and hence suitable as a beekeeping place.

PP-539 [Pollination and Bee Flora]
Agricultural intensification with seasonal fallow land promotes high bee diversity in Afrotropical drylands

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The exponential increase in the human population in tandem with increased food demand has caused agriculture to be the global¬ dominant form of land use. Afrotropical drylands are currently facing the loss of natural savannah habitats and agricultural intensification with largely unknown consequences for bee pollinators. In this study we investigate the effects of agricultural intensification on bee assemblages in the Afrotropical drylands of northern Tanzania. We disentangled the direct effects of agricultural intensification and temperature on bee richness from indirect effects mediated by changes in floral resources. We collected data from 24 study sites representing three levels of management intensity (natural savannah, moderate intensive and highly intensive agriculture) spanning an extensive gradient of mean annual temperature (MAT) in northern Tanzania. We used ordinary linear models and path analysis to test the effects of agricultural intensity and MAT on bee species richness. We found that bee species richness increased with agricultural intensity and with increasing temperature. The effects of agricultural intensity and temperature on bee species richness were mediated by the positive effects of agriculture and temperature on the richness of floral resources used by bees. During the off-growing season, agricultural land was characterized by an extensive period of fallow land holding a very high density of flowering plants with unique bee species composition. Our study reveals that bee assemblages in Afrotropical drylands benefit from agricultural intensification in the way it is currently practiced. However, further land¬ use intensification, including year-¬ round irrigated crop monocultures and excessive use of agrochemicals, is likely to exert a negative impact on bee diversity and pollination services, as reported in temperate regions. Moreover, several bee species were restricted to natural savannah habitats. To conserve bee communities and guarantee pollination services in the region, a mixture of savannah and agriculture, with long periods of fallow land should be maintained.

PP-540 [Pollination and Bee Flora]

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MAIN POLLEN STRUCTURES ASSOCIATED WITH THE BOTANICAL ORIGIN OF HONEY FROM HUILA, COLOMBIA

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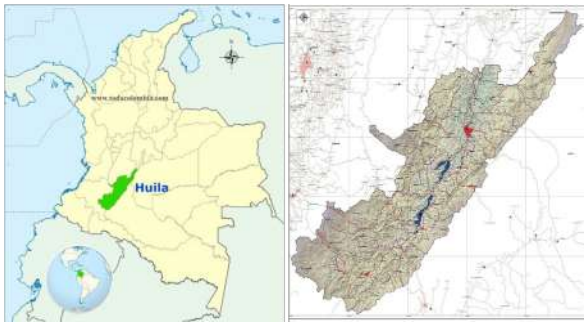
REMARKS

Honey is a natural and nutritious product produced by honeybees from floral nectar and plant secretions, containing sugars, acids, enzymes, pollen grains, and minor solid particles that contribute to its nutritional and functional value. Studies on honey, especially those examining its botanical origin, are important for evaluating quality and authenticity, as well as for identifying the floral resources used by bees during foraging. Melissopalynology, which allows the differentiation of pollen grains in honey, provides valuable information on both its botanical and geographical origin.

The Department of Huila, located in southeastern Colombia, is among the country's leading honey-producing regions, ranking fifth over the past four years. It encompasses a diverse range of ecosystems, including Andean highlands, dry forests, and the Magdalena River valley. This ecological diversity sustains a rich array of nectar- and pollen-producing plant species, making the region particularly favorable for apiculture.



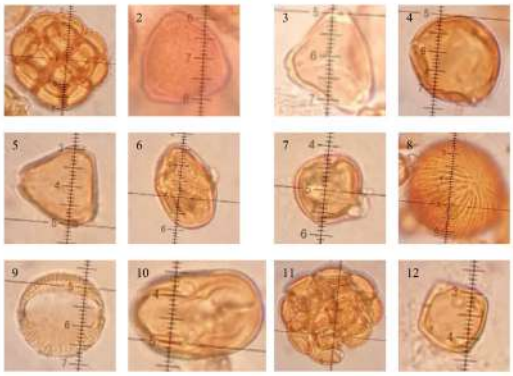
The present study aimed to identify the pollen types present in honey samples from Huila and to contribute to the melissopalynological knowledge of Colombia. Nine honey samples from *Apis mellifera* L., collected from seven different locations, were analyzed palynologically. The samples were processed using the standard acetolysis technique, and counts of at least 500 pollen grains were conducted to determine the frequencies of the pollen types.

Mellisopalynological process: The mellisopalynological analysis was carried out through the following steps: (i) preparation of an aqueous honey solution, (ii) application of the Erdtman acetolysis method (1960), (iii) slide preparation following the procedures of Louveaux et al. (1978) and Jones & Bryant Jr. (2004), and (iv) identification of pollen types and quantification of their frequencies.

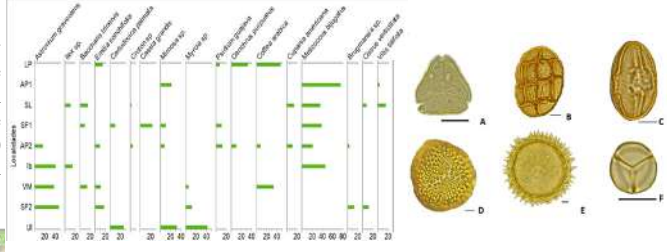
RESULTS AND DISCUSSION

Beekeepers in Huila rely on this floral diversity to maintain sustainable, year-round honey production. The flavor, color, aroma, nutritional content, medicinal properties (linked to plant-derived compounds), and market classification (monofloral vs. multifloral) all contribute to the high quality and commercial value of honey produced in the región.

A total of 36 pollen types corresponding to 25 botanical families were identified. The families Sapindaceae, Leguminosae, and Anacardiaceae showed the highest representation of pollen types (17.1; 9.98, and 9.81%, respectively). The greatest pollen diversity was observed in the sample from Alto Piravante 2, which contained eleven pollen types. Furthermore, some pollen types appeared in the majority of samples and were highly frequent in others, with a representation exceeding 50%—notably *Melicoccus bijugatus* and *Cecropia peltata*—highlighting the importance of these plant species for apiculture in the department.

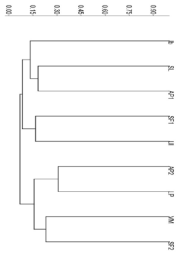


1 *Anadenanthera peregrina* (L.) Speg. **2** *Calycolpus moritzianus* (O.Berg) Burret. **3** *Psidium guajava* L. **4** *Vitis tiliifolia* Humb. & Bonpl. ex Schult. **5** *Psidium guajava* L. 6 *Adenaria floribunda* Kunth. **7** *Euphorbia hirta* L. **8** *Brugmansia* sp**. 9** *Ageratum conyzoides* (L.) L. **10** *Cassia grandis* L.f. **11** *Pithecellobium dulce* (Roxb.) Benth. 12 *Ageratum conyzoi*des (L.) L.



Huila. Repreative types of pollen: **A** *Myrcia* sp. **B** *Pithecellobium dulce*. **C** *Triumfetta bogotensis*. D *Croton* sp. **E** *Sida* sp. **F** *Mimosa pudica*. Scale bar: 10 µm.

The Jaccard index analysis revealed low similarity among the samples analyzed. Other pollen types, such as *Astronium graveolens* and *Mimosa* sp., showed high occurrence in the samples and are also considered important food resources for bees in the country. The pollen diversity characterizes the honey samples analyzed as multifloral and confirms the importance of certain botanical families Sapindaceae and Leguminosae in honey production.



PP-541 [Pollination and Bee Flora]
Floral authentication of Cypriot honey based on volatile composition

Mehmet Ali Karagozlu[1], Ozge Ozden[1], Salih Gücel[1], Liberata Liberata Gualtieri[2], Michelina Ruocco[2], Gennaro Di Prisco[2]
[1]Faculty of Agriculture, Near East University, Nicosia, Cyprus
[2]IPSP-CNR Institute for Sustainable Plant Protection, National Research Council, 80055 Portici, Naples, Italy

Consumers greatly value honey's unique organoleptic qualities, which include nutritional and health benefits, in the culinary industry as well as in the pharmaceutical and cosmetic sectors. Honey can be classified by kind or source because its composition differs by location based on the local flora. Geographical origin affected the volatile compounds in honeys from most native bees. The variety of flowers found in a certain habitat unique sugars, acids, and aromatic compounds. It is known that different species of native bees may forage on different plants and this may influence the honey's composition. In this study a total of 74 honey samples from different regions of Cyprus were analysed in this study. The headspace analysis of volatile organic compounds (VOCs) emitted by different honey samples was conducted using proton transfer reaction quadrupole interface time-of-flight mass spectrometry (PTR-Qi-TOF-MS), which enabled the identification of their volatile profiles. This will led us to characterize honey from different location and blooming based on smell by identifying the chemical compound in the volatile fractions.

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PP-542 [Pollination and Bee Flora]

Pollination in a changing climate: Effects of heat and water stresses on three canola varieties

University of Lethbridge

Fairo Dzekashu Foryuy & Shelley Hoover

Department of Biological Sciences, University of Lethbridge, Canada

1. INTRODUCTION

- Canola (*Brassica napus*), is an oil-seed crop of high economic importance with an annual contribution of $43.7 billion to the Canadian economy [1-2]
- Insect-mediated pollination of canola crops is affected by both heatwaves and water stress, with direct impacts on pollinator thermoregulation and foraging patterns, as well as indirect effects on plant physiology and rewards offered to pollinators[3].
- Studies aimed at examining the extent to which warming and water scarcity influences plant phenology, pollinator activity, and crop yield remains lacking.

2. OBJECTIVE

We examined the effects of heat and water stresses on flowering phenology, floral traits and pollinator visitation in three canola varieties.

3. METHODS

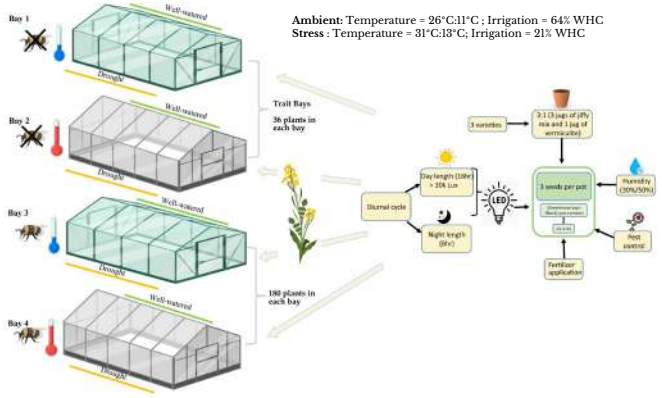

Figure 1: Experimental set up in greenhouses. Three seed varieties were used, Westar (WES), a Late and an Early Maturation (LM & EM) varieties.

5. IMPACT

Our findings informs canola growers about the effects of heat and drought on different canola varieties and does the same for beekeepers in terms of how the effects of changing climate on canola crop could affect bee foraging resources and honey yield.

6. CONCLUSION

- Warming and water stress significantly shortened flowering cycles by advancing flower onset, peak and end.
- Plants under ambient conditions produced broad flowers and large volumes of less concentrated nectar which enhanced floral visibility and attractiveness to pollinators.
- Increases in stressed conditions (heatwaves and water scarcity) above bee thermal optima negatively affect thermoregulatory and flight performance, leading to reduced pollinator abundance and visitation rate.

References

1. Hatzig, S. V. *BMC Plant Biology* **18**, 297 (2018)
2. GlobalData. The Economic Impact of Canola on the Canadian Economy. *Canola Council of Canada* 1–64 (2024)
3. Hemberger, J. A. *et al. Functional Ecology* **37**, 591–601 (2023)

Acknowledgement

We gratefully acknowledge the financial support for this project from the Canola Council of Canada's Canola Agronomic Research Program (CARP 2022.31) and from the Results Driven Agriculture Research (RDAR) program. We thank the Plant Gene Resources of Canada (PGRC) Saskatoon, Saskatchewan, Canada for providing us with Westar: CN 42942 seed variety and Certera AgriscienceTM, Saskatoon, Saskatchewan, Canada for providing us with EM and LM seed varieties.

4. RESULTS

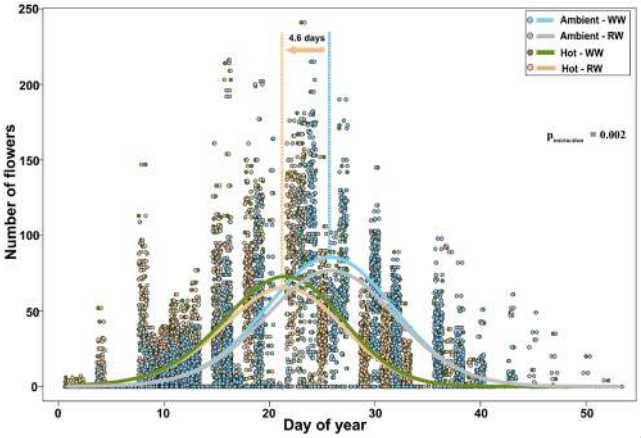

Figure 2: Flowering phenology (daily opened flowers) patterns over time for each treatment; Ambient Well-Watered (Ambient-WW), Ambient Reduced-Watered (Ambient-RW), Hot Well-Watered (Hot-WW), Hot Reduced-Watered (Hot-RW).

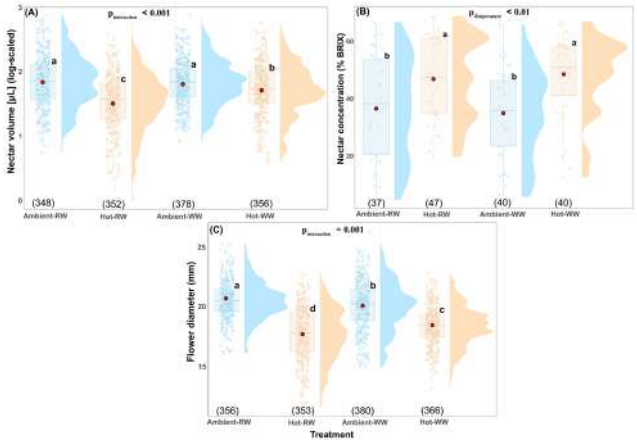

Figure 3: Effects of temperature and irrigation on floral traits (nectar volume in µL (A), concentration in %BRIX (B) and flower size in mm (C)) for each treatment. Ambient Well-Watered (Ambient-WW), Ambient Reduced-Watered (Ambient-RW), Hot Well-Watered (Hot-WW), Hot Reduced-Watered (Hot-RW).

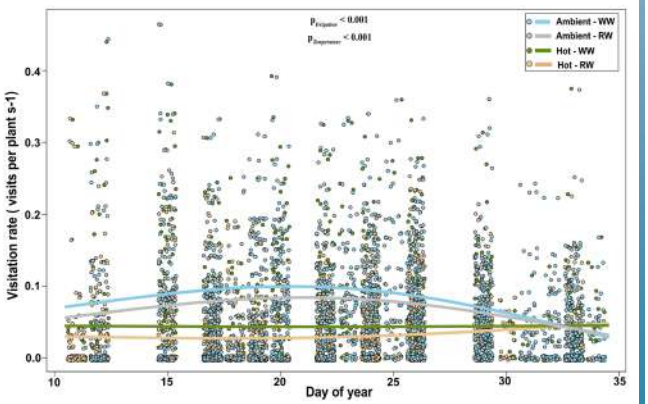

Figure 4: Patterns of visitation rate across the observation period for each treatment. Ambient Well-Watered (Ambient-WW), Ambient Reduced-Watered (Ambient-RW), Hot Well-Watered (Hot-WW), Hot Reduced-Watered (Hot-RW).

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PP-543 [Pollination and Bee Flora]

Pollination in a changing climate: Effects of heat and water stresses on three canola varieties

University of Lethbridge

Fairo Dzekashu Foryuy & Shelley Hoover
Department of Biological Sciences, University of Lethbridge, Canada

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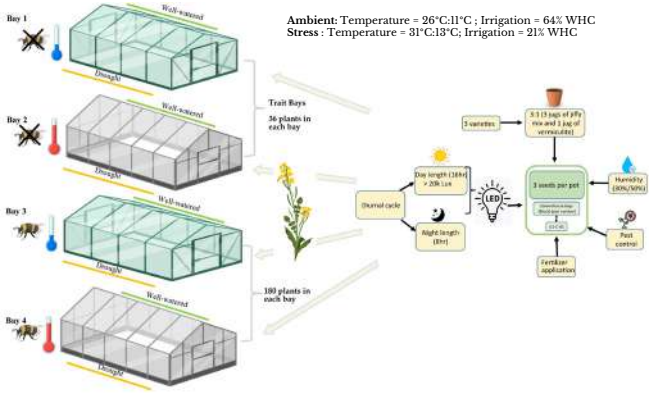

Ambient: Temperature = 26°C.11°C ; Irrigation = 64% WHC
Stress : Temperature = 31°C.13°C; Irrigation = 21% WHC

Figure 1: Experimental set up in greenhouses. Three seed varieties were used, Westar (WES), a Late and an Early Maturation (LM & EM) varieties.

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Our findings informs canola growers about the effects of heat and drought on different canola varieties and does the same for beekeepers in terms of how the effects of changing climate on canola crop could affect bee foraging resources and honey yield.

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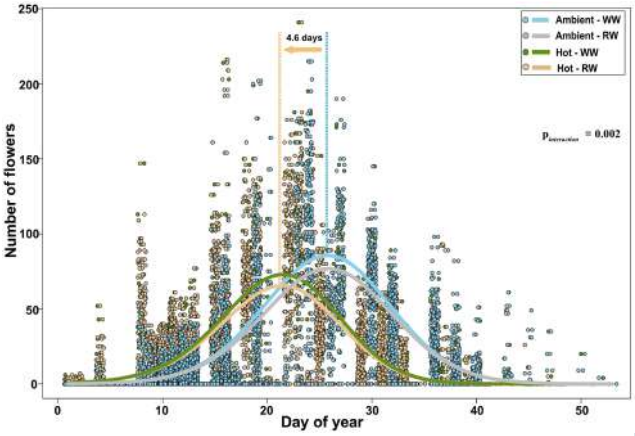

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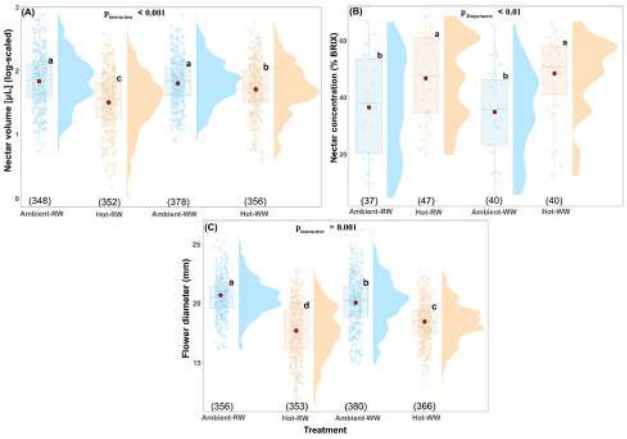

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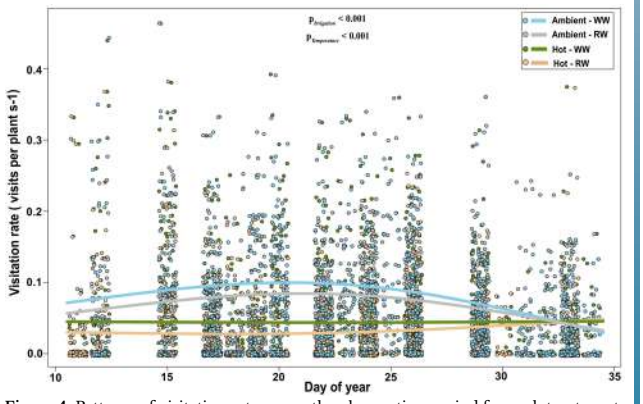

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PP-544 [Pollination and Bee Flora]

Melliferous plants visited by *Apis dorsata* during different climatic seasons in the Vidharba Region of Maharashtra State in India

by

G.N. Paliwal*, S.G. Paliwal and D.B. Tembhare

Centre for Bee development, Nalwadi, Wardha- 442001, India. Email : gopalpaliwal23@gmail.com

Melliferous plants foraged by *Apis dorsata* bee-species have been physically identified in an exclusive survey undertaken during the summer, winter, and rainy seasons of 2019-24. The scope of study was kept limited to the *A. dorsata* rich pockets occurring in the forests and plains of Vidarbha region of Maharashtra State in India. This species is noticed to be the versatile and voracious forager of wide variety of blooming vegetation that ranges from wild to the cultivated crops. Availability of nectar-pollen yielding flowers (quantity, quality and flowering spans) in different seasons have been noticed to be one of the key influencing factors for *A. dorsata* for deciding their migratory routs from mountains to the plains and vice versa in order to perform the breeding cycle. Actual photographs of foragers foraging on each plant's flower have been captured during the field visits. The *A.dorsata* foragers have been observed to forage upon around 77 species of plants, that belonging to about 34 families. Amongst them, around 35% are the domestic plants (food- and fruit crops) while 65 plants are wild in origin. The identified plant species which are classified into families namely Asteraceae, Bombacaceae, Ceesalpiniaceae, Crassulaceae, Fabaceae, Lamiaceae, Malvaceae, Meliaceae, Mimosaceae, Myrtaceae, Poaceae and Verbenaceae are proven as the prime resource of nectar and pollen for *A. dorsata.* The floral spectrum for winter, summer and rainy seasons suggests that *(A. dorsata)* bees has the tremendous role in bringing about qualitative and quantitative enhancement in the productivity, bio-diversity and richness in the varied vegetation of the region. The data obtained is essentially important to the local traditional honey hunters, farmers, and forest officials to adopt scientific techniques of *A. dorsata* management to conserve them for maintaining overall prosperity in the nature. In addition, the forest officials can also initiate the projects to cultivate identified wild plants under their social forestry programmes to increase the green cover with bee-loving plants. The floral calendar of various plants visited *by A. dorsata* has been prepared as per the seasons.

Key words: Melliferous plants, *Apis dorsata,* floral calendar

Introduction:

Bees are social insects. They are best known for their extremely selective selection of food plants yielding nectar and pollen for them. The pollen and the nectar are the basic foods of adults and young brood. Therefore, good bee-forage is a primary requirement for attending to the overall development of the progeny with the creation of honey, wax, pollen, royal jelly, propolis, etc as the final produces harvested from their nests.

An availability of nectar-pollen yielding flowers (quantity, quality, and flowering span) in different seasons has been noticed to be the key influencing factor for deciding the migratory routes for bees from the mountains to the plains and vice versa. Such seasonal migration has been seen performed by bees for undergoing the breeding cycle.

The data on the foraging of *A. dorsata* is essentially important to the local traditional honey hunters, farmers, and forest officials so as to adopt scientific techniques of its management to conserve them for maintaining overall prosperity in Nature through the process of pollination. In addition, the forest department can also initiate projects to cultivate the identified wild plants under their social forestry plantation programs to increase the green cover with bee-loving plants. The generalized floral calendar of various plants visited by bees is available but that particularly for *A. dorsata* as per the different months was noticed largely unavailable until the present study was undertaken. Therefore, the scope of the current study was kept limited only to the bee-species *A. dorsata* found in the forests and plains of the Vidarbha region of Maharashtra State in India.

Materials & Methods :

Extensive field visits were made to photograph forager bees of *Apis dorsata* species in and around flowers in the agricultural- and wild vegetation during all months of the year. The camera Cyber-Shot 3.2MP was used to capture the live pictures of foraging activity exhibited by the *A. dorsata* as bee-foragers.

Results and Observations :

The floral spectrum for winter-, summer- and rainy seasons suggests that *A. dorsata* bees have a tremendous role in bringing out qualitative and quantitative enhancement in the productivity, bio-diversity and richness in the regions of its habitats. The following details about foraging activity reporting months, the local name of the flower, scientific names, family-wise classification, type of plants, flowers colour, standard flowering period and occurrence of each plant species. The families namely Apocynaceae, Asteraceae, Caesalpiniaceae, Combretaceae, Cucurbitaceae, Fabaceae, Lamiaceae, Lythraceae, Malvaceae, Myrtaceae, Pedaliaceae, Poaceae, Rutaceae, Sapotaceae, Rubiaceae and Verbenaceae are represented by more than 2 plants, proven as the prime resource of nectar and pollen to *A. dorsata* bee-species. Actual photographs of *A. dorsata* worker bees (foragers) foraging upon each flower have been captured during these exclusive field visits. The month-wise floral calendar for *A. dorsata* bee-species has been worked out as in below.

The identified melliferous plants have been further listed into categories like 'annual herbs', 'perennial herbs', 'shrubs', 'climbers', 'small to medium wild trees', 'higher wild trees', 'cereals', 'pulses', 'oil seeds', 'spices vegetables' and 'fruit trees' (Table 1.). It is interesting to note here that amongst wild vegetation the highest no. of plants preferred by *A. dorsata* come into the category of small to medium wild trees (23 plants) followed by Annuals/herbs (17 plants), Shrubs (16 plants) and higher trees (10 plants). In the case of food plants, the crops like cereals, pulses, oil seeds, spices, vegetables, and fruit trees are foraged by them as per their seasonal availability in the plains.

Table 1. Listing of various foraging flora as per the pla

Type of vegetation	Number of plants	Scientific names of the plants
Annuals / herbs	17	*Cleome viscose, Gaillardia spp*e, *Tagetes patula, Tagetes erecta, Tagetes temifolia, Zinnia elegans, Sesamum rigidum, Parthenium hysterophorus, Celosia argentea, Ocimum basilicum, Senna tora, Hyptis suaveolens, Ocimum americanum, Ocimum sanctum, Psoralea corylifolia, Hibiscus panduraeformis* and *Hygrophila auriculata.*
Perennials / herbs	2	*Dahlia spps.* and *Nymphaea rubra/ rosea*
Shrubs	16	*Lawsonia inermis, Isomoea fistulosa, Rosa damascena, Opuntia elatior, Calycopteris floribunda, Calotropis giganteean, Vitex negundo, Dichrostachys cinera, Hamelia patens, Lantana camara, Mimosa hamata, Rotala illecebroides, Tecoma stans, Bougainvillea glabra, Maytenus emarginata* and *Cadaba fruticosa.*
Climber	2	*Combretum ovalifolium* and *Luffa luffa cylindrical.*
Small to medium wild trees	23	*Pergularia daemia, Butea monosperma, Butea monosperma lutea, Acacia farnesiana, Erythrina variegate, Gliricidia septum, Cassia fistula, Pongamia pinnata, Psidium guajava, Holarrhena pubescens, Wrightia tinctoria, Leucaena leucocephala, Bauhinia vahlii, Delonix regia, Delonix elata, Thevetia peruviana, Tectona grandis, Leucaena spp. Murraya koenigii, Bauhinia purpurea, Sesnania grandiflora, Eucalyptus spps.* and *Sapindus emarginatus.*
Higher wild trees	10	*Albizia lebbeck, Azadirachta indica, Bombax ceiba, Dalbergia sissoo, Mimusops elengi, Madhuca longifolia, Hardwickia binata, Tamatindus indica, Neolamarckia cadamba* and *Terminalia alata.*
Cereals	3	*Oryza sativa, Zea mays* and *Sorghum miliiforme.*
Pulses	4	*Dolichos uniflorus, Lablab purpureus, Lens culinaris* and *Cajanus cajan.*
Oil seeds	6	*Brassica Spps., Heliathus annus, Heliianthus carnosus, Sesamum orientale, Gossypium Spps.* and *Guizotia abyssinica.*
Spices	1	*Coriandrum Sativum*
Vegetables	3	*Allium cepa, Solanum melongena* and *Cucurbita maxima*
Fruit trees	7	*Citrus aurantifolia, Mangifera indica, Emblica officinalis, Syzagium cumini, Punica granatum, Manilkara zapata,* and *Ziziphus jujube.*
Plants	94	

There are total of 25 plant families from which just a single plant is selected for foraging by *A. dorsata* while in the case of 6 plant families each with 2 plants, from 7 plant families with 3 plants each while from the family Lamiaceae 4 plants, from the family Asteraceae about 10 plants and from the family Fabaceae total 22 plants are selected for the purpose of pollen & nectar collection throughout the year (Table 2).

Table 2. Listing of no. of plants from each plant families

	Names of the family represented	Total no. of families	No. of plants represented from each famiilty
1.	Acanthaceae, Amaranthaceae, Amaryllidaceae, Anacardiaceae, Apiaceae, Asclepiadaceae, Bignoniaceae, Bombacaceae, Brassicaceae, Cactaceae, Capparaceae, Celastraceae Cleomaceae, Convolvulaceae, Meliaceae, Mimosaceae, Moringaceae, Nyctaginaceae, Nymphaeaceae, Phyllanthaceae, Punicaceae, Rhamnaceae, Rosaceae, Sapindaceae, Solanaceae	25 families	Single
2.	Cucurbitaceae, Lythraceae, Malvaceae, Pedaliaceae, Rutaceae, Rubiaceae	6 families	2
3.	Apocynaceae, Caesalpiniaceae, Combretaceae, Myrtaceae, Poaceae, Sapotaceae, Verbenaceae	7 families	3
4.	Lamiaceae,	Single family	4
5.	Asteraceae	Single family	10
6.	Fabaceae,	Single family	22

Discussion:

Agricultural scientists the world over are in agreement with the fact that bee-pollination has a direct impact on overall yields and biodiversity amongst the wild & cultivated vegetation (Beeson, 1941; Narayanan, *et al*., 1961; Kapil and Jain, 1980; Schemske, 1981; Debbagh, 1987; Verma, 1987; Robinson, *et al*. 1989; Abrol, 1992, 1993; Free, 1993; Roubik ,1995; Somerville, 1997; Allen, 1998; Atwal, 2000; Johnson and Steiner, 2000; Kremen, *et al*., 2002; Denisow, 2004; Palatty and Shivanna, 2007, Bommarco, 2012; Cunningham, 2014; Garibaldi, *et al*., 2016;; Stein *et al*., 2017; Saunders, 2018; Cunningham-Minnick, *et. al*. 2019; Woodcock, *et al*. 2019; Theodorou, *et al.* 2020; Isaac, *et al*. 2021).

There are total four bee-species, *Apis cerana, A. mellifera, A. florea* and *A. dorsata* along with some other non-bee-pollinators (Garibaldi, *et al*. 2014; Evans, *et al*., 2018). However, owing to some species-specific morphological limitations, floral structure (Theodorou, *et al*. 2017) & varied nesting habitats (Cunningham-Minnick, 2019), these four bee species can be seen active in their own foraging niches i.e. selection of various foraging grounds and floral variety is specific for each bee-species thus, supporting the earlier observations by Frund, J. *et. al*. (2013). Amongst these bee species, *Apis cerana, A. mellifera, & A. florea* mostly forage upon the low-lying vegetation (grasses, crops, small plants, etc.) while *A. dorsata* has the capacity of foraging upon wide varieties of vegetation i.e. right from the low-lying grasses, crops to the tall & big wild plants (this is the unique observation in the present study). It means *A. dorsata* doubtlessly is the prolific and versatile forager, ultimately making it the strongest pollinator.

By way of melissopalynology and acetolysis techniques, the floral resources have been reported all over the world (Young, 1908; Betts, 1923; Pammel and King, 1930; Pellett, 1930; Eckert, 1942; Haydak, 1935; Todd and Vansell, 1942; Erdtman, 1952; Lovell, 1956; Deans, 1957; Nair, 1965; 1966; Pellett, 1976; Punt, 1976; Crane, 1979; Punt and Clarke, 1980; 1981, 1984; Bhambure, 1980; Punt and Clarke, 1981; Bhattacharya, *et al*., 1983; Crane, et al.,1984; Punt and Clarke, 1984; Chaubaland Kotmire, 1986a, 1986b, 1986c; Suryanarayana, *et. al*., 1992; Amoako, J. 1997; Yi-Feng, *et al*., 2006; Köppler *et al*., 2007; Nuru, 2007; Palatty and Shivanna, 2007; Adekanmbi and Ogundipe, 2009; Alemtsehay, 2011. However, in the present study, we tried to identify the best floral resources for *A. dorsata* by studying the actual physical visits of its foragers directly at the varied foraging ground on respective flora supporting the earlier studies (Fichtl and Admasu, 1994; Amsalu, 1996, Bista and Shivakoti, 2001; Ayansola and Davies, 2012; Tariku and Zerihun 2019). This is the uniqueness of the present study.

Conclusion:

A. dorsata-loving plants in the plains & forests have been identified in the present study for all seasons. A total of 94 plants which are most commonly foraged by it have been recorded. The most preferred families are Fabaceae, Asteraceae and Lamiaceae, respectively. The results would be helpful for the planners, department of social forestry and farmers to cultivate those plants which are preferred by this bee-species, in particular.

Acknowledgments :

We are thankful to Mission Samriddhi, Chennai for the financial support during the tenure of study.

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APIMONDIA SCANDINAVIA 2025
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PP-545 [Pollination and Bee Flora]

APIMONDIA SCANDINAVIA 2025 23-27 SEPTEMBER COPENHAGEN

Climate change may disrupt crop pollination in the Neotropics:
rising temperatures lead carpenter bees to avoid pollinating passion fruit flowers

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Introduction

Global warming has been identified as a potential factor in compromising crop pollination due to thermal stress on pollinators (Brown *et al*. 2016; Trunschke *et al*. 2024). Limited evidence has been produced for tropical regions, and there is a lack of information on whether bees can effectively pollinate wild and cultivated plants under even higher temperatures (Bezerra *et al*. 2019; Giannini *et al*. 2025).

Methodology

This study was carried out in Sítio São José, Maranguape – CE, Brazil using thermal imaging and bagging/unbagging experiments to investigate how rising temperatures affect the foraging activities of the carpenter bee *Xylocopa frontalis* and fruit set in two cultivated species of passion fruit (*Passiflora edulis* and *P. cincinnata*), which have distinct pollination requirements (Fig.1a,b,c,d). The study also determined the bee's critical and lethal temperatures through controlled temperature increments in laboratory experiments (Fig 1e,f).

Figure 1- *Xylocopa frontalis* visiting flowers of *Passiflora edulis* (a) and *P. cincinnata* (b), collecting bee temperature on flowers using the thermal camera (c), analyzing passionfruit fruits (d), caged bee (e) for determination of *X. frontalis'* critical and lethal temperatures (f).

Main results and conclusions

Results revealed that the bees avoided foraging on passion fruit flowers as both ambient temperatures and their own body temperatures increased throughout the day. This led to a significant ($p < 0.05$) reduction in the number and duration of flower visits during the hottest hours of the day, as well as a decline in foraging activity from the rainy season (milder temperatures) to the dry season (higher temperatures) (Fig. 2). Consequently, a deficit in natural pollination was observed, resulting in fruit set, fruit weight, pulp weight, and seed number falling below the yield potential during the hottest period of the year (Table 1, Fig.3). The study determined the critical (42.2 ± 1.31°C) and lethal (47.3 ± 1.79°C) temperatures for *X. frontalis*. These findings demonstrate that rising average temperatures during foraging under the sun, particularly during periods of the day or year when temperatures approach or exceed the critical threshold for *X. frontalis*, significantly affect the bee's foraging behavior on passion fruit flowers. This reduces its efficiency as a pollinator, particularly for *P. edulis*, whose flowers open at midday and have only a few hours in the afternoon to be pollinated.

Figure 2- Number of visits by the carpenter bee *Xylocopa frontalis* to the flowers of *Passiflora cincinnata and P. edulis* throughout the day according to the temperature and season of the year.

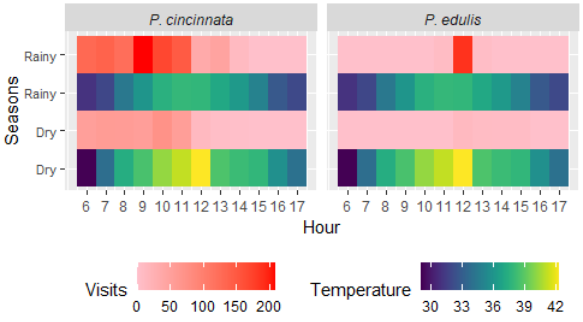

Table 1 - Fruit set, fruit weight, pulp weight, and number of seeds of *Passiflora edulis* and *P. cincinnata* according to three types of pollination.

Type of pollination	N	*Passiflora edulis*				*Passiflora cincinnata*			
		Fruits set	Fruit weight (g)	Pulp weight (g)	Number of seeds	Fruits set	Fruit weight (g)	Pulp weight (g)	Number of seeds
Restricted	30	0	-	-	-	0	-	-	-
Open	30	6	107.80 ±57.58[B]	40.70 ±29.89[B]	194.60 ±147.19[B]	7	84.49 ±16.94[B]	51.83 ±12.14	277.29 ±65.92[B]
Manual	30	23	218.15 ±37.68[A]	101.74 ±17.34[A]	399.70 ±112.93[A]	17	105.23 ±13.82[A]	60.30 ±9.58	346.29 ±55.07[A]

Figure 3- *Passiflora cincinnata* and *P. edulis* resulting from hand pollination and free pollination by *Xylocopa frontalis*: *P. cincinnata* fruits from hand pollination (a), and open pollination (b), pulp from *P. edulis* fruit from hand pollination (c), pulp from *P. edulis* fruit resulting from open pollination (d).

Practical implications for beekeepers

The pollination services provided by *X. frontalis* to *P. edulis* and *P. cincinnata* are already compromised during periods of higher temperatures and beekeepers should be aware that potential increases in average ambient temperatures could compromise pollination services in the Neotropics.

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PP-546 [Pollination and Bee Flora]

APIcité, a national label for pollinator-friendly cities

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INTRODUCTION

- The French National Beekeeping Union (UNAF), a trade union **representing 22,000 beekeepers in France**, has won the gold medal at the Apimondia Congress in Montreal for its magazine, *Abeilles et Fleurs*.
- UNAF is strongly engaged in the fight against **pesticides**, pursuing legal action and conducting media campaigns. UNAF takes part of european beekeepers coalitions and is an Apimondia member. As such, **UNAF organised the 41st Apimondia Congress in Montpellier (2009).**
- UNAF believes that it is important to highlight local authorities **actions which benefit honeybees,** that's why the APIcité label was launched in 2016. The program aims to scale these successful actions to a national level, with the long-term goal of influencing national policy.

HOW DOES IT WORK?

- The label is open to all local authorities across France, **from major cities to small villages**, provided they undertake substantial actions to support pollinators.
- **A 40-question form** must be completed by local authorities. Each answer must be accompanied by a supporting document.
- **Candidatures are studied depending on items :** Sustainable development; Biodiversity protection; Green space and natural area management ; Beekeeping ; Public awareness of environmental protection.
- Once a year, an **award committee** composed of UNAF members and representatives from partner environmental organizations reviews the applications.
- **APIcité partners** : French Association of Agroforestry (AFAF), Hortis, Noé, National Horticultural Society of France (SNHF), Office français d'apidologie (OFA).
- If a local authority deserves to be awarded, APIcité grants the candidature with **1, 2 or 3 "Bees".**
- When the award committee deliberates, some **advisements** are given to local authorities in order to improve their **environmental politics.**
- The APIcité label is awarded for **three years**, with ongoing support provided. Renewal requires a new application demonstrating progress.

RESULTS

- The label benefits from **national media coverage**, and UNAF highlights the most proactive initiatives in its publications and on its social networks.
- In addition to being an official reward, the label is a real incentive **to implement practices favouring honeybees and wild pollinators,** for instance : planting pollinator-friendly plants, conducting Asian hornet trapping campaigns, organizing events with local beekeepers, and promoting and supporting organic farming.
- UNAF provides winning towns and villages **with educational materials**, which include brochures, posters, games, videos, and other digital media.
- UNAF and its partners organize **webinars** for the APIcité label, offering them as training sessions for local authorities.
- The label provides a source of funding for UNAF. The annual fee for participating towns and villages is calculated based on the number of inhabitants and ranges from **€150 to €2,000.**
- Local initiatives often **inspire other communities and national policymakers,** facilitating the adoption of best practices.

CONCLUSION

- **The protection of bees and wild pollinators is a critical challenge for humanity.** Growing public awareness of this issue is a direct result of decades of relentless advocacy by pollinator defenders.
- French municipalities are demonstrating environmental commitment through the APIcité label, leveraging **the symbolic power of the honey bee** to mobilize communities and raise awareness for biodiversity.
- **251 towns and villages** are currently APIcité awarded from all over France.

UNAF
www.unaf-apiculture.info

APIcité
www.labelapicite.fr

Greetings to

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PP-547 [Pollination and Bee Flora]

Floral visitors of endemic *Centaurea lycaonica* (Asteraceae) from Turkiye

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1. Introduction

Reproduction plays an essential role in the life cycles of plants. Sexual reproduction of many crops and the majority of wild plants is dependent on animal pollination through insects, birds, bats and others, with insects playing the major role. Among the insect pollinators, solitary and social bees provide most pollination in both managed and natural ecosystems. In part due to the massive scale and homogeneity of modern agriculture, the majority of crops requiring pollination are dependent on managed pollinators, and especially on managed honeybees. Cooperation and harmony between flowers and insects are very important for the success of pollination in insect-pollinated plants (Abrol, 2012). With approximately 650 species worldwide, *Centaurea* stands as the largest genus within the subtribe Centaureinae in the world (Mabberley, 2008). Türkiye is a major center of diversity for this genus (Wagenitz, 1986), and recent research has documented 247 taxa within the country (İlçim and Demir, 2023, Uysal et al., 2024). Notably, 145 of these taxa are endemic to Türkiye, reflecting an endemism rate of 58.7%. *Centaurea lycaonica* Boiss. & Heldr. is an endemic plant that grows in a rock formation between Konya and Beyşehir within the *Phalolepis* (Cass.) DC. section and on another rock formation between Konya and Seydişehir. The distance between the two known distribution areas is only 20 km. The first small population (with a small number of individuals) is known as the type locality in the Turkish flora (Beyşehir Province) and is located 50 km west of Konya. The second population is located around İnlice village, approximately 55 km southwest of Konya. This natural population is larger in area and has more individuals on a large rock and rocky slopes (Çıtak and Dural, 2021). The plant is perennial, about 35 cm tall, leaves are pinnatipartite, capitula are single, involucre is ovoid, 10-11×5-6 mm, appendages are dark brown, flower color varies from rose to purple, achenes are about 5 mm long, oblanceolate, light brown to straw colored (Çıtak and Dural, 2021). The plant's threat category has been determined as CR (Critically Endangered). Literature has revealed that studies on the pollination biology of the genus *Centaurea*, a large and important species in Turkey, are quite scarce (Atasagun, 2019; Eroğlu, 2025). This study, conducted on the endemic taxon *C. lycaonica*, a threatened species within the genus with only two populations according to current data, aims to provide information about the species' pollinators.

2. Materials and Methods

2.1. Plant Materials

Specimens of *Centaurea lycaonica* were chosen from the İnlice Village in Konya, Türkiye. The flower and fruit samples to be studied were carefully selected, labeled and their flowers photographed, and collected for testing at various stages of development throughout June and July 2025. (accession numbers B.Çıtak-434, 37.44 48.6 N, 32.04 20.8 E). The study areas have a warm and temperate climate; The average annual temperature, sunshine duration, rainy day and rainfall amount are 20.2 °C (max: 26.7 °C, min: 12.7 °C), 9.8 hours, 6.78 days and 25.7 mm, respectively (https://www.mgm.gov.tr/veridegerlendirme/il-ve-ilceler-istatistik.aspx?k=A&m=KONYA).

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We would like to special thank to Dr. Osman Seyyar who controlled identification of insects, Dr. Hasan Hüseyin Doğan who photographed insects and Ali Çıtak who join the field works and collected the insects.

3. Results

3.1. Insect Species that Visit Flowers and Their Behaviors

5 insects' taxa (*Halictus scabiosae*, *Adscita scatites*, Coleptera, Diptera) have been observed to visit the *C. lycaonica* for various purposes. *Halictus scabiosae* is the most frequent visitors of the plant (Figure 1).

3.2. The role of *H. scabiosae* in Pollination

H. scabiosae comes in contact with the tubulate flowers to collect nectar upon landing on the Corolla (Figure 2). The other visitors of *C. lycaonica* are arrive the flowers for multiple purposes.

3.3. Pollination activity

The visits of *H. scabiosae*, the only pollinator of *C. lycaonica*, vary depending on temperature, wind and the amount of sucrose in the nectar (not calculated).

3.3.1. Temperature: *H. scabiosae* makes the most frequent visits during the morning hours at 22ºC. As temperature increases, the number of visits decreases.

3.3.2. Wind: At the morning hours, when the wind speed is below 1 m/ sec, *H. scabiosae* makes the most frequent visits.

4. Discussion and Conclusion

Centaurea species attract a lot of different pollinator with respect to their origins (Monticelli et al., 2022; D'Agostino and Abeli 2025). It is noteworthy in the literature that studies on pollinators of the *Centaurea* genus are quite limited. The visitors of Hymenoptera and Diptera taxa were observed in the genus *Centaurea*. One of the pollinators of the genus were determined as *Halictus* bees that observed in *C. lycaonica*.

We would like to point out that this study on the pollinators of the genus contributes to the field specifically for *C. lycaonica*, but more detailed data should be obtained by making more observations.

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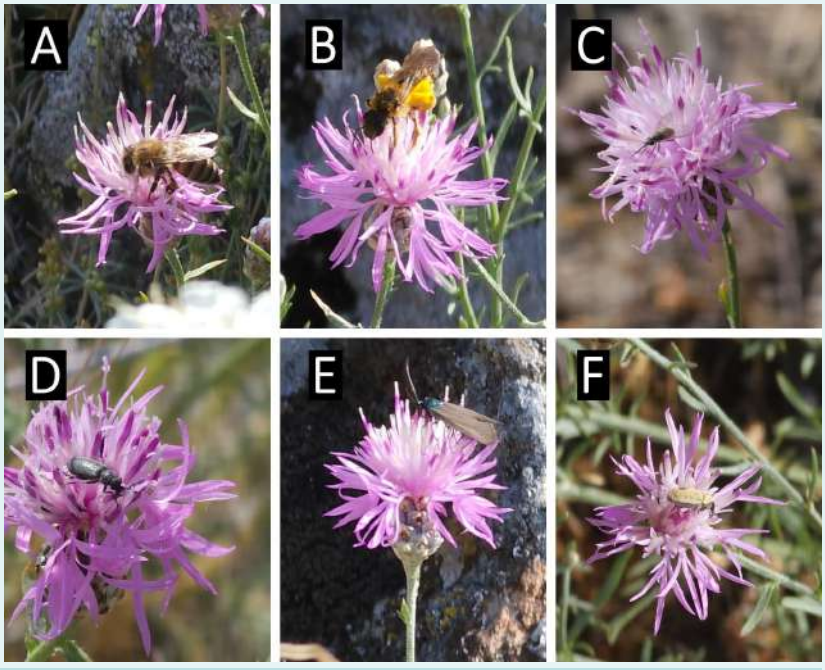


Figure 1. The photographs of insects which visit *C. lycaonica.* A-B. Hymenoptera (*Halictus scabiosae*) C. Diptera D. Coleoptera E. Lepidoptera (*Adscita scatites*) F. Coleoptera

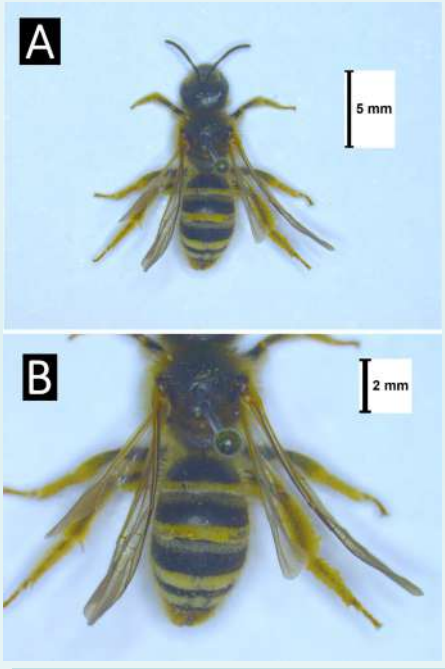


Figure 2. The light microscope photographs of *H. scabiosae*.

PP-548 [Pollination and Bee Flora]

Nectar resources in Japan: Enhancing honeybee visitation.

Taro MAEDA, Shigeki Kishi, Mari Ogihara, Mikio Yoshiyama

National Agriculture and Food Research Organization, Japan

Introduction

Understanding when and where different flowers bloom, and how much nectar they produce, provides valuable understanding for beekeepers and farmers cultivating pollination-dependent crops.
We are currently conducting research to evaluate floral resources, including nectar volume, through year-round surveys of flowering plants, and to enhance pollination by increasing the availability of nectar-producing flowers

Conclusion

・The average of potential honey yield per Japanese chestnut tree is estimated to be approximately 70 g.
・Areas with more fields and houses tend to have a higher number of flowers, including those that serve as nectar sources.
・Presence of Brassica flowers increases honeybee visits to Japanese apricot flowers.

1.Estimation of nectar volume.

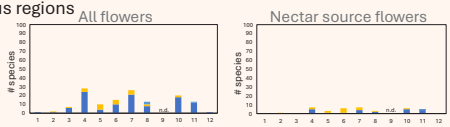
ex.) Japanese chestnut

	Porotan Mean ± S.D.	Tanzawa Mean ± S.D.	Tsukuba Mean ± S.D.	Average Mean ± S.D.
Nectar (μL) / flower	0.08 ± 0.037	0.14 ± 0.86	0.14 ± 0.05	0.12 ± 0.07
Brix value	41.4 ± 17.8	37.7 ± 15.4	36.0 ± 21.1	38.5 ± 17.4
Nectar(mL) / tree	40.9	78.6	266.5	104.1
Honey (g) / tree	29.6	51.9	167.9	70.1

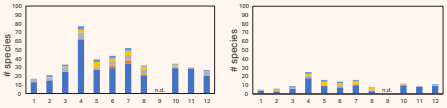
We measured nectar volume per flower using glass capillaries, and estimated the potential honey yield per tree by multiplying this value by the total number of flowers on each tree. Considering that nectar can be replenished over time, the actual yield may exceed this estimate. However, since seven flower-visiting insect species were observed besides honeybees, nectar consumption by these insects must also be taken into account.

2. Year-round dynamics of flowers

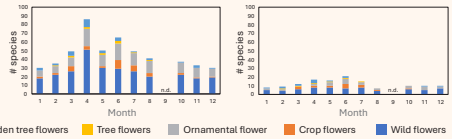
Mountainous regions



Rural farming areas



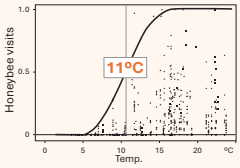
Populated rural village



We conducted monthly route censuses at three sites with different land-use conditions to comprehensively record flowering plant species. Among these, we quantified the number of flowers used by honeybees as nectar sources.

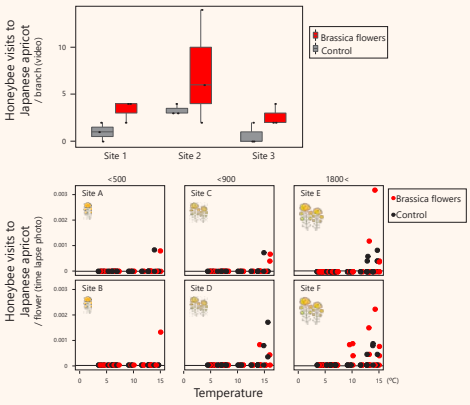
3. Enhancing honeybee visitation to Japanese apricot blossoms through Brassica flowers.

Japanese apricot bloom at **10 ºC** in February.



Apis mellifera does NOT work in cold condition.

Do **Brassica flowers** enhance honeybee visits ?



The number of honeybee visits to Japanese apricot flowers increased when Brassica plant flowers were nearby. This effect was more pronounced when the number of Brassica flowers was higher.

Maeda et al. (2023) Brassica plants promote Apis mellifera visitation to Japanese apricot in cold conditions. Scientia Horticulturae. 312:111844

This work was financially supported by the Ministry of Agriculture, Forestry, and Fisheries, Japan, through a research project titled "Beekeeping and Related Industry Promotion Project under the Sustainable Production Enhancement Program."

PP-549 [Pollination and Bee Flora]

The Role of Invasive Plant Species
Benefits and Risks for Beekeeping and Biodiversity

Anamarija Peter, Jana Šic Žlabur, Vesna Židovec, Mihael Kušen, Martina Šipek Penić, Dubravka Dujmović Purgar
University of Zagreb Faculty of Agriculture, Svetošimunska cesta 25, Zagreb, Croatia (apeter@agr.hr)

1 Introduction

Invasive plant species
- Rapid transformation of European landscapes
- Aggressive spread, monocultures, allelopathy
- Biodiversity & agriculture at risk
- Abundant nectar resources for bees

2 Benefits, risks, challenges and current state

Benefit: Abundant nectar → high honey yields.

Risk: Aggressive spread → loss of native forage, altered flowering cycles, potential negative effects on honey quality.

Challenge: Balancing nectar benefits with biodiversity conservation.

More nectar ≠ always better
Diversity = healthier colonies

Honey-Bearing Invasive Plants in Europe on EPPO/EU List

Plant Species	Common name	Value	Product
Robinia pseudoacacia	Black Locust	high	nectar
Impatiens glandulifera	Himalayan Balsam	high	nectar
Asclepias syriaca	Common Milkweed	moderate	nectar, pollen
Triadica sebifera	Chinese Tallow Tree	moderate	nectar
Ailanthus altissima	Tree of Heaven	low	honeydew
Centaurea solstitialis	Yellow Starthistle	moderate	nectar
Centaurea stoebe	Spotted Knapweed	moderate	nectar
Solidago canadensis	Canadian Goldenrod	moderate	nectar, pollen
Amorpha fruticosa	Desert False Indigo	moderate	nectar
Fallopia japonica	Japanese Knotweed	low	nectar
Heracleum mantegazzianum	Giant Hogweed	low	nectar
Hakea sericea	Needlebush	moderate	nectar
Prosopis juliflora	Mesquite	moderate	nectar
Baccharis halimifolia	Eastern Baccharis	moderate	nectar
Acacia saligna	Golden Wattle	high	nectar

woody - , herbaceouse , shrub - ; low - , moderate - , high - ;
nectar - , polen - , honeydew - .

3 Impacts on Beekeeping

Reduced forage diversity
→ lower honey yield and quality.

Disrupted flowering cycles
→ nectar shortages at critical times.

Altered nectar chemistry
→ risks for honey composition and bee health.

Weakened colonies
→ reduced pollination efficiency, long-term sustainability issues

4 Sustainable strategies

- Balance pollinator needs and biodiversity protection
- Integrate invasive plants into the bioeconomy (bioenergy, biomaterials, bioactive compounds).
- **Dual benefits**:
  - Control invasives while maintaining forage for bees
  - Support beekeepers with new economic opportunities

5 Conclusion

- By sharing knowledge and tools across research, practice, and policy, invasive plants can be transformed from a threat into an opportunity.
- **Now is the time to act**, ensuring beekeeping, biodiversity, and food systems thrive together in resilient ecosystems.

Scan to find out more about LIFE OrnamentalIAS

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APIMONDIA SCANDINAVIA 2025
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PP-550 [Pollination and Bee Flora]

Prediction of the Flowering of Chilean Native Species and Honey Yield Using Machine Learning An Approach to Climate Change Adaptation

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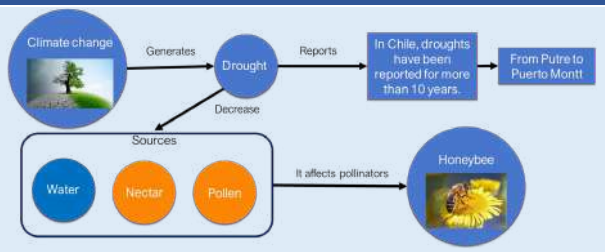
robertoahumadagarcia@gmail.com, rahumada@ucm.cl, vmonzon@ucm.cl

Introduction



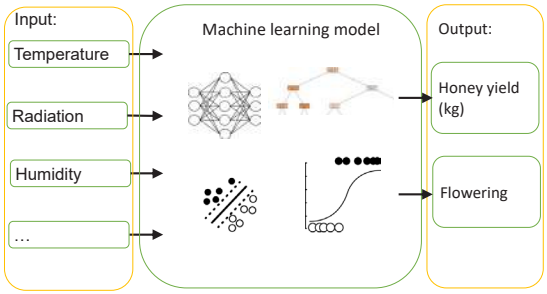
Studies have established a relationship between **climatic variables** such as **temperature** and **rainfall**, **flowering**, and **honey production**.
Currently, predictive models are being proposed to **support decision-making** and **adaptation to climate change** in **beekeeping**.

Materials and Methods

This study evaluates **machine learning models** (a type of artificial intelligence) to predict honey yield per hive and the flowering of native species.
The data supported by the literature for this application are:

- **Meteorological data**.
- **Historical records of honey production**.
- **Historical records of plant phenological stages** (budburst, flower bud, flowering).
- It may also include beekeeper management, internal hive conditions, and botanical information.
- In this first approach, only variables dependent on **temperature**, **radiation**, and **humidity** were considered, calculating monthly mean, standard deviation, minimum, maximum, and total values.

General Model



Machine learning models: neural networks, random forests, support vector machines (SVM), logistic regression.

Flowering Model

This study focused on native species of high importance for beekeeping in Chile: **Avellano**, **Corontillo**, **Litre**, **Peumo**, **Quillay**, **Tevo**, and **Tralhuén**.
At present, a validated predictive model is available for different **flowering stages of Quillay**: **initial flowering** (10%), **peak flowering** (10 - 50%), and **terminal flowering** (10% in decline).

The model predicts the different flowering stages starting from the moment the beekeeper reports the flower bud stage. The machine learning algorithm used is a **multilayer neural network**.

Results: The flowering models show an **error of about one week**, allowing the prediction of different flowering stages approximately **one month in advance**. These predictive model results will provide beekeepers with a reliable tool to improve their hive management and production planning.

Honey Yield Model

This study used **historical harvest records** and their corresponding **climate data.** The classification considered three categories: **poor year (below 20 kg)**, **moderate year (20 - 40 kg)**, **and good year (over 40 kg)**.
Machine learning algorithms called Bagging (Bootstrap Aggregating) were used, a technique that combines multiple models trained on random subsets of the original data.

Results Clasification

	Model	Normalization	Accuracy	Time (seconds)
1	Random Forest	Without normalization	0.7347	11
2	Random Forest	Normalization with norm	0.7347	9
3	Random Forest	Normalization min-max	0.7347	12
4	Random Forest	Normalization z-score	0.7347	16
5	Random Forest	Normalization div-max	0.7347	6
6	Logistic Regression with Bagging	Without normalization	0.7347	360
7	Logistic Regression with Bagging	Normalization with norm	0.551	41
8	Logistic Regression with Bagging	Normalization min-max	0.7551	60
9	Logistic Regression with Bagging	Normalization z-score	0.7755	60
10	Logistic Regression with Bagging	Normalization div-max	0.7347	60
11	SVM with Bagging	Without normalization	0.7347	60
12	SVM with Bagging	Normalization with norm	0.6939	26
13	SVM with Bagging	Normalization min-max	0.7959	24
14	SVM with Bagging	Normalization z-score	0.8163	30
15	SVM with Bagging	Normalization div-max	0.7347	60
16	Gradient Boosting	Without normalization	0.6735	25
17	Gradient Boosting	Normalization with norm	0.6735	26
18	Gradient Boosting	Normalization min-max	0.6735	33
19	Gradient Boosting	Normalization z-score	0.6735	33
20	Gradient Boosting	Normalization div-max	0.6735	33

Data from Australia were used (Campbell et al., 2020). The model was validated with 5-fold cross-validation using statistical techniques.

Results: The models show an accuracy of over 80% (correctly classified yields) up to three months before the main flowering period.

Conclusions

- The main studies suggest a relationship between **temperature** and **rainfall** with **flowering** and **honey yield** per hive.
- This work supports the possibility of predicting **phenological flowering stages** of **native Chilean trees** using **climatic variables** such as temperature, radiation, and humidity.
- These results indicate that using **machine learning algorithms** together with **meteorological data** makes it possible to predict **honey yield**.
- These results can be applied in **decision-making** and in **adapting beekeeping to climate change**.

Future Work

- The authors' goal is to strengthen **collaboration** between **universities** and **beekeepers** in order to gather information for the development of predictive models, with a focus on Chilean, Latin American, and global beekeeping.
- This study will promote the evaluation of different **machine learning methods** and **datasets on flowering and hive yields**.
- Similarly, the use of **deep learning models** (the foundation of ChatGPT) is being explored for these applications.

Acknowledgments

The author Roberto Ahumada-García acknowledges the financial support of ANID-Subdirección de Capital Humano/Doctorado Nacional/2024-21241043.
The authors acknowledge Richard Manríquez Ramírez, founder and CEO of Bee Fractal (Chile), for providing flowering data.
Richard Manríquez Ramírez has also launched the B-MaiA application. QR code for download:

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PP-551 [Pollination and Bee Flora]

BOTANICAL ORIGIN OF HONEYS COLLECTED IN ANDEAN ZONE OF MACIZO COLOMBIANO

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Abs Ref: 0487

INTRODUCTION

This study sought to characterize the beekeeping floral resources and determine the botanical and geographical origin of Apis mellifera honeys in two municipalities of Macizo colombiano, Cauca. The methodology encompassed a floristic inventory and the melissopalynological analysis of 36 honey samples. A total of 103 melliferous species were recorded, with Asteraceae, Fabaceae, Rubiaceae, and Malvaceae identified as the most representative families. The analysis revealed a predominance of nectar-pollen species, and a slight majority of multifloral honeys over monofloral ones. The results showed significant differences in species composition across the massif's altitudinal zones. This acquired knowledge is crucial for the differentiation and valorization of local apicultural products, potentially facilitating the future establishment of a Protected Designation of Origin for honey from Macizo colombiano.

MATERIALS AND METHODS

Study area

The Colombian Massif, also known as the Almaguer Knot, is Colombia's most important water source. It consists of a mountain range in the Colombian Andes that covers the departments of Huila, Cauca, Nariño, and Putumayo, north of the Pastos Knot.

It has an area of 32,682 km², distributed as follows: 13,716 km² of forests, 15,423 km² of agroecosystems, 2,567 km² of moorlands, 43 km² of snow-covered areas, 924 km² of xerophytic vegetation, and 9 km² of urban settlements. The altitude varies between 2,600 m.a.s.l. and 4,646 m.a.s.l.

Figure 1. Location and types of ecosystems present in Macizo colombiano.

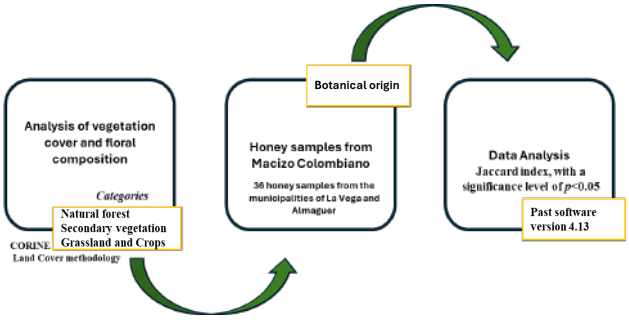

Figure 3. Methodology for Determining the Botanical Origin of Honeys from Macizo colombiano.

Figure 4. Methodology for Determining the Botanical Origin of Honeys from Macizo colombiano.

RESULTS AND DISCUSSION

Of the identified vegetation covers, grassland was the most extensive, spanning 54.49 ha (36.6%), followed by natural forest (49.26 ha, 33%), secondary vegetation (26 ha, 17.5%), and crops (19 ha, 12.8%). Despite their smaller overall area, crops and secondary vegetation collectively contained 81% of the high-value botanical species for beekeeping in Macizo Colombiano.

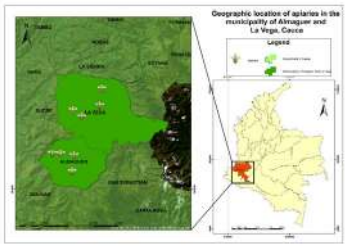

Figure 5. Study area, geographic location of apiaries in the municipalities of La Vega and Almaguer, Cauca, Colombia.

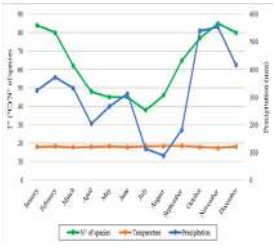

Figure 6. Monthly distribution of flowering of plant species of beekeeping importance in the Colombian Massif, Department of Cauca.

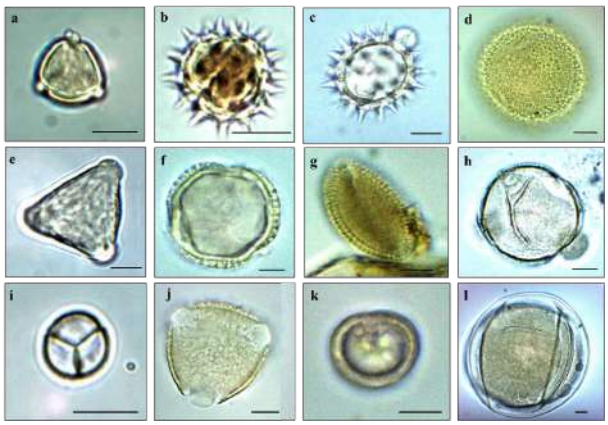

Figure 7. Most important pollen types: a) Allophylus mollis; b) Baccharis trinervis; c) Bidens pilosa; d) Croton sp; e) Cupania sp; f) Erythroxylum sp; g) Heliocarpus americanus; h) Melochia sp; i) Mimosa albida; j) Type Anacardiaceae; k) Type Moraceae; l) Zea mays. Scale: 10 µm.

Family	Pollen Types	I	II	III	IV	RFO	FC
Anacardiaceae	Type 1		9.96	9.88	1.00	11	LF
	Type 2				9.09	3	R
Araceae	Type 1				6.58	6	R
	Type Bactris	2.02				3	R
	Dieffenbachia interrupta	3.02				3	R
	Austroeupatorium inulifolium		1.48	7.83	1.15	11	LF
	Acmella ciliata	4.96		2.26	0.64	11	LF
	Baccharis trinervis	5.81	9.06	4.83	6.39	31	F
	Bidens pilosa	9.30	8.67	3.71	0.67	25	F
	Type Critonia				1.26	3	R
	Eirmocephala brachiata				0.33	3	R
	Emilia sonchifolia				2.08	6	R
	Hypochaeris radicata	4.46			2.73	11	LF
	Lepidaploa canescens				1.26	3	R
	Type Mikania				0.70	3	R
	Vernonanthura patens				0.33	3	R
Commelinaceae	Tradescantia microcephala				3.64	3	R

Family	Pollen Types	I	II	III	IV	RFO	FC
Cyclanthaceae	Carludovica palmata	3.56		7.42	0.06	11	LF
Dilleniaceae	Davilla kunthii	3.93				3	R
Erythroxylaceae	Erythroxylum sp.	1.00			9.70	14	LF
Escalloniaceae	Escallonia paniculata	1.44		0.67		8	R
Euphorbiaceae	Euphorbia hirta				0.36	3	R
	Ricinus communis	2.59		2.25	1.67	11	LF
	Sapium glandulosum	1.30		0.50		6	R
	Type Croton	2.11	9.79	0.50	1.21	19	LF
Fabaceae	Aeschynomene americana				0.91	3	R
	Gliricidia sepium		1.37			3	R
	Mimosa albida	10.26	2.12	5.75	5	28	F
	Phaseolus vulgaris	2.52				3	R
	Type Acacia	0.22				3	R
	Type Inga		0.38		1.15	6	R
	Type Mimosa			0.13		3	R

Figure 8. A representative sample of the Inventory of honey plant species in Almaguer and La Vega, Cauca, Colombia is presented. The full table will be provided in the final publication.

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PP-552 [Pollination and Bee Flora]

Unmanaged wild bees and managed honey bees do not share pollen resources: investigation on interspecific trophic competition in three National Parks

Boni C. B.[1,2], Coppola F.[1,2], Sagona S.[3], Quaranta M.[4] , Flaminio, S.[4], Biella, P.[5], Tempesti, S.[6], Lazzeri A.M.[7], Di Santo, M.[8], V., Felicioli, A.[1]

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INTRODUCTION

Clade Anthophila is in severe decline worldwide since several years[1]. In this context, expanding the knowledge of interspecific dynamics among bee species for a conservation action plan in protected areas aimed to counteract Apoidea decline is of fundamental importance.

National Parks play a pivotal role:
- Conservation of pollinators
- Promotion of typical products

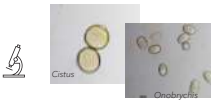
METHODS

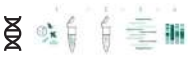
ITALY

2 SAMPLING SESSIONS:
Late summer and Autumn
1 h /session

Pollen trap on one hive

5-10 individuals of wild bees

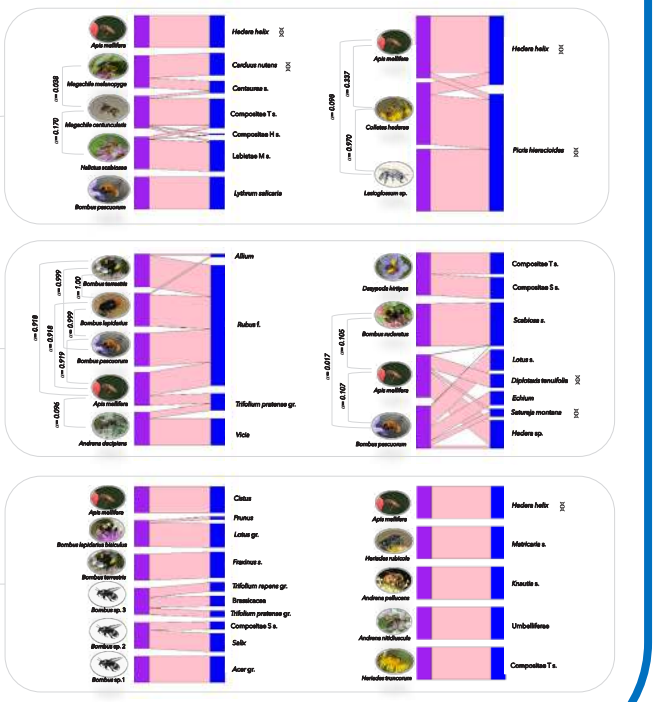




Pianka index[2]: niche overlap

$$\alpha jk = \frac{\sum_i^n Pij * Pik}{\sqrt{\sum_i^n Pij^2 \sum_i^n Pik^2}}$$

RESULTS



The pollen networks of bees sampled in the Foreste Casentinesi, Maiella and Abruzzo, Lazio and Molise National Parks in summer and in autumn, 2021. The lower bar width indicates the relative abundance (%) of pollen grains gathered per plant taxa across bee species (upper bar); (α= Pianka Index; s: shape; gr: group). = plant species identified through DNA metabarcoding analysis

SCAN ME

CONCLUSION

Wild bee species are sustained by different pollen pastures from those of honey bees. The low sharing of resources could be due to the natural trend occurring in natural populations, where species tend to minimize competitive overlap by a niche differentiation or by a niche complementarity, as a result of a co-evolution between wild bees and managed honey bees. National Parks play fundamental role in the protection of animal and plant species and conservation plans should focus on evaluating honeybee densities towards less intensive, more traditional, and sustainable beekeeping and on habitats protection to promote survival and reproduction of wild bee populations.

DIPARTIMENTO DI SCIENZE VETERINARIE

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APIMONDIA SCANDINAVIA 2025
SWEDEN | DENMARK | NORWAY

PP-553 [Pollination and Bee Flora]

Melittopalynological investigation of honey from sunderban ecosystem,India: way towards sustainable development

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Abstract: The Sunderbans support dense populations of *Apis dorsata* due to abundant floral resources and protective mangrove habitats. This study analyzed nectar sources for honeybees via microscopic examination of 12 honey samples from *A. mellifera* and *A. dorsata* colonies. Six *A. mellifera* samples were unifloral, with *Ceriops decandra* dominant in five and *Aegiceras corniculatum* in one. A total of 37 plant species were identified as forage sources. *Kandelia candel* pollen was found only in *A. dorsata* samples, suggesting species-specific foraging patterns.

Introduction: Sunderbans in west Bengal of india is a mangrove forest in the Ganga-Brahmaputra delta and has many islands, some inhabited, mostly covered with mangroves species *Heritiera fomes*, *Excoecaria agallacha*, *Sonneratia apetala*, and *Ceriops decandra*. *Apis dorsata* thrives here due to rich floral sources and protection from thorny mangroves. Honey hunting is a major livelihood for tribal communities of Sunderban. This study investigated melittopalynological investigation of honey from Sunderban.

Materials and methods: Periodic surveys were conducted in the Sunderban mangrove forests during 2022–2023, during which 12 honey samples were collected—9 from *Apis mellifera* colonies (April 2022 and 2023) and 3 from wild *A. dorsata* colonies (squeezed honey). All samples were analyzed using standard melittopalynological methods recommended by the International Commission for Bee Botany, with slight modifications. Pollen types were identified using reference slides prepared from anther specimens at the Melittopalynology Laboratory, Central Bee Research and Training Institute, Pune. Quantitative analysis followed the methodology of Deans and Louveaux with minor changes.

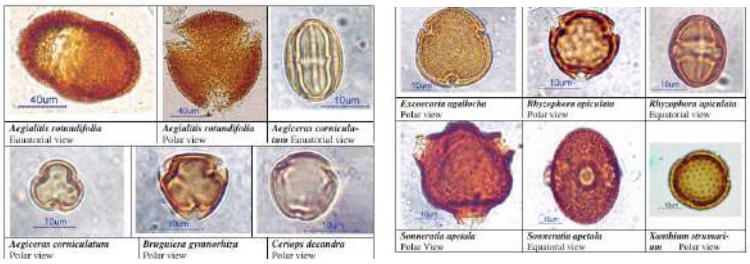
Results and discussion

Table 3 Pollen spectrum of honey samples collected from *A. dorsata* in Sunderbans region

Taxon	*A. dorsata*		
	2/D/10	3/D/10	5/D/10
Aegialitis roundifolia	5.19	8.83	–
Aegiceras corniculatum			5.14
Albizia sp.			
Avicennia officinalis	3.14	2.86	2.57
Bignoniaceae			
Bombax ceiba	0.65		
Borassus flabellifer	1.57	6.44	0.98
Bruguiera gymnorhiza			
Ceriops decandra	**50.15**	32.46	**61.86**
Chrozophora rottleri			0.79
Coriandrum sativum	1.73		
Helianthus annuus	3.62	8.35	1.97
Hygrophila sp.			
Kandelia candel	31.56	35.80	24.31
Osbornia type		5.26	
Phoenix sylvestris		(89.60)	
Poaceae	1.89		2.38
Xanthium strumarium	0.32		

Apis mellifera honey samples (9 total):
- Pollen count ranged from 35,000 to 155,600.
- 1 sample in Group III, 8 in Group II (floral honeys).
- 37 total pollen types; 4–12 types per sample.
- Predominant: *Parthenium hysterophorus*, *Phoenix sylvestris*, *Avicennia* sp., *Rhizophora* sp., *Xanthium indicum*.
- *Ceriops decandra* was dominant in one sample.

Apis dorsata honey samples (3 total):
- Pollen count ranged from 168,600 to 695,000.
- 2 samples in Group III, 1 in Group IV.
- 2 unifloral, 1 multifloral.
- 14 total pollen types; 8–10 per sample.
- *Ceriops decandra* predominant in 2 samples, secondary in 1.
- *Kandelia candel* was a consistent secondary pollen source.
- *corniculatum*, *Avicennia officinalis*, *Helianthus annuus*, etc.



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Conclusion: Honey samples from the Sunderbans showed rich floral diversity. *A. mellifera* honey had 37 pollen types, with moderate counts and varied sources. *A. dorsata* honey had higher pollen counts, dominated by *Ceriops decandra* and *Kandelia candel*. The study highlights the Sunderbans mangroves as a vital forage zone for both wild and managed bees and paves the way for sustainable development.

PP-554 [Pollination and Bee Flora]
Beeplants.eu

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To address concerns about regions to feed the honey bees, bumblebees, solitary bees, hoverflies, and all other insects that depend on flowers, the beeplants.eu baseline study is being conducted. We addressed this concern with beekeeper citizen scientists and started in 2024. We developed www.beeplants.eu. In 2024 we started with citizen scientists from Finland, Latvia, Norway, Denmark, the Netherlands, Belgium, and France. This app records the number of honey bees, bumblebees, solitary bees, hoverflies, and “other insects. The citizen science study set-up enables to collect a large number of data of various locations and and involves citizens in the investigation. A citizen scientist study, also means that we should keep it as simple as possible. The participants choose a plant in the bee plant catalogue in the app to make the recordings. They do the same observations at least three times a week at the same location of the same flowers/parts of trees during the entire flowering period of those plants. In 2024, we had 7544 overall observations on 113 plant species. Per observation of these plants, 45% of the recording had 1 pollinating insect, 23% had two insects, 10% had four insects, 1% had five insects, and 16% had no insects. After cleaning the database, to remove obvious errors, 5698 observations of 74 plant species remained. The data were analysed for the relative presence of specific flowers in winter, spring, and summer, the impact of temperature, and combinations of insects per observation. Of the 74 plant species, per observations, 42% had one pollinating insect and 58% had multiple pollinators visiting. The honey bees were mainly found on Acer campestre, followed by Lavendula angustifolia and Origanum vulgare, and the bumblebees in Tilia spp. The solitary bees were recorded on a wide variety and did not show any preference. The hoverflies were mainly recorded on Heracleum spp. The study will be continued in 2025 and 2026, and beekeepers from minimally Ireland, Spain, Portugal, Italy, Greece, Cyprus, Poland, and Germany will be asked to join. The area differences in sharing food sources are being investigated.

PP-555 [Pollination and Bee Flora]

Apimondia Copenhagen | 23-27.09.2025

Managed and wild bees: enemies or allies?

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Introduction

Many pollinators are declining, calling for appropriate mitigation policies to ensure ecosystem functioning, food security and human well-being.
There is consensus that factors such as pesticides and land management cause these declines. The role other potential stressors remain controversial[1,2]. For example, competition for resources with and pathogen transmission from managed bees are increasingly considered as contributing to wild bee declines, generating conflicts among beekeepers, farmers, conservationists and scientists.
To reconcile wild and managed bee proponents, we advocate increased communication and collaboration between stakeholders to co-create policies integrating ecological and socioeconomic dimensions.

We propose using modern analytical tools to improve our understanding of bee interactions in different contexts, alongside stakeholder engagement to reconcile managed and wild bee proponents[2].

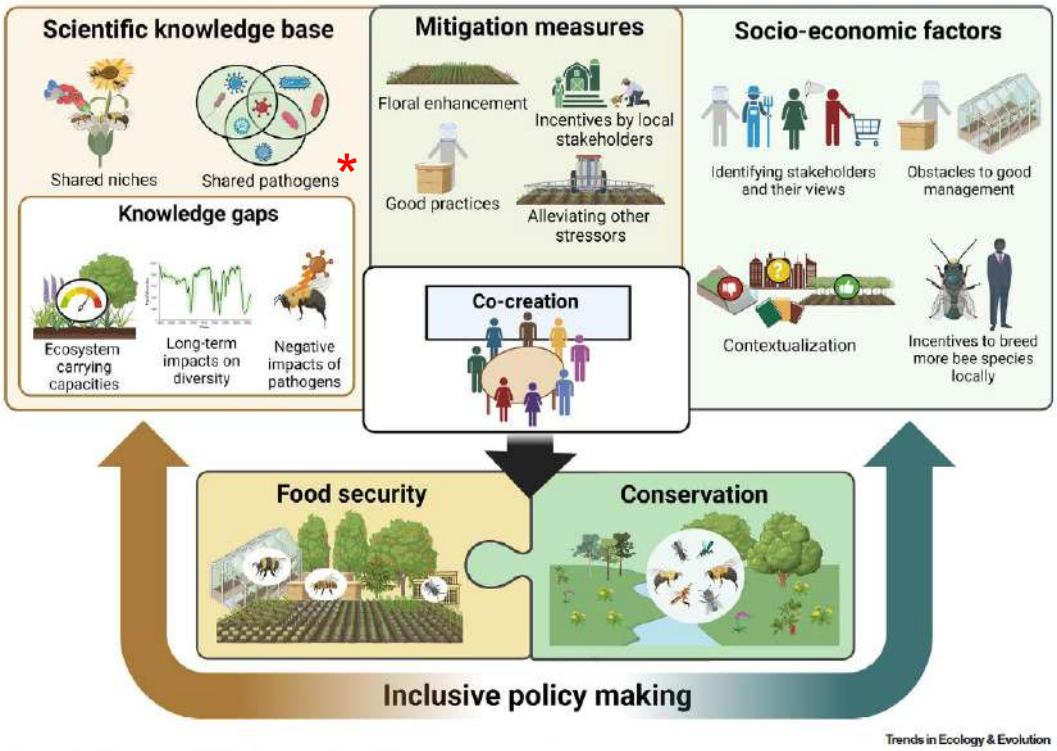

Figure 1. Guidelines towards inclusive bee policy-making. Inclusive policy-making to better integrate food security and conservation needs can be developed by taking into account both available and missing knowledge in a co-creation process considering socioeconomic factors. Figure created with Biorender.com.

Discussion

Following these guidelines will help promoting the dialog between wild and managed bee proponents, prioritizing the most impactful measures, and co-create consensual measures which can be used for policy-making to the benefit of all pollinators.

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*see poster Probst A. et al. Pathogens on the move.

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APIMONDIA SCANDINAVIA 2025
SWEDEN | DENMARK | NORWAY

PP-556 [Pollination and Bee Flora]

BEE-GUARDS
for resilient beekeeping

Assessing the impact of beekeeping on wild pollinators within the BEE-GUARDS project

Bogo G, Aizen M, Arbetma M, Bevk D, Boranski M, Brandt A, Brodschneider R, Budge G, Cutajar S, Dall'Olio R, de Groot G, Hatjina F, Jachuła J, Ladewig L, Manthos I, Morales C, Pufal H, Saez A, Splitt A, Vejsnæs F, Verbič T, Zattara E, Costa C
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INTRODUCTION

Beekeeping is often regarded as sustainable agricultural activity, yet concerns have emerged regarding its potential impact on wild pollinators. Within the BEE-GUARDS project, a dedicated Work Package (WP8) addresses knowledge gaps concerning interactions among managed and wild pollinators. By analysing **plant–pollinator–pathogen networks** across multiple countries, it aims to disentangle the **ecological effects of managed honey bees on wild pollinator communities**.

WP8 OBJECTIVES

- Assess the **impact of beekeeping** on wild pollinators at the agricultural landscape scale.
- Provide **methodological guidelines** for studying pollinator competition.
- Identify **optimal honey bee colony densities** based on landscape carrying capacity.
- Investigate **pathogen spillover** between honey bees and other bees.
- Improve **knowledge and awareness** among beekeepers and the public on the ecological role of pollinators.

Task 8.1 – Assessing competition between managed honey bees and wild pollinators

A field study is conducted in multiple European countries and Argentina, comparing areas with **high and low honey bee colony densities**.

Plant–pollinator–pathogen networks are established to evaluate pollinator diversity and abundance, floral resource availability, and potential competition. **Pathogen screening** is performed in selected sites to assess transmission between managed and wild pollinators.

Task 8.2 – Historical competition analysis

Hive **density data** from several European countries are combined with global **diversity records** to model trends in pollinators, providing insights into how **long-term** honey bee colony densities may have influenced wild pollinator diversity over time.

Task 8.3 – Pathogen transmission experiments

Lab studies assess **pathogen spillover** between honey bees and other bees. Survival, behaviour, and colony fitness are monitored in model species (*Bombus terrestris*, *Osmia* spp.) exposed to common and emerging pathogens, providing evidence of cross-species infection risks.

Task 8.4 – Case study on bumblebee colonies under high honey bee density

Experimental bumblebee colonies are placed at **varying distances** from a **high-density** honey bee mating station. Colony growth, fitness, and pathogens are monitored to evaluate the effect of honey bee density.

Task 8.5 – Citizen science initiative

An **easy and quick survey** enables **beekeepers and citizens** to record plant-pollinator interactions.
Data collected across many sites expands the scope of field surveys and fosters public engagement towards **pollinator conservation**.

CONCLUSION

BEE-GUARDS investigates how managed honey bees influence wild pollinator populations through competition and pathogen transmission. By combining field studies, historical analyses, laboratory experiments, and citizen science, it generates a **comprehensive picture of plant–pollinator–pathogen dynamics**. The findings will support **sustainable beekeeping practices** that safeguard **biodiversity** and promote coexistence between managed and wild pollinators.

Citizen Science

Survey
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Registration
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PP-557 [Pollination and Bee Flora]
Raising Public Awareness on Pollinator Welfare – Polish Case

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Apiculture Division in Puławy is the largest Polish facility for comprehensive research and deepening knowledge on the biology of pollinating insects. The project "Centre for information and improvement of knowledge about pollinating insects" raised awareness on the importance of pollinators among society and promoted good practices for their conservation. Two-year project completed in 2024 was implemented in order to provide participants with the classes on honey bees, bumble bees, mason bees and other common solitary bee species occurring in Poland. Particular emphasis of the conducted classes was placed on the importance of biodiversity and understanding the existing link between the state of the local environment and the quality of life. Participants were provided with the proper knowledge and practical guidelines to shape their surroundings ensuring pollinators' welfare.

Thanks to the huge interest among the society, a total of 62 workshops were conducted for almost 1,400 recipients - twice as many as planned. Continuously the expectations of the audience in relation to the content of the workshops were evaluated to adapt and improve them accordingly. In addition, the participants of the classes received self-made nesting constructions, compositions of nectar- and pollen-producing plants and seed mixtures.

The interest aroused by the project among potential recipients of the classes indicates that further activities of this type are expected by the Polish public in the future, and many people would be happy to take advantage of such an educational offer to deepen their knowledge on both pollinators and the state of science in this area.

Project number NdS/547976/2022/2023 funded by the Ministry of Science and Higher Education Republic of Poland, Science for Society Programme.

APIMONDIA SCANDINAVIA 2025
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PP-558 [Pollination and Bee Flora]

Effects on the Quality of Africanized Honeybee (*Apis mellifera*) Colonies from Agricultural Pollination Services

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INTRODUCTION

Pollination services are critical for both agricultural productivity and environmental sustainability. Approximately 73% of cultivated plant species worldwide depend on bee pollination to some extent. However, in Brazil, the commercial use of managed honeybee colonies for crop pollination remains underdeveloped, despite its estimated annual economic value of USD12 billion. The limited adoption is mainly due to the lack of beekeeper training and the absence of a structured migratory beekeeping system.

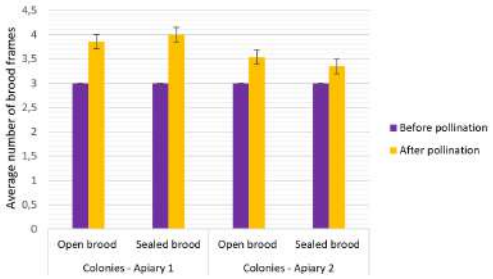
This study evaluates the quality of Africanized honeybee colonies *(Apis mellifera*) used in soybean (*Glicine Max*) pollination and assesses whether this practice strengthens colonies, potentially reducing the need for artificial supplementation.

METHODOLOGY

Thirty-three Langstroth hives with standardized brood and food frames were transported from a permanent apiary in Ribeirão Preto city, São Paulo, Brazil, to a soybean field in Anhumas city, São Paulo, where they remained for 12 days during the R2/R3 flowering stage. The hives were divided between two apiaries with different environmental conditions: one with partial shade and a nearby water source, and another exposed to full sun. Colony evaluations were conducted before and after the pollination period, analyzing brood frame numbers. Paired t-tests compared pre - and post-pollination colony conditions.

RESULTS AND CONCLUSION

All colonies showed significant brood frame growth post-pollination (open brood: t =6.3, $p < 0.0001$; sealed brood: t = 5.5, $p < 0.001$). Colonies placed in shaded conditions exhibited greater sealed brood production (4.0 ± 0.0 frames) compared to those in full sun (3.35 ± 0.49 frames, $p < 0.01$), reinforcing the importance of shade and water availability. These results align with prior studies indicating that exposure to extreme temperatures negatively affects bee colony development. Soybean pollination strengthened Africanized honeybee colonies, potentially reducing the need for supplementary feeding during dearth periods. Providing shaded environments further enhanced colony performance.



These findings highlight the benefits of integrating beekeeping with precision pollination strategies, emphasizing the need for structured migratory beekeeping in Brazil.

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PP-559 [Pollination and Bee Flora]

Use of Jataí Bee Colonies (*Tetragonisca angustula*) for Commercial Pollination of Strawberries (*Fragaria x ananassa*) in Protected Cultivation

Joyce Mayra Volpini Almeida Dias[1], Diego Moure Oliveira[1], Guilherme Jorge Gomes Sousa[1], Andresa AparecidaBerretta[2]

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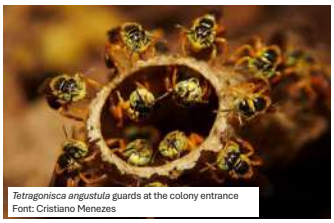
INTRODUCTION

Pollination is a key factor in improving the yield and quality of many crops, including strawberries (*Fragaria x ananassa*).Stingless bees, such as *Tetragonisca angustula* (Jataí), have been identified as potential commercial pollinators for protected cultivation systems.

This study evaluates the impact of Jataí bee colonies on fruit weight, deformation rate, and sweetness in greenhouse-grown strawberries.

Tetragonisca angustula
Font: Cristiano Menezes


Tetragonisca angustula guards at the colony entrance
Font: Cristiano Menezes

METHODOLOGY

The experiment was conducted in two identical greenhouses (1,638 m^2 each),containing 15,000 hydroponically grown 'San Andreas' strawberry plants under drip irrigation and biological pest control. Twelve *T. angustula* colonies were introduced in Greenhouse 1 during the flowering period, while Greenhouse 2 served as a control (without bees).

The colonies remained in the greenhouse for three months, corresponding to the peak flowering period. A total of 166 fruits were collected from Greenhouse 1 and 133 from Greenhouse 2. Fruit weight, deformation rate, and sweetness level (°Brix) were compared between treatments.

Strawberry's Greenhouse with *Tetragonisca angustula* colonies.
Font: Joyce M.V. Almeida-Dias

RESULTS AND CONCLUSION

Strawberries from the pollinated greenhouse (G1) had a significantly higher average weight compared to those from the control greenhouse (G2). The °Brix level was also significantly higher in G1 than in G2. Only seven fruits (4.2%) showed deformation in E1, while in E2, 24 fruits (18.1%) showed deformation, indicating a 76.6% reduction in fruit deformation (Table 1).

	G1	G2	Statistical Analysis
Weight (g)	15.1 ± 5.4	13.4 ± 5.0	t = 2.87, df = 297, p < 0.01
°Brix level	8.7 ± 1.6	7.3 ± 1.0	t = 4.07, df = 51.9, p < 0.001
Fruits deformation	7	24	X^2 = 9.32, df = 1, p < 0,01

Strawberry's fruits without deformation
Font: Joyce M.V. Almeida-Dias

Strawberry fruit with deformation
Font: Joyce M.V. Almeida-Dias

Jataí bees (*T. angustula*) enhance strawberry fruit quality and yield by increasing fruit weight and sweetness while reducing deformities, making them effective commercial pollinators for protected strawberry cultivation when deployed during flowering.

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APIMONDIA SCANDINAVIA 2025
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PP-560 [Pollination and Bee Flora]

Precision pollination: the use of artificial intelligence for optimizing applied pollination in coffee crops

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INTRODUCTION

Pollination is a key ecosystem service for agricultural productivity, particularly in self-pollinating yet pollinator-responsive crops such as Arabica coffee (Coffea arabica). Despite evidence of yield gains exceeding 15% when managed pollination is applied, the scalability and monitoring of this practice remain challenges in large-scale coffee production. To address these challenges, this study evaluates two artificial intelligence (AI) applications that optimize Applied Pollination (AP) in coffee plantations: (i) an AI-driven system for automated hive inspections and (ii) a machine learning model for coffee yield estimation based on fruit counts at different ripening stages.

METHODOLOGY

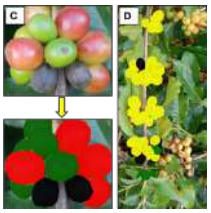
The automated hive inspection AI, developed using deep neural networks (DNN/CNN), analyzes hive images to assess colony strength, brood health, and food reserves. The AI-based coffee yield estimation model, trained with more than 3,500 field images, applies a YOLOv8 architecture to detect and classify coffee fruits at different maturation stages - green, ripe and overripe. Using a regression-based approach, the model estimates fruit density and subsequently the productivity of the area under analysis.

Database collection
automated hive inspection AI

Database collection
AI-based coffee

RESULTS AND CONCLUSION

The automated hive inspection AI enhances decision-making in hive management, ensuring that pollination units remain in optimal conditions.
The AI-based coffee achieved a mAP50 of 0.945 in the fruit counting, demonstrating high accuracy in predicting potential yields.



These AI-driven technologies can significantly enhance pollination efficiency, providing farmers with actionable insights to optimize harvest timing, resource allocation, and pollination strategies. The integration of AI and AP represents a breakthrough in precision coffee farming, reinforcing sustainability and economic returns for the industry.

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PP-561 [Pollination and Bee Flora]

49TH APIMONDIA INTERNATIONAL APICULTURAL CONGRESS, 23 - 27 SEPTEMBER, 2025

PHYSIOLOGICAL STRESS AND REPRODUCTIVE SUCCESS OF BUFF-TAILED BUMBLEBEES (*BOMBUS TERRESTRIS*) IN AGRICULTURAL LANDSCAPES

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Pollination is an important ecosystem service. Agricultural intensification and land expansion have negative effects on pollinator diversity. Insect pollinators remain under constant stress due to changes in the landscape, invasive pathogens, decreases in the amount of floral resources and detrimental effects of pesticides. We investigated whether habitat quality affects bumblebee body concentration of carbon (C) and nitrogen (N), the C/N ratio and *B. terrestris* reproductive success, each considered stress indicators.

METHODS: we placed commercially produced bumblebee hives in two contrasting agricultural landscapes during the plant flowering season. Hives were removed along with the generation change of bumblebee colonies.

Figure 1. An oilseed rape field (photo by Ronalds Krams).

Oilseed rape (*Brassica napus*) fields
Higher pollen and nectar abundance, monoculture, longer blooming season.

Apple tree (*Malus domestica*) orchards
Lower pollen and nectar abundance, higher floral diversity, relatively short blooming season.

Figure 2. An apple tree orchard (photo by Ronalds Krams).

We identified individuals of each bumblebee colony and counted the number of hatched and unhatched worker and queen cocoons as indicators of colony reproductive output. Afterward, bumblebees were dried in a laboratory drying furnace and homogenized to prepare biological samples for determination of C and N concentrations, and ratios, performed with a chemical element analyzer.

RESULTS:

Heavier reproductive individuals:
A potential offspring size/count tradeoff?

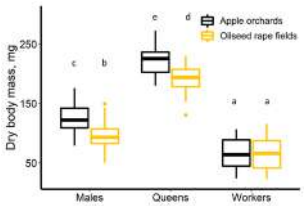

Figure 3. Dry body mass of bumblebees.

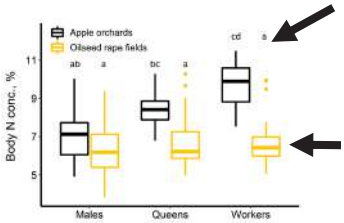

Figure 4. Body nitrogen concentration of bumblebees.

As expected:
More muscle for flying means more protein and more nitrogen.

Not expected:
Why did queens and workers lose their nitrogen?

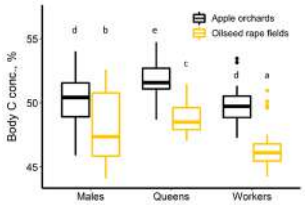

Figure 5. Body carbon concentration of bumblebees.

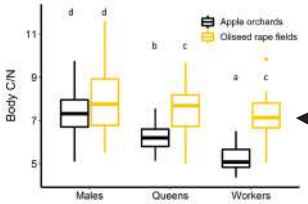

Figure 6. The body carbon-to-nitrogen ratio of bumblebees.

Higher C/N in rapeseed fields:
The general stress paradigm suggests more significant stress.

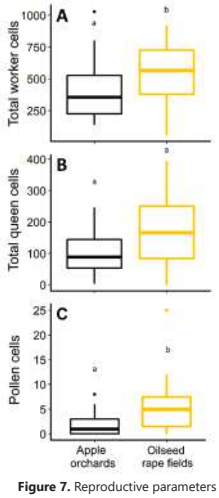

Figure 7. Reproductive parameters of bumblebees in apple tree orchards and oilseed rape fields. The higher number of worker cells (A) and more pollen cells (C) suggest higher reproductive output and more intense resources gathered in oilseed rape fields despite higher stress levels.

CONCLUSIONS:

- Bumblebee reproductive output was significantly higher in oilseed rape fields, a more productive habitat, than in apple orchards, a more natural habitat;
- Higher reproduction rates were achieved at the cost of physiological stress, evidenced by a significantly higher C/N ratio observed in bumblebees inhabiting oilseed rape fields;
- The C/N ratio of *B. terrestris* individuals was lower in apple orchards, where bumblebees had significantly higher body N concentrations.
- Body elemental analysis is a reliable method to assess the stress levels of bumblebees and can add to the understanding of pollinator decline reasons.

FUNDING:

This study was supported by the 1.1.1.9 Research application No 1.1.1.9/LZP/1/24/122 of the Activity "Post-doctoral Research" "Exploring the potential of native conifer products for honey bee protection".

PP-562 [Pollination and Bee Flora]
Spatiotemporal analysis of pollen assemblages in “”Apis cerana indica”” (Fab.) honey: A melissopalynological perspective from Kodagu, Karnataka, India

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Honey, a natural sweetener produced by honeybees plays a vital role in nutrition, medicine, and biodiversity conservation. Melissopalynology, the study of pollen in honey, helps identify floral sources, assess honey quality, and understand bee foraging patterns. Since honey composition varies with floral availability, analyzing pollen diversity is crucial for sustainable beekeeping and ecosystem management. Despite the significance of beekeeping in Kodagu region of Western Ghats, Karnataka,India research on the spatiotemporal dynamics of pollen in the native “”Apis cerana indica “”(Fab.) honey remains scarce. Here we show that honey samples from different forest ecosystems during major and minor honey flow periods exhibit distinct pollen compositions, reflecting seasonal shifts in floral resource availability. Analysis of eight honey samples, following Erdtman's (1953) methodology, identified five unifloral and three multifloral samples. During the minor honey flow period (November–December), “”Tabebuia”” sp., “”Sapindus laurifolius””, and “”Alternanthera sessilis”” were dominant in semi-evergreen, moist deciduous, and dry deciduous forests, respectively. In the major honey flow period (March–April), “”Cocos nucifera”” and “”Taraxacum”” sp. were predominant in semi-evergreen and dry deciduous forests. Absolute Pollen Concentration (APC) classified the honey samples as moderately high (Louveaux classes III and IV). Pollen diversity was highest in evergreen forests during the minor honey flow period and in semi-evergreen forests during the major honey flow period. These findings provide insights into floral resource dynamics, support conservation strategies, and promote sustainable beekeeping in the Kodagu region of the Western Ghats, Karnataka,India. The findings would also through light in understanding pollen dynamics and its importance in sustenance of bees for their development.

APIMONDIA SCANDINAVIA 2025
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PP-563 [Pollination and Bee Flora]

ASSESSING THE IMPACT OF RF-EMF EXPOSURE ON WILD BEES UNDER COMMERCIAL 5G RF-EMF

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Introduction

- RF-EMF powers modern communication, including 5G networks.
- 5G uses new frequencies, raising concerns about environmental effects.
- Pollinators, especially wild bees (Apoidea), are vital for ecosystems.
- No field studies have tested potential effects on insects.
- This study examines RF-EMF exposure at 3.4 GHz on, wild bees.

Materials and Methods

- A field study in Cyprus uses artificial wild bee nests, either shielded or unshielded from RF-EMF.
- Each nest is built from an outer PVC pipe (19 cm diameter and 38 cm length) and an inner pipe (12 cm diameter and 18 cm length) filled with dry reed stems, 17 cm long, 5-10 mm in diameter (Fig. 1).
- Shielding is created by covering the inner pipe with metal mesh (shielded) or a plastic mesh (unshielded control).
- 50 trap nests were installed near 3.4 GHz 5G-NR antennas across 25 different urban areas on the island and monitored systematically for bee occupation (Fig. 2).

Fig. 1. Close up of bee nests: Detail showing the internal pipe with the reeds nested inside the external pipe (left), inner pipe with metal mesh (center), inner pipe with plastic mesh (right).

Fig. 2. Locations with bee nest placement in Cyprus. A 5G antenna emitting at 3.4 GHz is present at each location.

- Since spring 2024, observations and biodiversity monitoring of wild bees along a variable transect have been carried out at each location once per month [(from April to October 2024 (August excluded)], during the main flowering period (Fig. 3).
- RF-EMF exposure pattern of each location was characterized using the band selective RF-EMF exposure meter (ExpoM-RF 4) at each site along pre-specified route at same time (Fig 3).

Fig. 3. Monitoring the biodiversity of bees, collected bees using an insect net (left), recorded the plants from where bees were caught (center) and RF-EMF measurements (ExpoM-RF 4) (right).

Results and Discussion

- During variable transect walks that were carried out six times at each site, variations in the abundance of wild bees were observed, with some sites hosting higher bee diversity (Fig. 4).
- The bee specimens collected with an insect net were pinned, and their genera were identified first; species-level identification is still in progress.
- Nests were occupied only in three sites, with very low activity, with a few closed reeds across five trap nests (Fig. 4).

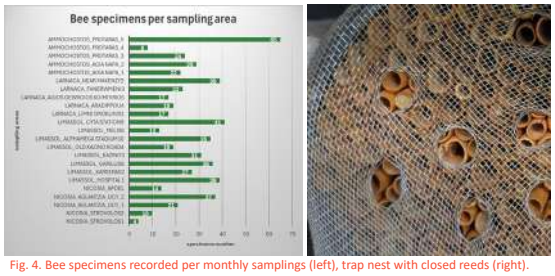

Fig. 4. Bee specimens recorded per monthly samplings (left), trap nest with closed reeds (right).

- RF-EMF measurements using the band selective RF-EMF exposure meter (ExpoM-RF 4) were made to characterize each site in terms of RF-EMF exposure (Fig. 5).
- The abundance and diversity of bees, both in nests and along transects at each location, will be analyzed in relation to the measured RF-EMF characteristics of each site to evaluate potential effects on wild bees (Fig. 6).

Fig. 5. Measurements of RF-EMF intensity at a location with bee nest placement (left - general view of the area, right – close up of the site).

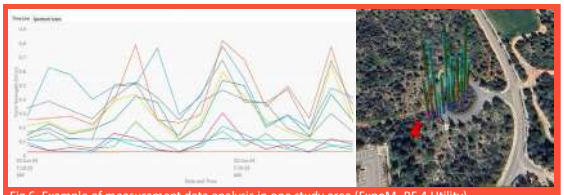

Fig 6. Example of measurement data analysis in one study area (ExpoM- RF 4 Utility).

Future work will include expanding the field study to multiple seasons and additional locations. Further collection of seasonal exposure data at the study locations will allow for quantifying changes in the network topology and power. All this data together will allow for assessing potential risks for wild and managed bees.

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PP-564 [Pollination and Bee Flora]

APIMONDIA SCANDINAVIA 2025 COPENHAGEN

URBAN AND PERI-URBAN CHALLENGES AND OPPORTUNITIES FOR POLLINATOR CONSERVATION IN SOFIA CITY, BULGARIA: PRELIMINARY STUDY

Student poster

Authors

Affiliation

Department of Landscape Ecology and Environmental Protection, Faculty of Geology and Geography, Sofia

Acknowledgments

We gratefully acknowledge funding from the project "Urban and Peri Challenges and Opportunities for Pollinator Conservation in Sofia: Study and 2025), funded by the Bulgarian National Science Fund (BNSF), Ministry of Research Project in Support of Doctoral Students

References

Apis mellifera on Aesculus ×carnea author's photo

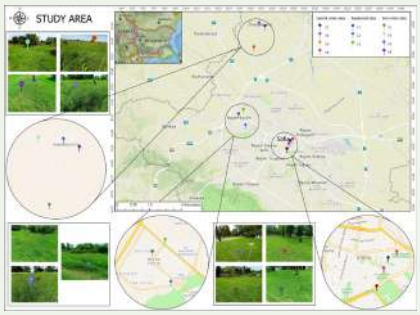
Melitta leporina on Vicia grandiflora author's photo

Introduction & Objective

Urbanization and climate change reshapes plant pollinator interactions, often by reducing diversity. But cities can also act as refuges when green spaces are well planed, managed and connected. This creates a need to understand not just who is present, how interactions are organized across urban gradients. We examine whether residential areas in Sofia, Bulgaria can function a stones between dense urban cores and peri urban habitats by analyzing network structure , and related properties, rather than species lists alone. By linking local interaction networks to landscape context, the study addresses a key gap for practical, city scale conservation and planning This approach could be also beneficial for beekeepers on where to place hives and when to plant or move them to keep forage

Study Area & Methodology

Research took place in and around Sofia, Bulgaria (42.6977 growing city with a mosaic of parks, inter block greens, roadsides, and unmanaged patches typical of post socialist urban fabrics. The continental climate (C January; ~580 mm precipitation) shapes flowering phenology and pollinator activity. We sampled three zones central parks/formal greens (the Lyulin residential district block lawns, mall adjacent greens, subway station), and peri field, hedgerow corridor, village green, periphery capturing contrasts and other conditions that could be



11

Study sites (64 m² each) across Sofia's urban gradient.

C1–C4 Central urban L1–L3 Residential

P1–P4 Peri-urban

Standardized 30-min observations per site between 11:00–16:00.

Multi-stage species identification protocol.

Preliminary IDs via iNaturalist mobile ap & Atlas of European Bees

Expert verification afterwards

References: Gazdic & Groom (2019); Pauly et al. (2011)

Digital field data capture via custom AppSheet mobile app.

Dropdowns + GPS coordinates for every observation

Every interaction photographed using Sony Xperia 1 V.

R

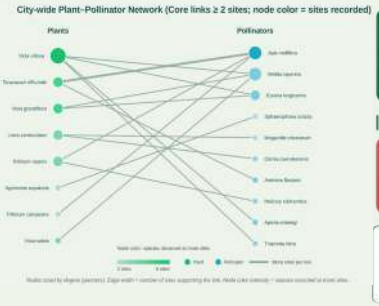
All analyses conducted in R 4.4.2 within RStudio environment.

dplyr tidyr bipartite igraph

Packages: Dormann et al. (2008); Csardi & Nepusz (2006)

The plot size was selected as a balanced approach, drawing on previous studies that utilized larger sampling areas in agricul al landscapes (Dupont et al., 2014)
Metrics: nodes/edges, degree, density, components, , degree centralization, (NODF). Tests: ANOVA + Tukey HSD, Kruskal Wallis as needed; community composition with PERMANOVA (Bray

Results



Study Overview

40 Pollinator Species

26 Plant Species

86 Unique Links (≥10 visits)

Diversity by Urban Zone

Central Urban	Residential	Peri-Urban
LOWEST DIVERSITY	HIGHER DIVERSITY	HIGHEST DIVERSITY
11 pollinator spp.	20 pollinator spp.	21 pollinator spp.
6 plant spp.	8 plant spp.	17 plant spp.

Key Pollinators (by # of sites)

- *Apis mellifera* (5 sites)
- *Anthena flavipes* (4), *Eucera longicornis* (3), *Melitta leporina* (4)
- *Apanta crataegi* (4), *Lasioglossum marginatum* (4)
- *Anthena wilkella* (3), *Halictus rubicundus* (3)

Key Plants (by # of sites)

- *Vicia villosa* (5 sites)
- *Vicia grandiflora* (4), *Taraxacum officinale* (4)
- *Lotus corniculatus* (3), *Vicia sativa* (3), *Trifolium repens* (3)

Statistical Analysis

Species Richness

ANOVA: $F_{3,16} = 4.76$, $P = 0.0014$

Tukey HSD:

- Peri-urban > Central ($P = 0.0022$)
- Residential > Central ($P = 0.0035$)
- Peri-urban > Residential ($P = 0.090$)

Species Means ± SE:

Central: 4.25 ± 0.75 spp

Residential: 9.67 ± 0.33 spp

Peri-urban: 8.75 ± 0.95 spp

Abundance Analysis

ANOVA: $F_{3,16} = 4.76$, $P = 0.043$

Central: 7.25 ± 1.31 individuals

Residential: 11.33 ± 0.88

Peri-urban: 11.75 ± 1.11

Peri-urban vs Central $P = 0.053$ (marginal)

Network Structure

Nestedness (NODF):

- Central: ~40–100 (highest)
- Residential: ~26.6–66.2
- Peri-urban: ~34.1–46.4

Correlations:

- Nestedness vs Connectance: $r \approx 0.74$, $P = 0.009$
- No clear link with links-per-species

40 pollinator species city sites were the least diverse and least abundant
sites were higher (see P values). Networks mirror this: the city core is most nested
links tend to pile onto generalists rather than spread evenly.

Conclusion

Management Action

Residential green spaces can act as stepping-stones. Native seed mixes for courtyards/verges & stagger bloom; relax mowing to 4–6 weeks; cut pesticides.

Policy Solution

Diversify the "guest list"; ensure continuous bloom (spring – autumn) and add legumes (e.g., Vicia spp., Fabaceae & Asteraceae) to support specialists and reduce over-reliance on hubs.

Implementation Strategy

Protect & connect hedgerows, railroad verges, riparian strips. Specify corridor width/spacing in plans; pilot "biodiversity highways" links from the city core to the peri-urban edges.

Build the Bee Superhighways

Linear Corridors Work: Site P2 Success Story

Central City	Residential	Peri-urban
4.25 spp/site	8.67 spp/site	8.75 spp/site

P2 (hedgerow corridor): 15 spp — highest richness near monocultures

Preliminary patterns suggest that central urban urban areas may support greater richness and more even interactions. Completing the study this year and integrating and landscape metrics (patch size, connectivity, edge density) could help explore thresholds that predict richness and network indicate where interventions would be most effective.

PP-565 [Pollination and Bee Flora]
Enhancing pollinator habitats through native plant selection: a case study in the Monte Conero Regional Natural Park

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Pollinators, particularly wild bees (Apoidea), play a crucial role in maintaining biodiversity and ensuring ecosystem resilience. However, their populations are under threat due to habitat fragmentation, intensive agriculture, and climate change. The research aims to investigate the relationship between native flora and Apoidea fauna in the Monte Conero Regional Natural Park (Ancona, Italy), a biodiversity hotspot with a diverse range of habitats. Despite their ecological importance, wild bee populations are declining due to habitat loss and changes in land use. Understanding how different habitat characteristics influence wild bee diversity and abundance is essential for developing effective conservation strategies. This study focuses on how habitat variability, including vegetation type, solar exposure, and proximity to the sea, affects Apoidea diversity in the Monte Conero area. Standardized entomological sampling techniques, such as pan traps, were used to monitor wild bee diversity and abundance across seven different sites within the park. Each site varies in solar exposure, distance from the sea, and vegetation composition. Additionally, floral resource availability and its attractiveness to pollinators were assessed. The study identified 35 different wild bee species across the seven monitored sites. The diversity of wild bees was influenced by habitat characteristics, with variations in solar exposure and vegetation type playing a significant role. These results highlight the importance of maintaining floral diversity and habitat heterogeneity for wild bee conservation. The findings provide essential data for developing targeted conservation strategies, such as promoting pollinator-friendly agricultural practices and restoring degraded habitats through the reintroduction of native plant species. Understanding the relationship between floral resources and pollinator communities can inform sustainable land management policies, benefiting both wild and managed bee populations. The study underscores the need for integrated approaches to habitat restoration, combining scientific research with community engagement and policy-making to safeguard pollinators and the essential ecosystem services they provide.

APIMONDIA SCANDINAVIA 2025
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PP-566 [Pollination and Bee Flora]

Mapping and Monitoring Tree Species in Dense Forest Ecosystems for Apiculture in Greece Using AI and Satellite Imagery

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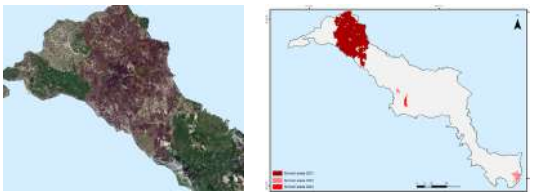
Background of the Study

Apiculture in Evia, Greece depends on four melliferous tree habitats: pine (*Pinus spp.*), Greek fir (*Abies cephalonica*), oak (*Quercus spp.*), and chestnut (*Castanea sativa*). In our study, we mapped and monitored these habitats over five years (2020–2024) using Sentinel-2 monthly mosaics and species-level semantic segmentation based on a Vision Transformer (ViT) architecture. The 2021 mega-wildfires caused severe habitat loss and fragmentation, threatening honey production and ecosystem services, thus monitoring is of great importance.

Key Contributions

Our five-year (2020–2024) mapping initiative provides annual maps of Evia's four key honey-producing tree species. We developed a hierarchical methodology, integrating Sentinel-2 data, a ViT deep learning model, and rigorous ground truth validation. This approach accurately quantified the devastating 2021 wildfire impacts (30% pine, 11.5% oak loss), offering vital insights for sustainable apiculture and forest management.



(a) (b)

Side by side comparison of Sentinel-2 monthly mosaic depicting the impact of the 2021 wildfire (a) and map of wildfires in Evia island and their impact on Apiculture (b).

Dataset Creation

Training data combined forestry polygons refined by expert photo-interpretation of Sentinel-2 monthly time series, constrained to single-species, medium–high density stands. A DJI Mavic 3 Multispectral campaign produced ultra-high-resolution orthomosaics for label verification. Inputs included annual monthly cloud-free Sentinel-2 mosaics (10 m) and a normalized DEM.

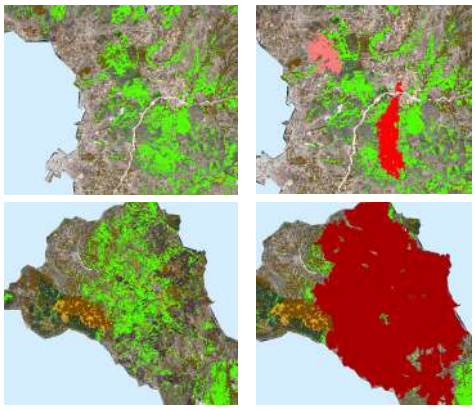
Methodology

We adopted a single-stage, end-to-end mapping pipeline with a ViT architecture for species classification over forested areas. Forest extent was first delineated using official maps to exclude non-forest pixels. For each forest tile, the ViT ingested a temporal stack of Sentinel-2 NDVI features across months plus a normalized DEM channel, learning phenology- and topography-aware representations to discriminate pine, fir, oak, and chestnut.

Training used tiled inputs, early stopping, class-balanced batches, and strong seasonal data augmentation; yearly outputs were temporally fused with the previous year's map to enhance stability and suppress spurious changes. We trained the ViT on expert-curated, single-species, medium–high density polygons validated by UAV multispectral orthomosaics, leveraging self-attention to capture long-range spatial context and cross-time relationships in heterogeneous Mediterranean forests. Post-processing applied confidence thresholding and small-patch smoothing to reduce mixed-stand noise, producing seamless 10 m annual four-species maps suitable for tracking wildfire impacts and guiding apiculture management.

Results and Discussion

In 2020, pine (~57k ha) and oak (~48.6k ha) dominated; fir (~10k ha) and chestnut (~8.5k ha) were more limited. The 2021 fires reduced pine to ~40k ha (−30%) and oak to ~43k ha (−11.5%), fragmenting habitats and constraining bee foraging. The ViT model accurately delineated species, with main errors in mixed stands and transition zones; NDVI+DEM proved sufficient and efficient. Annual temporal fusion improved map consistency year-to-year.



Conclusion

AI-enabled, Sentinel-2-based mapping provides robust, annual monitoring of melliferous tree habitats, critical for post-fire assessment and apiculture planning. Given pine honey's dependence on mature stands and *Marchalina hellenica*, production recovery will span decades without proactive restoration. The workflow is scalable, operationally relevant, and supports targeted conservation, restoration, and adaptive beekeeping in fire-prone Mediterranean forests.

Acknowledgements

This research was funded by the Greek Ministry of Rural Development and Food ' and The APC was funded by the Greek Ministry of Rural Development and Food under the BeeMap project "Ensuring production and increasing the quality of honey in the Cyclades Islands by mapping the beekeeping flora and estimating the beekeeping capacity" of the Measure16 under the Rural Development Programme 2014-2020.

PP-567 [Pollination and Bee Flora]
Competition between honey bees and wild bees? Effects of increased honey bee densities on foraging and reproduction of wild bees and other pollinators

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Wild bees have experienced alarming declines over the last decades, with many species critically endangered or already extinct. Besides important drivers of decline like habitat loss, intensification of agriculture, urbanization, and climate change, some postulate that the increasing density of honey bee colonies can potentially have negative effects on wild bees, as they might compete for floral resources. Currently, there are only a few experimental studies analyzing the effects of increased honey bee densities under field conditions, and so it is still unclear to what extent competition might affect the foraging behavior of wild bees and other pollinators, and if this has any impact on the reproductive success of wild bees.

To help answer these questions, we experimentally varied honey bee density in flower-rich meadows by moving five colonies into and out of our study sites every two weeks. While doing so, we documented the flower visitation rates of honey bees, wild bees, and other pollinators from May to August 2022, to see if there were any effects on foraging behavior. Simultaneously, we used the red mason bee Osmia bicornis to investigate if increased honey bee density reduced brood cell construction and cell provisioning, while also analyzing the pollen collected by Osmia to identify potential nutritional overlaps with the honey bees.

Our results showed a significant reduction in the flower visitation rates over all wild pollinators when honey bee densities were increased. We didn't find any effects on the reproductive rates of O. bicornis, despite a substantial overlap in the pollen collected by mason and honey bees.

Our study provides important data-based evidence for the current discussions on potential nutritional competition and emphasizes the complexity of the topic. Further studies are needed to understand the impacts on more specialized wild bee species.

This work was funded by the Ministry of Food, Rural Affairs and Consumer Protection Baden-Württemberg, Germany.

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PP-568 [Pollination and Bee Flora]

COMPOSITION AND CIRCADIAN DYNAMICS OF NECTAR SUGAR PRODUCTION IN WHITE AND PURPLE SOYBEAN FLOWERS

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[1] Embrapa Soja; [2]Marialva Municipality Department of Agriculture, [3]Former Embrapa-Bayer Post-Doc Student, [4]Basic and Technological Sciences Department, National University of Chilecito, Chilecito, Argentina, [5]Former MSc Student UNESP-Ilha Solteira.

INTRODUCTION

Approximately 90% of plants, including 75% of all domesticated crops, benefit from pollinators. Soybean [*Glycine max* (L.) Merrill] is only partially dependent on cross-pollination, as it is an autogamous and self-pollinated leguminous plant. In addition, soybeans are partially cleistogamic, meaning that flowers are broadly self-pollinated by the time of anthesis. However, their stigma remains receptive for approximately six hours, and the anatomical features of soybean flowers allow pollination by biotic agents, such as insects, predominantly several species of bees.

Thus, like other pollinated crops, soybean plants can benefit from diverse pollinator communities The chemical composition of the nectar of soybean flower is crucial for mediating plant–pollinator interactions, as it directly influences pollinator visitation and plant reproductive success. Plant–pollinator interactions are traditionally assumed to be a binary system in which both partners obtain a continuing mutual benefit, such as food resources on the pollinators´ side and reproduction on the plants' side.

This study investigated the hypothesis that nectar chemistry affects pollinator behavior by analyzing sugar and amino acid profiles in the nectar of six Brazilian soybean cultivars.

METHODOLOGY

Six soybean cultivars were sown in open-field plots, allowing free visitation by honey bees. Three cultivars presented purple flowers, and three white flowers. When the plants reached the full flowering stage (R2), we collected the nectar produced by the flowers of each cultivar on a daily basis.

NMR analyses were performed at the Multiuser Laboratory of Natural Products Chemistry of Embrapa Agroindústria Tropical, located at Fortaleza, Ceará State, Brazil. The NMR spectra were obtained at 600 MHz via DD2 NMR/MRI Console (for the ^{1}H nucleus) equipment and fitted with an NMR probe (Agilent Technology) with a 5 mm internal diameter (^{1}H-^{19}F/^{15}N-^{31}P), reverse detection, and a z-axis field gradient.

After characterization, the compounds (sugars) were quantified via NMR integration signals on the basis of the reciprocity among signals and the amount of the compounds in the samples, establishing a correlation with a reference sample of known concentration. Multivariate data evaluation methods were applied to the measured variables via the ChemoFace to address the variability of the samples

RESULTS

The results of the NMR spectroscopy analysis revealed that soybean nectar is predominantly composed of sucrose, α-glucose, β-glucose, and fructose, alongside with amino acids such as tyrosine and phenylalanine, which play biochemical and ecological complementary functions. The distinction between the α- and β-anomers was based on chemical shifts, with α-glucose detected at 5.2–5.3 ppm and β-glucose at 4.6–4.7 ppm.

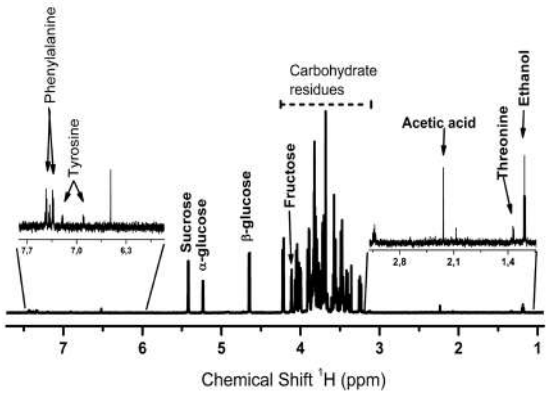

Figure 1 – *^{1}H NMR spectrum of nectar extracted from soybean flowers highlighting the prominent metabolites identified in all analyzed samples. The expanded regions display clear signals attributed to the amino acids phenylalanine, tyrosine, and threonine, as well as compounds such as sucrose, α- and β-glucose, fructose, carbohydrate residues, acetic acid, and ethanol. This study presents chemical shifts in parts per million (ppm).*

Multivariate analyses, including principal component analysis (PCA), highlighted variations in sugar composition between soybean cultivars and pollination scenarios, with greater sugar accumulation in the absence of bees.

Our results spotlighted the adaptive importance of nectar chemistry in shaping plant-pollinator dynamics and its implications for optimizing pollination efficiency in agricultural systems. This study highlights the importance of integrating nectar composition into genetic breeding strategies to support pollinator populations to improve crop productivity.

CONCLUSIONS

The results revealed that soybeans produced significant amounts of nectar of high quality.

PCA revealed that nectar sugar profiles vary according to soybean cultivar and pollination status. In the absence of bees, sucrose and total sugar accumulate, suggesting an adaptive "storage" mechanism, whereas foraging rapidly depletes these reserves.

Nectar secretion follows a pronounced circadian rhythm, peaking between 08:00 and 11:00 AM, coincident with maximal anthesis, highlighting the importance of synchronizing breeding strategies with the natural timing of floral activity, supporting the theory that soybeans are partially dependent on biotic pollination, which increments its yield.

The authors are thankful to BAYER for funding this study through the Embrapa-BAYER agreement #10200.14/0059-7; to ABELHA for funding the participation in Apimondia; to the students of the Chemical Ecology laboratory at Embrapa Soybean and to the GPBee of the Universidade Estadual de Maringá, for their invaluable collaboration.

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PP-569 [Pollination and Bee Flora]

Diversity and Coverage of Melliferous Plants in Northwest Bulgaria Across EUNIS Habitat Types

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Introduction

Melliferous plants provide nectar and pollen keeping pollinators fed throughout the year. That steady food supply supports both wild pollinators and managed honeybees, linking the importance of the healthy ecosystems to the livelihoods of beekeepers. But we still don't know enough about where these plants are and how diverse they are in different habitats, which makes it hard to target conservation and restoration efforts. This knowledge is especially important in anthropogenic landscapes, where fewer flowering resources can quickly weaken pollinator communities and the services they provide.

Study area

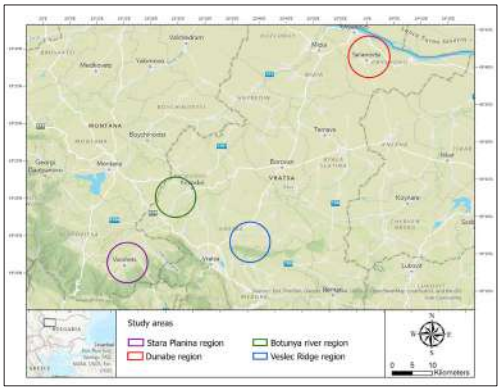


Fig. 1. Study area

Bulgaria is located in the eastern Balkans (Fig. 1), where diverse natural conditions shape its vegetation. The country sits in a climatic transition zone between Cfb (warm-temperate, fully humid with warm summers) and Csa (summer-dry Mediterranean influence), with elevations from sea level to 2,925 m and 28% of the territory above 600 m. Northwestern Bulgaria has a temperate-continental character, and at low elevations key stations such as Vidin and Pleven are classified as Cfa (humid subtropical: no dry season, hot summers) under the Köppen system; toward the higher Fore-Balkan, conditions grade into continental subtypes Dfa/Dfb. According to the 2012 Conspectus of the Bulgarian Vascular Flora, 4,102 plant species occur across temperate and mixed deciduous forests, coniferous forests, grasslands, Mediterranean scrub, and alpine zones. The four representative areas examined span roughly 20–1,300 m above sea level.

Methodology

312 km²
Total study area (4 × 78 km²) in Northwestern Bulgaria.
All fieldwork conducted in 2023.

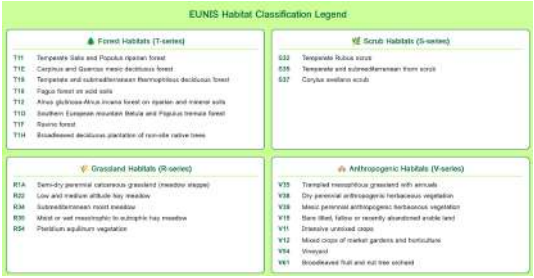
348
Phytosociological descriptions (relevés).
Vegetation recorded with the Braun–Blanquet cover–abundance scale.
Melliferous species filtered from a literature-based list for Bulgaria.

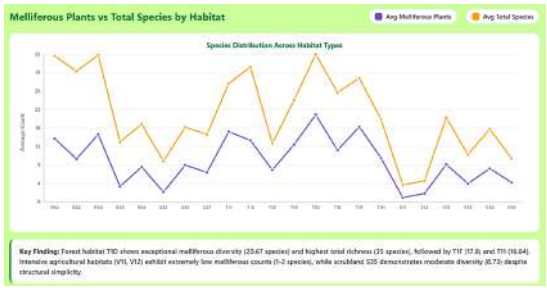
68% of relevés auto-classified with EUNIS-ESy in R.
32% resolved using *EUNIS Habitat Factsheets* by matching field data to diagnostic, constant and dominant species.
Total reliability: 10,084/10,717 plots (94%) uniquely assigned to EUNIS habitat, 7,810 to Level 3 (Bruelheide, Tichý, Chytrý & Jansen, 2021).

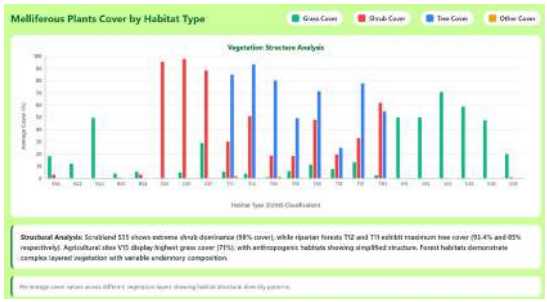
Habitats Surveyed

Results

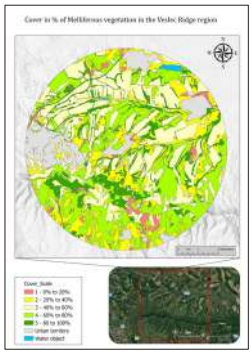
24 types of habitats were identified at level 3 of the EUNIS classification. Of them, five are grasslands, three shrublands, nine forests, and six are anthropogenic habitats.

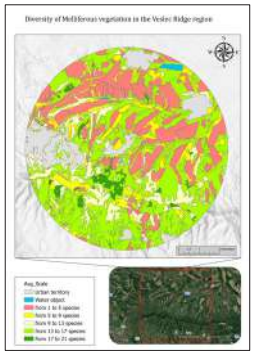






- **Grasslands:** highest diversity. Peaks: **R1A = 35** spp (15 melliferous); **R34 =** 35 spp (16 melliferous); **R34** has the highest mean melliferous cover = 50%.
- **Shrublands:** act as nectar corridors in farmed landscapes (e.g., **S35** along field edges); supply forage in late winter–early spring. Lower richness but high melliferous plants cover; important for colony build-up and crop pollination.
- **Forests:** key forage overall. **T1E, T1F, T1H** are main honey sources; others provide supplementary flow. Riparian and lime-dominated (plus some invasive honey plants) = highest value; conifer plantations = lowest.
- **Anthropogenic habitats:** strongly depend on agricultural practice. Ecotones host wild flora but are under pressure from field enlargement. Crops may be melliferous plants, yet uniform vegetation limits the diversity × area needed risking pollination deficits and arguing for minimum habitat-diversity thresholds.





Two representative maps (from the four study areas) are shown for the Veslec Ridge region. We chose this site for its clear north–south contrast: in the north, typical anthropogenic habitats are "cut" up by shrubland, while the south is dominated by natural forest and grassland ecosystems.
(Left: percent cover of melliferous vegetation; Right: species richness.)

Conclusion & Discussion

PP-570 [Pollination and Bee Flora]
Honeybees' effects on species diversity and plant pollinator interactions: insight for implementing sustainable beekeeping practices

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Beekeeping is frequently criticized for the potential that managed honeybees outcompete wild pollinator species. Proving or rejecting that honeybees have a detrimental effect on wild pollinator species is no easy task. One measure that is used to demonstrate negative impacts on wild species are changes in wild pollinator community composition (i.e., species turnover and loss) when honeybees are added to the area. Another measure that can be used is a disruption of plant-pollinator interaction networks (i.e., "rewiring"). The potential for honeybees to cause either wild pollinator species turnover or interaction rewiring will generally depend on levels of local resource availability and degree of wild pollinator generalization/ specialization.

We present results from a study in the Hallingdal valley of Southern Norway where honeybees are normally absent. No beehives are placed within 20 km of the Norwegian Beekeeping Association's facility in Nesbyen as a measure to protect the genetic lineage of the queens reared there. This area thus provides a unique opportunity for a manipulative experiment to test hypotheses for how variation in the honeybee density can affect native bee species assemblies along gradients of both floral resources and nesting site availability.

We used both netting and pan traps at 40 sites within the valley to measure the area's pollinator abundance and diversity, and document plant-pollinator species interactions. Data from 2022 describe baseline conditions, data from 2023 describe effects of introducing beehives at varying density within the study area, and data from 2024 describe effects that may have persisted after the hives were removed.

We present results of analyses exploring how spatial and temporal species turnover and plant-pollinator interaction rewiring reflect the conditions under which competition from honeybees has the greatest potential to disrupt pollination wild pollinator communities. We will also describe how findings are used within a model for prescribing appropriate honeybee colony stocking densities, accounting for local floral resource availability and nesting sites, to avoid negative effects from competition with local wild pollinators. This model will be invaluable to beekeepers by giving guidance in stocking densities that do not cause negative effects on local wild pollinators.

PP-571 [Pollination and Bee Flora]
Pollination of red clover (Trifolium pratense) using colonies of the South American bumblebee Bombus pauloensis

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The Apoidea (Hymenoptera) are key pollinators, particularly the bumblebees of the genus Bombus, which are distinguished by their morphology and behavior. Unlike honeybees (Apis mellifera), bumblebees possess long proboscises that optimize nectar access in flowers with deep corollas, such as Trifolium pratense (red clover). In Uruguay, Bombus pauloensis, a native species, has been successfully bred and identified as a long-tongued pollinator, positioning it as a potential pollinator for this legume, whose seed production is limited by pollination deficits. This study aims to assess the pollination capacity of B. pauloensis colonies in a red clover crop. Sixteen colonies were installed in a seedbed, while two apiaries of A. mellifera were positioned 400 meters away. Twelve observation plots were established at three distances from the nests (10, 80, and 160 meters) to monitor pollination activity and seed yield. A higher presence of bumblebees was observed in plots closer to the nests, with a decline in bumblebee numbers as the distance from the nests increased. Palynological analysis revealed that T. pratense was the most utilized resource, both as a pollen source (32-52%) and nectar source (19-52%), with peak utilization occurring during the period of maximum flowering ($P < 0.05$). Seed yield was highest near the nests (709 kg/ha at 10 m), decreasing with distance (423 and 328 kg/ha at 80 and 160 m, respectively). The number of seeds per inflorescence followed the same trend (43%, 30%, and 26%; $P = 0.0037$). A positive correlation was found between the number of bumblebees and seed yield ($r = 0.58$, $P = 0.04$), as well as between the number of bumblebees and the number of seeds per inflorescence ($r = 0.73$, $P = 0.007$). A linear model indicated that seed yield increased with the presence of bumblebees, following the equation: $y = 362.58 + 394.36x$ ($P = 0.01$). In contrast, A. mellifera showed no significant association with seed yield ($P = 0.12$). This study confirms that captive-bred bumblebees significantly enhance seed production in T. pratense, proving to be more efficient than A. mellifera.

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PP-572 [Pollination and Bee Flora]

هيئة أبوظبي للزراعة والسلامة الغذائية
ABU DHABI AGRICULTURE AND FOOD SAFETY AUTHORITY

Enhancement of Floral Resources for Honey Bees in the United Arab Emirates

Dr. Ihsan Abu AlRub | Lead Researcher
Abu Dhabi Agriculture and Food safety Authority (ADAFSA), UAE.

Introduction

Beekeeping in the United Arab Emirates (UAE) faces significant challenges due to the country's harsh arid climate and sparse bee forage. Honey production is concentrated during two main periods, and overreliance on two nectar flows—primarily from Sidr (Ziziphus spina-christi) in autumn and Samar (Vachellia tortilis) trees in late spring. Outside these seasons, some limited forage is available for bees to utilize, but forage scarcity is a major issue for bee management and can compromise colony strength and sustainability. Although nearly 200 flowering plant species in the UAE have been identified as potential forage sources, mostly remain underutilized by beekeepers.

Key Bee Forage Resources in the UAE

Tree	Season	Nectar/Pollen	Importance
Sidr	Oct–Nov	Nectar	Premium honey source
Samar	Apr–Jun	Nectar + Pollen	High-quality honey
Ghaf	Mar–May, Oct	Nectar + Pollen	Pre-Samar buildup
Damas	Nov–Dec	Pollen	Post-Sidr recovery
Mangrove	Apr–Jul	Nectar	Coastal forage
Date Palm	Feb–Apr	Pollen	Spring colony growth

Yearly Floral Map for Honey Bees in Lowland Areas of Abu Dhabi

The following projects are currently being undertaken by the Abu Dhabi Agriculture and Food Safety Authority (ADAFSA) to address bee forage scarcity in the UAE.

Project (1) Title: Enhancement Strategies for Improved Bee Forage in the UAE

Objectives:
To catalogue native and cultivated bee forage plants in the UAE.
To assess temporal availability of nectar and pollen resources.
To develop strategies that enhance year-round floral availability for honey bees

Project Components and Results:

1. Diversification of Bee Forage and Floral Gap Bridging

- Introduce drought-tolerant, nectar/pollen-rich species such as Acacia implexa.
- Supporting year-round bee forage and promote cultivation of native plants with extended flowering periods
- Prioritize species attractive to bees and adapted to arid climates

2. Strategic Plantation and Distribution

- Propagate and distribute suitable bee forage plants through ADAFSA nurseries: over 20,000 plants distributed (2021–2023)
- Develop floral corridors in agricultural zones and forest belts
- Integrate flowering species into urban and roadside landscaping.

Shortlist of prioritized flowering plants with high potential for enhancing honey bee nutrition:

Common Name (English)	Common Name (Arabic)	Scientific Name	Family	Flowering Period
Sweet Acacia	Anbar, Futnah	Vachellia farnesiana	Fabaceae	Mar-May
Gum Arabic Tree	Babul	Vachellia nilotica	Fabaceae	Mar-Nov
Salam	Salam	Vachellia flava	Fabaceae	Feb-Apr
Red River Gum	Cafor	Eucalyptus camaldulensis	Myrtaceae	Apr-Jun
Hickory Wattle	-	Acacia implexa	Fabaceae	Jan-Feb
Drum-stick Tree	Alban, Yasar	Moringa peregrina	Moringaceae	Feb-Jun
Rohida, Desert Teak	Ferfar	Tecomella undulata	Bignoniaceae	Jan-Apr
Rhanterium	Arfaj	Rhanterium epapposum	Asteraceae	Jan-May
Toothbrush Tree	Arak	Salvadora persica	Salvadoraceae	Mar-Jul
Hureim, Bean Caper	Harm	Zygophyllum, spp.	Zygophyllaceae	Mar-Jun
Caltrop	Zaher	Tribulus omanense	Zygophyllaceae	All year
Mesquite	Ghwief	Prosopis juliflora	Fabaceae	Oct-Jan, Mar-May

Project (2): Forest Mapping and Ecological Zoning project (2024–2026)

- A multi-phase initiative to digitize and analyse forest ecosystems for optimal hive placement and capacity estimation optimizing floral resource planning.
- Collaborative initiative: Dendra| SANAD | ADAFSA | DMT
- Ecological Mapping & AI-Enabled Forest Assessment
- Identify optimal apiary zones based on floral composition and capacity
- Regulate hive density in accordance with forage potential
- Build predictive honey capacity models using ecological and remote sensing data

Project Component Details

- Forests survey.
- Remote sensing technology: Ultra-High-Resolution (UHR) RGB (0.6 cm GSD), Multispectral (4.8 cm GSD for vegetation health), LiDAR (≥10 pts/m²) to assess canopy structure.
- Taxa modelled Sidr, Samar, Ghaf, Damas, and other species that look morphologically similar to the 4 species of interest (e.g. Gwaif).
- AI Capabilities Tree detection and segmentation, crown size, species ID, canopy height, health filtering.
- Outputs Hive capacity maps, honey yield models, ecological zoning

Methodology Summary

1. Field & Image Data Collection

- Tree tagging via GPS and species-level ID
- Ground-truthing: height, crown diameter, health condition
- Remote sensing imagery was collected using drones
- More than 100,000 taxa were identified on UHR imagery for training and validation of the AI models

2. AI Development Pipeline

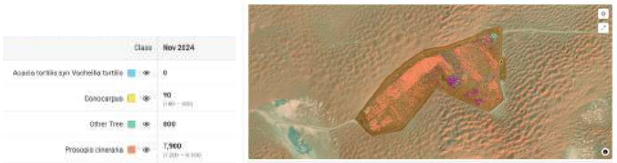
- Deep learning models for tree detection and crown segmentation
- Photogrammetry for 3D height estimation
- Binary classifiers paired with random forest for species detection (e.g., Sidr, Ghaf)
- Filtering non-productive/stressed trees from hive models

3. Hive Capacity & Yield Modeling

- Trees per hive and expected yield per species (based on expert inputs)
- Alternative model based on nectar sugar content per flower
- Adaptive rule-based modelling for "other" tree species
- Current Floral Resources & Underutilized Plants

Outcomes and Results

- 27 forests across Abu Dhabi were surveyed using a combination of remote sensing technology.
- AI algorithms successfully detected trees, segmented crowns, identified species (Sidr, Samar, Ghaf, Damas, etc.), and assessed canopy health.
- Based on tree species composition and density, forests were categorized according to their suitability for honey production for each honey flow.
- Developed hive capacity maps by correlating tree density, species composition, and nectar potential.
- All forest data are available through an interactive geospatial platform (Dendra Platform) enabling stakeholders to:
  - View species distributions.
  - Identify high-yield zones.



Conclusion

These projects integrated approach to address bee forage scarcity in the UAE merges cutting-edge technology with ecological fieldwork, and native plant enhancement. Critically, it also strengthens the sustainability and productivity of beekeeping, offering a replicable model for dryland regions worldwide.

Prosopis cineraria

Ziziphus spina-christi

Moringa peregrina

Vachellia tortilis

Acacia implexa

PP-573 [Pollination and Bee Flora]
Food for bees: A modelling framework for calculating daily floral resources availability across habitats and landscapes

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Together with nectar, pollen is one of the most important food sources for pollinators and contributes to the soil-plant-pollinator pathway of nutrient cycling. Access to balanced food resources is essential for the development, health, and fitness of bees and other pollinators. However, changes in the landscape and the associated loss of potential pollinator habitat result in the inaccessibility of key plant species that allow pollinators to thrive.
Our aim was to develop models and tools to assess the daily production of pollen, nectar and sugar and their changes throughout the year in flower-rich habitat types and flowering crops important for bees and other pollinators across Europe.

Our framework integrates data on the amount of pollen, nectar and sugars produced by a single flower unit (flower or inflorescence) of a given plant species with information on floral unit abundance (i.e. density of floral units per unit area), flowering phenology, plant composition of the habitat and mapping of habitats within the landscape. By combining this information with data on plant-pollinator interactions, it is possible to predict the spatio-temporal availability of floral resources to different types of pollinators within different habitat types and across different landscapes.

We applied our framework to 51 landscapes of 3x3 km in Denmark to predict the availability of floral resources for honeybees. We compared the model predictions with the results of honey pollen analysis from hives located at the central points of the analyzed landscapes. Honey samples were taken once per season, in late summer 2024, allowing the distribution and abundance of honeybee foraging resources to be determined from the beginning of the season to the time of sampling.

Mapping the spatio-temporal variability of floral resources in foraging landscapes of pollinators could help identify 'hungry gaps' where food supply is insufficient. It could help to better understand how landscapes, in particular farmland, can be improved for pollinators, benefiting the many crops and wildflowers that depend on them.

PP-574 [Pollination and Bee Flora]
Better steering bees for better crop pollination

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Department of Plant Protection Biology, Swedish University of Agricultural Sciences, Lomma, Sweden

As the climate changes, biodiversity loss accelerates, leading to increasingly unreliable pollination. This threatens global food security, forcing crop producers to rely more heavily on commercial pollinators, such as honeybees (Apis spp.), to meet the growing demand for flowering-crop-based products. Although effective pollinators of many crops, honeybees are generalist foragers and are known to have low or even absent affinity for target crops such as strawberries and pear. To mitigate this effect and avoid pollination deficit, farmers typically increase stocking density of honeybee hives, an approach that is not only economically unsustainable but may also have ecological drawbacks as competition with wild pollinators intensifies. Thus, there is a pressing need to enhance honeybee pollination efficiency for target crops, ensuring a more sustainable solution both economically and ecologically for farmers. To achieve this, the first step is to increase the attractiveness of the target crop to the honeybee forager. Here we present a recently commenced project aimed at evaluating a two-step method to enhance pollinator attraction to strawberry flowers, a crop known to have low attractiveness to honeybees. Using olfactory bioassays and free-foraging preference tests in semi-field environments, we investigate how (1) nectivorous flower-volatile-emitting yeasts and other olfactory attractants and (2) dietary conditioning enhance floral constancy and better steer pollinators toward target crops. Better steering honeybees to crops can help reduce stocking rates, minimizing the ecological impact of beekeeping while enabling beekeepers to provide more precise crop pollination for farmers. If successful, this two-step approach could contribute to more sustainable crop-pollination and beekeeping practices with honeybees.

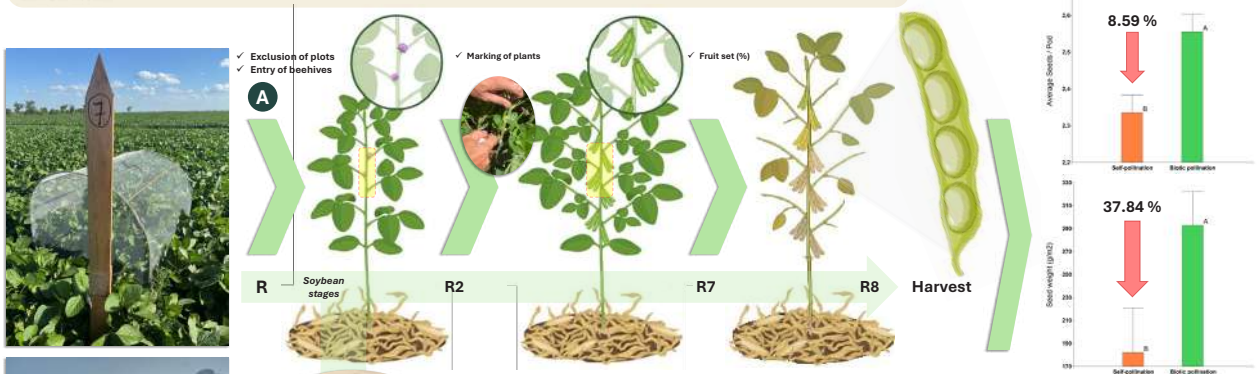
PP-575 [Pollination and Bee Flora]

Precision pollination in intensive systems: Technological opportunities for linking beekeeping and soybean production

Cavigliasso, Pablo; Vairolatti, Gabriel; Cerutti, Gabriel; Totis, Juan Pablo & Vairolatti, Soledad

Biotic pollination is essential for food production but remains undervalued in intensive crops such as soybean. Despite growing evidence of the positive impact of pollinators on agricultural productivity, few technological tools are available to monitor their activity in real time and optimize their management in the field. The development of efficient methods to predict pollinators activity, is crucial to improve the integration of beekepers into production systems.

The aim of our study was twofold: (1) to evaluate the impact of biotic pollination on soybean yield associated with honeybee hives, and (2) to validate a Pollination Efficiency Index (PEI) to predict the frequency of bee visits to the crop.
To evaluate pollination efficiency, experimental plots (1 m^2) were established in a soybean field in central Argentina, near the city of San Francisco in the province of Córdoba (latitude: 31°26'49" S; longitude: 62°08'43" W). Treatments included pollinator exclusion (self-pollination, n = 4) and exposure to pollinators (biotic pollination), with a focus on *Apis mellifera* **(A)**. Additionally, remote sensors mounted on the hives recorded pollen flow and foraging behavior. Alongside the remote measurements, we estimated the frequency of bee visits through visual observation in the different biotic pollination microplots **(B)**. This allowed us to cross-reference the different parameters.
The PEI, which was calculated at each station using the BeeVAI method to remotely estimate pollination efficiency based on eight parameters (environmental and hive), was related to the observed visit frequency at different distances from the hives to evaluate the correlation between these parameters **(C)**.
We analyzed the impact of pollinators on production parameters and the relationship between bee interaction in the crop and the PEI using generalized linear mixed models (GLMM), taking the distance of each plot from the honeybee hives into account as a random factor.



Our results showed that plots visited by *A. mellifera* produced 37.41% more soybean pods, 8.59% more seeds per pod , and 37.84% more total seed weight per unit area than excluded plots (GLMM: Z = 3.22, P = 0.0081; Z = 3.19, P = 0.0189; Z = 2.29, P = 0.0478, respectively). An increase in the frequency of bee visits was found to lead to an increase in pod formation (R^2 = 0.66; GLMM: Z = 3.59, P = 0.0003). Additionally, the proposed PEI daily mean values showed a significant correlation with the mean visit frequency recorded by field observations (R^2 = 0.57; GLMM: Z = 2.37, P = 0.0180), with a good fit observed up to 200 meters from the hives.

Our results confirm:

- ✓ **Pollination by honeybees in intensive agroecosystems such as soybean fields offers benefits** in terms of both quantity and quality, representing an opportunity for beekeepers.
- ✓ Simultaneously **predicting bee activity in different fields is crucial for optimizing logistics** and activities during pollination services, and the proposed **Pollination Efficiency Index (PEI) is an effective tool for this purpose**.

PP-576 [Pollination and Bee Flora]
DNA in honey describes the changes in flower visits and microbe encounters of honey bees over decades

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Background
Recent environmental changes due to land-use and climate change threaten also pollinators and the ecosystem service, pollination, they provide. To assess and understand what has changed and how, it is vital to find ways of comparing past and current interactions between pollinators, their floral resources as well as microbes that would be both beneficial and pathogenic to pollinators and the flowering plants.

Problem description
Honey bees are one of the world's most important pollinators. To understand how their interactions with the plants they visit, and the microbes they encounter in the environment have changed, we need points of comparison from the past.

Methodology
DNA in honey offers insights into the interactions of honey bees. Old honey samples could serve to describe honey bees' interactions in previous decades, providing a baseline against which to assess changes in interactions over time. Here we identify the taxonomic origin of plant, bacterial and fungal DNA in fifty-year-old and new honey samples by DNA metabarcoding and assess whether old honey samples could serve to show the interactions in the past.

Results and conclusion
The fifty-year old honey samples had preserved DNA of plants, bacteria and fungi, allowing us to show which plants honey bees visited, as well as the microbes, including pollinator and plant pathogens, honey bees encountered and possibly spread in the past. However, some differences in the DNA recovered between old and new honey suggest that differences in DNA degradation of different microbes could bias naive comparisons between samples. Thus old honey may be most useful for identifying interactions that historically occurred and should not be taken as proof that an interaction did not occur. With this, time series of honey may offer unique information about how honey bees' associations with flowers and microbes have changed during decades of environmental change.

Practical implications for beekeepers
Using old honey samples may allow to determine which kind of changes in the environment have caused changes in the flower usage and microbe exposure of honey bees. These can be used to mitigate unwanted changes, to conserve good floral resources and to help in disease management.

PP-577 [Pollination and Bee Flora]
There is a bee in my coffee!

Cristiano Menezes, Geraldo Stachetti Rodrigues
Embrapa Environment

The objective of this work was to consolidate a set of sustainable practices and develop an agroecosystem management tool for farmers to transform their farms into pollinator-friendly environments, aiming to maximize the provision of pollination services and their associated benefits. The environmental impact assessment technology for rural activities, APOIA-NovoRural, served as a model for the creation of a new module, APOIA-Polinização. Initially, coffee was the model crop, as it benefits from animal pollination and is economically significant for Brazil. The actions were structured around four key pillars that form an integrated pollination management approach: (1) Landscape management, which involves the strategic use of legally protected areas for permanent preservation and legal reserves, the restoration of degraded habitats, and the planting of bee pastures in underutilized areas of farms; (2) Pollinator management, which includes the logistics of distributing and renting bee nests, as well as establishing sustainable activities such as beekeeping and stingless beekeeping on farms; (3) Agricultural input management, which involves adopting best practices for the use of chemical pesticides, implementing compatibility protocols, optimizing application methods and timing, encouraging the use of biological inputs, and promoting ecological pest management; and (4) Production and commercialization management, which encompasses the transfer of technologies to enhance crop productivity and quality, as well as bee product quality, the development of food safety protocols, and certification processes aimed at adding value to both pollination-dependent crops and bee-derived products like honey. The management tool, established as an indicator-based system for recording, interpreting, and communicating field-observed attributes, allow farmers to: (i) diagnose the current state of integrated pollination management within their farms; (ii) develop an implementation plan for management improvements and recommendations to enhance pollination services based on farm-specific technical criteria; and (iii) monitor and communicate the short-, medium-, and long-term impacts of these changes using clear and effective economic, social, and environmental indicators. The tool and the set of practices that comprise it was implemented as a pilot in coffee production farms for validation and improvement.

PP-578 [Pollination and Bee Flora]
Pollinating bees of cultivated Myrtaceae

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Myrtaceae is one of the largest botanical family in the Brazilian flora, comprising approximately 1,000 species. Myrtaceae is well-represented in the Atlantic Forest and Cerrado, the two Brazilian biodiversity hot spots. Many species of Myrtaceae are of economic importance and have fleshy fruits also consumed by frugivorous animals, especially birds and mammals. “In Brazil, the estimated value of pollination calculated for Myrtaceae species totals approximately US$ 58 million, with Psidium guajava (guava) having the highest value, followed by Eugenia uniflora (pitanga) and Syzygium malaccense (jambo)". Many other species are employed in regional cultivation and are also used in urban landscape and reforestation projects, thus having immeasurable cultural and economic values.

There are over 40 species of Myrtaceae used as food crops in Brazil without any information regarding required pollinators. “We investigated the pollination biology and evaluated the potential pollinators of three target species: Campomanesia guazumifolia (sete-capotes), Eugenia brasiliensis (grumixama) and E. pyriformis (uvaia)."

The studied species bloom between August and December. All three species exhibited crepuscular flower opening around 05:00 am, with pollen as the sole floral resource. The flowers are white to yellow and emit sweet fragrances. Analysis of the breeding system indicated that these plants rely on floral visitors for fruiting. Bees were identified as the primary pollinators due to their behavior and frequency in visiting flowers. Social and solitary bees played distinct roles in the reproduction of these species. “Apis mellifera was the primary pollinator of Eugenia species; conversely, solitary bees took a leading role in the pollination of C. guazumifolia".

The attractive olfactory and visual floral traits and morphology for bees, with abundant pollen resources, as well as the sequential flowering of the species ensure the pollination of each of these crops regionally. The honeybee together with native bees play a crucial role in the fruit set of the studied Myrtaceae, guaranteeing the local production.

PP-579 [Pollination and Bee Flora]
Impact of climate change on honey bee food resources: a study at the European scale

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Plant-pollinator interactions are essential for plant productivity and ecosystem stability, as the majority of flowering plants depend on animal-mediated pollination, predominantly by bees. However, climate change poses increasing threats to these interactions, leading to vegetation loss and phenological mismatches. Despite these concerns, large-scale data on how such changes impact bee foraging resources remain limited. In this study, we leveraged a citizen-science network established within the framework of the European project "INSIGNIA-EU - Preparatory action for monitoring of environmental pollution using honey bees" to conduct an unprecedented Europe-wide study of pollen collected by honey bees (Apis mellifera). We used the ITS2 metabarcoding method to identify at the species level over 2,500 pollen samples collected fortnightly between May and August of 2023 from traps deployed in 310 apiaries located across all 27 EU countries. Using the relative abundances estimated from ITS2 sequence reads, we examined geographic and temporal distributions of floral resources and assessed risks of interaction losses under varying climate change scenarios. Additionally, we estimated the temperature and precipitation niche distributions of the plant resources identified to assess their risk towards environmental change. Our findings indicate that increasing temperatures and declining precipitation significantly reduce the diversity of foraging resources throughout Europe, by pushing many plant species beyond their climatic tolerance thresholds. This is a major concern, even when considering resilience through geographic and temporal shifts in resources, because the changes in plant diversity pose serious risks to bee nutrition, ecosystem health, and food security. Moreover, Southern Europe is projected to experience the most severe impacts, with some already observable. This study highlights the urgent need for measures to mitigate climate change effects on plant-pollinator systems, emphasizing their critical role in both ecological balance and agricultural productivity.

PP-580 [Pollination and Bee Flora]
Assessing pollinator food resources – a step-by-step guide using experimental and/or literature data

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Establishing and enhancing pollinator-friendly habitats in agricultural landscapes requires an understanding of their nectar and pollen production capacity. In order to assess the spatial and temporal availability of floral resources at the landscape scale, it is essential to first determine the floral resource production and flowering phenology of individual plant species, as well as the flora composition and distribution of habitats within the landscape.

However, for many plant species there is still limited information on their contribution to floral resource production in different habitat types. This gap in knowledge may be due to the labor-intensive and time-consuming nature of the field and laboratory work required, as well as the lack of standardized methodologies. We have, therefore, aimed to develop a method that is cost-effective and user-friendly.

Our method involves the assessment of flora composition, flowering phenology and flowering abundance, followed by quantification of nectar and pollen production per flower unit. The data thus obtained can be integrated into existing databases on floral resource traits, such as the comprehensive database of Filipiak et al. (2022), which is the first to compile data on food resources produced by both wild and cultivated plants in different ecosystems.

Further, we developed quantification methods that allow the extrapolation of species-level information to the habitat level, and further extend the analysis to the landscape level. Our methodology provides a basis for obtaining the total amount of food resources and illustrating their spatial and temporal distribution within a landscape. This approach can facilitate the identification of the most beneficial habitats to support continuity of food supplies for pollinators.

The developed method resulted from:
- the project no. PPN/IWA/2018/1/00103/U/0001 funded by the Polish National Agency for Academic Exchange (obtaining part of original data)

- the project no. NdS/547976/2022/2023 funded by the Ministry of Education and Science Republic of Poland, Science for Society Programme (method documentation)

- the Better-B project, which has received funding from the European Union, the Swiss State Secretariat for Education, Research and Innovation (SERI) and UK Research and Innovation (UKRI) under the UK government's Horizon Europe funding guarantee (grant number 10068544) (compilation of literature data)

APIMONDIA SCANDINAVIA 2025
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PP-581 [Pollination and Bee Flora]

APIMONDIA SCANDINAVIA 2025 23-27 SEPTEMBER COPENHAGEN

TECNOLÓGICO NACIONAL DE MÉXICO

Antioxidant and antibacterial properties of ethanolic pot-pollen extracts of *Melipona beecheii* and determination of main components

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INTRODUCTION

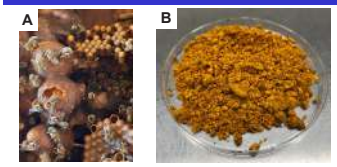


Figure 1. A) *Melipona beecheii*. **B**) *Melipona beecheii* pot-pollen.

Melipona beecheii pot-pollen is a natural product of high cultural value in traditional Maya medicine but remains less studied than honey or propolis. It is considered nutritionally complete and contains metabolites with biological activity that may aid in the treatment of foodborne and oxidative stress-related diseases.

Chronic and neurodegenerative diseases are global health concerns, often linked to oxidative stress (an imbalance caused by excess of reactive species). This imbalance is also related to gastrointestinal problems, it can also disrupt native bacterial microbiota and promotes foodborne bacteria that form biofilms and exhibit antibiotic resistance. These challenges require alternative antimicrobial and antioxidant sources as the ones found in nature.

METHODOLOGY

Figure 2. Pot-pollen samples from five sites in the Yucatan peninsula.

Figure 3. Obtaining the *Melipona beecheii* pot-pollen ethanol crude extract.

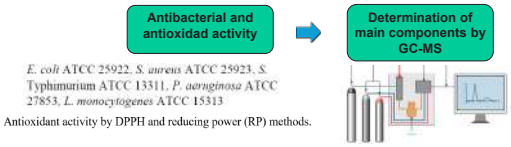
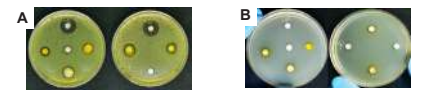


Figure 4. Biological activity and chromatographic analysis.

RESULTS



C

Extracto	CMI (mg / ml)				
	E. coli ATCC 25922	*S. Typhimurium* ATCC 13311	*P. aeruginosa* ATCC 27853	*S. aureus* ATCC 25923	*L. monocytogenes* ATCC 15313
MPC-1 Mama	8 ± 0.01[a]	8 ± 0.01[a]	6 ± 0.01[a]	40 ± 0.38[b]	8 ± 0.01[a]
MPC-2 Ticimul	40 ± 0.11[b]	40 ± 0.06[b]	6 ± 0.03[a]	40 ± 0.16[b]	8 ± 0.01[a]
MPC-3 Maní	40 ± 0.12[b]	8 ± 0.03[a]	8 ± 0.03[a]	40 ± 0.07[b]	8 ± 0.02[a]
MPC-4 José Ma. Morelos	40 ± 0.08[b]	8 ± 0.03[a]	8 ± 0.05[a]	8 ± 0.09[a]	8 ± 0.03[a]
MPC-5 Calkiní	40 ± 0.15[b]	40 ± 0.02[b]	8 ± 0.01[a]	8 ± 0.04[a]	8 ± 0.05[a]

D

Pot-pollen ethanol extract	IC_{50} DPPH (µg/ml)	IC_{50} RP (µg/ml)
MPC-1 Mama	28 ± 0.014[a]	30 ± 0.025[c]
MPC-2 Ticimul	70 ± 0.011[d]	40 ± 0.030[d]
MPC-3 Maní	55 ± 0.057[e]	50 ± 0.169[e]
MPC-4 José Ma. Morelos	80 ± 0.062[f]	40 ± 0.115[d]
MPC-5 Calkiní	17 ± 0.014[b]	20 ± 0.078[b]
Ac. ascórbico	3 ± 0.048[g]	2 ± 0.033[a]

Figure 5. Antibacterial activity of pot-pollen ethanol extracts against **A**) *Pseudomonas aeruginosa* and **B**) *Listeria monocytogenes*. **C**) Minimum inhibitory concentration (MIC). *P. aeruginosa* and *L. monocytogenes* were the most susceptible strains to all the extracts (MIC: 6-40 mg/ml). **D**) Antioxidant activity by DPPH (EC50 28µg/ml) and Reducing power (RP) (EC50 30 µg/ml) methods.

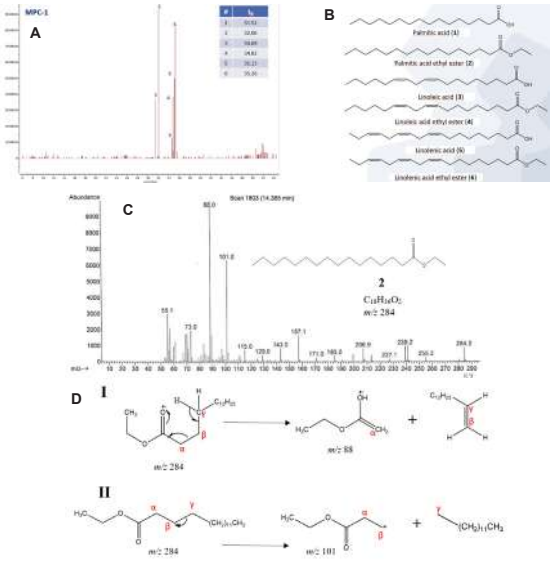


Figure 6. Gas-Chromatography - Mass Sepectroscopy analysis (GC-MS) **A)** Gas chromatogram of pot-pollen ethanol extract (MPC-1). **B**) Metabolites identified in the pot-pollen ethanol extract. **C**) Mass spectrum of palmitic acid ethyl ester (**2**). **D**) Fragmentation by Mass Spectrometry of palmitic acid ethyl ester (**2**).

CONCLUSIONS

The aim of this work is to contribute as far as posible to Yucatan peninsula's flora influencing in the value-added perceived that has not been recognized until nowadays and that is linked to the vegetal species in this región. The Discovery of valuable metabolites in studied and middle-know species contribute to the protection of ecosystems since their value and their biocultural diversity is attended and prometed its conservation.

ACKNOWLEDGMENTS

The authors wish to thank the Laboratorio de Microbiología Aplicada y Molecular at Instituto Tecnológico de Mérida for the facilities provided for this research.

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PP-582 [Pollination and Bee Flora]

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Evaluation of the antioxidant and antibacterial potential of phenolic compounds extracted from *Melipona beecheii* honey against *Salmonella enterica* Typhimurium and *Listeria monocytogenes*

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INTRODUCTION

Melipona beecheii honey has been used since ancienty times for its medicinal properties. This food is made from the néctar of flowers, which is transformed in the stomach of bees. This honey is mainly composed of monosaccharides and polysaccharides and also contains other minor molecules, such as proteins and phenolic compounds. The latter have demonstrated their ability to inhibit the growth of bacteria such as *Escherichia coli* and *Staphylococcus aureus*. To evaluate the antioxidant and antimicrobial activity of phenolic in *M. beecheii* honey against *Salmonella enterica* Typhimurium ATCC 13311 and *Listeria monocytogenes* ATCC 15313.

METHODOLOGY

The honey was collected from Ticimul, Yucatán, México

The extraction of phenolic compounds (PE) was carried out according to the method described by Ferreres et al. (1994) using Amberlite XAD7HP columna, and methanol as a mobile phase.

Crude phenolic extract (CPE)

Antimicrobial activity and minimum inhibitory concentration (MIC) (Ramón-Sierra et al. 2020)

The antioxidant activity of PE was carried out by DPPH mechanism and reducing power.

RESULTS

M. beechii honey contains 50.17 ± 2.5 mg of gallic acid equivallent (GAE) per 100 g of honey.

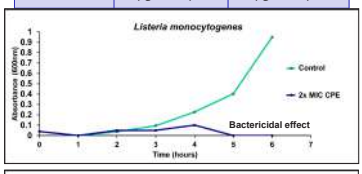
Antimicrobial activity

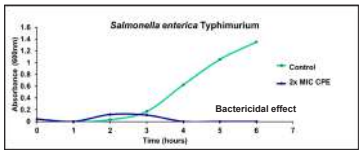
Salmonella enterica Typhimurium

Listeria monocytogenes

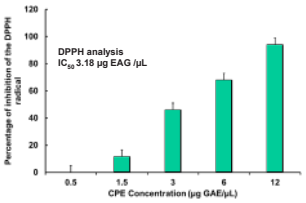
Minimum inhibitory concentration

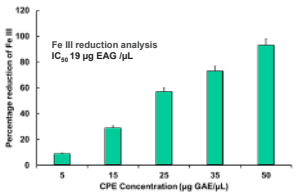
	Salmonella enterica Typhimurium	*Listeria monocytogenes*
ECF	111.5 ± 1.2 µg EAG/ µL	100 ± 1.2 µg EAG/ µL





Antioxidant activity





CONCLUSIONS

The phenolic extract of *M. beecheii* exhibits antimicrobial activity against *S. enterica* Typhimurium and *L. monocytogenes* in addition to presenting antioxidant activity. This finding contributes to the understanding of *M. beecheii* honey as a functional food with bioactive characteristics, as well as its potential to promote health.

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The authors wish to thank the Laboratorio de Microbiología Aplicada y Molecular at Instituto Tecnológico de Mérida for the facilities provided for this research.

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PP-583 [Pollination and Bee Flora]
In vitro evaluation of melliferous plant seed germination under field conditions with and without fire exposure – a preliminary study

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Beekeeping plays a vital role in biodiversity conservation and ecosystem resilience by ensuring pollination services for wild flora and agricultural crops. In Portugal, the production of Protected Designation of Origin (PDO) honey faces growing challenges due to landscape degradation, recurrent wildfires, and the spread of invasive species. These factors reduce the availability of melliferous flora, directly impacting the hive productivity and the economic sustainability of PDO honey production. This study evaluates the germination and regeneration two highly honeybee relevant plant species — Lavandula pedunculata and Cistus ladanifer— under burned and unburned conditions, while also assessing the germination capacity of the invasive Cytisus spp.

Experimental plots (100 m²) dominated by Lavandula pedunculata and Cistus ladanifer were established, with controlled fire applied to some plots, while others remained unburned as controls. Seeds were collected in August and September 2024 and subjected to in vitro germination trials. Two sterilization treatments were applied (7-12 minutes in bleach with Tween 80), along with two germination conditions: continuous light, or 7 days in darkness followed by light. Germination occurred in a growth chamber (16 h light / 8 h dark photoperiod, 22°C) using 9% water-agar medium autoclaved at 120°C and 1 atm for 15 minutes.

Lavandula pedunculata (unburned) showed the highest germination rates, reaching 100% under light and 94% under initial dark conditions with 12-minute sterilization. Burned Lavandula had lower germination (80%) and higher seedling mortality in darkness. Cistus ladanifer germinated more slowly, particularly under initial darkness, with 31.5% germination after 4 weeks when moved to light. Cytisus spp, an invasive species, showed strong post-fire germination potential, reaching 35% after 12 minutes of sterilization.

This work, developed under the BeeLand project, highlights Cistus ladanifer's ability to rapidly colonize degraded soils, with robust root and leaf development, particularly under dark conditions followed by light. Its pioneer role in ecological restoration, contributing to soil stabilization and facilitating native vegetation succession, is reinforced. These findings support integrating ecological restoration and sustainable land management to improve the resilience of honey-producing landscapes

PP-584 [Pollination and Bee Flora]

Unifloral honeys from native plants produced at the protected area of Montes del Queguay, Uruguay: palynological characterization

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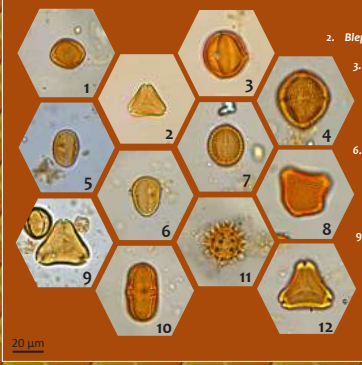
INTRODUCCION

- Melissopalynological analysis of 40 honeys to determine botanical origin and to evaluate the possibility of geographical identification
- Location: Montes del Queguay Area, Paysandú Department in Uruguay (area included into the protected area system-SNAP)
- Area characterization: great diversity of environments and types of vegetation, species with priority for conservation, including one of the largest masses of natural riverside forests.
- Sampling: honeys from main harvest season over 3 consecutive years (2022, 2023 and 2024)
- Methodology: standardized methods for melissopalynology (Louveaux et al. 1978)

MAIN POLLEN TYPES and frequency in samples (%)

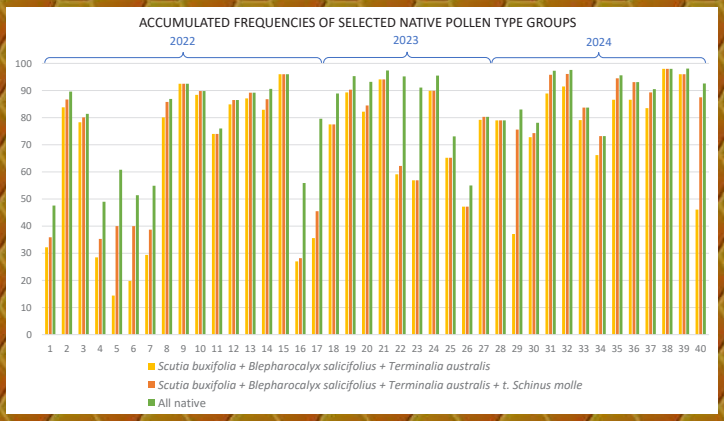


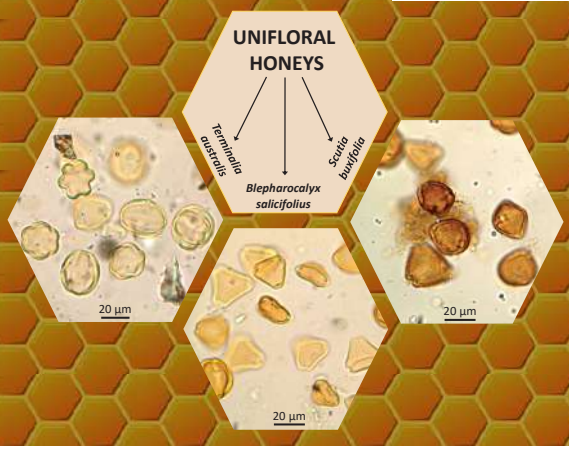
1. *Scutia buxifolia* (100%) *
2. *Blepharocalyx salicifolius* (100%) *
3. *Terminalia australis* (100%) *
4. t. *Schinus molle* (93%) *
5. *Lotus* spp. (80%)
6. *Echium plantagineum* (80%)
7. *Salix* sp. (75%) *
8. *Allophylus edulis* (55%) *
9. Myrtaceae (native) (60%) *
10. *Eryngium* sp. (90%) *
11. *Baccharis* spp. (73%) *
12. *Eucalyptus* sp. (88%)

* = native taxa

RESULTS

- 136 pollen types identified in 40 samples, 45 representing native taxa
- 19 samples resulted unifloral from native plants
- 13 unifloral honeys of *Blepharocalyx salicifolius* (3 on 2022, 2 on 2023 and 8 on 2024)
- 3 unifloral honeys of *Scutia buxifolia* (2 on 2022 and 1 on 2023)
- 3 unfloral honeys of *Terminalia australis* (1 on 2022 and 2 on 2023
- In 2024, only *Blepharocalyx salicifolius* unifloral honeys were obtained
- *Blepharocalyx salicifolius*, *Scutia buxifolia* and *Terminalia australis* were present in 100% of de samples with accumulated frequencies above 46% in 80% of the samples
- Accumulated frequencies of all native taxa per sample was above 46% in all the samples





DISCUSSION AND CONCLUSSIONS

- Beekeeping production in the studied area is highlighted by the production of unifloral honeys from native plants.
- Pollen spectra show high diversity but are almost always dominated by native taxa, were *Blepharocalyx salicifolius*, *Scutia buxifolia*, *Terminalia australis* and t. *Schinus molle* play a special role as nectar resources for bees.
- Diminishing in frequencies of native taxa are associated to blossoms of prairies (*Lotus corniculatus*), artificial woods (*Eucalyptus* spp.) and cultures (*Brassica napus*).
- On the basis of the data herein obtained, it can be assumed that the pollen characterization of unifloral honey samples from native species produced at Montes del Queguay Protected Area would be feasible from both botanical and geographical points of view.
- These results could stimulate producers to strength their beekeeping practices to harvest honeys with specific characteristics in order to search for an added value of their products.

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PP-585 [Pollination and Bee Flora]

Automated monitoring of pollinator visitation in agriculture

Sandra K Evans and GC Clouston

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Introduction

A significant proportion of agricultural crops are dependent on insect pollination, by both wild bees and managed honey bee colonies. Monitoring and measuring the presence, density and diversity of pollinators as well as their distribution in the crop provides further understanding of the dynamics of pollination communities in an agricultural context and how they affect crop yields.

Traditional methods for estimating pollinator visitation rates (bees on flowers, BOF) rely on manual observations, which are time-consuming, labour intensive, and often lack granularity. Consequently, growers frequently encounter undetected pollination deficits during this critical stage of crop development. Insufficient pollination results in both lower crop yields and poor quality produce, leading to economic losses for growers and seed producers, impacting incomes, market prices and customer satisfaction and ultimately, food security.

In-Field Sensor

Light
Tracks photoperiod and meteorological conditions.

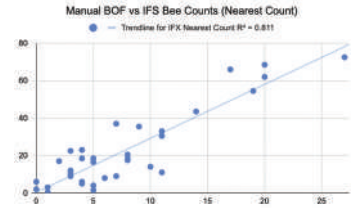
Humidity
Optimises fungicide application timing.

Temperature
Monitors growing degree days, frost alarms.

Accelerometer
Ensures correct installation, orientation and maintenance.

Acoustics
Identifies winged pollinators and pests, without the need for line of site.

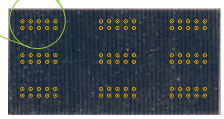
Accuracy



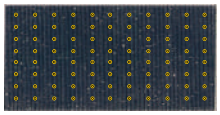
The number of bees observed manually vs. in-field sensor bee counts using acoustics

Topology

Sensors can be spread in an even mesh across the whole field giving both spatial and temporal information. This generates useful information on the consistency of pollinator distribution. Alternatively, the sensors can be distributed in multiple high density clusters, generating much higher resolution data on pollinator visits. A typical application of clustering is when evaluating relative pollinator visitation to male and female lines, and the pollinator distribution between them, during hybrid seed production.



Cluster: Small groups or clusters of sensors



Mesh the whole field using hundreds of sensors

Crop Types

The sensors have been used worldwide across various crops to monitor pollination and optimize hybrid seed production and pest management.

- Apple
- Almond
- Avocado
- Blueberry
- Broccoli
- Canola
- Carrot
- Kiwi
- Macadamia
- Onion
- Oil seed rape
- Radish
- Raspberry
- Strawberry
- Sunflower
- Watermelon

User Interface

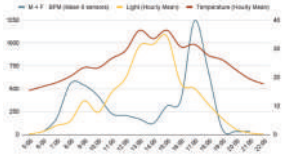
BeeHero monitors pollination activity, temperature, and humidity across the entire crop, giving growers a complete picture of their fields. Building on this, we now also track biodiversity and pest presence, providing deeper insights that support stronger yields and healthier hives.

Results

First 5 Days in Apple Orchard
Bee activity closer to hives. More activity on pink lady. More activity on pollinizers.

Last 5 Days in Apple Orchard
Lower activity on pollinizers and overall. Activity moving up rows. More on Cosmic Crisp.

Impact of Environmental Conditions on Bee Foraging in Vegetable Seed



Bee Visitation to Different Cultivars of Almonds

Real-time, In-Field Response

One of our growers consistently noticed lower yields in one corner of their field. Using PIP technology, we identified reduced pollination activity in that area. By bringing in more bees at the right time, we equalized pollination and improved yields.

Avg. Bees Per Minute

	May 9	May 10 +8 hives	May 11
Point 1	0.61		0.65
Point 2	0.55		0.80
Point 3	0.48		0.94
Point 4	0.37		0.59

If you can monitor it, you can manage it.

Hazera Seeds of Growth · Limagrain · Bayer Crop Science · syngenta · Pioneer Hi Bred International · Pacific Seeds · Rijk Zwaan · BASF We create chemistry

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PP-586 [Pollination and Bee Flora]

Insect pollination of wild and cultivated vanilla in Peru

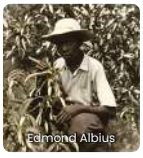
Sandra K Evans and Huw Evans

Introduction

Vanilla is part of the orchid family and is the second most expensive spice in the world (the first being saffron). 98% of the vanilla we consume today is synthetic, while the remaining 2% is cultivated. 100% of cultivated vanilla is hand pollinated; this manual and labour intensive process is further complicated by the vanilla flower only being open for one day. Indigenous to Central and South America, insect pollinated wild vanilla is rare, impractical to harvest, and not commercially available. If the pollination could be automated, vanilla could become one of Peru's largest exports.

Background

The vanilla plant avoids self pollination using a mechanical system, the mechanism relies on the visiting insects to be specific dimensions. Different species of vanilla come in different sizes, requiring different sized insects for successful pollination. When French colonialists first brought vanilla back to Europe 1819, it would not fruit (produce pods) due to a lack of native pollinators. At the age of 12, a young slave called Edmund Albius discovered the physical mechanism and developed a method that made it possible to pollinate vanilla by hand.


Edmond Albius

Aims and Objectives

Wild Pompona

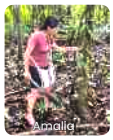
The primary objective of this study was to identify the wild pollinator of Vanilla pompona, known for its large aromatic pods, allowing cultivation in its natural habitat, generating valuable income for indigenous communities who are stewards of this species' habitat. Working with an indigenous community in Ucayali region of Peru, we used chemical lures, sound recording equipment and camera traps to identify what we believe to be the wild pollinator of this plant - Eulaema cingulata. Second objective was to explore the use of honey bees as pollinators of cultivated vanilla at San Rocco (Junin region), the first and largest producer of Vanilla planifolia in Peru.

Planifolia

Wild Vanilla Pompona

Our Mission: To identify the wild pollinator of vanilla in the Peruvian rain forest.

Paradishari


Amalia

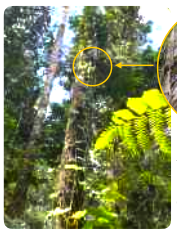
Daughter Alexa

Brother Wilde

Cousin Carlos

Amalia lives in a small semi closed community in the heart of the Peruvian rainforest. She is a school teacher and has started cultivating Vanilla pompona to help subsidise her small cacao plantation, all to help feed her young daughter Alexa. Transported by her brother and guided by her cousin, we set off into the rain forest in search for wild Vanilla pompona.

First sighting of wild Vanilla Pompona



First sighting of flowering Vanilla pompona. Not accessible, too high to monitor.

Eulaema Cingulata

Using a chemical lure (Benzyl acetate) within 30 seconds we managed to attract Eulaema cingulata which very quickly began to show keen interest in an opening orchid flower found by our guide Carlos.

Next Steps: Establish if Eulaema cingulata can be reared as livestock.

In a similar way that bumble bee colonies have been bred in cardboard boxes to pollinate crops in poly tunnels, research suggests a similar approach can be taken with large orchid bees.

Cultivated Vanilla Planifolia

Our Mission: To verify if a honey bee has the correct dimensions for pollination.

San Rocco is the first and remains the largest producer of Vanilla planifolia in Peru. Covered growing areas provide both shade and bio isolation as the plant is not indigenous to Peru. San Rocco also produces coffee and honey managing their own honey bee colonies.

Plan A: "Flower at hive entrance" The first attempt to lure a honey bee into an orchid flower was to add some honey and leave the flower at the entrance to a hive. Unfortunately the africanised bees attacked the flower confusing it as an intruder.

Plan B: "Forage flower" Hoping the bees would treat forage with greater compassion, we baited an orchid flower placed further away from the hive trying various rewards. From right to left: brown sugar syrup, white sugar syrup, honey from shop, home brew swarm lure made using aniseed tea, bees own honey type 1 and bees own honey type 2. None succeeded.

Plan C: "Coma bee" Put a bee in the freezer, insert unconscious bee in a flower, then observe if the bee triggers the pollination mechanism when it gains consciousness and reverses out.

Plan D: "Dead bee on wire" Take a dead bee, that was possibly in the freezer too long, put it on a wire (we salvaged from an old brood frame), physically guide the bee into a vanilla flower, withdraw the bee to see if it collects a parcel of pollen on its thorax. Then push that bee back into a different flower observing the pollen being deposited.

We have videos we can show at the poster presentation

Next Steps: Establish if honey bees can be trained to visit orchid flowers.

Bees have been employed to detect land mines, using a reward (sugar syrup) with an added odour of TNT, the bees learn to associate the reward with the smell of landmines. When the feeder is closed the bees seek the same scent elsewhere. The next step is to adopt this approach but using the smell of orchid flowers.

We would like to acknowledge the help of Jessica Ortega Castro and Choco Peru for the introduction to Amalia and arranging access to the Chicosa tribe. We would also like to thank Amalia Cacique for providing food, accommodation and for her general tenacity and determination without which this work would not have been possible.

BeeHero X
The innovation arm of BeeHero
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We would like to acknowledge the help of Gustavo Uccelli Romero, the staff of San Rocco and Gilmer the farm manager/ beekeeper for the opportunity, accommodation. Without this help and support this work would not have been possible.

PP-587 [Pollination and Bee Flora] [Poster Gelecek]

Improving the efficiency of almond pollination using fewer stronger hives

Dr Huw Evans

Introduction

Founded in 2017, BeeHero is the world's largest provider of precision pollination, delivering data-driven managed pollination for commercial crops. A lot of our efforts are focused on optimizing how bees are used for almond pollination in California's Central Valley. Using electronic monitoring equipment, we can establish and optimize the ideal state of a bee colony to maximize the amount of pollination trips made by that colony. Monitoring bees leaving hives vs bees in the crop gives us valuable insights into alternative forage and post-bloom foraging opportunities. We also optimize hive placement in or around the crop, the total number of hives required and how these hives are distributed across the drops. Most recently, we have been investigating the effects hive orientation has on pollination trips. General beekeeping advice on hive placement suggests there are benefits from the entrance of the hive having a southernly (in the northern hemisphere) or easterly exposure. While amateur beekeepers tend to have a lot more flexibility with the direction in which they orientate their hives, for reasons of practicality, this is not a freedom most commercial beekeepers enjoy, especially when shipping bees for pollination services. We therefore started investigating if the strength of the colony could reduce the importance or significance of hive orientation.

Methods and Materials

The experiment was conducted at an almond orchard situated east of Fresno, in California's Central Valley. The experiment was run in collaboration with a team from the USDA ARS, Honey Bee Breeding and Genetics, Batton Rouge, LA. The team were assessing the foraging behaviour of Pol-line bees, a strain of bee specifically bred by the USDA for pollination. A comparison was made with the foraging behaviour of Russian bees. It was important that all comparisons between strains were made under the same environmental conditions so in the same orchard, two pallets of the Pol-line bees were placed next to two pallets of Russian bees. We concluded the addition of stock bees would make a valuable control. This is where working for the world's largest pollination supplier (BeeHero) proves invaluable, following a phone call late that evening, we arrived on site the following morning to find two pallets of stock bees sitting next to the pallets of Pol-line and Russians.

We monitored a total of 24 colonies, placed on six pallets. each supporting 4 hives. Inherent to the configuration on the pallets, 12 colonies' entrances faced due east while the other 12 faced due west. Colonies were fitted with proprietary electronic equipment to track the bees' behaviour. Every five minutes, readings were taken from the the sensors, and every 20 minutes this information was conveyed back to the cloud via the cellular network using a communications gateway. This allows us to remotely monitor data coming back from each colony. Flight or foraging activity is monitored using bee counters fitted across the hive's entrance. The bee counter has 26 tunnels, each with two light beams. The order in which the bee breaks the light beams signifies direction, allowing the bee counter to log both bees leaving and bees returning to the hive. A weather pack collects wind speed and direction as well as ambient air temperature and rainfall. This meteorological information is extremely valuable as it gives context to all other monitored parameters.

Results

Figure 1 shows the start times of east facing colonies (Blue line) vs the start time of the colonies facing west (Orange line) from mid-February until mid-March 2023. Colonies facing east tend to start flying sooner than the west facing colonies. There are some exceptions, where bad weather delayed all colonies activity until later in the day, when any advantages of facing the early morning sun were lost. On average, across the whole season, we calculated colonies facing east started flying an average of 45 minutes before those facing west, which is in very close agreement with USDA (Tuscon, AZ) original findings on hive orientation. We then investigated how the strength of a colony may affect its sensitivity to orientation. When grouped by strength there was little to no difference in flying start times in east facing colonies. However, we observed a much bigger difference in foraging behaviour between the strength groups in colonies facing west. We found that weaker colonies start flying as much as two hours later than their stronger counterparts facing in the same direction (Figure 2).

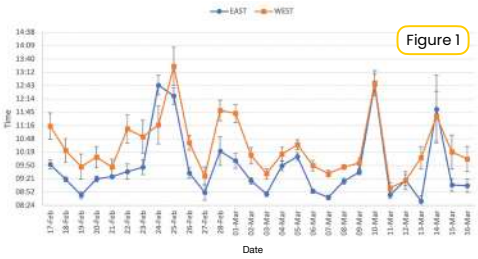

Figure 1

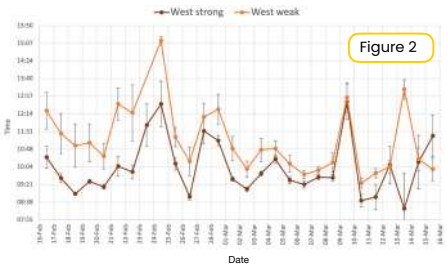

Figure 2

Discussion and Conclusion

Our results show that stronger colonies, across all three strains of bee, are far less sensitive to hive orientation. This is an important finding when seen from the perspective of a pollination service provider. Commercial beekeepers tend to keep their hives on pallets, where the hives face in opposing directions. It would be impractical to group the hives on a pallet by strength, trying to ensure all weak colonies face east. Likewise, it would not be practical to communicate a preferred pallet orientation to the person delivering the bees to site. These findings reframe how a grower pays for pollination. Traditionally, growers pay for the number of hives – most often two hives per acre, an attitude primarily driven by crop insurance companies, keen to ensure the crop received adequate pollination. However, this model fails to account for colony strength. Moving to "bee frames per acre" is a more sophisticated approach, but still neglects the fact that we can no longer compare a frame of bees with a frame of bees. A single bee frame in a weak colony facing west will start foraging later then that same frame of bees in a stronger colony facing west. As we move into the era of precision pollination, shifting to the metric of pollination trips per acre is advised. Thus, if a single twelve-frame colony, on average, provides more pollination trips than the total trips made by two six-frame colonies, in theory, the same number of pollination trips could be achieved using less than half as many bee hives. This has obvious advantages for all stakeholders involved in the pollination industry, particularly given that more than two million hives are transported annually to California's almond orchards.

USDA

We would like to acknowledge the help of the USDA. The team was lead by Dr. Elizabeth (Liz) Walsh and included Drs. Frank Rinkevich, Kate Ihle, and Mike Simone-Finstrom.

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Hive Orientation and Colony Strength Affect Honey Bee Colony Activity during Almond Pollination
Sandra Kordić Evans; Huw Evans; William G. Meikle; George Clouston
insects 2024, Volume 15, Issue 2, 112

PP-588 [Pollination and Bee Flora]
Is pollen from wind-pollinated species an overlooked gem? Assessing amino acid profile in 30 plant species

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Many species of wind-pollinated plants are frequently visited by bees to collect pollen. This has been especially observed in solitary bees; for example, pollen from poplar (Populus), oak (Quercus) and birch (Betula) is often found in the pollen provisions prepared for the offspring of the red mason bee (Osmia bicornis). Honeybees also collect pollen from wind-pollinated species, such as common hazel (Corylus avellane) and maize (Zea mays).
Pollen from wind-pollinated plants is often considered as of poor quality. Yet, data on its chemical composition is generally scarce.

The main objective of this study was to determine the amino acid composition in pollen of wind-pollinated plants on which bees were reported to forage. Twenty four tree species and six herbaceous species were included in the analyses. Assessment of the amino acid composition were performed using ion-exchange chromatography (IEC).

The highest concentration in the aqueous phase was found for proline and arginine in most species. In samples after acid hydrolysis, high amounts of aspartic acid, glutamic acid, alanine, leucine, and lysine were detected across samples?. Among non-proteinogenic amino acids, gamma-aminobutyric acid was found in all pollen samples. The highest content of water-soluble amino acids was detected in the pollen of Cannabis sativa, Picea abies and Populusspp. Protein-bound amino acids were of high concentration in the pollen of Fraxinus excelsior, Plantago media and Quercus palustris.

This study fills the gap in knowledge on pollen resources quality and suggests the need to reconsider wind-pollinated species in managing pollinator-friendly habitats.

The study was a part of the project no. 2023/07/X/NZ8/00792 funded by the National Science Centre, Poland.

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PP-589 [Pollination and Bee Flora]

Historical agroeconomic analysis of the relationship between commercial pollinator use and *Vaccinium angustifolium* (lowbush blueberry) (Ericales: Ericaceae) yield in Quebec, Canada (2015-2021)

Mireille Levesque[1], Frédéric McCune[2], Valérie Fournier[2], Pierre Giovenazzo[1] (Pierre.Giovenazzo@bio.ulaval.ca)
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Introduction

Lowbush blueberry is Canada's top fruit export, relying on insect pollination for productivity. As blueberry flowers require insect pollination, blueberry farms rely on commercial pollinators to ensure productivity of their fields.

Our study aimed to assess the impact of commercial pollinator density and diversity on lowbush blueberry yield using historical data, from 2015 to 2021, across various production contexts.

Methodology

Using data from 178 fields (≈3,000 ha; 11% of Québec's production) collected between 2015 and 2021, we assessed how commercial pollinator density and diversity affect yield. We analyzed honey bees (*Apis mellifera*), bumble bees (*Bombus impatiens*), and alfalfa leafcutter bees (*Megachila rotundata*), along with field characteristics, hive strength, landscape, and weather.

Statistical analyses were conducted in R (v4.1.2; R Core Team, 2021) using mixed linear models (nlme::lme). All models included the nested random effects of field, site, and farm, as well as year as a fixed effect.

Honey bees
Apis mellifera

Bumble bees
Bombus impatiens

Alfalfa leafcutter bees
Megachila rotundata

Selected results

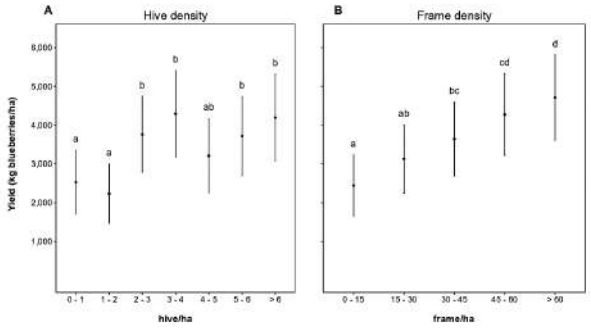


Figure 1. Mean (± SE) yield (kg blueberries/ha) of lowbush blueberry fields in relation to (A) honey bee hive density (hive/ha, n=562) and (B) frame density (frame/ha, n=395) Statistically different groups ($p < 0.05$) have different letters.

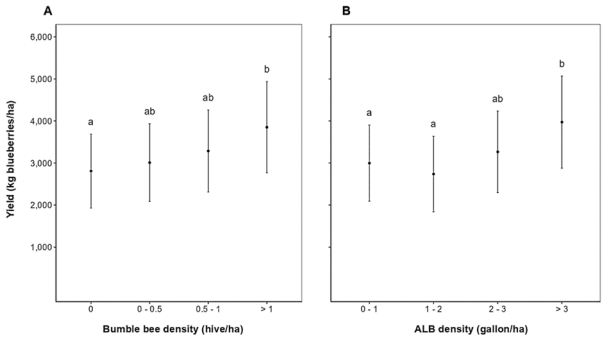


Figure 2. Mean (± SE) yield (kg blueberries/ha) of lowbush blueberry fields (n=562) in relation to (A) bumble bee density (hive/ha) and (B) alfalfa leafcutter bee (ALB) density (gallons/ha). Statistically different groups ($p < 0.05$) have different letters.

Conclusions

- Pollinator density and diversity, combined with environmental factors, play a major role in lowbush blueberry productivity.
- Yields increased with higher densities of honey bee frames, bumble bee hives, and leafcutter bee gallons, and were further boosted by pollinator diversity.
- Yield was also influenced by year, snow cover, field age, and frost during pollination.

Reference manuscript

Levesque M. & al. 2025. Historical agroeconomic analysis of the relationship between commercial pollinator use and *Vaccinium angustifolium* (lowbush blueberry) (Ericales: Ericaceae) yield in Quebec, Canada (2015-2021). https://doi.org/10.1093/jee/toaf242

PP-590 [Pollination and Bee Flora]

HiveTracks
know your bees!

Leveraging Beekeeper Data for Biodiversity Monitoring, Reporting, and Validation (MRV)

Author: Dr James Wilkes, Max Rünzel; HiveTracks, Inc. Creston, North Carolina, United States of America

Keywords: Biodiversity MRV · Honey bees · Plant–pollinator interactions · Ecosystem services · Environmental monitoring

The Challenge

Biodiversity underpins food, water, and ecological stability. Yet, current monitoring methods are either too broad (remote sensing) or too narrow (field assessments).

Our Approach

HiveTracks uses a global network of beekeepers to systematically monitor plant–pollinator interactions. This provides a scalable, ground-truthed model for biodiversity assessment.

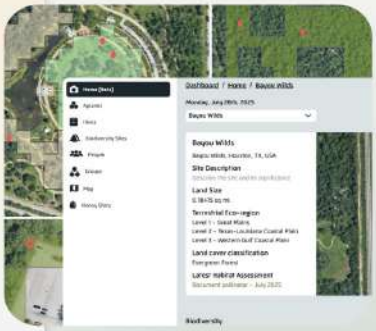
Data Collection

Beekeepers collect:

- Apiary locations
- Colony health metrics (population, brood, queen status)
- Harvest data
- Photos of hives, brood patterns, plants & pollinators

Technology Backbone

- Mobile & web apps for data entry and image uploads
- AI-powered species recognition (with metadata: time, location)
- GIS-based sampling strategies to calculate abundance & diversity (e.g., Shannon Diversity Index)



Enriched with External Data

- Land use maps
- Weather & climate data
- Flowering & resource availability datasets

Impact

- Tracks biodiversity trends at local to global scales
- Bridges macro desktop models with ground-truthed field data
- Supports conservation, sustainable land management & policy

Conclusion

HiveTracks' MRV framework empowers beekeepers as biodiversity monitors, delivering robust, scalable, and verifiable data to safeguard ecosystems worldwide.

See our biodiversity impact at
www.hivetracks.com/biodiversity

Contact James: James@hivetracks.com **Contact Max:** Max@hivetracks.com

PP-591 [Pollination and Bee Flora]
PMS: The data standard of the pollinator community

Michael Rubinigg[1], Eduardo Marcos Alejos[1], Grega Lipovcek[2], Gregor Sušanj[2], Noa Simon Delso[1]
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and accessibility across scientific, conservation, and policy-making communities. Pollinators, essential for ecosystem health and agricultural productivity, face increasing threats from habitat loss, climate change, and pesticide use. Comprehensive and harmonised data collection and sharing are imperative to address these challenges. The Pollinator Metadata Standard (PMS), developed under the auspices of Apimondia Working Group 12 on Standardization of data on bees and beekeeping, provides a robust framework for standardising pollinator and beekeeping-related terms, ensuring consistency and clarity in data representation.

PMS evolved from the BeeXML standard (https://beexml.org/). It is designed to facilitate the integration of diverse datasets by defining a taxonomy of classes, descriptors, and units essential for accurate data comparison and analysis. The standard operates through a collaborative, software-based process, allowing registered users to propose, discuss, and approve terms traceably and counts 473 Metadata Standard Elements, built on a Controlled Vocabulary of about 8.000 terms. This process ensures that data elements are linguistically precise, scientifically accurate, and universally applicable across different languages and regions. Implementing PMS within platforms such as the EU Pollinator Hub (https://pollinatorhub.eu) exemplifies its practical application, enabling the management of datasets through a structured and transparent workflow.

PMS ensures that pollinator data are consistently defined, translated, and updated, fostering global collaboration and data sharing. By adhering to PMS, researchers, policymakers, and conservationists can more effectively monitor pollinator populations, assess threats, and implement targeted conservation strategies by bringing together data from different sources. This standardisation effort represents a significant achievement of Apimondia WG 12, advancing pollinator research and contributing to preserving biodiversity and ecosystem services.

APIMONDIA SCANDINAVIA 2025
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PP-592 [Pollination and Bee Flora]

Pollinator Diversity and Forage Resources in Agroecosystems: Implications for Sustainable Beekeeping in the Philippines

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INTRODUCTION

Pollinators play a crucial role in maintaining biodiversity and supporting agricultural productivity. However, there is **limited data on pollinator diversity and forage resources in agricultural and agroforestry areas in the Philippines**. This study aimed to assess the diversity of pollinators and their forage plants in the UPLB La Granja Research and Training Station (LGRTS) in Negros Occidental and the UP Land Grant in Pakil, Laguna.

METHODOLOGY

Sampling Methods

Observation: 07:00 -15:00 Once a week, 7 months

Pan Traps

Net Sweeping

Sampling from Opportunistic Plants

Malaise Traps

Bee-keeping Trainings

A bee pasture was developed in the sites to support pollinator populations alongside the introduction of stingless bees. Observations were integrated into **Bee-keeping Training Programs** to enhance local knowledge and participation in the community.

RESULTS AND DISCUSSION

Pollinator Inventory

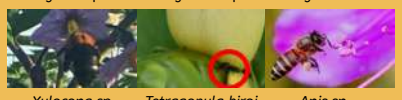
BEE SPECIES

Records Before Bee Pasture Development

Carpenter Bees | Halicitid bees | Moths | Beetles

Records After Bee Pasture Development

Thyreus sp. | *Megachile* sp. | *Amegilla zonata*


Xylocopa sp. | *Tetragonula biroi* | *Apis* sp.

The introduction of Stingless bees was successful in the sites.

NON-BEES

Dipterans or flies, wasps: *Crabronidae*, *Scoliidae*, *Sphecidae*, and *Polistinae*, moths and butterflies of the families *Nymphalidae*, *Erebidae*, *Pieridae*, and *Pterophoridae*, Tetrigids, and Chrysomelid beetles.

Forage Resources

Fruit trees*

Mango *Mangifera indica* | **Pomelo** *Citrus maxima*

Jackfruit *Artocarpus heterophyllus* | **Durian** *Durio zibethinus*

Rambutan *Nephelium lappaceum* | **Santol** *Sandoricum koetjape*

Woody plants

Katmon *Dillenia philippinensis* | **Coconut** *Cocos nucifera*

Herbaceous plants

- ***Musa sapientum***
- ***Sphagneticola trilobata*** - visited by *Apis dorsata*

Organically grown vegetables

Okra *Abelmoschus esculentus* | **Eggplant** *Solanum melongena* | **Chili pepper** *Capsicum frutescens* | **String beans** *Phaseolus vulgaris*

Population Density

Pollinators peaked at **09:00 to 11:00** in the morning, attributed to the period of **anthesis** of forage sources.

Other introduced and native ornamental plants

The presence of *Boerhavia diffusa, Cleome rutidosperma, Spatiphyllum commutatum, Hamelia patens, Duranta erecta, Talinum fruticosum, Ocimum basilicum, Melothria indica, Tabernaemontana sp., Vitex negundo, Zinnia sp., Cosmos sulphureus,* and *Cuphea hyssopifolia* were recorded.

CONCLUSION AND RECOMMENDATIONS

The study highlights the importance of maintaining diverse floral resources for sustaining pollinator populations. Beekeepers can enhance honey production and pollination services by integrating native bee plants and promoting stingless beekeeping as an alternative livelihood, particularly in areas where traditional farming is declining.

This study was funded by the UPLB Basic Research, OVCRE, UPLB.

SCAN QR CODE FOR REFERENCES

APIMONDIA SCANDINAVIA 2025
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PP-593 [Pollination and Bee Flora]

Abstract Ref No.: 1223

Impact of Integrated Beekeeping and Habitat Conservation Measures of Native Pollinators on Pollination and Rural Livelihoods in Apple Cultivation in Kullu and Shimla Districts of Himachal Pradesh India

INTRODUCTION

Decline of indigenous pollinator diversity and populations due to habitat loss, chemical sprays, monoculture plantations, and climate change, is leading to a decline in pollination ecosystem services, thus negatively impacting apple cultivation in Himachal Pradesh, India. To tackle this, the GIZ projects 'Sustainable Agriculture Systems Policies' and 'Green Innovations Centre for Agriculture and Food Sector' introduced following interventions:

- Integrated beekeeping of *Apis cerana* in apple orchards
- On-farm habitat management for pollinators
- Integration of pollinator habitat and bee management into trainings in Good Agriculture Practices
- Awareness campaign about wild pollinators, importance of bee flora, and judicious use of pesticides

The objectives of the current study were:

- Assess the impact of introduced on-farm interventions on apple fruit-setting
- Document the diversity of insect pollinators
- Assess the impact of *Apis cerana* in pollination
- Document existing bee flora
- Recommend and demonstrate additional on-farm pollination management measures
- Recommend steps to be taken by farmers, research institutes, and government agencies to encourage pollinator conservation

METHODOLOGY

For collection of data on pollinator diversity and populations:

- Field investigations were conducted to collect primary data in six locations in Shimla, detailed in *table 1*.
- Secondary literature was used to collect data for Kullu district

Further, focus group discussions and consultations were held with farmers and local forest and horticulture officials of the government. The conceptual framework used is depicted in *figure 1*. In addition, good pollinator management practices were demonstrated alongside technical advice to beekeepers, including habitat management measures such as trap nests and mud hives.

Methods

- **Relative abundance of insect visitors:** The apple trees were selected at random. *Apis mellifera*, *Apis cerana*, and syrphids were counted on per sqm bloom area of selected cultivar for 5 minutes, replicated 3 times at noon time for 3 sunny days.
- **Fluorescent pan traps:** Insect visitor diversity was assessed using fluorescent pan traps (white, yellow, blue, green colours) following standard protocols. Captured insects were washed, preserved in 70 % alcohol, and mean catch per bowl was calculated.
- **Scan sampling:** Insect visitors were counted on 100 flowers in each of the plots over 3 sunny days. By walking slowly along a set path recording visitors by inspecting each flower sequentially.

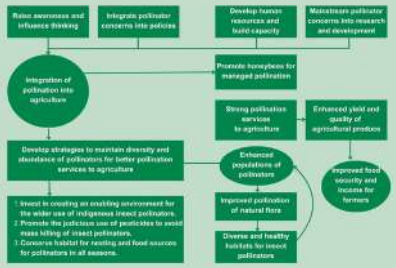


Figure 1: Integrating services of insect pollinators into agricultural economy (Partap et. al. 2012)

Farmer Name, Village Name	Age of plantation	Area (Acres)	Remarks	Study/activity conducted
Deshraj Mehta, Devidhar	18 years	1.8		• Insect pollinator data and bee flora study • Bee hotel demonstration
Hansraj, Devidhar	27 years	0.4	Orchard at higher elevation far from forest	• Insect pollinator data and bee flora study • Selected for caged study • Mud hive demonstration
Kapil Sharma, Khabal	29 years	0.5	Orchard at higher elevation near to forest	• Insect pollinator data and bee flora study • Mud hive demonstration
Pramod Kumar, Sandasu	25 years	0.5	Orchard at lower elevation near to forest	• Insect pollinator data and bee flora study
Sunil Kumar, Sandasu	3 years	0.2	Orchard at lower elevation near to forest	• Insect pollinator data and bee flora study • Bee hotel demonstration
Yashpal Sharma, Jagoti	8 years	0.12	Orchard at lower elevation far from forest	• Insect pollinator data and bee flora study • Bee hotel and pollen dispenser demonstration

Table 1: List of six sites in Shimla where field investigations were done

RESULTS & CONCLUSIONS

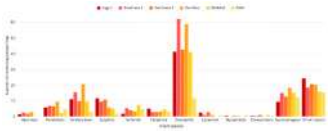


Figure 2: Number of trapped insects/ traps in the pan traps in six different locations

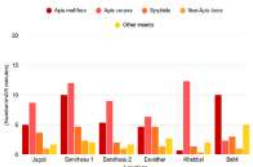


Figure 2: Abundance of insect visitors by visual observation (No./m2 / 5minutes) on apple bloom in different locations

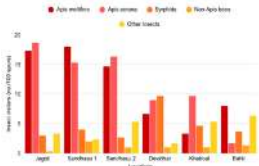


Figure 3: Abundance of insect visitors (no./100 spurs) by scan sampling on apple bloom in different locations

Hymenoptera	Diptera	Lepidoptera	Coleoptera
Apidae • *Apis cerana* • *A. mellifera* • *Bombus sp.*	Muscidae • *Musca sp.* • *Orthalia sp.*	Nymphalidae • *Vanessa* • *cashmirensis Neptis sp.*	Coccinellidae • *Coccinella septumpuntata*
Halictidae • *Nomodo sp.* • *Halictus dasygaster* • *Halictus sp.* • *Xylocopa sp.*	Syrphidae • *Melanostoma univittatum* • *Eristalis sp (4)* • *Episbium boleatus* • *Scaeva pyrastri* • *Metasyrphus corollae* • *Metasyrphus sp.*	Noctuidae • *Plusia onchaica* • *Heliothis armigera* • *Agrotis flammatra*	Chrysomelidae • *Altica sp.* • *Nonartha variabilis* • *Minastra cymura*
Vespidae • *Polistes maculipennis* • *Vespa sp (4)*		Pieridae • *Pieris canidia* • *Delias belladon*	Scarabaeidae • *Protaeetia neglecta* • *Brahmina cronicolis*
Ichneumonidae • *Netalia tatra*		Lycanidae • *Heodes sp.*	

Table 2: Recorded insect species visiting apple bloom

- The composition of insect pollinators is almost same in all the studied locations.
- However, the abundance of pollinators varied among the locations
- *Apis cerana* is the predominant pollinators which is naturally occurring in these localities.
- These observations clearly indicate that pollination management in terms of polliniser and pollinator management is required to obtain commercial fruit set.
- Further, there is pollination deficit under the current scenario in apple orcharding and requires special efforts to compensate it through:
  - Adoption of managed pollination
  - Good management practices
  - Enriching the local habitat to maintain and increase the population of local natural insect pollinators
  - Maintain proper polliniser varieties and proportions

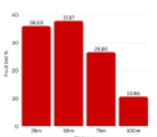


Figure 5: Percent fruit set at different distances from introduced Apis mellifera colony

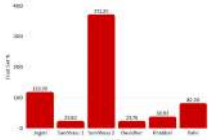


Figure 6: Percent fruit set (spur basis) at different locations

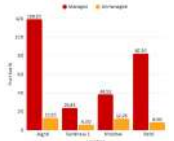


Figure 7: Comparative fruit set in managed and naturally pollinated orchards in different locations

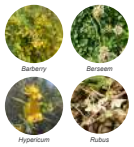


Figure 8: A few of the over 30 identified bee flora species

RECOMMENDATIONS

FARMERS AND FARMER ASSOCIATIONS

- Classify orchards with respect to polliniser proportion and accordingly adopt pollination management practices
- Organise a bee flora conservation and plantation day in the village
- Participate in community hiring of honey-bee colonies from trusted beekeepers
- Establish and strengthen beekeeping collectives within farmer associations

POLICY SUPPORT

- Within agricultural development strategies and policies, integrate managed pollination and conservation of pollinators
- Link honey production enterprises with crop pollination.
- Formulate strategies to encourage wider use of managed crop pollination and develop incentives for good quality colonies for pollination.
- Integration of bee flora plantations in forest management plans
- Regulations to prevent disease spread and protect wild pollinators

RESEARCH INSTITUTES

- Understand the causes of pollination decline and assess pollen deficit
- Develop strategies for insect pollination and pollination aids
- Assess ecological and economic value of insect pollinators
- Create a database of insect pollinators
- Understand the uses and commercialisation potential of other native insect pollinators

EXTENSION SERVICES

- Develop and strengthen research and extension institutes
- Create more awareness and understanding of pollination services
- Promotion of pollination and *Apis cerana* beekeeping as an enterprise.
- Strengthen research capabilities in managed crop pollination (pollination deficit protocol)
- Promote adoption of Good Agriculture Practices for pollination management

SUCCESS STORY

Three apple farmers from Gojra village in Kullu district started beekeeping with *Apis cerana* after receiving training from GIZ in October 2021, with one colony each. The status in 2025 is given in *table 3*.

Collectively constituting 82 colonies, the apple orchards of these as well as neighbouring farmers receive pollination services. The neighbours time their chemical sprays in coordination as not to harm the bees. The farmers currently do not rent out the bee colonies. Mr. Lal Chand, a part-time carpenter, has modified the hive so that the colonies can be inspected and manipulated efficiently with least disturbance. He modified the bee frame so that the bees can raise comb without fixing comb foundation sheets/strips. The sale of honey is bringing additional income to the small farm owners.

Taking inspiration, ten farmers in the vicinity have also started rearing about 40 colonies in total, and have received hives, bees and technical advice from these trained beekeepers, displaying a multiplier effect. This is an example of beekeeping for pollination in mountain regions and should be replicated.

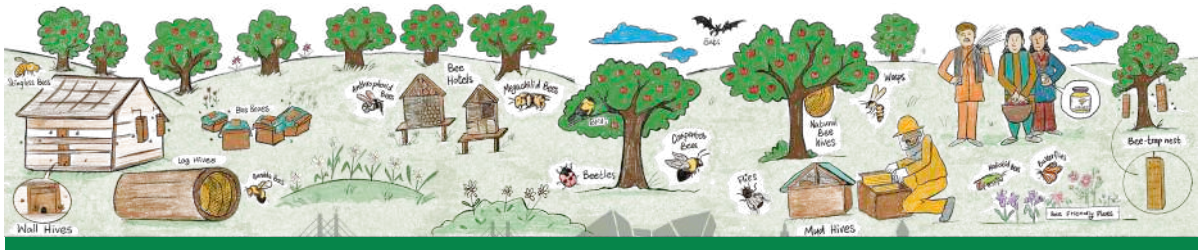
Farmer	No. of bee boxes in 2025	Honey Production
Rajesh Kumar	52	100 Kg
Vijay Kumar	20	25 Kg
Lal Chand	10	20 Kg

Table 3: Details of beekeeping of farmers in Gojra

Figure 9: The farmer Rajesh Kumar with his bee boxes in his apple orchard in Kullu, Himachal Pradesh

INTERVENTIONS

Wall Hives · Log Hives · Bee Hotel · Mud Hive · Bee Flora · Trap Nest



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- Technical Authors: Dr Harish Sharma (Retd Professor, Dr YS Parmar University of Horticulture And Forestry), Regina Sanchez Sosa y Hernandez#, Sashi Kumar#, Umesh Kumar#, Puneet Bansal# (#GIZ India)
- Implementation Partners: Department of Horticulture, Himachal Pradesh; Dr. YS Parmar University of Horticulture and Forestry (represented by Dr. Kiran Rana); Kullu Phalotpadak Mandal (represented by Mr. Davinder Thakur); Chuwara Valley Apple Society
- Poster Design: Godwin Emmanuel, Samruddhi Mane; Illustration: Nitasha Nambiar

The interventions, the study, and presentation in Apimondia 2025 are conducted under the aegis of the AgSys and GIC projects, implemented in India by the Deutsche Gesellschaft für Internationale Zusammenarbeit in cooperation with the Indian Ministry of Agriculture and Farmers Welfare, and funded by the German Federal Ministry for Economic Cooperation and Development.

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PP-604 [Pollination and Bee Flora]
Pollinator Protection Education for Farmers and Pesticide Applicators

Ana Heck, Meghan Milbrath
Michigan State University
BRIDGING RESEARCH AND PRACTICE (BRAP)

In the United States of America, Michigan is the second most agriculturally diverse state. Many of the crops grown in Michigan depend on bees for pollination, including apples, blueberries, cherries, and some vegetables. Farmers in Michigan rent honey bee colonies to pollinate fruit and vegetable crops. Depending on the crop and its pest management, honey bees are exposed to pesticides leading to chronic, sublethal effects and occasionally acute bee kills.

Michigan State University Extension (MSU Extension) encourages farmers and other pesticide users to improve pollinator health by learning about bees, installing pollinator habitat, and minimizing pesticide exposure to pollinators. Many farmers enjoy learning about honey bees and how they can support honey bee health. MSU Extension works across different agricultural sectors and shares information at farmer meetings about honey bees. Some of the recommendations to protect pollinators from pesticides align with integrated pest management strategies which aim to reduce costs and manage pests sustainably.

MSU Extension collaborates with educators and other colleagues across the country to develop and deliver education on pollinator protection. This education includes crop-specific recommendations on how to reduce pesticide risk to bees while managing pests. MSU Extension is a member of the Honey Bee Health Coalition, which facilitates a group of professionally diverse organizations in the agriculture sector to support honey bee health. Some of the coalition's work has focused on creating and sharing information about how farmers and pesticide applicators can protect bees from pesticides. MSU Extension also coordinates the Managed Pollinator Protection Working Group, which includes members from over 20 states who work together to develop and promote pollinator protection education. These collaborations have allowed educators to share and co-develop resources on reducing risks of pesticides to honey bees in agricultural settings.

Many beekeepers also have an opportunity to share information with farmers about the importance of bees and how to protect them from pesticides. By understanding pest management needs and strategies to reduce pesticide risk to bees, beekeepers can engage local farmers in conversations about how to improve pollinator health.

BEEKEEPING FOR RURAL DEVELOPMENT

PP-484 [Beekeeping for Rural Development]
Integrating Sustainable Beekeeping and Environmental Stewardship Using 20-Liter Water Bottles as Alternative Beehives in Uganda:

Prince Eng Dr Kimbugwe Edward
Prince Eng. Dr. Kimbugwe Edward, Mrs. Namiiro Rose

Sustainable beekeeping is an essential practice that supports biodiversity, enhances ecosystem resilience, and provides socioeconomic benefits to communities. In the context of resource efficiency and environmental stewardship, the use of 20-liter empty water bottles as alternative beehives offers an innovative, cost-effective, and eco-friendly solution. This approach not only repurposes waste materials but also lowers the entry barrier for small-scale beekeepers, particularly in resource-constrained communities.

This paper examines the design, implementation, and benefits of utilizing recycled water bottles as beehives. It explores their potential to provide a suitable habitat for bees, their effectiveness in maintaining bee health, and their role in reducing plastic waste in the environment. Additionally, the study highlights the integration of these hives into broader conservation efforts, such as promoting pollinator-friendly vegetation and engaging local communities in sustainable practices.

Case studies demonstrate the practicality -scalability of this method, showcasing its potential to support biodiversity while encouraging responsible waste management. The paper concludes by advocating for the promotion of alternative beekeeping models that align with the principles of circular economy and environmental conservation, making sustainable beekeeping accessible and impactful in diverse settings.
Using 20-liter empty water bottles as alternative beehives offers several advantages, particularly in promoting sustainable beekeeping and environmental stewardship. These benefits include:

1 Cost-Effectiveness, Reduces the financial burden of traditional hive materials like wood, Waste Repurposing, Reuses plastic waste, contributing to waste reduction and promoting circular economy principles. Reduces environmental pollution caused by improper disposal of plastic bottles.2. Lightweight and Portable, Easy to transport and install, allowing for flexible placement in urban, rural, or remote areas. Suitable for nomadic or migratory beekeeping practices.

3. Weather Resistance, Plastic bottles are resistant to weather conditions such as rain, humidity, ensuring longer durability compared to certain traditional materials.

4. Ease of Maintenance, Transparent bottles allow beekeepers to monitor hive activity and health without disturbing the bees. Simplifies hive inspection, reducing stress on the colony. 6. Scalability, Enables quick and affordable scaling of beekeeping operations, especially in regions with high demand for honey, pollination services.

5. Environmental Impact, Encourages the growth of local pollinator populations, supporting biodiversity and agricultural productivity.

PP-485 [Beekeeping for Rural Development]
Traditional beekeeping in Marrah Mountains (Sudan) and adoption of modern beekeeping equipment

Sabah Mohamed Abdelwahab Mohamed
Department of Crop Protection, Faculty of Agriculture, University of Khartoum

Sudan is the largest country in Africa. Agriculture is of particular importance to the gross national product. Beekeeping can provide valuable food and medicine for local resident. Moreover, honey and beeswax are important cash crops offered on local market, Beekeeping can be carried out as a productive secondary activity with low-level technology, or as a primary undertaking with more complicated techniques. In addition beekeeping does not compete for resources with other types of agriculture - the nectar and pollen of plants are a true bonus. Traditional beekeeping in Marrah Mountains (Sudan) and adoption of modern beekeeping equipment (Honey pressure). Twenty one traditional beekeepers in jabal Marrah Mountains were share in designing honey pressure to achieve honey specification. In this area traditional beekeepers use clay pots hives, so they made this presser to extract honey. the beekeepers in the Jabal Marrah Mountains adopted the idea and began to develop their work

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PP-486 [Beekeeping for Rural Development]

APIMONDIA SCANDINAVIA 2025 23-27 SEPTEMBER
Abs Ref: 0146

CHEMOMETRIC QUALITY ASSESSMENT OF COLOMBIAN HONEYS BASED ON PHYSICOCHEMICAL PARAMETERS AND SENSORY ATTRIBUTES

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REMARKS

Physicochemical properties of honey refer to quantifiable physical and chemical attributes that are critical for determining its quality, safety, stability, authenticity, and compliance with international standards (such as Codex Alimentarius or EU regulations). Honey sensory analysis evaluates its intrinsic properties by integrating visual, olfactory, gustatory, and tactile perceptions. Specialized receptors detect stimuli, convert them into neural signals, and transmit them to the brain, where color, aroma, taste, texture, and mouthfeel are processed

The honey sensory process provides a structured evaluation of its organoleptic qualities. The profile is assessed through vision, olfaction, and taste: vision reveals color and appearance, olfaction detects volatile compounds that define aroma, and taste identifies basic sensations. Flavor, mainly driven by aroma in combination with taste, creates a complex profile that can also help detect adulteration, as atypical attributes may indicate fraud or loss of authenticity.

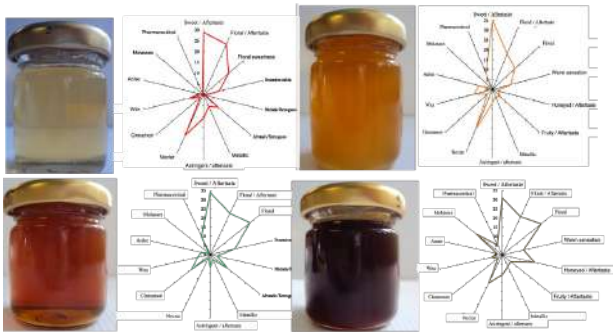
Floral honeys are generally amber in color, although darker products are also known, as is the case with honeydew honeys from Oak (Quercus sp.) and Ulmo (Quillaja saponaria). Additionally, the color has been attributed to the mineral content of the samples and the presence of tyrosine and tryptophan, which are generally absent in light-colored honeys. The quality and color tones of different types of honey are influenced by seasonal periods.

MATERIALS AND METHODS

Thirty-four honey samples from *Apis mellifera* and *Melipona* spp., collected from different regions of Colombia, were provided by local beekeepers. Their physicochemical properties were analyzed, including moisture, electrical conductivity, pH, free acidity, color (Pfund scale), °Brix, °Baumé, ash content, and water activity. All analyses followed the official methods established by the International Honey Commission. Principal Component Analysis (PCA) was applied to explore relationships between variables (physicochemical properties) and samples. Sensory properties were assessed according to National Honey Board™ guidelines, and statistical analyses were performed using JMP software.

RESULTS AND DISCUSION

Colombian honey is renowned for its rich diversity of flavors and aromas, largely influenced by the country's varied flora and geography. The honey is typically classified by color, which ranges from very light to dark amber



White: Extremely light in color with delicate floral notes. Often mild and sweet with a subtle aroma. **Extra Light:** Pale gold with a gentle sweetness and soft, floral fragrance. **Light Amber:** Light amber in color with a balanced sweetness and mild fruity or floral undertones. **Amber:** Richer golden-brown hues, offering deeper flavors with hints of caramel, nectar, and gentle spice notes. **Dark Amber:** Dark and intense in color, with strong, robust flavors, sometimes with malty, herbal, or slightly earthy notes.

Aroma

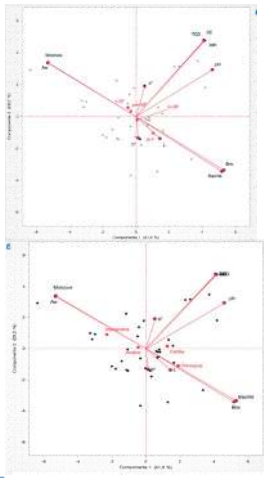
S. Attribute	Á	ELA	LA	DA	EW	W
Sweetness	M	A	A	M	A	A
Nectar		A	A			A
Herbal		A	A		A	A
Spices	M	B		M	B	B
Wax		M	M			B
Anisado		A	M	M		
Floral		A	A		M	A
Molasses	A			A		
Spicy	B	A		B		A
Medicinal	B			M		

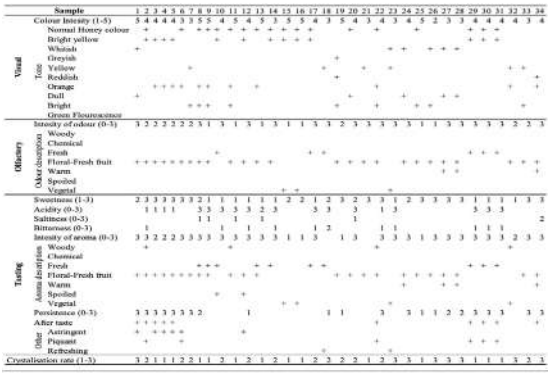
Taste

S. Attribute	Á	ELA	LA	DA	EW	W
Sweetness		A	A		A	A
Nectar		A		A		A
Herbal		A	A	A		A
Spices	M	B		M		B
Wax	B			B		B
Anisado	M		M	B		
Floral	M		B	A		
Molasses	B			A		
Spicy		B	B			
Medicinal	B		B			

Aftertaste

S. Attribute	Á	ELA	LA	DA	EW	W
Sweetness	A	A		A	B	B
Floral		M	M	B	B	B
Molasses	B			A		
Spices	M		M	B		
Afrutado		A		M		
Astringent		M	M			B
Metalico	B			A		
Persistence	M	A	A	A	B	B





APIMONDIA SCANDINAVIA 2025
SWEDEN | DENMARK | NORWAY

PP-487 [Beekeeping for Rural Development]

Gastronomy as a Key for Market Access and Value Chain Development for Honey

Case Study in the Dominican Republic

Alejandra Flórez[1,2], Mónica Ponce de León[2]

[1] Universidad Nacional Pedro Henriquez Ureña, Graduate School, Dominican Republic. [2] Innovación Rural Desarrollo Sostenible SRL, Dominican Republic

Introduction

This study shows how the use of honey in gastronomy can be a key factor for rural development and small beekeepers. The study shows patterns of behavior of honey consumption in a sample of restaurants and gives an approach of the number of small beekeepers benefited.

Description

The aim of the study is to analyze the potential use of honey in restaurants and correlate it to how many beehives are needed to fulfill the rising use of honey in gastronomy. This can be projected also to estimate how many small beekeepers can be benefited by the use of honey in restaurants.

This study serves as a framework for future studies and projects that can be part of the "Strategic Plan for Sustainable Gastronomic Tourism of the Dominican Republic".

The study is based in the business case of "Nucayní" honey in Dominican Republic from January 2024 to July 2025. The data is based on a sample of 49 restaurants located in Santo Domingo that use honey as an ingredient. The sample included mid sized restaurants with capacity to seat from 50 to 100 clients.

Beekeeping in Dominican Republic

More than 3,000 beekeepers[1]	Total honey production: 750,000 kg (in 2023) [2]
Per capita consumption of honey: 0.04 kg / year[1]	Tropical climate with dry and humid forest. Mostly multifloral honey.

Honey in Gastronomy

Main uses:

- Savory Food: marinades, glazes, sauces, dressings
- Beverages: Cold (alcoholic and non-alcoholic), Hot (coffee, tea and other infusions)
- Bakery and confectionery
- Direct use: as complement of desserts, snacks, etc.

Functional Characteristics:

Natural sweetener	Flavor enhancer	Flavor balancing
Hygroscopic (retains moisture)	Helps caramelization and Maillard reaction	

Data Analysis

1. Honey usage kg/year:

Total: 20,602 kg/yr

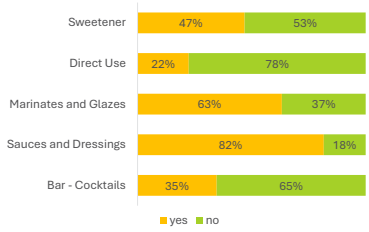
Per restaurant:

Average: 455 / Minimum: 14 / Maximum: 1,975 kg/yr

kg honey/yr	kg honey/yr		# of restaurants	
	total	%	total	%
1500-2000	8,218	40%	5	10%
1000-1500	7,072	34%	5	10%
500 - 1000	1,686	8%	2	4%
200-500	2,864	14%	12	24%
less than 200	763	4%	25	51%
total	20,602	100%	49	100%

- 74% of honey was used in 10 restaurants, each one with a consumption of more than 1,000 kg/yr.
- 73% of restaurants analyzed used less than 500 kg of honey/year.

2. Honey Uses in Restaurants



- Most of the restaurants in the sample use honey in sauces, dressings, marinates and glazes, which implies use in savory food.
- Of the 49 restaurants, 17 use honey in their bar. Of the other 32, only 6 of them does not serve cocktails.
- All the restaurants in the sample prefer to use honey in liquid state and not crystallized.

3. Beekeeping to fulfill restaurant demand

With an average production of 20 kg of honey per hive, the beehives needed to fulfill restaurant needs vary between 10 and 75 depending on the level of usage of honey.

In the case of small beekeepers with an average of 25 hives per apiary, each mid sized restaurant using honey can benefit up to 3 apiaries, contributing to rural development in the country.

Description	High Use	Medium Use	Low Use
kg Honey / yr	1,500	500	200
kg / hive / year	20	20	20
# hives / restaurant	75.0	25.0	10.0
hives / apiary	25	25	25
# apiaries / restaurant	3.0	1.0	0.4

Conclusion

- Honey is a versatile ingredient in gastronomy having many benefits in food´s flavor and texture. This shows that it can be used in many kinds of preparations.
- The sample of restaurants studied show that honey can be a key ingredient in their preparations, showing a use of more than 1,000 kg of honey per year per restaurant.
- There is an opportunity for increasing use of honey in restaurants as they incorporate it as an ingredient in more recipes, even if is only to replace other sweeteners.
- The use of honey as a key ingredient in restaurants increase per capita honey consumption in the country, which can strengthen the beekeeping value chain and therefore promoting rural development.
- Honey used in restaurants is preferred in liquid form, so there is a higher demand of honey from botanical sources that do not crystallize rapidly.
- With a secure market, beekeepers need to assure the proper logistics to deliver the product to the restaurants.
- According to ADERES there are 4500 restaurants in Dominican Republic. If each restaurant used 100 kg of honey per year, it would mean 900 apiaries benefiting at least 450 families and 22,500 beehives supporting agriculture and food safety.
- Restaurants can find other natural alternatives to honey in the market including cane sugar, agave syrup, stevia and maple syrup. But there are also industrialized honey flavored products that cost less than raw honey resulting in one of the major limitations for market development.

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4.Maicelo-Quintana, Jorge L. et al. Potential application of bee products in food industry: An exploratory review. Heliyon.

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PP-488 [Beekeeping for Rural Development]
Traditional Knowledge in Beekeeping: Lessons from indigenous practices

Robert Nil Mutisi
Department of Agriculture, Zimbabwe Open University, Harare, Zimbabwe

The accumulated indigenous knowledge over many centuries plays a significant role in sustaining bee colonies and the production of hive products globally. Africa is endowed with the highest number of bee colonies, natural vegetation and varying climatic condition that is interwoven as it relates to medicinal, spiritual, economic, environmental and social spheres of life. Traditional knowledge seemed going out of fashion as many people are skewed towards modern technology. There is little documentation on traditional knowledge in beekeeping and yet many communities practice this for their livelihoods. Lessons learnt from traditional practices remain undocumented and unknown to communities yet many people can benefit from them. The study was undertaken to identify and document lessons from indigenous beekeeping practices that can be used to motivate people to engage into beekeeping. In this study, focus shall be centered on gender, hive styles and construction material, source and access of hive material, prediction of seasons, apiary management, forest management, bee pests and the use of honey. Makoni and Mutasa districts of Manicaland Province in Zimbabwe were purposively chosen to be focal districts of the study. 30 participants, 15 from each of the two districts were purposively selected to participate in the study. Sem-structured interviews, key informants and field observations were used to generate data. Data were presented in tabular form with figures and words. The analysis of data followed a rigorous thematic approach. Findings of the study revealed that most participants learnt about beekeeping from their forefathers and were prepared to pass on the skills to the future generation. On record were few women who participated in beekeeping since women have been inherently distanced from beekeeping due to cultural barriers. The traditional way of predicting seasons together with the beekeeping and tree flowering calendars made it possible for respondents to have sustainable harvests of bee products. In conclusion there is need to use traditional knowledge in beekeeping that resonates well with Nature-based beekeeping which can easily be adopted in beekeeping for rural development. Policies and procedures for government and development partners should accommodate traditional knowledge in their planning for developmental work.

PP-489 [Beekeeping for Rural Development]

UNLOCKING THE POTENTIAL OF RURAL HONEY INDUSTRY: A MARKET-DRIVEN APPROACH

Authors Arthur Madalitso Ngwende – BBA, MSc Agri. Applied Econ.

BACKGROUND

The TRADE programme is a commercialization initiative by the Malawi government with financial support from International Fund for Agriculture Development (IFAD) and OPEC Fund for International Development (OFID) to increase incomes and improve livelihoods of the smallholder producers in the rural areas. It has been investing in the honey value chain since 2022.

Figure 1: TRADE Programme current reach

CHALLENGES

- Low production and productivity
- Unorganized stakeholders (farmers and the private sector).
- Lack of proper storage facilities
- Lack of access to finance
- Not enough extension officers to promote modern bee technologies
- Limited local technology development (Kaitano, 2016).

INTERVENTIONS

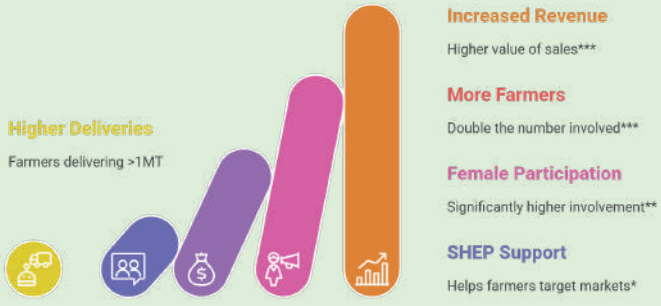
- Win-win partnerships between producers, public and private players
- The TRADE programme employs three key tools business coaching, the SHEP approach, and business meetings to foster win-win market partnerships.

OBJECTIVE OF THE STUDY

This study explores factors that would influence TRADE's interventions on achieving commercialisation in rural areas.

RESULTS - T-TEST

Table 1. Factors Influencing Farmer Groups Market Participation



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*Key; ***=1% significant level, **=5% significant level and *=10% significant level*

METHODOLOGY

- Random sampling on groups the programme is working with
- T-tests and multivariate regression
- Business coaches met farmers in a space of 6 months, business meetings were held just before the swarming season and SHEP were structured participatory trainings conducted in 12months.

RESULTS - MULTIVARIATE

Table 1: Factors affecting tools

	Business Coach	Business Meeting	SHEP
	Coef.	Coef.	Coef.
Delivered_Volume	.0494031	.4889534*	.5383566**
NKhatabay	.1899524	-.6695778***	.4796254*
Income	2.03e-08	9.35e-08	-1.14e-07
Gender Leader	-.1508279*	.2829889	-.1321609*
Farmers	-.0020749	.0008312	.0012438
Female	-.001465	.0166892	-.0152242
Youth	-.0047591	-.0114042	.0161633
Contract	.1642649***	-.2368177**	.0725528
PreviousYear	-.0493722	.1090549*	-.0596827
_cons	.1105404	.6622361	.2272235

*Key; ***=1% significant level, **=5% significant level and *=10% significant level*

DISCUSSION

- **Delivery History is a Strong Predictor of Performance:** Farmers delivering >1MT had significantly higher previous-year deliveries (4.93MT vs. 0.67MT, p<0.05) in t-test and Previous-year delivery positively influenced participation in Business Meetings (β = 0.109, p<0.10). High past performance correlates with both continued delivery and better access to support systems.
- **Group Size and Collective Action Matter:** High-volume groups had almost twice the number of farmers (97 vs. 49, p<0.01). Group size (farmers, female, youth) was not significant—but acted as control for interpreting impact of structured interventions. While group size alone may not predict access to interventions, it is a critical enabling factor for performance and sustainability.
- **Gender Inclusion Influences Outcomes:** Higher female participation was linked to higher delivery volumes (49 vs. 22, p<0.05). Female leadership negatively associated with access to Business Coaching (β = -0.151, p<0.10*) and SHEP (β = -0.132, p<0.10*). Gender-inclusive groups perform better, but female leaders face access barriers to institutional support.
- **SHEP Participation Has the Strongest Impact:** SHEP participants delivered significantly more honey (0.54MT vs. 0.04MT, p<0.10). SHEP is a strong positive predictor of delivery volumes (β = 0.538, p<0.05). SHEP is both impactful and scalable—should be prioritized for investment and rollout.
- **Contract Participation Enables Structured Engagement:** Contracted farmers were more likely to receive Business Coaching (β = 0.164, p<0.01*) but less likely to attend Business Meetings (β = -0.237, p<0.05*). Contracts formalize engagement and streamline support delivery—an effective entry point for coaching and services.

CONCLUSION

This study demonstrates that smallholder beekeepers have strong potential to drive a commercially viable honey sector when supported through inclusive and well-structured interventions. Quantitative analysis revealed that prior delivery experience, group size, increased revenue, contract participation, and structured support, particularly through the SHEP model, were positively associated with increased delivery volumes, while qualitative patterns showed that groups led by women consistently outperformed those led by men. Despite some statistical models indicating reduced access to services for female-led groups, these findings highlight the importance of actively promoting women's leadership in beekeeping cooperatives. Additionally, services that offer long-term, hands-on guidance especially those empowering farmers to identify and engage with their own markets, proved to be the most effective in stimulating sustained honey production. To unlock the full potential of rural beekeepers, future programming should prioritise gender-responsive leadership, contract-based engagement, and scalable market-oriented training models that align with both local context and commercial demand.

REFERENCES
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APIMONDIA SCANDINAVIA 2025
SWEDEN | DENMARK | NORWAY

PP-490 [Beekeeping for Rural Development]

Apimondia 2025 No.0196

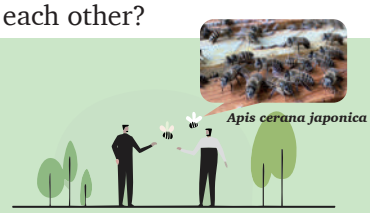
Care Between Bees and Humans: the Case of Beekeeping in Japan

Ria TSUZUKI (Kyoto University, Japan)

How can bees, humans, and other species care for each other?

The relationship between humans and nature has changed because of global climate crisis

Honeybees as environmental indicator animals gaining attention



Japanese honeybee beekeeping is carried out in a way that allows them to coexist with the surrounding environment

▷How can social science discuss about care between humans and nonhumans?

Care

- is a situated, material practice involving ongoing **tinkering and adjustments** in response to specific needs, which emphasizes the **relational and improvisational** nature of care in everyday [Mol, Moser & Pols 2010]
- is about **staying with the trouble**—remaining present in complex, entangled relationships with more-than-human others [Haraway 2016]

For beekeeping, beekeepers engage in ongoing, situated acts of "tinkering" — adjusting hives, responding to bee behavior, and maintaining ecological balance.
In this meaning, care theory offers a productive lens for understanding beekeeping not as mere resource extraction, but as a relational and responsive practice.

▷How about care for **avocational beekeeping** in Japan ?

among humans and nonhumans

Beeboxes

- ❖ Beekeepers make various types of beeboxes
- ❖ wating bees coming to stay → makes beekeepers happy

Bee attractors

- ❖ applying bee attractors such as bee orchid → also generate some relationship with others

Honey harvest

- ❖ harvesting honey once a year (fall)
- ❖ the honey would be collected from thousands flowers

among nonhumans (predetors)

giant hornet / wasp
- using its pheromone to attack
- bee colony can protext by themselves

western honeybees
- steal japanese honeybees' honey

bears
- steal honey and also broke their box

acarine disease (Acarapis woodi)
- bees can protect to some extent

***Mark I* : Care among multiple species**

beekeeper, honeybee, predetor, beebox, attractor, flower, other pollinator

***Mark II* : Care in alluring**

beekeeper ⇄ honeybee → predetor
beebox, attractor ⇄ flower, other pollinator

These examples come from small-scale avocational beekeeping in Japan. When applying the idea of care to commercial contexts, we must also consider its **ambivalence** — including issues of control and exploitation. Still, caring for bees with attention to many other species may be a way of caring for **nature and our planet as well**.

For more discussion about care theory

For further research about beekeeping in Laos

For who has any questions or interest in my research (email)

PP-491 [Beekeeping for Rural Development]

APIS ARBOREA

LocApiary Program

Restoring Wild Honeybee Populations for Regenerative Apiculture

Our Vision

Making wild populations a cornerstone for sustainable and regenerative beekeeping by promoting local ecotypes to support their long term health and resilience.

How We Work

Biomimicry
Natural nest design & density

Local Genetics
Adapted strains & reproductive isolation

Knowledge Integration
Research + traditional wisdom

Self-Willed Ecologies
Support natural & evolutionary processes

Why It Matters

- Builds self-sustaining, resilient bee networks
- Preserves genetic diversity
- Promotes stable host–parasite relationships
- Strengthens human–pollinator connections

A Rengenerative Model for Apiculture

- Wild colonies show >65% survival (vs. 38% managed hives, 2025)
- Preserve genetic diversity & reduce disease spread
- Empower local communities & regenerative agriculture
- Embracing evolutionary processes; no allopathic treatments

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PP-492 [Beekeeping for Rural Development]

Abstract Ref. Number: " 0261 "

Title: "Api-Tourism Centre in Nashik, Maharashtra: A Unique Model for Sustainable Tourism"

BASWANT Honey Bee Park

Honey bees are among the most vital pollinators on our planet, contributing to over 75% of global food crops. They play a key role in maintaining biodiversity, supporting ecosystems, and ensuring food security. However, rapid urbanization, pesticide overuse, habitat loss, and climate change have caused a steep decline in bee populations worldwide. Recognizing the urgent need for action, Baswant Honeybee Park was created.

Baswant Honey Bee Park was created as a dedicated space to protect and nurture bee species, raise public awareness, and train communities in sustainable beekeeping practices. Baswant Honey Bee Park is a dedicated space designed to protect, nurture, and celebrate the vital role of honey bees in our ecosystem. Baswant Honeybee park is a blend of conservation, education, and hands-on training. This park stands as a living example of how people and nature can thrive together.

At the heart of the project lies the Centre Attraction Point – a unique installation that delivers a powerful message: bees are essential for the sustenance of life on Earth. This focal feature draws visitors in, inspiring them to appreciate how deeply human life and nature depend on these tiny yet powerful pollinators.

Visitors enter through the information tunnel, an interactive walkway where they can learn about different bee species and the impact of pollination on food production. The walkway is lined with informative signboards and bee-friendly plant displays, guided tours are available to make the experience more engaging and educational.

Surrounding the central feature is the Bee Zone, a thriving, pesticide-free habitat filled with carefully selected native flowering plants that bloom throughout the year. This ensures a continuous supply of nectar and pollen, not only for honey bees but also for butterflies, solitary bees, and other beneficial insects. The zone is designed to mimic a natural ecosystem, providing shelter, food, and breeding areas for pollinators.

A major highlight of Honey Bee Park is its Beekeeping Training Centre, designed for both classroom learning and hands-on practice. Trainees learn essential skills such as bee biology, hive management, sustainable honey harvesting, and production of value-added products like beeswax candles, propolis and royal jelly.

The center hosts workshops for farmers, students, and women entrepreneurs, ensuring that knowledge spreads beyond the park boundaries. Every visit supports conservation efforts and helps fund training programs for local communities. This is a combination of conservation, education, and livelihoods.

Honey Bee Park also serves as a hub for eco-tourism and community engagement. We organize school visits, awareness drives and honey-tasting sessions. These activities not only educate but also generate revenue to support conservation work. Visitors leave with a deeper appreciation for bees and a greater understanding of how their own actions can help protect pollinators.

The park houses a Bee Museum that showcases a wide range of beekeeping equipment and tools, including wooden hives, honey extractors, protective gear, smokers, and hive inspection kits. Each display is accompanied by informative descriptions explaining its purpose and use, allowing visitors to understand beekeeping practices in a practical and visual way.

Benefits & Impact:

- **Environmental:** Increased pollination, biodiversity enhancement, and protection of native bee species.
- **Economic:** Income generation from honey and bee products, rural job creation, and training-based livelihoods.
- **Social:** Education, awareness, and empowerment, especially for women and young people through skill-building.

BASWANT Honey Bee Park

BASWANT HONEY BEE PARK, Pimpalgaon (B), NASHIK, (MS) India

www.baswant.com

PP-493 [Beekeeping for Rural Development]

RURAL DEVELOPMENT TRADITIONAL KNOWLEDGE IN BEEKEEPING: LESSONS FROM INDIGENOUS SPECIES - A CASE STUDY AT TWIFO PRASO, CENTRAL REGION, GHANA, WEST AFRICA.

RAYMOND KARIKARI

About 80% of honey produced in Ghana is by wild honey and traditional hunters, the other 20% from modern beekeeping

BACKGROUND/PURPOSE

Wild honey hunting

A result of wild honey hunting

Tensions between human and wildlife

The tragic outcome of human-elephant conflict

Lighting of torches

Burnt beehive

Bush fires

PROBLEM DESCRIPTION

Snakes are also a threat to beekeepers

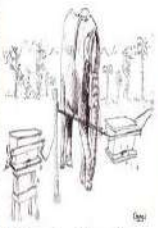
Wax moth and black beetle, pests that threaten hives

Absconding, causing colony losses in traditional processes

METHODODLOGY

Shareholders met to discuss modern beekeeping methods

Beehaving, baseline before interventions



Using beekeeping to solve human-elephant conflict

Beehive fence naturally deters elephants

Most people formed small beekeeping groups

Establishment of an apiary

Empowering women through hands-on beekeeping

RESULTS AND CONCLUSION

Beekeeping creating jobs and income

Tricycle supporting beekeeping transport needs

Beekeeping Center at Twifo Praso, Ghana

PRACTICAL IMPLICATIONS

Beekeeping and Honey Centre, Bimponso, Ghana

Community members showcasing honey, beeswax and tools gained through beekeeping prectises

Practical application of beekeeping skills with active harvest and community engagement

PP-494 [Beekeeping for Rural Development]
Telling the Story of Bee-Friendly Practices to Enhance the Quality of Beekeeping Development

Guofeng Sun
China Bee Products Association (CBPA)

INTRODUCTION: China is one of the world's leading producers and exporters of bee products, with beekeeping playing a crucial role in agriculture, ecological balance, and rural livelihoods. To promote the sustainable growth of the beekeeping industry, the China Bee Products Association (CBPA) has introduced the concept of "Bee-Friendly" practices.

What is "Bee-Friendly"?

"Bee-Friendly" is a development philosophy proposed by CBPA that aims to ensure the sustainable coexistence of bees, ecosystems, and people. It focuses on four key principles:
1. Fair Trade – Ensuring that beekeepers receive fair compensation for their work and promoting ethical business practices.
2. Bee Welfare – Encouraging responsible beekeeping practices that protect the health and well-being of bee colonies.
3. Pure Bee Products – Guaranteeing the authenticity and quality of honey and other bee-derived products.
4. Eco-Friendly Practices – Reducing the environmental impact of beekeeping and supporting biodiversity.

How "Bee-Friendly" Stories Drive Industry Growth

By telling compelling "Bee-Friendly" stories, aims to increase public awareness, boost consumer confidence, and drive sustainable development in the beekeeping industry. Here are some key initiatives:
• Empowering Rural Women – Beekeeping provides stable employment opportunities for women in rural areas, helping them achieve financial independence and improve their families' well-being.
• World Bee Day Initiatives – Public events and educational campaigns raise awareness about the critical role bees play in pollination, food security, and ecological stability.
• "Bee+" Business Models – Integrating beekeeping with other industries, such as eco-tourism, organic farming, and environmental education, to create diversified revenue streams and promote sustainability.

The Impact of "Bee-Friendly" Practices
1. Raising Public Awareness – Engaging storytelling helps consumers and businesses understand the importance of ethical and sustainable beekeeping.
2. Driving Market Demand – Encouraging more companies and individuals to choose "Bee-Friendly" certified products, thereby increasing market growth.
3. Ensuring Long-Term Sustainability – Supporting beekeeping methods that protect both bee populations and the environment for future generations.

CONCLUSION: The "Bee-Friendly" initiative is more than just an industry guideline; it represents a movement toward sustainable, ethical, and high-quality beekeeping. By sharing these stories, we can inspire greater consumer trust, encourage industry-wide adoption of bee-friendly practices, and ensure a thriving future for both beekeepers and bees.

PP-495 [Beekeeping for Rural Development]

Establishing a Beekeeping Group in the remote tropical Cocos (Keeling) Islands with Islamic Cocos Malay women

Maria checking her colony.

Cocos Bee Ladies

Working with the bees

Methodology:
Following a visit to the islands in 2020, Paula wanted to support the local Cocos Malay women with their beekeeping, using Apimaye beehives, showing that community and empowerment of women strengthens a community and economic possibilities. The islands are said to be at risk from climate change and the Australian Government is recommending evacuation of the islands, despite its investment in the airport runway development and strengthening for military purposes. Historical research on the development and erosion of the islands is producing mixed results, with the overall land mass visibly relocating amongst the islands, creating the debate on marine defences and how to maintain the populations living on these remote islands.
With most food being imported by ship and fortnightly by plane, a need for development of farming and agriculture using the current infrastructure would secure the survival of the population. The community are mostly employed by the government with a selection of small tourism businesses. Many Home Islanders grow their own food, have chickens and fish daily. By teaching the women as a group to take care of and manage the native honeybees, the islands would be able too grow more food, with thanks to the pollination, as well as have the benefit of the medicinal properties of honey and products from the hive.

Young girls learning about bees

Asma's queen

Cocos (Keeling) Islands, 12 degrees south of the equator.

Asma checking her colony.

Pollen collection

Results:
Living for 12 months within the 500 strong Cocos Malay community, we observed how their support and culture of each other mirrored that of the 'hive'. The overall wellbeing of the community outweighing personal or individual needs. The family and faith being the foundation of the community, with 3 generations of a family living together in most homes. This community is under threat due to the airport expansion plans and the Australian Government recommending evacuation from the islands with threatened sea level rising above the islands 1.5metre elevation. Having been originally brought to the islands as slaves 200 years ago, the Cocos Malay have been unable to claim indigenous rights to the land, making them vulnerable and in a legal battle to retain the right to remain on their home island. Keeping bees is part of several projects providing hope and self sufficiency to the Cocos Malay who until 1984 were cut off from the rest of the world surviving from the Clunies-Ross Coconut plantation.

'When a bee sees food she dances more...When a human sees food, they eat more. When the Cocos Malay have food, they share more'

Honey varieties light to dark

Conclusion:
Bee-keeping has connected several of the women of the Cocos Malay community, who would otherwise not be socialising together and enabled shared values and motivation to protect their island home through working with their bees. Honey production has provided a welcome additional income, as well as providing a natural and healthy food source. Lip balms are also made and sold to locals and tourists. Pollen and propolis production are in abundance, but but not yet utilised. There is scope for development of honey production and export of bee products, including queens to mainland Australia, that has lost substantial numbers of bee colonies due to varroa in the past three years. Niche tourism, including Apitherapy also has potential in this unique slice of paradise, where the bees are thriving. A planned documentary of the women's story will highlight the importance of bees and how women bee-keeping can bring together a community and offer hope when there is uncertainty. If the bee species on the Cocos (Keeling) Islands is also a secluded population of a now endangered species, the importance of supporting this community with research and training will have far reaching positive consequences.

Cocos Malay women sharing food

Cut comb honey selling to locals and tourists

Research and project coordinated by Paula Carnell, with grateful support from Apimaye Hives, Beewise, Perth.B.J Sherriff beesuits, A. Topolofski, University of Agriculture, Krakow, Poland. S. Rasic. University of Belgrade. Funded by Golden Bee Productions & Paula Carnell. Ltd. To support the further research with this project please go to 'https://paulacarnell.com/goldenbee or email paula@paulacarnell.com

Generous support received from Apimaye Hives with 10 complete beehives. Adam Topofilski with honey bee wing analysis, and Dr Liz Barbour of Y-Trace Pty Ltd for nectar analysis.This project was funded by Golden Bee Productions CIC.

PP-496 [Beekeeping for Rural Development]

Sustaining Honeybee Populations in the Cocos (Keeling) Islands within an extreme environment for humans, yet perfect for honey bees, *living wild in the calophyllum and palm forests & managed using plastic beehives*

High tides and heavy rain create flooding on an islands with a 1.5m elevation

Unexpected bee subspecies with natural resistance to Varroa

Ancient Calophyllum trees and blossom

Wild swarms create large colonies. This one attached to an Octopus tree.

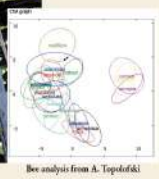
Methodology: Visiting the Cocos (Keeling) Islands in 2020, there were wild bees on Home Island, and a mixture of wild and hived colonies managed by two beekeepers on West Island. The two populated islands are separated by a lagoon, 9km wide and a string of a total of 27 islands make up the coral atoll. The beekeepers use a mixture of wooden and Apimaye plastic hives. For security of the bee population, there had been suggested that establishing managed bees on Home Island would secure the population. Due to biosecurity, queens can no longer be imported to the islands, situated around 4000 km from mainland Australia. Queens had previously been imported from Western Australia, most likely an Italian strain from Rottnest breeders. I decided to spend a year on the islands, living amongst the Islamic Cocos Malay community on Home Island to support the development of bee colonies. The plan was to establish a sustainable population of bees from existing colonies, providing pollination for the small farms on the island, and a business income from honey production for the local Cocos bee-keeping ladies. As the Home Island population are muslims, working with the bees according to the 16th Sura of the Qu'ran was appropriate. In the Qu'ran bees are referred to as female, which, at the time, was scientifically unknown. It made sense, therefore to work with the women of Cocos to preserve and research the bees of their islands.

Observing a wild colony inside an Australian pine tree.

Results. On arrival in April 2024, the wild colonies had died out on Home Island, leaving the nearest bees as wild colonies on South Island and hived & wild bees on West Island. In July 2024 a split was taken from a semi feral colony on West Island and transported across to Home Island by barge (9km). Then in August 2024 a further swarm was captured and also transported across the lagoon. By November 2024 there were 5 colonies, managed by Paula and two local Cocos Malay women. By February 2025 there were 5-8 colonies, consisting of 2 wild (in trees) and 5 managed Cocos Malay ladies). The bees were sent for analysis to Prof Adam Topofilski in Poland and the results showed a high genetic sampling of Apis mellifera intermissa. This challenges the belief that the bees were brought from Europe in the 1940s. Key learnings from observing the expansion of these colonies:

1. Very mild mannered in temperament on Home Island, compared to the colonies on West Island. Could this be due to management methods? (No smoking, minimal honey harvesting, no over manipulation, or from selecting feral swarms?)
2. The environment on Home Island (HI) is very relaxed and community based due to 100% Islamic practice.
3. Abundance of forage, year round. Calophyllum trees in full bloom every 6-8 weeks. Coconut blossom, abundance of blossom on mangrove trees. Wild flowers.
4. Apimaye beehives are perfect for managed colonies on the islands. Resistant and resilient to tropical weather conditions (extreme heat and humidity, strong winds and heavy rain.) Ease of movements for temporary relocation is also useful during floods. With women managing the colonies, it was essential to have hives that were easy and light to manoeuvre. Honey harvesting using the natural comb provided a pure honey product and maintained colonies through their own wax production, rather than quickly filling up hives and swarming if foundation was used.
5. No pests, diseases or predators for the bees enabling them to thrive.
6. It was believed that no other bee species lived on the islands, however Paula Carnell located numerous colonies of a carpenter bee , ceretina sp. spread across the islands.

A giant colony wrapping beeswax around the trunk of a coconut palm



Bee analysis from A. Topolofiki

Bees not eating their own honey due to abundance of nectar

Conclusion.
Due to the abundance of nectar and pollen year round, the bees were not interested in consuming their own honey. This meant hives soon built up honey stores in all available space, frames and lids of hives. Wild colonies in trees, able to survive outside on branches, soon built up to be substantially sized, sending off swarms regularly. Heavy monsoon style storms and cyclone weather put wild colonies at risk, however they appeared to adapt, attaching palm fronds and leaves as 'roof' structures over their brood combs. Further research on the native bee species, their locations and habitat is required and to study any interaction between the two species.
Further research:

- Analysis of honeybee species
- Study of Queens and sustainable reproduction
- Thorough bee audit of all bee species across islands
- Training on Queen rearing for local Cocos bee ladies.
- Analysis of honey and propolis for medicinal benefits and properties

Ceretina sp.

Transporting swarm in a box from a Frangipani tree

Beekeeping classes on Home Island

Bees building natural comb in Apimaye hives

Research and project coordinated by Paula Carnell, with grateful support from Apimaye Hives, Beewise, Perth, B J Sherriff beesuits, A. Topolofiki, University of Agriculture, Krakow, Poland. S. Rasic, University of Belgrade. Funded by Golden Bee Productions & Paula Carnell. Ltd. To support the further research with this project please go to "https://paulacarnell.com/goldenbee or email paula@paulacarnell.com

PAULA CARNELL

PP-497 [Beekeeping for Rural Development]
Female Entrepreneurship in Beekeeping: Innovation and Training as Vectors of Sustainable Development in the Sertão Pernambucano, Brazil

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Iasmine Therua Cataldi Dos Santos Silva
Department of Animal Science, Federal Rural University of Pernambuco, Recife, Pernambuco, Brazil

Beekeeping has been consolidated as an important alternative for income generation, especially for women, as it requires low initial investment and promotes environmental conservation. However, small producers face challenges such as limited access to technology, poor technical assistance and devaluation of honey in the market. This study evaluated how technical training and innovation in beekeeping production can strengthen female entrepreneurship, add value to honey and boost the economic sustainability of beekeeping in the Sertão Pernambucano. The research was carried out with 20 women beekeepers from Fazenda Floresta, in the municipality of Parnamirim, central Sertão of Pernambuco - Brazil, a community in a situation of social vulnerability. A participatory and socio-educational approach was adopted to map the main challenges faced by beekeepers and, in a multidisciplinary way, implement strategic solutions. The actions included training on hive management for high productivity, beekeeping pasture, wax processing, hive shading and food safety, in addition to the implementation of a collective apiary with 40 hives and the introduction of honey bee jelly as a new market product. Female entrepreneurship and environmental education activities were also promoted with 47 children from the community. The results demonstrate significant advances considering that women have acquired technical knowledge and essential skills for the management of their beekeeping business; the price of honey produced increased from US$ 1,36/kg to US$ 6,80/kg, thanks to the added value and the strengthened visual identity; the commercialization of fractionated honey expanded access to new markets, such as farmers' markets and direct consumers; The involvement of the children ensured the continuity of environmental awareness and sustainable entrepreneurship. This project not only strengthened women's autonomy and leadership, but also contributed to a replicable model of inclusive rural businesses, promoting bioeconomy, food security, and economic resilience for smallholder beekeepers.

APIMONDIA SCANDINAVIA 2025
SWEDEN | DENMARK | NORWAY

PP-498 [Beekeeping for Rural Development]

Increasing the Value of Beekeeping Products by pollen surveys at Indigenous tribes in Taiwan

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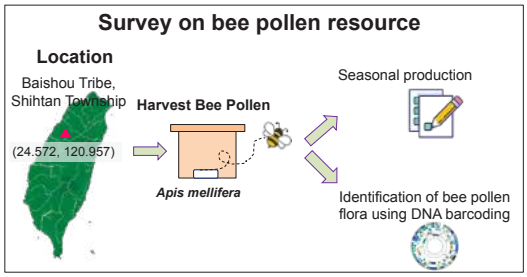
Abstract

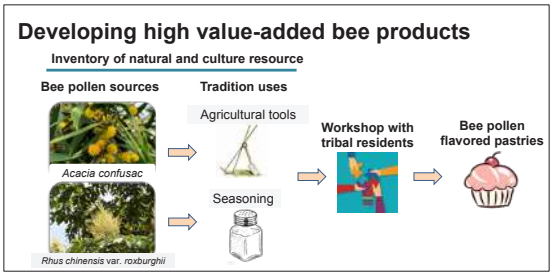
This study addresses the challenges faced by Taiwan's indigenous tribes, specifically the Saixia tribal's Baishou tribe, where a lack of rural job opportunities leads to youth outmigration and cultural erosion. We explored the potential of transforming indigenous agriculture, particularly beekeeping, to create sustainable livelihoods. While the region boasts diverse botanical resources suitable for beekeeping, an initial survey of the Baishou tribe revealed limited bee pollen production (approximately 240g from five colonies over seven hours in spring), and making direct bee pollen sales unviable. However, we identified *Bidens pilosa* var. *radiata* and *Acacia confusa* as dominant pollen sources. Leveraging traditional indigenous knowledge, we assisted local youth in developing bee pollen-flavored pastries using small quantities of *Acacia confusa* and *Rhus chinensis* var. *roxburghii* pollen. These plants hold cultural significance, traditionally used for tools, clothing, fuel, and seasoning. By integrating these cultural narratives with the new products, the pastries were successfully marketed at local tourist attractions, leading to a 21.3% increase in profit. This demonstrates that combining traditional tribal wisdom with resource surveys can significantly enhance the value of bee products and foster rural economic growth.
Keywords: Indigenous tribe, beekeeping, bee pollen, tribal wisdom, rural economic growth

Introduction

Taiwan's indigenous tribes reside in mountainous areas that serve as vital reservoirs of biological and natural resources. However, in modern society, due to factors such as terrain, water resource protection regulations, and government land management policies, rural communities in mountainous areas face significant restrictions in land use and economic development. This has led to young adults migrating to urban areas for career opportunities, posing a risk to the sustainable development of indigenous communities. To balance rural economic growth with ecological preservation, many countries are promoting forest beekeeping. Bradbear (2009) provided an extensive review of the case, pointing out the positive impact of beekeeping on forest management and conservation. They emphasized how bee pollination promotes forest ecosystems and biodiversity, while products such as honey and beeswax provide important economic income for residents in remote areas. In addition, bee pollen is a promising product in forest beekeeping. Bee pollen is a pellet of pollen mixed with bee saliva and nectar, collected by bees and brought back to the hive, serving as their primary nutritional source for growth and development (Campos et al., 2008). It's rich in carbohydrates, proteins, vitamins, and minerals. Studies suggest that bee pollen's balanced nutritional profile may help improve metabolic syndrome, reduce the risk of cardiovascular disease and diabetes, and regulate ovarian function. Additionally, bee pollen contains phytochemicals like polyphenols and flavonoids, which possess antioxidant, antibacterial, and anti-cancer properties (Cai et al., 2017; Li et al., 2018; Khalifa et al., 2021).However, introducing advanced production, processing, and quality management knowledge and operations can be challenging for small-scale producers (Contreras-Medin et al., 2025). Research by Zhou et al. (2024) on consumer psychology and behavior indicates that incorporating cultural elements into products positively impacts brand perception. They found that "brand happiness" mediates the relationship between brand richness benefits and purchase intention, increasing consumers' willingness to pay a premium. To support the sustainable development of indigenous communities and local economies, this study focuses on the diversity of bee pollen flora and its connection to indigenous traditions, aiming to inspire the development of high-value-added products.

Materials and methods





Results

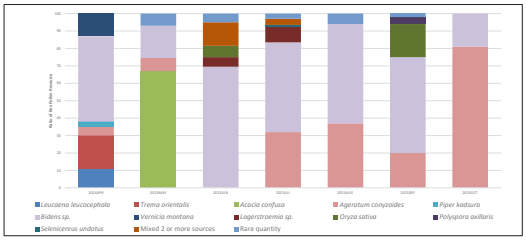


Figure 1. Pollen flora of Baishou tribe, Shihtan Township (March-October).

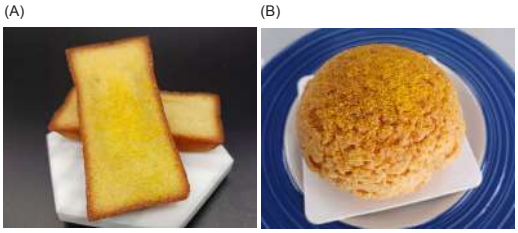


Figure 2. Bee pollen flavored pastries. (A) *Rhus chinensis* pollen flavored cake. (B) *Fraxinus formosana* pollen flavored cream puff.

Table 1. Monthly bee pollen production survey in Baishou Tribe, Shihtan Township.

Location	Baishou Tribe, Shihtan Township, Miaoli County						
No. of colonies.	7 colonies						
Harvest time	4-7 hours						
Production of Bee Pollen(g)							
2023 Apr.	2023 May	2023 Jun.	2023 Jul.	2023 Aug.	2023 Sep.	2023 Oct.	
240	275.3	245	65	96.4	135	95	

Table 2. Analysis of profit increase of bee pollen flavored cake.

	Original pastries price (TWD $/per.)	Price of pastries after adding bee pollen (TWD $/per.)	Price of bee pollen at place of production (TWD $/g)	Profit increase ratio (%)
Pastry	40	50	1.3	21.8
Puff	50	55		7.4

Discussion

Western honey bee (*Apis mellifera*) foraging behavior tends to favor large areas of major nectar and pollen sources. Our survey results highlight the seasonal pollen flora most attractive to Western honey bees; however, the overall plant diversity of the area still requires more detailed investigation. The survey of bee pollen flora provides insights into a portion of the local plant resources and agricultural practices. In this study, the production of bee pollen is not the primary factor in increasing product value. We suggest that integrating indigenous traditions with bee pollen resources, especially incorporating indigenous cultural narratives, is key to attracting consumers and increasing the value of bee products. This study proposes a model that can increase the value of indigenous beekeeping products, thereby contributing to the sustainable development of indigenous communities and rural economies.

APIMONDIA SCANDINAVIA 2025
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PP-499 [Beekeeping for Rural Development]

Environmental and microbial drivers of nectar flows: the case study of sunflower *Helianthus annuus*

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#0446
Date: 23-27/September/2025

Introduction

Among nectareous plants of interest for the sector, sunflowers (*Helianthus annuus*) are of particular interest: they are rich in nectar and pollen and can ensure substantial honey harvests for beekeepers. However, a drop in sunflower nectar secretions, and therefore, in honey production, has been complained by beekeepers since 2017 at least. This decline is mainly driven by heat waves and particularly intense dryness, but also other factors factor might affect plant performance: the decreased microbial diversity of soils in the agroecosystems, which does not allow the establishment of a beneficial "dialogue" between sunflowers and soil microbiome. Soil microorganisms are responsible for the solubilization of microelements useful for nectar secretion such as manganese and magnesium. Plant Growth Promoting Bacteria (PGPB) are soil-born microorganisms widely used as bio-fertilizers in agriculture to increase plant growth and resistance to environmental stress factors, also in microbial degradated soils.

The research aim: to determine the impact of PGPB fertilizers on: a) Soil microbial communities of the Sunflower rhizosphere. b) Gene expression of passive sugar transporters (SWEET) responsible for nectar secretions.

Methods

1. In field trial

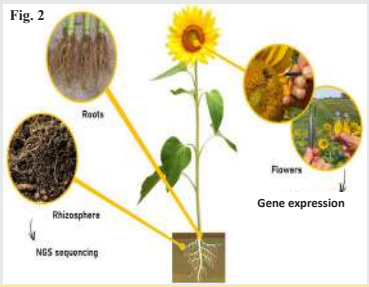
A field trial involving a high oleic hybrid sunflower variety (LST907) and a non-hybrid variety (Peredovick) was established in 2023 and 2024. Both sunflowers varieties were divided into plots, and the rhizosphere was inoculated with different microbial inoculants of *Bacillus, Paenibacillus,* and *Lactobacilllaceae*. Microbial treatments were performed once a month, till blooming (Fig.1).

Fig. 1

2. Samples collection

Samples collection of flowers, rhizosphere, roots were collected from the different experimental conditions at blooming time. All samples were immediately stored in dry ice until DNA and RNA extraction, which was performed with commercial kits. Extracted RNA was immediately converted in cDNA with RevertAid First Strand cDNA Synthesis Kit

Fig. 2



3. Samples analysis

NGS: rhizosphere microbiota and endophytes were analyzed at University of Bologna. Extracted DNA was amplified (V3-V4 regions of the 16SrRNA) and sequenced on Illumina Novaseq 4000 platform.

Gene Expression: BLAST (blastn suite) was used to identify the *Helianthus annuus* SWEET9 gene region on a de novo assembled whole genome sequencing of h. annuus, by alining the SWEET9 gene's nucleotide sequence of *Brassica rapa*. Primer design was performed with PRIMER 3 software. We quantified the expression of SWEET genes in sunflower by qPCR in triplicates. Relative abundance was calculated using the 2^-ΔΔCt method: Ct values of SWEET genes were normalized to a stable reference gene β-tubulin and the results compared to all the experimental conditions described in "In field trial "section".

4. Statistical analysis

Datasets were analyzed with ANOVA when data were normal and homoscedastic, while GLM was applied for non-normal homoscedastic data.

Results

Some PGPB are drivers of sunflower rhizosphere microbial composition, impacting more than the variety

- ASVs showed that the rhizosphere of LST907 sunflower variety acquired a different microbiome when compared to the Peredovick variety (PCoA - Fig. 3), with 164 missing microbial genera (16.2%) in LST907.
- LST907 did not show root colonization by typical honeybee commensal microorganisms such as *Bombella, Commensalibacter, Bartonella,* and *Frischella* that actually were present in the Peredovick variety.
- Lactobacillaceae could colonize and drive the sunflower rhizosphere better than other PGPB. Lactobacillaceae also shower a greater colonization of the Peredovick rhizosphere as showed by the weighted unifrac PCoA analysis ($p<0.05$, Fig.4a and 4b).

Fig. 3

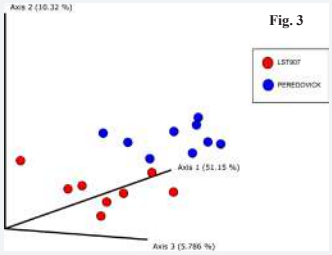


Fig 4a - LST

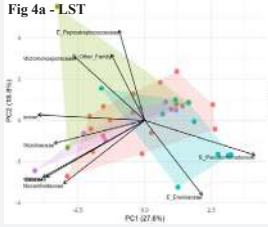
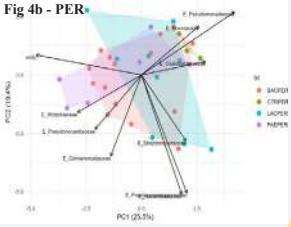


Fig 4b - PER



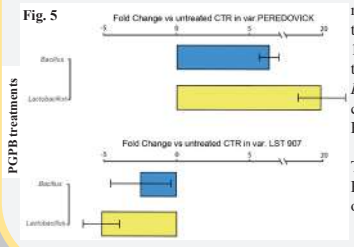
- *Bacillus* and *Paenibacillius* PGPB treatments, on the contrary, did not significantly alter the Sunflower's rhizosphere.

Results

Gene expression of sugar transporter *HeSWEET9*

The results clearly show a varietal effect, meaning that the two genotypes respond differently to the treatments. The application of PGPB strains led to an increase in the expression of the *HeSWEET9* gene in the Peredovick variety, where both the microbial treatments increased the gene expression of 7.36 and 19.78 folds in Peredovick plants treated with *Bacillus* and *Lactobacillus* respectively, when compared to untreated Peredovick sunflowers (CTR).

Fig. 5



The application of the same PGPBs led to an opposite result on the LST 907 variety (Fig 5).

Conclusions

Overall, this research highlights the impact of biobased microbial fertilizers (PGPB) on the rhizosphere microbial community and, consequently, on the regulation of sugar transporter gene expression in sunflower plants. Such modulation may influence the intensity and dynamics of nectar flow, providing potential benefits for pollinators and honeybees. In this way, PGPB treatments can affect not only plant physiology but also the trophic potential and ecological role of nectar-producing crops such as sunflowers.

This study was carried out within the Agritech National Research Center and received funding from the European Union Next-GenerationEU (PIANO NAZIONALE DI RIPRESA E RESILIENZA (PNRR) – MISSIONE 4 COMPONENTE 2, INVESTIMENTO 1.4 – D.D. 1032 17/06/2022, CN00000022).

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PP-500 [Beekeeping for Rural Development]
Honeybee Colonies Fencing - A Solution to Destruction of Crops

Sankarankutty Kannamvallimadam
SAKARANKUTTY KANNAMVALLIMADAM, PAYYANUR, INDIA

In Western ghats of South India, farmers face significant problems with wild animals, primarily due to crop damage caused by animals like elephants, wild boars, deer, and monkeys entering their fields to forage, often resulting in substantial economic losses and impacting their livelihoods, especially when living near forest boundaries. Crop damage by the wild animals in and around protected areas in India is also a very serious issue among the farmers and conservationists.
Taking into consideration particularly in the forest boundary region of Kerala, Tamil Nadu, Karnataka states, we have developed fencing the boarder with Apis cerana bee colonies, and found that, it serves as a natural defence to thwart the menace of wild animals especially elephants.
In Vythiri village of Wayanadu district, a fencing of 25 Apis cerana colonies was erected in the year 2024, where there was severe attack of elephants. The farms of tapioca, banana, were destroyed every year and 95 % of crops were damaged and farmers face huge loss due to farming. The bee colonies fencing helped to restrict the entry of elephants to the fields. The model can be replicated in different parts of the forest boundaries.

PP-501 [Beekeeping for Rural Development]
Traditional beekeeping in georgia

Roland Gogoberidze[1], Irakli Rtskhiladze[2]
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[2]Beekeeper, Tbilisi, Georgia

Beekeeping has evolved significantly over the past 150 years with scientific advancements and modern hive technologies improving colony management, beekeeper convenience, and efficiency. However, traditional beekeeping remains a crucial part of Georgia's cultural and ecological heritage and deserves preservation.
Adjara, a southwestern province of Georgia, remained isolated for decades, particularly under Soviet rule. Until Georgia's independence in 1990, access to the region required special permission. This isolation contributed to the preservation of conventional hive designs and techniques long after they had disappeared elsewhere.
Traditional Hives in Adjara
Beekeeper Roland Gogoberidze still maintains two types of traditional hives:
1. Djara ( )
o Made from a horizontally split and hollowed linden trunk (80 cm long, 35 cm wide).
o It can be opened in autumn for honey extraction and then resealed.
2. Khovani ( )
o A single hollowed linden trunk (60 cm long, 30–35 cm wide).
o Non-openable horizontally, functioning as a self-sustaining colony.
Hive Placement and Management
Both Djara and Khovani are traditionally placed on beech trees, as brown bears cannot climb them, protecting the colonies naturally.
• Khovani, being lighter, can be manually lifted onto trees.
• Djara, heavier, requires special lifting equipment.
• One beech tree can support up to thirty hives.
Currently, Roland Gogoberidze maintains forty traditional hives, preserving centuries-old beekeeping traditions. These methods provide valuable insights into sustainable apiculture and the potential integration of natural hive designs into modern beekeeping.

PP-502 [Beekeeping for Rural Development]
Selective Breeding for the Conservation and Performance Enhancement of Apis mellifera intermissa in Algeria

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[3]Association Nationale des Apiculteurs Professionnels. Chifa, Blida.

The conservation of local honeybee ecotypes in Algeria is a crucial challenge to ensure the sustainability and productivity of beekeeping in the face of environmental pressures and threats to biodiversity. This study aims to establish a breeding and preservation program for local populations of Apis mellifera intermissa to improve their resilience and performance through a combination of controlled selection and mass selection techniques.

Initially, 70 mother colonies were evaluated based on specific criteria, including gentleness, frame stability, and varroa sensitivity. Using principal component analysis (PCA) with R Studio, 15 queens were selected for further assessment. In a second phase, four mother colonies were retained at the controlled mating station SFC26 and three at the SFC09 site. These colonies were chosen for their superior performance and distinct morphological traits.

In parallel, mass selection was conducted to enhance desirable genetic traits in the broader population. For biometric analysis, 1,800 worker bees were sampled—1,440 from SFC26 and 360 from SFC09—and subjected to wing morphometric analysis. Statistical evaluation of the biometric data confirmed significant variations in wing venation patterns, indicating genetic diversity and local adaptation of the selected colonies. These results reinforced the effectiveness of combining different selection techniques to achieve genetic improvements.

The study continued with the rearing of F1 drones from the selected mother colonies for further controlled matings. Daughter queens and their colonies were evaluated for honey production, brood development, and resilience to environmental stressors. The initial selection of daughter queens resulted in a new generation of bees with 20% higher honey production, better disease resistance, and increased adaptability to local climatic conditions.

This work highlights the importance of combining controlled selection and mass selection to improve the performance of Apis mellifera intermissapopulations. It contributes significantly to the sustainability of beekeeping in Algeria, promoting genetic diversity, enhancing honey production, and aligning with sustainable development goals by preserving natural resources and fostering innovation.

PP-503 [Beekeeping for Rural Development]

From threats to solutions: meliponists' perceptions and proactive practices in Brazilian meliponiculture

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Introduction

Modern agriculture heavily relies on monocultures and intensive pesticide use, practices that harm not only the land but also pollinators, including native bees, which are essential for most crop plantations [1,2]. In Brazil, integrating meliponiculture (stingless bee beekeeping) into rural properties can play a crucial role in promoting more sustainable land use while fostering rural development [3,4].

⚠Meliponiculture faces various threats that impact bee health and productivity, requiring adaptative responses from meliponists.

Aims

The study analyzed rural meliponists' perceptions of threats to meliponiculture and the strategies they employ that address these challenges.

Methodology

In 2022 an online survey was completed by 252 rural meliponists from across Brazil.

Figure 1. *Geographic Distribution of Survey Responses*

Topics covered:

- Threats in meliponiculture
- Land use
- Bee management
- Beekeeper training

Results

Figure 2. *Perceived level of harm caused by different threats to meliponiculture*

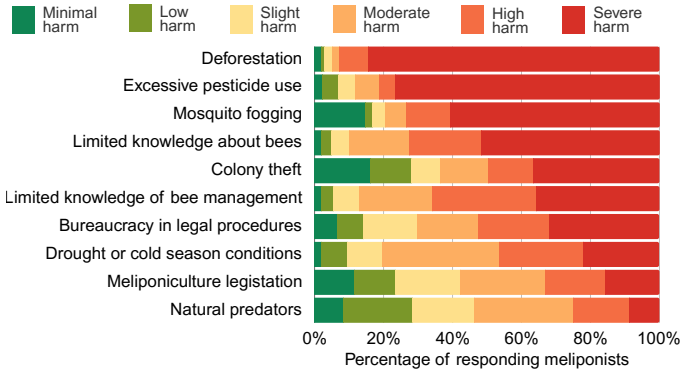
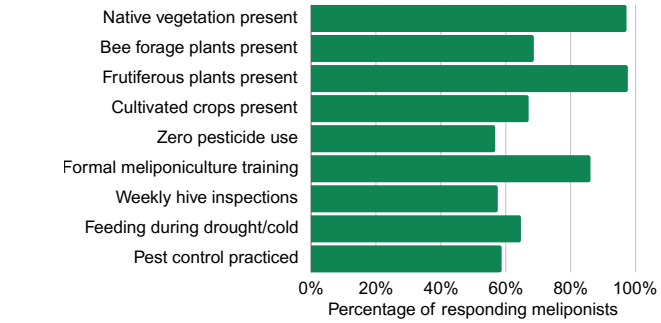


Figure 3. *Actions undertaken by meliponists that mitigate theats to meliponiculture*



- The results show the impact of conventional agricultural practices on meliponiculture in rural areas: pesticides and deforestation are perceived as the main threats to the activity. In addition, lack of technical knowledge and colony theft further increase risks [5].
- Meliponists demonstrate adaptive strategies and sustainable land use through the avoidance of pesticides, forage planting, forest preservation, and regular colony monitoring.
- Formal training in meliponiculture emerges as a key factor to reduce vulnerabilities and strengthen the activity [6].
- Excessive red tape within the legal system poses a greater challenge to meliponists than the actual legislation itself. Targeted public policies are needed to streamline processes, support management, and promote sustainable practices [7]. Participatory governance can further enhance the sector's potential and long-term growth.
- Integrating stingless bee beekeeping into agriculture can promote food security, biodiversity conservation, and sustainable rural development [8].

Conclusion

Meliponiculture in Brazil faces major challenges including deforestation, pesticides, mosquito fogging, and limited technical knowledge. Despite this, rural meliponists show resilience through sustainable practices such as forest preservation, forage planting, pesticide avoidance, and training that strengthen sustainable beekeeping. This study offers practical insights for new meliponists and promotes targeted management strategies, participatory governance, and specific public policies to support the long-term sustainability of meliponiculture and its vital role in biodiversity, pollination, and rural development.

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APIMONDIA SCANDINAVIA 2025
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PP-504 [Beekeeping for Rural Development]

Honey Tastings: A Platform for Bee Conservation and Market Development

Practical Strategies for a Successful Honey Tasting for Beginners

Alejandra Flórez[1,2], Mónica Ponce de León[2]
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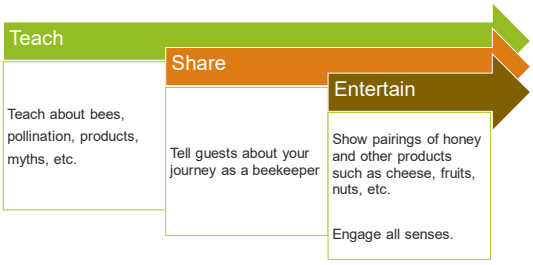
Introduction

Honey tastings have become an effective platform for raising public awareness about the vital role of bees in our ecosystem and stimulating market growth for beekeepers. While honey is a widely consumed product, consumer understanding of its origins, varieties, and health benefits remains limited. Furthermore, prevalent myths and misconceptions surrounding honey production and consumption, such as concerns about adulteration and overharvesting, often hinder market appreciation and growth. These misconceptions not only impact consumer confidence but also discourage sustainable beekeeping practices. By providing consumers with the opportunity to experience the diverse flavors and aromas of different honeys, well-organized honey tastings can effectively address these challenges.

Practical Strategies for a Successful Honey Tasting for Beginners



Key Points to Organize Honey Tastings For Beginners

1- Honey Variety and Samples

- Choose 3-5 different kinds of honey.
- i.e. different origins, different states (liquid, crystallized), different colors, honeycomb
- 5-10 ml per sample per person.

2- Clear Instructions

- Give directions on how to look, smell and taste the honey.
- Start with the samples of softer flavors

3- Supporting Material

- Be ready with color guides, information of samples, etc.
- Provide water and neutral flavor crackers to cleanse the palate between samples

4- Food safety

- Provide individual samples
- Provide clean utensils, clean table, optional: use placemats

5- Presentation of Honey

- use glass or clear plastic (avoid use of one use plastic)
- make sure there is enough light to see honey colors properly

6- Product Showcase

- Make sure you have availability of product, communicate payment means, share social media information (preferably with QR codes for easy sharing)

Printable Color and Flavor Charts

Complete honey flavor charts can be very complex for beginners, but it is a very practical tool for beginners to identify flavors in honey. In Dominican Republic we have mostly multifloral honey, so flavor profiles are always mixed and different.

You can find printable color and flavor charts in the QR below (in English and Spanish).

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PP-505 [Beekeeping for Rural Development]

APIMONDIA SCANDINAVIA 2025
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COPENHAGEN

EUROPEAN APICULTURE SECTOR POLICIES - POSITIVE AND NEGATIVE ELEMENTS FOR HEALTHY MARKET CONDITIONS

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Problem description: Currently, the dysfunction of the honey market has a devastating effect on the beekeeping sector in Europe where there are considerable variations from country to country when considering the market health described by indicators. Since policies are made to regulate markets, it would be expected that positive and negative elements of national policies would have a relation to market health.

Table 1: Honey trade balance in 2023 for selected countries, based on data of FAOSTAT for all selected countries, and compared with EUROSTAT based data for EU Member States. Countries are sorted descending after the FAOSTAT-based trade balance. No statistics exists for Kosovo.

	Faostat data				Eurostat data
	Exports, tonnes	Imports, tonnes	Population, 1,000	Per capita trade balance, kg	Per capita trade balance, kg
Bulgaria	10,991	3,226	6,796	1.14	-0.19
Serbia	1,510	377	6,773	0.17	
Türkiye	9,386	15	87,271	0.11	
Albania	4	50	2,812	-0.02	
Slovakia	1,694	1,814	5,518	-0.02	-0.17
Spain	27,352	31,005	47,912	-0.08	-0.18
Bosnia and Herzegovina	7	469	3,185	-0.15	
Denmark	2,826	4,154	5,948	-0.22	-0.28
Italy	5,730	24,361	59,499	-0.31	-0.08
Croatia	739	2,775	3,896	-0.52	-0.19
Germany	18,021	64,469	84,548	-0.55	-0.43
UK	2,268	50,917	68,683	-0.71	

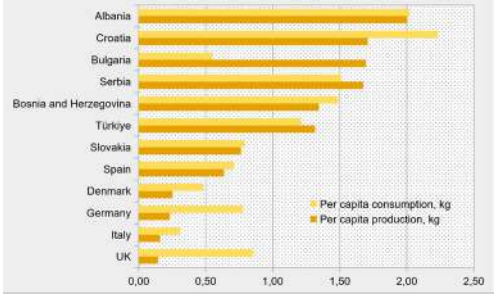

Figure 1: Per capita annual production and consumption (kg) of honey in selected BeSafeBeeHoney countries (Based on data of FAOSTAT, 2023, production figures for Italy based on FAOSTAT data for 2022).

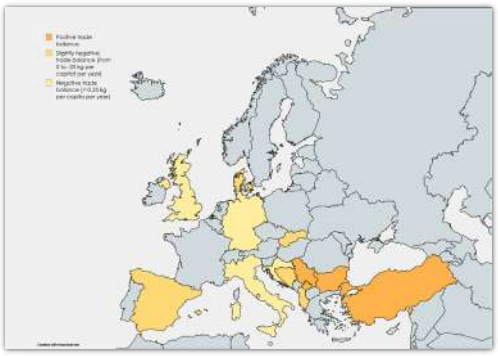

Figure 2: Countries represented in responses to the policy survey, coloured according the size of their honey trade balance.

Table 2: Promoting and deteriorating national policy examples for countries with positive, slightly negative and negative trade balance for honey.

	Number of responses		Comments
	Promotional policies	Deteriorating policies	
Positive	11	3	Three countries: Türkiye and Serbia - no national policies mentioned for Bulgaria
Slightly negative	11	6	Five countries: Bosnia & Herzegovina, Slovakia, Denmark, Spain and Albania
Negative	6	2	Four countries: Croatia and United Kingdom – Germany and Italy not mentioning national policies

CONCLUSIONS

Qualitative analyses of the policy survey responses gave reason to conclude that there is a **general perception of three major policy issues being determinative for a thriving honey market**, namely I) subsidisation, II) product classification and labelling, and III) regulation of the approval, registration and use of pesticides and veterinarian medicine.

Responses highlights challenges within the sector resulting from **irregular market mechanisms**, with indications that the predominant market channels operate largely beyond public oversight, contributing to concerns about effective regulation and control.

Acknowledgement: The present work is made within the frames of the **BeSafeBeeHoney** COST Action 22105 as a contribution to **Work Group 5** concerning *EU policies, safety practices and market analysis of the honey value chain*, supported by **COST** *(European Cooperation in Science and Technology)*.

SCAN ME

APIMONDIA SCANDINAVIA 2025
SWEDEN | DENMARK | NORWAY

PP-506 [Beekeeping for Rural Development]

Introducing children to beekeeping as a pathway to sustainable development

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Introduction

In Slovenia, we are aware of the important role bees play in the environment, and for decades we have been trying to pass this awareness on to young beekeepers. It is a process through which we aim, in the long run, to change the way of thinking towards sustainable development. It is crucial in this regard to create awareness and habits in the early stages of life.

Methods of work

Beekeepers visit children in kindergartens, and children visit us at the Slovenian Beekeeping Centre. Beekeepers and advisors of the Beekeepers' Advisory Service conduct lectures on bees and the importance of their conservation, bee products, etc. with workshops and science days in primary and secondary schools. Teachers conduct an elective subject in beekeeping in the third triad of primary schools. Also, with the help of beekeeping mentors and / or teachers, beekeeping clubs are conducted in primary and secondary schools in classrooms and educational apiaries. We help each other with a 40-hour curriculum for lower and higher levels. We organize school, regional and national competitions on beekeeping knowledge. We prepare motivation letters for the preparation of diploma, master's and doctoral theses for faculties and universities.

Figure 1: Different methods of work.

Projects
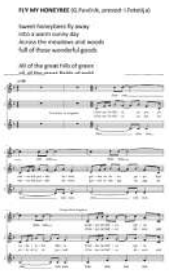
Figure 2: A song about a bee.

- Cooperation between the Beekeepers' Association of Slovenia and the Centre for School and Extracurricular Activities by implementing science days
- Cooperation of the Beekeepers' Association of Slovenia and local Beekeeping Societies with primary and secondary schools by implementing beekeeping circles
- Cooperation in the Traditional Slovenian Breakfast project in educational institutions with visits by beekeepers
- Painting beehive panels, performing plays on the theme of beekeeping, singing beekeeping songs, planting melliferous plants
- Setting up educational apiaries with hives and bee colonies in primary schools through sponsors

Figure 3: Painted beehive and other children's products.

Figure 4: An educational apiary.

Results

- Early formation of environmental awareness in children, which also indirectly affects parents
- Greater interest in beekeeping among the younger population
- Active participation of children in sustainable activities, such as beekeeping, planting melliferous plants, creating beehive extensions that are installed on beehive
- Increased interest in research tasks related to beekeeping, especially in the agricultural and economic fields, and further education in this field at primary, secondary and tertiary levels

Figure 5: Planting melliferous plants.

Photos: SBA Archives

Conclusion

Involving children in beekeeping through various methods and at different levels has proven to be an effective tool for raising awareness among children and the wider public about the importance of bees for the environment. Through such long-term and continuous efforts, we can contribute to the goals of sustainable development.

PP-507 [Beekeeping for Rural Development]
Beekeeping Survival Guide 2025

Sam Comfort
Anarchy Apiaries

The Beekeeping Survival Guide celebrates its 15th year in publication by inviting the world to take home a copy of the latest edition. One double-sided page folds into a tiny book that makes the art and science of beekeeping more accessible. A child, a busy farmer, a disabled person, a poor or socially disadvantaged population could use this pamphlet to begin their beekeeping journey with little to no costs and inputs. The goal is to inspire more beekeepers focused on sustainable practices: less use of chemicals in the hive, less purchasing and shipping of ill-adapted honey bee genetics, less movement of novel bee diseases, and evolving away from expensive, complicated equipment. The pamphlet starts by describing basic honey bee biology. A brief review of beekeeping history highlights approachable, inspectable hive designs that anyone can build with free/found materials. There are detailed instructions how to build a Comfort Hive as well as a skep, and how to stock them by staging bait hives and catching swarms. The pamphlet then focuses on simple, small-scale queenrearing methods that induce brood breaks as the primary or sole control of varroa mites. An advanced section explains bee yard planning, how to produce splits and package bees, handle various problems, as well as how to grow a local network that could strengthen the resilience of the bee population, provide pollination, and educate the public. Anarchy Apiaries produces this free “punk zine” as part of a grassroots effort to take back the means of production. Anyone can become a beekeeper and find richness in this world. Sharing, copying and redistributing, uploading/downloading the Survival Guide are highly encouraged. We will have copies on site, so pick up yours today!

PP-508 [Beekeeping for Rural Development]

"Tree beekeeping - beekeeping in a forest environment from a tree-beekeeper's perspective Andrzej Pazura"

a Polish forester with eighteen years of tree-beekeeping experience, founder of the European Forest Bee Association
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Honeybees have been associated with forest environments for centuries, where old trees provided safe nesting sites, and a variety of plants and trees ensured a steady food supply. Human intervention disrupted this balance by relocating bees to agricultural landscapes. In Poland, the method of breeding bees in trees has a history spanning millennia, but it has not been practiced for over a hundred years. Tree beekeeping returned to Polish forests in 2007 through the initiative of people, who learned this unique craft from beekeepers in the Urals, whose families have been breeding bees in tree beehives for at least seven generations. Tree beekeeping reestablishes a symbiotic relationship between honeybees and forest ecosystems by enabling bees to nest in healthy, living trees. Unlike agricultural apiaries, tree hives mimic the natural cavities found in old trees, offering optimal conditions for bee colonies to thrive. This practice also promotes the regeneration of melliferous plants and supports the conservation of bee-related fauna, which is critical for maintaining forest biodiversity.

A man-made tree beehive serves as an equivalent to a natural cavity in an old tree, fulfilling the essential needs of a bee colony. Our collected knowledge equips us to construct tree beehives in suitable trees, spaced appropriately in areas with good sunlight and protection from adverse weather conditions. Traditional hand tools are used in the construction process to shape the hive's interior for safe handling. Once the tree beehive has been constructed and occupied by bees, maintenance occurs during two key periods: autumn and spring. The autumn inspection, sometimes combined with honey harvesting, is conducted after the flowering season and involves checking honey reserves while securing the beehive for winter. Spring inspection takes place as plants begin to bloom, focusing on cleaning out dead bees from the hive's bottom and preparing the beehive for a new swarm in the event of colony loss.

Platform for building tree-beehives. A structure assembled for the duration of creating the chamber for the bee colony.
It ensures safety when working at heights of 4-6 meters and facilitates the proper construction and securing of tree-beehives.

The bee exit point from the tree hive. It prevents access by intruders and ensures fresh air circulation throughout the year.
The wooden peg serves an additional function inside the tree-beehive, protecting the honeycombs and brood from breaking off.

Tree-beekeeping workshops – a form of practical learning for building tree hives and tree-beehive logs.

Log hive mounted in young forests where old and thick trees are lacking.
The interior is made exactly like in a tree-beehive, but in a thinner piece of wood. It must be equipped with a roof and securely attached to another tree.

"Śniot", a board used to protect the tree-beehive during winter and against pests.
Between the board and the wood there is an insulation made of small twigs and grass .

Queen cells in the nest of wild bees, indicating the natural reproduction process of the bee colony.
By opening the tree-beehive during the autumn inspection, we can determine whether the bees swarmed this year.

The reintroduction of tree beekeeping in Polish forests has demonstrated significant ecological and cultural benefits including (a) the reestablishment of bees in their natural environment, contributing to forest pollination and biodiversity; (b) creation of bee-related fauna and biodiversity hotspots; (c) socio-cultural knowledge passed down through generations fosters environmental stewardship and reconnects communities with their cultural heritage.

Methods of entering bees in tree-beehives. On the left, leziwo; on the right, kiram.
Leziwo – two flexible ropes used to make loops around the tree, allowing the beekeeper to climb into the tree hive;
Kiram – a wide, rigid rope that wraps around the tree and the person.

Tree beekeeping is more than a method of honey production; it is a practice that deepens our understanding of bees in their natural habitat. Beekeepers gain firsthand insight into bee behavior and ecology, while the traditional skills required for hive construction and maintenance enhance their connection to nature. By integrating this ancient practice into modern forestry and conservation efforts, tree beekeeping offers an innovative and sustainable approach to safeguarding pollinators and enriching forest ecosystems.

The nest of a young bee colony in a new log hive. The constructed combs serve the colony for several years.

A bee colony in the tree-beehive preparing to swarm. Bees living in the forest make reproductive decisions based on the weather and the availability of food sources in a given year.

Damage to tree-beehives during winter caused by bears and woodpeckers.
In the photo, an oak log damaged by a bear, exhibited in the "Shulgan Tash" National Park.

Modern method of inspecting log hives using a ladder.
Made of aluminum, they are foldable, lightweight, and convenient for inspections.

Tools used for building tree-bee hives. They were handmade by craftsmen (blacksmiths) based on patterns preserved in museums and open-air museums.

PP-509 [Beekeeping for Rural Development]
Beekeeping Entrepreneurship, Training, Honey Processing and Marketing

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Bee9 and Farmers Beekeeping Academy and Training Centre a passionate initiative nestled in the heart of Mysore with a mandate to provide next generation environmental stewards-our future beekeepers!. It was established in 2013 mainly to produce beekeeping entrepreneurs through training and education and providing comprehensive training programmes for farmers, youth, women and children. These programs equip them with modern and scientific beekeeping techniques, artificial queen rearing methods and imparting the importance of pollination for sustainable agriculture, horticulture productivity and increase in forest produce.

Organising training programmes to spread awareness and advocating the importance of beekeeping and its crucial role in ecosystem service to students of schools, colleges including Agriculture and Horticulture Universities of India. Through building beekeeping skills and the confidence gained in our programs foster a hands-on learning environment, allowing young individuals to develop practical beekeeping skills and gain the confidence to become future beekeeping leaders. Further, by fostering a love for bees in young minds we can aim to create a ripple effect of positive change for our planet and we strongly believe that, by equipping them with the knowledge and skills we can inspire a generation dedicated to protecting these vital pollinators and promoting sustainable beekeeping practices.
Created a state-of-the-facility for branding, processing of honey based on the floral source mono-floral, bi-floral and multi-floral honey and other value added products such as royal jelly, beeswax candles, soaps creams, bee pollen and bee propolis. Created a good market niche for our products in the name of Mack Bee9 Nutraceuticals, Bee9 Elegance for Honey, spices and dry fruits, Bee9 cool joint and expanding the units of Bee9 in Malaysia and other countries. The details will be discussed.

PP-510 [Beekeeping for Rural Development]

QUEEN SELECTION CRITERIA ADAPTED TO THE TERRITORY.

HANDLING OF LIVE MATERIAL AND MULTIPLICATION OPTIONS.

MUÑIZ, GERÓNIMO Beekeping Technician
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Through more than 20 years as a queen breeder in Argentina I have been selecting and breeding queens adapted to the environment of Buenos Aires province, specifically center area and to the practices management applied by beekeepers to their colonies *(FIG.1)*. Applying mass selection different selection criteria have been considered *(FIG 2)*.

Figure 1
Influence are of our queen rearing company.

Figure 2

In order to evaluate the development of nuclei prepared at the beginning of the season headed by queen cells, mated queens or queen less (including combs with open brood) an assay was developed. Forty five nuclei were prepared and installed containing two brood combs, one with wax foundation and a feeder. Fifteen nuclei were include in each treatment: T1-QL: Queenless nuclei: 15 nuclei were orphan; T2-QC: Queen cells: 15 nuclei where queen cells were introduced; T3-MQ: 15 nuclei where mated queens were introduced. The variables Period (days) until nuclei were placed in a brood chamber, period until the brood chamber was completed and the honey yield were registered in each colony. Cost involved in each treatment was also registered. Results are shown in Table 1.

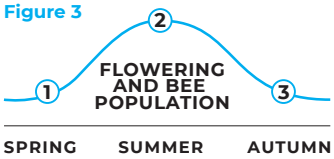
Table 1

	Mated Queen (MQ)	Queen Cell (QC)	Queen Less (QL)
Nucleis	15	15	15
Finished the test	15	13	8
Effectiveness	100%	86%	53%
Honey yield Kg. per hive	32	27	23,6
Kg. lost per hive		5 Kg per hive	8,4 Kg per hive
Total Kg. lost in %		-27%	-61%
Loss of money with respect to MQ (%)		-22%	-50%
Missing queen laying days	3=6.000 bees	15 = 30.000 bees	28 = 56.000 bees

Nuclei headed by mated queens (MQ) developed faster and had better honey yield, followed by the queen cell treatment (QC). The queen less nuclei not only developed slower but also many nuclei were lost. The results indicate that the investment in these beekeeping inputs is highly convenient.

In our area of influence, where we sell our queens and queen cells, the weather at the beginning of the season is highly variable, so many beekeepers choose to make nuclei later to obtain better results. After many years, our recommendations can be summarized in the following figure *(FIG 3)*.

Figure 3



Always remember to order mated queens or queen cells well in advanced. We are working with live material and must respect their biological cycle.

1. BEGINNING OF THE SEASON

We have all the season to develop and correct problems with queen. We can harvest them and recover the investment in live material. They're a good option for replacing dead hives during the winter or increasing their numbers. You can make them with mated queens or queen cells.

2. IN THE MIDDLE OF THE SEASON

They are an alternative for replacing queens at the end of the season or expanding the number of hives. You can do them with only cells, since there are good conditions for fertilization. We have brood available in all hives and we easily obtain mated queens or queen cells.

3. END OF THE SEASON

Ideal for replacing dead hives in the next season or performing an early queen replacement. It is recommended to do so with mated queens. We have brood available, the queen will have little laying time and will start almost new next spring.

PP-511 [Beekeeping for Rural Development]

URBAN BEEKEEPING: benefits and detriments

Gorazd Trušnovec, Urban Beekeepers' Association of Slovenia

ABSTRACT

Urban beekeeping is an interesting activity, flourishing with the popularization of beekeeping in general. In some world capitals, it has experienced rapid growth over the last decade, reminding us of the importance of living in healthy environments and green cities. Urban beekeeping and bee products can also contribute to locally produced food with a low carbon footprint, no transport and, above all, a symbolic message about the importance of growing our own food in an environment free from pesticides and the poisons associated with intensive agriculture.

Urban beekeeping can also be used for a wide range of educational activities in cities with positive social impact. However, recent evidence shows that densifying and increasing the number of honeybee colonies does not only have benefits. The carrying capacity of space is limited and as the number of hives has increased, honey yields have started to decline - partly due to climate change. Increasing scientific research shows that too many honeybees mean a lack of forage not only for bees but also for other important, unmanaged pollinators - and concentrating honeybees also helps spread different pathogens faster. A "heretical" idea emerged that honeybees do not necessarily have only positive effects on biodiversity and that the limitless expansion of beekeeping is not the best thing we can do for nature conservation.

We should therefore behave responsibly and think about the number of honeybees we care for and the impact on the environment - the carrying capacity of space has its limitations. Thus, urban beekeeping, which has experienced fast growth in the last decade, should be approached in a more careful & holistic way.

KEYWORDS
urban beekeeping, honeybees, pollinators, carrying capacity, social impact, food chains, environmental impact, sustainability, conservationism

ACKNOWLEDGEMENTS
Photography by Luka Dakskobler, Tine Lisjak & Borut Krajnc

ABOUT THE AUTHOR
- practicing beekeeper since 2010
- semi-professional beekeeper, managing 45 beehives
- president of the **Urban Beekeepers' Association of Slovenia** (est. 2014)
- beekeeping instructor, member of **Beekeeping Academy of Slovenia**
- first urban beekeeper in Slovenia with eco/organic certification (since 2024) for all bee products

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GREEN CITIES OF TODAY & THE FUTURE

68% of the world population projected to live in urban areas by 2050, says UN.

NEGATIVE ASPECTS OF URBAN BEEKEEPING

- limited working / storage space
- limited location availability
- difficult general logistics
- public prejudices and fears
- overpopularization, leading to high hive density
- overcrowding the given space with honeybees
- greenwashing / beeswashing (question of integrity)

(MORE) NEGATIVE ASPECTS OF URBAN BEEKEEPING

- careless hobby approach, frequent swarming
- bee-health issues: spreading pathogens
- limited foraging resources
- honeybees dominating over other important pollinators
- possible incidents – allergic reactions to bee stings

POSITIVE ASPECTS OF URBAN BEEKEEPING

- symbolic message / environmental issues
- creative free time activity
- community building
- general novelty and differentiation
- local food production / short food chains
- tradition / identity
- empowerment of underprivileged

(MORE) POSITIVE ASPECTS OF URBAN BEEKEEPING

- possibility of getting top quality bee-products
- high demand, fast-growing operations
- a positive media attitude & support
- changed customer habits
- part-time business opportunities
- ESG & sustainability reporting for the partner companies
- environmental pollination service

FINDING THE RIGHT BALANCE – KEEPING THINGS IN PROPORTION

- limiting the number of hives with honeybees
- upgrading the beekeeping practice
- improving the foraging conditions
- conserving all pollinators
- thinking about environment preservation
- keeping wild green areas

PP-512 [Beekeeping for Rural Development]
Beekeeping training and extension education as a vital input for sustainable livelihood in India

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Beekeeping is a widespread activity with a wealth of existing local knowledge and skills. The additional, scientific and technical knowledge through theoretical and practical training can lead to greatly improved harvests of honey, other bee hive products and colony multiplication. Through training, beekeepers or honey hunters/ harvesters will be able to build on their resources to create more income by harvesting and processing honey and other hive products more skilfully, and to obtain better prices by saving and selling hive products and by making secondary products. Beekeepers and trainers often lack appropriate training materials. Through extension programme, follow up action can be done for implementing the programme successfully. In India, the Directorate of Beekeeping under Khadi and Village Industries Commission is engaged in implementing Beekeeping programmes and extension activities throughout the country and Research and Training by Central Bee Research and Training Institute, Pune. The other agencies involved in Beekeeping training and extension programmes are Khadi and Village Industries Board in each state, Universities, ICAR institutions, Agriculture and Horticulture Departments, Forestry Departments, Tribal Development Department, Rural Development Department Beekeeping Institutions, National Diary Development Boards, Rubber Board etc.

In all Centres, 5 days to one month theory and practical oriented training is the usual schedule for beekeeping training in addition to long term apiarist courses. Most of the rural population are directly depended on bees and beekeeping for their livelihood. More that 40-45% of farmers are not only practicing beekeeping for honey and other value added products but they use mainly for cross pollination which yields more that 90 % of the income. The details of training, extension and for sustainable beekeeping as a livelihood option will be discussed.

PP-513 [Beekeeping for Rural Development]

Status of stingless bees in Tanzania: Ecology, Productivity and Management

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[1]University of Dar es Salaam, [2]Sokoine University of Agriculture, [3]Tanzania Forestry Research Institute, [4]Tanzania Wildlife Research Institute, [5]Beekeeping Training Institute, [6]Zanzibar Agricultural and Livestock Research Institute, [7]Tanzania Forest Services Agency

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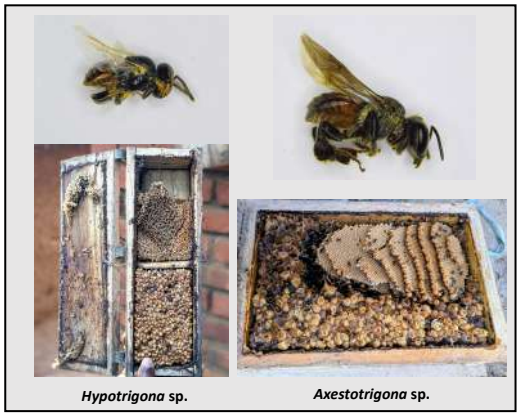
1. INTRODUCTION

Beekeeping in Tanzania has traditionally focused on the western honey bee, *Apis mellifera* L. Recently, stingless beekeeping (meliponiculture) has gained momentum, yet documentation on species distribution, hive designs, productivity, and management remains limited. This study investigated these aspects to provide a clearer picture of the meliponiculture landscape in Tanzania. The study is part of an ongoing project aimed to develop standardized protocols for managing local stingless bee species.

2. METHODOLOGY

A total of 68 stingless beekeepers were interviewed. The survey spanned 26 districts across 16 regions, including mainland Tanzania and Zanzibar islands. Data collected included species kept, hive types, colony stocking techniques, and general management practices. Bee specimens were collected and stored in 70% ethanol for identification.



Hypotrigona sp. *Axestotrigona* sp.

3. RESULTS & DISCUSSION

3.1 Species Distribution

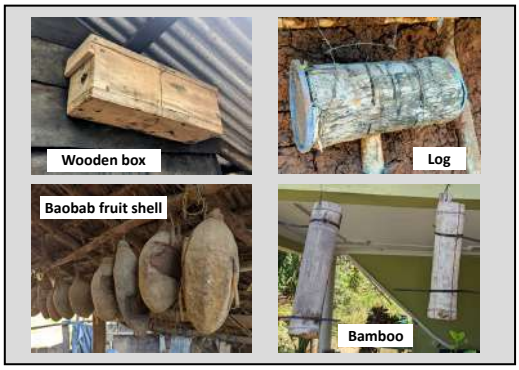
Axestotrigona species are dominant across most areas of Tanzania.

Hypotrigona species are prevalent in coastal zones and Zanzibar.

3.2 Hive Designs

Modern hives with vertical or horizontal partitions are common.

Traditional hives are made from local materials such as logs, bark, straws and grasses, bamboo & baobab fruit shells.



3.3 Colony Stocking Techniques

Main technique: Transferring wild colonies to managed hives.

Colony splitting and trap-nest techniques are less common but practiced in some areas.

3.4 Management Practices

Majority keep stingless bees near their homesteads. This facilitates easy and regular colony inspection.

Meliponary Layouts include:

i. Tree meliponaries
ii. Breast-height (stand) meliponaries
iii. House-eaves meliponaries (most prevalent)
iv. Meliponary shades

Meliponary shade Stand meliponary House-eave meliponary

4. CONCLUSION

Meliponiculture is growing as an income-generating activity with great potential for enhancing livelihoods and forest conservation. Further research is needed for optimizing hive design, colony management, and sustainable practices

ACKNOWLEDGEMENT

We acknowledge the Beekeeping Value Chain Project (BEVAC) funded by the European Union and implemented by ENABEL for supporting this research. We are also grateful to the Institutions participating in this project.

PP-514 [Beekeeping for Rural Development]
Reconnecting Societies From Soil to Sky: Indigenous Insights into Apiculture

Melanie Margarita Kirby, Davon E. Collins
Institute of American Indian Arts, Santa Fe, New Mexico, USA

The Institute of American Indian Arts (IAIA) based in Santa Fe, New Mexico- USA, is a global leader of contemporary Indigenous artistry and diversity. Through the concept of art as a traditional path of creativity, IAIA excels at skill building, provoking thought and providing a place to embrace the past, enrich the present, and create the future, moving ahead to establish paths where traditions are rediscovered, explored, deepened. And, where art and cultural identity are celebrated and revered. IAIA Land-Grant Programs is the agriculture extension department which focuses on the development of integrative approaches weaving the arts and earth sciences together through Indigenous Traditional Ecological Knowledge (TEK) and Western sustainable agriculture science. This presentation will share an introduction and overview of Indigenous Research Theory and practices as related to pollinator stewardship and conservation at IAIA. IAIA Land-Grants Program established a tribal beekeeping and mentorship program 4 years ago. With funding from the USDA-ARS SW Climate Adaptation Science Center, they also offer online programming for tribal and Indigenous environmental stewards on pollinator stewardship. Through a cooperative agreement with the USDA Office of Tribal Relations, the program has developed a Grassland and Pollinator Stewardship research of interest to tribal communities and the development of resource guides for tribal college campuses developing pollinator conservation programs. Additionally, IAIA Land-Grant Programs is working on a NIFA- New Discovery grant funded project to develop a Tanoan/Puebloan bee atlas and to research the nutritional values of culturally relevant foods, pollens, and honeys for the intermountain southwest region. IAIA Land-Grant Programs recognizes that Apiculture weaves science, art, and cultural stewardship together to promote consilience- unity of knowledge systems.

PP-515 [Beekeeping for Rural Development]
Sustainable beekeeping for women and youth empowerment, improved livelihoods and food security in Zimbabwe

Jacqueline Gowe
Jacqueline Gowe Founder/CEO Sweet Maungwe plc

Sweet Maungwe is a honey producing and processing company which aims to promote sustainable beekeeping practices as aviable livelihoods strategy for rural communities. Zimtrade a trade promoting organisation is currently with Sweet Maungwe to develop honey clusters in 3 provinces of Zimbabwe. By providing training,equipment and market access community uptake has increased particularly among women and youth.this has helped to increase their income and improve their food security. Of the 2000 women and youth Zimtrade has capacitated more than 20%. Our approach will focus on environmentally friendly beekeeping practices, pollinator conservation and value chain development. The recently launched Kampala declaration CADDP document achnoledgged that agriculture is as important as water andfertliser. We expect to improve the livelihoods of 1000 rural households by 2030 and enhance biodiversity in our project. By promoting sustainable beekeeping we will contribute to the achievement of the Sustainable Development Goals (SDGs) particularly SDG1 (No Poverty), SDG2, (Zero Hunger) and SDG15 (Life on Land). Through attending Zimtrade promotions Sweet Maungwe has developed a bespoken brand and is working on supply niche markets In Malaysia and France The product range is pure honey, honey with ginger cinnamon andcombeb, candles, body butter, lip balms and candles

PP-516 [Beekeeping for Rural Development]
Apitourism is in Turkey with “apiTURroute” Project

Asli Özkirim, Mustafa Ertekin
Department of Biology, Microbeeotic Laboratory, Hacettepe University, Ankara,TURKİYE

Beekeeping is an important sector for not only producing honey but also pollination and other bee products. On the other hand, today, no matter what you produce, no matter how high quality and valuable they are, unless you promote them, it is not in demand or used incorrectly. Until now, it seemed that honey and other bee products produced in the beekeeping sector could also be promoted through marketing and advertisement. However, now consumers want to observe the production conditions of the food they will buy and experience it where it is produced. The processing of food alienates humans from nature. Experience in the natural environment also corrects consumer misinformation. “Apitourism” is the type of tourism, which was established years ago in Slovenia, the impact of apitourism, and whose impact factor is increasing, and which is the most effective method of existence of our age, aimed at the promotion of beekeeping and bee products. Apitourism is also the new entrepreneurial field of beekeeping. Apitourism in Turkey was created in 8 different routes in parallel with its seasonal diversity and beekeeping based on its historical background. In the apitourism activities developed as the ApiTURroute project, “api” represents the beekeeping area, “TUR” represents Turkey, and “route” represents the routes to be followed during the trips. The ApiTURroute project was carried out in 3 stages:1. Determination of routes and associating beekeeping activities with the history, nature and culture of the region 2. Certification of beekeeping units on the routes (beekeeping, museums, university laboratories, beekeeping associations, etc.) in accordance with certain criteria (Hacettepe University Apitourism Certificate Program www.harum.hacettepe.edu.tr) 3. The certificated stations are recognized by tourism companies and tourism companies create the “apitourism” title in their website menus. We think that apitourism is a new field of initiative that will introduce beekeeping and directly affect all activities related to beekeeping (production, marketing, export, product development, etc.). Beekeeping sector that is always on display and in front of everyone's eyes will definitely develop and become more beautiful. Therefore, apitourism will be the most important field of activity contributing to this development in the near future.

PP-517 [Beekeeping for Rural Development]
Biodiversity of “”Apis dorsata”” and its conservation strategies in India

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The Wild honey bees are distributed throughout the Asia including the Indian sub-continent. In India has eleven honey bee species have been identified, the domesticated are three species (“”Apis cerana cerana””, “”Apis cerana indica””, “”Apis cerana himalaya””), Amongst the wild bees two little bees(“”Apis florea””, “”Apis andreniformis””) and there are four wild and giant honey bees (“”Apis dorsata dorsata””, “”Apis dorsata bingami””, “”Apis dorsata breviligula””, “”Apis laboriosa””), introduced European honey bee species “”Apis mellifera”” and Stingless bee “”Trigona”” species are well distributed in plains, forest and hill areas of India.

The study on the Biodiversity of “”A. dorsata””, distribution, honey production, people involved in honey harvesting/hunting and its economics has been undertaken. The nest population ranges from solitary both in terrestrial and arboreal habitats to as many as 610 in a single Banyan tree “”Ficus bengalensis””. As these bees are migratory in nature move from one region/area to other region/area by leaving remnants on rock cliffs, tree branches, buildings due to change in the cropping pattern and environmental condition. These remnants act as attractants to bees to construct nests for the next season. There is manifold increase in crop yield of Agriculture, horticulture and forest produce.

The details of sustainable honey harvesting from these giant bees and the conservation strategies are documented. The production of the honey ranges from 25 to 60 kgs and beeswax from 5-8 kgs per year per colony. As these “”A. dorsata”” nests on man-made structures such as tall buildings, underneath bridges, these bees are the excellent pollinators, the pollination efficiency was also documented. Three fourth of the honey produced in India is from these wild bees. Many people particularly tribal communities are largely dependent upon for their livelihood and sustain the nests through scientific honey harvesting and colony management for pollination service and ultimately for the conservation. Different regions and geographical areas have adopted different methods of conservation strategies. The details will be discussed.

PP-518 [Beekeeping for Rural Development]

Figure 1. Age distribution of respondents

BTHE NET
Bee Stronger Together

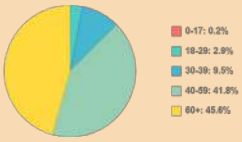
Age dynamics in european beekeeping: demographic challenges and the rise of female practitioners

Lauriane Mariamé, Aleksejs Zacepins, Robert Brodschneider, Kristina Gratzer, Ivana Tlak Gajger, Gyula Kasza, Aránzazu Meana, Flemming Vejsnæs, Fani Hatjina, Lotta Fabricius Kristiansen, Aleksandra Splitt, Juraj Toporcak, Kamiar Torabi, Sandra Mustafa, Noa Simon Delso, Filippo Jannoni-Sebastianini, Francesca Santaniello, Marco Pietropaoli, Giovanni Formato

Demographic crisis reveals continued aging patterns

European beekeeping faces persistent demographic challenges with severe aging threatening sustainability amid climate change and economic pressures from honey fraud. This study analyzes age/gender dynamics across 17 European countries to understand transitions and identify solutions. Research employed mixed-methods combining a survey of 766 beekeepers across 17 EU countries (2024-2025) with consultation involving 47 specialists from 13 countries. Analysis included national statistics, EU workforce data, descriptive statistics, chi-square tests. Beekeepers were categorized as Young (18-39), Middle-aged (40-59), Senior (≥60) enabling assessment and policy recommendations.

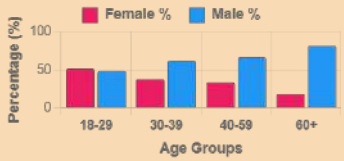
Figure 1. Age distribution of respondents



Aging patterns in european beekeeping

European beekeeping exhibits severe demographic stratification with 83.2% of practitioners exceeding 40 years, substantially surpassing broader agricultural patterns (12% under-40). Age distribution reveals critically low younger cohort representation: 5.6% (18-29) and 10.8% (30-39), indicating imminent knowledge erosion and operational collapse.

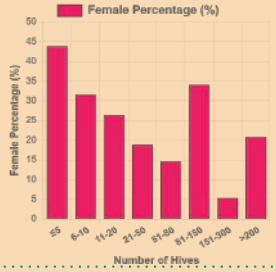
Figure 2. Feminization by age



Young women are driving demographic renewal

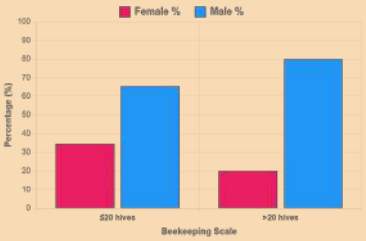
European beekeeping demonstrates pronounced age-dependent gender stratification: female participation increases systematically from 18.4% (≥60 years) to 51.4% (18-29 years), representing a 33 percentage point differential. This demographic transition indicates substantial sectoral transformation with potential renewal opportunities requiring targeted support frameworks.

Figure 3. female participation by beekeeping scale



Women lead hobbyist growth, but face entry barriers to professional beekeeping

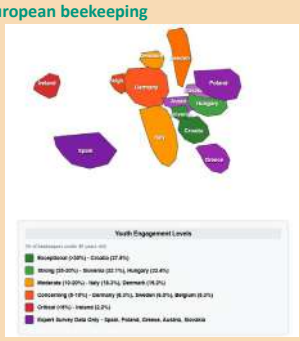
Women are reshaping beekeeping through small-scale, hobbyist models, comprising 43.8% of beekeepers with ≤5 hives but only 20.1% manage more than 20 hives. This reflects persistent barriers: high entry costs, limited land access, and economic risk. Despite rising urban and post-COVID interest, scaling obstacles may confine feminization to hobbyist practice, limiting sectoral renewal impact.



Youth can manage at scale—if supported

Operational scale shows no significant age differences: beekeepers manage similar hive numbers regardless of age ($r = -0.011$, $p > 0.10$), indicating demographic renewal will not sacrifice efficiency. Young people have the necessary skills but face system-level barriers. Support for training, financing, and land access could unlock their potential and maintain productivity as demographics shift.

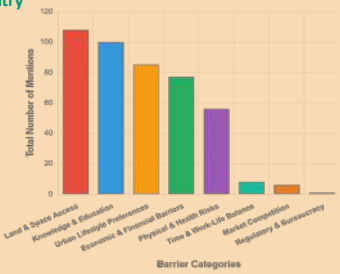
Figure 4. Mapping youth involvement in european beekeeping



National clusters

Demographic dynamics vary significantly across Europe. Cluster analysis shows Croatia, Slovenia, and Hungary report strong youth engagement (>30% under 40), while Ireland and Belgium exhibit extreme aging (<6% under 40). National profiles reflect different barriers: land access, urban disengagement, or economic constraints. Intervention strategies require geographic specificity—urban-focused approaches for Germany/Sweden, land reform and educational integration for Southern/Eastern European contexts.

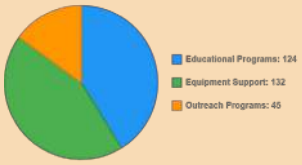
Figure 5. Expert ranking of barriers to youth entry



Structural and economic barriers block young professionals

Expert analysis identifies primary youth barriers: land access (108 mentions across 7 countries) and education gaps. Economic unviability is central—94% cite honey fraud/low prices as deterrents (European Commission, 2023; EU Pollinator Hub, 2025). Structural issues create hobbyist-professional divide. Market regulation and startup support reforms are essential for professional entry pathways.

Figure 6. Program types by frequency of mentions



Program gaps

Support programs exist but misalign with needs. While 84.6% of countries report youth initiatives, the primary barrier—land access— seems to lack dedicated support. Programs focus on training/equipment but inadequately address structural obstacles. Effective interventions must prioritize land access, fair markets, and demographic-responsive models.

Technology and innovation

Technology adoption demonstrates generational divides: digital monitoring adoption is 43% (under-40) versus 18% (over-60), with social media showing 67% versus 12% respectively. Overall adoption remains low (28.6%) due to rural connectivity and cost barriers. However, 88% of successful young beekeepers employ integrated pest management, combining traditional knowledge with modern strategies (Warner et al., 2024).

CONCLUSIONS

European beekeeping faces dual demographic shift—enduring aging and rising female participation among younger cohorts. Economic unviability from honey fraud remains the primary professional entry barrier, pushing youth toward hobbyist roles. Women lead small-scale growth but experience steep professional drop-offs. Croatia's success (37.5% under 40; 46.1% women) demonstrates renewal potential. Urban beekeeping offers opportunities but requires ecological safeguards. Policy must enforce EU Honey Directive, support gender-inclusive models, address land access barriers, and promote diversified business models with urban-pollinator integration.

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PP-519 [Beekeeping for Rural Development]

Promoting Pollinator-Friendly Landscapes in Rural India

Sujana Krishnamoorthy & Dhanshree Chavan
Under The Mango Tree Society (UTMT Society), India

Theme: Pollination and Bee Flora

Sub-theme: Pollinator-Friendly Rural Landscapes

Introduction

Pollination is crucial for food security in India, yet pollinator populations are under severe threat from habitat loss, agrochemicals, deforestation, and unsustainable farming practices. The decline in natural habitats results in diminished pollinator services, negatively impacting biodiversity and agriculture.

Objectives

- **Promote** pollinator-friendly rural landscapes.
- **Reduce** unsustainable honey-hunting practices.
- **Integrate** sustainable beekeeping into smallholder agriculture.
- **Enhance** biodiversity and rural livelihoods.

Result

- **70%** reduction in unsustainable honey-hunting practices.
- **90%** of beekeepers report an increase in local pollinators.
- Average income increase: **Rs. 27,000** ($315) per beekeeper annually.
- **15%** improvement in green cover through fallow land cultivation.
- Crop yield improvement for vegetables, oilseeds, pulses, and fruits.
- **86%** of smallholders found the initiative highly beneficial.

Conclusion

Pollinator conservation can coexist with poverty reduction. Sustainable beekeeping strengthens ecosystems, boosts crop productivity, and improves rural incomes—demonstrating a scalable model for environmental and economic sustainability.

Methodology

1. Implemented the **Bees for Poverty Reduction Programme** across 282 villages.
2. **Community sensitisation** on pollinator importance and sustainable practices.
3. Distribution of **pollinator-friendly seeds and saplings** (e.g., sunhemp, pigeon pea, sesame, mango, moringa).
4. **Training farmers** to maintain indigenous bee colonies and leverage traditional knowledge.

"Rural women need local, accessible, low investment interventions that align with our daily activities. Beekeeping is the perfect fit. It helped me adapt to climate challenges"

- Sonali Mukane
27-year-old beekeeper in Palghar

Keywords

#Pollinators #Beekeeping
#Biodiversity #SustainableFarming

PP-520 [Beekeeping for Rural Development]

Creation of the first sensory panel of honeys in Uruguay

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Uruguay is a major honey producer, with an annual production of approximately 13,000 tons, making honey the most economically important beehive product. However, around 90-95% of the honey produced is exported in bulk, without differentiation. Although the country has comprehensive regulations and a traceability system, it is essential to establish protocols that allow our honeys to be presented in a differentiated way in the market, given the significant economic impact of the production and export of this product.

It is essential to establish quality and differentiation standards in the marketing of honey, to strengthen the sector. These standards include a sensory description of the product, which must be carried out by evaluators selected and trained specifically for this purpose. The main objective of this work is to develop and implement the first panel of judges trained in Uruguayan honeys, which will support research activities and provide services to the beekeeping sector, contributing to the characterization and valorization of honeys produced in the country.

PANEL DEVELOPMENT

- **RECRUITMENT**
- **SELECTION**
- **TRAINING**
- **VALIDATION**
- **EVALUATION**

The commercialization and export of honey with differentiated characteristics is crucial to obtain better sales prices and generate higher income for beekeepers, which plays a fundamental role in the development and sustainability of the beekeeping sector in Uruguay. Having this panel allows to highlight the unique qualities of each honey, strengthening the positioning of Uruguayan honeys in markets.

PP-521 [Beekeeping for Rural Development]

Promoting commercial beeswax rendering through the adoption of African steam cooking principles for use in beeswax steam extraction- the process of simply converting two (2) buckets with lids into a 3 – container steam extractor system

Rita Naa Asabia Okine
data ghana beekeepers association

BACKGROUND:
Bees wax processing is done after extracting honey from the combs. Africa which should be leading the world in her organic beeswax production is lacking behind due to the method being used to process its beeswax. However, steam cooking which is part of African traditional cooking could be adopted to process comb into beeswax.

Problem Description:
About 60% of the honey on the market is from the wild and most of the honey hunters after squeezing out the honey from the comb throw it away thus losing the precious organic beeswax. as the current processing mechanism is cumbersome.

OBJECTIVE: To convert 2 buckets into an efficient 3 container beeswax steam extractor system – an innovation to promoting commercial beeswax trade in Africa.

METHODOLOGY:
2 stainless buckets with lid of dimension. Top, bottom and height dimensions are 33, 23 and 29cm respectively,
- Metal drilling machine and bit
- Metal cutter

One of the buckets is cut into two and the top one is converted into a sieve by covering its open bottom with its perforated. the small base from the cut- out bucket is placed in the original bucket whilst combs is put into the sieve and mounted on the small base. The set- up is placed in the normal bucket with water and placed on fire.

As the steam from the water melts the combs at 60-65 degrees the molten wax is collected in the small bucket below.
Result and conclusion;

To encourage mass production of beeswax for its commercial trade, we have to adopt a less cumbersome processing method at a cheaper cost and less operational processing time as the process can run virtually on its own. Demonstration to beekeepers is easily understood. Honey hunters and beekeepers will be able to get beeswax to the market by increasing their yields in beeswax rendering and commercial trading

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PP-522 [Beekeeping for Rural Development]

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Protected Geographical Indication Miel de Galicia: Preserving Quality, Identity, and Origin of honey

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Background

"Miel de Galicia" is a designation of origin and a quality label for the honey produces in Galicia (Northwest Spain). Due to the relevance of honey production and the reputation given by consumers since ancient times, this designation was locally recognized in 1988. In 2007, the label "Miel de Galicia" has been recognized and registered as a **"Geographical Indication"** at the European Union level.

Beekeeping in Galicia is a sector with a rich tradition and great honey quality. Despite current challenges, the region continues to be a benchmark for high-quality honey, supported by the commitment of beekeepers and the trust of consumers. Cultural heritage elements and historic documents support the tradition of honey production in the area.

More information: https://mieldegalicia.org

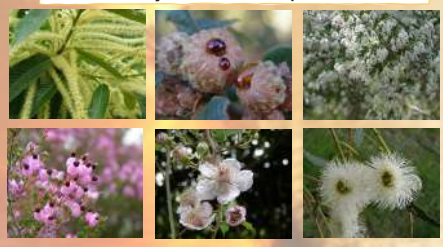
A) "Albariza" traditional apiary, B) "Lacena" apiary inside a house

C) *Codex calixtinus* (S. XII) which mentions Galician honey
D) Family crests, referring honey bees and beekeeping.

The protected area covers a surface of 29.574 km² at the Northwest of the Iberian peninsula. It is an Autonomous community characterized for rural areas and beatiful natural landscapes. Agriculture inland and fisheries in the coast are the main source of income for families.

PGI Miel de Galicia specific label

Some honey resources in the protected area



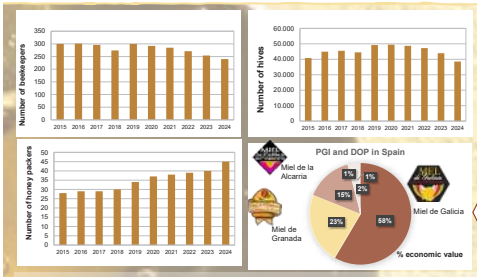
The main melliferous sources are extensive deciduous forests dominated by chestnut and oak trees, alongside shrublands with *Erica* on mountain slopes, as well as brambles in agricultural lands. Coastal areas are mainly covered by eucalyptus forests.

Problem description and methodology

Miel de Galicia logo

Globalization promotes trade in undifferentiated products, favoring the appearance of frauds. In this context, EU quality food policy aims to protect the names of specific products to promote their unique characteristics, linked to their geographical origin as well as traditional know-how. Due to the healthy properties attributed to honey and the value of this product in rural areas, the establishment of geographical labels allows its valorization. This paper analyzes the role of the PGI Miel de Galicia in the beekeeping sector almost 40 years after its creation.

Results and practical implications



Currently, the PGI Miel de Galicia covers nearly 40,000 hives in almost 1,000 apiaries, 60 registered trademarks and 45 packaging companies, most of them small and medium-sized. Over the existence of this quality label, the beekeeping sector has undergone a transformation toward better technical capabilities and greater professionalization. This quality scheme has acted as a trigger for beekeeping, leading to an increase in production capacity, as well as an increase in the number of small honey packers. It is the most important geographical indication for honey in Spain.

The beekeeping sector in the area faces important challenges such as the presence of the invasive Asian hornet (*Vespa velutina*) and climate change affecting flowering and honey bees behavior. Honey yield is around 15-20 kg per hive with an estimated honey production covered by the PGI Miel de Galicia around 700,000 kg. The honey is sold in bulks or bottled identified with the label. The estimated economic value is 5 million euros.

Protection
Responsible for safeguarding the PGI Honey from Galicia, ensuring the compliance with the Product Specification.

Promotion
Promotes awareness among consumers and encourages consumption, bringing the honey of Galician beekeepers into households.

Control
From flower to table, defending product quality, highlighting a unique food. Entity accredited by ENAC the Spanish National Accreditation Body (since 2015).

The Regulatory Council is the entity responsible for this quality scheme and carries out the administrative and legal functions, in addition to those indicated in the chart.

Different activities of PGI Miel de Galicia

Acknowledgements

XUNTA DE GALICIA
Cofinanciado por la Unión Europea

EAFRD aid granted with PEPAC funds with 70% financing and an applied amount of €90,000

The authors thank the Galician beekeepers whose dedication and expertise make possible a unique product closely linked to our land.

PP-523 [Beekeeping for Rural Development]

TWENTY-EIGHT YEARS OF NATIONAL APICULTURE PROGRAMME – WHAT HAS EVOLVED IN PORTUGUESE BEEKEEPING

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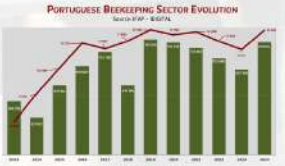
INTRODUCTION

Beekeeping is an agricultural activity, but its marked specificity conditions its integration into Common Agricultural Policy (CAP). In fact, the aid provided by the CAP is linked to land use and is paid on the surface, which makes it impossible to create viable aid for the beekeeping sector as in Portugal, the majority of Portuguese apiaries are installed on other farmer's properties.

In 1997, the European Union, through Regulation (EC) N.º 1221/97, established a specific support three year program for the beekeeping sector (NAP-PT), with the aim of **(1) supporting the consolidation of beekeeping as an economic activity** that contributes to rural development, **(2) reinforcing the production and quality of honey** produced by European beekeepers, **(3) balancing the European trade balance** and **(4) combating the spread of Varroosis** in the Member States **and the problems raised by this disease in the production of quality honey.**

BEEKEEPERS AND BEE COLONIES

Since 1997, when the first NAP-PT was established, the Portuguese beekeeping sector has changed. From not knowing how many beekeepers and hives existed, today there's a feasible mechanism of recollecting data **(Graph on the right)**. in 2023, the sector is more professionalized **(table on the right side)** with 8.37% professional beekeepers, there are stronger organizations which representing more beekeepers (69%).



Even so, the role played by these organizations in the market has to be consolidated – only 15 of the 81 industrial honey plants belong to beekeeper organizations, with a market share less than 10%.

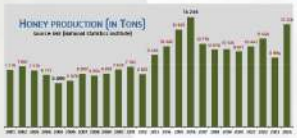
BUDGET AND EXPENDITURE

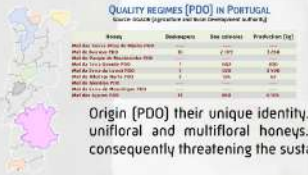
Portugal's apiculture program budget has grown over the years. The main reason for this growth is the recognition, by the EU, of the environmental importance of beekeeping within the CAP, as well as the emergence of new problems and challenges, such as the predator *Vespa velutina nigrithorax* and climate change. Unlike other countries, Portugal never chose to increase the program's budget – financial execution never justified this, as it only achieved an execution rate of over 90% in five years. The specific weight of the fight against Varroosis stabilized at around 50% of the budget.

Also noteworthy is the importance of technical assistance, whose specific weight in Portugal is higher than the EU average.

Finally, it is worth highlighting that since 2020, Portugal has adopted budget management mechanisms that allow it to meet budgetary needs and reduce inefficiencies.

MARKET AND HONEY QUALITY





One of the main objectives of the NAP-PT (since its establishment by the EU in 1997) was to help beekeepers adapt to growing market demands. However, the EU honey market is flooded with low-quality, low-priced imports. Portugal is a prime example, as it has become a key player in imports since 2014 (13,000 tons of honey in 2024). Currently, Portugal is one of the EU's largest honey importers, and this exposure to low-quality, low-priced products has serious consequences in the prices paid to producers.

Honey production in Portugal is subject to large fluctuations (between good and bad years) due to the country's enormous exposure to 3 factors: (1) climate change (extreme drought in 2022 and 2023); (2) devastating and enormous forest fires (2013, 2017 and 2025) and (3) the arrival (in 2011) of the predator *Vespa velutina nigritorax* – at this level, the NAP-PT already has a specific measure in place.

In Portugal, the natural landscapes are very well suited to beekeeping and are the territories where are produced the most representative Portuguese honeys, like Rosmaninho honey (*Lavandula stoechas*) or Urze (*Erica spp*). But like most of the Portuguese territory, these territories are changing and threatened by the loss of habitats and floral diversity, which concede honeys with Protected Designation of Origin (PDO) their unique identity. Portugal has nine honeys with PDO, which together include 17 specific varieties of unifloral and multifloral honeys. Climate change is disrupting the production cycles of native and wild flora, consequently threatening the sustainability of honey production according to PDO specifications.

VARROOSIS

The data shown on the table on the right consists of the results of laboratory analyses of bee diseases performed between 2011 and 2021 (unfortunately, DGAV has not provides data since then). These analyses are largely funded by the National Apiculture Program (over 90% of them) and are the result of the presence of beekeeper organizations working alongside with beekeepers, seeking to raise awareness of the importance of using laboratory tests for accurate disease diagnosis in apiaries. The sampling covers the entire national territory.

Thus, it is possible to determine the prevalence of bee diseases in Portugal and confirm that Varroosis remains a critical factor for Portuguese beekeeping. We can say that it's still relevant to support bee disease control within the framework of the national apiculture programs.

Epidemiological evolution of the main bee pathologies

Year	Number of Analysis	Varroosis	Nosemosis	American Foulbrood	Acaroselose
2011	9 050	55%	17%	1%	3%
2012	9 520	54%	18%	1%	2%
2013	2 910	37%	22%	2%	4%
2014	9 189	55%	19%	2%	3%
2015	5 537	53%	23%	1%	5%
2016	5 136	44%	22%	1%	5%
2017	6 918	27%	16%	1%	4%
2018	6 981	51%	13%	0%	2%
2019	2 883	44%	22%	1%	9%
2020	1 720	37%	25%	0%	11%
2021	1 004	45%	24%	0%	8%

CONCLUSIONS

Regarding the irreversible loss of botanical heritage due to catastrophic events such as forest fires, we believe that NAP-PT can contribute in a positive manner to the reinstating and the sustainable growth of PDO certification ensuring protection for beekeepers who remain in the most vulnerable areas and in traditional production systems.

After analyzing all the data presented here, we concluded that the NAP-PT was a game-changer for the Portuguese beekeeping sector in its first years of implementation. However, this capacity to promote change is fading. Indeed, currently there's a mismatch between existing measures and the reality of the sector, due to: (1) none of the new measures (climate change, marketing) were introduced for 2023-2027; (2) the NAP-PT maintains the same operating model, which creates inefficiencies and management difficulties to the beneficiaries.

There is also the need to update the NAP-PT's objectives, as the current ones have either already been achieved or are unattainable (such as reducing the incidence rate of Varroosis). Also, Investment measures (like fight against varroa, queens, transhumance and *Vespa velutina*) must also be targeted directly at their beneficiaries. In short, NAP-PT has not kept pace with the positive developments it has brought to the sector.

For the next CAP support framework, it is necessary to begin a true diagnosis of the sector and its present needs, outlining and planning how to achieve useful progressive goals, rather than focusing on achieving political and financial indicators: productivity should replace production, for example.

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ENHANCING PROPOLIS PRODUCTION: A STRATEGIC APPROACH TO BOOST BEEKEEPING PROFITABILITY THROUGH EFFECTIVE MEDIATION

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INTRODUCTION

Propolis, a resinous substance collected by bees from plant exudates, has garnered significant commercial interest due to its antimicrobial and antioxidant properties [1]. This material is composed by 40-70% resin and/or vegetable balsam, 10–30% beeswax, 5–10% aromatic and volatile compounds, 5–10% pollen, and other organic components [2].

Figure 1 - Beekeeper collecting propolis. Source: Authors.

Figure 2 - Grounded Propolis. Source: Authors.

Stimulating propolis production within beekeeping operations can substantially increase profitability by diversifying hive products and optimizing resource use. Additionally, it reinforces the critical role of a mobilizing agent to facilitate the connection between beekeepers and the industry, ensuring quality standards and market access.

This study examines the case of #PortugalPropolis project, implemented by Montesino, a beekeeping microenterprise founded in 2012, which collaborates directly with Portuguese beekeepers to enhance propolis production through strategic hive management techniques, such as specialized collection methods and selective breeding.

METHODOLOGY

Within the #PortugalPropolis project, Montesino provides collection grids and offers training sessions, lectures, and production guides to build technical capacity among producers. In addition, this company acts as an intermediary between beekeepers and industry, supporting distribution and commercialization while also implementing services to overcome common barriers to production, such as the extraction of propolis from grids — a task that had often discouraged participation.

Initially, the project involved only a small group of producers with an overall production of 25 kg. However, over the years, services gradually expanded, and the network of participating beekeepers steadily increased. At present, the project includes approximately 200 beekeepers, collectively ensuring an annual production about 2,000 kilograms of propolis.

Propolis production from the #PortugalPropolis project in 2023 and 2024 was estimated based on sales to Montesino, which purchases propolis from across Portugal and classifies it by extraction type—grids, pre-extracted, or frame scrapings. Each sample is coded by beekeeper and extraction method, ensuring full traceability to the final customer.

RESULTS AND DISCUSSION

In the period 2023-2024, an increase in propolis production was observed in all types of extraction (Figure 3).

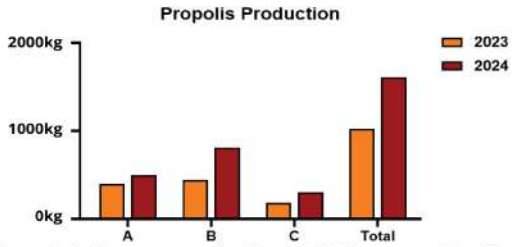

Figure 3 - A: Company extraction; B and C: Beekeeper extraction. Note: A and B reference to propolis grids; C reference to scraping propolis.

The results corroborate with recent research that points to an increase in production due to the economic potential of propolis [1,5].

CONCLUSION

Propolis production has shown steady growth in recent years (with a focus on 2023–2024), supported by Montesino through both production assistance and guaranteed sales. As a socially responsible intermediary, Montesino not only strengthens beekeepers' incomes but also supports rural livelihoods and ecosystem sustainability, fostering the long-term development of beekeeping.

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PP-525 [Beekeeping for Rural Development]
Climate Disaster in Rio Grande do Sul, Brazil: Impacts on Beekeeping and Meliponiculture and Strategies for Recovery

Jenifer Dias Ramos[1], Betina Blochtein[1], Cristiano Menezes[2], Aroni Sattler[3], Luiz Eduardo Vicente[2], Luciana Spinelli Araujo[2]
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In May and June 2024, Rio Grande do Sul, southern Brazil, faced its most severe climate disaster. Intense rainfall triggered flash floods, inundations, and landslides, severely impacting various sectors. Beekeeping was heavily affected, with the loss of thousands of beehives. In response, the State Beekeeping Federation (FARGS) led a campaign to document these losses, consolidating data later supplemented by the Bee Observatory of Brazil through the initiative "Integrated Mapping of Beehive Losses." This effort is part of the "Bee Observatory of Brazil, Focusing on RS" project, coordinated by Embrapa (Brazilian Agricultural Research Corporation) and made possible through a Cooperation Agreement with the Public Prosecutor's Office of RS, Embrapa Meio Ambiente, the A.B.E.L.H.A. Association, and agricultural input companies. Its goal is to compile the collected data into a technical report on beekeeping and meliponiculture losses caused by the floods and propose recovery measures for the sector. The methodology included data collection through an online form, technical visits to apiaries, and interviews with beekeepers to map affected areas and understand the causes of losses. Among the 239 surveyed beekeepers, 35% reported colony losses, resulting in a total of 21,025 lost beehives of ""Apis mellifera"" and stingless bees across 88 municipalities of the State. This severe impact disrupted honey production and other related activities. Additionally, beekeepers reported damage to equipment and infrastructure, as well as challenges in maintaining the remaining colonies due to a lack of flowering and adverse weather conditions. The report concludes that the recovery of the beekeeping sector in RS requires urgent and integrated measures, including the reestablishment of bee stocks, provision of hive boxes and supplemental feeding, financial support, technical training, and a strengthened support network for beekeepers. These actions aim not only to mitigate the immediate consequences of the disaster but also to enhance the resilience of beekeeping in facing future climate challenges. The consolidation of data on bee losses due to climate disasters is unprecedented in Brazil and will serve as a reference for future initiatives.

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PP-527 [Beekeeping for Rural Development]

From Honey Hunting to Beekeeping:

A Journey of Transformation in Tamil Nadu

SLU

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01. How it was?

For generations, indigenous communities in Tamil Nadu depended on honey hunting from wild colonies deep in the forests. This tradition carried immense skill and courage, but also exposed hunters to severe risks, including falls, stings, and wild animal encounters. Knowledge of bee behaviour and seasonal cycles was inherited and kept the practice alive.

02. Why change was needed?

Honey hunting became increasingly unsafe and unsustainable. Lengthy forest treks and smoke-driven harvests damaged habitats and stressed wild bee populations. Families remained trapped in poverty, with little money for education, especially for girls, leading to early marriages and lost opportunities

03. Seeds of Change

SEEDS Trust introduced beekeeping as a safer, sustainable livelihood alternative. Training sessions helped families learn hive management with *Apis cerana* bees, building on their traditional knowledge. Community-run nurseries and women's participation strengthened conservation and income opportunities.

04. How life changed?

Beekeeping reduced risks and offered a steady source of income throughout the year. Families could invest in their children's schooling, while women gained stronger roles in household decisions and local organizations. Managed pollination improved crop yields, linking livelihoods with healthier farming systems.

05. Where we are now?

Today, communities benefit from safer honey production, stronger household incomes, and a reduction in poverty-related problems. Children, especially girls, have better access to education, and families are less vulnerable to hardship. At the same time, forests and native pollinators are better protected.

06. Building resilience

Beekeeping is now spreading across Tamil Nadu as a model of sustainable rural development. This approach empowers communities to balance economic needs with conservation goals. The journey shows that when local knowledge is combined with innovation, both people and nature can thrive.

PP-528 [Beekeeping for Rural Development]

The Environmental State of Beekeeping in The Solomon Islands

Andrew Hogan

Current Beekeeping Projects

While there are few beekeepers currently in operation in the Solomon Islands, there is significant support from the Taiwanese and Australian Governments. Ten new farms have begun operations in Honiara alone since 2021. St. Joseph's School has four hives with 172 student keepers, who learn beekeeping and increase school income. The school hopes to give hives to graduates who hold a particular interest in beekeeping, proliferating apiculture around the country and bolstering economic opportunities. While hives were ravaged by invasive Asian Honeybees and Varroa, there is still opportunity for growth in the industry. Pictured below are two hives in Honiara and Tenaru, respectively.

Monique Jacques, National Geographic

Environmental Problems

Logging and mining harm both people and the environment in the Solomon Islands. Corruption is very common, making legal loopholes difficult to control. Logging companies pay a fraction of the value for land and do not pay all residents, with money going almost entirely to village leaders. This gives most villagers no control over their environment. Logging has damaged water quality, hurt crop production, and interferes with the activities of native animals, making life in the islands more difficult, especially in rural areas.

Uses for Beekeeping

The tropical climate of the Solomon Islands could serve as the ideal ecosystem for honey production. Honey is currently imported and sells for $0.06/mL, showing the viability of beekeeping. The industry could replace some of the income of logging or mining, while being more sustainable and bring income to villagers rather than foreign companies. Bees can also help repair some of the damage done by logging, making farms more productive and increasing biodiversity, and reducing the effects of erosion. 80% of Solomon Islanders are farmers, making the rehabilitation of their environment vital to life, and showing the importance of bees.

Acknowledgements

I want to thank the Smith Fellowship Committee and Bob Pfunder for the opportunity to study in the Solomon Islands. Thank you to Katie Ditrano and Sophia Anderson for joining me, and to Charlie Hergott for his support. Additionally, I'd like to thank Archbishop Christopher Cardone O.P. for welcoming me so graciously to the Solomons. Thank you to Matilda Hoeai Maneniaru, Sr. Hilda, Peter Daka, Daisy Kariame, Laurence Blattmer, Sr. Antonia Leoa, Alick Apuapuri, Dr. Jeffrey Markert and Dr. Rachael Bonoan for helping with my research. Finally, I need to thank Fr. Mark, Peter, Joe, Selwyn, Harry, Billy, Jeffrey, Everesto, Mikey, James and the DMI Sisters for helping me adjust to the Solomon Islands.

PP-529 [Beekeeping for Rural Development]
The Impact of Natural Disasters and War on Beekeeping: Challenges and Strategies for Preservation

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Bees and other pollinators are essential for biodiversity, supporting ecosystems and food production. However, habitat loss, pesticide use, climate change, natural disasters, and wars are driving their decline, threatening global food security.

Wildfires in Australia (2019–2020) destroyed 68% of New South Wales' national parks, severely impacting honeybee populations. In Greece, the 2021 North Evia fires burned 520,000 acres and 6,500 beehives, drastically reducing pine honey production. Portugal's 2023 wildfires damaged beekeeping areas, prompting government aid. In 2024, hurricanes Helen and Milton in the U.S. wiped out 95,000 hives across Florida, Georgia, and the Carolinas, affecting over 2 billion bees. Emergency relief efforts by Greater Good Charities and Mann Lake Bee & Ag Supply provided pollen substitutes, syrup, and sugar to prevent colony starvation.

In Ukraine, the ongoing war has devastated beekeeping. Explosions, shelling, and fires have destroyed apiaries in Donetsk, Luhansk, Kharkiv, Mykolaiv, Zaporizhzhia, Kherson, and Odesa regions. Toxic weaponry contaminates plants and water, killing bees. Military activity damages soil, forests, and meadows—key nectar sources. Landmines and occupation prevent beekeepers from accessing hives, while economic instability and beekeeper displacement further threaten the industry.

According to the Brotherhood of Ukrainian Beekeepers NGO, by 2023, over 30% of Ukraine's apiaries had been destroyed in combat zones and occupied territories. Russian aggression has polluted vast areas with landmines, unexploded ordnance, and military debris, significantly deteriorating the condition of melliferous plants in eastern Ukraine.

Efforts to support beekeeping include relocating apiaries to safer regions, rehabilitating war-damaged land, and providing international aid. FAO, charitable organizations and NGOs supply beekeepers with equipment, financial assistance, and bee colonies.
The Brotherhood of Ukrainian Beekeepers NGO and the Charitable foundation "Help on Bee Wings" have been helping Ukrainian beekeepers since 2022 with the support of partners from around the world.

Raising international awareness about the destruction of bee populations and the economic devastation of beekeepers due to natural disasters and wars is crucial. Global cooperation, experience exchange, and preventive action will help develop strategies for habitat restoration and long-term resilience in beekeeping. Early warning technologies, pollinator-friendly landscape recovery, and protection of wild bees must become global priorities.

PP-530 [Beekeeping for Rural Development]
Monitoring honeydew flow and its influencing factors: Insights from the 2024 season in Slovenia

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Slovenian forests cover approximately 58% of the country and provide a vital source of nectar, pollen, and honeydew for bees. Honeydew, secreted by sap-sucking insects such as aphids and scale insects (Hemiptera), plays a crucial role in forest ecosystems by sustaining various insect populations. Climate change is altering floral and honeydew availability, potentially impacting honey production and bee colony sustenance.

This study, conducted in 2024 as part of an ongoing research initiative by the Agricultural Institute of Slovenia in collaboration with the Slovenian Beekeepers' Association, aimed to assess honeydew availability and its suitability for honey production at different altitudes. A key objective was to determine whether higher-altitude locations could serve as viable beekeeping sites under shifting climate conditions.

To achieve this, honey yield, temperature, humidity, wind, and precipitation were monitored at 35 observation sites, each hosting a single honeybee colony. The presence of honeydew-producing insects was visually assessed, and molecular DNA analyses were performed for species identification. Honeydew samples were collected from both honeydew droplets and the honey stomachs of bees captured at hive entrances. The sugar composition of honeydew was analyzed using high-performance liquid chromatography (HPLC).

Findings from the 2024 season indicate that 29 out of 35 monitored colonies had positive honey balances, with the highest yield recorded at Snežnik – Črni dol (26.6 kg). Molecular analyses identified 19 honeydew-producing insect species, with the genus Cinara being the most diverse. HPLC analyses detected various sugars, including glucose, fructose, sucrose, and melezitose, alongside unidentified sugars requiring further characterization.

The study highlights the importance of monitoring honeydew dynamics and honeydew-producing insect diversity. Results suggest that higher-altitude sites may provide stable alternative forage sources for beekeepers, supporting adaptation to climate variability. Future research will focus on refining sugar composition analyses, assessing honeydew producer diversity across locations, and improving data transmission efficiency in remote areas.

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PP-531 [Beekeeping for Rural Development]

Belacolmea: cosmetics to diversify and make beekeeping more profitable

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BACKGROUND AND PROBLEM DESCRIPTION

European beekeeping overview

Beekeeping is an activity deeply rooted in the tradition of the Galician Community (NW Spain), of great social importance, currently going through a difficult situation due to several problems. The recent introduction of the invasive species *Vespa velutina*, the difficulty in controlling the rate of varroa infestation and the impact of climate change, among other factors, are causing serious economic losses and an uncertain future. In this context, the Agrupación Apícola de Galicia, the main beekeeping association in the region, aims to comprehensively develop the beekeeping sector in Galicia by conducting analyses, studies, and research that address existing challenges, with the goal of revitalizing and modernizing local beekeeping. Most beekeepers depend economically on the sale of honey and therefore product diversification can be an interesting alternative to increase family income.

Some beekeepers were producing home-made cosmetics with high production costs and a lack of quality assurance. For this reason, the Agrupación apicola de Galicia decided to develop a cosmetic line serving as brand that could provide beekeepers with quality cosmetics helping them to increase their incomes.

Agrupación Apícola de Galicia head office

https://apicoladegalicia.com/

METHODOLOGY

Different studies were carried out in collaboration with the University of Vigo. First the Department of Vegetal Biology and Soil Sciences participates to select which type of Galician Honey was most suitable for cosmetics.

Samples used in the selection

The Department of Applied Physics designed the protocol and tested the creams with 60 volunteers. The variations in the degree of hydration and sebum, as well as the tightening power of the facial cream and the soothing power of a foot salve were studied. Skin bio metrology techniques were used, for the determinations of the hydration degree, amount of sebum and skin elasticity, on the previously selected volunteers. In addition, surveys were carried out for sensory and subjective evaluation.

Volunteers testing the cosmetics elaborated within this activity

RESULTS AND PRACTICAL IMPLICATIONS

Cosmetics was introduced on the market after two years of study, research and development, in compliance with the requirements and all the necessary guarantees for consumers. A unique and exclusive line in the country was born using Galician honey (PGI Miel de Galicia) as the main ingredient, together other products from the hive such as wax, propolis and royal jelly. The line has nine different products. The initiative was funded by ADERCOU..

1. Natural soap with honey and propolis
2. Face cream
3, Body cream
4. Hand cream
5. "Apireparador", balsam for damaged skin
6. Skin blisters and abrasions
7. Lips balsam
8. Feet balsam
9. "Apidor", cream for local pain relief.

Studies have shown these cosmetics have very good results for their intended purposes, including skin moisturising and in the case of the facial creams the anti-ageing effect. The product line is on sale and the packaging associates the products with Galician beekeeping and Galician Honey.

Beekeeping diversification into cosmetics not only represents an economic opportunity, but also a way to innovate, sustain beekeeping, and respond to new market trends. Furthermore, it promotes the responsible and comprehensive use of hive resources, fostering a more holistic and sustainable approach to beekeeping. Due to this, this project received several awards: **Galicia Rural Development Awards XIII edition, agricultural and livestock sector category** and **Red PAC**.

Thanks: Faculty of Sciences (Ourense), Dept of Applied Physics (University of Vigo), O Teu xacobeo Xunta de Galicia, Naranjalimon, to Manoli, local shops, volunteers and beekeepers.

PP-532 [Beekeeping for Rural Development]
Creating value for traditional beekeeping (designing honey presser and bee suit) in Jabal Marrah Western Sudan

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Traditional beekeepers from Jabl Marrah Mountains in western Sudan were trained to produce hygiene honey from their traditional straw log hives in 2013 by the trainer Sabah Abdelwahab in Bendisi, and another group were trained in Golo area for production of honey from clay pot hives in 2019.Honey bees (Apis mellifera) is naturally available in the area, climate is suitable for bees activities, there is water and cultivated lands available, different good bee forage plants available almost all over the year, traditional beekeeping one of the important activities in the area.

the population in Golg area is around 75000 families which about 525000 persons, were lived in 153 villages.

the honey production per clay pot hive is about 25 kilograms.
The production were sold in the capital of Sudan in clean and attractive containers with different size, which more profitably with 40 percentage than the price in the local area.
Note: Photos are available.

PP-533 [Beekeeping for Rural Development]

Fairtrade as a tool for development, sustainability and market access

FAIRTRADE

For more than three decades, Fairtrade has been making an impact on the way trade works. Every producer should have access to a better way of doing business, and a better way of living. Fairtrade is the most recognized and trusted sustainability label and a leader in the global movement to make trade fair.

CLAC is the Fairtrade producers' network in Latin America and the Caribbean. It has around 1,000 member organizations in 23 countries. They represent more than 500,000 producers and workers and their main products are: coffee, banana, cocoa, sugar, honey, fruits, flowers, grapes for wine, quinoa and others.

Small beekeepers' organizations face many challenges such as compete in the global market, strengthen its capacity to adapt to climate change, get fair prices for their honey and decent working conditions. To have a voice for genuine honey producers at a global scale and offer a better future for young people are also important issues that need to be addressed.

Fairtrade aims for a world in which all producers enjoy secure and sustainable livelihoods, fulfil their potential and decide on their future. To achieve these, the system works on 3 levels: economic, social and environmental.

Fairtrade sets minimum prices for honey, providing a safety net against market volatility and beekeepers receive the market price when it is higher.

The system has a Fairtrade premium that is paid directly to producer cooperatives, who decide democratically how to use it.
Also, it promotes sustainable trading relationships with pre-financing possibilities for the beekeepers' organizations.

Compliance with International Labour Laws (ILO) and national laws, health & safety requirements, non-discrimination, gender equality and explicit regulations against gender-based violence, forced labour, and child labour.
GMO ban and a Hazard Materials list are in place.

Sustainable management of natural resources and good practices are promoted. To embed fairness in trade policy, we unite our voice with farmers, the Fair Trade Advocacy Office and other organizations to push human rights and decent livelihoods higher up the political and economic agenda. Fairtrade Standards support compliance with HREDD regulation, guiding supply chain actors to prevent and mitigate human rights and environmental risks.

MIGUEL ÁNGEL MUNGUÍA
President
of the Fairtrade Honey
Network from LAC

CLAC FAIRTRADE

PP-534 [Beekeeping for Rural Development]

Beekeeping and opportunities in a Patagonian prison

Author: Luciana Edith Pavon, Teacher/beekeeper.

Keywords: EDUCATION PRISON OPPORTUNITY WORK RESILIENCE

There is a penitentiary in the city of Cipolletti, Río Negro, in the Argentine Patagonia. Since 2018, a course-workshop has been held there to learn the beekeeping trade. It began with just a single swarm captured from a street tree, which was later converted into a hive for learning experiences. A sample of that first harvest, in February 2019, was sent to an international honey competition (Mercosur), winning first prize in its dark honey category. This recognition generated a careful and focused attention from society, as prison is not always seen as a place of opportunity and good news.

Learning and work are two pillars that can strengthen the self-esteem of a person incarcerated. In this northern region of Patagonia in particular, the spring and summer months allow students to explore the different stages of honey production, from the awakening of the hive to the arrival of autumn. The project provides a great incentive to think about the more or less immediate future, both for those leaving prison and for those who will spend a few more years there. It has allowed those who learned to have a trade and real employment opportunities upon release, considering that the area is a fruit-producing area that requires pollination for different species. Each student spends the course caring for a beehive, providing an opportunity for analysis, evaluation, and decision-making to solve problems. Their responsibility to care for the very lives of these bees for a year is at stake. Community harvesting brings with it the collective practice of sharing and joining forces for the common good, something that needs to be reflected upon and encouraged.

Furthermore, within the institution, we have apiaries for inmates who, thanks to their focus on production and the opportunities this activity provides, have found a significant investment of their time and dedication in a cause that both dignifies and motivates.

Beekeeping as an educational activity has provided tools to generate well-being, not only for inmates, but also for those around them, for the bees, and for the environment. Honey harvesting has been a sweet symbol in a hostile place that, even in its most difficult moments, finds nuances of hope in beekeeping education and production.

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ABSTRACTS OF POSTERS

Presented as images on pages 190-731

APITHERAPY

PP-321 [Apitherapy]
Preserving boar semen quality parameters with propolis extracts during long-term storage

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Propolis is a natural resinous mixture used by honeybees with a variety of biological effects, including antioxidant and anti-inflammatory properties. In animal reproduction studies, propolis has exhibited the potential to protect spermatozoa during storage. The aim of this study was to evaluate the effects of aqueous and ethanolic propolis extracts on boar semen quality parameters during 72-hour liquid storage at 17°C.

Eleven semen samples were collected from boars at an artificial insemination (AI) station and subsequently diluted with a long-term extender. The samples were then divided into separate parts and supplemented with 5% and 10% aqueous (5AP, 10AP) or ethanolic (5EP, 10EP) propolis extracts. One part of each sample was designated as the control group, receiving no addition of propolis extracts. Assessment of sperm viability and motility was conducted prior to dilution and after a 72-hour storage period using a sperm class analyzer (SCA). A total of 66 sperm motility and viability tests were performed At the beginning of the experiment, the mean motility of the semen samples measured by SCA was 90.56 (SD (standard deviation) = 6.990) %. After 72 hours, the results demonstrated that aqueous propolis extracts (5AP, 10AP) in boar semen helped to maintain sperm motility in comparison with control group and ethanolic propolis dilution. In aqueous groups, SCA motility was reduced by 7.95 (SD = 13.142) % in 5AP and 6.50 (SD = 8.302) % in 10AP, while in control group it was reduced by 7.97 (SD = 10.435) %. Conversely, ethanolic propolis extracts (5EP, 10EP) had a detrimental effect on semen SCA motility. Furthermore, the viability of semen samples diluted with aqueous propolis extracts was more than 10% higher compared to the control group ($P < 0.05$), further supporting the beneficial effects of propolis.

In conclusion, the present study indicates that aqueous propolis extracts provide protective benefits for boar sperm during storage, while ethanolic extracts may have a cytotoxic effect. Further research is necessary to understand the mechanisms underlying these effects.

PP-322 [Apitherapy]
Spotted Lanternfly Honey: A New Frontier in Medicinal Honey Research from the US

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The invasive spotted lanternfly Lycorma delicatula, first reported in the Northeastern United States in 2014, has become both a challenge and an unexpected opportunity. As its range expands, beekeepers in regions like Pennsylvania and New Jersey are reporting a distinctive, dark fall honey produced by managed honey bees Apis mellifera using the honeydew of these phloem-feeding insects. This novel honey, characterized by unique aromas and flavors, prompted an investigation into its properties and potential medicinal uses.

Samples of suspected spotted lanternfly (SLF) honey were collected from regional beekeepers and analyzed for a comprehensive suite of biochemical and microbiological properties. These included pH, color, antibacterial activity, antioxidant capacity, phenolic and flavonoid contents, and detailed metabolomic profiling. Comparisons were made to manuka honey, the gold standard for medical-grade honey, to contextualize the findings. Remarkably, SLF honey demonstrated exceptional antimicrobial, antioxidant, and anti-inflammatory properties, suggesting significant potential for applications such as wound healing and other medicinal uses. This study highlights a promising new variety of honey with exceptional bioactivity, underscoring its value for both the apicultural industry and medical research. The emergence of this honey offers an exciting avenue for innovative honey products that contribute to health and wellness.

PP-323 [Apitherapy]
Moroccan Propolis' potential as a multitarget therapeutic product: from experimentation to clinical perspectives

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Modern apitherapy is a promising branch of medicine and owes much to the serious work and multiple scientific researches in progress. It is important to emphasize that modern apitherapy is conceived as being innovative, codified, based on proven and reproducible facts, not alternative but complementary to conventional therapies. In this era of viral pandemics, alarming resistance to antibiotics and oxidative stress at the center of all cellular aggressions, our work aims to bridge the two fields of biology and medicine. This presentation will be navigating both experimental findings and clinical perspectives of propolis, from a clinician point of view.

Beehive products, and specially propolis, are not yet or hardly considered in health systems. The main obstacles to their pharmaceutical exploitation are the lack of standardization and data from well-conducted clinical trials related to the safety (allergy, toxicity) and therapeutic efficacy related to their use. Morocco, as a north-African and Mediterranean country, is characterized by its floral biodiversity. In fact, our research revealed the variability of Moroccan propolis and its richness in flavonoids as well as its important antioxidant power. It would be interesting to study the effect of its individual components (CAPE, pinocembrine, galangin...) in propolis mixture plans (exp brazilian propolis) but also with other products of the hive such as arbutus honey characterized particularly by the presence of epicatechin.

Within the products of the Moroccan beehive, and in particularly propolis, there are valuable molecules whose mechanisms of action and clinical interest need to be further investigated, to enable the transfer of experimental results from the laboratory to the patient's bedside.

PP-324 [Apitherapy]
The effect of dehydrated honey as an energy source on boar sperm quality parameters

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The semen used in artificial insemination (AI) procedure is diluted with various types of extenders that act as an energy source, provide temperature protection, facilitate membrane stabilization, pH buffering, antibiotic action, and generally extend sperm storage time. Dehydrated honey (DH) is a more convenient liquid honey alternative consisting of various types of carbohydrates that can act as an additional energy source for spermatozoa. The objective of this study was to evaluate the effect of storage at 17°C for 96 hours on the motility and viability of boar spermatozoa when different concentrations of DH were added to semen samples. Twelve semen samples were collected from 12 breeding boars, diluted with long term extenders, divided into separate parts and supplemented with 0% (DH0), 0.1% (DH0.1), 0.5% (DH0.5), 1% (DH1) and 2% (DH2) dehydrated honey. All samples were stored in a refrigerator at 17°C for a period of 96 hours. Total sperm motility (SCA) and sperm viability (HOST test and eosin/nigrosin staining) were determined before and after 96 hours of storage.

Following the designated storage period, the eosin/nigrosin staining method showed the greatest reduction in sperm viability in the DH0 control group, with a percentage of non-viable spermatozoa of 45.92% (SD (standard deviation) = 16.262). In DH1, the percentage of non-viable spermatozoa was 40.33% (SD = 13.330), which was 5.59% lower. Furthermore, the hypo-osmotic swelling test (HOST) revealed the lowest viability in the DH0 control group (46.92% (SD = 9.931)), while in the DH1 group it was 49.00% (SD = 10.126). The DH1 group exhibited the highest total sperm motility and the lowest percentage of non-motile spermatozoa (11.66% (SD = 9.324)). In contrast, the DH2 group had the highest percentage of non-motile spermatozoa (27.44% (SD = 16.138)) ($P < 0.05$).

In conclusion, after 96 hours of storage at 17°C, semen samples with a 1% DH concentration had the highest levels of motility and viability across multiple assessments. In comparison, the control group had the greatest reduction in viability, highlighting the potential benefits of using appropriate concentrations of DH to maintain semen quality during storage.

PP-326 [Apitherapy]
Identification of 2,4-Di-tert-Butylphenol as an Antimicrobial Agent Against Cutibacterium acnes Bacteria from Rwandan Propolis

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Background/OBJECTIVES:
Acne is the most prevalent dermatological condition among humans, affecting approximately 80% of adolescents during puberty. To date, numerous compounds have been used for acne treatment, including erythromycin ointments and antiseptics, with varying degrees of success. The emergence of erythromycin-resistant C. acnes strains has spurred the search for new antimicrobial agents, particularly from natural sources.

The composition of propolis is highly variable, influenced by factors such as plant sources, bee species, harvesting seasons, and climatic conditions. This diverse apiary product has been shown to possess a wide range of clinical applications, including antioxidant, anticancer, anti-inflammatory, and antimicrobial properties. It is essential to acknowledge that propolis is not a uniform substance; its chemical profile is shaped by local environmental factors, meaning its effectiveness can differ across various conditions. In our study, we collect and analyze Rwandan propolis to evaluate its antibacterial activity and identify the most potent extracts against Cutibacterium acnes.

METHODS: Propolis collected in Rwanda identified as having a antibacterial activity on C. acnes was extracted and fractionated by flash chromatography and tested against C. acnes growth by using NCLSI recommendations.

RESULTS: In our research, we identified a molecule, 2,4-Di-tert-butylphenol (2,4-DTBP) which inhivbited the C. acnes growth at a concentration of 16 µg/mL. Based on these results, we formulated an ointment (1%) using OFAP18 and petroleum jelly for the potential treatment of acne using a mouse model.

CONCLUSIONS: In vitro and in vivo evidence suggests that 2,4-DTBP has anti-inflammatory properties and could effectively manage the overgrowth of C. acnes as well as serve as a potent alternative for the formulation of an active propolis ointment for acne treatment.

PP-328 [Apitherapy]
Analysis of bee propolis as a hypoglycemic agent and diabetes control

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Propolis is a natural product derived from plant resins collected by honey bees. This natural product has been used in folk medicine for centuries. The main chemical classes present in propolis are phenols, flavonoids are well-known plant compounds with biological activity

properties, including anti glycemic effect. This study tested the impact of Colombian propolis as a regulating agent of glucose concerning metabolic activity on 45 healthy young people of two sexes aged between 17 and 24 years and five men as volunteers with a medical declaration of hyperglycemia was considered. The metabolic conditions for glucose were evaluated in pre-and postprandial conditions besides the blood group and the arterial pressure. The work was carried out in three different stages that included the characterization of total equivalent flavonoids present in an ethanolic fraction of propolis, in a second phase, the glycemia curves in a group of volunteers that were evaluated, and in the final phase, a regulatory effect of EEP on blood glucose. Equivalent total flavonoids in propolis samples were evaluated, and samples from Cucaita were used as an antihyperglycemic test. Fasting glucose levels in the studied population was of 82,3 ± 7,10 mg dL-1, which conform to a normal distribution and which evolves to 127,1 ± 9,65 mg dL-1after ingestion of glucose solution and subsequently at 83,3 ± 11,7 and 72,4 ± 12,3 mg / dL at 60 and 90 min. When comparing these values with the glucose and EPP treatments given in the test, the regulatory effect of the propolis components is observed. Normally, the absorption of glucose in the body occurs rapidly, and blood glucose levels rise within 30 to 60 min. of fluid intake. Diabetes is a metabolic disorder in which there is an inability to oxidize carbohydrates generated by disturbances in insulin function. Propolis may have acted indirectly by increasing β cell insulin secretion and improving insulin sensitivity.

PP-331 [Apitherapy]
Royal jelly as a natural supplement for improving semen quality and blood parameters in breeding dogs

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Royal jelly, a secretion from worker honeybees, is known for its antioxidant and reproductive benefits. While its effects on various species are studied, its role in canine fertility remains unclear. Enhancing semen quality is crucial for breeding success, and natural alternatives to synthetic supplements are gaining interest. This study aims to assess the impact of royal jelly on semen quality and blood parameters in breeding dogs, providing insights into its potential as a natural reproductive health supplement. The study was conducted in a kennel with six German Dwarf Spitz dogs (2.5–3 years old), divided into two groups: a control group (n=3) receiving glucose (100 mg/day) and an experimental group (n=3) receiving royal jelly (100 mg/day) for ten days. Semen and blood samples were collected at three time points: before supplementation (T1), 10 days after supplementation (T2), and two months post-supplementation (T3). Semen was analyzed for volume, motility, concentration, and morphology, while blood samples were examined for biochemical and morphological parameters. Royal jelly supplementation significantly improved sperm motility and volume in the experimental group compared to the control group ($p<0.05$). The sperm motility in the royal jelly group increased from 65.0% (SD=13.2) at T1 to 85.0% (SD=5.0) at T2 and remained elevated at T3 (86.7% (SD=2.9)). The control group did not show a statistically significant difference ($p>0.05$). Semen volume also increased in the royal jelly group (T1: 1.6 (SD=0.06) ml; T2: 2.0 (SD=0.46) ml; T3: 2.0 (SD=0.44) ml), while the control group showed a decreasing trend (T1: 1.43 (SD=0.49) ml; T2: 1.27 (SD=0.20) ml; T3: 1.33 (SD=0.40) ml). Blood morphology remained within the normal range across all time points in both groups, and blood biochemistry showed no significant differences but indicated improvements in some parameters. These findings suggest that royal jelly supplementation can enhance semen quality without negatively affecting overall health.

The study highlights the potential of royal jelly as a valuable supplement for improving fertility in breeding dogs, offering a new market opportunity for beekeepers. With increased awareness of natural reproductive enhancers, royal jelly could gain broader recognition in veterinary applications, encouraging sustainable and profitable beekeeping practices.

PP-332 [Apitherapy]
"Treatment with bee air"

Bedri Statovci
Beekeper - Village: Batllave, Municipality of Podujeva - Republic of Kosova

The 45-year-old patient with pulmonary problems was treated with 18 sessions of bee air and propolis steam at the bee clinic.
With the permission of the 45-year-old patient, we present to you his card, which one was treated with bee air last year, from May 21 to May 31, 2024. This card of our clinic is printed in Albanian and I feel obliged to give you every explanation, even in detail.
- On May 21: An allergy test was performed. The next day we realized that the patient did not have any reaction and that his body accepts bee products.
- On May 22: The patient underwent a spirometry, where the result was 443 l/min, where for this age and body height, the normal parameter should be around 583 l/min.
- After three sessions, on May 23, the patient informs us that last night he stopped using the preventive spray (Preventive Inhaler).
- In session no. 7 (May 24), spirometry shows a positive change in breathing (492 l/min), for 49 l/min. increase in respiratory capacity.
- In session no. 14 (May 29), we offered the patient the propolis vapor treatment for the second time.
After consultation with the patient, taking into account his mood, we agreed that the 18th session (May 31) would be the last, and in this case, his spirometry was 581 l/min.
During the treatment of 16 sessions with bee air and two sessions with propolis vapor, the patient noticed a positive change in spirometric respiratory parameters, where after the third session he removed the preventive spray from use and at the end of the 18th session, the respiratory capacity increased by 138 l/min, from the initial 443 l/min to 581 l/min. For a 45-year-old patient with a body height of 178 cm, the normal respiratory capacity should be 583 l/min, based on the standard spirometry list.
Based on experience and literature, we have come to the conclusion that: three factors determine the successful treatment of this category of patients:
• The month of may,
• Convenient inhaler and
• The combination of sessions with bee air and propolis steam.

PP-333 [Apitherapy]
The Effect of Bee-Propolis in Gingivitis & Plaque Control

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OBJECTIVE: This study was conducted to evaluate effect of bee propolis in plaque control and gingivitis by using ethanolic extract of bee Propolis Gel.

MATERIALS-METHODS: A total of 30 patients were included in the present study. Patients with plaque index more than 1.0 and gingival index more than 0.5 were included in the present study. These patients were divided into 2 groups. Group I: (15 Patients) placed on local application of propolis gel without scaling and polishing. Group Group II: (15 Patients) placed on local application of propolis gel after scaling and polishing. The PI and GI index score was recorded in both groups from baseline up to four weeks at the interval of one week. The data was analyzed using Statistical Package for Social Science (SPSS) version 11.5 (SPSS Inc., Chicago, Ill.). The p value was taken as significant when less than 0.05. Mann– Whitney U-test will be used to assess the statistical significance difference for Group I and Group II. While Changes in PI and GI score at different interval over time was assessed by using Wilcoxon's sign-ranked test.

RESULTS: When the PI index score was assessed among the Groups at baseline, at 2 nd week, 3rd week & and 4th week, a highly significant difference was found among the groups ($p<0.00$). GI index score among the groups was highly significant at baseline, 2nd week, and 3rd week ($p<0.00$), whereas GI value among the groups in 4th week was significantly different ($p<0.01$). Intra-group comparison for PI and GI index scores at baseline and at a different interval was carried out among the groups, and the difference was found to be highly statistically significant.

CONCLUSION: The present study showed evidence of the efficacy of alcohol-free ethanol extract containing 3.5% Indian propolis for the control of plaque and gingivitis, suggesting that it can be used as a therapeutic and preventive use for the control of periodontal diseases. However, it is necessary to perform a clinical trial, double-blind, randomized control trial to prove the efficacy of an alcohol-free 3.5% ethanol extract of propolis gel.

PP-335 [Apitherapy]
Use of bee royal jelly in the therapy of gynecological pathologies: results of a clinical study

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Apitherapy as a method of prevention and treatment of various diseases has been successfully used for many centuries. However, fundamental research into the effectiveness of bee products are insufficient. In order to strengthen the evidence base for apitherapy, Medok Company LLC (Ukraine) organized a series of clinical studies of beekeeping products. In 2019, at the Kharkiv National Medical University (Ukraine), at the clinical sites of the Department of Obstetrics, Gynecology and Pediatric Gynecology, a clinical study was conducted on the effect of royal jelly on the state of the reproductive system and the course of gynecological diseases in women. 110 female patients ages from 6 to 46 years were observed for a year. Based on a comprehensive examination, the following pathological conditions were verified for these patients: menstrual dysfunction, disorders of sexual development, tumors, inflammatory diseases of the female reproductive system, genital injuries, etc. In addition to standard treatment regimens, all patients were prescribed a course of apitherapy. Capsules with royal jelly (per os), suppositories with royal jelly (per vaginam), and suppositories with drone homogenate (per rectum) were used. After the treatment, the examined patients showed a statistically significant decrease in the pathological clinical manifestations of gynecological diseases.

In particular: 1) normalization of hormonal levels, 2) rapid hemostasis in case of abnormal uterine bleeding, 3) restoration of menstrual function, 4) positive dynamics in the development of secondary sexual characteristics in case of delayed sexual development, 5) reduction in the severity of pain syndrome in dysmenorrhea and regression of ovarian retention formations, 6) reduced recovery time in the postoperative period, 7) relief of swelling and discomfort in the mammary glands, 8) elimination of pathological discharge due to external genital inflammation, 9) leveling of menopausal symptoms, etc.
Based on the results of this clinical study, strong conclusions were drawn that the use of products with royal jelly contributes to pronounced immunostimulating, antiseptic and anti-inflammatory effects. The products used during the therapy also demonstrated high effectiveness with no complications or adverse reactions, which demonstrates the high potential of their usage to improve people's health.

PP-339 [Apitherapy]
The Role of Apitherapy in Integrative Medicine: A Comprehensive Approach to Healing with the Hive

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Background & PURPOSE:
Apitherapy—the medicinal use of bee products—has been practiced for centuries, yet its integration into modern healthcare remains limited. As a professional beekeeper, apitherapist, and integrative health practitioner, I prioritize apitherapy as a primary treatment modality, integrating honey, propolis, royal jelly, bee venom, bee pollen, hive air therapy, and beekeeping for health into personalized treatment plans. This research explores the role of honeybee medicine in integrative healthcare, particularly its impact on inflammation, autoimmune disorders, pain management, and neurological health.

Problem Description:
Despite growing interest in natural medicine, many practitioners underestimate the therapeutic potential of hive products, and beekeepers struggle to market their products for medicinal value. This creates a gap between traditional wisdom, scientific validation, and economic sustainability for beekeepers. My work focuses on bridging this gap through medicinal beekeeping practices to ensure high-quality, therapeutic hive medicines and expand access to apitherapy as a mainstream treatment option.

METHODOLOGY:
This study examines clinical research, case studies, and patient outcomes where apitherapy is the primary treatment approach for inflammatory, autoimmune, and neurological conditions. Therapies explored include:

Bee venom therapy (BVT) for pain, autoimmune diseases, and nerve regeneration
Propolis for immune modulation and antimicrobial resistance
Honey for wound healing, gut health, and metabolic support
Hive air inhalation for respiratory and nervous system balance
Beekeeping as a therapeutic intervention for mental and physical health
Results & CONCLUSION: Findings suggest apitherapy provides significant benefits in pain relief, immune support, and neuroprotection. Patients report reduced inflammation, improved energy, cognitive function, and stress resilience. BVT has shown promise in rheumatoid arthritis and multiple sclerosis (MS), while hive air therapy supports lung health and nervous system function.

Practical Implications for Beekeepers:
Beekeepers play a critical role in producing high-value, medicinal-grade bee products yet face challenges achieving sustainable wages. Recognizing apitherapy as a medical system can elevate the economic value of their products, shifting the industry beyond bulk honey production to a regenerative, health-focused model. Collaboration between beekeepers, researchers, and healthcare providers is essential to ensure apitherapy becomes a viable path for beekeepers worldwide, creating economic opportunities while advancing holistic health.

PP-340 [Apitherapy]
Physico-Chemical and Antibacterial Properties of Herbal-Infused Honey

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BACKGROUND/PURPOSE:
Honey is known for its antibacterial, antifungal, and antioxidant properties, primarily due to its high sugar content, low water activity, and presence of hydrogen peroxide and other bioactive compounds (Wang H. et al., 2023; Bartkiene E. et al., 2020). Additionally, when infused with medicinal herbs, the bioactive properties of the honey can be significantly enhanced. Herbs contribute additional phytochemicals, including flavonoids, polyphenols, and essential oils, which further boost the mixture's ability to combat harmful microorganisms (Vaou N. et al., 2021). Thust honey-herb infusions may be effective against a range of pathogens, including antibiotic-resistant bacteria (Kumar S. et al., 2024).

PROBLEM DESCRIPTION:
The growing interest in natural antimicrobials necessitates the exploration of novel honey products formulation with enhanced multifunctional properties. However, limited research exists on the combined effects of herbal infusion on honey's antibacterial activity and quality parameters. This study investigates the effects of Thymus vulgaris L. infusion on the physico-chemical properties and antibacterial efficacy of multifloral honey.

METHODOLOGY:
Two groups of samples were prepared and analysed: (1) raw multifloral honey and (2) raw multifloral honey infused with Thymus vulgaris L. Summer honey was collected in Lithuania in 2024. Herb enriched honey was prepared by addition of 5% (by mass) of dried herb (all parts of the plant without roots). Physico-chemical parameters, including pH, moisture content and electrical conductivity were analyzed. Antibacterial activity was assessed against 10 pathogenic and opportunistic bacterial strains using the agar well diffusion method.

RESUTS and CONCLUSION: Herbal infusion altered honey's physico-chemical properties, increasing electrical conductivity and pH, but the moisture content was found to be the same in both samples. The raw honey sample demonstrated increased antibacterial activity against Staphylococcus aureus, Salmonella enterica, Pseudomonas aeruginosa, and Enterobacter cloacae, whereas the infused honey sample was effective only against Salmonella enterica.

PRACTICAL IMPLICATIONS FOR BEEKEEPERS:
Herbal-infused honey offers an exciting innovation for beekeepers, combining medicinal plant infusions to enhance its antibacterial properties and mineral content. This high-value product meets consumer demand for natural remedies, boosting both economic returns and the sustainability of apiculture, as well as promoting non-traditional agriculture - cultivation of medicinal herbs.

PP-342 [Apitherapy]
Exploring the nutritional value of fresh bee pollen from different Belgian areas

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Apitherapy is a critical opportunity for beekeepers aiming to valorize bee products other than honey. Bee pollen has been consumed as healthy food for a long time in Romania, but also in Australia, Argentina and China. Its nutritional qualities include a high protein content and antioxidant potential, and interesting concentrations of vitamins and minerals. These properties depend on geographical and botanical origin and on seasonality. Pollen conditioning, i.e. dryring or freeze-drying, also impacts final properties. In Western countries, including Belgium, consumption of bee pollen remains marginal. To promote the product, it is essential to demonstrate its healthy properties at a local level.

For two years, bee pollen was collected monthly from three apiaries in Belgian urban, suburban and rural areas. Samples were directly stored at -18°C upon arrival at the laboratory. Health-promoting factors studied were: (a) proteins and amino acid profiles, (c) antioxidant potential and total polyphenols, (d) minerals, (e) absence of unacceptable levels of pesticides and trace elements and (f) absence of cytotoxicity. Botanical origin of samples was also determined.

Due to distinct meteorological conditions in 2023 and 2024, pattern of pollen botanical origin identified the first year was not observed the second year. However, the phenomenon did not affect pollen characteristics. Overall, protein content was always between 23 and 27 g/100 g of dry pollen. Pesticide residues were barely observed (respectively 1 and 4 molecules in 2023 and 2024) and generally below MRLs. Health promoting characteristics of pollen were never influenced by the area of sampling, contrary to seasonal pattern. Indeed, pollens from August always had lowers polyphenol concentrations. Amino acid profiles were also modified in August, but all essential amino acids were still present. Overall, the growth of CaCo2 cells was never affected by pollen during MTT assays, and some samples even showed a growth-promoting activity.

Globally, this work confirmed the high potential of Belgian bee pollen in apitherapy or as food ingredient.

PP-343 [Apitherapy]
Identification of Cough Suppressant Components in Honey: Flazin and a New Compound, Melpyrrole

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BACKGROUND: Honey has long been used as a folk remedy for cough, and numerous studies have demonstrated its ability to improve both the frequency and severity of cough compared to usual care. However, the active components responsible for honey's cough-suppressing effect have not been elucidated.

OBJECTIVES: The objectives of this study were to evaluate the antitussive effect of honey in a controlled experimental setting and identify its active components.

METHODS: Antitussive effects of honey and its components were evaluated by in vivo experiments with guinea pigs, in which cough responses were induced by inhalation of citric acid (which stimulates Aδ-fibers) or capsaicin (which stimulates C-fibers). Fractionation of honey was conducted using Sepabeads SP-850 and anion-exchange column chromatographies. Screen for candidate active components and prediction of their structures were performed based on the fragment patterns observed in LC MS/MS and subsequently confirmed either by direct comparison with authentic standards or by chemical synthesis.

RESULTS AND DISCUSSION: Acacia honey, administered at 1 g/kg, significantly reduced the frequency of cough induced by both citric acid and capsaicin compared with vehicle-treated controls. These findings suggest that intragastrically administered honey suppresses both types of cough evoked by the stimulation of Aδ- and C-fibers, as well as dextromethorphan (DM). LC-MS/MS-based multivariate analysis of the honey fractions yielded two active candidate components. One component was identified as flazin by direct comparison with an authentic standard. The other was estimated to be a novel compound in which the furan ring present in flazin is replaced by a pyrrole ring, as deduced from its LC-MS/MS fragment patterns. The structure of this novel compound was subsequently confirmed through chemical synthesis, and it has been named “melpyrrole.” When administered individually at doses of 0.1 and 1 mg/kg, both flazin and melpyrrole exhibited significant antitussive activity in guinea pigs, with effects equal to or greater than those observed with DM. These findings provide a basis for the evidence-based standardization of honey products and would lead to the future development of a new type of cough medicine.

PP-345 [Apitherapy]
Evaluation of therapeutic properties of Apis florea honey against Helicobacter pylori

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Honey is not only considered as a fabulous food product, but also it has healing properties. Iranian men are susceptible to gastrointestinal cancer caused by Helicobacter pylori. It is very imperative to find effective methods to control this bacterium without side effects. In this study Apis florea honey samples from 7 various floral and geographical origins of Iran and 5 samples from each region were analyzed in terms of acidity, pH, moisture, sucrose, fructose, glucose, proline, diastase, Ash and HMF. Also, honey samples were analyzed for antioxidant activity using the FRAP, DPPH and ABTS methods. Using atomic absorption measurements, the honey samples were also tested for their phenolic and flavonoid content, protein concentration, and mineral content. Furthermore, antibacterial activity of honey samples against H. pylori was assessed in mice's gastrointestinal tracts both in vitro and in vivo. In-vitro antibacterial activities of different honey samples was performed using the agar well diffusion method and In-vivo antibacterial activities of them was analyzed by introducing H. pylori into the gastrointestinal tract of mice, feeding them with the honey samples for 75 days and dissecting their stomachs. The Sydney system was also used to assess the degree of inflammation in addition to detecting H. pylori contamination. The results showed that the highest and lowest phenol contents were observed in Bushehr (755.83 g/g) and Iranshahr (348.83 g/g), respectively. According to the results, the highest and lowest levels of antioxidant activity with ABTS method, were found in Bushehr (786.40 ± 29.73 µg/g) and Iranshahr (324.90 ± 4.90 µg/g) honey samples. The DPPH and FRAP methods confirmed the results of the ABTS method for honey antioxidant activity. A statistical analysis of the honey samples revealed significant positive correlations between antioxidant and antimicrobial activity. According to the results of antibacterial activity test, in the Bushehr honey sample, gastric mucosa showed mild inflammation and mild degeneration, along with severe eosinophilia. Based on these results, Jujube (Zizyphus spina Christi) honey from Bushehr could prevent and cure infections and inflammation caused by the bacteria H. pylori in the gastrointestinal tract.

PP-348 [Apitherapy]
Antioxidant activity and total phenolic content in pollen loads and bee bread collected from an ecological apiary

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Bee products, such as pollen collected by bees and bee bread, play an important role in the human diet due to their nutritional and health-promoting properties. Phenolic compounds present in these products exhibit strong antioxidant effects, which can contribute to protecting the body from oxidative stress.

The aim
The aim of the study was to investigate the antioxidant properties and total phenolic content of pollen and bee bread collected from an ecological apiary.

Material
The pollen loads and bee bread samples were collected in 2024 beekeeping seasons in an ecological apiary of the National Research Institute of Horticulture, Apiculture Division in Puławy, located in the Poleski National Park.

METHODS: The radical scavenging activity of the extract of pollen loads and bee bread samples was assessed by using (2,2-Diphenyl-1-picrylhydrazyl) assay according to the method reported by Kahraman et al. (2022). The principle of the method is based on the measurement of the reducing ability of antioxidant components toward DPPH radical.
TPC was determined in aqueous extracts of pollen loads and bee bread samples by using the Folin–Ciocalteu method which was described by Pelka et al. (2021). The principle of the method is to use the ability of phenols to form a colored blue complex with the reactants of the Folin-Ciocalteu reagent and a saturated solution of sodium carbonate (Na2CO3).

RESULTS: The results showed that bee bread samples from ecological apiaries contained a higher total phenolic content (mean 1439.7 mg GAE/100 g) compared to pollen loads (mean 304.8 mg GAE/100 g) collected from the same apiary. Antioxidant activity expressed as the percentage of DPPH reduction, was also higher in bee bread samples (mean reduction 94.4%) compared to samples of pollen loads (mean reduction 87.9%).

CONCLUSION: Bee bread obtained from an ecological apiary compared to pollen loads is characterized by higher biological value determined by antioxidant activity and total phenolic content. The results obtained in this work constitute the basis for continuing research into the use of bee bread in human nutrition and the treatment of civilization diseases.

PP-349 [Apitherapy]
Spectroscopy can predict the antioxidative properties of propolis

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Background & Purpose
Propolis, a resinous substance produced by bees, is valued for its antioxidant properties due to its high polyphenol content. However, its composition and biological activity vary by geographic origin. A rapid and reliable method for assessing its antioxidative properties would facilitate its application in health-related fields. This study aimed to identify the most effective spectroscopic technique for screening and predicting antioxidant activity.

Problem description
This study aimed to identify the most effective spectroscopic technique for screening and predicting antioxidant activity.

Methodology
Propolis samples were collected from Australia (N = 8), Denmark (N = 38), and Norway (N = 7). Four spectroscopic techniques were evaluated: infrared (IR), Raman, near-infrared (NIR), and proton nuclear magnetic resonance (^{1}H NMR) spectroscopy. IR, NIR, and Raman spectroscopy were performed on raw propolis, while ^{1}H NMR spectra were recorded from chloroform extracts. Antioxidant activity was assessed using the DPPH free radical scavenging assay, which measured radical scavenging activity (RSA). Spectral data were analyzed for correlation with RSA, and predictive models were developed for each technique.

Results & CONCLUSION: IR, Raman, and NIR spectroscopy revealed that Danish and Norwegian propolis contained higher polyphenol levels than Australian samples, which had the highest carbohydrate content. Consistently, Danish and Norwegian propolis exhibited greater RSA. The strongest correlations between spectral signals and RSA were found at 1,631 cm ^{1} (Raman) and 1,666 nm (NIR). Among the tested techniques, NIR spectroscopy demonstrated the highest accuracy in predicting antioxidant activity (R^2 = 0.75).

Practical Implications for Beekeepers
A rapid and reliable method for estimating the antioxidant potential of propolis could help beekeepers identify and market high-quality samples, increasing their commercial value and applications in health and nutrition. Spectroscopic screening provides a fast, non-destructive alternative to conventional chemical analysis, enabling the differentiation of high-quality propolis. This approach could facilitate the development of high-value propolis-based products and expand their role in functional foods, nutraceuticals, and pharmaceuticals.

PP-350 [Apitherapy]
Comparing Propolis from Different Bee Species and Regions Using ¹H NMR Spectroscopy

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Background & Purpose
Propolis is a resinous substance produced by bees that protects the hive and defends against disease. While its composition varies by geographic origin, less is known about how different bee species affect its chemical makeup.

Problem description
This study uses proton nuclear magnetic resonance (¹H NMR) spectroscopy to compare the chemical profiles of propolis from different bee species. It aims to provide insights into species-specific propolis production and its functional properties.

Methodology
Propolis samples were collected from local beekeepers. The samples included propolis from Apis mellifera (A. mellifera) colonies in Denmark, Norway, and Australia, as well as from Tetragonula carbonaria (T. carbonaria) colonies in Australia. A two-phase extraction method (methanol–water and chloroform) separated the samples into aqueous and lipid phases, followed by ¹H NMR spectroscopy. Correlation analysis and principal component analysis (PCA) were used to assess chemical variations among samples.

Results & CONCLUSION: Scandinavian A. mellifera propolis contained higher polyphenol levels, while propolis from both Australian bee species had more carbohydrates. Additionally, T. carbonaria propolis had shorter, less functionalized wax chains than A. mellifera propolis and a higher terpenoid content. These findings demonstrate that both geographic origin and bee species significantly influence the chemical composition of propolis, highlighting species-specific adaptations in resin foraging and biosynthesis.

Practical Implications for beekeepers
¹H NMR spectroscopy enables the rapid identification of propolis variants suitable for pharmaceuticals, nutraceuticals, and cosmetics. Identifying species-specific propolis profiles enables beekeepers to refine harvesting strategies and target propolis with desirable bioactive properties. Spectroscopy also serves as a quality control tool to ensure consistency in commercial propolis products.

PP-351 [Apitherapy]
Discovery of Novel Anti-Inflammatory Compounds in Propolis

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Background
Immunosenescence increases immune activity with age, possibly contributing to diseases such asrheumatic disorders and cancer. These conditions are typically managed with NSAIDs, corticosteroids, and cytostatic agents. However, side effects often limit long-term use, highlighting the need for safer alternatives. Propolis, a resinous substance produced by bees, has well-documented anti-inflammatory properties and represents a potential alternative.

Problem description
This study investigated whether propolis contains novel compounds with anti-inflammatory activity.

Methodology
The immunosuppressive effects of ethanol-extracted propolis were evaluated by measuring its ability to inhibit IL-1 release from human peripheral blood mononuclear cells (PBMCs) stimulated with LPS or PHA. The composition of propolis was analyzed using reverse-phase HPLC. Multivariate data analysis was applied to HPLC signals and anti-inflammatory data. Principal Component Analysis (PCA) was used to analyze the full HPLC chromatograms from all samples. The relative anti-inflammatory effect of each compound was estimated based on HPLC peak concentration and potency.

Results & CONCLUSION: Propolis completely inhibited IL-1 release, whereas dexamethasone achieved a 70% reduction. Propolis samples from within each region showed slight variations, whereas samples from different regions varied more significantly. Danish and Norwegian samples exhibited greater activity (~26%) than Australian samples (~5 %), likely due to higher polyphenol content. Reverse-phase HPLC identified bioactive compounds, including p-coumaric acid and pinocembrin, which inhibited immune activity by 19.9% and 16.0%, respectively. Mass spectrometry is currently being used to analyze three unidentified compounds, which are estimated to contribute 8.3%, 7.7%, and 7.2% to the inhibitory activity of propolis.

Practical Implications for Beekeepers
Identifying novel anti-inflammatory compounds in propolis could enhance its medical applications and commercial potential. Beekeepers can leverage this knowledge to promote high-quality propolis with potent bioactive properties, increasing its value in nutraceutical and pharmaceutical markets. Recognizing regional variations in propolis composition may enable producers to market distinct varieties for targeted health applications, further strengthening its commercial and therapeutic potential.

PP-352 [Apitherapy]
Antimicrobial Potential of Stingless Bee Honey: Physicochemical Characterization and Activity Against Pathogenic Bacteria

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Background/Purpose
Stingless bee honey is a complex natural product composed of sugars, organic acids, proteins, minerals, vitamins, phenolic compounds, and flavonoids. Due to its bioactive properties, it has been traditionally used in phytotherapy and homemade remedies. The growing demand for natural therapeutic alternatives is driven by concerns over the side effects of synthetic drugs and the rise in antibiotic resistance. This study aimed to characterize the physicochemical properties and antimicrobial activity of stingless bee honey from different species and assess its effectiveness against pathogenic bacteria.

Problem Description
Escherichia coli and Staphylococcus aureus are major bacterial pathogens responsible for various infections. Their increasing resistance to conventional antibiotics highlights the urgent need for alternative antimicrobial agents. Stingless bee honey has demonstrated antibacterial potential, but its variability among species remains poorly understood. This study sought to evaluate honey samples from multiple stingless bee species to determine their antimicrobial properties and potential therapeutic applications.

Methodology
Honey samples from 15 stingless bee species across different Brazilian regions were analyzed. Physicochemical characterization was conducted, and antimicrobial activity was assessed using the broth microdilution method. The minimum inhibitory concentration (MIC) and minimum bactericidal concentration (MBC) were determined for each sample to evaluate their effectiveness against E. coli and S. aureus.

Results and CONCLUSION: A high variability in physicochemical properties was observed among honey samples, but no direct correlation with antimicrobial activity was found. However, honey from Melipona rufiventris and Scaptotrigona tubiba exhibited the highest antibacterial activity, comparable to propolis. These findings reinforce the potential of stingless bee honey as a natural antimicrobial agent and suggest its application in developing alternative treatments for bacterial infections.

Practical Implications for Beekeepers
The identification of highly bioactive honeys provides an opportunity for beekeepers to promote specific species for medicinal use, increasing the market value of their products. Understanding the antibacterial potential of different honey types may also encourage sustainable beekeeping practices and the development of functional honey-based products with health benefits.

PP-355 [Apitherapy]
Anticancer potential of bee venom for head and neck squamous cell cancers – the preliminary results

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Background/PURPOSE:
The anticancer activity of bee venom (BV) and melittin have been shown in various cancers, as well as their beneficial effect on immune system. However, the BV activity in regard to head and neck squamous cell cancer (HNSCC) remains almost unexplored. HNSCC relates to poor survival outcomes, unsuccessful treatment in many cases or serious disability. Therefore, new effective therapies are urgently needed. Currently, immunotherapy occurs as the novel, promising anticancer strategy. In this aspect a role might play extracellular vesicles (EVs) that regulate the activity of cells, including immune cells populations. Cancer induces immunosuppression that favors its growth and metastasis. The solutions that boost the immune system may improve effective tumor inhibition and drop out in the end.

Problem description:
The aim of this preliminary study was to evaluate the anticancer potential of BV for pharyngeal carcinoma and healthy human keratinocytes cell lines (HaCat), as well as BV's effect on EVs secretion.

METHODOLOGY:
Bee venom was obtained from honeybees using low-voltage electrical stimulation. The melittin concentration was estimated with UHPLC-ESI-MS. The BV activity was determined in the in vitro studies with FaDu and HaCat cell lines. After BV treatment the viability with MTT assay, staining with crystal violet, scratch assay and apoptosis analysis with flow cytometry were performed. EVs were isolated from cell culture supernatant using pre-clearing with differential centrifugation and Size Exclusion Chromatography (SEC) and characterized by Nanoparticle Tracking Analysis (NTA).
Results and CONCLUSION: The melittin is 60% of BV composition. The BV treatment results in case of: 1)FaDu: inhibited growth, inhibited wound healing, visible morphological changes, proapoptotic effect and increased level of EVs in the supernatant. 2)HaCat: no effect on cell viability, no visible morphological changes and no/ slightly anti- apoptotic effect. In summary, those preliminary studies revealed no toxic effect of BV for HaCat and potential anticancer activity in case FaDu in which might take part EVs, however, further investigation with the use of other methodologies is urgently needed.

PP-356 [Apitherapy]
Antiviral Effects of Chestnut Honey Against Influenza A Virus Through Innate Immune Modulation

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The continuous emergence and spread of viral infectious diseases, such as influenza, pose significant public health and economic challenges. Current antiviral treatments and vaccines have limitations due to viral mutations and drug resistance, necessitating the development of alternative therapeutic agents. Natural products have gained increasing attention for their potential antiviral properties. In this study, we investigated the antiviral effects of chestnut (Castanea crenata) honey against influenza A virus infection. Using an in vitro model with Raw 264.7 macrophage cells, chestnut honey treatment activated key innate immune signaling pathways, including TBK/IKK, IRF, and RIG-MAVS, leading to enhanced immune responses. In an in vivo mouse model, oral administration of chestnut honey prior to viral infection increased survival rates by 60% and reduced virus-induced weight loss by 20.9%, while also mitigating lung inflammation. These findings suggest that chestnut honey exhibits strong antiviral activity by modulating innate immunity and inhibiting viral replication. Therefore, chestnut honey has the potential to be developed as a functional natural remedy for the prevention and treatment of influenza and other viral infections.

PP-357 [Apitherapy]
Stability and permeability studies on canine skin of two liquid formulations based on apitoxin

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Bee venom is a product secreted by worker and queen bees,from “Apis mellifera” highly sought after and valued. This product is a solid mainly composed of peptides responsibles for its biological activities. It has demonstrated anti-inflammatory, antinociceptive, immunomodulatory, antimicrobial properties, among others. “In vitro” and “in vivo” studies have shown the ability of melittin, the main component of apitoxin, to inhibit the production of inflammatory mediators such as prostaglandins and cytokines, as well as to modulate the activity of immune cells like macrophages and neutrophils. Despite these benefits, there are no veterinary products on the market containing this active ingredient, making its application as an anti-inflammatory of interest. In this context and considering the significant deficiencies of current anti-inflammatory treatments for chronic diseases, we aimed to develop a liquid formulation for topical use in canines. In this study, we present the results obtained from the stability analysis of apitoxin in aqueous solution and in two developed topical formulations. Additionally, we present the permeability studies conducted on canine skin using Franz diffusion cells. Stability studies in aqueous solution indicate that melittin has limited stability under these conditions, improving when stored under refrigeration. However, in the developed formulation, through the addition of stabilizing and antioxidants agents, stability was extended beyond six months at temperatures between 2–8°C. To determine the permeation capacity in canine skin, the Franz cell model was used, where a skin sample is placed in contact with the formulation being tested, and the amount of melittin capable of permeating this barrier is quantified by HPLC method. In this assay, no melittin passage through the skin was observed for one of the formulations; however, it was absorbed onto the skin used in the test. For the second formulation, evaluation is still in progress. In conclusion, we successfully established the composition and storage conditions of an apitoxin solution for topical use in canines to extend its shelf life. Additionally, we determined that one of the developed solutions allows penetration into canine skin but does not permeate through it.

PP-358 [Apitherapy]

Transcriptomic analysis of the Pseudomonas aeruginosa biofilm exposed to ConA-unbound protein fraction of Melipona beecheii honey

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Melipona beecheii honey has been used since ancient times for its medicinal attributes. It has recently been reported that the ConA-unbound proteins from this honey present antimicrobial activity against various pathogenic strains of clinical interest. In addition, they inhibit the formation of the Pseudomonas aeruginosa biofilm, affecting its cellular integrity, flagellar gene expression and decreasing the formation of the exopolysaccharide matrix. This bacterium is classified by the WHO as high priority on its list of bacterial pathogens, therefore, the study of the mechanisms on the antibiofilm capacity of the honey proteins in P. aeruginosa is of interest. In this work, the effect of the crude protein extract of M. beecheii honey and its ConA-unbound fraction on the biofilm transcriptome of P. aeruginosa ATCC 27853. The crude protein extract of M. beecheii honey was obtained by ultrafiltration and the ConA-unbound (F1) fraction was obtained by affinity chromatography. Transcriptomic analysis was carried out by RNA-seq analysis. The results of the RNA-seq analysis of the P. aeruginosa biofilm showed a total of 6,404 of which genes with p-value ≤ 0.05 and fold change ratio (log2) ≥ |1| were identified as DEG (genes statistically most affected), obtaining 35 differentially expressed genes; 7 overexpressed and 28 underexpressed in the presence of ECP. In the case of the F1 fraction, 231 genes were differentially expressed; 33 overexpressed and 198 underexpressed. Several of the affected genes were related to ribosome biogenesis, affecting the stability of the 50 and 30s subunits. It also affected genes involved in lipopolysaccharide metabolism. On the other hand, the RNA-seq analysis showed an effect on the function of certain genes related to stress and the formation of the biofim of P. aeruginosa ATCC 27853, affecting genes such as phoQ, arnC, oprD, and fliC. Therefore, the ConA-unbound proteins from M. beecheii honey presented an effect on several pathways that are related to the formation of the P. aeruginosa biofilm. This basic research about the proteins from M. beecheii honey, could give added value to this product, increasing its harvest and sustainable marketing. Additionally, promoting the meliponiculture positively can impact biodiversity and the local economy.

PP-359 [Apitherapy]
Inhibitory effect of Melipona beecheii honey on morphological transition of Candida albicans

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Candida albicans is a polymorphic commensal fungus that is part of the microbiota in humans, as well as in other mammals and birds. Under certain conditions where the host's immune system fails, it becomes pathogenic. One of its main virulence factors is its morphological transition from yeast to hyphae. Recently, C. albicans has been classified as a critical priority fungus on the WHO's priority fungal pathogen list due to its high mortality rates, the severity of the disease in immunocompromised patients, and the development of antifungal resistance.

The honey of Melipona beecheii has been reported to have inhibitory effects on the growth of C. albicans yeasts. The objective of this study was to evaluate the effect of M. beecheii honey on the morphological transition of C. albicans, specifically its transition from yeast to hyphae. The minimum inhibitory concentration (MIC) of honey was determined using the macrodilution method. To assess the effect of honey on filamentation, susceptibility assays were performed using culture medium supplemented with honey at concentrations of 8%, 10%, and 12% (w/v), and the percentage of filamentation inhibition was determined. Additionally, the effect of honey on the expression of the SAP6 and HWP1 genes, which are involved in C. albicans virulence and morphological transition, was evaluated using qRT-PCR.

The MIC of M. beecheii honey against C. albicans ranged between 10% and 12% (w/v). A percentage reduction in filamentation of 81% was observed in treatments with M. beecheii honey concentrations of 10% or higher compared to the control. Molecular analysis revealed that honey repressed the expression of the SAP6 gene, which encodes the aspartic protease Sap6 involved in tissue invasion and expressed during hyphal formation, and the HWP1gene, which encodes the adhesion protein Hwp1 of the hyphal cell wall and is induced during the yeast-to-hypha transition. Both genes were repressed by a factor of 4.8-fold.

This study highlights the importance of stingless bee honey in the field of microbiology as a potential alternative for the treatment of diseases caused by microorganisms resistant to currently available antibiotics.

PP-360 [Apitherapy]
Heavy metals in honey and pollen collected in different ecological areas

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Honey and pollen are natural products valued for their nutritional and medicinal properties, but environmental contamination can affect their quality and safety. Urban areas, with higher industrial and vehicular emissions, may contribute to increased heavy metal deposition, potentially leading to unsafe honey products or pollen. Heavy metal accumulation in honey and pollen raises concerns regarding consumer health and apiculture sustainability. This study aims to assess and compare the levels of heavy metals in honey and pollen samples collected from forest, agriculture field and urban areas, providing insights into potential contamination sources and risks.

Honey and pollen samples were collected during flowering season from urban apiaries, representing pollution sources, along with control samples from an agriculture field and forest. Cd, Cr, Cu, Ni, Pb, Mn, Fe, Zn were analyzed in the collected samples. Inductively Coupled Plasma Mass Spectrometry with optical emission spectrometer (ICP-OES) was used to quantify heavy metal concentrations.

All heavy metals tested were detected in the honey and pollen samples, except Cd which was not detected in samples (LOD = 0.01 mg/kg). The concentrations of heavy metal in honey and pollen differed significantly, with higher concentrations of heavy metals detected in pollen than in honey. The largest differences in honey samples were found for Cr, with 47% lower concentration in honey collected in the city center compared to the agriculture field site. Cu and Ni concentrations were also lower in the urban honey samples. Although Pb is usually considered to be a major source of urban pollution due to heavy traffic, its concentration was lower in urban honey samples compared to the agriculture honey samples. The most significant variation in pollen samples was observed for Mn, with its concentration being 51% lower in pollen collected from the city center compared to that from the forest. However, one pollen sample from an urbanized area contained significantly higher amounts of Fe, as well as increased levels of Zn and Pb.

Analysis revealed that pollen always contains higher concentrations of heavy metals than honey.

PP-364 [Apitherapy]
Bee products as nutrition and natural therapy. Case studies

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The diet is the foundation of the illness prevention and preservation of human health. However, bee products have been used by humans since ancient times to promote health.

Introducing bee products such as honey, pollen, bee bread, royal jelly (RJ), drone, and queen larvae into the diet will come with lots of benefits due to their complex composition and source of macronutrients and micronutrients. Bee products also exert therapeutic properties as anti-inflammatory, antimicrobial, immunomodulatory, wound healing, growth stimulator effects, etc.

Bee pollen and bee bread are promoted as functional foods with a wide range of nutritional properties. A high concentration of essential amino acids, unsaturated and saturated fatty acids, sugars, polyphenols, and minerals makes pollen and bee bread very important for the human diet. RJ has unique healing properties and enhances growth and longevity due to the presence of a number of biologically active compounds. Drone and queen larvae play a complementary role in the medical treatment of various health problems.

This presentation will show the effects of Api-nutrition and Apitherapy in some difficult cases where conventional medicine had low results. Using bee products, metabolism was enhanced and speeded the recovery. For example, a 37-year-old woman immobilized for the last 18 years, had a surgical intervention 2 years ago, complicated with a local chronic infection with E. Coli. The postoperative wound never healed, resulting in a crater with a dimension of 3 cm depth and 4.5 cm length. RJ was recommended in a dose of 100mg/kg daily and a mixture of Fallopia japonica honey with green propolis (5%) in a dose of 40 grams daily. Fallopia honey with 5% of green propolis was applied 2 times/day. After 4 weeks, a clean wound, 1 cm deep and 2 cm long, was soon completely healed. Another case refers to child growth and development. A mixture of bee products (honey, drone larvae, bee bread, and propolis) offered 3 months per year, stimulated child development, including a hypopituitarism case.

As a conclusion, bee products are a valuable resource that can be used by humans for their therapeutic properties but also as functional food.

PP-367 [Apitherapy]
Identification of the Chemical Compound of Beehie Air (Apiair) and Its Effects on the Rats with Asthma

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The use of bee products such as honey, propolis, pollen, bee bread, royal jelly, bee venom, and beeswax for health purposes is called apitherapy, which means treatment with bee products. One of the apitherapy methods is Apiair (beehive air) therapy, which involves the inhalation of volatile components naturally released from bee products such as honey, propolis, beeswax, and pollen inside the hive. These components mix with the air inside the hive and are inhaled in a controlled manner through a specially filtered fan mechanism. Apiair therapy is used as a supportive treatment for respiratory diseases such as asthma, bronchitis, emphysema, and COPD. This method is commonly practiced in Germany, Austria, Slovenia, Ukraine, and Hungary. However, there is currently no scientific study validating its effectiveness. With the growing interest in traditional and complementary medicine, Apiair therapy is being applied in an uncontrolled and unregulated manner. Therefore, this study aimed to investigate the biochemical effects of Apiair (beehive air) therapy on rats with asthma model. Additionally, the composition of hive air in all bee colonies used for Apiair application was analyzed using the GC/MS method. In this study, 32 female Wistar Albino rats were used and homogeneously divided into four groups: Control group, Apiair group, Honey group, Apiair + Honey group At the end of the study, when the beehive air groups were compared with the control group, it was observed that MDA and SOD values were lower in the Apiair + Honey group and IgE and CRP values were lower in the Apiair group which was exposed to hive air for 30 minutes. Additionally, the hive air content analysis showed differences in volatile components even among colonies that were placed close to each other. A total of over 42 different volatile compounds were identified, with varying profiles between hives. These findings suggest that Apiair therapy has positive effects on rats. However, the differences in hive air composition between colonies indicate that standardization is necessary to ensure the effectiveness and consistency of this therapy.

PP-369 [Apitherapy]
Philippine Stingless Bees Propolis: Medicinal Properties and Prospects for Animal and Human Health

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The Philippine stingless bee (Tetragonula biroi Friese) propolis contains different bioactive compounds that are responsible for its medicinal properties to address various disease condition. Utilizing different models of wounds like full thickness incisional, sutured, surgical, and burn wounds and bed sores, treatment with our locally developed sterile propolis wound dressing significantly hastened the healing rate of these wounds through significant reduction of inflammation, exudation, faster wound apposition, and prevented the development of pus formation and necrosis. The potent anti-inflamamtory activity is attributed to propolis capacity to down regulate the the pro-inflammatory cytokines TNF , IL1 and IL6. Furthermore, propolis exhibit remarkable anti-pain activity against somatic and cutaneous pain associated with the occurrence of wounds. Histopathologic examination of wound sites showed re-epithelialization and intact dermal matrix with fast growth of hair follicles and sebaceous glands with propolis wound dressing treatment. The hair growth promoting effect of propolis is through stimulation of hair follicles development by activating the Wnt/β-catenin signaling pathway. Cost benefit analysis shows huge savings with treatment of propolis wound dressing. Collectively, these information infer the uniqueness and high potential of the Philippine stingless bee propolis for development of high value biomedical products such as the propolis wound dressing for the management of different types of wounds in animals and humans.

PP-370 [Apitherapy]
Brain Protecting Effect of Philippine Stingles Bee Propolis: Potential for the Management of Ischemic Stroke

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Stroke is the number two cause of mortality in humans globally. The neuroprotective activity of the Philippine stingless bee propolis against the most common type of stroke, ischemic stroke was investigated using Sprague-Dawley (SD) rats. SD rats were divided into two treatment groups (n=10 per group): Vehicle group, treated with distilled water and Philippine stingless propolis (PSP) group. Ischemic stroke was surgically induced in 8-week old SD male rats by occluding the blood vessel supplying the brain. Neurologic deficit scoring (NDS) was done after recovery from anesthesia and daily during the 7-day treatment period. The Philippine stingless bee propolis (PSP) and vehicle distilled water were given via gavage daily after performing NDS for the entire 7-day treatment period. PSP treatment significantly improved the ischemic stroke-induced motor deficits like limb and tail paralysis, and immobility compared with the control distilled water treated rats. Moreover, PSP treatment remarkably reduced the brain swelling, and attenuated brain microscopic abnormalities like hippocampal asymmetry, hippocampal fibrosis and gliosis, cerebro-cortical edema, fibrosis, neuronal degeneration due to ischemic stroke insult. Additionally, time course study using another set of ischemic stroke SD rats showed that PSP treatment significantly minimized ischemic stroke-induced brain infarction compared with the distilled water treated rats. These findings reveal the brain protecting effect of the Philippine stingless bee propolis against ischemic stroke.

BEE BIOLOGY

PP-374 [Bee Biology]
Evaluation of Hygienic Behaviour in Honey Bees ''Apis mellifera intermissa'' Through Pin Testing: Implications for Sustainable Beekeeping and Environmental Resilience

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This study evaluates the hygienic behavior of ""Apis mellifera intermissa""of 8 colonies in Boumerdes, Algeria, from March to September 2024, using the pin test method. Hygienic behavior, crucial for colony health, involves the removal of dead or diseased brood and is a key defense against pathogens like "" Varroa destructor"". The removal rates were measured at 6-hour, 24-hour, and 48-hour intervals across different months. The results revealed seasonal variations, with higher removal rates during the spring and summer months (March-July), reaching up to 98% within 48 hours. A decline in removal rates was noted in late summer, likely due to environmental stress. Statistical analyses (for a single 5% significance) confirmed significant differences in removal rates across months and colonies ($p < 0.05$). Some colonies exhibited consistently strong hygienic behavior, highlighting the potential for selective breeding programs. These findings offer valuable insights for improving colony health and disease resistance, with implications for beekeeping practices in Algeria.

PP-376 [Bee Biology]
Genetic structure of new zealand honey bees: unexpected african lineage markers and their implications for selective breeding

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Mānuka Health New Zealand Limited 1-4

New Zealand's honey bee populations present a unique case study in genetic isolation and controlled breeding. This research investigated the genetic structure of Apis mellifera populations in New Zealand, focusing on unexpected African genetic markers and their implications for breeding programs. The study utilized high-resolution SNP genotyping to characterize genetic admixture patterns and evaluate their potential significance for apicultural practices.

Between 2022 and 2023, honey bee samples were collected from four distinct regions of New Zealand.
1. Comprehensive genetic analysis revealed varying levels of lineage admixture across sampled populations:
- Eastern European (C) lineage was dominant, comprising 78-94% of genetic composition
- Western European (M) lineage was consistently present in all samples, ranging from 4.2% to 22.1%
- African (A) lineage markers were either absent or present at low levels (0.7-6%)
- Middle Eastern (O) lineage was not detected
2. The presence of African genetic markers, despite no historical records of direct African honey bee introductions, suggests complex patterns of genetic inheritance through indirect pathways.
3. The consistent presence of M-lineage markers in all samples indicates the persistent influence of historical A. m. mellifera imports.

Regional variations in genetic composition were observed. This genetic heterogeneity across regions likely reflects the complex interplay between human-mediated breeding choices and the historical development of beekeeping in different parts of New Zealand, rather than representing a single causative factor. While previous understanding of New Zealand honey bee populations was based on managed European lineages, our findings reveal more complex patterns of genetic admixture. This unexpected genetic complexity emphasizes the need for more precise molecular diagnostic approaches in selection programs, as even moderate levels of genetic introgression can affect breeding outcomes and population management strategies. Our research demonstrates the complexity of honey bee genetic structure in isolated populations and highlights the importance of comprehensive genetic monitoring in breeding programs. The findings contribute to our understanding of honey bee evolution in isolated environments and provide valuable insights for apicultural practices worldwide. This research emphasizes the need for continued genetic monitoring and evidence-based breeding strategies in maintaining sustainable honey bee populations NZ.

PP-389 [Bee Biology]
In vivo evaluation of “progen” probiotic against Nosema ceranae

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Nosema ceranae is a microsporidian fungus that infects the epithelial cells of the midgut of honey bees. The honey bee gut microbiota consists of a wide range of bacteria, including numerous Lactic Acid Bacteria. In this research, the effect of the specific honey bee probiotic “Progen” on N. ceranae spores and honey bee survival was tested. Briefly, N. ceranae spores were first extracted and confirmed by DNA extraction and PCR. Then, the frames containing covered pupa from colonies without N. ceranae infection and without previous treatment with antibiotics or Fumagillin were kept overnight in the incubator. The newborn bees were collected the next day and starved for 2 hours. Each bee was inoculated with approximately 50,000 spores. After feeding, groups of 40 bees were placed in wooden cages and kept in an incubator at a temperature of 30 degrees Celsius and a relative humidity of 65%. The negative control bees were fed separately with 5 microliters of sugar syrup without spores and the positive control with 5 microliters of sugar syrup with spores without probiotics. The treatments with three doses of 0.5, 1 and 1.5 grams per liter of probiotic “Progen”, positive control treatment and negative control treatment in most of them were treated in a completely randomized design for 21 days. Daily mortality, number of spores, feed consumption and water consumption were recorded. The results showed that the highest percentage reduction of N. ceranae spores in each bee compared to the positive control is related to the treatment containing 1.5 grams of probiotic with an average of 2.99E±06 spores per bee, with 82.63%. The treatment containing 1.5 grams of probiotics with 15.5% deaths had the lowest amount of mortality during the experiment. There was no significant difference in the consumption of sugar syrup and water between experimental treatments at the 5% level. The treatment containing 1.5 grams of probiotics had a significant difference with the positive control treatment in the factors of spore count, survival and mortality at the level of 5%.

PP-392 [Bee Biology]

A nutritionally complete pollen-replacing diet protects honey bee colonies during stressful commercial pollination - Depletion of isofucosterol and 24-methylene cholesterol from this diet identifies isofucosterol as an essential micronutrient

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A steady supply of nutritionally adequate pollen from diverse flower sources is crucial for honey bee colonies. However, climate instability, large-scale agriculture, and the loss of flower-rich landscapes have made this supply increasingly scarce and unpredictable, threatening both apiculture and sustainable crop pollination.

We developed a nutritionally complete pollen-replacing diet that supports continuous brood production from May to October in honey bee colonies in tented enclosures, fed exclusively on this diet (no access to pollen and nectar). This represents more than six cycles of brood production and more than 2 full replacements of all worker bees in the colony. The diet has a Feed Conversion Ratio that is 30% better than pollen and similar to that of commercial shrimp and chicken livestock feed (1.8 kg diet/kg honey bee produced). Colonies fed a (third party) commercial diet severely declined in brood production after 36 days and died out.

Honey bees cannot synthesize or interconvert sterols and source them from pollen. Six sterols make up 90% of the total sterols in honey bees. To date it is not known whether individual sterols are functionally interchangeable or are essential nutrients. Omitting isofucosterol, the third most abundant sterol in honey bees, from a complete diet containing all six major honey bee sterols in concentrations and ratios similar to pollen, causes significant reductions in brood production and neuromuscular dysfunction in adults and identifies isofucosterol as a critical micronutrient for honeybees. In contrast, omitting 24-methylene cholesterol, the most abundant honey bee sterol, does not significantly affect brood production and, surprisingly, bees with no 24-methylene cholesterol in their tissues are viable.

In a season-long experiment in the commercial pollination of blueberry and sunflower fields (two crops that are nutritionally deficient for honey bees) and intermittent storage in bee-yards, a treatment group fed a nutritionally “Complete Diet” overcame the detrimental effects of the season-long nutritional stress, unlike colonies in “No Diet” and “Commercial Diet” groups. This field study suggests that feeding a complete, pollen-replacing diet to nutritionally stressed colonies can address the root causes of honey bees’ growing nutritional deficiencies, supporting their health and their vital pollination services.

PP-393 [Bee Biology]
Diastase Activity in Honey Stomachs of New Zealand Bees: Unique Findings and Their Significance

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Mānuka honey (Leptospermum scoparium) is a unique product created by honeybees (Apis mellifera) that collect nectar from mānuka flowers native to New Zealand. One distinguishing feature of this honey is its high content of dihydroxyacetone (DHA), a precursor to methylglyoxal (MGO)—a key bioactive component. Mānuka nectar has a more complex and bioactive-rich composition compared to other floral nectars. Diastase activity (α-amylase) plays a crucial role in transforming nectar into honey by breaking down complex carbohydrates and is an essential indicator of honey quality.

This study analyzed enzymatic activity not only in mānuka honey as the final product but also during the primary processing of nectar by bees in their honey stomachs. It provides new insights into the physiological characteristics of New Zealand bees and the unique qualities of mānuka honey.

Conducted in 2023, the study involved 15 mānuka honey samples from three locations in Taranaki, with five samples from each site. From each location, 30 worker bees were sampled, and their honey stomach contents analyzed. Diastase activity was measured using the Phadebas method, with three technical replicates per sample.

RESULTS: In unsealed honey, diastase activity ranged from 6.2 to 30.6 DN. Variability among samples can be attributed to environmental factors such as mānuka vegetation density, seasonal conditions, and resource availability. However, diastase activity in honey stomachs was significantly higher than in unsealed honey—a novel finding. Enzyme concentrations in honey stomachs were 16 times greater than the standard for honey, highlighting bees' exceptional enzymatic capacity during nectar processing.
Key Findings
• Diastase activity in honey stomachs ranged from 140.8 DN to 161.6 DN, indicating bees' adaptation to mānuka nectar, rich in complex sugars and DHA.
• The unique composition of mānuka nectar may have driven evolutionary enhancements in New Zealand bees' enzymatic systems.
• High enzymatic activity suggests a healthy physiological state for bees, even under intensive commercial beekeeping. Proper management and ecosystem preservation are critical for maintaining healthy colonies in New Zealand.

PP-394 [Bee Biology]
Computer modelling for extreme environments – how BEEHAVE model can be used for extraterrestrial applications and establishing directions of future studies

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Bee colony models are a popular and useful tool for their development dynamics prediction, enabling to analyze combination of various factors on bee colony in short time. Due to increasing interest in human settling on other celestial bodies, there is a need to verify the possibility of using natural pollinators, such as bees, for extraterrestrial crops pollination. To achieve this goal, the impact of space travel and conditions on pollinators should be thoroughly investigated.

However, a traditional way of anticipating long-term effects requires perennial observation. From the close perspective of setting up a lunar or Martian base, the time is very limited. This scarcity of time can be filled by computer model usage, such as BEEHAVE, which good capabilities of projection of a real-life colony dynamic was proven by many researchers already

Data on rocket-launch-related hypergravity impact on honey bee queen effects on colony development was used to expand the simulation capabilities of the model and dedicated "space travel" modules were developed. Created expansion enabled to acquire developmental effects observed in the experimental apiary. Model's analysis enabled to determine directions for further research on honey bees in context of their extraterrestrial usage with the most crucial areas being defined.

Identified issues should be addressed in the upcoming field studies to be able to conclusively answer the question of whether beekeepers will someday be needed on Mars. Additionally, the discussed application proved modelling tools versatility, being possible to be used for extreme environments as well and which are limited mainly by available data.

PP-395 [Bee Biology]
Biometric analysis and estimation of the africanization degree of Apis mellifera L. (Hymenoptera: Apidae) from Two colombian island zones

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Morphometric assessments of bees have proven to be valuable in classification processes in animal systematics, facilitating the identification of hybrids and pure races. With the ongoing Africanization process in the Americas, it has become necessary to investigate the expansive effect and the degree of introgression that this process implies. In this study, the nature of wild colonies established on the island zones of Múcura Island in the San Bernardo Archipelago and San Andrés Island was analyzed through biometric and discriminant analysis. Samples of Apis mellifera were collected from the study areas, and anatomical variables such as forewing length (La), hindwing length (Lp), femur (Fm), tibia (Tb), and cubital index (Ic) were evaluated to estimate the introgression of Africanized bees in the study area. The discriminant analysis of the evaluated populations revealed values indicating a dominance of Africanized bees in the San Bernardo population (FDm -2.50), positioning them as descendants of hybridization events, introgression, and the expansion of Africanization from the continental side to overseas territories in the Colombian Caribbean. Meanwhile, the San Andrés bee population exhibited characteristics typical of bees bred and maintained in a special genetic reserve zone, with forewing length values ranging from 9.10 to 9.95 mm, similar to those observed in bees from San Cosme, Argentina. In contrast, bees from Múcura Island displayed ranges of 8.06–8.77 mm, which are characteristic of Africanized bees (Ruttner, 8.66 ± 0.16 mm), with FDm values between 1.5 and 7.0. These bees are part of the Seaflower Business Challenge genetic reserve, recognized for their productivity in continental areas of Central America.

PP-396 [Bee Biology]
Honey Bee Drone Husbandry

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Background
Colony productivity and fitness are influenced by the quality, number and genetic diversity of drones mated to the queen. Drones' critical and exclusive function is reproduction. Breeding programs typically focus on queen and colony performance. Drone fertility and production are often overlooked. The quantity and quality of drones produced are highly variable within and between colonies, affected by many interacting factors. Rearing a plentiful supply of healthy, mature drones from select stocks can be challenging.

Problem
Breeding programs should include management and selection practices to enhance drone fertility and production. Drones appear plentiful during swarm season, although colonies highly regulate their numbers. Drones are costly; their nutritional demands are comparable to queen rearing, and their numbers are more numerous. Their haploid condition and longer development time increase vulnerability to adverse effects of parasites, pathogens, chemical residues and environmental changes. Drones have a high rate of attrition at every life stage. During stressful periods, drone brood is cannibalized and adults expelled. The fragility of drones, known to practitioners of Instrumental insemination, can be a limiting factor.

Methodology/Discussion
Commercial queen production requires massive numbers of drones from numerous colonies to form drone congregating areas. The inflight, polyandrous mating of queens enhances colony fitness. Semen concentration, volume, viability and drone size are affected by genetic and environmental factors. Management practices that improve rearing conditions, nutrition, and decrease exposure to pesticides, parasites and pathogens, should be implemented. Breeding programs should include these targeted criteria.

Drones offer unique opportunities for selection and research. Referred to as “clones,” drones are haploid, all their spermatozoa are identical. Instrumental insemination, a proven tool to control mating, enables novel crosses to identify traits occurring in low frequency or not expressed phenotypically. Increasingly, molecular tools explore gene expression patterns, identify genetic markers, diagnose colony health and traits of resistance to pests and pathogens. The ability to store semen, short-term at room temperature, allows easy transport. Cryopreservation enables long-term storage, although some damage occurs in processing. This is sufficient for stock reconstruction, conservation and selection across time. Best management practices for successful drone husbandry support selective breeding and research programs.

PP-398 [Bee Biology]
Mass Queen Rearing Techniques in Apis mellifera in South India

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The commonly reared Apis cerana is used for commercial beekeeping in South India. Although Apis mellifera, L. was introduced successfully in South India, the poor availability of bee colonies and the menace of bee-eaters created a disruption in A mellifera beekeeping in South India. Beekeepers rear colonies by simple division which may have undesirable characteristics. The brood development and honey yield can be increased by breeding selected maternal and paternal lines. To ensure a large supply of colonies with quality queens, mass queen rearing technique has been suggested for A mellifera. There is very little awareness on A mellifera queen rearing. The factors to be focussed upon in mass queen rearing technique are queen cell cup size, double layered cell bars, age of larvae, bee flora, and climatic conditions. Management with maximum brood strength and migration to different floral sources is practised for honey harvesting and colony multiplication for A. mellifera beekeeping. Apiary locations and suitable floral resources that are manned by human activity like farms of coconut, cashewnut, rubber, til, sunflower which provide multiple ecosystems addresses social dimensions also. Colonies are migrated to the coconut fields in Pollachi, TamilNadu for queen rearing, Palghat and Mannarkat in Kerala for rubber honey, Kadallur in Tamil Nadu for cashew nut honey and sesame honey, and Guntalpetta Karnataka for sunflower honey. After having adopted this technique, we noted that the highest larval acceptance and adult emergence were in Pollachi, Tamil Nadu in the month of October in Coconut fields. The performance of grafted queens when compared with that of naturally reared queens revealed that the grafted queen colony was significantly superior to the naturally reared queen colony.

PP-399 [Bee Biology]
Evaluation of a Simple Antibiotic-Free Cryopreservation Protocol for Drone Semen

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The increasing reliance of modern agriculture on honey bee (Apis mellifera) pollination has driven efforts to preserve and enhance populations. Cryopreservation of drone semen presents a promising solution for preserving genetic diversity and supporting breeding programs without live animal transport risks. This study evaluated a one-step dilution, antibiotic-free, slow-freezing protocol for drone semen under field conditions using both in vitroand in vivo parameters. As antimicrobial resistance rises, minimizing non-therapeutic antibiotic use is essential. Yet, their inclusion in semen extenders remains standard. In vitro assessments are essential to evaluate semen quality, but ultimate validation requires confirming the protocol's ability to produce fertilized eggs. To achieve this, a fertility trial was conducted in collaboration with beekeepers, ensuring both scientific rigor and practical applicability. The experiment was run in three successive replicates, one month apart. Semen collection and virgin queen insemination were left to trained beekeepers. Fresh semen was kept at 16°C in the dark until evaluation and insemination or freezing. Under fluorescent microscopy, two mixes of fluorescent dyes evaluated semen viability. Calcein Violet 450AM, marking live cells in blue, was associated with Draq5, marking all nuclei in red. LIVE/DEAD Sperm Viability kit, marking dead cell nuclei in orange-red (Propidium iodide), and live spermatozoa in green (SYBR14), was associated with Hoechst 33342, marking all nuclei in blue. Both techniques gave similar results, showing a post-thaw viability drop of 37%. A total of 16 virgin queens were inseminated with frozen–thawed semen (Fz) and 13 with fresh semen (F) as a control group. Survival rates until egg-laying onset (F 5/13, Fz 8/16) and female brood production (F 3/5, Fz 5/8) were similar; however, colonies with queens inseminated with fresh semen (3/3) were more likely prepared for wintering (Fz 1/5).
These results suggest frozen–thawed semen supports viable queen insemination, with potential for female brood production even without antibiotics in the diluent. This study highlights the need for further refinement of cryopreservation protocols, particularly regarding semen quality and queen longevity, to improve cryobanking feasibility for Apis mellifera conservation and breeding.

PP-400 [Bee Biology]
Physiological effects of electroshock stimulation on western honey bee

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Bee venom contains various bioactive substances, and numerous studies have confirmed its potential for medical applications. Consequently, the production and purification of bee venom have gradually developed into a commercial model. Electroshock is one of the methods used to stimulate honey bees to produce a larger amount of clean crude bee venom. This study investigates whether electroshock affects bee behavior and internal physiology. Commercial bee venom extractors were used applying electric shocks of 61, 64, 67, and 70 Voltage for 3 seconds with 3 second intervals, continuously for 10 minutes. The average temperature increase at the center of the honeycomb was 1.8°C, 1.6°C, 2.1°C, and 1.8°C, respectively. The temperature increases at the top of the beehive, where the electric shock plate was placed, was 5.8°C, 5.6°C, 5.7°C, and 5.2°C, respectively compared to before the treatment. The top temperature peaked 2.2 to 9.8 minutes after the end of the electric shocks and then gradually returned to a stable temperature within approximately 90 minutes. RT-qPCR (Reverse transcription quantitative PCR) was used to measure the RNA expression levels of abaecin, hymenoptaecin, and heat shock protein 70 genes in worker bees after electroshock treatment. The results showed higher expression levels of abaecin 1.3 to 3.3 times, hymenoptaecin 3.5 to 4.6 times, and heat shock protein 70 1.2 to 4.8 times respectively, from treatments compared to before treatment, indicating increased expression of antibacterial peptides and heat shock protein due to electroshock. Additionally, the lifespan of newly emerged worker bees subjected to electroshock was observed in the laboratory, revealing that the average lifespan of electroshock-treated worker bees (23.5 days) was longer than the control group's (21.8 days). In conclusion, the results suggest that electroshock treatment may positively impact bee lifespan and antibacterial peptide expression.

PP-401 [Bee Biology]
Bumblebee infestation status and interspecific competition between bumblebees and honeybees increase with proximity to honeybee hives

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Bumblebees are key pollinators in temperate regions of the northern hemisphere. Niche overlap and competition between bumblebees and honeybees may represent a significant stressor to bumblebees by reducing nutrient acquisition and facilitating spillover of pathogens and parasites from honeybees. One of these parasites is the bumblebee wax moth (Aphomia sociella), whose larvae can be found in bumblebee and wasp nests, as well as weakened commercial honeybee hives. Using Bombus terrestris colonies as experimental models, we expected that young queen and worker bumblebee immunity (measured by encapsulation response) would become weaker under both competitive (i.e., proximity to honeybee hives) and parasite (A. sociella infestation) pressure and, specifically, that the immunity of bumblebees in closest proximity to honeybee hives would be weakest in nests infested by A. sociella. We observed increased infestation, lower reproductive output, and weaker encapsulation response in bumblebee colonies that were near honeybee hives. Our data provide insights on the ecology of A. sociella infestations where honeybees and bumblebees coexist. Our observations of reduced immune response in bumblebees inhabiting colonies nearer to honeybee hives are of critical importance, as this reduction in immune response could facilitate additional infestations of other parasites and pathogens within bumblebee colonies.

PP-403 [Bee Biology]
Food supplementation with a molybdenum complex improves honeybee health

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While the honeybee Apis mellifera plays a major role in insect-mediated pollination, colony losses have systematically increased in the last decades through a multifactorial process. Honeybees obtain their nutrients from pollen gathered on flower resources and/or from turbid waters. In some cases, the lack of flower diversity can lead to nutritional deficiency, which is considered one of the main causes for colony mortality. One way to improve honeybees' health and resilience to stress is therefore to optimize their nutrition. To overcome nutritional stress, beekeepers can choose from different food supplements, such as sugar syrups and fondants. Micronutrients, and especially metals, are important for animals' health as they play an essential role in numerous physiological processes. However, little is known about the effect of micronutrients supplementation in field conditions and more generally about the metals that are needed for honeybees' health. Molybdenum (Mo) is a trace element of essential importance for life in almost all living organisms, which is naturally present in honeybees, but to date, its role in honeybees remains unknown. During the last decade, we developed a non-toxic molecule based on molybdenum and explored its efficiency as a food supplement for honeybees. This molecule diluted in syrup was recently tested through test campaigns led on 173 hives spread within four apiaries in France and Spain. The effect of supplementation on overwintering mortality, and honey production were evaluated. We observed a decrease of overwinter mortality for the 4 apiaries and an increase of honey production. These results will be presented in the context of the nutritional status (protein, lipids and carbohydrate) of worker honeybees, and the activity of the enzyme alkaline phosphatase.

PP-404 [Bee Biology]
Gene Expression Responses to Thermal Stress in Mediterranean Apis mellifera Subspecies

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Climate change poses a significant threat to the welfare of honey bees (Apis mellifera), both by exacerbating challenges such as nutritional stress (increasing susceptibility to pathogens and shortened flowering periods), and by directly altering honey bee physiology and thereby, affecting their lifespan. One of the most worrying abiotic stressors resulting from climate change is rising temperatures, which induce heat stress and lead to molecular changes such as gene expression and enzyme activity. The PRIMA project MEDIBEES (Monitoring the Mediterranean Honey Bee Subspecies and Their Resilience to Climate Change for Sustainable Agro-Ecosystems) aims to understand the impact of climate change on different Apis mellifera subspecies in the Mediterranean region. As part of the project, the effects of temperature and relative humidity (RH) on survival and adaptability were studied in five honey bee subspecies: A. m. ligustica (Italy), A. m. iberiensis (Spain), A. m. syriaca (Jordan), A. m. ruttneri (Malta), and A. m. anatoliaca (Turkey). Newly emerged workers were used in survival trials under six different conditions: 35°C, 40°C, and 45°C at 75% RH, as well as 35°C at 15%, 30%, and 50% RH. Bees were sampled from each condition after 2 hours and 2 days to compare acute and chronic stress, respectively. In addition, the dehydration capacity of newly emerged workers was also assessed by analysing body water loss (BWL) during 2 hours under nine conditions, which combined temperatures of 35°C, 40°C and 45°C with RH levels of 10%, 25% and 50%. Twenty-one samples were obtained (12 and 9 from survival and BWL, respectively) from each subspecies. Finally, a pool of nine bees from each sample was selected for the total RNA extraction. Whole transcriptome analysis by total RNA sequencing (RNA-Seq) identified specific genes associated with heat stress in the subspecies studied, and the gene expression was further evaluated using quantitative PCR assays. These findings provide a foundation for identifying specific stressors affecting A. mellifera health and welfare in the context of climate change, offering crucial insights for conservation strategies and sustainable beekeeping practices.

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PP-406 [Bee Biology]
Differences between uncapping and removal behaviors in Apis cerana from the perspective of long non-coding RNAs

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Background/PURPOSE: Hygienic behavior is a critical immune response in social insects, essential for protecting colonies from disease. In honeybee colonies, this behavior involves two distinct steps: uncapping and removal of unhealthy or deceased brood. While previous research has explored the development of hygienic behavior, the mechanisms driving the division of labor between uncapping and removal remain poorly understood. Long non-coding RNAs (lncRNAs) have been implicated in regulating honeybee physiology, but their role in these specific tasks has not been investigated. This study aims to elucidate the differences between uncapping and removal behaviors in Apis cerana from the perspective of lncRNAs.

Problem Description: Despite the importance of hygienic behavior in colony health, the molecular mechanisms underlying the division of labor between uncapping and removal tasks are unclear. Understanding these mechanisms could provide insights into how honeybees coordinate complex behaviors to maintain colony hygiene.

METHODOLOGY: We used strong hygienic A. cerana worker bees and assessed uncapping and removal behaviors in three colonies using freeze-killed brood. Antennal RNA sequencing was performed to identify differentially expressed lncRNAs, followed by lncRNA-mRNA association analysis to explore the molecular differences between the two behaviors.

Results and CONCLUSION: We identified 1,323 differentially expressed lncRNAs in the antennae. The lncRNA-mRNA association analysis revealed that target genes of these lncRNAs were primarily associated with response to stimulus, receptor activity, and synapse. Notably, the lncRNA XR_001766094.2, enriched in cellular response to stimulus, was exclusively expressed in uncapping worker bees. This suggests that XR_001766094.2 may play a key role in distinguishing uncapping from removal behaviors by modulating responsiveness to external stimuli. Our findings highlight distinct molecular profiles underlying uncapping and removal behaviors, with uncapping bees potentially exhibiting faster stimulatory responses and heightened olfactory sensitivity. These differences may facilitate the rapid execution of hygienic behavior in colonies. This study provides a hint for understanding lncRNA-mediated gene regulation in hygienic behavior.

Practical Implications for Beekeepers: Understanding the molecular basis of hygienic behavior could aid in breeding programs to enhance colony health and disease resistance. XR_001766094.2 emerges as a promising molecular genetic marker that can potentially assist this targeted breeding endeavor.

PP-407 [Bee Biology]
A rapid cost-effective genotyping method for Africanized Apis mellifera bees with high honey production potential

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Beekeeping has increasingly incorporated technological advancements, particularly in genetic improvement and colony selection for high honey productivity, aiming to enhance profitability. However, most beekeepers still rely on capturing migratory swarms, dividing colonies, and purchasing colonies from other producers, without implementing any structured breeding program. These practices may reduce efficiency and competitiveness, highlighting the need for precise and accessible genetic selection techniques. This study aimed to develop a rapid and cost-effective genotyping kit for high honey-producing colonies using the G-quadruplex PCR technique. A total of 220 colonies of Africanized Apis mellifera honey bees from 10 beekeepers in the Pólo Cuesta region, São Paulo, Brazil, were evaluated. Honey production was individually assessed during the orange blossom (2021), wildflower (2021), and eucalyptus (2022) honey flows. The two highest- and lowest-producing colonies from each beekeeper were selected, forming the High Honey Production (HHP) and Low Honey Production (LHP) groups (20 colonies each). The HHP and LHP groups produced an average of 89±23.9 kg and 25±9.3 kg of honey per colony over the three seasons, respectively. A total of 120 worker bee pupae larvae were collected from each selected colony, and genomic DNA was extracted and genotyped for two pre-selected SNPs (FAPESP Project 2013/01588-1) using allele-specific primers for G-Quadruplex-based genotyping. Samples that turned blue after the G-quadruplex reaction were considered positive for the SNP tests. The genotyping results were analyzed using a chi-square test (χ^2) to assess the correlation between SNPs 1 and 3 and honey production, revealing a significant association ($P<0.05$). Thus, the G-Quadruplex genotyping method effectively validated SNPs 1 and 3 as markers for honey production. This technique offers a precise, cost-effective alternative to TaqMan® probe-based genotyping, providing rapid and easily interpretable results for honeybee breeding programs.
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PP-410 [Bee Biology]
The Role of Nitric Oxide in Honeybee Epithelial Immunity

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Research on honeybee immunity has a long tradition due to the critical role of bees as pollinators in sustaining ecosystems and agriculture. The alarming trend of global colony losses underscores the urgent need to understand factors affecting honeybee health. One key area of investigation in this field is epithelial immunity, which safeguards the honeybee's digestive tract from pathogens and supports overall resilience. This research aims to examine the role of nitric oxide (NO) in epithelial immunity. In fruit flies, NO has been shown to enhance antimicrobial peptide (AMPs) synthesis, contributing to pathogen defence. AMPs combat pathogens by disrupting their membranes. However, the role of NO in honeybee epithelial immunity remains unknown.
To investigate the impact of NO on epithelial immunity, we fed honeybees L-arginine, a precursor of NO, to enhance its production. In addition, they were given bacterial lipopolysaccharides to stimulate AMPs production. To assess the role of NO, an NO synthase inhibitor was administered to block its synthesis. AMPs expression levels were then quantified using qPCR, while AMPs localization and abundance in the honeybee's digestive tract were analyzed through immunohistochemistry.

Our results show a strong link between NO production and immune response. Reduced NO levels due to NO synthase inhibition decreased AMPs production. The main advantage is that we can stimulate AMPs production by increasing NO levels. These findings emphasize the crucial role of NO in honeybee immunity and provide insights into supporting their health. These findings have important practical implications for beekeepers striving to maintain healthy colonies. By understanding the role of NO in honeybee immunity, beekeepers may explore dietary supplements or natural sources of L-arginine to enhance bees' immune defences. Strengthening AMPs production through targeted nutrition could help bees combat infections more effectively, potentially reducing losses caused by bacterial or fungal diseases.
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PP-411 [Bee Biology]
The Palmer Method For Mass Production Of Apis Mellifera L. (Hymenoptera: Apoidea) In Tropical Zone As A Condition For Reducing Introgression By Africanization

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Bee nuclei serve as the foundation for the formation of new colonies. In beekeeping, the Palmer method has enabled the efficient and sustainable production of biological material by managing nuclei and fertilized queens, considering in turn the Page method. This approach facilitates the controlled expansion of colonies within apiaries while ensuring optimal thermoregulation conditions in nuclei (50 long x 24 wide x 20 deep, and 4 frames, in a dual core Palmer nucleus with 7 frames, feeder system and queen excluder), to rapidly accumulate brood and food reserves. These productive units are consistently available, leveraging bees' natural nesting behavior. A genetic improvement plan supports the establishment of Palmer nuclei using Apis mellifera L. lineages C or M, enabling the selective breeding of drones and the controlled fertilization of queens from these lineages. This process ensures genetic diversity, drift, enhancement, and preservation. This research examines the productive management conditions for large-scale biological material at the Guadalajara de Buga beekeeping station (969 o.v.s.l; average temperature: 24°C; annual precipitation: 1,380 mm) in contrast to those at the "Honey Land" station in San Andrés Island (85 o.v.s.l; 27°C and 822 mm annual precipitation). These conditions facilitate the production of biological material, which is distributed to beekeepers in hillside regions of Colombia and from overseas territories to mainland areas of Central America. The queens, drones, and bees associated with the system established in both tropical zones are evaluated in terms of morphometry using discriminant analysis, wing venation, size, and weight and ADNm-PCR. Despite the challenges, the work has been recognized by beekeepers and has contributed to reducing the Africanization process by introgression.

PP-413 [Bee Biology]
Development of a carbohydrate feeding product for honey bees (Apis mellifera) with beneficial effects on their lifespan

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Background and problem description: Recent researches has shown that the longevity of honey bees (Apis mellifera) is more and more affected by specific pathogens but also by xenobiotic components existing in the environment. In order to counteract their negative effects as much as possible, the use of phytonutrients with strong antioxidant role in supplementary feeding is one of the solutions. PURPOSE: To this end, we focused on testing a hydric extract of Siberian ginseng root (Eleutherococcus senticosus) administered on solid carbohydrate support of fondant and candy type (Candy board energetic®) equivalent of 0.1g root powder/100g product. METHODOLOGY: In this regard, a laboratory experiment was set up in Romania, carried out and repeated during the active season (May-July) of 2022 and 2023, for a duration of up to 28 days, on two groups (experimental and control), each consisting of 3 cages populated with 100-300 young non-flying bees collected from the same colony at time of cages population. The cages were checked out daily to record honeybee mortality. Two statistical tests were used to evaluate honeybees' longevity (SPSS: Kaplan-Meier; Cox regression). Results and CONCLUSION: The obtained results show that the honey bees in all experimental variants had significantly higher longevity ($p<0.001$) compared to the control group in which the bees were maintained only on carbohydrate feeding, free of added phytonutrients. Practical implications for beekeepers: Supplementary feeding with Siberian ginseng root extract (Eleutherococcus senticosus) represents a promising option to improving supplemental feeding with substances that have beneficial effects on the lifespan of honeybees, having a positive impact both during the production period and during inactive periods of the year that involve resource conservation.

PP-414 [Bee Biology]
Testing the palatability of some protein supplements administered in honeybee supplementary feeding late in winter

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In the production of nutritional supplements based on pollen substitutes, there are often problems related to attractiveness and consumption, even if their composition responds to the nutritional requirements of honeybees. Attractive substances (e.g. volatile oils) but also the ratio of proteins to carbohydrates can influence consumption. As a result, carbohydrate-protein formulas based on pollen substitution require palatability testing, a property that reflects the degree of their attractiveness and consumption. Since there are various protein ingredients on market, simple (e.g. soybean flour), in mix (products with more ingredients) or ready to use (protein candy or patties), beekeepers can test the palatability of various formulas for personal use. In order to support these evaluations, a rapid comparative test was developed for several formulas (4 home-made formulas based on protein substitutes, 4 ready to use protein products of the patty type, a home-made formula based on monofloral pollen with 23% PB). The carried-out tests took into account the application of some standardization principles for experimental purposes: use of the same carbohydrate base, equivalence of the protein percentage, equality in the administered quantity and equality in contact surface with the honeybee's cluster. The experiment was carried out on 24 colonies divided into groups of 3 colonies/group, standardized as bees' intervals and brood surface, in February (2023) in order to benefit from protein "hunger", a natural physiological state in this year period. For the comparative testing, we applied a comparison method in pairs of two different patties (250 grams/patty) placed similarly above the wintering cluster on each experimental colony. Patty consumption was evaluated after 5 days of administration. Following this test, variable results were obtained with maximum of 158 g consumed product (commercial patty) and a minimum of 9 g (home-made formula, equally with a ready-to-use formula). The pollen-based products recorded an average consumption of 33 grams. By comparing several and different formulas in pairs under the same experimental conditions, with the evaluation of the consumed quantity before complete consumption, it is possible to quickly assess the palatability degree of protein formulas, in protein necessity conditions generated by brood rearing for wintering bee replacement.

PP-415 [Bee Biology]
Testing the effectiveness of a nutritional supplement based on carbohydrate-protein substitutes during the replacement period of wintering honeybees

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Background and problem description: The period of replacement of wintering honey bee generations represents a critical period, when depopulation and mortality can occur. The quality and quantity of food reserves, when the consumption of energetic and protein substances from the honeycombs increases, is very important. To support the nutritional needs of the progressive increase in the number of larvae and to avoid depletion of the adult population, the administration of protein patties at the end of winter becomes a necessity, therefore their quality must be known and scientifically validated for the safety of administrations. PURPOSE: We tested the efficiency of a commercial energy-protein product (Super Protein Pattie®-SPP), with a content of 12.5% crude protein from inactivated yeast (Saccharomyces) and soybean (Glycine max) rich in essential amino acids, embedded in a mass of carbohydrate substances with added vitamins and minerals, probiotics, oils and phytonutrients from 14 medicinal plants. METHODOLOGY: Thus, a comparative experiment was set up, to test the effectiveness of carbohydrate-protein patties as supplementary feed on groups of standardized honeybee colonies consisting of 10 colonies/group. The experimental group was administered protein patties based on pollen substitutes (SPP) and one control group was administered protein patties based on 56% frozen pollen with 12,5% CP, collected in spring, containing pollen from the species: willow (Salix spp.), rapeseed (Brasica spp.), hawthorn (Crategus spp.) and fruit trees (Prunus spp., Pyrus spp., Malus spp.). The measurements targeted the amount of brood at the beginning and end of the testing period (15.02-21.03), using the Netz frame. Results and CONCLUSION: Statistical analysis of the obtained data (SPSS, T-student test for independent samples) shows that no significant differences were found between the two groups (t=-0.968, two tailed p=0.35), although in the control group it was found that the mean brood area was larger than in the experimental group (Mean exp.=22.45; Mean ctrl. =25.58) and significant difference compared to one unfed group (t=5.388, two tailed p=0.000; Mean=11,23). Practical implications: Based on the datas, the administration of tested carbohydrate-protein substitutes patties during certain periods when their administration is allowed contributes to supporting brood rearing and the development of honeybee colonies.

PP-416 [Bee Biology]
Testing the quality of carbohydrate patties during honeybee colonies wintering period by total substitution of natural food reserves

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Colonies wintering and replacement of winter honeybee generations represent critical periods in beekeeping. Nutrition plays an important role as both quantity and quality, therefore in a first stage of this period the nutritional requirements of honeybees are mainly based on honey reserves in combs to ensure the thermal regime inside the cluster. Further on, as bees resume the activity of brood raising, the consumption of carbohydrate-protein food intensifies proportionally with the brood quantity, based on fat body and stored food. However, natural food reserves (honey and bee bread) may be insufficient or inadequate for various reasons such as the lack of honey flora resources, their contamination or the presence of honeydew honey or heather honey, therefore ensuring the winter reserves may require total or partial substitution; as a result, testing the quality of some substitutes during the winter period becomes imperative. In this regard, over an experimental period of three months (2023/2024), we set up a comparative experiment in Romania for the wintering of an experimental honey bee (A. m. carpatica) colonies group fed exclusively on carbohydrate patties (Dulcofruct Bee Nutrition Science™) prepared as sugar fondant with ginseng extract (Eleutherococcus senticosus). As control group, colonies wintered on the basis of natural reserves, honey and bee bread. All colonies were standardised as strength and successively provided as were consumed, with carbohydrate patties placed above the colonies' nest. The quality of wintering was assessed by measuring the quantity of bees when time allowed interventions in the hive (above 12°C) as well as by checking out the moment of brood rearing starting and its area at the end of experiment. Through the carried-out research, we demonstrate that there were no significant differences between the parameters measured during the experimental period in the two groups of honey bee colonies, and the resumption of brood rearing in the experimental colonies based on the bees' body nutritional reserves took place as compared to the control colonies. The obtained results show us that partial or even total replacement of honey storage with quality carbohydrate patties represents a true insurance policy during critical periods of the year.

PP-417 [Bee Biology]
Complete Mitochondrial Genome of Apis cerana (Hymenoptera: Apidae) from Two Geographical Regions: Insights into Structure and Genetic Differentiation

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The honeybee Apis cerana is an important pollinator that is distributed across most regions in China. Mitochondrial DNA (mtDNA) is inherited maternally in bees; therefore, the mtDNA characteristics of a single bee can represent those of the entire colony. Comparing the mitochondrial genomes of A. cerana from different geographic regions via third-generation sequencing technology could provide insights into species differentiation and enable the identification of stable molecular markers to distinguish among geographically distinct populations. Here, we determined the complete mitochondrial genomes of the Apis cerana-Diannan and Apis cerana-Yun-Gui Plateau populations by using PacBio HiFi sequencing technology. The A. cerana-Diannan and A. cerana-Yun-Gui Plateau mitochondrial genome lengths were 16,214 and 16,304 bp, respectively. Both A. cerana mitochondrial genomes contained 13 protein-coding genes (PCGs), 22 transfer RNAs (tRNAs), 2 ribosomal RNAs (rRNAs) and an AT-rich region. The relative synonymous codon usage (RSCU) values for 13 PCGs were greater than 1. The length of the AT-rich region of A. cerana in different regions was different. Phylogenetic analyses revealed that these two geographically distinct A. cerana populations belong to the same phylogenetic branch, but the genetic distance between DN and YG is further than that between YG and A. cerana-Aba and A. cerana-Central China. Overall, A. cerana with different geographic distributions exhibit genetic diversity at the mitochondrial genome level. A large fragment was found to be inserted or deleted in the AT-rich region, shedding light on the genetic differentiation of A. cerana in different ecological environments.

PP-424 [Bee Biology]
Food storage behaviour in stingless bee Melipona quadrifasciata

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Stingless bees store nectar and pollen in food pots, where a fermentation process occurs, altering some characteristics of these products. Some previous descriptions suggest that the food pots of stingless bees follow a linear cycle: the pot is built, filled with nectar or pollen, sealed for several weeks, and then opened for consumption. However, a recent study indicated that multiple opening and closing events occur before consumption. A colony of Melipona quadrifasciata was observed from March 18 to April 20, 2024. Initially, food pots were opened to assess their contents and classified as honey (H), pollen (P), or empty (E). Data collection occurred twice daily (early morning and late afternoon). The opening status of each pot was recorded as Open (O) or Closed (C), along with its contents (H, P, or E).

Initially, 12 pots were identified, and during the experiment, this number increased to 21 (9 of honey and 12 of pollen), although not all coexisted simultaneously. Pollen pots generally had a longer lifespan than honey pots, with a median duration of 29 and 5 days, respectively. Pollen pots exhibit more frequent changes about its condition of opening, proportionally to their lifespan. Additionally, honey pots remained open longer on average (73% of the time) compared to pollen pots (25%). When observing the consecutive time each pot remained in a state, similar results were noted: on average, honey pots were open 64% of the time without closure, while they remained closed constantly 24% of the time. Pollen pots, on the other hand, remained closed for 53% of the time and were open continuously for only 19% of the time. These findings suggest that honey and pollen pots exhibit distinct properties, with pollen pots being more numerous and tending to remain closed for longer durations and altern between close and open conformation more times. Understanding the behavior of nectar and pollen storage by stingless bees is crucial for nutritional studies and development of products for human consumption, such as samburá and honey.

PP-425 [Bee Biology]
Assessing Hybridisation in Apis mellifera ruttneri: Morphometric Insights from Gozo and Malta

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INTRODUCTION: The Maltese Islands host the endemic honey bee Apis mellifera ruttneri, which has evolved distinct traits suited to local environmental conditions. However, extensive importation of foreign honey bee subspecies, particularly A. m. ligustica and A. m. carnica, has raised concerns regarding genetic hybridisation and loss of adaptive alleles.

Aim
This study aimed to assess the morphological integrity of A. m. ruttneri in Gozo and Malta through traditional and geometric morphometric analyses to determine the extent of hybridisation. Sampled colonies from Gozo and Malta were compared to reference honey bee subspecies using traditional and geometric morphometry methods. The findings aim to provide baseline insights into conservation strategies for protecting the genetic purity of this endemic subspecies.

Methodology
Between August and November 2021, 34 A. m. ruttneri colonies were sampled from Gozo and 21 from Malta. Traditional morphometry was conducted by measuring 11 wing angles, four distances, and the cubital index, while geometric morphometry involved 19 landmark-based wing shape analysis. Separate discriminant analysis models were applied to each approach to classify sampled colonies relative to reference subspecies (A. m. ruttneri, A. m. ligustica, A. m. intermissa, A. m. carnica, and A. m. sahariensis).

RESULTS: Discriminant analyses indicated clear hybridisation trends. Traditional morphometry classified 82.35% of Gozitan colonies and 76.19% of Maltese colonies as A. m. ruttneri, with others showing affinity to A. m. ligustica. Geometric morphometry revealed a stronger hybridisation trend, with only 41.18% of Gozitan and 23.81% of Maltese colonies classified as A. m. ruttneri. The wireframe analyses showed subtle but consistent wing venation differences between hybrid and pure colonies.

Discussion & CONCLUSION: The presence of hybrid traits in both Gozitan and Maltese populations highlights ongoing genetic introgression, likely exacerbated by the operation of a commercial queen-rearing enterprise in Gozo since 2015. Hybridisation threatens the adaptive traits of A. m. ruttneri, which are crucial for local apiculture sustainability. Urgent conservation measures, including restricting foreign honey bee imports and establishing nation-wide breeding programs for A. m. ruttneri, are necessary to preserve this unique subspecies. Without intervention, the genetic integrity of A. m. ruttneri faces irreversible decline due to continued hybridisation.

PP-426 [Bee Biology]
Comparison of the structure of the convoluted aorta in the worker, queen and drone of Apis mellifera; gross dissection, histology and microCT

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The convoluted aorta of Apis mellifera is a critical yet understudied organ, with little existing literature exploring its structure or function across castes. This study arose from the challenges encountered during a dissection class, where locating the aorta proved difficult. Using ventral-side-up dissections, the project aimed to refine dissection techniques and investigate potential structural differences in the aorta among workers, queens, and drones. A total of 30 workers, 15 drones, and 8 queens (sourced from other club members) were analysed. Distinct patterns of convolutions were observed among castes. Workers exhibited 8–10 tight convolutions adhered by connective tissue, potentially enhancing heat dissipation during sustained flight and supporting thermoregulation within the hive. Queens had 6–10 loose convolutions, reflecting their largely sedentary role with only occasional flights for mating or swarming. Drones exhibited 2–4 tight convolutions, a structure that may be linked to their larger body size and reduced capacity for heat dissipation during intense, short-duration mating flights.

Specimens were prepared by fixing in isopropyl alcohol for 24 hours, staining with fuchsin, and mounting in xylene under coverslips. While dissection and preparation presented considerable challenges in technique standardisation, the findings highlight structural adaptations of the aorta that align with the physiological demands and behaviours of each caste.
Dissected aortas were sent for histology to be compared with whole body histology to give a direct comparison. This was cross referenced with micro CT carried out at Liverpool University. These histological comparisons and future morphometric analyses could further elucidate how structural features influence circulatory efficiency, thermoregulation, and overall fitness.

These preliminary observations provide a basis for future research into the functional morphology of the convoluted aorta. The study underscores the value of exploring caste-specific adaptations in social insects, offering insights into their evolution and ecology while advancing knowledge of insect circulatory systems.

PP-429 [Bee Biology]

Creation of honey bee germplasm repositories across Europe to enhance the protection of honey bee genetic resources

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Honey bee germplasm repositories may play a crucial role in the conservation and improvement of honey bee populations. By preserving genetic material from diverse bee populations, these repositories can ensure the maintenance of genetic diversity, which is vital for the resilience and adaptability of honey bee populations in the face of environmental stressors. These may include the introduction of exotic pests, extreme weather events, natural disasters, or excessive genetic introgression due to migratory beekeeping. Furthermore, germplasm repositories (cryobanks) help safeguard against the loss of unique or endangered subspecies, contributing to long-term sustainability in apiculture and pollination services. Additionally, cryobanks can provide a valuable resource for researchers and beekeepers to access genetically diverse stock, which can be used to breed bees with desirable traits, such as disease resistance or increased productivity. Within the framework of the BeeGuards project, consortium partners will establish six germplasm repositories across six countries, encompassing six honey bee subspecies: Croatia (A. m. carnica), Greece (A. m. cecropia, A. m. macedonica), Italy (A. m. ligustica, A. m. siciliana), N. Macedonia (A. m. macedonica), Poland (A. m. mellifera, A. m. carnica) and Spain (A. m. iberiensis). The repositories will store a variety of biological materials, including semen, tissues for DNA extraction, and whole bee workers for morphometric and other analyses. Furthermore, the BeeGuards project will advance research on the cryopreservation of honey bee embryos and embryonic cells, potentially opening new avenues for the conservation of a broader range of pollinator species. Cryopreserved samples will support the conservation of endangered subspecies and ecotypes by mitigating inbreeding risks in small, vulnerable populations and facilitating the restoration of biodiversity losses resulting from diverse environmental scenarios. Moreover, these samples will serve as a genetic resource repository, providing customized responses to emerging challenges in apiculture and ecosystem management. Once established, these germplasm collections can be maintained at a low cost and may qualify for national conservation funding dedicated to the preservation of local genetic resources. This work is supported by the EU Horizon Europe (grant 101082073).

PP-430 [Bee Biology]
The registration and monitoring of dwarf honeybee (Apis florea F.) in Iran

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The dwarf honey bee, Apis florea F. is one of the two species of honey bees in Iran which is found in southern, southeastern and western provinces. The purpose of the current project was to implement the legal duty of registration, monitoring and protection of the dwarf honey bee, which was carried out in the framework of the national plan for the registration and monitoring of indigenous populations of the country and jointly by the Animal Science Research Institute and the Breeding Center of Iran. For this purpose, 1050 worker bees were collected from 35 colonies from 7 provinces in 2021-2023. Then, 17 morphological characteristics were measured and 17850 data were obtained. Analysis of variance of morphometric characters showed that characteristic of hind metatarsus width had the lowest diversity. However, length of half loop over the third and fourth dorsal abdominal segments, length of hind leg and tongue had the highest diversity as the most distinctive morphological characteristics throughout the Iranian dwarf honey bee. The number of right wing hooks were more than left wing hooks. So, it is suggested to count just the number of right hooks. There was a significant positive correlation between the width of the third and fourth dorsal abdominal segments, length and width of the front wing and length of hind leg. There was also a significant negative correlation between the length of tongue and length of fore wing and cubital index. Besides, there was a significant positive correlation within specification of the third and fourth dorsal abdominal segments, length and width of the front wings, and length of legs in dwarf bees with latitude, elevation and annual rainfall. Results indicated that bees from highlands are larger and also confirmed that wing of honey bees in elevated and high rainfall areas has less hook numbers. Based on the results from the investigation of the biological characteristics, the average honey production, calmness, aggressiveness, brood rearing, colony area and number of queen cells were 1.35 kg, 1.79, 1.7, 619.25 cm3, 907.31 cm3 and 2.34 numbers, respectively.

PP-432 [Bee Biology]
Comparing several metabarcoding approaches to assess wild bee diversity in contrasted agricultural landscapes using complementary COI and 16S markers

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DNA metabarcoding is widely used to study pollinator populations at large scales, as it enables the rapid identification of specimens without requiring taxonomic expertise. The most common approaches involve partially or completely destroying captured specimens to sequence a specific region of the COI gene, the most frequently used marker, allowing for their identification. However, since the method is destructive, it can be problematic when dealing with rare specimens, especially if they cannot be assigned to the species level due to the marker's low discriminatory power for these taxa, or amplification difficulties. To address this, we designed a study to evaluate DNA metabarcoding from trapping and storage liquids compared to destructive approaches, such as metabarcoding from bee leg tissue and morphological identification. Over three days, we deployed three colored pan traps at seventeen sites with contrasted agricultural landscapes and practices in ZA PYGAR, in the south-west of France. Trapping liquids were stored at -20°C, and captured specimens from each trap were preserved in ethanol at -20°C for five months. Bees were morphologically identified by an entomologist, with two legs being sampled from each specimen: one for individual barcoding and the other for site-level metabarcoding. Additionally, DNA was extracted and sequenced from both the storage and trapping liquids. To gain in taxonomic resolution and limit amplification failure for a given marker, we used a 400bp COI marker and a 250bp 16S marker, as reliable and extensive reference databases are available for both in our study area, and as previous studies suggest they are complementary. The use of liquids has emerged as a promising strategy to accelerate the metabarcoding workflow, render it non-destructive, and facilitate the identification of specimens that may have eluded capture.

PP-433 [Bee Biology]
Thermoregulation in Indian bees, Apis cerana indica F. during Winter and Summer Seasons

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Honeybees (Apis spp.) are heterothermic insects, meaning they have the ability to switch between ectothermy and endothermy depending on environmental temperature fluctuations. This adaptability plays a crucial role in their foraging behavior, hive thermoregulation and overall colony survival. External temperature variations significantly influence honeybee activity, especially in terms of foraging initiation, peak activity periods and cessation of foraging for the day. In the present study, the foraging activity of Indian honeybees was monitored using a combination of advanced in-hive and external sensors over a three-month period during both winter and summer seasons. Observations were made on the daily initiation and termination of foraging activities, along with the peak periods of foraging within the day. A bee counter was employed to record the number of bees exiting and re-entering the hive, providing precise data on foraging intensity under varying climatic conditions. Additionally, environmental parameters such as temperature and relative humidity were continuously recorded both inside and outside the hive. The collected data were analyzed to establish correlations between bee activity and prevailing meteorological conditions. Special emphasis was given to identifying the exact time at which bees initiated thermoregulation during both winter and summer seasons. This aspect is critical in understanding how honeybees adapt their physiological and behavioral mechanisms to ensure colony homeostasis under different climatic conditions. The findings from this study provide insights into the relationship between environmental factors and honeybee foraging behavior, offering valuable information for beekeepers and researchers interested in optimizing hive management and improving pollination efficiency in changing climatic scenarios.

PP-434 [Bee Biology]
Ecological Implications of Apis florea Fabricius Detection in the Philippines: Potential Impacts and Inter-Species Dynamics

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The detection of Apis florea Fabricius in the Philippines was first reported in 2020, with populations identified in four locations across Mindanao, one of the country's three major islands. Its identity was definitively confirmed in 2024 through morphometric analysis. This species typically constructs its nests on the small branches of various shrubs and small trees, including Mangifera indica, Moringa oleifera, Podocarpus spp., Tamarindus indica, Terminalia catappa, and Theobroma cacao. However, the precise origin of the A. florea population in Mindanao remains unclear. Non-native species often spread globally through international trade, and Mindanao's proximity to neighboring Asian countries where A. florea is already established—such as China, Laos, Thailand, Vietnam, Cambodia, Malaysia, Singapore, and Taiwan—suggests a potential regional source.

Given the known ecological risks posed by introduced species, this study investigates the impact of A. florea's introduction on local bee populations, particularly honey bees and stingless bees, using palynological analysis. This approach allows for an in-depth assessment of niche overlap and its subsequent effects on species coexistence, pollination dynamics, and overall environmental stability.

PP-435 [Bee Biology]
Field-realistic stressors alter the bumblebee gut microbiome

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Like many pollinators, some bumblebee species are declining, threatening bee health and colony survival, which in turn has an impact on environmental health and food security. In bumblebees, the specialised gut microbial community, ubiquitous across Bombus species, is thought to contribute to host digestion, metabolism, and pathogen defence, influencing how bees respond to stressors. Stressors such as pesticides and pathogens are thought to alter the bee gut microbial community composed by core and non-core taxa; however, the interactions and potential sensitivity of these important taxa and their functions remain undetermined. Here, the interactions of Bombus terrestris gut microbial community with field-realistic combinations of pesticides, including the neonicotinoid insecticide thiamethoxam, the pyrethroid insecticide cypermethrin, and the fungicide tebuconazole, and the gut pathogen Nosema ceranaeare investigated. The gut microbial community of 40 B. terrestris colonies exposed to different stressor combinations were assessed using the molecular technology known as amplicon sequencing. Non-core taxa of the Bombus gut microbiome, particularly within the Burkholderiaceae family, showed significant differences in relative abundances in bees exposed to the field-realistic combination of pathogen, fungicide and pesticide stressors when compared to controls. In contrast, core gut bacterial taxa showed no significant difference in relative abundance between treatments. These findings highlight the bacterial family Burkholderiaceae as a key target for future functional analyses of microbial responses to pesticide degradation. Understanding the complex interaction between environmental stressors and the bumblebee gut microbiome is an important priority for developing strategies to protect and restore beneficial gut microbial communities supporting resilience of bees and other pollinators to environmental challenges.

PP-436 [Bee Biology]
Where do honeybee queens mate? A critical review

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We have known for 250 years that honeybee queens and drones must leave their nest to mate. Evidence began to surface 100 years ago that drones congregate in the air on their mating flights. With the discovery in the 1960s that drones in some aerial locations within the landscape could be attracted to queens or queen mandibular pheromone, it became possible to search for “drone congregation areas.” It was subsequently assumed by most researchers that DCAs represent mating swarms of drones, with many authors claiming, without direct evidence, that drones and queens orient to DCAs where matings occur. It is frequently implied that DCAs have evolved specifically for the purpose of mating.

There are several issues with this generally accepted explanation that mating occurs exclusively in DCAs. (1) In relatively featureless landscapes, drones are reported to fly randomly through the landscape and DCAs do not exist. (2) When drone flights have been tracked with radar, drones move from one aggregation site to the next along flyways, and fly to more distant DCAs (and not the same DCA repeatedly) as they age. (3) Where drone densities are extremely high (e.g., in commercial queen mating yards), queens have been observed to mate very quickly and close to their hive. (4) Few people have observed matings, some of which occurred outside of a DCA. An alternative, neutral hypothesis is that honeybee mating frequency is dependent on landscape features and drone densities: queens mate wherever they encounter drones.

I have extracted statements concerning the location of mating from nearly 200 scientific articles and books. In my presentation, I will summarize these data and review the evidence for and against DCAs as mating sites. In my opinion, we actually know very little about where queens mate. This uncertainty will be resolved only when queens can be fitted with tiny transmitters and tracked on mating flights within a landscape in which the densities of flying drones and locations of DCAs are known.

PP-438 [Bee Biology]

The use of season specific assessment of mite population growth and SMR level in selection programs for Varroa resistant honeybees

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Varroa resistance in honeybees represents a complex trait and measuring of reliable and cost-effective resistance traits still remain an open issue to many breeding organisations and breeding companies. In this study we used commonly applied phenotyping approaches to characterize resistance traits in Austrian Apis mellifera carnica populations. The basic concept was to use date dependent mite population growth to filter out colonies with low infestation rates and higher SMR (suppressed/non mite reproduction) at the end of season. The study was performed from 2022 to 2024 and included 205 colonies from two genetic origins (a) = long term selected population; b) = unselected population genetic introgression of origin a)). Phoretic mite infestation got measured from early August on (29/30th week) and measurements were periodically repeated every three-weeks using dust shaking method. When colonies reached thresholds defined by AGT (2018), a brood comb was sampled to evaluate brood infestation and SMR. By segmentation of the data applying empirical thresholds for SMR and brood infestation (SMR>30% and brood infestation <10%; (Grindrod and Martin 2021)), 16.1% of colonies could be characterized resistant (mean SMR=56.2%; brood infestation =4.7%) and remained untreated up to week 39 (+/- 24th septembre). Susceptible colonies (67.8%) showed an average SMR level of 23.7% and brood infestation rate of 33.1%. Phoretic mite infestation rates were in correspondence to resistance categories and SMR/ brood infestation level. In resistant colonies phoretic mite infestation reached a level of 3.7% (1.9% in selected and 6.9% in unselected population) and susceptible population had an infestation level of 7.2% (5.6% in selected and 9.2% in unselected population). In general mite population levels were significantly higher in unselected population. We further derived growth curves of phoretic mite population over time to support additional threshold data for decision process in selecting resistant breeding colonies. As a conclusion, the combination of behavioural traits (SMR) with bee- or brood infestation rates within a time window of substantial mite population development, can aid to discriminate resistant colonies from those, not being successful in controlling mite population growth. Consequently, this approach can assist in the selection of successfully operating colonies in resistance breeding programs.

PP-439 [Bee Biology]
The conservation of the European dark honey bee, Apis mellifera mellifera

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The European dark honey bee (also called the Black German Bee, British black bee, Native Irish Honey Bee, Cornish black bee or the Nordic brown bee), Apis mellifera mellifera, is a subspecies of the western honey bee, which reached Europe after the last ice age about 11.000 years ago. Current theories suggest that A. m. mellifera was the most dominating honey bee subspecies in many northern European countries up till about 1800. After this, many beekeepers, started to modernize beekeeping strategies. One of these strategies was to import large amounts of other honey bee subspecies (e.g. A.m. carnica, A.m.ligustica) or hybrids (the Buckfast bee), thereby nearly extinguishing the local dark honey bee. However, with the modern awareness of the necessity to protect native, local bees, the interest in the dark honey bee has increased steadily during the last decades, both among beekeepers as well as academic researchers.

Today, about 15 European countries have local organisations with the goal to promote the dark honey bee both from a practical as well as from a scientific point of view. SICAMM is the International Association of the European Dark Bee, representing all these local organisations. Over the last thirty years SICAMM has played a vital role in organizing conferences which foster communication and collaboration among beekeepers, scientists, policymakers and conservationists. Due to the increasing interest in the dark honey bee across Europe and outside, SICAMM has now become a professional Federation with National Delegates from across Europe, working teams and a Science Board. The primary goals of SICAMM are to conserve, protect and promote the European dark honey bee. SICAMM is also interested in offering support to initiatives whose objectives are the welfare of other localised, wild and free living bees that are under threat. SICAMM intends to play a crucial role in raising awareness of the importance of conservation areas for European dark honey bee populations and in supporting scientific and applied projects aimed at protecting this precious natural resource. A short overview of ongoing research on the genetics, microbiology, bee product science, and pollination ecology will also be presented.

PP-440 [Bee Biology]
Protein existence of sperm proteome of Apis mellifera iberiensis drones

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The identification and characterization of sperm proteins is essential for a better understanding of their physiological function. UniprotKB is one of the most widely used databases for studying of cellular proteome. One way to assess the confidence of the proteins that make up spermatozoa from species that are not widely studied in this database is to examine the evidence type that supports the protein existence. UniprotKB classified five evidence types of protein existence; at protein level, at transcript level, inferred from homology, predicted or uncertain. Thirty-eight ejaculates were obtained from Apis mellifera iberiensis adult drones using manual procedures and were pooled in 4 samples of 8-10 drones. Semen samples were washed four times in PBS discarding the supernatant and storing the wet pellet. Proteome were analyzed in the Proteomics Unit (University of Valencia). The LC-MS/MS was performed in a Tims TOF fleX mass spectrometer and data were acquired using the DIA-PASEF mode. Results were generated with the unique genes and protein groups quantified with FDR≤1%. Protein existence data from the proteome (gene count) of the organism and spermatozoa were obtained from the Uniprot database (UP000005203; 06/02/2025). A total of 1,425 proteins (unique genes) were detected, of which 733 were common to all 4 pooled sperm samples, representing 3.8% of the total proteins in the proteome of the organism (19,504). Less than 1% of the sperm proteins were classified with experimental evidence at protein (0.3%) or transcript level (0.7%), slightly less than the organism proteome (1.7%). This rate is lower than that observed in studies of other livestock species such as pigs or cattle (> 30% proteins classified for these protein existence classes). The majority of sperm proteins of A. melliferadatabase were inferred from homology (55.3%) or predicted (43.8%). The low protein evidence rate at protein or transcript level could make functional analysis difficult. We have validated, at protein level, a significant number of predicted proteins that will contribute to consolidate the honeybee proteome and facilitate its annotation. This work was supported by the Spanish AEI-MICINN (grant PID2023-148475OB-I00), DGA-FSE (grant A07_23R), Generalitat Valenciana CIAICO/2022/174, PROMETEO/2022/062, AGROALNEXT/2022/063 and NextGenerationEU (PRTR-C17.I1).

PP-443 [Bee Biology]
WikiBeedia: The online encyclopedia for beekeepers

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One of the goals within the EU-horizon funded project "BeeGuards" is to create an online beekeeping encyclopedia suited for scientists, beekeepers and anybody interested in bees. In times of artificial intelligence hallucination and fake news, this should enable researchers and extension workers to provide correct, up-to-date information to practitioners. Therefore we created wikiBeedia.eu, which aims to be the world's number one online encyclopedia on bees and beekeeping. It contains articles organized along the following topics: Research, Biology, Diseases, Management, Forage, and Hive Products.It includes information on the honey bee (Apis) but also content on non-Apis bees. Part of the ambitious plans is to make the articles available in all 27 EU languages plus several other languages, including Chinese, to reach many potential readers. This approach makes it also the definitive online dictionary for terms on bees and beekeeping. WikiBeedia is meant to be filled with content by both scientists and beekeepers, as both groups can profit from the knowledge and experience of each other. For the technical implementation we found a system which offered us an uncomplicated approach. We decided to use the wiki-hosting platform "miraheze" which provides a good online support service and has suitable tools to inform how to edit our encyclopedia. With that platform, we now have a relatively easy approach for editing and translating articles. Photos can be uploaded in galleries and videos can be linked. We invite all interested people, being researchers, beekeepers or interested public, to visit wikibeedia.eu and browse through the available information or register as contributors. As the next step, we will recruit and install administrators from around the globe that help with quality control of articles and technical issues of WikiBeedia. If you want to participate or help in recruiting contributors or need any information, contact info@wikibeedia.eu.

PP-444 [Bee Biology]
Statement for the conservation of Dark Honey Bee (Apis mellifera mellifera) and other European Native Honey Bee subspecies in their native range

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Thirty years ago, a rescue organization for the conservation of the dark honey bee (Apis mellifera mellifera) was founded: SICAMM (Societas Internationalis pro Conservatione Apis Melliferae Melliferae). Since then, the interest in the dark honey bee has increased significantly. This poster presents the SICAMM conservation commission's proposed blueprint. It sets out how the foundation's mission could be realised and how all its members, associations and individuals could contribute. We have chosen Apis mellifera mellifera as our symbol because it is native to Western and Northern Europe. However, SICAMM's federation also includes the conservation efforts of associations for other native European bee species. All European honey bee subspecies are common goods, as are their evolutionary history, biological constraints, importance, situation and the solutions for their conservation in their native range. Main topics: i) Evolutionary history of the different honey bee subspecies in Europe; ii) Importance of conserving the native honey bee subspecies in their natural range, iii) Biological constraints for benefiting from natural selection in honey bee conservation, iv) Four scenarios to describe the existing situations of Honey bee conservation, v) Solutions for conservation in order to secure the existing honey bee populations.

PP-447 [Bee Biology]
Occurrence and survival of free living honeybees in the Tribec forests, Slovakia

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In 2017, an observational experiment was initiated in the Tribec Mountains to investigate the occurrence and survival of free-living honeybee colonies in the natural conditions of broadleaf forests. Initially, colonies were placed in traditional log hives, but they struggled to survive beyond a single season. By 2020, the study transitioned into a purely observational approach, focusing on swarms that naturally settled in the area. Despite careful monitoring and preparations, most swarms failed to survive the winter. Genetic analyses conducted on the local bee populations revealed a significant presence of the Italian honey bee (Apis mellifera ligustica), although the original bee race in this area was the Carniolan one, suggesting potential genetic or environmental factors influencing colony survival. Data collected over several years indicated that none of the established colonies were able to maintain stable populations. In 2024, ten of the fifteen designated nesting sites were occupied by swarms, yet none survived until autumn. The ongoing experiment aims to provide deeper insights into the ecological and environmental factors that hinder the long-term survival of honeybee colonies in these natural forest conditions.

PP-448 [Bee Biology]
Identification of Informative DNA Markers for Honeybee Resistance to Varroosis

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Understanding the genetic mechanisms underlying honey bee resistance to Varroa destructor is crucial for identifying DNA markers associated with this trait. This may enable marker-assisted selection to improve the genetic structure of bee populations. Key resistance-related behaviors, such as hygienic behavior and grooming, contribute to mite control in colonies. Hygienic behavior, which involves the removal of dead or infested brood, is controlled by multiple genetic loci (Spötter et al., 2012). Grooming behavior, including self-grooming and mutual grooming among worker bees, remains less studied in terms of inheritance mechanisms (Traynor, Mondet et al., 2020). The aim of this study was to evaluate the informativeness of three ISSR primers for the detection of genetic polymorphisms associated with honey bee resistance traits, in particular grooming behaviour.

The research was conducted at an apiary in Donets village, Kharkiv region, Ukraine, where 57 colonies were assessed morphometrically. The colony composition included A.m. carnica (78%), A.m. macedonica (A.m. sossimai) (20%), and A.m. buckfast (2%). Only A.m. carnica (var. ukrainica carpatica) colonies were selected for further analysis. Based on ethological assessments, two groups of seven hives were formed, representing high and low grooming activity. Worker bees were collected, preserved in ethanol, and stored at -20°C before DNA extraction using the NeoPrep100 DNA Magnen Plant kit. PCR amplification was performed using primers S1, S6, and S8 under previously established conditions (Metlytska, 2012), with amplicon separation in 2% agarose gel. The analysis of ISSR-PCR electrophoregrams revealed a significant level of polymorphism only with the ISSR-S1 primer: (AGC) C. The other primers used were not informative for detecting genetic differences between the studied honeybee groups. The use of ISSR-S1 identified amplicons of 500, 550, and 600 bp in bees from resistant lineages, whereas these fragments were absent in bees with low grooming behavior.

The presence of ISSR-S1 marker loci in colonies exhibiting high grooming activity suggests potential genetic determinants of varroosis resistance. However, due to the anonymous nature of ISSR markers, further sequencing of identified amplicons is required to determine their chromosomal localization and genomic function. Additionally, subspecies variations in bee grooming behaviour and mechanisms of its inheritance require further study.

PP-450 [Bee Biology]
Increasing Honey Bee Populations through Thermodynamic Hive Design

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The goal of beekeepers should align with the goal of their bees: to develop a strong and productive colony.
The beekeeper has three main stewardship responsibilities that impact the honey bee population: food, health and shelter. The beekeeper insures that the colony has 1) Food: including access to quality forage, provides supplemental feeding to insures food storesl; 2) Health: the beekeeper monitors their colonies and applies treatments or methodology as needed to suppress pathogens and parasites; and 3) Shelter: the beekeeper provides a hive for the colony that allows for inspection, manipulation, transportation, an appropriate volume of space to promote growth and control swarms in a hive that protects the colony from climatic and environmental impacts. This presentation demonstrates how the bee population is strongly dependent on the third responsibility of the beekeeper: Shelter in shape, size and design. To answer to the basic question on the suitability of Langstroth hive to the bee biology, an honeybee population dynamic model dependent to thermodynamic variables was built. Modern mechanical and thermal engineering techniques were used to evaluate how hive design affects heat efficiency and how this last influence the bee population dynamics. In the study, Langstroth hive, other type of standard hives, and innovative hive designs ultimately developed with optimal heat efficiency to maximize bee population growth and success are compared. The trajectories of bee populations housed in different hives were modeled for a variety of hive design characteristics such as geometry, material, heat retention and other parameters. The most important variables were identified and a prototype was built to create the most thermal efficient hive design.The prototype were used to experimentally validate the study.

At the intersection of thermodynamics and biology, the shelter design of the hive has an enormous effect on the population. With optimized heat efficiency and geometry the bee population is capable of up to 200% greater growth compared to that in standard hives. As an outcome, the thermodynamic hive design exhibits the potential to achieve double growth and population with efficient resource economics. For beekeepers, this provides a new hive design to better support their bees.

PP-451 [Bee Biology]
Studying ozone pollution effects on honey bee behaviour and cognition

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Cities around the world are growing at an accelerated rate and so is the interest in urban beekeeping and projects that allow the inclusion of native bees in these urban spaces. Nonetheless, living in an urban environment presents many challenges for bees, such as being exposed to higher air polluted levels associated to cities. Air pollutants are known to have a major effect on human health, but little is known about how it might be affecting bees.

This project aims to characterize the impact ozone, a harmful but common air pollutant in cities, has on honey bees (Apis mellifera), to provide insight for urban bee conservation projects. This project is divided on studying the effects of how different concentrations of ozone could affect bees from an individual level to the entire colony, by changing their behaviour, cognition, and gene expression.

First work was to assess cognitive effects with learning and memory tests, by using nurse honey bees and exposing them to low (0 ppb) and high (200 pb) ozone concentrations for an hour. Preliminary results suggest ozone does not influence the learning capabilities and long-term memories of nursing bees. However, contrary to expected, higher ozone levels shown an improvement in the short-term memory. Future work will compare these effects on another cast of the colony, forager honey bees, as well as brain gene expression analysis to support and understand better these results.

PP-452 [Bee Biology]
Gene expression analysis in different working groups of Indian Honey Bees, Apis cerena indica F

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Honeybee colonies exhibit a highly organized division of labour, with distinct groups of bees performing specialized tasks essential for colony survival. Within this system, different groups of bees are assigned specific tasks based on age, physiology, and environmental demands. Thermoregulation is particularly critical, as honeybees must maintain hive temperatures within a narrow range to support the delicate balance of brood care and food storage, especially during seasonal temperature fluctuations. The interplay between these specialized roles, driven by both genetic and environmental factors, allows the colony to adapt to changing conditions across seasons. This study explores gene expression variations in three distinct groups of honey bees nurse bees, foraging bees, and thermoregulating bees across two different seasons, summer and winter. RNA sequencing was employed to investigate the molecular profiles of these groups, with a focus on understanding how seasonal changes impact the gene expression related to behaviour, metabolism, stress response and also specially to identify genes involved to perform thermoregulation across the seasons. By identifying differentially expressed genes during temperature fluctuations, this research seeks to uncover the molecular pathways that enable bees to maintain hive stability. By comparing gene activity between the summer and winter seasons, the study aims to elucidate the seasonal adaptation mechanisms at the molecular level in these bee groups, shedding light on how honeybees adjust to varying environmental conditions. This research contributes to a deeper understanding of the genetic regulation underlying the division of labour and seasonal physiological adaptations within honeybee colonies and the essential role of thermoregulation in maintaining colony homeostasis throughout the year.

PP-453 [Bee Biology]
Genetic diversity in honey bees: a glimpse into long-term evolutionary history and recent human impacts

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For Apis mellifera, as for any species, preserving a sufficiently high genetic diversity is essential for adaptability and, consequently, long-term persistence. This explains (i) why genetic diversity is considered as one of the three fundamental units of biodiversity and (ii) why goal A of the UN CBD 15 (2022 Kunming-Montreal conference) emphasizes the importance of maintaining genetic diversity in both wild and domesticated species to safeguard species' adaptive potential. In practice, tracing genetic diversity over time is complex, but demographic modeling using large genomic datasets can provide insights into both natural processes and human-driven impacts. We have recently conducted a large-scale genomic analysis to trace honey bee evolution and assess diversity across three main lineages (M, C and O). Using whole-genome resequencing from 9 genetic groups, we investigated the history of divergence, gene flow, and recent changes in effective population sizes. Our demographic inferences based on Approximate Bayesian Computations suggest that A. mellifera diversity was partly shaped by past climate events, with spells of isolation during glacial periods, and secondary contacts with gene flow between lineages following postglacial expansions. These processes predate beekeeping, supporting historical gene flow between the M and C lineages. Demographic modeling based on linkage disequilibrium revealed moderate to strong bottlenecks over the past 25 generations. Coupled with whole-genome diversity analyses, our results suggest that modern beekeeping practices (e.g. queen rearing) have substantially reduced the diversity of honey bees. In particular, we highlight genetic bottlenecks in black honey bee (A. m. mellifera) populations from two island conservatories. Our study provides key insights about the determinants of present-day genetic diversity in honeybees. Given the pivotal role of A. mellifera for wild plant and crop pollination, the observed loss of diversity raises concerns about the long-term sustainability of the current trajectory. We stress the need for increased public funding for conservatories to safeguard genetic resources.

PP-454 [Bee Biology]

Mitochondrial genome analysis of Apis mellifera intermissa and sahariensis reveals alignment biases and genetic variability

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Genetic characterisation of Apis mellifera subspecies is crucial for the understanding of biodiversity, population evolution and conservation strategies. Mitochondrial DNA (mtDNA), inherited maternally and highly conserved, is a valuable marker for studying population genetics and phylogeography. While extensive research has been conducted to explore the genetic diversity of Apis mellifera, the genetic makeup of certain African subspecies remains insufficiently described. In Algeria, two subspecies, Apis mellifera intermissa and Apis mellifera sahariensis, exhibit distinct geographical range and morphological characteristics. We aimed to investigate their mitogenome in order to provide key insights into their population structure and their evolutionary history as part of the partnership PHC Tassili 2021-2023 and the INRAE TSARA initiative. In this study, we analyzed the complete mitogenome of 151 haploid drones from A. m. intermissa and A. m. sahariensis, obtained through whole-genome sequencing using Illumina technology, to assess genetic diversity. Comprehensive analyses using a dataset of drone sequences from European and African reference populations revealed no significant genetic admixture in Algerian honey bees. The results highlighted the genetic proximity between the Algerian subspecies and the Iberian Peninsula subspecies, A. m. iberiensis. We also confirmed the absence of genetic differentiation between the two subspecies as no distinct mitochondrial haplotypes were found. Additionally, our analysis identified alignment biases that may affect the accuracy of mitochondrial genome studies. The presence of Nuclear Mitochondrial DNA segments (NUMTs) causes reads misalignment, leading to errors in variant calling. These biases, potentially due to sequence complexity and reference genome selection, could lead to misinterpretations of genetic variation. Overall, this study enhances our understanding of the genetic diversity of A. m. intermissa and A. m. sahariensis, and highlights the need for conservation efforts. These findings emphasize the importance of applying rigorous bioinformatic approaches when analysing mitochondrial sequences, particularly in highly diverse or structurally complex genomes.

PP-455 [Bee Biology]
Selection of Varroa-resistant honeybees in central eastern Argentina. A 15 years´ experience

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INTRODUCTION: Two basic concepts separate current beekeeping from what we knew in the past: Varroa and artificial feeding. Producing honey again in a sustainable way and without contaminants was the motivation behind this experience. In this sense, the objective of this development was to obtain bee populations that could sustain themselves without varroa treatment and, at the same time, be productive in a commercial approach.

MATERIAL-METHODS: The experience began in 2009 with 550 productive hives located in 10 different apiaries in the central-eastern area of Argentina, Department of Islas del Ibicuy in Entre Rios province and district of Magdalena, in Buenos Aires province. The method was the suspension of all forms of mite control (synthetic or organic acaricides, biological or thermal control), and also no artificial or proteins feed were add it.

RESULTS: In the spring of 2011, the second year without treatment, 80% of the colonies were dead, leaving only 116 alive. For repopulation, we decided to use the capture of swarms, which showed a high survival rate when found in natural hive conditions.
During the first 6 years, we installed in two different ways: 1- offer the swarms the possibility of building natural nests in spaces formed by 2 Langstroth supers nailed together without frames or stamped wax, trying to replicate natural conditions. And 2- swarms were installed in standard Langstroth material with the difference that empty frames were interspersed, without stamped wax, so that they could freely make their combs. In the sixth year, it was decided to continue only with Langstroth material, given that the similarity of winter survival was confirmed between hives with natural nests and swarms that were captured and installed in Langstroth material.

DISCUSSION:
After 15 years of experience, we have more than 600 hives, which have never been treated with acaricides, and are maintained exclusively with the honey and pollen collected by them, with winter mortality rates close to 25%. This production method can be certified by the absence of residues.

PP-457 [Bee Biology]
Evaluating Bee Feeding Practices of Turkish Beekeepers: Insights from the COLOSS Nutrition Task Force Survey

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Bee nutrition plays a critical role in honey bee health, influencing both colony strength and productivity. Understanding the feeding habits of beekeepers is essential for developing sustainable beekeeping practices and ensuring the health of honey bee colonies. This study aims to evaluate the feeding strategies of Turkish beekeepers using the Coloss Nutrition Task Force (NUTRI TF) survey. The NUTRI TF is a community of independent experts in bee nutrition, working to establish a multinational network that facilitates collaboration and produces scientifically sound outputs. The task force identifies nutrition as a major driver of bee health and an important beekeeping management practice, involving stakeholders such as beekeepers, researchers, and associations. This study seeks to fill the gap by investigating the motivations and practices surrounding carbohydrate, protein, and other supplementation among Turkish beekeepers. A comprehensive survey was developed, building on a preliminary study conducted the previous year. The survey included questions regarding beekeepers' practices related to carbohydrate and protein supplementation, as well as the use of additional feed sources. Additionally, questions were designed to explore the primary motivations behind these feeding strategies, such as supporting colony strength, enhancing productivity, or mitigating adverse environmental conditions. Data was collected from Turkish beekeepers through an online survey platform and analyzed statistically. The results provide valuable insights into the current feeding practices and decision-making processes of Turkish beekeepers, contributing to a broader understanding of beekeeping nutrition management in diverse agro-ecological contexts.

PP-458 [Bee Biology]
Summer Bee / Winter Bee - Physiological & Temporal Comparisons

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Apis mellifera, the western Honey bee, has evolved to survive as a superorganism in challenging temperate regions, and other seasonal cycles of dearth, without external resources. Winter survival requires a healthy cohort of long-lived (diutinus) worker bees, which can live four to five times longer than summer bees.

The DNA for these two types of bees are the same, although their seasonal gene expression results in different proteins and physiologically traits, which affect longevity. Sociogenomics has made clear that external and internal stimuli affect gene expression, and these factors in turn affect the temporal polytheism, or age plasticity, of worker bee life history.

External factors thought to stimulate the onset of winter bee brood production are food availability, daylight length, and temperature. Internal factors involve intricate social regulatory mechanisms operating within a Honey bee colony, which integrate an array of pheromones, hormones, and protein production which are in a feedback loop with population dynamics, and are social drivers of aging influencing worker maturation, and thus lifespan.

Seasonal adaptations for a colony's winter survival are nuanced and multifaceted. Winter bees develop larger fat bodies, which regulate metabolism, energy storage, immunity and endocrine signaling, releasing higher levels of vitellogenin (Vg), an egg-yoke precursor protein, into their hemolymph. This influences anti-oxidant levels and immune responses and, without brood to feed, extends the bee's physiological state which is similar to a nurse bee during summer. Winter bees also exhibit hypertrophied hypopharyngeal glands, and lower immune response on their exoskeletal cuticle, due to the insular nature of the winter nest.

The focus of a winter colony begins with thermoregulation, requiring protein primarily from within the bees and carbohydrates from stored honey. Once brood-rearing expands vitellogenin levels drop and Juvenile hormone rises, jump starting worker maturation.

It is invaluable for beekeepers to understand the links between nutrition, biology, behavior and physiology in the winter bee colony. A time-line comparison will highlight significant physiological and behavioral differences, and their known drivers. This will provide insights into the value of healthy fat bodies going into dearth, and the physiological transitions which can cause colony fragility in midwinter.

PP-460 [Bee Biology]
Effect of supplementation with multifloral pollen on the strength and honey production of honey bee colonies located in “ Eucalyptus grandis “ monocultures

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In Uruguay, forest development has created an opportunity for beekeeping in “ Eucalyptus grandis “ plantations. Flowering begins in late summer and extends until mid-autumn. Since these plantations consist of large areas of a single crop whose pollen is deficient in some essential amino acids, colonies become weak by the end of the season, compromising their ability to overwinter. This study evaluated the effect of supplementing colonies located in a forested area with multifloral pollen by measuring colony development and honey production. A total of 24 standardized colonies were used and divided into two groups (Control and Supplement). The adult bee population was recorded at the beginning and end of the trial, the area of capped brood was measured throughout the trial using image analysis, and the weight of honey produced per hive was recorded. At the end of the trial, the adult bee population was significantly higher in the Supplement group compared to the Control group (Mann-Whitney test, $p = 0.040$). ANOVA analysis of the capped brood area and honey production showed no significant differences between the groups. The trial began with similar adult bee and brood populations, and no differences in brood area were observed throughout the study. Therefore, the difference in the number of adult bees at the end suggests a higher survival rate in the supplemented colonies. This effect could continue to amplify in the weeks following the removal of hives from the forest, as nutritional stress has been reported to have long-term effects. Although honey production did not show significant differences, the supplemented group was more uniform (18.3 ± 4.9 kg) compared to the control group (22.0 ± 13.8 kg). Thus, we consider that supplementation with multifloral pollen facilitates colony management by promoting more homogeneous colonies in terms of productivity and allowing colonies to maintain a larger adult bee population at the end of “” E. grandis “” flowering, which supports better overwintering.

PP-461 [Bee Biology]
Using nutritional ecology as driver of pollen preferences in the ApisRam honey bee model

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The most recent version of the guidance document on the risk assessment of plant protection products and bees (Apis mellifera, Bombus spp. and solitary bees), published by EFSA in 2024, has shown that measures are being taken to increase pollinators protection to the potential negative effects of PPPs. Nevertheless, there are still several drawbacks on the proposed scheme that increase its uncertainty. Adding pollinators' behaviour on top of the toxicity endpoints can reduce the risk assessment uncertainty. In other words, there is a need to add more Ecology into the (Eco)toxicology assessment, which can be achieved by the implementation of a system-based ERA in which the multiple interactions between the pollinators and the surrounding landscape are considered in a single system. To develop such a system, agent-based models of several pollinator species have been developed. These virtual pollinators interact with the virtual landscape and collect resources. For the collection of pollen, we have developed a methodology to classify pollen preferences according to the nutritional content of pollen. Important nutrients as proteins, lipids, potassium, and sodium are included in the strategy to classify pollen nutritional content. This strategy, based on nutritional ecology, was applied to set pollen preferences for Apis mellifera, Bombus terrestris and Osmia bicornis. In here, we show how in the honey bee model, ApisRam, forager bees change their behaviour on pollen collection, with and without, considering the pollen quality strategy. These preliminary simulations show how the nutritional content of pollen can be used to reduce the uncertainty of risk assessment by performing a better prediction of bee behaviour and its interaction with the landscape.

PP-466 [Bee Biology]
Advancing Genetic Resiliency in Honeybee Populations through Long-Term Breeding and Population Tracking

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Background/PURPOSE:
The increasing decline of honeybee populations, largely due to disease susceptibility and genetic bottlenecks, threatens global pollination services and food security. Traditional breeding programs often focus on accelerating resistance traits in a way that reduces genetic diversity, leading to unintended consequences such as diminished colony adaptability. This study aims to develop a long-term breeding program that enhances Varroa resistance, queen longevity, and genetic resiliency while maintaining intra-population diversity. Our research focuses on utilizing population-level tracking and genetic fingerprinting to establish a robust honeybee breeding methodology.

Problem Description:
One of the greatest challenges in modern beekeeping is the lack of stable, inheritable resistance traits in commercially available honeybees. Many known resistance mechanisms (e.g., VSH, SMR) appear recessive, resulting in weakened expression over generations. Additionally, queen failure rates are at an all-time high, increasing costs for beekeepers and reducing colony sustainability. This study investigates whether maintaining an inbred meta-population under natural selection pressures can stabilize resistance traits without reducing genetic diversity, ensuring that beneficial alleles persist in future generations.

METHODOLOGY:
Since 2016, Diggin' Livin' Apiaries has maintained a closed breeding population exceeding 250 colonies, with no introduction of new matrilineal genetics. We employ: Walk-away splits in isolated mating yards to encourage natural queen selection. Minimal Varroa treatments (1-2 oxalic acid applications annually) to allow for the expression of natural resistance traits. QR code tracking & genetic fingerprinting to evaluate parentage, longevity, and Varroa resistance over multiple generations. Comparative analysis of allele frequencies in Varroa-resistant colonies and surrounding feral populations.

Results & CONCLUSION: Preliminary data suggest that resistance traits can be stabilized over time while maintaining genetic diversity. Early results from Unhealthy Brood Odor (UBO) testing indicate an above-average presence of hygienic behaviors linked to Varroa resistance. Additionally, QR code tracking has provided insights into queen longevity and reproductive success, key factors in colony sustainability.

Practical Implications for Beekeepers:
Demonstrates a sustainable, closed breeding approach that allows natural selection to improve colony vigor.
Provides a scalable model for genetic tracking, allowing beekeepers to monitor lineage performance and enhance selection.
Addresses queen longevity issues, offering insight into breeding for extended reproductive viability.

PP-467 [Bee Biology]
Immunoregulation Mechanism and Key technologies for high-value utilization of Major Royal Jelly Proteins

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China currently is the largest producer of royal jelly. Royal jelly major proteins (MRJPs) are the key active ingredients of royal jelly and have various health functions such as enhancing immunity. Our team had previously analyzed the architecture of the native MRJP1 oligomer, which provided a molecular basis for elucidating its physiological function, and subsequently demonstrated that royal jelly could regulate gut microbiota, and high-pressure processing effectively regulated the aggregation of royal jelly proteins. We have obtained the results as follows: (1) MRJPs could regulate the structure of the flora, taking the phylum level as an example, the abundance of Bacteroidota was increased and the abundance of Proteobacteria decreased with adding MRJPs, and MRJPs also increased the generation of short chain fatty acids (acetic acid and propionic acid), lowered the pH of the fermentation broth to improve the structure of the gut microbiota; (2) The development of the spleen and liver, the quantity of peripheral blood leukocytes, immunoglobulin content, immune factor level, and the proliferation ability of spleen lymphocytes were improved significantly by feeding MRJPs. 16S rRNA high-throughput sequencing technology analysis showed that the immunity of mice was enhanced by regulating the component and richness of the gut microbiota; (3) Royal jelly could decrease intestinal permeability and the expression of IL-6, increase the expression of IL-10 and sIgA, regulate the relative abundance of the intestinal flora to improve symptoms of DSS induced IBD in mice; (4) high-pressure processing treatment regulated the aggregation behavior mainly by affecting the higher-order structure (tertiary and quaternary structures) of MRJPs and the inter-chain hydrogen bonding and hydrophobic interactions. This study will provide a new perspective for the study of structure-activity relationship and biological activity mechanism of MRJPs, and provide a scientific basis for the development and utilization of royal jelly, which has important theoretical and practical significance.

BEE HEALTH

PP-001 [Bee Health]
Effectiveness of oxalic acid in the control of varroa mites in Africanized honeybee colonies in the tropical conditions of Costa Rica

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At present, synthetic acaricides are regularly used for the control of Varroa destructor. However, acaricide resistant mites have appeared in different countries. This problem has led to the development of natural, non-toxic products for the control of varroa mites, such as different organic acids. In the present study, oxalic acid´s effectiveness in controlling varroa mites was evaluated in the tropical conditions of Costa Rica. The experiment was conducted during July and August (rainy season) in an apiary of 16 Africanized honeybee (AHB) colonies in Atenas, province of Alajuela. The colonies were divided into four groups to apply oxalic acid in different ways: 1- trickling METHOD: it was applied weekly to the top of the frames by the means of a syringe, 2- glycerin shop towel method: impregnated shop towel was placed on the top of the frames, 3- impregnated cardboard method: four impregnated cardboard strips were used per colony, and 4- control group: no oxalic acid was applied. The treatments were applied during four weeks in the brood chamber, and observations were made to determine possible adverse effects. Further flumethrin treatments were subsequently applied during five weeks as a shock product to eliminate surviving mites and calculate the effectiveness of oxalic acid treatment. The cumulative mite-fall after oxalic acid and shock product was assumed to be 100%. Fallen mites were collected with a bottom board trap. The effectiveness of the different methods for varroa control corresponded to 74.4% with the glycerin shop towel, 63.0% with trickling and 50.0% with cardboard strips. For the control group, a 34.1% natural fall of mites was registered. According to the results, oxalic acid showed effectiveness in the control of V. destructor in AHB colonies under tropical conditions. The towel method presented the greatest effectiveness, followed by trickling method, so both can be considered as an alternative in the integrated management of varroa mites by beekeepers. The concentrations of oxalic acid used in the study are considered safe for use in AHB´s since no queens were lost, and there was no brood or adult bees mortality in any of the colonies during the experiment.

PP-002 [Bee Health]
Small hive beetle (Aethina tumida) in Africanized honeybee colonies in Costa Rica: strategies for detection and monitoring

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The small hive beetle (SHB), Aethina tumida, is a pest of honeybee (Apis mellifera) colonies. Endemic to sub-Saharan Africa, this pest has been reported in Africanized honeybee (AHB) colonies in North, Central, and South America. Specifically in Central America, it was first found in El Salvador in 2013, in Nicaragua in March 2014, and in Guatemala in August 2020. In Nicaragua, the SHB was confirmed in AHB colonies in San Juan del Sur, Department of Rivas, approximately eight kilometers north of the Costa Rican border, which increased the risk of entry to this country. After the SHB was confirmed in Nicaragua, a sentinel apiary with four AHB colonies was established close to the border in Santa Cecilia, La Cruz, province of Guanacaste, Costa Rica. In addition, epidemiological surveillance was conducted in the main beekeeping areas in the country (2015-2022) to determine the SHB's possible distribution. Beehives were monitored visually by examining all individual honeycombs, hive covers, and bottom boards. Furthermore, training was offered to beekeepers such as workshops and fieldwork, and training materials were distributed such as brochures focused on SHB recognition and identification, and methods for colony inspection. SHB was detected and confirmed in the sentinel apiary in August 2015 in La Cruz, Guanacaste, Costa Rica, where only adult beetles were detected inside AHB colonies. In addition, in September 2018, adult SHBs were found in a honeybee swarm located in the province of Heredia-Central Valley in the middle of the country, about 265 km south from the first detection site. Furthermore, in October 2019, the SHB was confirmed in a commercial apiary in Liberia, province of Guanacaste, approximately 25 km south from the initial point of detection in the country. Nowadays, the SHB has been found in different commercial apiaries in collaboration with trained beekeepers, especially in the provinces of Guanacaste, Alajuela and San José. In conclusion, implementing strategies to detect and monitor the SHB, as it spreads to new countries or beekeeping areas, requires implementing sentinel apiaries, developing of epidemiological surveillance, and providing training activities for beekeepers, as demonstrated in the case in Costa Rica.

PP-011 [Bee Health]
Nutrition of the honey bee parasite Varroa destructor: insights from behavioural and molecular studies

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Varroa destructor is one of the major threats to the Western honey bee Apis mellifera, causing colony weakening in many countries. Relying mostly on olfactive cues, the mite is able to detect suitable host stages to pierce their cuticle and feed on their body fluids. Yet, in artificial environments with few or no odours coming from the bee, V. destructor is still capable of finding a synthetic food source. In our studies, we first explored the behaviour of mites in these artificial control environments. We demonstrated that even deprived from olfactive information, the mite assesses the shape of its substrate to find a proper feeding site. Based on these observations, we developed a feeding device using 3D tube-shaped Parafilm dummies and studied the nutritional requirements of mites. Cell-free honey bee larval hemolymph included into a dummy is sufficient to maintain the mites alive for weeks, which shows that most of their needs are met with nutrients present in the diet. Proteomic and metabolomic analyses ran on these larva-derived diets led to the identification of crucial candidate proteins and metabolites required in the mite physiology. Nevertheless, these nutrients are still not sufficient to trick V. destructorfemales into laying eggs. Altogether, our result shed light on the foraging and nutritional requirements of this major honey bee parasite although further analyses are still needed to explore the link between nutrition and reproduction.

PP-012 [Bee Health]
Considerations when sampling honeybee (Apis mellifera) colonies for volatile organic compounds (VOCs) associated with honeybee diseases, pests and environmental contamination

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Honeybee disease and pests cause significant colony losses globally each year. It has long been established that odour and pheromones in the form of volatile and semi volatile organic compounds play an important role in honeybee colonies. Due to their wide-ranging foraging activity honeybees also collect VOCs from the local environment in the form of nectar, propolis, water and electrostatic particles that attach to their bodies. Samplers collect VOCs indiscriminately, and therefore analysis yields valuable data related to both VOCs associated with honeybee and the local environment. Honeybee diseases and pests also produce VOCs and their early detection could be used for diagnosis and treatment, potentially improving colony survival. Relatively few field-based studies have taken place that use VOC sampling and analysis as a means of early detection of diseases and pests in honeybee colonies or for the detection of local environmental contamination. The VOC profiles of honeybee colonies were sampled using a variety of samplers (PSP, MonoTraps and Tenax TD) positioned at different location within colonies and for different time periods. GCxGC TOFMS was used to determine the most effective position in hive, sampler and duration of sampling to detect VOCs associated with disease, pests or environmental contamination.

The locations of samplers had no statistically significant impact on the quantity or peak area of VOCs detected. The number and peak area of VOCs detected for honeybee VOCs increased with duration of sampling but decreased for environmental VOCs. The peak area of honeybee and environmental VOCs detected varied with the type of sampler used. MonoTraps consistently detected the smallest peak areas. PSPs and Tenax TD were comparable for detecting honeybee VOCs and Tenax TD detecting the largest peak areas for environmental VOCs. These results have demonstrated which type of sampler, duration and location in hives have the lowest burden on colonies and beekeeper to effectively detect specific VOCs. Further research will identify honeybee disease and pest biomarkers to facilitate early detection at sub- clinical or low levels thereby improving treatment outcomes and to also ascertain the level and distribution of environmental contamination, potentially influencing resource distribution for decontamination.

PP-013 [Bee Health]
Biopolymer carriers of natural miticides with application in organic beekeeping

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Honey bees Apis mellifera are vital to pollination and food production, making them a biologically significant species with profound economic, agricultural, and ecological importance. However, in recent years, the number of bee colonies has sharply declined due to habitat destruction, pesticide exposure, and various parasitic diseases. Among these threats, Varroa destructor stands out as the primary parasite responsible for significant global bee colony losses, making its management one of the most challenging aspects of organic beekeeping. Organic beekeeping is required to comply with Regulation (EU) 2018/848 and to use only specific organic miticides, including formic acid and oxalic acid, as well as menthol and thymol, in cases of infestation with Varroa destructor. The use of formic acid presents challenges primarily related to its application within hives. To address these issues and mitigate associated risks, we explored the integration of liquid miticides into a gel matrix. In this study, we successfully developed a self-supporting composite matrix made from biodegradable polymers that is loaded with organic miticides. The polymer concentration is varied from 1% to 20% by weight. The newly developed self-standing gels have their own shape, allowing for experimentation and evaluation of their effectiveness as a function of their geometric characteristics. The functional properties of these innovative carriers were rigorously evaluated, focusing on stability, rheological behaviour, and release profiles. This comprehensive assessment aimed to elucidate how these factors affect the controlled release and overall effectiveness of the miticides. Preliminary field trials were conducted at a bio-apiary in Bulgaria under real environmental conditions to evaluate the carriers' effectiveness, their impact on bee health, and overall performance within a natural setting. Our findings offer valuable insights into the carriers' resilience against diverse weather conditions and their capacity to safeguard bees from pests without compromising their health, thereby promoting sustainability and safety within apiculture practices.

PP-014 [Bee Health]
Combining high-resolution smartphone images with new open-source software based on deep learning techniques will make Varroa diagnosis easier and more efficient

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Varroosis represent a critical threat to apiculture, causing one of the most devastating diseases impacting honey bee (Apis mellifera) populations through compromising their immune systems, reducing their lifespans, transmitting viral diseases and potentially leading to colony collapse. Given the essential role of honey bees in pollination and the global food supply chain, effective management of Varroa mite infestations is paramount. Considering that the eradication of varroosis does not appear to be a realistic goal, control measures to mitigate its negative impact are essential. In any control strategy, moni-toring the level of Varroa infestation is crucial. One of the most accurate and least invasive Varroa monitoring method is analyzing the daily mite fall onto sticky boards placed at the base of the hive. However this procedure, typically performed by visual inspection, demands substantial time and effort and is prone to errors and inconsistencies. The objective of this study was to develop an improved and simplified deep learning-based approach for the automated detection and counting of Varroa mites using images of sticky boards captured with smartphone cameras. A novel, realistic dataset was developed for this purpose, incorporating images with diverse artifacts and blurred regions, thereby increasing the complexity of the task. From this dataset, a new open-source software has been released. The software is completely free, no installation and no internet connection are required, working in low-range computers (no GPU is needed). It is based on a one-stage detector: the Yolo nano neuronal network, achieving a mean average precision (mAP) of 0.956 on the validation set. Being a free tool compatible with widely used commercial smartphones and computers, it can be highly beneficial for both beekeepers seeking to monitor varroa infestation levels in their hives and researchers, as it will facilitate the development of experimental protocols. This work was supported by the Spanish AEI-MICIN (grant PID2023-148475OB-I00), the EU Horizon Europe (grant 101082073), the DGA-FSE (grant A07_23R) and La Rioja Government (grant INICIA2023/02).

PP-015 [Bee Health]
Lactic acid treatment works through a local way of action against Varroa destructor

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Lactic acid is an alternative treatment to hard chemicals against Varroa destructor, the parasitic mite of the Western honey bee Apis mellifera. This soft acaricide is used only for small apiaries due to its laborious administration. However, the mode of action of this honey bee medication remains unknown, especially in a realistic in-hive scenario, i.e. after an indirect exposure of the mite through honey bees. We investigated the nature of lactic acid activity in the hive treatment context. The local and/or systemic way of action of this honey bee treatment against V. destructor was studied through a toxicological approach at the individual level. On one hand, we showed the altered morphology for the arolia of mites, affecting their grip skills, and studied the evolution of the process over time. On the other hand, we found that haemolymph contaminated with lactic acid did not kill the feeding parasitic mite. In addition, the off-target effects of such medication should not be overlooked either as many acaricides are known to impact honey bees. Therefore, honey bees workers were fed on diets contaminated with field-relevant concentrations of lactic acid and did not show an increase of lactate in their organs or haemolymph. These findings support a local mode of action and provide a new comprehension of lactic acid activity against the parasitic mite through honey bee exposure. Studies focusing on the mode of action of alternative treatments are of prime interest and could give rise to new opportunities for control strategies against V. destructor.

PP-016 [Bee Health]
UBeeO: A Novel Tool for Selecting Pest- and Disease-Resistant Honey Bees

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The health of the honey bee (Apis mellifera) is declining, and sustainable solutions are needed to address their primary threat, the parasitic mite Varroa destructor (Varroa). To be sustainable, solutions must meet the needs of both bees and beekeepers, meaning that they must be long-term, low-cost, and capable of generating healthy and productive honey bee colonies. One of the most important Varroa and disease resistance traits in honey bees is hygienic behavior. Hygienic bees detect and remove Varroa-infested and diseased brood from colonies proactively, preventing and mediating the negative effects of mites and the pathogens they vector. The selective breeding of truly Varroa-resistant honey bee stock is a promising long-term, low-cost, and effective solution to the current honey bee health crisis. Large-scale breeding programs have successfully bred hygienic stock using freeze-killed brood (FKB), pin-killed brood (PKB), and Harbo (SMR) assays. Though useful, these assays vary in their utility and sensitivity. For example, while more mite-resistant colonies can be identified through SMR selection than FKB, the SMR method is labor intensive, and most accurate late in the bee season when mite populations are high, and viruses have already spread through non-resistant colonies. In contrast, FKB is faster and more accessible to beekeepers, but is less effective at identifying mite-resistant bees, likely because it relies on removal of dead brood (necrophoresis) rather than removal of living-but-unhealthy brood. UBeeO is a novel pheromone-based tool that measures colony response to unhealthy brood odors, providing new opportunities for rapid and reliable selection of pest and disease-resistant honey bees. Compared to low-scoring colonies, high UBeeO colonies exhibit better winter survival and have significantly lower mite, virus, Vairimorpha, and chalkbrood loads. UBeeO responsive bees also have better long-term memory of diseased brood odors and exhibit different gut microbiome compositions than bees that do not respond to UBeeO. Here we will review the latest findings related to UBeeO technology, and discuss the potential implications of UBeeO-based selection for honey bee health, colony productivity, pollination services, and the spillover of diseases from honey bees to other pollinator species.

PP-018 [Bee Health]
Harmonized Diagnostic Methods for Tropilaelaps Mites: Strengthening Surveillance and Control Against an Emerging Global Threat to Beekeeping

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Tropilaelaps mites are external parasites of honeybees, native to East, South and Southeast Asia. They reproduce and feed within the brood, weakening and ultimately killing colonies, leading to significant production losses. Among the four known Tropilaelaps species, T. mercedesae and T. clareae are capable of infesting Apis mellifera. Given their impact on honeybee populations, Tropilaelaps spp. infestation is listed as a notifiable disease by the World Organisation for Animal Health (WOAH) and is subject to regulation within the European Union (EU). Reliable, standardised diagnostic tools are essential for early detection, particularly in regions where these mites have not yet been reported.

To address this need, the Anses laboratory in Sophia Antipolis (designated as the EU Reference Laboratory for Bee Health and the WOAH Reference Laboratory for Tropilaelaps) has developed and validated a set of analytical methods for the identification of Tropilaelaps mites and their differentiation from other mite species found in honeybee colonies.
These methods include: i) Morphological identification, allowing Tropilaelaps spp. mites to be recognised in less than an hour based on distinctive features, ii) Conventional PCR, providing confirmation of morphological results, ii) High-Resolution Melting (HRM) PCR and sequencing, enabling species-level identification.

The inclusivity and specificity of these diagnostic tools have been verified using specimens from various geographic origins. The protocols have been officially published in the WOAH Terrestrial Manual of Diagnostic Tests and Vaccines and disseminated within the EU network of national reference laboratories for bee health.

The recent spread of Tropilaelaps mites into Central Asia, Western Siberia, and Eastern Europe poses an increasing threat to global beekeeping, exacerbated by climate change and global trade. Establishing a robust, harmonized diagnostic framework ensures reliable identification, supports surveillance programs, and strengthens international efforts to prevent the spread of this parasite. These tools are essential for early detection and response, helping to safeguard honeybee populations and mitigate the potential impact on apiculture.

PP-019 [Bee Health]
Api-vectoring potential of the entomopathogenic fungus Beauveria bassiana by Bombus terrestris for thrips control in strawberry production

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Thrips infestations are increasingly problematic in tunnel production of strawberries, especially early in the season, and the growers have limited control options against these pests. The entomopathogenic fungus Beauveria bassiana shows promise as a microbial control agent, but targeting thrips directly remains challenging. Api-vectoring of microbial control agents is used against grey mold in strawberry production using the 'Flying Doctors' hive design (BioBest, Belgium), while few attempts for insect pest control with this method have been made. This study aimed to investigate the potential of vectoring B. bassiana (BotaniGard WP) to strawberry flowers by bumblebees (Bombus terrestris) to target Western flower thrips (Frankliniella occidentalis), and to evaluate the consequences of B. bassiana exposure for bumblebees, both individually and in groups, as well as potential hive contamination by B. bassiana. Through different sets of laboratory and greenhouse experiments, we assessed the bumblebee and thrips survival when exposed to different B. bassianaconcentrations, the bumblebee vectoring capacity, the efficacy of api-vectored B. bassiana on thrips survival and reproduction, bumblebee activities during exposure, and B. bassiana distribution inside hives. Laboratory results showed susceptibility of both thrips and bumblebees to B. bassiana. Approximately 50% thrips mortality was achieved with relatively low conidia concentrations in strawberry leaf bioassays. Complete mortality of bumblebee workers occurred by exposure to the BotaniGard WP product, while incubation of the exposed worker with 5 nestmates resulted in mortality of approx. of the individuals. In greenhouse experiments, bumblebees carried and deposited 10 colony forming units (CFU) per strawberry flower and vectored the fungus back to the hive, with 10^2-10^3 CFU detected in hive areas and up to 10 CFU in the cells built by the bumblebees. Despite high fungus levels in hives, bumblebee survival was unaffected in the greenhouse setup using the 'Flying Doctors' hive, though foraging activities decreased slightly over time. This project aims to promote the multi-functionality of commercial bumblebee hives and targeted biopesticide application, to establish foundations for more widespread use of api-vectoring of microbial control agents beyond control of plant pathogens and to qualify risk assessment on hives when using microbial control agents.

PP-025 [Bee Health]
An Automated AI-Based Diagnostic Method for Assessing Varroa destructor Infestation in Honeybee Colonies-First results and findings

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Varroosis, classified as a Category C, D, and E disease under EU Regulation 2018/1882, is a primary cause of winter losses in beekeeping. The parasite, Varroa destructor, directly weakens affected colonies as a brood parasite and serves as a vector for various viruses. Traditional diagnostic methods include wash tests, the "powdered sugar method" and counting mites dropping onto a bottom board. This study aims to validate an automated, AI-based method for determining within-colony mite fall. The BeePal Varroa-Detector utilizes "debris diagnosis" at the bottom board combined with AI-driven image recognition. Unlike conventional practices that conduct periodic mite fall assessments for a limited duration, this system analyzes debris continuously. The debris is transported on a conveyor belt into a diagnostic area where it is photographed, stripped, and collected in a drawer. Captured images are evaluated using cloud-based AI, producing scan results displayed through a dedicated software interface. The AI generates personalized infestation forecasts for each colony in combination with additional sensor information to predict future infestation-levels and helps the beekeeper in planning varroa-treatment and verifying treatment success. Various technical challenges associated with automation have been addressed. Validation was achieved by counting mites in high-resolution scans over a complete month. The AI detection accuracy stands at approximately 95%, distinguishing between false positives (FP), where objects are incorrectly identified as mites, and false negatives (FN), where mites are missed by the AI. Results derived from the AI analysis were compared with findings from a wash test conducted on the same colony, with colony strength initially determined using the Liebefeld estimation method. The mite counts identified through AI detection were significantly higher than those anticipated from the wash method, indicating potential underestimation by traditional techniques. Further investigation is warranted to explore these findings in depth; the implications of the results will also be discussed.

PP-026 [Bee Health]
Exploring virome dynamics in Varroa destructor-resistant and susceptible honey bee colonies

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Honey bees are native to Africa, Europe, and the Middle East. They have been introduced to Oceania, Asia, and America in several waves, mainly due to honey production and their importance in pollination. With the spread of honey bees, the mite Varroa destructor and several viruses have also been distributed worldwide. Most beekeepers rely on acaricides to control mite populations. However, the emergence of acaricide-resistant V. destructorpopulations has been reported, limiting their long-term efficacy. One promising strategy to cope with the mite is the identification of Varroa-resistant honey bee populations that survive infestations naturally. In the northeast part of Uruguay, a population of africanized honey bees has demonstrated resistance to V. destructor without acaricides due to a highly hygienic behaviour. In a previous study, we sequenced the virome (viral communities) from nurse samples collected from V. destructor-resistant and susceptible colonies in apiaries nearby in spring and autumn. In this study, we continued studying the viral profiles of these populations and aimed to characterize and compare their viromes and the whole genomes obtained. Our results revealed that virome composition varied significantly with season rather than V. destructor - resistance or susceptibility. The whole-genome phylogenetic analysis of the Acute Bee Paralysis Virus (ABPV), Black Queen Cell Virus (BQCV), Deformed Wing Virus (DWV), Lake Sinai Virus (LSV), and Sacbrood Virus (SBV) did not indicate any clear association between viral variants and V. destructor resistance. Interestingly, phylogenetic reconstruction and bootstrapping analysis of ABPVclustered Uruguayan genomes with sequences from Brazil and Zimbabwe and separately from the rest of ABPV complete genomes available at the NCBI. Most of the BQCV and all DWV genomes clustered with a genome from Argentina. We also observed that there are two variants of LSV circulating in our country. Future research will focus on detecting new viruses in both V. destructor-resistant and susceptible colonies to enhance our understanding of the complex interactions among viruses, Varroa mites, and honey bees to promote sustainable beekeeping.

PP-031 [Bee Health]
Prevalence of honeybee pathogens in South Korea: A five-year nationwide surveillance (2020–2024)

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Since the winter of 2021, the colony collapse disorder (CCD) phenomenon has caused significant damage to honeybee (Apis mellifera) populations in South Korea. The potential causes of CCD include abnormal climate conditions, pesticide use, declining floral resources, and the increasing prevalence of honeybee pathogens. To investigate the role of pathogens in honeybee health, we conducted a nationwide surveillance study over five years (2020–2024). A total of 1,825 honeybee colonies from 4,953 apiaries were extensively sampled across South Korea, and the prevalence of 12 major honeybee pathogens was analyzed using quantitative real-time PCR (qPCR) and reverse-transcription qPCR (RT-qPCR). The results indicate that viral pathogens exhibited the highest prevalence among all honeybee diseases. Black queen cell virus (BQCV) had the highest overall infection rate (68.1%) over the five-year period, and particularly in 2023, it showed an exceptionally high prevalence of 83.3%. Additionally, deformed wing virus (DWV, 24.7%) and Israeli acute paralysis virus (IAPV, 21.1%) were frequently detected, with peak infection rates occurring in the winter season. Among fungal pathogens, Vairimorpha (Nosema) ceranae had the highest prevalence (28.7%) and was most frequently detected in spring and summer. These findings highlight the increasing burden of viral infections on South Korean honeybee colonies, particularly the widespread and persistent occurrence of BQCV. The seasonal variations in DWV, IAPV, and V.ceranae suggest the need for targeted, season-specific disease management strategies. This study provides epidemiological data on honeybee pathogens in South Korea, which is expected to contribute to the establishment of long-term surveillance and disease control strategies for honeybee health management.

PP-035 [Bee Health]
Varroa monitoring and biomechanical treatment

Frederik Husted Andersen
Frederik Husted Andersen

Treatment of honey bee colonies against varroa mites faces several problems. Pesticides affects the wax and may, over time, cause resistance in the mites. Organic acids have traditionally been used in Denmark as plan-based rather than need-based and are not without harm to the honeybees. Both of these treatments must consider the honey harvest periods, meaning they cannot be used from approx. March to August in which period the varroa population is rapidly increasing. My project investigates the possibilities of avoiding chemical treatments - if not completely then at least only when need be. Identifying when there is a need for treatment is not trivial. Aspects include the local environment, beekeeping practices and the bee families. Monitoring is essential for assessing the varroa population and I have compared two different methods for estimating the varroa population: Alcohol wash of approx. 300 bees provides the varroa index, i.e., number of varroa mites per 100 bees. This reflects the size of the varroa population relative to the bee population. Sampling the natural varroa mite fall on sticky boards over a 7-day period. This provides the daily varroa mite fall, which is proportional to the size of the varroa population. I have sampled my bee colonies each month, year-round, for almost three years. The two monitoring methods, although not reflecting the same aspects of the varroa population, seem equally effective at estimating the infestation level. I have experimented with biomechanical techniques, including queen caging and brood removal, to see if these techniques keep the varroa population below thresholds, and this seems the case.
The winter period in Denmark seem not to induce a significant drop in the varroa population. The fastest increase in varroa population seem to take place in August to September. Hence, sampling the varroa level over this period may prove helpful in detecting bee families better at maintaining a low varroa level than others. The effort required for monitoring varroa level and adapting biomechanical methods are rather high. While this may be manageable for hobbyist beekeepers as myself, it may be prohibitive for large professional beekeepers.

PP-036 [Bee Health]
Field-deployable molecular diagnosis of sacbrood virus using a rapid point-of-care assay

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Sacbrood virus (SBV) is a significant pathogen affecting honeybee colonies, leading to larval mortality and economic losses in apiculture. While laboratory-based molecular diagnostic techniques provide accurate detection, their application in field settings is hindered by logistical challenges, including sample transportation delays and long processing times. These limitations highlight the need for a rapid, field-deployable diagnostic tool that enables on-site virus detection and immediate intervention. To address this, we developed the Q-POC SBV Kit, a portable molecular assay designed for point-of-care (POC) SBV detection. Unlike conventional RT-qPCR methods requiring centralized laboratory testing, the Q-POC SBV Kit delivers results within hours rather than days, eliminating the time lag caused by sample transportation. The system integrates sample processing, amplification, and real-time detection into a single compact platform, making it highly accessible for use directly in apiaries. Performance evaluations confirmed the high diagnostic accuracy, sensitivity, and specificity of the Q-POC SBV Kit, comparable to laboratory-based RT-qPCR. Its ability to detect low viral loads makes it particularly effective for early disease identification, supporting proactive management strategies to mitigate SBV spread. The system's efficiency, portability, and ease of use allow beekeepers and field researchers to conduct rapid diagnostics without requiring specialized technical expertise. By reducing reliance on centralized laboratory testing and enabling real-time on-site diagnosis, the Q-POC SBV Kit represents a major advancement in honeybee health monitoring. Its rapid detection capabilities empower beekeepers to implement timely control measures, ultimately improving colony health and enhancing the sustainability of apicultural practices.

PP-040 [Bee Health]
Efficacy of queen isolation and organic acid treatment as control strategy against Varroa destructor

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The global beekeeping industry has sustained continuous damage due to Varroa mites. In Korea, large-scale disappearance and mortality of overwintered honeybee colonies were reported between 2022 and 2024, with Varroa mites identified as one of the primary causes. Although various methods have been employed to control this pest, a lack of appropriate control manuals in the face of climate change and the emergence of Varroa mites resistant to conventional treatments have made effective control difficult. In light of the limitations of single-method approaches, integrated pest management (IPM) strategies that combine multiple methods are gaining attention. In this study, we evaluated the efficacy and adverse effects of queen isolation and formic acid application, together as a means of Varroa mite (Varroa destructo) control. The results showed that queen isolation effectively exposed Varroa mites on worker bees, and 98.7% of those mites were eliminated by formic acid treatment. However, this combined treatment reduced the worker bee population by an average of 60%—significantly higher than in other treatment groups—and also negatively affected queen survival. These findings highlight the need for further research aimed at securing colony stability while pursuing safer and more effective strategies for Varroa mite control, both in single-method and integrated approaches.

PP-041 [Bee Health]
Biotic and abiotic stresses on honeybee health

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Background/PURPOSE: Honeybees are vital pollinators, playing a crucial role in sustaining ecosystems and agricultural productivity. However, they face a multitude of biotic and abiotic stressors that threaten their health and survival. These stressors include parasitic mites, pathogens, invasive species, agrochemicals, habitat destruction, and climate change. Understanding the interactions between these stressors is essential for developing strategies to mitigate their impact on honeybee colonies.

Problem Description: The decline in honeybee populations is a global concern, driven by a combination of biotic threats such as Varroa destructor mites and vectored viruses, and abiotic factors like pesticide exposure and environmental changes. These stressors often interact synergistically, exacerbating their negative effects on colony health. Despite extensive research, the complex interplay between these factors remains poorly understood, hindering effective conservation and management efforts.

METHODOLOGY: This review synthesizes existing literature on the biotic and abiotic stressors affecting honeybee health. It examines the impacts of ectoparasitic mites, pathogenic microorganisms, invasive species, agrochemicals, and environmental changes on honeybee colonies. The review also explores the interactions between these stressors and their cumulative effects on colony survival and productivity.

Results and CONCLUSION: The review highlights that V. destructor and vectored viruses are among the most significant biotic threats, while agrochemicals and habitat loss are major abiotic stressors. Climate change further exacerbates these challenges by altering floral resources and increasing the prevalence of pathogens. The interaction between multiple stressors often leads to greater colony losses than any single stressor alone: pesticide exposure can weaken bees' immune systems, making them more susceptible to parasitic mites and viruses.

Practical Implications for Beekeepers: Beekeepers can adopt several strategies to mitigate these stressors, such as breeding mite-resistant bee strains, reducing pesticide use, and providing diverse foraging habitats. Regular monitoring and early intervention are crucial for managing colony health. Additionally, policymakers should consider the broader environmental impacts of agricultural practices and climate change to support sustainable beekeeping and pollinator conservation. By addressing both biotic and abiotic stressors, beekeepers can enhance colony resilience and ensure the continued provision of pollination services.

PP-045 [Bee Health]
Status of the Yellow Legged Hornet, Vespa velutina, in North America

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The first sighting of live yellow legged hornets, Vespa velutina (Lepeletier), in North America occurred in July of 2023 near Savannah, Georgia, a busy port city on the southeastern coast of the United States when a beekeeper reported unusual predatory hawking behavior around beehives. This announcement raised very serious concerns across the apiculture industry because numerous large honey bee production operations use the region's mild climate and productive landscapes for overwintering colonies, early season queen production, and building colonies for pollination of early spring crops such as almonds. These concerns are justifiable because yellow legged hornets have a record of invasiveness following their introduction and establishment in France in 2004 and subsequent expansion across western Europe where negative impacts to honey bee health were reported. This hornet species also has invaded South Korea (2003) and Japan (2013). US state and federal agencies responded rapidly to confirm the identification and deploy an intensive trapping and nest removal program, but new hornets nests were found in 2024, indicating that the founder population was able to establish, overwinter, and expand its range to include the neighboring state of South Carolina. This presentation will detail the history of the invasion and regulatory response, report the current status of the hornet population, describe the hornets observed biology, and examine the local landscape and natural challenges for controlling this honey bee pest. The presentation also will discuss potential impacts for beekeeping in the region and implications for the entire US apiculture industry and will detail the foci of current and planned research and the expanding control program.

PP-046 [Bee Health]
Effects of Diet and Probiotics on the Health of Honey Bees

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Honey bees, Apis mellifera, depend on pollen as their primary source of proteins, lipids, and micronutrients. Pollen consumption is critical for their physiological functions and influences multiple health parameters, including metabolic processes, immunocompetence, pathogen resistance, and detoxification capacity against pesticides. To offset pollen dearths, beekeepers often feed pollen substitutes to their colonies; however, the nutritional efficacy of these substitutes remains uncertain. In addition to these protein supplements, other nutritional supplements like probiotics have been introduced to the market to enhance colony health. Probiotics contain live microorganisms that are directly fed to bees to boost their gut microbiome. In this study, we conducted a comparative analysis of diets comprising natural pollen and pollen substitutes, both independently and in conjunction with a probiotic supplement. Controlled feeding trials were performed to assess the impacts of these dietary regimens, utilizing 16S rRNA amplicon sequencing for bacterial profiling and quantitative polymerase chain reaction (qPCR) to evaluate differential expression of honey bee immune, developmental, and metabolic genes. Our results indicate that diet has a significant effect on bacteria diversity and abundance in the midgut, and probiotic supplementation may offer benefits when combined with a pollen diet.

PP-047 [Bee Health]
Survey Research: Utilization of No-Mite-Low-Mite-Queen Best Practices (NMLMQ)

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BACKGROUND: The purpose of this study is to determine the percentage of Maryland beekeepers utilizing no-mite-low-mite-queen best practices (NMLMQ), and the beekeepers' rationale for or not participating in NMLMQ to reduce varroa mite loads. Problem Description: The Annual U.S. Beekeeping Survey, released December 5, 2024, indicates the highest colony losses since the 2010-11 beekeeping season, when colony loss rates were first determined. U.S. beekeepers lost an estimated 55.1% of their managed bee colonies in 2023-24 – 14.8% higher than the 13-year average annual loss rate of 40.3%. Two ongoing projects (Scientific Beekeeping, R. Oliver 2017-ongoing, Selective Breeding for Mite Resistance; University of Minnesota, M. Spivak, 2022-ongoing) have demonstrated that selective breeding of honey bee queens in colonies with no to low varroa mite growth over time enables the rearing of new colonies that maintain low mite counts over time. Why do some beekeepers choose not to pursue the NMLMQ to achieve higher percentages of mite resistant colonies in their operations, decrease annual colony losses and reduce treatment costs? METHODOLOGY: Two hundred members of the Maryland State Beekeepers Association will be e-mailed a link to a survey entitled "Utilization of Mite Resistant Bees" on June 7 to complete by July 7, 2025; based on their response to the first question, the survey divides the respondent pool into two arms – those that practice NMLMQ and those that do not. The survey will attempt to ascertain the beekeeper's rationale for or not participating in NMLMQ. Those who do not complete the survey by July 7 will be sent follow-up emails one month after the initial email. 30% response will be targeted. Results and CONCLUSION: The survey results will be presented at Apimondia 2025. Practical implications for beekeepers: After practicing NMLMQ, a beekeeper can potentially achieve no to low mite counts in their apiaries; NMLMQ also results in a greater percentage of colonies that overwinter successfully, resulting in decreased colony losses. A beekeeper could theoretically reduce miticide treatments and do so without harming neighboring colonies. An educational program may be developed to address the reasons why beekeepers are not engaging in such practices.

PP-048 [Bee Health]
Use of a plant extract (ApiSave), as a natural and novel alternative to synthetic chemicals, to control honeybee diseases in North America

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In north America, honeybees are affected by several diseases including European Foulbrood (EFB) and viruses. To address these problems, beekeepers often opt for antibiotics and chemical treatments which in time contribute to the development of resistance to the treatment compounds by the affecting organisms and the presence of chemical residues in bee products. This situation has lead beekeepers and the beekeeping industry to try alternative solutions with natural products. In our research projects, we tried a natural and novel plant extract (ApiSave), under different formats, to control bacterial and viral diseases affecting honeybee colonies. In one experiment, we reared honeybee larvae in the lab with 1% (v/v) and 5% (v/v) ApiSave and Melissococcus plutonius cells in royal jelly diets for 6 days. The resulting survival rate was greater or equal to 75% up to 4 days before declining, suggesting a potential for ApiSave to control EFB. The investigation of the virus load in the reared larvae showed the presence of all tested viruses (ABPV, BQCV, DWVA, DWVB, IAPV, KBV, LSV, and SBV) in all treatments but DWVB was the lowest in 5% (v/v) ApiSave treatment, Treatment 1, and Treatment 2, suggesting a possible inhibitory activity of the treatments against the virus. When the plant extract was used as treatment against M. plutonius in EFB infected colonies, the treatment with 15% (w/w) ApiSave suggested that the plant extract was able to control the disease in 3 colonies out of seven after loosing 3 colonies due the advanced state of the disease before treatment. This study demonstrated that at the right concentrations, the novel plant extract has the potential of controlling EFB and DWVB virus in affected honeybee colonies.

PP-049 [Bee Health]
Light therapy applied to bees, a game changer approach to protect bees from climate, toxicity and transport stressors

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Bee populations are threatened by increasing myriad sources of stressors, from parasites to climate change and insecticide use. Combined with intensive beekeeping practices and long transportation for pollination, these culminate in physiological stress undermining the mitochondrial function of the cell. Over time, mitochondrial dysfunction leads to reduced metabolism and immunity, impaired cell respiration and cell death. Glen Jeffery, Professor of Neuroscience at UCL (University College, London), has been studying the effect of various wavelength radiation on cells for the past 40 years. With focus on ageing and age related retinal disease in human and how the impact of these can be avoided using a range of cellular, molecular and optical techniques. In 2019, the Company Beefutures joined forces with Glen´s team to investigate several aspects of bee health issues, suspecting that many environmental and agricultural stressors could be the overlooked causes of colony declines and overwintering failures. The 3 years of field research conducted in 3 apiaries in France and Norway have revealed shocking discoveries, pointing at a viable pathway to help bees coping with major climatic and toxicity stessors. It demonstrated the portability of the therapeutic effect to a complex superorganism such as bee colonies, linking metabolic metrics of individual bees with overall colony thermoregulation performance. With non intrusive, autonomous and low powered light device in hive, bees treated with light shown much higher resilience to stressors, higher metabolic rate and thermoregulation performance than controlled beehives. In this talk, Glen will give a short introduction to the main principle of photobiomodulation and his discoveries on mitochondrial function improvements. Glen will also present the highlights of the findings on applying light therapy in honeybee hives in the context of neonicotinoid exposure, transportation of bees and climate change stressors.

PP-052 [Bee Health]
Greater wax moth control in apiaries can be improved by combining Bacillus thuringiensis and entrapments

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The greater wax moth (GWM), Galleria mellonella (Lepidoptera: Pyralidae), is a major bee pest that causes significant damage to beehives and results in economic losses. Bacillus thuringiensis (Bt) appears as a potential sustainable solution to control this pest. Here, we develop a novel Bt strain (designated BiotGm) that exhibits insecticidal activity against GWM larvae with a LC50 value lower than 2 μg/g, and low toxicity levels to honey bee with a LC50 = 20598.78μg/mL for larvae and no observed adverse effect concentration = 100 μg/mL for adults. We design an entrapment method consisting of a lure for GWM larvae, BiotGm, and a trapping device that prevents bees from contacting the lure. We find that this method reduces the population of GWM larvae in both laboratory and field trials. Overall, these results provide a promising direction for the application of Bt-based biological control of GWM in beehives, although further optimization remain necessary.

PP-054 [Bee Health]
The diversity of insecticide target site mutations in Apis mellifera

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Insecticides are widely used to combat agricultural pest species, such as aphids, caterpillars, planthoppers and locusts, or to limit the spread of disease-carrying mosquitos. However, these insecticides do not only affect their target species but also non-target species such as pollinators which inadvertently encounter them while foraging. Over one hundred different pesticides and pesticide derivatives have been found in honey bee hives. Insecticides are one of the factors behind the decline of pollinator populations.

Pest species, such as aphids and Lepidoptera, have developed widespread resistance to a large number of compounds. However, research on insecticide resistance in honey bees is rather limited and focuses on only one type of resistance: metabolic resistance. Therefore, we aim to expand the available data on insecticide resistance in honey bees by studying another type of insecticide resistance: target site resistance. In this study, we screened 4897 publicly available Apis mellifera genomes for mutations in 17 insecticide target site genes covering all commonly used insecticides. These genomes originated from 54 countries and cover more than 20 subspecies and honey bee breeds. A total of 5269 synonymous and 4465 non-synonymous mutations were identified. These mutations show differing geographical and functional patterns of diversity.

While the majority of mutations were classified as rare mutations or could not be linked directly to insecticide resistance, several potential insecticide resistance mutations have been identified. Furthermore, mutations potentially associated with previously reported local adaptation to high altitude and Varroa destructor are described. This study serves as a basis for further research on insecticide resistance and local adaptation in pollinators.

PP-057 [Bee Health]
Exploring the role of opportunistic pathogens in honeybee health: the case of Serratia marcescens synergy with Nosema ceranae

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Honeybee's population losses show periodic fluctuations in intensity at global level, with their decline often driven by specific pathogens, such as the gut microsporidia Nosema ceranae and a multitude of viruses. However, many of these pathogens alone rarely bring honeybee colonies to death. Indeed, negative synergies with other pathogens or environmental factors often occur and get the colonies to collapse. The study of honeybees' pathogen synergies at the colony level is a little explored aspect and has focused especially on the pathogens-pesticides negative effects. However, other biological synergies, especially with pathogen and non-core opportunistic gut bacteria such as Serratia marcescens, is rarely explored and may explain important drawbacks in colony losses and may help beekeepers with a more accurate diseases management. To achieve this goal, our research wants to explore the development dynamics of S. marcescens within the co-infection of N. ceranae, determining the incidence of S. marcescens on the survival rate of honeybees and proposing possible solution (e.g. beneficial bacteria uptake and medicaments) on controlling these pathogens. Briefly, different Serratia strains were isolated from weak honeybees and inoculated into new-born, healthy honeybees' in co-infection with N. ceranae. Infected honeybees were reared in cages, and the impact of the multiple infections on their survival was observed in controlled lab conditions. Quantitative PCR was used to quantify Serratia and N. ceranaein the honeybee gut and hemocoel. Moreover, by feeding specific additives based on beneficial bacteria such as Lactobacillaceae or antimicrobial agents such as fumagillin, a possible co-infection control strategy was tested. Our results, showed that all tested Serratia strains were found capable to cross the gut epithelium and proliferate in the hemocoel and the co-infection with N. ceranae facilitated the surge of Serratia population within the gut, leading honeybees to a rapid death. Beneficial microbes from flowers, particularly Apilactobacillus kunkeei, effectively reduced Serratia load, suggesting it as a potential organic microbial resource management, easily applicable in commercial apiaries. These findings underscore the complexity of microbial interactions in the honeybee, recalling the need for wider research in determining multifactorial interactions between pathogens and environmental bacteria within the honeybee's gut.

PP-058 [Bee Health]
Semi-field tests of repellent and attractant molecules to Aethina tumida, a pest of Apis mellifera

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Worldwide, honey bee colonies are being negatively impacted by pests and pathogens. A pest species, that is difficult to control in apiaries and within colonies around the world is Aethina tumida, the small hive beetle (SHB). In the United States of America, there are currently no effective chemical treatments for SHB control within or outside hives. At the University of Florida's Plant Science Research Center in Citra, Florida, the Honey Bee Research and Extension Laboratory operates and maintains a building of enclosed, mesh structures, referred to as flight cages. These flight cages can house honey bee colonies and have walls capable of containing small insects such as SHB. Assays to test the efficacies of SHB repellents and attractants within the flight cages are being developed. Pyrrolidine, an organic compound found in natural alkaloids, is being trialed as a repellent chemical. This chemical has already demonstrated some significant potential as a SHB repellent in laboratory trials but has not yet been tested under field conditions. Isopentyl acetate, the major component of honey bee alarm pheromone, and commercial pollen substitutes are being trialed as attractants. Position, quantity, and application schedule of compounds are being tested to determine how to reliably exclude SHB from hives. For the attractant assays, a trap is being developed to contain beetles drawn to the attractant. This work will allow researchers to develop new compounds or devices and test their efficacy based on standardized methods. With further development, it is possible to develop a push/pull strategy for SHB, moving them away from honey bee colonies and attracting them to other sources.

PP-059 [Bee Health]
Fly aggression behavior and infestation rates of Senotainia tricuspis (Meigen, 1838) (Diptera, Sarcophagidae) in an apiary in Central Italy (Pisa province)

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Senotainia tricuspis (Meigen, 1838) (Diptera, Sarcophagidae) is an endoparasitoid of Apis mellifera L., that causes myiasis in several North African, Middle Eastern, and European countries. Despite the availability of data on the infestation percentages and the increasingly growing awareness of the senotainiosis damage in beekeeping, the aggression and parasitization behavior of S. tricuspis towards A. mellifera remains poorly investigated. In order to identify further tools for the control of senotainiosis in beekeeping, this investigation aimed to provide the infestation rate of S. tricuspis, to describe its aggressive behavior and to provide data on pupation and adult emergence. Data were collected once a week from June to November 2004 and 2005 in an apiary in province of Pisa (Tuscany, Italy), where observations of aggressive behavior were conducted indirectly by using video camera and directly by an observer. In 2004, a peak of 75% of infestation on the 1st of October was recorded, while in 2005, the peak of infestation (45%) occurred on the 3rd of September. Four behavioral categories of the attack were described, for a total of 55 aggressions, 21 beecatchers, 104 chases and 6 parasitization events recorded with the camera. Through four days of direct observations, a total of 1633 aggression events were recorded. The daily temporal pattern of the number of aggressions showed two main peaks: one during the morning from 10:00 to 11:00 and one in the afternoon from 15:00 to 17:00. The morphometric data on the first-instars of S. tricuspis allowed to hypothesize a penetration in the bee through its prothoracicspiracle as a modality of entrance in the host body. Third-instars successfully pupated when sinking occurred in topsoil or clay soil, and adults emerged when a 4 °C diapause of 6 months occurred, despite the minimum duration of exposure to the same cold period remains unknown. Moreover, the high value of the mortality rate of larvae in sandy soil allowed to suggest that mulch and/or minimum soil tillage could prevent severe senotainiosis in apiaries.

PP-061 [Bee Health]
Application of MALDI-TOF mass spectrometry for the identification of the fungus Ascosphaera apis

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Background/Purpose
Ascosphaera apis is a fungus responsible for chalkbrood disease in bees, which occurs sporadically in Slovenia. Although it usually does not lead to colony collapse, chalkbrood weakens bee colonies, reduces their resistance to other infections, and decreases honey production, making it economically significant. Understanding the pathogen and using reliable diagnostic methods are essential for managing and preventing its spread.

Problem Description
Diagnostic methods for chalkbrood disease and the influence of different A. apis isolates on the incidence and severity of the disease remain poorly researched. Traditional mycological diagnostics have primarily relied on the morphological and biochemical properties of fungi. However, the MALDI-TOF system (matrix-assisted laser desorption/ionization time-of-flight mass spectrometry) has been used for fungal identification. Many fungal species can be identified based on specific protein profiles, but the current manufacturer's database does not yet contain corresponding reference profiles for A. apis.

Methodology
To apply MALDI-TOF MS for diagnosing A. apis isolates, a reference spectra database was first required. Reference strains (AFSEF 7405 and ARSEF 7406) were analyzed to create specific protein spectra for comparison with spectra obtained from field samples. Our isolates were obtained from mummified bee larvae collected from bee colonies with chalkbrood signs in apiaries across Slovenia. Samples were inoculated on SDA medium at 30°C, where white, fluffy mycelium developed. Initial identification was conducted through macroscopic and microscopic examination. Cytoplasmic proteins of A. apis were extracted from mycelium grown in liquid SDA medium and processed according to the manufacturer's instructions.

Results and CONCLUSION: MALDI -TOF MS efficiently identified A. apis isolates by detecting distinct protein spectra. An internal database for A. apis and related fungi was created for the first time, confirming MALDI-TOF MS as a rapid and reliable tool for A. apis identification. The newly established database offers great potential for expanding the monitoring of bee pathogens.

Practical Implications for Beekeepers
By understanding the biology and symptoms of A. apis and utilizing MALDI-TOF MS, beekeepers can adopt proactive measures to protect their colonies, reduce economic losses, and improve overall beekeeping practices.

PP-062 [Bee Health]
Administration of coconut oil-enriched diet in honey bees' nutrition: effects on survival and health

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Honey bee (Apis mellifera) nutritional health strongly depends on nectar and pollen, which provide the main source of carbohydrates, proteins and lipids. Administration of supplemented artificial diets is a common beekeeping practice to cope with honey bees nutritional deficiencies and mortality in critical periods. However, the formulation of an integrative diet for honey bee colonies able to prevent nutritional deficiencies is yet to be found. Lipids are the main components of fat body organs functioning as storing energy with great biosynthetic and metabolic activity. Lipids have also a significant role in insect nutrition as structural components in cell membranes, energy sources and reserves, and are involved in many physiological processes. Mechanism regulating fat intake in bees is yet unknown. However, lipid restriction has been proved to affect the social or-ganisation, health, hive duties and productivity of the whole colony. In this study the effects of 0.5% and 1% fat-enriched diet administration on summer newly emerged and forager bees' sur-vival rate, feed intake and health (i.e., immune and antioxidant system, fat and vitellogenin con-tent) was investigated. Diet supplementation with both 0.5% and 1% coconut oil determined an increase in newly emerged bees survival rate from the 3rd to 14th day of feeding compared to con-trol. Moreover, an overall increase in fat content over longer times (i.e., 20th day of rearing) was recorded. In newly emerged bees fed 1% enriched diet a decrease in feed consumption and phe-noloxidase activity was recorded, while no differences in vitellogenin content occurred. Also in foragers bees fed both 0.5% and 1% coconut oil-enriched diet an increase in fat content was rec-orded. Therefore, inclusion of low percentages of coconut oil in honey bee diets may enhance newly emerged bees' survival and lipid content in summer bees. This suggests a potential nutri-tional role of coconut oil inclusion in preventing lipid deficiency in bees. Further investigations to assess the suitability of the use of such supplement feed to prevent fat loss also in weak families during winter are necessary.

PP-064 [Bee Health]
RNA metagenomics-based surveillance of diverse honey bee (Apis mellifera) pathogens revealing the seasonal pathogen dynamics in Taiwan

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The honey bee (Apis mellifera) plays a crucial role in maintaining biodiversity within ecosystems. There has been a rising interest in beekeeping in Taiwan. However, the beekeeping industry still faces many challenges, especially various pests and diseases. In this study, RNA metagenomics was employed to investigate the composition of pathogens in honey bees collected from northern, central, southern, and eastern Taiwan in January, March, July, and November in 2024. This study aiming to elucidate the relationships between pathogen dynamics, seasonality, and geographic distribution. From the results, the fungal pathogens, Vairimorpha ceranae was predominant throughout Taiwan in 2024 with Vairimorpha apis coexisted, except northern Taiwan in January. Ascosphaera apis was only identified in July in southern Taiwan. Furthermore, the highest diversity of bacterial pathogens (Melissococcus plutonius, Spiroplasma apis, and Spiroplasma melliferum) was found in March. For the honey bee viruses, Deformed wing virus, Black queen cell virus, Lake Sinai virus, and Sacbrood virus were the core honey bee viruses detected in all samples. The highest diversity of honey bee viruses was observed in honey bees collected from central and eastern Taiwan. Among different seasons, a greater diversity of honey bee viruses was identified in samples collected in November. This study represents the comprehensive honey bee pathogen surveillance and provides valuable insights into the temporal and spatial dynamics of honey bee pathogens in Taiwan. This information can improve disease management strategies to support bee health and the beekeeping industry.

PP-065 [Bee Health]
Magnetic resonance imaging (MRI) of the honeybee

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Although the honeybee's morphology is fairly well described, little is known about the dynamic functioning of its various organs. MRI technology has the advantage of providing contrasting images of soft tissues such as muscles, organs and brain. But MRI was not suited to very small animals such as insects. Today, this technique is demonstrating its outstanding capacity to study the soft tissues inside of the bee's exoskeleton, both post-mortem and, above all, in vivo We have developed experimental protocols for obtaining highly resolved images of the whole honeybee and its organs using high-field MRI (9.4 Tesla) on post-mortem honeybees positioned in fluorocarbon oil for 24 to 48 hours. These images enable detailed identification of organs in the abdomen, thorax and head, and in particular the brain. We have also developed a set-up with a micro-coil and experimental technology for obtaining well-resolved images of the honeybee in vivo, anaesthetised by cold, for 12 to 24 hours. The images obtained of the brain make it possible, for example, to identify the mushroom bodies. MRI adapted to very small animals is a promising technique for better describing the biology of insects and bees in particular. It should be possible to identify changes in contrast following exposure to neurotoxic pesticides (e.g., neonicotinoids insecticides) or mitotoxic pesticides (e.g., SDHI fungicides), either post mortem or in vivo. In the latter case, it should be also possible to detect the sublethal effects of pesticides on a honeybee, larva, drone, queen... following a chronic exposure at low doses. Thus, bee MRI is a new non-invasive, rapid and relatively inexpensive technique for laboratories already equipped with an imager. In addition, this technique does not require the sacrifice of a large number of individuals for toxicological studies. This technique is highly complementary to electron microscopy and micro-computed tomography (micro-CT) techniques, with the great advantage that MRI can be carried out in vivo, on a single individual that can be its own control after sublethal exposure to pesticides. The authors have no links of interest and they thank the CNRS and the Fondation Lune de Miel for their financial support.

PP-066 [Bee Health]
Small Hive Beetle Outbreak in Reunion: A new haplotype defined in clade C

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In July 2022, an outbreak of Small Hive Beetle (Aethina tumida) was reported for the first time in a French department in the Indian Ocean, Réunion Island. Aethina tumida is a parasite of the Apis mellifera that causes significant damage to honeybee colonies, particularly when weakened. Over the past few decades, it has spread to many countries worldwide, and eradication is often difficult, if not impossible, once introduced. In this area of the Indian Ocean, it is endemic to Madagascar and has been reported in Mauritius since 2016, posing a serious threat to neighbouring territories, including Réunion Island. Tracing the origin and pathway of introduction remains challenging. Alongside epidemiological investigations, molecular characterisation of specimens is a valuable tool for identifying the source of the invasion. Sequencing the cytochrome oxidase I (COI) gene is a widely used method for identifying insects. The sequences are compared with those available in the databases (BOLD, GenBank, etc.). Phylogenetic analyses of A. tumida specimens from various countries have identified three distinct clades, with 24 different haplotypes observed to date. In this study, beetles collected from two separate outbreaks were initially identified morphologically. Molecular analyses were then performed on two specimens (an adult and a larva) from these outbreaks. Genomic DNA was extracted using QIAamp® DNA Mini Kit, and PCR amplification was performed using eight oligonucleotide primers. The amplified fragments were sequenced using a SeqStudio Analyser, followed by phylogenetic analysis. The phylogenetic results revealed that both specimens belonged to a newly defined haplotype, H25, which is part of clade C. This suggests an introduction from either an unidentified African source or the Asian continent, since this haplotype closely resembles those previously identified in China and the Philippines. Due to the lack of genetic data on A. tumida in Mauritius, an introduction from this territory cannot be excluded. This finding highlights the complexity of A. tumida's global spread and the need for further genetic studies. Understanding invasion pathways is crucial for improving biosecurity measures and preventing future introductions of this parasite, which is listed as a notifiable disease by the World Organisation for Animal Health (WOAH).

PP-068 [Bee Health]
Genomic variations among different isolates of Vairimorpha ceranae reveal the risk of microsporidian adaptation to thermal stress in Taiwan

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Microsporidia are obligate intracellular parasites and Vairimorpha ceranae is one of the microsporidian pathogens that cause microsporidiosis in Apis mellifera. Previous reports in 2012 suggested that mature spore counts increased as temperatures decreased in A. mellifera colonies. However, according to the monitoring data from 2020–2021 in Taichung, Taiwan, the mature spore load showed a different prevalence trend with spore counts increasing at higher temperatures. To better understand the potential genomic differences of V. ceranae, which may increase the thermotolerance, the genome of V. ceranae in Taichung, Taiwan (TVc) was compared to the V. ceranae isolate from Chiang Mai, Thailand (ThaiVc) in this study. Besides, two publicly available genomes from NCBI were also included. By using a combination of NGS and ONT sequencing, we assembled the genomes of TVc and ThaiVc. Comparative genomic analysis identified 162 distinctive genomic regions (DGRs) in TVc, including 87 DGRs longer than 450 bp, which were absent in ThaiVc and previously published V. ceranae genomes. Furthermore, the transcriptomic data showed that 112 genes overlapped with these DGRs. Among these genes, nine genes were selected for further investigation. Of these selected genes, three genes were highly expressed during the early stage of TVc infection, while the remaining six exhibited lower sequence identity to ThaiVc than to other isolates, assuming these genes might contribute to the different fitness between TVc and ThaiVc. Our findings first proposed the potential role of genomic variations in V. ceranae. However, the correlation between these DGRs and environmental fitness still needs to be further investigated.

PP-070 [Bee Health]
Efficacy of lithium citrate and amitraz for the control of the mite Varroa destructor in honey bee (Apis mellifera) colonies in a subtropical environment

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The mite " Varroa destructor " is considered the most damaging biotic factor to honey bees " Apis mellifera " worldwide. Therefore, many synthetic and organic compounds are continuously tested in different formulations for their acaricidal activity, mostly in temperate climate countries. The objective of this study was to evaluate the efficacy of amitraz and lithium citrate applied with two different formulations for the control of " V. destructor " in honey bee colonies located in a subtropical environment. The evaluations were carried out in 21 colonies at the University of Guadalajara's Honey Bee Research Center, in Zapotlan Jalisco, Mexico. The colonies were standardized in population and levels of "" V. destructor " and had young sister queens. The mean mite infestation rate of the colonies at the pre-treatment period as determined with alcohol washes was 5.1±0.7%. The colonies were randomly assigned into groups of seven units for each of three experimental treatments and received 1 L of 50% sucrose syrup and a weekly treatment for five weeks. Treatment (T) 1, the control group, received only sucrose syrup. T2, 10 ml of a 1% amitraz solution in vegetable oil, was soaked onto two Scott Shop® towels that were placed above the frames of the brood chamber of each T2 hive. T3, lithium citrate, was supplied in 50% sucrose syrup at a concentration of 6 mM. Mean V. destructor infestation rates at the end of the five-week treatment period were 5.2±1.9, 1.9±1.4, and 2.1±1.7% for treatments 1, 2 and 3, respectively. There were significant differences between the treatments ($H= 31.7$, $p<0.0001$), with both T2 and T3 having significantly lower mite infestation rates relative to the control (T1) and the pre-treatment infestation rate. No significant differences for mite infestation rates were found between T2 and T3. These results suggest that both amitraz and lithium citrate are equally effective for reducing " V. destructor " infestation rates in honey bee colonies in a subtropical environment.

PP-071 [Bee Health]
Beeswax foundation as a new method of transporting organic therapeutic agents for bee disease control

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The fight against known bee diseases - bacteria, bacilli, germs, streptococci, fungi - is ineffective using existing methods. We have proposed a completely new method of treating and preventing bee diseases that has never been used before. It is based on the restoration of bees' protection against pathogenic microflora, which they provide for themselves in nature. For the first time in the world's beekeeping practice, we have proposed a mechanism for the delivery/transportation of protective components to the bee family. It is worth noting that the therapeutic and prophylactic substance is introduced into the wax base to perform several important functions.
For the treatment and prevention of a number of diseases, the most important are
- time to start treatment or prevent it
- time (duration) of the drug's effect on pathogenic microflora
- a reliable and simple method of feeding the drug substance, which ensures constant contact of the bee with the drug substance from egg to adult.

The period of spring development of bee colonies coincides with the period of development of major diseases; at the same time, bees are most intensively forming honeycombs. It is known that bees sometimes use up to 40% of the wax from the wax base itself and add up to 60% of their own wax when rebuilding honeycombs from wax. Using this fact, as well as the fact that propolis is the main component of protection against bee diseases, we introduced propolis fractions into the beeswax. The new product Propolis Wax Base was tested in vitro at the Prokopovych Institute of Beekeeping and other laboratories. The results of laboratory tests showed that the wax base with propolis has an inhibitory effect, the antifungal effect on Askosphaeraapis and Aspergilliusflavus fungi is 85-95%. This was confirmed in production conditions at apiaries. As a result of the work carried out, the mass production of Propolis Wax Base has been established.
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PP-072 [Bee Health]
Beeswax foundation Dombrovskyi «Antivarroa»

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The Varroa destructor mite (hereinafter referred to as Varroa) is the biggest threat to bees worldwide. Our research aims to develop a new ecological method that will help to curb the development of the mite by influencing its behavior in search of a host. The mite is oriented by smell thanks to special sensors located on its forelimbs. Pheromones and chemical signals play an important role in maintaining its connection with the host, the bee. Taking advantage of this, we have proposed a new approach to curbing the development of Varroa destructor in bee colonies by adding extracts from medicinal essential oil plants and fruits to the wax that will be used to make the honeycomb base, which change its orientation. Foreign odors disrupt Varroa's relationship with the honey bee at the stage when female mites have to enter the cells before sealing. Due to the unpleasant odor in the cell, it does not enter it, but remains on adult bees. We have achieved two goals. First, the female mite does not enter the cell with the pupa, so it does not harm it, and the bee is born healthy. The second goal, which is achieved by using the Antivarroa honeycomb base, disrupts the Varroa reproduction cycle. The mite can only reproduce in sealed brood cells. For three years, the effectiveness of using the Antivarroa honeycomb base was tested both in the laboratory and in apiaries. The results obtained in colonies relocated to Antivarroa wax in the spring, which were not treated with any chemicals during the year, had a Varroa infestation rate of 0.5% - 4%. Control families on a routine basis that were not treated with any product were affected by 35% - 47%. Families that were treated once with amitraz remained 8% affected. Production trials have confirmed the results of laboratory studies and the high efficiency of Antivarroa wax in containing Varroa development. All rights to the above products are protected by patents and copyrights.

PP-073 [Bee Health]
The Bidens pilosa phytogenic treatment reveals a negative impact on Vairimorpha ceranae through the suppression of V-Type ATPase expression in infected honey bees (Apis mellifera)

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Microsporidia are obligate intracellular fungal parasites. Vairimorpha ceranae is a microsporidian pathogen that is primarily causes microsporidiosis in honey bees (Apis mellifera). Despite extensive research on V. ceranae pathogenesis, the effects of phytogenic extract treatments on its infection dynamics still unknown. In particular, the precise role of Bidens pilosa (BP) in modulating V. ceranae gene expression during infection has not been thoroughly investigated. Herein, the transcriptome data revealed that the BP treatment significantly suppresses V. ceranae gene expression during infection, particularly affecting metabolic pathways. Among these pathways, the V-type ATPase pathway has demonstrated that positively correlated with spore counts and infection load in this study. The highly expressed genes, which were identified in previous study, during V. ceranae infection were investigated under BP treatment. The expression levels of these genes were down-regulated at the early stage of infection, suggesting that BP treatment influences V. ceranaeinfection process. Besides, RNA interference (RNAi) targeting to the V-type ATPase gene of V. ceranae was performed and further demonstrated that knock-down of V. ceranae ATPase gene can improved honey bee survival rate and also reduced the V. ceranae infection. Both mature spore counts and genome copy numbers decreased by approximately two-fold at 15 d.p.i., by dsRNA of V-type ATPase-related gene treatment, highlighting the importance of V-type ATPase in the life cycle of V. ceranae. Given its ability to suppress V. ceranae gene expression at the early infection stage, BP treatment could potentially serve as a promising strategy for reduction of microsporidiosis.

PP-074 [Bee Health]
The Role of Nitric Oxide in Honeybee Immunity: Assessing the Impact of Acetamiprid Exposure

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"In insect physiology, nitric oxide (NO) plays essential roles in molecular mechanisms underlying physiological processes, including immunity and stress responses. In honeybee immunity, NO acts as both a signalling and an effector molecule toxic to microorganisms. Exposure to neonicotinoid pesticides, such as acetamiprid, can disrupt NO metabolism, potentially affecting immune responses and neural function.

Bee population declines are linked to multiple environmental stressors, including pesticide exposure. Neonicotinoids impair immune function and behaviour, yet their precise effects on NO-related immune and neural functions remain unclear. As NO regulates immunity and neurotransmission, understanding how acetamiprid affects NO pathways is crucial for assessing pesticide-related risks.

Our current findings describe the relative gene expression of nitric oxide synthase gene expression (AmNOS) in physiologically normal honeybees. Using quantitative PCR, we assessed AmNOS expression in the head, thorax, and abdomen of bees aged 1, 2, 3, 6, and 8 days, reared under controlled laboratory conditions. AmNOS expression was highest in the head, where NO primarily functions in neuronal processes. Expression levels increased from day one, peaking in 3-day-old bees, likely reflecting early nervous system development associated with the transition to adult functionality. This increase aligns with elevated NO production, essential for its role as a signalling molecule in neural processes such as long-term memory formation.

Since NO plays a critical role in the nervous system, we extended our study to examine whether acetamiprid exposure disrupts NO regulation, leading to deficits in NO metabolism and associated physiological changes. To address this, we measured changes in gene expression and quantify antimicrobial proteins, oxidative and nitrative stress markers, and key immune pathway proteins. Additionally, biogenic amine levels were analysed to assess potential neurochemical disruptions.

Understanding how pesticides affect NO metabolism in bees can help beekeepers make informed decisions about hive management and pesticide exposure. This knowledge can contribute to developing targeted strategies for mitigating pesticide-induced stress, optimizing colony health, and supporting regulatory choices to reduce their impact on pollinators.

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PP-077 [Bee Health]
Prevalence of Paenibacillus larvae in Apis mellifera in the Netherlands

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Background
Paenibacillus larvae is the causative agent of American Foulbrood (AFB), a disease of the brood in Western honey bees (Apis mellifera). Following changes in policy regarding the control of AFB in the Netherlands in 2005, a prevalence study was conducted in 2008, which served as a baseline measurement. The prevalence of P. larvae was found to be very low.

Problem description
In order to determine whether the changes in policy have had an effect on the prevalence of P. larvae in the Netherlands, we conducted a study, which allowed us to compare the current prevalence with the prevalence in 2008. In addition, we were interested if the very few outbreaks of AFB reported annually over the past decades reflected the current prevalence of P. larvae.

Methodology
A total of 623 brood comb honey samples originating from 224 apiaries across the country were analyzed for the presence of P. larvae by real-time PCR. Samples were pooled per apiary, resulting in 223 pooled samples.
Results and conclusion
One pooled sampled tested positive for P. larvae, resulting in a prevalence of 0.4% (95% CI: 0.02-2.9%) on the level of apiaries. When tested individually, two out of the three samples from this pool yielded a positive result, resulting in a prevalence on the level of colonies of 0.3% (95% CI: 0.06- 1.3%). Based on these results, we can conclude that the low prevalence of P. larvae in the Netherlands has not increased since the changes in policy and is in accordance with the very few clinical outbreaks reported annually.

Practical implications for beekeepers
The low prevalence of AFB in the Netherlands in both 2008 and 2023 is likely due to Dutch beekeeping practices. Most beekeepers use artificial swarming in spring, splitting the colony into nukes and leaving periods without brood, which limits P. larvae growth. While this method reduces honey production, it may explain the lower prevalence of P. larvae in the Netherlands compared to other countries.

PP-078 [Bee Health]
Quantitative method for detection of formic acid in bee hive air samples

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Formic acid is utilized as a natural biocide in bee hives, offering an environmentally friendly alternative to synthetic chemicals. However, the quantitative determination of formic acid in air samples presents a significant analytical challenge due to its low concentrations and the complex nature of the sample matrices. To address this challenge, we employed a sophisticated hyphenated system that integrates gas chromatography (GC) with a mass-selective detector (MSD). Our setup includes a gas valve box featuring two gas valves, which enhances the efficiency of sample handling and minimizes contamination. The system utilizes a PE-5ms column, known for its ideal separation capabilities, along with a deactivated capillary to prevent any chemical reactions that could lead to the degradation of formic acid during analysis. In this analysis, the air sample is passed through a heated transfer line, which facilitates the rapid vaporization of volatile compounds, ensuring that formic acid is effectively introduced into the gas chromatograph. For the mass analysis, formic acid was specifically quantified using the mass-selective detector in Selected Ion Monitoring (SIM) mode. This approach allows for the selective detection of specific ions associated with formic acid, enhancing the sensitivity and specificity of the measurement. To further minimize errors related to sample introduction and ionization variability in the mass-selective detector, we employed chloroform as an internal standard. The internal standard compensates for potential fluctuations in detector response and sample variability. In addition to establishing the calibration curve, we conducted comprehensive investigations to determine the limits of detection (LOD) and quantification (LOQ) for the method. These measures are critical for assessing the analytical method's sensitivity and reliability, particularly when detecting formic acid at trace levels that may be present in environmental samples. This study provides a reliable framework for the quantitative analysis of formic acid in air samples, contributing valuable information to the field of environmental monitoring and assisting in the management of bee health through more precise assessments of biocide usage.

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PP-079 [Bee Health]
"Varroaresistenz 2033" – a German initiative to stepwise abandon chemical varroa treatment

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Many beekeepers in Germany are experiencing high colony losses due to Varroosis infestation of their bees (Apis mellifera), despite intensive medical treatment. The leading German beekeeping associations aim at a sustainable reduction of loss rates and a significant decrease in the use of medications by 2033 by increasing the availability and distribution of resistant bees. The project focuses on systematic selection and dissemination of resistance traits, according to the methods outlined in the EurBeSt study (EU, 2022), as well as on adapted colony management using biotechnical methods (Büchler et al., 2020). The German Beekeepers' Association (DIB) and the German Professional Beekeepers' Association (DBIB) have signed a cooperation agreement with the leading breeding associations for Buckfast (GdeB), Carnica (AGT), and Mellifera bees (BDB), as well as the German Bee Research Association. Since March 2023, three specialist symposia of several days were organized, each with about 150 participants, and working groups for breeding, biotechnology, and education & science were established. A project homepage (www.varroaresistenz2033.eu), social media appearances, and presentations at conferences serve to reach out to the entire beekeeping community. The structures of the beekeeper associations and local clubs serve to disseminate the motivation and the specialized information prepared in the working groups to the beekeeping community in various ways and on a broad front. Some pioneer beekeeping operations that have successfully been managing their colonies medication-free for years serve as important flagships. The reduced varroa and virus load during the rearing of winter bees, achieved by biotechnical methods involving brood interruption, leads to an improved overwintering success and reduces or eliminates the need for a chemical winter treatment. As a result, differences in mite susceptibility between colonies become more visible, allowing the selection of resistant colonies and contributing to integrate selection decisions into the general beekeeping practice.

PP-080 [Bee Health]
Ultrasonic combating of Varroa Destructor and Acarapis Woodi mites

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Several years of research to date have clearly shown that bee colonies can be protected against of the Varroa destructor and Acarapis woodi mites by. the acoustic field of a sonic emitter. The power density of the emitter's acoustic waves does not exceed 1 milliwatt per square centimeter, which ensures full safety for biological animal cells. Bees are safe at every stage of their development, and the subtle ultrasonic massage, frequency of 22 – 24 kHz, is manifested by their increased activity. The aim of the presented study was to determine the number of Varroa destructor daughter offspring in the sonic drop with simultaneous determination of the condition of young Varroa mite offspring. During the implementation of this study, an intensive fall of Acarapis Woodi was observed in a few of the studied bee colonies. An important feature of the sonic fall of Varroa mites is the presence - about 30% - of young, light yellow daughters. In the period from October 1 to November 30, a total fall of 1572, usually dead or exhausted Varroa parasites, was recorded in one of the research colonies. The fall included foundress females, young daughters, and larval forms as well as males. For example, on November 6, the daily fall contained 31 female founders, 22 daughter daughters, and 7 larval forms, a total of 60 Varroa mites. Additionally bees were stimulated to grooming and VSH behaviour. In one of the surveyed bee colonies, the largest sonic fall of Acaraois woodi occurred so far - approximately 430 pieces per day. The bee mite causes a bee disease called acarapidosis. The mites parasitize in the first pair of spiracles of young bees. Acarapis woodi is an internal parasite that attacks honey bee colonies. It can lead to the collapse of a bee family. The bee mite is visible only under a microscope. The fall of the Acarapis Woodi mites subsided at the end of November. Our investigation show sufficient ultrasonic protection against both Varroa Destructor as well as Acarapis Woodi parasities.

PP-081 [Bee Health]
Pesticides in honey, beeswax and toxicity to honey bees (Apis mellifera) from hives kept in avocado (Persea americana) orchards managed with different cultural systems in Jalisco, Mexico

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Honey bee colonies are commonly used to provide pollination services to avocado orchards in Mexico. However, it is not known if the pesticides used in these orchards affect bee health and leave residues in hive products. Samples of honey and beeswax were collected from hives placed in three types of avocado orchards differing in management practices: organic (pesticides not used), certified (pesticides used under regulations), and conventional (pesticides used without regulations). A chemical analysis of the samples revealed residues of pesticides, mainly acetamiprid, hexazinone, and thiabendazole. In honey samples, acetamiprid exceeded the European Commission's MRL, and there were no differences in acetamiprid concentration between the three orchard types (P=0.0963). In beeswax samples, acetamiprid concentration was significantly lower in organic orchards (P<0.001) and varied compared for the other two pesticides (P<0.001). Additional pesticides detected at lower concentrations included coumaphos and cyhalothrin in honey, and methiocarb, coumpahos, mepanipirim, cyhalothrin, pentachlorophenol, chlorpyrifos, and permethrin in beeswax. Based on these results, experiments were conducted to determine the toxicity and behavioral effects on bees of the three main pesticides found in hive products. Avocado plants inside meshed cages were sprayed with the pesticides using either of two doses, the doses recommended by the manufacturers, and the doses used in conventional orchards, which are twice higher. Then, bees were introduced into each cage and observed for mortality and inability to fly and walk. In the cages with plants treated with the recommended doses, bee mortality rates were 47%, 7% and 6%, for the acetamiprid, hexazinone, and thiabendazole treatments, respectively, and a significantly higher number of bees showing behavioral changes were observed for the acetamiprid treatment (P<0.001). Also, mortality and behavioral changes of the exposed bees were higher with the conventional treatments (P<0.001). We conclude that acetamiprid may reach concentrations above MRL in honey, irrespective of the type of orchard management. The pesticides tested at doses used in the orchards have detrimental effects on honey bee health and behavior, particularly acetamiprid. Alternative methods of pest control should be implemented in avocado orchards to reduce the use of pesticides that affect honey bee health and pollute hive products

PP-082 [Bee Health]
Silveco+Bee® the new tool for disinfection against Paenibacillus larvae - causative agent of american foulbrood (AFB) preliminary studies

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American foulbrood (AFB) affects the larval stage of honeybee Apis mellifera causing their death and occurs throughout the world. AFB is considered the most widespread and destructive infectious honeybee disease and it can cause serious economic losses to beekeeping. AFB is classified on „Listed Diseases and Other Diseases of Importance" by World Organisation for Animal Health (WOAH). Paenibacillus larvae, the causative organism, is a Gram-positive bacterium that can produce over one billion spores in each infected larva. Five different genotypes (ERIC I, II, III, IV and V) of P. larvae are differentiated. The spores are extremely resistant to heat and chemical agents, and can survive for many years in scales (from diseased dead brood), hive products and equipment without losing infectivity. Therefore, disinfection aimed at destroying P. larvae spores is crucial both in good beekeeping practices (GBPs) and biosecurity measures in beekeeping (BMBs). Effective disinfection is also crucial when eliminating AFB outbreaks by competent authorities. The aim of the study was to assess the effectiveness of a new product - Silveco+Bee® in destroying P. larvae spores. The above-mentioned product contains hydrogen peroxide, formic acid, glycolic acid and nano silver complex as active substances. The research was carried out based on PN-EN 13704:2018-09 and PN-EN 16437+A1:2020-03 standards using additional of P. larvae spores – ATCC 9545 (ERIC I). The conducted research proved that Silveco+Bee® is effective (99,99%), in destroying P. larvae spores at a concentration of 40% and with an exposure time of 60 minutes. Silveco+Bee® can be an excellent alternative to disinfection based on the use of agents containing in its composition sodium hypochlorite or sodium hydroxide. Thanks to its disinfecting properties, apart from beekeeping, it can also be successfully used in the area of food production to ensure consumer health protection.

PP-084 [Bee Health]
Understanding and Awareness on Risks of Synthetic Pesticides Use on Honey Bee Colonies in Western Amhara, Ethiopia

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In Ethiopia, the impact of synthetic pesticides overuse in agriculture becomes a significant concern on honey bee colonies. Most synthetic pesticides are toxic to honey bees, leading to direct mortality upon exposure. Studies carried out around Lake Tana, Ethiopia confirmed that, the main pesticides used on vegetable and pulse crops production during irrigation season are highly toxic to bees and other beneficial insects. However, farmers in the study area are highly dependent on these pesticides to manage crop pests. Presence of inadequate knowledge on the alternative pest management practices and risks of synthetic pesticides in the ecosystem is the underlying reason for over reliance of farmers on pesticides. Considering this as a major driver of honey bees' colony collapse in Amhara region, a project was developed focusing on agro-ecological farming methods. The overall, objective of the project was to promote agro-ecological farming methods via Integrated Pest Management (IPM) approach and address the very low awareness of farmers about the risk of pesticides on honey bee colonies and other beneficial insects. The project was implemented and supported beekeepers for three years (March 2022 to March 2025) in Fogera and North Mecha districts of Amhara Region, Ethiopia. Training has been provided for 83 development workers and 883 farmers on the harmful impacts of pesticides on honey bee colonies, and on the IPM concept. Farmers Field School (FFS) approach was deployed and 22 IPM-FFS groups were established with 630 members. As a result, the IPM vs conventional pest management practice demonstration indicated that, on average farmers conventionally applied 16kg/ha and 20kg/ha active ingredient agro-chemical on their grass pea and onion crops respectively which is maximum as compared to the global average. Farmers understood, the IPM approach is feasible economically and environmentally compared with the conventional approach. Currently more than 250 farmers are practicing IPM in their own farm and the interest of farmers to practice IPM and the income of beekeepers increased by 68% and 53% respectively. The result is indicative that we can reduce the risk of agro-chemicals on honey bee colonies and on the agro-ecology at large.

PP-085 [Bee Health]
Single-Nucleotide Polymorphisms (SNPs) in the ORβ-2R-L Gene of French and Spanish Varroa Mite Populations Are Not Directly Linked to Amitraz-Resistant Phenotypes

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For decades, amitraz has been utilized by beekeepers globally as an effective control method for varroa mite (Varroa destructor) infestations in honey bee (Apis mellifera) colonies. Reports of amitraz resistance, mainly from commercial beekeeping operations in France and North America, have recently been linked to the identification of single-nucleotide polymorphisms (SNPs) in the ORβ-2R-L gene in the mites' genome. Here, we present data collected from apiaries from the AURA region in France and the Valencia region in Spain in 2022. Bioassay ("Pettis test") outcomes, which detected the susceptibility of individual varroa mites towards amitraz, were recorded, and each mite was classified as either "sensitive" or "resistant". We later genotyped 92 of these individual mites which had previously been categorized in accordance with their phenotypic response towards amitraz. The genetic analysis focused on the β–adrenergic-like octopamine receptor, which is considered the primary target for amitraz in varroa mites. Particular attention was given to a SNP at position 260 of the ORβ-2R-L gene, which had previously been described by Hernández Rodríguez et al. (2021). In addition, we identified a novel SNP at position 868 of the ORβ-2R-L gene that was only identified in the Spanish mite sample. We also identified a mutation at positions 344-355 in the same gene, which occurred only in the French mite sample. Our results confirm our own previous results published in 2024, suggesting that there is no direct link between the SNP at position 260 of the ORβ-2R-L gene alone and amitraz resistance development in varroa mites. Furthermore, our genetic analyses suggest that the SNP at position 868 of the ORβ-2R-L gene as well as the mutation at positions 344-345 in the same gene are not directly associated with amitraz resistance development either. These results reinforce the higher level of complexity involved in the development in amitraz resistance compared with pyrethroid or coumaphos resistance in varroa mites. They also align with recent publications suggesting a higher genetic variability in the varroa mite genome than previously expected due to the mites' incestuous reproductive system.

PP-086 [Bee Health]
Monitoring the Health of Bee Populations in the Philippines: Pests and Diseases

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A significant threat to beekeeping in the Philippines is posed by pests, including small hive beetles and mites, as well as diseases such as American Foul Brood, European Foul Brood, and chalkbrood. With the noticeable decline in colonies of Apis mellifera and stingless bees due to these threats, it is crucial to assess the extent of the damage before additional colonies are lost. This study focuses on implementing strategies to effectively address and mitigate the impact of pests and diseases on bee colonies. From April 2024 to March 2025, brood and adult bees were collected from selected bee farms across the Philippines. Interviews with beekeepers and sample analyses revealed that Varroa destructor, small hive beetle, Ascosphaerosis, DWV, and IAPV were the most common pests and diseases affecting A. mellifera. Additionally, the ectoparasitic mite Acarapis externus was identified for the first time in the necks of adult A. cerana bees. For stingless bees, ants and larvae of soldier flies were frequently found in weak or dead colonies, while a Histerid beetle, Procoryphaeus sp., is suspected to be a new pest. Based on these findings, it is recommended to implement strict guidelines for inter-island colony movement to prevent the further spread of these pests and disease threats.

PP-088 [Bee Health]
Drone viral infection, immunity and flight performance

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Drones' flight performance is the paramount for their mating success in honey bees. Mating flight is energetically costly and may be hindered by biotic and abiotic factors. Using the flight mill, we assessed the flight ability of drones from three age cohorts (one, two and three weeks old). Then we subsequently examined their sexual maturation, viral infection by deformed wing viruses type A and B (DWV- A, DWV-B) and Israeli acute paralysis virus (IAPV) as well as expression of six immune genes by RT-qPCR. Sexually mature drones flew longer distances compared to immature drones. Though DWV-A and IAPV infections were common in drones, their impact on drone flight differed. Interestingly, flight distance and speed were negatively correlated with loads of IAPV and DWV-B respectively in 14-15 days old drones, but not in 7 days old. Flight speed was negatively correlated with the expression of protein lethal 2 (Pl2) and peptidoglycan recognition protein S2 (PGRP-S2) in 14-15 days old drones. Our findings suggest effect of viral infection on drone flight and a possible trade-off between drones' flight ability their immunity. Deepening our understanding of drone mating success and its relation to their health status is an important step for the success in breeding efforts for honey bee health.

PP-091 [Bee Health]
Real or fake friends? Study of Trichoderma strains in Brazilian stingless bee hives

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The fungal companions of stingless bees are still a mystery. The environment of stingless bee colonies, with its homeostatic conditions and abundance of nutritional resources, favors microbial growth. Some interactions between fungi (Zygosaccharomyces) and stingless bees (Melipona scutellaris) have already demonstrated the beneficial partnership between the organisms involved. However, other antagonistic interactions involving fungal entomopathogens of bees are considered a risk to the productivity of beekeeping and meliponiculture. During the management of Brazilian hives of the species manduri (Melipona marginata), mandaçaia (Melipona quadrifasciata) and marmelada (Frieseomelitta varia), the predominance of mycelial growth was observed. These fungi were found growing on the batume and wooden box of healthy Melipona hives, but were not observed colonizing the internal resources of the colonies. Only in the dead colony of marmalade was it possible to observe macroscopically the growth of the same fungus in the pollen pots. The cultivation-dependent techniques allowed the obtaining of twelve strains phylogenetically identified to the fungal genus Trichoderma, with a predominance of the species T. atroviride. The analysis of microextracts of axenic cultures of Trichoderma spp. strains by HPLC-HRMS/MS combined with metabolomic approaches indicated the production of pyrone derivatives by the microorganisms. Subsequent tests with Trichoderma atroviride CLMD 34 in cellular (co-cultures) or chemical (antifungal susceptibility assays) antagonism assays against three entomopathogenic fungi (Beauveria bassiana, Metarhizium anisopliae and Isaria javanica) highlighted the possible role of pyrones as a modulating agent of ecological interaction. This secondary metabolite is currently being isolated, characterized and tested to understand whether it has any role in the colony environment. If Trichoderma spp. acts as a beneficial symbiont for bees, the accumulation of these metabolites in the hive microenvironments could prevent the proliferation of entomopathogenic agents. However, the limitation of Trichoderma growth mainly in the external substrates of the hive may indicate its saprotrophic commensal ecological character. The current work investigates the possibility of Trichoderma strains acting as a harmonious symbiont, with the aim of elucidating its still uncertain roles both for stingless bees and for meliponiculture.
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PP-094 [Bee Health]

Altering the expression of hsp and amp genes to potentially enhance stress tolerance by curcumin and quercetin containing nutritional supplement in honey bees (Apis mellifera)

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Background/purpose
Honey bees (Apis mellifera) play a crucial role in agriculture as pollinators of crops and plant species, however the different abiotic and biotic stressors are greatly affecting them. Exposure of cells to stressors such as high/low temperature, pesticides and pathogens can damage cellular proteins. Heat shoch proteins (HSPs) respond to various abiotic and biotic stressors, act as molecular chaperons to protect against apoptosis, thus, they are vital for cellular protein homeostasis and regulate the cell cycle. Although, viruses can hijack HSPs and can utilize the native HSPs of the host to help them invade cells and nucleus. In addition, the different stressors affect the regulation of genes coding for antimicrobial peptides (AMPs), which are part of the innate immune system.

Problem Description
We assume that changes in the expression of hsp and amp genes can lead to increased stress tolerance depending on the type of stress. The aim of our research was therefore to change the expression of genes encoding HSPs and AMPs in honey bees, following treatment with curcumin, as a potentially applicable cytoprotective agent and with quercetin, as a plant flavonoid.

Methodology
For alteration of gene expression, bees were provided feeding solutions containing curcumin (0.3 and 0.03 mmol) and quercetin (0.1 and 1 mmol) for 48 hours. After the treatment, whole head tissue homogenate was used for RNA isolation then cDNA synthesis was performed and the relative expression of hsp (hsp60, hsp70, and hsp90) and amp (defensin, vitellogenin and apidaecin) were determined using real-time PCR.

Results, CONCLUSION: Our results suggest that curcumin and quercetin containing feeding solutions have significant effect on the relative expression of researched genes compared to their controls. With curcumin treatment we successfully increased the expression of hsp60 and hsp70 while quercetin treatment caused reduced mRNA levels of hsp70 and hsp90. In the case of amp genes, however, no significant changes were observed due to the different treatments.

Practical Implications for Beekeepers
Based on our research curcumin and quercetin can serve as nutritional supplements for bees to help them tolerate the various stress factors depending on the type of stressor that should be avoided.

PP-095 [Bee Health]
Paenibacillus melissococcoides: a new pathogen of honey bee brood?

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Because honey bee colonies contain many individuals in close physical contact, they constitute fertile grounds for numerous pathogens to multiply and spread. Among these, the two globally distributed brood bacteria Paenibacillus larvae and Melissococcus plutonius are the causative agents of American (AFB) and European foulbrood (EFB) diseases, respectively. By affecting larvae, these bacteria can lead to colony weakness and possibly to death. In Switzerland, high numbers of EFB cases were reported each year, leading to increased research efforts into the epidemiology of EFB. During such research, an atypical bacterium was found in addition to M. plutonius in an apiary affected by EFB. It turned out to be a new species, which we named Paenibacillus melissococcoides. As this new bacterium was discovered in a brood diseased colony, we investigated whether it was present in larval jelly and in larvae, and tested, in vitro, whether it was pathogenic to the brood. To better understand the interaction between bacteria of the genus Paenibacillus and A. mellifera, we also compared the virulence of P. melissococcoides with that of two closely related Paenibacillus species, which were previously found to be associated with honey bees. In this presentation, we review what we have learned to date on the ecology and pathogenicity of this species and discuss whether P. melissococcoides is a new honey bee pathogen. The discovery of this new species brings new insights into EFB epidemiology and the suite of bacteria associated with it, as well as a better understanding of the ecology of Paenibacillus species when they encounter honey bees. We argue that P. melissococcoides can be classified as an EFB secondary invader, but because of a few cases where it was found in brood diseased colonies in the absence of M. plutonius and P. larvae, P. melissococcoides may be a brood pathogen in its own right, occasionally obscuring the diagnosis of foulbroods.

PP-096 [Bee Health]
Evaluating Possible Effects of Radio-Frequency Electromagnetic Fields (RF-EMF) Exposure on Biodiversity, Development & Fitness of Insects

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The Horizon Europe project 101057216 Exposure To electromAgnetic fIelds and plaNetary health aims to develop and validate approaches to assess the impact of existing and novel communication technology from a planetary health perspective while exploring options for exposure reduction and interacting with the public and stakeholders about exposure levels and possible associated risks. Among the endpoints studied are possible effects on insect biodiversity and fitness, focused on pollinators, like bees. Newly introduced telecommunication technology (3G/ 5G/ 6G) results in changes in exposure patterns and biological interactions of RF-EMFs that can be absorbed in different organisms with unclear biological consequences. We exposed honey bee colonies indoors at 3.6 GHz and followed the development of amateur stages. We installed an RF-EMF antenna in an experimental field, in Greece. The antenna will expose two parts of the field to 5G signals within the 3.6 GHz and 26 GHz bands, respectively, and leave two other parts unexposed. We will systematically record insect biodiversity and simultaneously, we will deploy managed bee hives to study their development over time. In parallel, wild and managed bees were digitized using micro-CT scanning.3D digital insect models have been created for adult wild and managed bees. Indoors exposure of bees at 3.6 GHz has shown delayed larvae development and eventually emergence. Background RF-EMF exposure was found to be at very low levels, in comparison to the exposure caused by the installed antenna mast. Preliminary pre-exposure sampling has shown that there are no significant differences in insect biodiversity between the different parts of the experimental field. We will monitor the honey bee colonies and solitary bees in the field, sample insect species and perform numerical simulations of the insects' exposure using the digital models.

Digital bee models will be made available for educational purposes. New telecommunication networks create new exposures to RF-EMFs but also create new opportunities for exposure reduction or prevention, which are not possible in legacy networks. Any advice for beekeepers will depend on evidence of the presence or absence of unintended biological effects and will take into account potential technical and non-technical interventions mitigating or avoiding such effects.

PP-098 [Bee Health]
Actinobacteria from Stingless Bees: Isolation, Characterization, and Antimicrobial Potential

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Stingless bees (tribe Meliponini) are eusocial insects widely distributed across tropical and subtropical regions, playing a fundamental role in the pollination of various plant species. Meliponiculture has gained increasing attention due to its relevance in environmental conservation and the production of medicinal honey. The colonies of these bees harbor a complex and largely unexplored microbiota, including bacteria from the phylum Actinobacteria, which are well known for their ability to produce bioactive secondary metabolites. Among these, the genus Streptomyces stands out as one of the primary producers of natural antibiotics. However, the interactions between stingless bees and their microbial communities, particularly actinobacteria, remain poorly understood. This study aimed to isolate and characterize actinobacteria associated with stingless bees of the species Melipona bicolor, Melipona mondury, and Melipona quadrifasciata, evaluate their viability in microbial interactions, and identify the secondary metabolites they produce. Using microbiological and chemical approaches, three strains of actinobacteria were successfully isolated: two from M. bicolor, one from the cuticle of forager bees (MBFE) and another from the internal tract of worker bees (MBOI), and one from the larval food of M. mondury (MMAL). No cultivable actinobacteria were obtained from M. quadrifasciata. Morphological characterization and phylogenetic analysis indicated that the isolates belong to the genus Streptomyces, with high similarity to the species Streptomyces halstedii. UHPLC-DAD-QTOF-MS/MS analysis and chemical dereplication strategies revealed that MBOI and MMAL were capable of producing two antimicrobial compounds previously reported in the literature as Streptomyces metabolites: Bafilomycin Cl and Caboxamycin. Coculture assays demonstrated that the MMAL isolate exhibited significant antifungal activity against Trichoderma atroviride, Aspergillus fumigatus, and Trichoderma harzianum. Additionally, organic extracts obtained from the MMAL bacterial culture were evaluated for their inhibitory effects against fungal and entomopathogenic pathogens, including Ascosphaera apis, Beauveria bassiana, and Metarhizium anisopliae, confirming its microbicidal efficacy. The findings of this study reinforce the potential of actinobacteria associated with stingless bees as promising sources of bioactive secondary metabolites with antimicrobial properties. Furthermore, this research provides novel insights into the role of these bacteria in maintaining colony health in Melipona bicolorand Melipona mondury, emphasizing their relevance in protecting bees from pathogenic microorganisms.

PP-099 [Bee Health]
Brain Fatty Acid Profile Alterations in Honey Bees Induced by Neonicotinoid Acetamiprid

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Background/Purpose
Neonicotinoids pose a serious threat to pollinators like the Western honey bee (Apis mellifera), which plays a crucial role in ecosystem stability. While acute toxicity is less common, sublethal exposure may significantly impact bee physiology and behavior. Despite growing evidence of neonicotinoid-induced effects, the biochemical mechanisms remain unclear. Given the importance of lipid metabolism in neural function, we investigated how sublethal acetamiprid exposure alters the honey bee brain's fatty acid profile.

Problem Description
Global bee population declines are attributed to multiple stressors, including pesticides. Acetamiprid, a commonly used neonicotinoid, may not only interact with neural receptors but also induce oxidative stress and disrupt lipid metabolism. However, the extent of these effects on the honey bee brain remains insufficiently studied.

Methodology
Experiments were conducted at an apiary in Ugod, Hungary. Honey bees were collected and housed in controlled laboratory conditions (30°C, 90% humidity) in specialized cages. Experimental groups received varying acetamiprid doses (LD50/10, LD50/20, LD50/40 per bee per day) ad libitum for 48 hours. After treatment, bees were euthanized with dry ice and stored at -80°C. Their central nervous systems were dissected, homogenized, and analyzed via gas chromatography-mass spectrometry (GC-MS) to determine fatty acid composition.

Results and CONCLUSION: Acetamiprid exposure significantly altered brain fatty acid metabolism. Lauric acid (C12:0) and myristic acid (C14:0), markers of oxidative stress, increased. Additionally, linoleic acid (C18:2, n-9,12) and alpha-linolenic acid (C18:3, n-3; ALA), associated with neurodegeneration, were elevated. Stearic acid (C18:0) and palmitic acid (C16:0) also increased, along with shifts in total saturated and total fatty acid levels. Our findings indicate that acetamiprid disrupts lipid homeostasis in the bee brain, potentially impairing neural function.

Practical Implications for Beekeepers
Sublethal acetamiprid exposure, even at low doses, may contribute to colony health issues by affecting neural function. Beekeepers should consider these risks when managing hives in agricultural environments. Further research is needed to assess long-term ecological consequences and mitigate pesticide-related harm in apiculture.

PP-101 [Bee Health]
Evaluation of a Promising Novel Acaricide Against Varroa destructor

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Infestation of honey bees by Varroa destructor is a significant cause of colony loss, particularly during winter months in Canada. Currently, beekeepers have limited options available to treat bee colonies for varroosis. Varroa mites have quickly developed resistance to a number of registered compounds (i.e. fluvalinate, coumaphos, amitraz), while remaining treatment options often pose health hazards to beekeepers or have variable efficacy. As such, alternative control strategies are urgently required, particularly those that involve new active compounds. Based on previous laboratory screening assays, we discovered a new acaricidal substance, 1-allyloxy-4-propoxybenzene, referred to as 3c (3,6), which causes disruption of host-finding behaviour, paralysis and death of mites. From 2019 - 2024, field trials were conducted in the Canadian provinces of British Columbia and Alberta to evaluate the effectiveness of this acaricide under a range of environmental conditions. These experiments showed efficacy of up to 94.6 ± 1.2%, using a 6-week treatment period with release devices containing 8 - 10 g of 3c (3,6) applied to wooden applicators in glycerol and isopropanol. Our findings show 3c (3,6) as being generally safe for honey bees, having limited effects on adult bee populations and no risk to the development of brood at 5 and 10 g per colony under OECD 75 testing. Nevertheless, some colony-level trials have shown elevated risks to queens at high doses. In terms of residues, fall applications of the compound were undetectable in honey harvested the following summer, while spring applications resulted in 0.060±0.004 ppm of the compound in honey extracted during same season. Overall, the data produced to date support the registration of this novel active for control of V. destructor.

PP-102 [Bee Health]
Neurotoxic pesticides induced alterations in nursing behavior and foraging-related genes in the nurse bee of the honey bee, Apis mellifera. L

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Honey bee, a vital pollinator in the natural and agricultural ecosystem, has been experiencing a global population decline, mainly attributed to pesticides. Both forager bees and nurse bees are exposed to pesticides, and the main exposure route in nurse bees is pesticide-contaminated food sources. Previous studies showed neurotoxic pesticides triggered an abnormally early transition of nurses to forager bee-like states, but their effects of pesticides on nursing behavior remain unclear. Therefore, we investigated the effects of five neurotoxic pesticides (acetamiprid, imidacloprid, carbofuran, cypermethrin, and fipronil) on nursing behavior in this study. Considering the possible exposure routes in nurse bees, nurse bees were exposed to field-realistic concentrations of pesticide-laced sucrose solution ad libitum for 10 days. After chronic exposure to pesticides, nursing behavior was assessed in three aspects: 1) the duration of nursing behavior per visit to the queen cell; 2) the total duration of nursing behavior; 3) the number of bees visiting to a queen cell. Moreover, we analyzed the transcriptome profiles of genes such as cGMP-mediated kinase protein foraging (For), Kruppel homolog 1 (Kr-h1), Adenylate cyclase 3 (Ac3), Probable nuclear hormone receptor HR 38 (Hr 38), and Early growth response 1 (Egr1), which are related to foraging activity and division of labor to understand the physiological mechanism underlying changes in caste differentiation and behavior using qRT- PCR. As a result, pesticides generally reduced all observed aspects of nursing behavior. In reverse, all selected foraging-related genes were upregulated by the treatment of pesticides, suggesting the inversely proportional relationship between the expression of tested genes and nursing behavior. These findings imply that pesticide-induced disruption of nursing behavior may alter colony composition, potentially leading to colony collapse. This study highlights the sub-lethal and chronic risks of neurotoxic pesticides, even at field-realistic concentrations, emphasizing the need for cautious pesticide use to prevent honey bee population declines.

PP-104 [Bee Health]
Effectiveness of innovative BeeSmoke pelleted fuel and remedy ApiBonum ib on the vitality of honeybee colonies

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An innovative and sustainable approach to beekeeping involves using commercially available pellet fuels, such as BeeSmoke Forte and BeeSmoke, for daily work in the apiary. A study was conducted to determine the effectiveness of these fuels, including their impact on the strength and behavior of honeybee colonies, their ability to reduce the number of parasitic mites V. destructor, and the presence of insecticide/acaricide residues in honey. It was observed that the smoke produced from burning BeeSmoke Forte, BeeSmoke, and pure wood pellets in a smoker did not alter the behavior of the honeybees or result in their death. Furthermore, the study indicated that BeeSmoke Forte and BeeSmoke significantly affect the number of fallen parasitic mites, specifically Varroa destructor. Also, the study analyzed the honey collected before and after using pellet fuels for the presence of insecticide/acaricide residues, and their negative results indicate that the honey collected during the active beekeeping season when these fuels were used is safe for bees and humans to consume. At the same time, on another apiary, we aimed to determine the acaricidal properties of the innovative agent ApiBonum ib, and its impact on the vitality of honeybee colonies. The research, which was conducted in field conditions, determined the decline of mites in all honeybee colonies treated with ApiBonum ib. Also, it was found that ApiBonum ib has a positive effect on the vitality, i.e. strengthening of honeybee colonies, since an increase in the number of honeybees was observed in half of the experimental colonies at the end of the study, compared to the initial clinical examination. As a natural remedy, ApiBonum ib is not harmful to bees, when used there is a lower risk of developing resistance in mites, as well as the appearance of residues in honeybee products. ApiBonum ib can be a useful tool for maintaining the vitality and hygiene of colonies and possibly as an immunomodulator that stimulates the hygienic behavior of honeybee colonies.

PP-107 [Bee Health]
Pesticide exposure assessment in stingless bees

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Bees are crucial pollinators of many crops and wild plants, and pesticide exposure is one of the primary environmental stressors affecting their health. Most information regarding the impacts of pesticide exposure has been derived from studies on honey bees; however, recent research has increasingly focused on pesticide exposure and its effects on non-Apis bees, including other social bees such as bumble bees and stingless bees. Differences in life history traits between honey bees and stingless bees are likely to influence the routes and levels of pesticide exposure. Quantifying food ingestion is a key component in estimating pesticide exposure to bees through their diet. Foraging bees consume the largest amounts of nectar, and artificial syrup (50% sugar in water) is a suitable medium for quantifying food intake. It is known that foragers of honey bees and bumble bees tend to prefer foods containing neonicotinoid pesticides. In this study, we investigated the consumption of syrup contaminated with the neonicotinoid imidacloprid by the stingless bee Melipona quadrifasciata. We used three different concentrations of imidacloprid (7, 70, and 700 ppb), with the first two concentrations typically found in honey and nectar. Foragers were fed for three days, and consumption was measured at the end of the experiment. The study was conducted with three colonies, with two of the colonies being tested twice. We observed that bees fed syrup containing 70 and 700 ppb of imidacloprid ingested significantly lower amounts of syrup. Nonetheless, each bee fed 700 ppb consumed approximately 5 ng of active ingredient, an amount sufficient to kill almost all the bees within 48 hours. Our study demonstrates that, unlike honey bees and bumble bees, stingless bees seem to avoid feeding on syrup contaminated with imidacloprid.This result may have important implications for stingless bee health.
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PP-108 [Bee Health]
Building tools for Integrated Varroa Mite Management: field monitoring of varroa sensitivity to acaricides in the Grand Est region

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ADA-GE aims to support beekeeping development in the region. Placing specific emphasis on experimentation, through projects to monitor varroa infestation, it collaborates regularly with ITSAP, the ADA network, APINOV and ARISTA Bee Research. Varroa destructor remains a foremost challenge for honeybee health. The number of active substances is today limited. Sensitivity loss to amitraz has been recently observed, adding up to the already documented tau fluvalinate resistance. Building ALTERNANCE project, ADA-GE monitors varroa population sensitivity level to these two molecules at apiary scale. Two kinds of tests were carried out: Pettis test that involves applying the molecule through direct contact of phoretic mites on live bees; and Phenotypic test in petri dishes by sampling varroa mites from closed brood. Concurrently, varroa infestation measurement was made at each stage of the protocol, reporting treatment effectiveness in the field. Varroa-model© was used for better understanding of varroa population dynamics. Over two years, 646 phenotypic tests were made, and 343 hives were monitored. In 2024, two causes have been identified to explain high level of varroa mites remaining post treatment: 6 apiaries failures linked to varroa medium to high loss of sensitivity towards acaricides, and 3 apiaries with failures linked to late treatment, preventing sufficient reduction in varroa dynamics in the colony, 4 apiaries where treatment was efficient and varroa sensitivity was still sufficient. A strong correlation was found between treatment effectiveness and laboratory measured sensitivity. This confirms the need for integrating complementary strategies such as winter treatment and population-based control method. Interannual monitoring also showed a slight improvement for miticide sensitivity when a molecules rotation was introduced for a first year. So far, the study revealed a high degree of heterogeneity towards miticide sensitivity within the apiaries, with moderate to prominent levels of resistance. This result underlines the importance of a global, integrated approach combining environmental factors, infestation monitoring and associating population-based control methods with existing acaricide treatments. ADA-GE aims to continue this study to refine its understanding of sensitivity-loss dynamics and give beekeepers a flexible and optimised tool to build the most suitable integrated management strategy to their apiaries.

PP-111 [Bee Health]
Pathogens on the move: impact of transmission between managed and wild bees

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Wild and managed bees are essential pollinators, supporting natural ecosystems and agricultural productivity. However, growing concerns about wild bee declines have highlighted the need to better understand the impact of shared pathogens. Indeed, previous research has suggested that pathogens can be shared between managed honey bees and wild pollinators. However, the extent of this transmission, the consequences for wild bee reproduction, and the role of bee management remain unclear. In this project, we will use a comprehensive approach with nine managed and wild species to better understand these factors using genomic tools, we will explore which pathogens are shared, which actually have an impact on survival and reproduction, and how viruses evolve as a result of interspecific transmission. This project will also compare historical and contemporary samples to study long-term pathogen infection dynamics. In addition, we will evaluate whether improved control of Varroa destructor, a known vector of viruses, can reduce virus spillover to wild bees, and whether managed solitary bee densities affect their level of infection. Altogether, this interdisciplinary project will integrate state-of-the-art molecular techniques with innovative field and laboratory assays to provide critical insights into pathogen spillover dynamics. In collaboration with farmers and beekeepers, BEENERGIA (Bridging Ecological and socio-Economic scieNces to Enhance our undeRstandinG of the Interactions between mAnaged and wild bees) aims to develop evidence-based management strategies to mitigate disease transmission and support both wild and managed bee populations. These findings will contribute to a more sustainable coexistence of managed and wild pollinators, informing conservation policies and promoting best practices in beekeeping and pollinator management.

PP-112 [Bee Health]
Gut microbiome composition and hygienic behavior as indicators of varroa resistance in an Italian honey bee breeding population

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Honey bees are essential pollinators critical to maintaining biodiversity and agricultural productivity globally, contributing significantly to food security and ecosystem stability. However, honey bee colonies are facing numerous challenges, among which the Varroa destructor mite is one of the most significant threats. Selective breeding programs aimed at enhancing hygienic behavior, a trait that enables bees to detect and remove infected or infested brood, represent a pivotal strategy to improve colony health and resistance to this pest. Recently, attention has also been directed towards the potential role of gut microbiota in enhancing bee health and resilience. In the current research, we investigated the association between gut microbiome composition and hygienic behavior in a population of honey bees selectively bred since 2015 for docility, honey production, and hygienic behavior. A total of 77 colonies were sampled three times between June and October 2021, and hygienic behavior was assessed using the standardized pin test method in March and July. Microbial community diversity was characterized through high-throughput sequencing, and associations with hygienic performance were statistically analyzed. Our results demonstrated a clear but seasonally dependent relationship between microbiome diversity and hygienic behavior. Colonies exhibiting superior hygienic responses showed distinctive microbial community structures, particularly in October, after the varroa infestation typically peaks. β-diversity analyses confirmed significant differences in microbiota composition among colonies varying in hygienic ability. Notably, beneficial bacterial genera, such as Bifidobacterium and Lactobacillus, were enriched in colonies demonstrating high hygiene scores, suggesting their involvement in colony immune function and resistance mechanisms. These findings suggest beneficial gut microbiota may enhance honey bee immune function and hygienic efficiency, thus potentially contributing to improved colony resilience and reduced disease incidence. Clarifying these microbiome-behavior interactions provides valuable insights into bee health management and suggests novel approaches for incorporating microbiome manipulation into selective breeding programs. Consequently, this research opens avenues for future studies investigating probiotic-based approaches to improve honeybee health and varroa resistance.

PP-114 [Bee Health]
Treatment-free beekeeping: case study in Negev Desert

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Primal Bee

Treatment free beekeeping- managing bees without the use of artificial antibiotics or chemical pesticides, is one of the most difficult challenges and diffuse desires for many hobbyist beekeepers. The purpose of this work is to present a case study demonstrating success in treatment-free beekeeping due to ideal internal hive conditions, treatment-free stock, and a pseudoscorpion symbiosis providing biological control. Between 2015-2025, this study was conducted in a semi-desert climate on the border of BeerSeeva Negev desert. Attempts were made to select survivor colonies by catching feral colonies and swarms using a standard wooden Langstroth hive. Thermodynamic hive prototypes were designed and built, to ensure an ideal internal nest environment. The hive design was optimized, foundation drawn by bees and living pseudoscorpions were installed in the hive. Strong survivor colonies of Apis mellifera ligustica cultivated locally for 40y, were collected from swarms and feral colonies and maintained treatment-free for 5y. Survivor colonies were observed raising the internal hive temperature from 35°C to 45°C similar to an immune response to combat bacterial infection. This immune response was effective due to the thermal efficiency of the Primal Bee hive. The pseudoscorpions survived on the bottom board in the thermodynamic hives, and predation of Varroa was observed. Honey was harvested also in late autumn up to wintertime where nearby professional operations in standard hives are fed up to 60L of sugar syrup to survive. This presentation will highlight for beekeepers the importance of providing an ideal internal environment in the hive and the synergistic results of thermodynamics, bee biology, biological control and survivor stock genetics.

PP-116 [Bee Health]
Development of a metabolic preparation with high antimicrobial potential for use in the prophylaxis against Paenibacillus larvae causing American foulbrood in bee colonies

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The honeybee is accompanied by a microflora whose biodiversity is modified by a number of environmental and stress factors. One such threat is the bacterium Paenibacillus larvae, which causes the brood disease American foulbrood, which is subject to physical eradication by order of the Veterinary Inspectorate. Infected colonies weaken very quickly, the number of brood and bees being reared decreases dramatically, with the consequence that the economics of the farm is reduced or the apiary is completely closed and pollination is impaired. Seeing the untapped potential of biotechnology and microbiology in prevention of livestock diseases, an effort was made to develop and test, both in vitro and in vivo, a targeted and contact metabolic biopreparation with high antimicrobial potential against P. larvae, which, when used as a preventive measure, would reduce losses in apiary management and increase the preservation of the safety of the honeybee in the food production chain. The research problem was to reduce American foulbrood pressure in bee colonies by promoting the development of a physiological microbiome of competing brood and blocking the excessive proliferation and production of P. larvae endospores. The aim of this study was to provide beekeepers with a microbial product that: used in specific doses and forms of application, will reduce the pressure of the pathogen on the bee microbiome; will eliminate the increasing number of infested areas and disease outbreaks; will strengthen the microbiome of honeybee larvae and adults and break the chain of infection. The effect generated in this innovative product was achieved by multiple antagonistic and antimicrobial mechanisms conferred by the synergistic formulation consisting of a consortium of probiotic bacteria and 14 plants. Classical and molecular microbiology methods were used: antimicrobial activity (MIC, MBC, time-kill, halo effect) was determined according to EUCAST standards and qPCR. The safety of the product against bees was confirmed. The antimicrobial activity of the product was confirmed under laboratory conditions and a statistically significant reduction of several log orders of P. larvae in field apiaries. In an antibiotic-free, environmentally safe and food-safe manner, a probiotic administered prophylactically will be able to control P. larvae population.

PP-118 [Bee Health]
Development of a starch-vaseline formulation for controlled release of thymol as acaricide in beehives

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Thymol is a volatile monoterpene-phenolic antioxidant of plant origin, authorized in organic beekeeping for varroosis treatment. Beyond commercial products, beekeepers often use homemade oil-ethanol solutions applied on cardboard strips. However, these formulations dissipate rapidly, impacting bees' behavior and requiring re-application. Controlled-release thymol formulations offer a promising alternative by ensuring prolonged exposure at effective doses, while minimizing the risks of overexposure and reducing application frequency. Starch, especially its amylose component, can form inclusion complexes with various small molecules including thymol. In this work we evaluated a starch-vaseline-based formulation for varroosis control, applied on the same cardboard strips used for ethanol-oil solutions. The emission profile of both formulations were characterized by gravimetry and periodic volatile collections. The starch-based formulation exhibited a more consistent release rate, averaging 192 mg/día for 23 days (slope of emission curve: -5), compared to the reference formulation which dissipates rapidly at 458 mg/día for 10 days (slope -100). To assess efficacy, the formulations were tested in a 45-day field trial (March 2024) across 3 apiaries. Varroa infestation levels were estimated in samples (300-400 bees/colony) at the beginning and the end of the assay. The trial included 3 treatments: oxalic acid in glycerol applied on cardboard strips (12 colonies) as a positive control; thymol in an oil-ethanol solution applied on cardboard strips in colonies with an open entrance (11 colonies); and thymol in the starch-vaseline matrix on cardboard strips in colonies with an open entrance (14 colonies). Both thymol treatments incorporated 8g/colony were incorporated; and all treatments were re-applied after 15 days.

Comparing initial and final infestation levels, preliminary data indicate a 2.3-fold reduction in varroa infestation for oxalic acid, a 2.5-fold reduction for the starch-based thymol formulation, and no reduction for the oil-ethanol thymol solution.

These findings suggest that starch-based thymol formulations may be an effective alternative for sustained Varroa control in beekeeping.

PP-119 [Bee Health]
In-person workshops increase the likelihood of beekeepers adopting best management practices that are supported by science

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Beekeepers worldwide are experiencing significant honey bee (Apis mellifera) colony losses, caused by biotic and abiotic factors. While some factors are beyond a beekeeper's control, others can be mitigated by adopting best management practices (BMPs). Despite BMPs being widely recommended, many beekeepers do not readily adopt them. Barriers to adoption may include the scientific information not being delivered appropriately, beekeepers being skeptical of its credibility, or lacking experience. Using Varroa destructor management as a model topic, we assessed the effect of two different information delivery methods on behavior change in beekeepers. Beekeepers attending an in-person workshop were more likely to adopt the alcohol wash, the recommended, but lethal to honey bees, monitoring method for V. destructor. Participants attending the virtual training were more inclined to use an inferior practice, the powdered sugar shake, assumed to be non-lethal. In a separate experiment, we negated this assumption after evaluating the survivorship of honey bees subjected to the powdered sugar shake. Not only does the powdered sugar shake reduce honey bee survivorship, it also resulted in more variable estimates of mite infestation levels which could impact subsequent decision making by beekeepers. Understanding how to invoke behavior change in beekeepers and scientifically testing long-standing assumptions are crucial to increase the adoption rate of BMPs and the success of beekeeping operations.

PP-121 [Bee Health]
Incidence of Vairimorphosis (nosemosis) across continental Croatia over two consecutive years

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Vairimorphosis (nosemosis), a disease affecting adult honey bees, is widespread across the territory of the Republic of Croatia. Despite its prevalence, beekeepers often remain unaware of its presence within their hives and, as a result, generally do not pay significant attention to its potential impact on colonies. This is particularly the case since the emergence of Vairimorpha (Nosema) ceranae, which has now become the predominant species. The clinical signs of infection caused by V. ceranae differ considerably from those associated with Vairimorpha (Nosema) apis, a species more familiar to beekeepers. The absence of visible faecal marks on hives and combs, a common sign of V. apis, has contributed to a widespread misconception among beekeepers that Vairimorphosis is not present in their apiaries. This study aimed to assess the prevalence of Vairimorphosis in honey bee colonies across continental Croatia, focusing on apiaries managed by experienced beekeepers who maintain 100 or more honeybee colonies. The research was conducted over a two-year period to evaluate the occurrence and spread of the disease. Samples were collected in late summer from a total of 30 apiaries for Vairimorphosis analysis conducted in 2017 and 2018. At each selected apiary, a total of 60 bees were sampled between 25 and 70 randomly selected colonies. In total, laboratory analysis was conducted on samples from 2,122 colonies. Microscopic examination of the collected samples revealed the presence of Vairimorpha spp. spores in 45.29% of the analysed colonies in 2017. In 2018, the prevalence of infection was 35.57%. Beekeepers were informed of the 2017 results and recommendations. Recommended interventions included maintaining hygienic water sources, replacing old combs, and disinfecting stored combs using acetic acid fumes. Beekeepers also made independent decisions regarding the use of commercially available compounds registered on the Croatian market. Some decided to dismantle weak and heavily infected colonies, followed by disinfection of hives and combs.

PP-123 [Bee Health]
Postbiotics in beekeeping: benefits in the strength of the beehives and direct effect against Varroa destructor

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Beekeeping is facing many risks today that jeopardize its continuity. Some of the more important are scarcity of food resources, climate change, exposure to agricultural pesticides or pathogens such as Varroa destructor or Nosema ceranae. Bioactive compounds, like probiotics, are being investigated such as a novel and promising approach to improve the strength of the beehives due to their ability to enhance the immune system and compete with pathogens. The aim of this study was to explore the beneficial effects of postbiotics (i.e. inactivated beneficial lactic acid bacteria and their metabolites from natural microbiota of honeybees) in beekeeping in two different ways, such as feed supplements and as a direct tool to fight against V. destructor. Two different experiments were carried out to achieve these goals. The first experiment was performed in beehives under field conditions, applying postbiotics together with sucrose syrup. Two assessments (before and after supplementation) of the strength (number of bees, brood and pollen/honey reserves) and sanitary status (V. destructor and N. ceranae infestation levels) were performed. Beehives that consumed postbiotics increased the population of adult bees and the queen egg laying, as well as their storage of pollen, and reduced the loads of N. ceranae. The second experiment was carried out to assess the possible effect of postbiotics against V. destructor under laboratory conditions. Four different species of lactic acid bacteria isolated from honeybees and larvae samples were cultured, inactivated by heat and tested. Frames from beehives with high V. destructor infestations levels were taken to laboratory, and pupae and mites were extracted from capped cells. The mites were exposed to the different bacterial species via bioassay and subsequently their viability was checked. Three species significantly reduced the viability of the mites (Leuconostoc mesenteroides, Lactobacillus helsingborgensis and Bacillus velezensis). These results showed how postbiotics could be a promising tool to help the beekeepers to face the risks to which beekeeping is currently exposed, showing that could improve the strength, production and sanitary status of the beehives such as feed supplements and act against V. destructor.

PP-124 [Bee Health]
Hive type and genetics for improved varroa survival and resistance

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A long-term sustainable solution to varroosis is the selection and breeding of varroa-resistant lines. In Galicia (North Spain), Iberian genetic lines have been managed without treatment since 2015, following the MENA programme. This programme aims to control varroa by creating optimal in-hive conditions. This includes putting frames in 'hot arrangement' (parallel to the hive entrance), using no artificial wax sheets, and adding an additional frame so as to reduce the distance between frames (=MENA hive type). Beekeepers do minimal interventions so as not to disturb colony homeostasis, continuously monitor natural varroa fall, and treat only if necessary (if infestation is above a certain threshold). Each year, new queens are bred from the untreated survivor colonies. The ECOAPI project (MICINN-TED 2021) aims to elucidate the role of genetics, hive type and environmental factors in the resistance of colonies to varroa. To this end, in 2023-2024, we conducted a field experiment comparing the type of hive management (MENA vs conventional) and three genetic lines (two lines originating from the MENA programme and one commercial) in three apiaries with different environmental conditions (n=75). Varroa infestation was monitored by counting natural mite fall on the bottom boards and in adult bees with icing sugar. Colony strength (number of brood frames/adults) and hygienic behaviour (pin test) were assessed. Colonies were equipped with internal temperature and humidity sensors, as well as with a scale. All colonies were left untreated. The results revealed that the two genetic lines originating from the MENA programme had superior hygienic behavior and lower varroa loads compared to the commercial line, however, no difference in overwinter survival was observed. In regards to the hive type, colonies housed in MENA hive types had a higher survival rate than bees in conventional hives, despite similar varroa levels. A possible explanation could be that colonies in MENA hives could better maintain homeostasis in winter, as we recorded that they had a higher internal temperature compared to conventional hives. ECOAPI (TED2021-131393B-I00) is funded by the Spanish Ministry of Science and Innovation and the State Research Agency.

PP-126 [Bee Health]
Comparing Apis mellifera health outcomes using biotechnical methods, organic chemicals or synthetic chemicals to manage Varroa destructor during the initial invasion phase in subtropical Australia

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Varroa destructor is the most damaging pest of Apis mellifera world wide. Australia is the last large scale beekeeping industry to have to alter management practices to accommodate Varroa destructor. The presence of both worker and drone brood year-round as well as the need to keep supers on for honey production year-round in subtropical Australia present challenges for conventional chemical Varroa management. This is further compounded by Australian consumer perceptions and beekeeper preferences against the use of chemicals in beekeeping. This presents opportunities for Australian beekeepers to take advantage of recent research into biotechnical methods of Varroa management. This will also be imperative in the high risk event of a tropilaelaps clareaeincursion into Australia. However, extremely high infestation rates during the initial invasion period caused by up to 150 feral colonies per square kilometre question the viability of biotechnical methods or even organic acid management under these challenging conditions. A comparison is underway at the Varroainvasion front in subtropical New South Wales comparing the effect of biotechnical, organic chemical and synthetic chemical management methods on colony survival and health. This will also compare alcohol wash and natural mite fall as viable monitoring methods during the invasion period. A two frame queen isolator trap cage will be used for biotechnical methods. Sublimation of Api-bioxal oxalic acid and FormicPro formic acid pads will be rotated for organic acid treatment. Bayvarol (active ingredient flumethrin) and Apivar (active ingredient amitraz) strips will be rotated for synthetic chemical treatment. All hives will be have a monthly alcohol wash and daily mite drop calculated to compare these methods of monitoring under heavy invasion conditions. Initial results will be available for analysis in August 2025. These results will have major implications for both recreational and commercial beekeepers assessing the viability of different management methods in their apiaries as Varroa continues to spread in Australia. Extension activities will be undertaken throughout 2025 to assist local beekeepers managing Varroa destructor for the first time. Wider extension activities will be undertaken in 2026.

PP-127 [Bee Health]
Novel Approach to Hive Health and Varroa Control

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Annual Bee hive losses of 40-50% have become common, with recent years trending even higher. These losses are often attributed to a combination of environmental, chemical, and pathogenic components. Solutions are needed that can reduce the impacts of external stressors while simultaneously cleansing the hives of pest and pathogenic pressures to promote healthy and vigorous hives. However, current methods of treating hives can have their own toxicity to bees or their human caretakers, can be difficult to implement, and can induce resistance in the intended target. Here we show results from hive treatments conducted in Corrales, New Mexico, that suggest that ApiVera enhances hive resilience, improves brood health, and contributes to higher survival rates, while simultaneously reducing pathogen load in the hive, including Varroa mite and total microbial counts, using an oxidative chemistry that is less likely to produce resistance, making it a promising alternative or supplement to conventional beekeeping management strategies.

PP-128 [Bee Health]
Evaluation of screen and sticky bottom boards for the control of Varroa destructor in Africanized and European honeybees

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The ectoparasitic mite Varroa destructor is the main biotic threat to honey bees worldwide. Honey bees exhibit various behavioral resistance mechanisms to manage Varroa parasitism, with grooming being one of the most important. It consists on the dislodgement of the mites from parasitized bees and can be autogrooming (by dislodging the mites from themselves) or allogrroming (when receiving help from other bee to dislodge the mites). However, detached Varroa mites that fall to the bottom boards (except the damaged ones) might parasite bees again, limiting the benefits of the grooming behavior. This issue could be mitigated by using bottom boards designed to prevent mites from re-entering the colony. In this study, we evaluated the effectiveness of screened and sticky bottom boards in limiting Varroa population growth in colonies of European and Africanized honey bees, which have previously been shown to differ in grooming behavior. Colonies were divided into six groups: European bees with conventional bottom boards, European bees with screened bottom boards, European bees with sticky bottom boards, Africanized bees with conventional bottom boards, Africanized bees with screened bottom boards, and Africanized bees with sticky bottom boards. Adult population, brood, and Varroa infestation levels were assessed every 30 days from January to May. At the beginning of the experiment (January, summer in the Southern Hemisphere), all colonies had an infestation rate below 1%. By May, the infestation levels in Africanized bee colonies remained around 2% across all groups, whereas European bee colonies exhibited significantly higher infestation rates, between 4 (sticky bottom boards) and 8 times (conventional and screened bottom boards) higher than their Africanized counterparts. In European bees, colonies with sticky bottom boards had 36% and 52% lower infestation rates than those with conventional and screened bottom boards, respectively. Our results confirm that European honey bees are significantly more susceptible to Varroa than Africanized bees. Furthermore, sticky bottom boards proved to be a valuable tool in reducing Varroa population growth and could be effectively integrated into pest management strategies.

PP-130 [Bee Health]
Living with the small hive beetle: what we have learned after 15 years of continuous pest pressure in Hawaii

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The small hive beetle (SHB; Aethina tumida) is an invasive bee parasite that continues to spread globally. The SHB arrived in Hawaii two years after Varroa destructor was detected, compounding an already difficult situation for beekeepers. Here we present a longitudinal perspective on the establishment of this pest, from initial densities to current levels, seasonal patterns, and management strategies of the local beekeepers. On Oahu, colony inspections during the dispersion phase included complete colony assessments (traps and visual screenings), although most “free beetles” were found on the cover and side honey frames. The 2010-2011 SHB prevalence was low, less than 3 beetles/hive/week. We sampled four additional sites on Oahu from 2011 to 2012 and found the average had increased to 7.24 beetles/colony/week. We sampled again in 2015 -2016 and in 2022- 2023 and found that colonies averaged 28.39 and 11.98 SHB per hive/week, respectively. Although we detected strong seasonal peaks in each study period, there was large inter and intra-colony variation in infestation and no congruent seasonality pattern from one year to the next. The first years of SHB invasion were linked to a decrease in swarm establishment success. Adult beetles were observed entering swarm boxes at a rate of 1 beetle/min and a swarm could attract over 100 beetles. Swarm losses to SHB are now rare. Similarly, the collapse of managed colonies to SHB (slime outs) are also less common now. The beekeepers have evolved in their SHB management practices. Initially, the preferred tools for beetle control included oil traps between the frames, oil pans below a screened bottom board, and floor of the hive traps filled with killing agents, some off label. Using soil pesticide drenches to kill beetle pupae was quickly abandoned. Recently, beekeepers have incorporated the use of microfiber sheets to entrap the beetles. However, we have shown that these sheets produce microplastic contamination inside the hive. While oil traps remain the most common SHB control method in Hawaii, a growing proportion of beekeepers are not using any traps and manage the beetle by keeping strong colonies and ensuring full bee coverage of the frames.

PP-132 [Bee Health]
Addition of postbiotics enhances the effectiveness of oxalic acid treatments against Varroa destructor under field conditions

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Varroa destructor poses one of the greatest risks to the beekeeping sector. Currently, efforts are underway to design alternative strategies for controlling this parasite. One example of an alternative treatment is postbiotics that are liquid extracted from inactivated acid-lactic bacteria derived from health bees. Postbiotics have shown high efficacy in vitro against V. destructor. The objective of this study is to evaluate the effectiveness of applying postbiotic compounds, both alone and in combination with oxalic acid, under field conditions. Two experiments were conducted, one in summer and the other in autumn, where the hives were divided into four groups according to the treatment received: control (C), postbiotic (POS), oxalic acid (OX), and the combination of both (POX). For product application, cellulose strips impregnated with each product were made, and eight strips were placed in each hive. All hives were monitored at the beginning and end of the experiment, estimating the number of bees and the amount of capped brood, and bee and brood samples were taken to determine the levels of phoretic varroa and varroa in brood, respectively. Additionally, strips were placed on the bottom boards, and mite fall was measured every two days. To calculate the effectiveness of each treatment, mite fall data were used, and the number of remaining mites in the hives was estimated based on the bee, brood, phoretic varroa, and varroa in brood data. Results showed that the combined compound (POX) was the most effective in reducing phoretic varroa levels in both experiments. Treatment efficacy was very low in the C and POS groups, and significantly higher in the OX and POX groups. Thus, the postbiotic alone did not show a clear effect against V. destructor under field conditions, but it significantly improved the results of oxalic acid when applied in combination, suggesting it could be a useful adjuvant to enhance the effect of this compound.

PP-133 [Bee Health]
Honey bee nutrition as a beekeeping management practice: the first global survey by the COLOSS Bee Nutrition Task Force

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Honey bee malnutrition and starvation are current major global challenges. The pollen and nectar shortages are dramatically impacting bee health and the beekeeping sector, forcing repeated and prolonged emergency feeding interventions to ensure their well-being and their productivity. While poor nutrition has a negative impact on honeybee health and development, there is a limited understanding on the role and impact of feeding practices and perceptions among beekeepers. The COLOSS Bee Nutrition Task Force, that gathers experts in bee nutrition, has therefore developed and implemented a global nutrition survey to provide an overview of current feeding practices and the nutritional challenges faced by honey bee colonies. The Task Force monitored 218,768 colonies distributed across 20 countries (year: 2022). This survey revealed that feeding practices are a very common strategy used by 77% of the beekeepers. Beekeepers perceive negatively supplemental bee feeding products (40.7%) highlighting dissatisfaction with commercial products. Most beekeepers (52.4%) describe that prolonged drought periods represented the most severe cause of honey bee nutritional stress. Future activities involve integrating data from subsequent years and deepening knowledge of the beekeeper feeding strategies in broader areas of the world. This work highlights that, to face the dramatic increase of nutritional stress events, innovative strategies for sustainable beekeeping are needed.

PP-138 [Bee Health]
Honey Bee Colony Losses in Turkey: Winter 2022/23 and 2023/24 Findings from the COLOSS Monitoring Questionnaire

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Honey bee colony health is essential for pollination services and agricultural sustainability. In Turkey, high colony loss rates continue to raise concerns. The 2023 and 2024 COLOSS Honey Bee Colony Loss Surveys aimed to assess these losses and identify contributing factors to improve colony management strategies. Despite previous research, limited data exist on the causes of colony losses in Turkey, hindering effective interventions. Continuous monitoring through standardized surveys is crucial to understanding loss trends and their underlying factors. The 2023 survey included 50 beekeepers with 4,371 colonies before winter, while the 2024 survey expanded to 131 beekeepers with 11,505 colonies. Both surveys used the COLOSS standardized questionnaire to record losses due to dead/empty colonies, colonies alive after winter but with unresolvable queen issues, and natural disasters. In 2023, the overall loss rate was 34.1 percent, with 25.1 percent attributed to dead/empty colonies, 7.4 percent to queen problems, and 1.6 percent to natural disasters. In 2024, the overall loss rate increased slightly to 35.8 percent, with 19.8 percent due to dead/empty colonies, 7.8 percent to queen problems, and 8.1 percent to natural disasters. While overall losses remained high, natural disaster-related losses increased, whereas dead/empty colony losses declined. These findings highlight the need for better queen management, colony health strategies, and climate resilience. Greater beekeeper participation in surveys will improve data accuracy, aiding effective loss prevention. Adaptive management is crucial for sustainable beekeeping in Turkey.

PP-141 [Bee Health]
Optimized nutrition for managed bees: a scalable solution to pesticide exposure

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BACKGROUND: The decline of managed and wild bee populations is a global concern due to their critical pollination services. Among the causes, insecticides play a major role, with both lethal and sublethal effects. Sublethal impacts are particularly critical because of the subtle impairment of individuals, later translated into the deterioration and collapse of entire colonies.

Problem: Addressing the effects on insect pollinators, multiple countries have banned and restricted major neuroactive insecticides. However, legislation alone is insufficient, it is slow, temporary and local. Worse, it may drive the insecticide market and encourage the use of alternative products prone to evolution of resistance by pests. Hence, ensuring food security amid pollinator decline and potential pest outbreaks requires urgent, multilevel strategies. This presentation summarizes key findings on how targeted nutrition can protect managed bees from pesticide exposure.

METHODOLOGY: Nutrition is a key factor in bee health, and specific nutrients have been studied for their potential to enhance resilience against insecticides and environmental stressors. Over the past eight years, we have tested plant-based metabolite compositions designed to protect cognitive, motor, and immune functions in managed bees. These formulations have been evaluated against insecticides with different mechanisms of action, targeting a broad spectrum of protection.

Results and CONCLUSIONS: Our research demonstrates impairments in learning, memory, motor control, temperature regulation, sensory sensitivity, and immune function caused the neonicotinoid imidacloprid, the pyrethroid deltamethrin, and the phenylpyrazole fipronil. Our compositions provided protection ranging from 40% to 100%, leading to the development of a specific formulation that offers prophylactic protection when administered via pollen patties or syrup. These findings support the idea that managed bees can be shielded from realistic pesticide exposure through targeted plant-based nutrition. This research opens avenues for precision nutrition approaches to improve pollinator health.

Practical implications for beekeepers and stakeholders: Our compositions: 1. Are easily administered to managed bees via pollen patties or sucrose syrups, 2. Contain specific doses of plant-derived molecules, eliminating contamination concerns. 3. Are protected by intellectual property rights (patents and PCT), 4. Are available for entrepreneurial beekeepers and stakeholders interested in technology transfer and product development.

P-142 [Bee Health]
Simultaneously applying Darwinian selection for honey bee survival in 8 European countries

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The ectoparasitic mite Varroa destructor remains the biggest biotic threat to European honey bees (Apis mellifera L.). The majority of beekeepers rely on varroa treatments to maintain their colonies, but effectiveness is limited for a number of reasons, including pesticide resistance or continued brood production throughout the winter, which limits the effectiveness of miticides and results in continued high colony losses. A potentially more sustainable solution focuses on breeding honey bee lineages with natural resistance to V. destructor. Observations of African and European populations surviving without treatment highlight the beneficial role of adaptation in addressing the varroa problem. In response, a method has been developed to establish sustainable populations of untreated European by splitting the fittest colonies: the Darwinian Black Box (DBB) protocol. A notable case demonstrate 16 years of survival without varroa treatment, likely due to naturally selected resistance traits as well as beekeeping practices incorporated into the DBB protocol. However, the effectiveness of this approach across diverse climatic conditions and honey bee populations remains uncertain.

In this study we apply the DBB protocol across eight European countries using locally adapted A. mellifera subspecies. Colony performance and survival are monitored, and data are collected to identify early signatures of surviving DBB colonies. This includes genetic markers as well as colony development patterns captured through an automated hive weight monitoring tool (BEEP, NL). Additionally, we assess the potential correlation between colony responsiveness to vibrational stimuli and performance within the DBB protocol.

By assessing the broader application of this method and identifying early indicators of success, we will determine the effectiveness and limitations of the DBB protocol as a practical tool for sustainable beekeeping. This research has the potential to provide beekeepers with a viable, pesticide-free strategy, fostering resilient honey bee populations and supporting a sustainable future for apiculture in Europe and beyond.

PP-143 [Bee Health]
Varroa Surviving Bees in Argentina (ASVA): A national project

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INTRODUCTION: Global beekeeping has undergone profound changes since Varroa destructor shifted to its new host, Apis mellifera, in the late 1950s in Vladivostok, Russia. Today, except for Australia and a few African countries, Varroa-free zones are virtually nonexistent. Argentina, characterized by a broad latitudinal gradient, encompasses diverse climatic conditions that influence bee populations. Consequently, European and Africanized honey bee populations coexist within the 32°–35° latitudinal range, forming a transition zone between both ecotypes. Africanized bees predominantly inhabit the northern regions, whereas European ecotypes are more common in the south. While most Varroa-resistant bee populations in Argentina belong to Africanized ecotypes, some European-derived populations have also demonstrated long-term survival against the mite. This study aims to investigate the population dynamics of Varroa destructor and its association with honey bee pathogenic viruses in Apis mellifera colonies with varying degrees of susceptibility to the mite.

MATERIALS-METHODS: Seventeen apiaries across different geographic regions of Argentina were sampled, all of which had remained untreated with acaricides for at least two years. The study assessed the genetic lineage of the resident bee populations, the Varroa-bee interaction, and the prevalence of honey bee viruses.

RESULTS: The Patagonian region exhibited the lowest proportion of bees with African lineage (A), the lowest viral loads, and the lowest Varroa infestations. In contrast, the NOA + Cuyo region had the highest proportion of African lineage (A), the highest Varroa loads, and the highest viral loads.

DISCUSSION: Although honey bee populations in Patagonia displayed the lowest pathogen burdens and the lowest prevalence of African lineage, they are highly adapted to cold climates and may struggle to thrive in other regions of Argentina. Given this constraint, three apiaries from the Central region and three from the NOA region were selected for further investigation in the second phase of this study.

PP-145 [Bee Health]
French beekeepers against neonicotinoids: a 30-year struggle

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In the early 90s, a new generation of pesticides used to coat seeds, the neonicotinoids, appeared and enjoyed considerable success. These hyper-powerful molecules (imidacloprid, thiamethoxam, acetamiprid, etc.) are diffused throughout the plant as it grows, from seed to flower. In large-scale farming areas, beekeepers complained about the sudden loss of bee populations and honey harvests, and blamed these new treatments. Scientists very quickly provided undeniable proof of the causal links between neonicotinoids and excess bee mortality. And this at infinitesimal doses. On the basis of the European directives in force, UNAF engaged in a very long legal, political and media struggle at national and European level, which lasted for more than twenty years. This struggle is eloquent in many respects, and for that reason deserves to be analysed to serve as an example to follow for future controversies. It made it possible to ban these molecules at national level and to marginalise them at European level. But today, with the agricultural crisis, these achievements are once again under threat...

PP-147 [Bee Health]
Effect of land use and honeybee colonies on the distribution of Vespa velutina in the North Portugal

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The invasive species yellow-legged hornet, Vespa velutina, is established in Iberia since 2011. One of its most notableecological and economic negative effects is its impact on pollinators, and in particular in honeybee colonies, Apis melliferaiberiensis. Despite its presence in the region for more than a decade, there is limited knowledge regarding the influence of thisinvasive species on the decline of western honeybees in the region and the role of beekeeping practices in hornet dispersal.Moreover, despite numerous studies examining the environmental factors contributing to the invasion of the yellow-leggedhornet, little is known about the effects of land use over temporal patterns. This study aims to analyze how climate, land use,and wildfire pressures have shaped the distribution of V. velutina and how these factors will impact future dispersal patterns.Additionally, we seek to investigate the influence of the hornet on local apiary populations and the significance of these apiariesin the dispersal of the hornet. To conduct our research, we used crowd-sourced data on hornet nest sightings, which we analyzed employing GIS withexplanatory variables available encompassing land use, climate and other environmental variables. Through this study, weanticipate shedding light on observed patterns and gaining a better understanding of the intricate dynamics involving theyellow-legged hornet, ultimately contributing to informed strategies for its management.

PP-149 [Bee Health]

Thermotolerance of the honey bee: differences between three subspecies of Apis mellifera living in Mediterranean basin

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Italy, Jordan and Spain are three Mediterranean countries, where different local subspecies of Apis mellifera live, highly adapted to different environments. The Mediterranean is a worryingly vulnerable area in the face of climate change, and today bees are trying to adapt to new and increasingly extreme climatic environments. Both thermal tolerance and the degree of plasticity play key roles in determining the geographical distribution of species. Within the MEDIBEES project, thermal tolerance assays have been carried out comparing Apis mellifera ligustica in Italy, A.m. syriaca in Jordan, and A.m. iberiensis in Spain. Thermotolerance is defined as the temperature range between the coldest temperature (critical thermal minimum, CTmin) and the warmest temperature (critical thermal maximum, CTmax) at which an organism can maintain muscle control. From the 3 subspecies, workers and drones of different ages were exposed to two different temperature ramps: from 30 to 70ºC (heat study), and from 35 to 0ºC (cold study). Our results showed differences in both heat and cold tolerance between subspecies, as well as sex and age-related differences within all of them. In heat assay, the Iberian bees showed signs of thermal stress up to 40ºC, and both A.m. iberiensis and A.m. syriaca individuals showed hyperthermia up to 45ºC, where mortality was detected in some ages or castes. Contrastingly, A.m. ligustica showed lower heat tolerance with a mortality threshold at 41ºC in all the groups. Regarding cold-tolerance, the 3 subspecies showed different effects: while no signs of cold stress or hypothermia were detected in A.m. syriaca, all of them appeared in A.m. iberiensis and A.m. ligustica, but at different temperature ranges. In the Iberian bees, mortality occurred in foragers below 6ºC, while Italian foragers was the only group which did not show mortality by cold. Further experiments are actually carried out within MEDIBEES to property understand the molecular bases of the differences founded. These results are under the project 2011-MEDIBEES, which is part of the PRIMA programme supported by the European Union.

PP-151 [Bee Health]

Studying dehydration as an adaptive trait in honey bees: differences among nine Apis mellifera subspecies living in Mediterranean basin

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Adaptability is defined as the ability of an organism to adapt to new situations. Nowadays, climate change is creating new environments to which all living organisms must respond and adapt. The increasingly high temperatures suppose one of the most important abiotic pressures, but changes in precipitation patterns are also key. Both variables are closely related and, when get combined, act as new independent stressor. In bees, the dehydration capacity is defined as an adaptive trait under heat stress. One way to study this characteristic is calculating the body water loss (BWL) per bee before and after the exposure to a specific combination of temperature and humidity. Within MEDIBEES project, BWL assays were performed with nine subspecies living in Mediterranean basin: Apis mellifera ligustica in Italy, A.m. syriaca in Jordan and Lebanon, A.m. iberiensis in Spain, A.m. anatoliaca in Turkey, A.m. lamarkii in Egypt, A.m. ruttneri in Malta, and A.m. intermissa and A.m. sahariensis in Algeria. In this study, we tested 9 different conditions which combined 35ºC, 40ºC and 45°C of temperature with 10%, 25% and 50% of RH. Using standard protocols, the same experiment has been carried out at different laboratories of each country with their corresponding subspecies. The results showed differences in the dehydration ability between subspecies which point to a different adaptability to hot environments. An additional study was carried out in Spain to analyse the adaptation of 3 different subspecies in the same apiary: A.m. iberiensis (local subspecies) was compared with two introduced subspecies stablished during 1 year (A.m. ligustica and A.m. carnica). Our results show no signs of adaptation of the Italian bees to the Spanish environment, and a similar behaviour between A.m. iberiensis and A.m. carnica. Additionally, we demonstrate the repeatability of our tests comparing A.m. iberiensis to the previous year. This knowledge of the adaptability of bees is key to understanding the challenges facing beekeeping today and in the future. These results are under the project 2011-MEDIBEES, which is part of the PRIMA programme supported by the European Union.

PP-154 [Bee Health]
Apiguard® and Oxalic Acid three-year monitoring trial 2021 – 2023 – Nord East Italy

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2Consorzio Apicoltori Gorizia

The objective of this monitoring was to verify at different times of the year the strength and vitality of bee families subjected to a well-defined plan of varroa control with Organic treatments in Nord East Italy. In 2021, 413 hives were monitored, of which 36 were tested according to organic IMP protocol, where Apiguard® (thymol) and oxalic acid were used in different combinations and times of the year. In the following two years, we increasing the number of hives monitored, reaching 424 in 2022 and 479 in 2023 and the protocol was adjusted. In 2021, group where both active ingredients were used during the year, there was not lost hives, moreover the reduction of strength at the end of autumn was more contained.
In 2022 and 2023, regarding strength in spring, again there was a difference between full treatment and other 2 groups where at some point of the year only 1 of the treatment was used. The conclusion after 3 years of using Apiguard® + oxalic acid in a IPM protocol, none of the colonies were lost. Varroa population was controlled over the years. The colony strength is higher than the other groups. The spring treatment and post acacia harvest are decisive to keep the varroa load low, and reduce the reinfestation in September. An IPM based on organic product like Apiguard® in combination with Oxalic acid, can be used safely and effective for organic and conventional beekeepers.

PP-157 [Bee Health]
Low Varroa destructor infestation and the potential of organic beekeping in Pernambuco Brazil

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Beekeeping has been consolidated as an important source of employment and income for small producers in the Brazilian Northeast, playing a fundamental role in the regional economy and in the fixation of man in the countryside. In addition, the region has ideal conditions for the production of organic honey, being one of the few in the world with this potential, due to the vast availability of native flora free of contamination by agrochemicals. The objective of this study was to evaluate the infestation rate by the Varroa destructor mite in the regions of Sertão, Agreste and Zona da Mata of Pernambuco – Brazil, in order to ensure the sustainability of organic beekeeping in the region. Varroa destructor is one of the main parasites of bees of the genus Apis, and can compromise the health of the swarms and the productivity of the hives. Its control is a challenge for worldwide beekeeping, and its presence at low rates is a positive indicator for the sustainable production of organic honey. The average annual temperature in the Sertão of Pernambuco is 31,8°C, in the Agreste 29,2°C and in the Zona da Mata 30,6°C, with average relative humidity of 30%, 51% and 80%, respectively. Bee samples were collected from 85 colonies, which were transferred to a container containing 70% alcohol to determine the infestation rate, using the methodology of De Jong and Mantilla (1986). The analyses were carried out at the Laboratory of Animal Genetics and Bee Breeding Prof. Dr. Warwick Estevam Kerr, in the Department of Animal Science at Federal Rural University of Pernambuco. The results indicated an average Varroa destructor infestation rate of 1.27 ± 0.025, which is considered low. It is concluded that the low mite infestation in Pernambuco favors the production of high-quality organic honey, reinforcing the viability of sustainable beekeeping in the region and its socioeconomic importance for local beekeepers.

PP-158 [Bee Health]
Management of pests and predators of Honeybee: Control strategies for improved bee keeping in India

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Beekeeping is one of the small scale industries in India which provides lively hood of many marginalized sections of the society. However, health of honey bee is utmost priority for improved bee keeping The Indian bee is comparatively free from many infectious diseases except Thai Sac brood virus. In our country bee enemies are more dangerous taking a heavy toll of life, as a result of which annually many colonies deserted by the bees. Pests of honey bees causes losses to bee keeping thereby affecting the yield of apiculture and also hampers the upliftment of weaker sections of the people especially tribal, vulnerable people from far rural part of India. In view of the above present study focussed on Overview and Management of pests and predators. The greater wax moth, Galleria mellonella is major pest of honey bee recorded from South part of India it is seen causing severe damage in the plains and lower altitudes but it is rare in high altitudes. It is one of the most observed throughout the year but more common and severe during July to October and November to December. They attack weak colonies and carry away the honey, pollen and the brood. The yellow banded hornet, Vespa cincta F. is a large wasp with a broad transverse yield band on the abdomen. Wax beetles. The tenebrionid beetle, Platybolium alvearium B., is found in the hives under unhygienic conditions feeding on the debris and on old combs in weak colonies. The Robber bee, the leaf cutter bee Megachile disjuncta, dragon flies and capture bees and feed upon them. In the present study we have enlisted the pests, and predators of honey bees from different parts of Maharashtra and also focussed on their control by using appropriate strategies for improved beekeeping in Maharashtra, India.

PP-159 [Bee Health]
How does combined exposure to pesticides and Nosema ceranae affect bee health?

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Agricultural intensification in recent decades has led to extensive use of agrochemicals. In fact, beekeeping is not exempt from this problem, and acaricides must frequently be applied to control Varroa destructor. Diseases caused by different pests and pathogens are more probable in crowded apiaries with honey bee colonies in stressful environments. In this scenario, the honey bees are chronically exposed to mixtures of pesticide residues which weaken the colonies on a stress treadmill. Therefore, the question is how the early ingestion of pesticides can alter the development of gut defensive barriers like the microbiota or digestive diseases such as nosemosis. Hence, the current study aimed to assess the interaction between Nosema ceranae infection with a common pesticide mixture. For that, we caged newly emerged bees (3 replicates with bees from 5 colonies) and reared them under lab conditions. Adult bees were chronically exposed to the herbicide glyphosate (0.7 mg/L), the acaricide oxalic acid (280 mg/L) or both administered in sucrose solution (1:1), besides a group without pesticides. According to the literature, these concentrations correspond to the maximum value of residues detected in hives. Meanwhile, the same 4 treatments were performed, adding N. ceranae (80.000 spores/bee) at 2 days of age. Therefore, we carried out 8 treatments with the different possible combinations of exposures, measuring intake and survival. Then, the infection development was monitored at 6, 9 and 12 days of age while the gut microbiota was analysed at 10 days. Lastly, we assessed physiological alterations in 14-day-old bees, measuring dry weight and gustatory responsiveness. The experiment was performed twice, at the beginning and end of the queen oviposition period (early spring and late summer). Our results showed no synergic interactions between the combinations of stressors on survival. However, the pesticides had lethal effects depending on the brood cohort (e.g. oxalic acid showed high mortality in late summer bees). Finally, we found signs of gustatory desensitization when more stressors were combined. Future studies must assess more mixtures and integrate different sub-lethal effects (e.g., in microbiota and behaviour) for a greater understanding of the scale of the bee health impairment.

PP-163 [Bee Health]
Profiling the Bee Gut Microbiome for Diagnosing Stressor Exposure: The Neonicotinoid Insecticides Example

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The European honey bee (Apis mellifera) plays an essential role in agriculture around the world. In North America alone, honey bees contribute over $20 billion in economic value annually by pollinating crops and producing honey. However, since 2006, North American beekeepers have lost more than a quarter of their colonies each winter. The causes of colony losses are complex, including interacting effects of stressors such as pesticides, nutritional deficiencies, pests, and pathogens. The bee gut microbiome plays a crucial role in colony health and disease, and bee gut microbiome changes, or dysbiosis, can serve as an indicator of bee health status. We are investigating the effect of different stressors on the bee gut microbial community. Here, we report the use of shotgun metagenomics sequencing, which allows for deep taxonomic resolution, to investigate the response of the gut microbial community to two neonicotinoid insecticides, clothianidin and thiamethoxam. Our results reveal common dysbiosis signatures including an increase in Bifidobacterium spp.after chronic sublethal exposure, and an increase in Apibacter adventoris after short-term acute exposure. Other dysbiosis signatures were unique to each insecticide exposure, such as an increase in Snodgrassella alvi in response to clothianidin and a decrease in Lactobacillus spp. following thiamethoxam exposure. These findings deepen our understanding of how the gut microbiome responds to stressors and reveal identifiable microbiome profile signatures. The identification of these dysbiosis signatures highlights the potential utility of honey bee gut microbiome profiling as a diagnostic tool for bee health. Access to timely and accurate bee health diagnostics will inform regulatory actions to reduce exposure to stressors and will facilitate managing and improving bee health.

PP-165 [Bee Health]

Distribution of pyrethroid and amitraz resistance in Varroa destructor mites from honey bee (Apis mellifera) colonies in Portugal

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Honey bees (Apis mellifera) are widely used for pollination and honey production worldwide. However, they face a serious threat from the ectoparasitic mite Varroa destructor. This parasite causes varroosis and transmits multiple viruses, such as the Deformed wing virus (DWVV), compromising the health and survival of colonies. While there are many acaricides commercially available to treat colonies against varroa, the recurrent use of certain molecules is leading to the development of varroa resistance. In Portugal, two classes of synthetic compounds are currently used: pyrethroids (fluvalinate and flumethrin) and formamidines (amitraz). However, the excessive and repeated use of acaricides has led to the development of resistance in mite populations. Pyrethroid resistance is linked to mutations in the Voltage-Gated Sodium Channel (VGSC) gene, with amino acid substitutions, at position 925 and 918. Amitraz resistance is associated with mutations in the Octopamine-like β-adrenergic receptor (Octβ2R). The amino acid changes include asparagine (N) to serine (S) at position 87 (N87S), observed in France; tyrosine (Y) to histidine (H) at position 215 (Y215H), in the USA; phenylalanine (F) to leucine (L) at position 290 (F290L), in Spain; and tyrosine (Y) to phenylalanine (F) at position 337 (Y337F), in Turkey. The distribution of resistance alleles has not yet been explored in Portugal. To fill this data gap, Varroa mites from honey bee colonies across various regions of the country were analyzed through DNA extraction, PCR with specific primers, and Sanger sequencing. The results confirmed the of widespread distribution of resistance alleles to pyrethroids at positions 925 and 918, like those observed in Spain. In contrast, preliminary results did not detect any amitraz resistance alleles, although the small sample size warrants caution in interpretation. This study represents an important step in understanding V. destructor resistance to chemical treatments in Portugal, providing essential data for monitoring acaricide resistance and supporting the development of more effective management strategies to help beekeepers better protect their colonies.
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PP-167 [Bee Health]

Evaluating pesticide efficacy for the control of Vespa velutina nigrithorax: one more step to protect the bees

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The yellow-legged hornet Vespa velutina nigrithorax is an invasive species in Europe that poses a significant threat to both economy and biodiversity. Its high adaptability and efficient reproductive capacity contribute to its rapid spread, while its predatory behavior for insects, particularly toward honey bees, severely impacts apiculture by increasing colony losses and raising maintenance costs for beekeepers. Consequently, developing effective control strategies to mitigate or eradicate this species has become a priority. Currently, control strategies for the yellow-legged hornet rely mainly on chemical control with pesticides, either by injecting them into nests for destruction or by using baited traps. However, the lack of a species-specific standardized protocol based on scientific methods, such as pre-tested pesticide concentrations to ensure efficacy at the European level, has led to the implementation of improvised control measures adapted from other pest species. Consequently, it raises concerns regarding both efficacy and environmental sustainability. This work aimed to evaluate the efficacy of four pesticides, namely, Starpride MAX (acetamiprid), Spintor (spinosad), Cythrin (cypermethrin) e Pirecris (natural pyrethrins) against Vespa velutina nigrithorax. Oral toxicity tests were conducted following an adapted version of OECD Guidelines for the Testing of Chemicals on honey bees. The results demonstrated that acetamiprid, even at low concentrations, affects the hornets within 24h, whereas spinosad, at higher concentrations, only showed effects at 48h. Cypermethrin also induced mortality within 24h, but requires substantially higher concentrations, even with avoidance behavior with a 3-hour fasting period. Pyrethrins yielded the least promising results. This study provides crucial data on the efficacy and ecological impact of these pesticides, contributing to the refinement of control practices for this invasive species. Additionally, it underscores the importance of integrated pest management strategies that balance efficiency with ecological sustainability, ultimately supporting the protection of honeybees and the apiculture industry.

PP-168 [Bee Health]
"Breeding mite and disease resistant honey bees in the US"

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The number one threat to honey bee health worldwide, is indisputably the varroa mite. The only truly sustainable approach to mitigating the effects of varroa mites and the viruses they transmit, is selecting for strong genetic host resistance mechanisms.

Though we know strong host resistance is required for sustainability, there is an obvious shortage of successful breeding programs and resistant queens on the open market.

In this presentation I will show that measuring strong resistant traits is achievable by most beekeepers with minimal lab equipment.

Our results have shown that using a simplified Harbo VSH assay, measurable gains in mite and disease resistance can both be achieved in a population. The Harbo VSH assay technically measures the bees' ability to suppress mite reproduction. Not only can lower mite loads be expected with VSH selected stock, but also lower viral loads and decreased instances of common brood diseases.

The results of our breeding program will have a strong positive effect on the health and survival of colonies utilizing selected queens. Projected expansion of the current breeding program and collaboration with producers, could have a significant impact on the health of the US honey bee population as a whole.

PP-170 [Bee Health]
Workshop on Europe's vulnerability and preparedness for new invasive species: integrating science and practice to combat threats

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Since the relentless assault of the Varroa mite, several other invasive species have emerged, posing significant threats to honey bees in Europe and beyond. Among the offenders are the yellow-legged Asian hornet Vespa velutina, the small hive beetle Aethina tumida, the Tropilaelaps mite Tropilaelaps spp., and the red dwarf honeybee Apis florea, recently discovered in Malta. These alien invasive species impact honey bees and other pollinators through predation, diseases, parasites, and competition, potentially leading to significant ecological consequences and economic impacts for the beekeeping sector.

In this workshop, we are calling for scientists and practitioners (beekeepers and advisors) to come together and discuss a pressing question: How can we collectively prepare for and manage these invasions?

Over ninety minutes, participants will be actively engaged in a facilitated discussion. First, they will critique and identify lessons learned from past experiences. Next, they will imagine 'ideal' ways to tackle invasive species. Finally, they will define 'realistic' strategies to combat them. The workshop aims to identify tangible solutions and actions to improve Europe's ability to detect and manage new invasive species impacting its beekeeping sector and beyond. This will only be possible by combining the knowledge and efforts of both science and practice.

PP-171 [Bee Health]

A highly sensitive multiplex qPCR-assay for discrimination of Nosema ssp in honeybees reveals that Nosema is no predisposing factor for the prevalence of ABPV, CBPV, SBV and DWV in Vienna, Austria

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Our indispensable pollinator – the honeybee (Apis mellifera) – is being threatened by various pathogens which often result in decreased performance capacity of worker bees and in worst case in colony losses. Common cause of winter-colony-losses is the infestation with varroa mites in combination with viral diseases. Nosema ceranae (N. ceranae) – an obligate intracellular microsporidium which proliferates in midgut-epithelial cells of the bee – is often discussed in the context of colony losses. In literature there is no consensus whether N. ceranae is a causative agent concerning losses of bee colonies or not. To enable a reliable quantitative diagnosis of N. ceranae, we designed a modified multiplex qPCR assay in this undergraduate student project – detecting both N. ceranae and N. apis simultaneously by targeting the DNA dependent RNA-polymerase II subunit B1 (RPB1). 20 apiaries in Vienna throughout three different timepoints (May, June, September) were monitored. While N. apis was absent in the tested sample-set, prevalences of N. ceranae were 20% in May, 14,5 % in June and 5% in September. Statistical analysis of our N. ceranae spore-load data in relation to viral load of bee viruses (ABPV, DWV, SBV, CBPV) revealed that none of the viral pathogens correlated significantly with N. ceranae infection. In conclusion, N. ceranae manifested regardless of co-analyzed bee viruses and showed higher prevalence in spring/summer (May, June). N. ceranae has efficiently replaced N. apis in apiaries in Vienna. Finally, the aim of this study is the establishment of a sensitive qPCR-assay for detection of Nosema ssp with the ulterior motif to help beekeepers in monitoring their Nosema-status and to report to the beekeeping community that certain bee viruses resulted in no predisposition for Nosema and vice versa

PP-177 [Bee Health]

The importance of gut flora in the overwintering process for Swedish honey bees (Apis mellifera) – effects on bee health?

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Winter mortality of honeybees (Apis mellifera) is one of the biggest challenges in beekeeping, with significant economic and ecological consequences. Although most Swedish beekeepers overwinter their bees on sugar water to maximize honey harvest, there is a lack of scientific studies investigating how this practice affects bee health compared to overwintering on their own honey. Today, it remains unclear how different overwintering diets influence the gut microbiota of honeybees and their ability to survive the long Swedish winter. In general, scientific studies on winter diets are rare, especially those focusing on the microbiome and subsequent spring survival. In this study, we investigated how the overwintering diet affects the gut microbiota as well as the health and survival of the Swedish honeybees. We 1) analyzed the gut microbiome of Swedish honeybees (Apis mellifera) colonies using third-generation sequencing (Oxford Nanopore Technologies), 2) compared the bacterial composition and relative abundance across the three different diets (honey, sugar, honey-sugar mixture) over one winter season (October 2024 to March 2025) and 3) examined whether the overwintering diets affect the bees´ health condition at the beginning of the new season. To assess the bee health, we focused on visible signs of diarrhea and monitored colony development during the spring, including brood and drone development as well as their pollen collection (April to June 2025). Our first preliminary results showed that the microbiome differs depending on the food the honeybees have eaten during overwintering. In addition to characterizing data on the gut microbiome of the Swedish honeybees, this study aims to identify the optimal winter diet to support successful overwintering. Winter mortality is costly, both for the professional beekeeper and the recreational beekeeper, and even a delayed spring start can negatively impact colony productivity. That is why we also analyzed the mixed diet - consisting of honey and sugar - as an interesting alternative, which may help future beekeepers to cultivate honeybee colonies with a healthier and more diverse microbiome flora, which can support the bees' fitness and resilience at the onset of the new season.

PP-599 [Bee Health]
Analysis of the Number of Scientific Publications on the Oriental Wasp (Vespa orientalis) in Southern Spain

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Background/PURPOSE: The oriental wasp (Vespa orientalis), as invasive species, has garnered growing scientific attention due to its negative impact on local ecosystems and apiculture in southern Spain. This study aims to analyze the evolution of the number of scientific publications on this issue to understand the extent of research and predominant areas of focus.

Problem Description: The expansion of the oriental wasp has raised concerns among beekeepers and ecologists due to its predation on honeybees (Apis mellifera), which are crucial for pollination and honey production. Insufficient research could hinder the implementation of effective control and mitigation measures.

METHODOLOGY:: An exhaustive review of academic databases and specialized publications was conducted to identify relevant studies on the oriental wasp in the Andalusia region. Temporal and thematic trends of the published articles were analyzed. This review allowed us to identify the main research focuses and evaluate the scientific response to the invasion of this species.

Results and CONCLUSIONS: The results reveal an increase in the number of publications in recent years, reflecting greater concern and effort by the scientific community to address this threat. However, gaps in current knowledge were identified, particularly concerning effective control methods and the long-term impact on local biodiversity. It is imperative that more research is conducted to develop sustainable management strategies. Additionally, it is crucial that local and national administrations implement more rigorous measures to control the spread of this invasive species and protect both honeybee colonies and regional biodiversity.

Practical Implications for Beekeepers: Beekeepers need to stay informed about research trends to adopt evidence-based practices and collaborate with researchers and local authorities in developing sustainable management strategies. Continued research is essential to provide effective solutions and protect honeybee colonies.

PP-605 [Bee Health]
Monitoring the honey bee pathogens in the agricultural environment: Results from the BeeNet project

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Monitoring the health of the agricultural environment is a relevant issue for EU and rural development policies. The BeeNet project aimed to assess the health of the Italian agroecosystem by monitoring 363 sites with honey bee colonies over three years, covering the entire national territory. From June 2021 to March 2024, foragers were sampled four times per year to evaluate the presence and abundance of main pathogens (DWV, KBV, ABPV, IAPV, CBPV, BQCV, SBV, Nosema ceranae, Lotmaria passim, Crithidia mellificae, and C. bombi) using molecular assays. DWV was the most prevalent and abundant pathogen, followed by BQCV, CBPV, and N. ceranae. DWV-B was the most frequently detected variant, surpassing DWV-A, and aligning with previously observed patterns. The BQCV prevalence yielded unexpected results, as it emerged as the second most abundant virus, infecting colonies without displaying clear seasonal or geographical trends. CBPV infection outbreaks were irregular across seasons, with spring and autumn identified as the most susceptible periods. Over the years, the CBPV infection risk has increased, transitioning from initially low-risk areas to high-risk zones with heterogeneous values. N. ceranae was detected throughout the country without specific geographical trends, with abundance peaks occurring in late summer. ABPV infections were recorded in late summer and autumn, particularly in Italian regions at the northern and southern extremes. KBV was detected sporadically, while none of the samples tested positive for IAPV. SBV was the least prevalent virus detected, likely due to its primary impact on brood rather than adult bees. The highest prevalence was observed in central and southern regions. None of the samples tested positive for C. mellificae or C. bombi, while L. passim was detected at low prevalence. Similarly, no significant seasonal or geographical trends in the prevalence or abundance of trypanosomatids were observed. During the project, the same pathogens were found in wild bees, providing new insights into the epidemiological status of managed honey bee colonies across Italy. Assessing the bee health status is crucial not only for helping beekeepers maintain the well-being of their colonies but also for protecting pollinator populations, contributing to environmental quality and sustainability.

PP-606 [Bee Health]
Interspecific transmission of bee pathogens in wild pollinators in National Parks

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The health of pollinators has garnered significant attention due to their essential role in maintaining biodiversity and supporting ecosystem services. However, habitat destruction, environment fragmentation, pollution, and diseases pose serious risks to their populations. One key factor affecting pollinator health is pathogen spillover, a process in which infectious agents transfer between different species. This transmission can occur through shared resources (food and water) or direct contact, leading to increased pathogen prevalence among pollinators from different taxa. Among the most studied cases of pathogen spillover in pollinators, honey bee and bumblebee pathogens have been found to infect wild bees and hoverflies. This transmission not only amplifies the spread of diseases but can also have sublethal consequences, affecting the fitness and survival of affected hosts. This study focuses on evaluating the presence of bee pathogens in wild pollinators by conducting a field survey in four National Parks located in Northern Italy. In total, 852 hoverflies, 764 wild bees and 424 honey bees were sampled and individually analysed through qPCR to assess the abundance of 11 bee pathogens. Field sampling was carried out during the summer months. The main objective is to assess the extent of pathogen spillover and identify the taxa most vulnerable to infections. The research also examines various factors influencing pathogen transmission, contributing to a deeper understanding of disease dynamics in pollinator communities. Although no visible symptoms of infection were observed among the collected pollinators, the qPCR analysis revealed prevalence and abundance in each investigated target insect. Additionally, instances of co-infection were detected, indicating varying levels of susceptibility to pathogens among different wild pollinator species. The findings of this study offer valuable insights into the ecology and health status of wild pollinators. By identifying the risks associated with pathogen spillover, the research underscores the need for effective conservation strategies. These measures are particularly relevant within the One-Health approach, which emphasizes the interconnectedness of human, animal, and environmental health. Understanding the mechanisms of pathogen transmission in pollinators is crucial for developing policies aimed at mitigating disease risks, preserving biodiversity, and ensuring the sustainability of pollination services critical for ecosystems and agriculture.

BEEKEEPING ECONOMY

PP-468 [Beekeeping Economy]
Tracing the Origins of Honey: A Study of Public Procurement Practices in Slovenian School Canteens

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Background/purpose
Slovenian elementary schools must provide a morning snack that meets national dietary guidelines in educational institutions and promotes food diversity. These meals, along with breakfast, lunch, and an afternoon snack, cover about 70% of a student's daily intake. Public procurement laws mandate 15% organic food, encourage local sourcing, and require 20% to be certified under quality schemes. Honey, a staple in Slovenian cuisine, holds an important place in school meals, particularly in morning snacks.

Problem description
Due to the emphasis on price in public procurement, local Slovenian honey may not be as widely represented as it could be. To investigate this, a structured questionnaire on food procurement practices was sent to 450 schools in Slovenia. Responses were received from 157 schools, and the frequency of honey inclusion was additionally assessed from one-month menus of 100 schools.

Results and conclusion
Honey was offered at least once a month in 78% of schools and at least twice a month in 33%. It was most commonly used as a spread, sometimes mixed with butter or served with tea. According to the questionnaire, honey is one of the most frequently purchased local products, along with fruit, vegetables and milk. Specifically, 89% of schools buy locally produced honey, 75.8% buy honey from quality schemes, 75.2% buy organic honey and 4% buy none of these. Despite the frequent purchase of local or organic honey, only 17% of menus identified local honey, 4% organic honey and 1% honey from a quality scheme. Of the schools that purchased local honey, 75.2% bought it directly from beekeepers, 11.8% from honey companies or distributors, 5.2% from agricultural cooperatives and 7.8% from other suppliers. Similarly, 69.2% of organic honey was purchased directly, while quality scheme honey was less frequently purchased directly from beekeepers (61.4%).

Practical implications for beekeepers
The results highlight a strong preference for locally produced honey in Slovenian elementary schools, most of which obtain honey directly from beekeepers, though this is not clearly indicated on menus. Strengthening relationships between schools and beekeepers will help ensure consistent access to high-quality, locally produced honey in school nutrition programs.

PP-469 [Beekeeping Economy]
The apitourism regions for boosting the tourism heritage of the Republic of Benin

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Tourism is the third most crucial socio-economic sector that generates incomes and employment in Benin. As such, it occupies a prominent place in the country's development policies with great investments from the central government. In response to the sustainable development goals requirements, tourists are worldwide increasingly demanding on the quality and diversity of the services they receive. Strengthening the tourism sector requires then environmentally and socio-economically sustainable innovations beyond the classic visit of places, natural wonders and human past and present glories. Bees, with their great ecological and socio-economic functions, offer many facets which may be valued to support the well-diversified tourism heritage of the Republic of Benin. The honeybee diversity analysis indicated that the country bears three honeybee races (adansonii, iberiensis and scutellata) and many solitary bee species with their specific habitats, challenges and services for satisfying tourist curiosities. The geographic distribution of the native bees and apicultural management systems revealed three main apitouristic regions that are well integrated in the classic tourism heritage of the country. The southern apitourism regions, which extend from the coast to the latitude of Abomey, benefit from the strong and rich socio cultural and environmental tourist heritage of the south Benin with the highest tourism reception capacities. The central Apitourism regions from the district of Djidja and the Plateau department to the latitude of Bembereke benefits from the best apicultural potential with well diversified beekeeping systems and bee populations. Serving as the departure areas for ecotourism and hunting trips to the north, it is the second tourism region with 18% of the country's tourism reception capacity available for the apivisitors. The northern apitourism regions including the department of Atacora and Alibori are areas of specific old traditional honeybee management systems around the W and Penjari national parcs with their water fall and wildlife safaris. The involved actors, their roles, and responsibilities, as well as the challenges that may emerge from integrating the bee sector into the tourism heritage of the country, are also analysed with the required adaptation strategies.

PP-471 [Beekeeping Economy]
Beekeeping entrepreneurship, its scope in Yamunanagar district, haryana, INDIA

Naresh Pal[1]
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Beekeeping entrepreneurship is a concept that involves bee management and conversion of sector into business. Beekeeping is one of the most important inputs in economic development of the country, hence entrepreneurs in Beekeeping plays an important role in the development of a country. The production of quality honey and other hive products, multiplication of bee colonies more efficiently, increases the profitability of its businesses. The skill and methodology as well as hard work of an entrepreneur is important. Both Small and medium scale beekeeping in urban and rural areas of Yamunanagar have good scope as the area is potential for beekeeping entrepreneurs. Besides honey, it offers scope for production and marketing of other bee hive products like bees wax, pollen, propolis, royal jelly and bee venom. In addition, sale of packaged bee, the rearing and sale of good colonies have tremendous scope as entrepreneurship activity. Renting out bee colonies for pollination can also be another source of income. Apart from direct employment, hive manufacturers, apicultural equipment and machinery manufacturers, transport system for migration of colonies, traders, product quality experts, packers, sellers, raw material dealers, etc also offers tremendous scope. Majority of the bee-keepers are youths belonging to the age of 20 to 35 years. The constraints are many; beekeepers mostly sold their honey directly to the traders, they have no opportunity to decide or get satisfactory price of their produce, unconditional weather and climatic conditions, bee diseases and unfixed price of honey are major problems faced by the beekeepers. Government has focused on increasing beekeeping activities and honey production but need to take significant initiative to provide better marketing facilities for the sale of honey.

PP-473 [Beekeeping Economy]
Trends in marketing of honey in india

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In India, about 36 lakh bee colonies (both A. c and A.m.) reared by about 5 lakh beekeepers. Quantum of honey produced is about 1, 34,000 Metric. tonnes of honey. India stands 7th position in world honey production. Beekeeping activity remains unorganized for various reasons like lack of quality testing facility district wise, logistics and migration, unscientific management, unskilled labour etc. which affects marketing of honey. The challenges like storage of honey, processing, packing, grading as per parameters, pricing, minimum price support, market promotion, export facilities etc. are other factors which affect honey marketing. The floral sources of honey in India, such as tulsi, ajwain, acacia, mustard, sunflower, rubber, seasam, eucalyptus jamun, plectranthus etc. are favoured by customers and key factors driving the market growth. Besides this, modern scientific equipment and laboratory facilities, training programs and mentoring services to educate farmers on the latest beekeeping practices can enhance marketing and trade activities in the country. The education and awareness programmes on the importance of honey can help in utilization of honey extensively which increases market growth. Moreover, scientific validation of the therapeutical properties of various unifloral honeys and stingless honey can also create a favourable market outlook due to its neutraceutical ingredient. The easy product availability through e-commerce platforms, and social medias like WhatsApp groups, Facebook etc. are escalating the product demand across the country. As per latest report of IMARC Group expects the market to reach INR 50.0 Billion by 2033, exhibiting a CAGR of 7% during the forecast period (2025-2033).

PP-474 [Beekeeping Economy]
Production and marketing experience of honey and pollen in the high tropics with seven beneficiaries and apiaries with average heights of 3,500 above sea level in the municipalities of Aquitania, Sogamoso and Tota, Boyacá, Colombia

Mario Fernando Parrado Molano
COMAPIS APICULTURA General manager

Colombia has 3 departments (Boyacá, Cundinamarca and Santander) that produce pollen. Having productions during 33 weeks of the year, hives that produce up to 55Kg of pollen/hive/year. They are apiaries installed in places far from urban centers, crops and roads. COMAPIS developed and executed a project financed by AICCA in the Boyacá region for the restoration of the upper basin of the Lake Tota ring, one of the highest lakes in the world, and Colombia's onion larder, with a height of 3,500 meters above sea level, but the daily and indiscriminate use of insecticides is the greatest impact along with the reduction of forests to plant onions in the region. The main challenge was to locate the apiaries, with the experience of COMAPIS it was determined: to reduce impact by insecticides, little wind, low humidity and high solar radiation; 2 apiaries were located in Sogamoso, two in Aquitania and three in Tota, Boyacá, 36 hives were installed from four-frame nuclei with young, fertilized and marked queen, they were supplemented with syrup in top feeders designed by COMAPIS, facilitating feeding and reducing heat loss; Training and assistance were carried out every 15 days at each apiary. For the entire project, in 6 months of execution we obtained several pollen harvests, a total of 257Kg of pollen collected; four harvests of honey totaling 127Kg, a seal was developed with the region's designation of origin for beekeeping products, the sales price per Kg of honey was $69,000 (US$16.51). To date there are nine apiaries and they have harvested more than 750kg of honey and 1,254kg of pollen. Pending challenge, create the association.

PP-475 [Beekeeping Economy]

Jeometry beewear: using smart design to reinvent the beekeeping suit for women and streamline production for affordable domestic manufacturing

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[3]Author and Illustrator, "Printing on Fabric: Techniques with Screens, Stencils, Inks and Dyes," Lark Books, Sterling Publishing, USA 2013

Background/PURPOSE:
I am a third-generation, SC Journeyman beekeeper with 20+ years' experience sewing and designing Jennythreads apparel for real women. At a 2023 conference, a panel of women beekeepers got on the subject of hating their beekeeping suits. "The crotch is at my knees!" one said, "I bend over and stuff falls out of the pockets!" said another. I shot up my hand, saying, "I'll design one." Cheers all around the room!

Problem description:
Today's predominant style of beekeeping suit is based on a baggy, boxy men's work suit, sized for someone over 6 feet tall. This tired and antiquated design routinely frustrates the fastest growing segment of beekeepers today: WOMEN. See, women's body proportions are different from men: we have longer legs, shorter torso, narrower shoulders, and smaller stature. Additionally, beekeeping suits are over-complicated, outfitted with unnecessary and redundant components. This leads to over-production, thus dependency upon offshore labor for cheaper production cost.

METHODOLOGY:
I surveyed over 100 female beekeepers online and in person for their input, using feedback to design an innovative new suit specifically to fit women's figures and priorities. I have personally wear-tested a year's worth of prototypes in my own apiary, making improvements and eliminating redundancy, waste, and vulnerability with each new version. I have graded the pattern from one size to five: XS to XXL.

Results and CONCLUSION: I have founded Jeometry Beewear™ reinventing the beekeeping suit, tailoring it to women's proportions, and streamlining design to a simpler, smarter, lighter, suit that works WITH its wearer and not against her. I have sourced lightweight, breathable, 100% recycled PET suit fabric and secured suit production with local manufacturers in the USA. I have price-structured this suit for affordability, both direct-to-consumers, and wholesale to distributors worldwide.

Practical implications for beekeepers:
With good gear like a well-fitting, functional suit, female beekeepers will feel more comfortable, protected, and calm as they head into the apiary. Rather than relying on far-flung factories, my Jeometry Beewear™ suit can be produced efficiently in-country, closer to the beekeepers who wear them. Let's use smart design to empower women and save the bees!

PP-477 [Beekeeping Economy]
A new device to detect the adulterated honey: Business plan

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INTRODUCTION: The importance of honey authenticity is becoming more relevant today due the adulteration of this product in the world market; affecting not only exporters but also beekeepers.

Problem/OBJECTIVE: Honey is one of the main exportation products of Mexico, which is sent to countries such as Germany, USA, UK, Switzerland and Netherlands, with earnings of up to 2.25 million dollars in 2024. However, adulteration has increased from 14% to 35% between 2019 and 2021. There are reports in the media by scientists and businesses mentioning that adulteration will increase up to 60% in the worldwide. This is why a product is needed that quickly identifies adulterated honey, in our institute it has been designed and constructed a device to detect adulterated honey based on the patent MX/a/2015/017884. The main objective of this research is to create a business plan with its benefits and advantages in a business environment. We are presenting the structure of a business plan for the marketing of a product that detects adulteration in honey quickly.

Main results and conclusions
The business plan allows you to visualize the business environment, which in this project focuses on the state of Yucatan. This project offers technological solutions to beekeeping in Yucatan, where around 7,000 beekeepers depend on the sale of honey. The investment they make to maintain their hives and guarantee the purity of their product has been analyzed.
The device can not only be considered as a purity reversal advantage, it also includes 3D printing technology with recyclable materials and reusable component up to 10 times. It will be sold in an initial kit with 60 tests, covering two annual honey harvests.
The business model focuses on promoting fair trade and improving traceability of honey to facilitate its export. It is estimated that profits will be reinvested in technological improvements and research.

Practical implications for beekeepers
This business will help beekeepers and exporter verify the authenticity of honey, protecting production and its competitiveness in local and international markets.

PP-478 [Beekeeping Economy]
To the front line: honeybee pollination as part of security of supply

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BACKGROUND/PURPOSE: Pollination is a critical ecosystem service for agricultural productivity, directly impacting food security and security of supply. A new project in Finland aims to develop honeybee pollination practices and networks to increase the role of pollination in food security and to be better prepared for future crisis situations.

PROBLEM DESCRIPTION: Declining pollinator populations, coupled with increasing agricultural demands, create a potential shortfall in pollination services and food supply stability. At the same time, all the bumblebees used for crop pollination in Finland are imported, while honeybee pollination is generally under-utilized. This project addresses the following questions: How can the supply and demand of pollination services be better connected? How can beekeeping contribute to security of supply? How can pollination practices be developed to better adapt to different crisis situations?

METHODOLOGY: The project has two main objectives. The first one is to create a national model of operation for beekeepers and farmers consisting of guidelines for crisis situations and strategies for developing pollination services. The second objective is to create a pollination services network where farmers and beekeepers can more easily connect. We will achieve these objectives with different experiments on pollination services and beekeeping practices as well as organizing workshops and webinars for farmers and beekeepers to develop future pollination services together.

RESULTS AND CONCLUSION: A previous project revealed that breeding domestic bumblebees is possible. Furthermore, honeybee pollination in greenhouses, a novel pollination method in Finland, yielded higher quality crops than bumblebee pollination. This project will take these findings further and towards self-sufficiency in pollination and food production, aiming at better resilience in crisis situations.

PRACTICAL IMPLICATIONS FOR BEEKEEPERS: This project emphasizes the importance of beekeeping in nationwide food security. Increased demand for food security and managed pollination services creates potential expansion opportunities for beekeepers. By working closely together with farmers, beekeepers will have the latest knowledge of pollination demands and therefore the ability to adapt in changing times, placing them at the front line of food security.

PP-479 [Beekeeping Economy]
Expanding market opportunities with horizontal top-bar hive nuc production

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BACKGROUND:
As beekeeping markets grow increasingly competitive, differentiation is key to building a sustainable, high-value business. Standardized Horizontal Top-Bar Hives (HTBHs) and matching nucleus colonies (NUCs) represent an underdeveloped niche with high return on investment (ROI) while meeting demand for ergonomic, accessible, and sustainable solutions. Unlike Langstroth hives designed for commercial beekeepers, HTBHs appeal to hobbyists, small farmers, and natural beekeepers, creating demand for standardized hive equipment and NUCs.

Problem Description:
The beekeeping industry primarily focuses on mass-produced Langstroth NUCs, making it difficult for small- and mid-scale beekeepers to compete on price. However, this overlooks a growing segment seeking low-cost, low-maintenance sustainable hives that reduce physical strain. The limited availability of standardized top-bar NUCs creates a market gap where demand exceeds supply. Many buyers modify Langstroth frames or purchase package bees, increasing colony losses and reducing success rates.

METHODOLOGY:
Producing regionally adapted HTBH NUCs allows beekeepers to establish a premium-priced product with reduced competition. These NUCs cater to a specialized market, enabling direct-to-consumer sales and higher margins. Additionally, manufacturing and selling HTBHs boosts revenue and creates a market for HTBH NUCs while minimizing overhead. Key innovations include standardized internal dimensions and the Flex Hive adapter, allowing seamless component interchangeability. This game-changing approach removes historical barriers, ensuring greater accessibility and compatibility. It also enables HTBH NUC production from existing Langstroth colonies, making HTBHs a viable alternative for backyard beekeepers

RESULTS:
Early adopters report higher profit margins as HTBH NUCs command premium prices while costing less in materials and labor. Selling both Langstroth and top-bar NUCs provides market flexibility and attracts new beekeepers, small farmers, and permaculture enthusiasts. Positioning as sustainable beekeeping experts helps entrepreneurs build customer loyalty and long-term growth.

Practical Implications:
HTBHs and NUCs provide a unique, high-ROI business model. Beekeepers can diversify revenue through premium NUC sales and specialized education, increasing profitability and reducing competition. Standardized dimensions ensure interchangeability, making HTBHs more accessible for backyard beekeepers, lowering adoption barriers, and promoting sustainable beekeeping. Those investing in this emerging market are well-positioned for long-term financial success.

PP-480 [Beekeeping Economy]
Standardized Slovenian Honey and Bee Products Jars: Quality and Recognition

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Due to its diverse flora, geographical conditions, and good beekeeping practices, Slovenian honey and other bee products are synonymous for quality, and therefore deserve recognizable and carefully designed packaging. This not only serves to protect and preserve the product, but also plays an important communication role.

17 years ago, a standardized honey packaging was developed in Slovenia – a glass jar with a capacity of 720 ml, intended exclusively for bee products and products of Slovenian origin. Today, we already have five standardized jars.The jar is recognizable by its embossed bottom with the imprint of Slovenia's indigenous bee – the Carniolan honeybee (Apis mellifera carnica). The Slovenian Beekeepers' Association carefully monitors the correct use of these jars in accordance with the regulations.

Different sizes of honey jars are adapted to different target groups and marketing strategies. The larger jars are intended for families and regular honey consumers. The smaller jars are suitable as gifts, for buying several different types of honey or for packaging other bee products and products with added value. The smallest jar is ideal for gift sets and tourists, as it is easy to carry and suitable for hand luggage in case of air travel. Selling in smaller packages allows beekeepers to charge a higher price per unit.

The main purpose of standardized jars is to strengthen consumer confidence in Slovenian bee products. The packaging attracts attention with its motivational role. Based on the positive experience with the use of foods in standardized packaging, its commemorative role provides a return to purchase. The jars enable beekeepers to be more competitive on the market, and make it easier for consumers to recognize honey and bee products of Slovenian origin. This way, they can distinguish high-quality local honey from imported products that often flood the market.

The greater use of these jars means greater recognition of both the packaging, the honey and bee products among consumers. Greater interest in purchasing leads to greater demand for Slovenian bee products, which, given the limited supply, which depends on the beekeeping harvest, can contribute to higher sales prices and improved sales economics.

PP-481 [Beekeeping Economy]
Apiculture and Meliponiculture Practices: A Story from Malaysia

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BACKGROUND: Beekeeping in Malaysia has a long history as a traditional trading and economic activity. The first modern beekeeping activity (Apiculture) using honey bee Apis mellifera was officially documented by the Department of Agriculture Malaysia in the 1980s. After almost 40 years, in 2016, stingless bee rearing (Meliponiculture) was introduced to complement honey bee rearing. Both beekeeping practices brought various benefits to many stakeholders. METHODOLOGY: We would like to share our experience in apiculture and meliponiculture practices in Malaysia. RESULTS: The beekeeping practices significantly boosted the income of local beekeepers, providing them with substantial financial gain, particularly for those from low-income backgrounds. In addition, the primary motivation for local honey consumption is its health benefits. In 2024, the value of honey harvested from honey bees and stingless bees gained up to RM30 million, with more than 60,000 hives throughout Malaysia, indicating the industry's bright future. However, both apiculture and meliponiculture in Malaysia have their challenges, e.g., pests, natural disasters, black soldier fly attacks, floods, log theft, etc. The high potential of the beekeeping industry requires strategic plans to address several issues, e.g., food security, climate change, and socioeconomic and health challenges. CONCLUSION: Local beekeeping practice can be strengthened by appreciating and recognizing bee species diversity, reinforcing the beekeeping activities and bee products, proper capacity building of beekeepers, and aligning to world beekeeping practices. Implications: We hope this presentation will enhance mutual sharing sessions and collaboration in practicing the best approach to beekeeping for the benefit of all.

BEEKEEPING TECHNOLOGY AND QUALITY

PP-180 [Beekeeping Technology and Quality]
The levels of pesticide persistence in commercially available beeswax from different countries

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Beeswax is the most contaminated hive material because of its lipophilic nature, which allows pesticides to persist for more than 30 years. Beekeepers often supply reused beeswax to the bees, which is called as foundation. Foundation is the least replaced material, and it increases the risk of beeswax contamination. It has been shown that persistence in beeswax and foundation can cause toxicity, evolution of resistance in Varroa mites, and reduced treatment efficacy, which poses risks for honey bee health and apiculture. In addition, pesticide persistence can migrate to honey and pollen, posing risks to consumers of beekeeping products. Pesticide persistence in beeswax, honey, and pollen has been reported in different European countries, including banned pesticides, such as propargite and coumaphos. This contamination could have originated from contaminated beeswax because of beeswax trade is not regulated globally, and most of the beeswax in the market is imported from non-European countries such as China and Türkiye where pesticides banned in Europe are currently approved for use. To address this issue, beeswax and foundation samples were collected from ten European and non-European countries to determine pesticide persistence levels. Samples will be analysed using ultra-high-performance liquid chromatography-mass spectrometry (UHPLC-MS) and gas chromatography-tandem mass spectrometry (GC-MS/MS) to screen for over 300 pesticides, including banned pesticides in Europe. This study aims to provide data to regulatory bodies to eliminate contaminated beeswax in the beekeeping market, enhance honey bee health and ensure the safety of beekeeping products. In addition, this study advocates for global regulations on beeswax trade and promotes sustainable beekeeping practices to mitigate contamination risks in apicultural products.

PP-181 [Beekeeping Technology and Quality]
Use of Alternative Protein Sources in the Nutrition of Honey Bees Under Commercial Colony Management Conditions in New Zealand

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Modern beekeeping and climate change place honey bees under constant stress, depleting their immune resources and reducing their recovery ability. Complete nutrition, beyond basic proteins, fats, and carbohydrates, must include amino acids, polyunsaturated fatty acids, enzymes, microelements, and phytonutrients. This approach supports colony health, productivity, and physiological resilience, particularly under intensive commercial use. Our research investigated spirulina as a promising protein alternative under commercial queen-rearing conditions. Spirulina is notable for its high protein content, balanced amino acid profile, polyunsaturated fatty acids (linolenic acid), and antioxidants, aligning well with the biological needs of honey bees. Unlike many commercial protein substitutes with limited amino acid content and digestibility, spirulina provides comprehensive nutrition. The study emphasized spirulina's effect on hypopharyngeal gland development, royal jelly production, and colony resilience during intensive queen-rearing cycles. At a concentration of 30% of the total feed, spirulina effectively met protein and amino acid requirements while enhancing hypopharyngeal gland functionality, critical for larval nutrition and queen quality. Physiologically healthy larvae for grafting were consistently available, boosting queen production efficiency. Although spirulina alone showed positive results, its maximum benefit emerged when combined with minerals such as magnesium, zinc, and manganese. This enhanced diet extended the bees' lifespan under laboratory conditions, with 30% survival for the spirulina-fed group compared to 28% for the commercial feed group. Notably, royal jelly production increased by 12% in queen cells. Nurse bees fed this diet began filling queen cells with royal jelly as early as the three-day egg stage, indicating a surplus of royal jelly—a key marker of physiological health under stress. These findings highlight spirulina's potential as a superior protein source for bees, particularly in commercial operations. By improving colony nutrition, spirulina enhances productivity, supports hypopharyngeal gland health, and increases stress resilience. Combining spirulina with essential minerals ensures optimal results, offering an effective solution to address nutritional deficits and sustain bee health under modern intensive beekeeping conditions. Spirulina represents a viable alternative to commercial pollen substitutes, capable of significantly improving colony performance, resilience, and the production of high-quality queens.

PP-183 [Beekeeping Technology and Quality]
Production, Processing and Quality of Indian Honey from Apis Dorsata

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2,

"Madhu" i.e. Honey in Sanskrit the original Indian language, is collected by Rock bees or Giant bees Apis dorsata honeybees are well known and used since ancient times. The Indian traditional medicine system – Ayurveda, describe several formulations and its health benefits, still continued and practiced. Honey is an important item in Indian religious rituals. It has been estimated that out of total production of honey in India (133,000 MT) about 60 – 65 % honey is contributed by Apis dorsata.bee colonies alone, besides Indian native Apis cerana, Apis florea and exotic Apis mellifera bees. This dorsata honey is most commonly marketed and used in India and else where. The huge sized Apis dorsata bee colonies found on trees and rocks in forests and mountains in large numbers and not easily accessible. As also found in urban areas on tall concrete buildings, galleries, bridges, water tanks. Honey produced in forests originated from the nectars of several medicinal plants and trees, almost free from chemicals in best natural environment. The size of the dorsata bees, colonies, comb (0.5-1.5 M) and quantity of honey stored is larger than mellifera and cerana bees hence it need different management and techniques. It yields about 10 – 40 kg honey from single colony. Methods for collection, extraction, production and handling of honey by safe and hygienic techniques being developed and standardized. Assessment of quality of dorsata honey contain high moisture 24.5 %, HMF 110ppm (Maximum), Diastase activity (DN) 8.20 (Maximum) besides other characteristics. The quality of honey including reduction of excess moisture from 24.5% to 19.5 %. Turbidity / Optical Density improved to 0.45, besides organoleptic testes and other vital natural properties could be maintained. Beekeeping technology and quality of honey from dorsata bee colonies improved besides conservation of bees and welfare of local honey collectors. The proper scientific handling, processing and storage etc. of honey benefitted to over 6000 beneficiaries by the CBRTI programme. It has great scope as "Organic honey", if proper certification is done. This will help to cover even 40-50% of almost 90 % untapped potential of dorsata honey.

PP-184 [Beekeeping Technology and Quality]
Three digital beekeeping tools in Taiwan: Varroa mite monitoring system, nectar source geographic information system and apicultural traceability system

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Beekeeping is labor intensive. Our institution has developed the following three applications to support the advancement of apiculture in Taiwan.
(1) Varroa mite monitoring system: Monitoring Varroa mite population is essential for integrated pest management, but the small body size makes visual identification difficult. This system is able to monitor the infestation level of the Varroa mite in a beehive by using mobile device to take several photos of live honeybees on frames. A computer vision algorithm based on deep learning analysis of the photos counted the number of honeybees and mites. Trained on a dataset of 3,987 images, the algorithm reaches a precision of 83% for honeybee counting and 78% for mite counting. This non-destructive method provides a fast and effective alternative to traditional approaches, completing the analysis in less than one minute.
(2) Nectar source geographic information system: In the past, there was a lack of comprehensive information on nectar and pollen sources for beekeepers, and no system existed to connect farmers in need of pollination with beekeepers. Traditionally, beekeepers search for apiaries independently with limited exchange of experiences. Making it difficult for newcomers to identify suitable locations. To address this, our institution developed a cloud-based platform using ArcGIS to manage geographical data on nectar and pollen crops. The system includes orthophotos, electronic maps, and thirteen major crop distribution layers. Users can select crop layers to identify suitable locations, enhancing pollination services and apiculture development.
(3) Apicultural traceability system: Beekeepers typically used branches, stones, bricks, or markings to track hive status, with most records kept on paper. This made data difficult to utilize or analyze effectively. To improve apiary management, our institution designed a database format tailored to Taiwanese apiculture. The user interface adopts a calendar format, recording key parameters such as personnel, tasks, time, location, and equipment involved in beekeeping. Data is uploaded to a public cloud-based platform, only providing necessary information to certification companies and consumers to comply with Good Agricultural Practice standards. Additionally, the system includes predefined expert guidelines for pest control and queen rearing, along with a report export function for assessment and analysis.

PP-185 [Beekeeping Technology and Quality]
Finding DCAs with mechanical drones and data collection of DCA locations

Julia Mahood
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Background/PURPOSE:
Apis mellifera honey bees mate while flying in discrete leks called drone congregation areas (DCAs), the locations of which are known to remain constant year after year.

Problem/description
As there is no communication or intergenerational learning between male nestmates, it is not understood how drones find these static locations, or what it is about them that leads to the creation of a DCA. In the past, researchers have found DCAs using helium ballons or poles with pheromone lures attached, however this method is self-limiting as surveying area over tree canopy, water or tall structures is not easily accessible.

Methodology
Using a mechanical drone – an unmanned aerial vehicle (UAV) – to look for DCAs is a method that allows the user to survey more expansive areas. Furthermore, the sharing of DCA locations will help researchers gain insights about DCAs. The citizen science project MapMyDCA.com is a free online tool that offers instructional information about looking for DCAs using UAVs. The website's main component is a map where users can pin DCA sites that they have located, and where anyone visiting the site can view pinned DCA locations and information that the users have shared about the locations (time of day, landscape features, known apiaries in the areas). All data is easily downloadable for study.

Results and conclusion
Since the site launched in December 2019, 163 users have registered on the site and 37 DCAs have been pinned in 8 countries. One significant insight garnered is that 30 % of pinned DCAs occur over tree canopy, a contradiction from older research using more limited surveying methods.

Practical implications for beekeepers
Individuals who are queen breeders can benefit from having the ability to find locations of DCAs in their breeding areas. The further use of the project will grow this database of known DCAs that will aid in the understanding of an area of honey bee mating behavior that has been difficult to study.

PP-186 [Beekeeping Technology and Quality]
Climate Hive "BEELIVE" – Reducing Humidity in the Beehive

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BeeLive Climate Hive – Reducing Humidity in the Beehive
The BeeLive Climate Hive, developed by Josef Basl Zeilinger and manufactured by Bienen Ruck, is a groundbreaking innovation in beekeeping, designed to optimize the internal climate of the beehive and support both bee health and beekeeper efficiency. Tested in over 2000 beehives, it has already proven its effectiveness in real-world conditions.

Key Features:
Humidity Regulation: The hive includes a special climate membrane film that allows excess humidity to pass through, helping to maintain an ideal environment for the bees.
Insulation: No additional insulation is required, as the hive is already tailored for optimal performance. If desired, breathable materials such as coarse wood shavings can be used, but airtight materials should be avoided.
Winter Benefits: It regulates humidity by draining excess moisture, which is vital for bees in colder months. The hive also traps warmth inside, preventing damage to hive materials and frames.
Summer Benefits: The BeeLive Climate Hive provides heat protection by blocking direct sunlight and prevents overheating. It also aids in honey drying by storing heat during the day and releasing it at night, while ensuring the bees can work more efficiently after cold nights.

Technical Details: The hive features 4 mm holes for improved air circulation and faster evaporation of accumulated moisture. These holes are sized to prevent bees from entering the area, thus ensuring a safe and stable environment. Temperature inside the hive rises by 2-4°C with the BeeLive Climate Hive, which helps reduce energy needed by the bees to regulate their environment.

Benefits for Bees and Beekeepers:
The stable climate reduces stress on bees, improving their health and colony growth.
The durable hive extends the life of hive materials, making it a smart investment.
The bees use less energy on climate control, allowing them to focus more on foraging, which boosts productivity.

In conclusion, the BeeLive Climate Hive is an innovative solution that enhances beekeeping sustainability and efficiency, improving both the health of bees and the success of beekeepers worldwide.

PP-187 [Beekeeping Technology and Quality]
Appalachian Multi-purpose Apiary Informatics System (AppMAIS)

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Appalachian State University

Beekeepers traditionally monitor honey beehives manually to evaluate their health and determine their growth and yield. With the emergence of Internet of Things (IoT) devices and tools, there have been some efforts in recent years to automate such monitoring. Automatic monitoring systems can significantly benefit beekeepers and researchers as they can obtain critical data and provide insight into hives' health and performance more regularly. As part of the Appalachian Multipurpose Apiary Informatics System (AppMAIS), a North Carolina Research Initiative (NC ROI) grant, we installed 28 hives in 14 different locations in the Western region of NC. We used Beemon, a system designed and developed in our Visual and Image Processing (VIP) lab, to collect humidity, temperature, weight, audio, and video recordings from these hives. These hive data are uploaded to a server in our department for analysis. Over the past two years, we have used image processing, signal processing, AI, and ML techniques to analyze AppMAIS data, which has helped us learn much about the health of these hives. For example, we have used image processing and optical flow to estimate traffic in and out of the hives, which is an excellent indicator of their health. Also, we have utilized AI and ML on audio recordings of hives that had swarmed to detect swarms' unique identifiers.

This presentation will provide us with an opportunity to share the Beemon system and its significance with the audience and present some of our results and findings. We hope to expand our collaborations.

PP-189 [Beekeeping Technology and Quality]
Heather honey proteins

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Ling heather (Calluna vulgaris) honey has many special characteristics: thixotrophy, strong flavor and taste, challenging to extract, high mineral content and high protein content. Ripening of heather honey is a heavy task for the bees and its water content can be quite high. Therefore, EU Food legislation allows heather honey to have,more moisture than other types of honey. It is known, that some bee strains are not able to produce ripe heather honey, and it has been suggested that this is linked to thickening of ripe honey. Our aim in this work was to study the proteins of heather honey, The samples included honey from two beekeepers in southwest Finland and commercially available Norwegian heather honey packed in packing enterprises. For comparison we had samples harvested prior to blooming of heather. We performed liquid chromatography mass spectrometry-based proteomics analysis of the soluble proteins and studied their species of origin. To estimate the amount of heather honey in the samples, we studied them organoleptically (taste, flavour, thixotrophy), by pollen analysis, and measuring electric conductivities. The samples contained both bee and plant proteins. However, when pollen and insoluble proteins were separated by centrifugation, the remaining soluble protein consisted predominantly of bee proteins, secreted from hypopharyngeal glands. The concentrations of bee proteins was higher in samples with higher fraction of heather honey, and we hypothesize that this contributes to the heavy burden of drying the heather nectar, linked to its composition and high humidity. Protein content, electric conductivity, and the amount of heather pollen were higher in Norwegian than Finnish amples, suggesting that they contained less of other types of honey, As the electric conductivity in samples with high fraction of heather honey can exceed 0,8 mS/cm limit set for blossom honeys in the honey directive, the need for adjusting the directive will be discussed.

PP-190 [Beekeeping Technology and Quality]
Automated entrance monitoring to investigate honey bee foraging trips using an open-source wireless platform and fiducial tags

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Honey bee foraging is a complex behavior because it involves tens of thousands of organisms making decisions about where to collect pollen and nectar based on the quality of resources and the distance to flowers. Studying this aspect of their biology is possible through direct observations but the large number of individuals involved in this behavior makes the implementation of technologies ideal to scale up this type of study. Consequently, there is a need for instruments that can facilitate accurate assessments of honey bee foraging at the colony level. To address this need, this work aimed to develop an automated imaging system for monitoring the in-and-out activity of honey bee foragers as they walk through a customized entrance with a camera sensor at the hive entrance. We used AprilTags attached to each bee's thorax to provide unique identification numbers and directionality that allowed the system to track in-and-out events throughout the foraging season of the colony. Our design relies on low-cost Raspberry Pi computers and cameras, along with commercially off-the-shelf components, making it easily reproducible with the open-source documentation provided in our manuscript. Additionally, the hardware was powered using solar panels to allow for monitoring of colonies in remote locations. We successfully deployed and evaluated our system in six locations, demonstrating consistent results. Here, we present the details about the development of the system, data collected from multiple colonies, and post-processing analysis from one of our apiaries. Our results highlight the system's effectiveness in monitoring honey bee trips, which lays the groundwork for future estimations of foraging distances. Understanding the land area used by honey bee colonies is important in the consideration of apiary placement.

PP-191 [Beekeeping Technology and Quality]
Chemometric Classification of Peruvian Honeys from Bajo Mayo, San Martín, Peru: Multivariate and Factorial Modeling Approaches

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Honey is a natural product made mainly from the nectar of flowers; its final quality depends on its botanical and geographical origin. The variability is wide even for honey from the same region. Their botanical and geographical properties is still difficult to determine, so it is increasingly necessary to standardize analysis protocols that contribute to the verification of the quality of this important product of the beehive. This work was structured based on honey samples collected from the Mayo River, located in the northwest of the San Martín region and the Amazon. Physicochemical and sensory properties of fifteen samples of honey from the Mayo River have been evaluated, taking as reference the physicochemical parameters of color, the chromaticity of the CIELab system, pH, free acidity, total sugars, moisture, ash, electrical conductivity, density, and water activity. Additionally, the sensory attributes and intrinsic properties of the honey samples have been related to their classification through a Neuronal Probabilistic Network system, cluster analysis, discriminant, multiple factorial, and PLS-PATH, which have allowed the differentiation and classification of the honey, according to their geographical origin under three categories associated to the Pfund scale in amber, light amber, and extra light amber. The work allowed for the evaluation and study of the physicochemical, chromatic, and sensory properties of Peruvian honeys through correlation analysis, simultaneously examining groups of variables that led to the identification of common structures with defined characteristics, which facilitated the formulation and generation of classification processes.

PP-192 [Beekeeping Technology and Quality]
Multivariate techniques and factorial multiple models in classification of honeys from states of Lara and Yaracuy (Venezuela)

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Honey is as diverse as its botanical origin, nature, and composition, with varying color shades. It is a natural product with sweetening properties, produced by bees from the nectar of flowers and secretions from plants. Its physicochemical properties depend on the harvest season, environmental factors prevailing during that period, and biogeographic zones. The aim of this study focused on the characterization of honeys from Lara and Yaracuy (western-central region of Venezuela), specifically from nine localities in the states of Lara and Yaracuy, including the regions of Crespo, Simón Planas, Palavecino, Jiménez, Morán, Andrés Eloy Blanco, Irribarren (west of Barquisimeto), Peña, and Urachiche. The samples were studied and classified based on physicochemical parameters such as color, chromaticity from the CIELab system, pH, free acidity (XAL), total sugars (Xs), moisture (Xw), ash content (Xc), electrical conductivity (EC), density, and water activity (aw). Additionally, sensory attributes and intrinsic properties of the honeys were correlated for the classification of homogeneous honeys through multivariate analysis, multiple factorial modeling, and PLS-PATH. Light amber honeys exhibited delicate and subtle aromas with floral or fruity notes, characterized by a mildly acidic profile, a fragrant and persistent bouquet, sweet notes, and a pronounced aftertaste. The amber and dark amber groups displayed bright hues, with a pronounced floral aroma and a persistent aftertaste. In all cases, metallic notes were weak or absent, and subtle smoky notes were perceived, though they were not dominant. Most of the samples did not show granulation or sedimentation. In the crystallized samples, the aftertaste of sweetness and the fine, homogeneous granulation were predominant. This study allowed for the evaluation of the physicochemical properties of Venezuelan honeys, facilitating the use of new analytical tools for their classification.

PP-193 [Beekeeping Technology and Quality]
Refractive, Codounis, Kirkwood and Tabouret Indices in the Evaluation of Selected Colombian Honeys

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Honey is fundamentally a solution of reducing sugars and is typically supersaturated with respect to glucose at room temperature, with lower solubility compared to glucose, which is the least soluble of the major components. The botanical origin of honey determines its chemical composition, organoleptic characteristics, and therapeutic properties. Honey often undergoes total or partial crystallization during storage periods, and some that do not crystallize remain in a metastable state. Changes in external factors, such as pressure or temperature, lead to the crystallization of the product. In this study, honey samples from different biogeographical environments in Colombia, collected at various altitudes, were evaluated. The color tones of the samples were grouped according to their origin, and classification estimates were made considering the respective refractive indices, Tabouret index, and Kirkwood index. The physicochemical parameters considered in the differentiation of these samples are primarily based on the contribution of fixed solids (Xs), reducing sugar levels (Xr), and the pH of the honey. The Kirkwood Index (KI) should be less than 73.1 for a sample to be considered honeydew. The granulation of honey is a natural phenomenon and depends on temperature, viscosity, and moisture levels. The Tabouret Index is commonly used in this context. Crystal formation begins in a section of the honey, which may cover part of it, and in some cases, the process is accompanied by the formation of spots and color changes. Fructose inhibits granulation by increasing the solubility of glucose in the honey, and maltose also has an inhibitory effect on this process. The tendency to granulate can be estimated by considering the water activity values and the Glucose/Water (G/H) ratio through the Tabouret Index (TI). Electrical conductivity (EC), pH, and color are the most commonly used parameters to determine the botanical origin of honey.

PP-195 [Beekeeping Technology and Quality]
Chemometric analysis in classification of Colombian honeys according to phenolic, reductive capacity and antiradical potential

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Honey is a natural food product and sweetener that is known for many medicinal and biological properties including antioxidant, antibacterial, anti-inflammatory, and wound healing capabilities, on the other hand biological and medicinal properties are attributed to chemicals profile of honey that contains a variety of enzymes, sugars, vitamins, minerals, phenolic compounds. The antiradical, antioxidant, and reducing capacities of honeys, depend on its geographical origin, climatic conditions, as well as processing, storage, and handling. However, its botanical origin is considered to have the greatest influence on these properties. This research work consider floral, monofloral and honeydew samples from different biogeographical associations in Colombia. Honeys that were analyzed in terms of color, CIELab parameters, phenols (Folin-Ciocalteu), flavones and flavonols, (flavones and flavonols by aluminiun trichloride), ferric reducing power (FRAP), and free-radical scavenging (ABTS) assays. Physicochemical parameters were also examined to assess the overall quality of the honey. All data were processed using Principal Component Analysis (PCA), Hierarchical Cluster Analysis (HCA), Linear Discriminant Analysis (LDA) and Neural networks. Amber, (A), Dark Amber (DA), Light Amber (LA) and Extra Light Amber (ELA) honeys showed the highest content of bioactive compounds and reductive capacity and antiradical potential. The global classification accuracy responds to biogeographical origin. The study shows a strong relationship between color shades and bioactive compound profile, which consolidates as an objective approach in the preliminary evaluation of the properties of Colombian tropical honeys.

PP-196 [Beekeeping Technology and Quality]

Is what you see what you get? Investigating the pollen composition and commercial label of Greater Cape Floristic Region honey

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Honey is classified as authentic based on its composition and description. The description of the honey, be it the botanical (the type of product) or geographical (where it is from) origin, should reflect the true properties of the honey. If not, then the product is considered fraudulent. The most conventional method for inferring the botanical and geographical origin of honey is through melissopalynology, which is the study of pollen and spores in honey. While South African honeys are ubiquitously marketed under labels such as “Fynbos”, “Protea”, “Strandveld”, or “Cape” honey, there is very little melissopalynological research available to inform the validity of these descriptions. As such, melissopalynological analysis was performed on one hundred honeys from Southern Africa, with the majority originating from the Greater Cape Floristic Region (GCFR), South Africa. The aim was to determine whether the number of honey types available on the local market truly reflected the diversity of honeys produced in the GCFR. This was done by recording the pollen spectra of the honeys, comparing the pollen spectrum with the honey's commercial label, and investigating the viability of geographical differentiation at an international, national, and regional level. The honeys were incredibly diverse (> 70 pollen types), which is consistent with the pollen diversity described in the only other study from the region. Few honeys qualified as monofloral, with the most common types being Eucalyptus, Lobostemon/Echium, and local monofloral types, such as Aizoaceae-type, Erica, and Phylica. The commercial denominations of the honeys could be categorized into four groups, being neutral (49%), botanical (24%), and geographical (23%) denominations, or a combination (4%) thereof. The prevalence of honey marketed under neutral denominations is likely a consequence of the lack of origin verification services. In general, the commercial denomination did not reflect the pollen composition of the honey, with many monofloral honeys sold under neutral denominations e.g. “raw honey”. The pollen diversity allowed for geographical differentiation at three scales, being international, national, and regional. Lastly, honeys with ambiguous geographical origins were identified and photos of differentiating pollen taxa included for future reference.

PP-197 [Beekeeping Technology and Quality]
A new tipe of cells built by bees. Holistic approach

Dragos Negru
no affiliation

INTRODUCTION: There are a known a few types of cells built by bees. However, by giving the bees the possibility to build the combs naturally,appear in addition other types of cells.

Objectives
I sought to identify ways to evaluate the activity of bee colonies and the condition of the queen without opening the hive. The capacity to build natural honeycombs is the bees' most important characteristic,

The conversion cell
Conversion cells are the cells resulting from the reduction of the drone cells' diameter only in the upper part. They represent a partic-ular type of cells that reflect certain changes in the colony..

Method
Inserting one single empty frame into the active area of the nest and examining the types of built-up cells, we learn with just one look the status of the colony and what its needs are, without disturbing the bees by other op¬erations such as lifting the frames and searching for the brood or the queen bee.

I call this method “the eloquent honeycomb method” because the “speech" of the colony is present in the construction modality of the honeycomb. The method is applied during the active season, provided that there is nectar collection in nature.

RESULTS: The use of the eloquent honeycomb method at queen rearing and also when asessing the situation of the queen in the colony.

The interpretation:
- no honeycomb: the queen bee did not hatch;
- drone cells: the queen is not mated
- conversion cells and drone cells: the queen bee hatched and is newly mated, with the spawning about to begin. This type of cells is built when the spawning has not yet begun
- conversion cells and worker bee cells: the queen bee has started laying her eggs.

CONCLUSION: Using this method, a new type of cell built by bees is highlighted, as well as its importance in assessing the state of the queen in the bee colony. The effectiveness and precision of the method also represent an advantage and pave the way for a holistic approach to beekeeping.

PP-198 [Beekeeping Technology and Quality]
Physicochemical characterization and determination of the biological activity of monofloral encenillo honey from the high Andean zone of Colombia

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Honey is the best-known natural product with sweetening properties. It is produced by bees from flower nectar and plant secretions. Encenillo honey (Weinmannia tomentosa L. f; Cunoniaceae) is the only certified monofloral honey in Colombia. It comes from native plants free of human intervention, from high Andean zones located between 2400 and 3700 meters above sea level. The objective of this study has been focused on the melissopalynological characterization, determination of sensory attributes, physicochemical properties and volatile components, as well as the determination of total phenol and flavonoid contents, their reducing capacity, antiradical potential, and antibacterial activity. Pollen grains in the samples were greater than 45%, conferring a monofloral quality. Pfund color was 69.0 ± 1.00, pH and total acidity were 3.87 ± 0.04 and 31.8 ± 1.40 meq kg ¹, respectively, still within standard limits. Electrical conductivity was 0.525 ± 0.004 mS cm ¹, moisture content was 20.1 ± 0.43 g 100 g ¹, ash content was 0.198 ± 0.002%, reducing sugars were 69.7 ± 0.17 g 100 g ¹, total phenols were 1570 ± 14 mg kg ¹, and flavonoids were 129.4 ± 1.20 mg kg ¹. Analytical determinations for FRAP and ABTS showed significant levels for these parameters that correlate with the observed phenol levels. Tabouret's index was 3.75 ± 0.06, based on a fructose/glucose ratio of 1.35 ± 0.03 and a water activity of 0.604 ± 0.050. The honey exhibited Newtonian behavior. GC/MS analysis identified 25 volatile compounds, including alcohols, aldehydes, ketones, esters, hydrocarbons, furans, nitriles, sulfides, and terpenes. Phenolic extracts showed biological activity against Staphylococcus aureus, Pseudomonas aeruginosa, and Escherichia coli.

PP-199 [Beekeeping Technology and Quality]
Effect of collection month on the freezability of drone semen of Apis mellifera iberiensis reared under field conditions

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Honeybee colonies raise large numbers of drones during the reproductive season, which occurs in spring in Spain. From that point onward, the number of drones declines to varying degrees, depending on numerous factors such as colony size and food availability. But not only the quantity but the quality of drones may be affected by food scarcity or lower food quality, although this has been hardly studied. This study aims to analyze the effect of the month of semen collection from drones reared under field conditions on their sperm quality and sperm survival to the cryopreservation procedure. Mature flying drones of the Apis mellifera iberiensis subspecies were recovered from 10 hives, in the afternoon of days with good weather, on their return to the hive after blocking the entrance with a queen excluder. Semen was collected from the ejaculates of 224 drones (56/moth) and were pooled in groups of eight, diluted in kiev medium to a final concentration of 10% egg yolk plasma and 10% of DMSO, and packed in 0.25 ml straws. Cooling rate was 0,5ºC/min from 20 to 5 ºC and 3ºC/min from 5 to -40 ºC, when the straws were submerged in liquid nitrogen, and kept frozen for a minimum of 24 hours prior to evaluating post-thaw quality. Sperm quality analysis of fresh and cryopreserved samples included individual sperm motility and sperm viability assessments. No significant differences were observed between moths for sperm quality of fresh samples. Freezing decreased the sperm quality parameters in all groups ($p<0.01$), but this decrease was more pronounced for the samples collected in June and July with values of individual sperm motility and viability after freezing ranging between 58% to 66 % in May and April, and between 31% and 38% afterwards. It is concluded that sperm freezability may be reduced in the drones reared under field conditions collected after the reproductive season. This work was supported by the Spanish AEI-MICIN (grant PID2023-148475OB-I00), the EU Horizon Europe (grant 101082073) and the DGA-FSE (grant A07_23R).

PP-200 [Beekeeping Technology and Quality]
The Consumer as the Harvester: Disrupting Honey's Supply Chain

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Simon Mildren, Melbourne, Australia

Background/PURPOSE:
Innovation in beekeeping has primarily focused on AI and sensor technology, significantly improving hive monitoring and colony health. However, these advancements have yet to address a fundamental challenge, disrupting the honey supply chain itself to enhance transparency, efficiency, and consumer engagement.

Problem Description:
Despite technological progress, the industry continues to grapple with issues such as honey fraud, inefficient extraction methods, and limited consumer involvement in harvesting. These challenges not only impact honey purity but also create barriers to a more transparent and sustainable supply chain.

METHODOLOGY:
This study explores the potential of HiveKeepers' patented system technology, which allows beekeepers and consumers to take an active role in honey harvesting. Through controlled trials and user feedback, we assess its impact on extraction efficiency, product authenticity and supply chain dynamics.

Results & CONCLUSION: The HiveKeepers system simplifies honey extraction, eliminating unnecessary intermediaries while preserving purity and authenticity. Our findings indicate that this approach enhances beekeeper efficiency, reduces opportunities for honey adulteration, and fosters a direct connection between producers and consumers. Early adoption suggests a significant improvement in supply chain transparency and consumer trust.

Practical Implications for Beekeepers:
By shifting honey harvesting closer to the consumer, this innovation creates new opportunities for beekeepers, including alternative revenue streams, direct-to-consumer sales models and increased market differentiation. This reimagined approach to honey production has the potential to reshape the industry, making it more resilient, sustainable, and consumer-driven.

PP-201 [Beekeeping Technology and Quality]
From Hive to Honesty: How Technology is Combating Honey Fraud and Restoring Trust

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Background/PURPOSE:
Honey fraud is one of the most significant challenges facing the beekeeping industry, with adulteration and mislabeling undermining consumer trust and beekeeper livelihoods. Traditional methods of quality assurance often fail to address the full scale of fraud, highlighting the urgent need for innovation in both harvesting and traceability.

Problem Description:
Despite advancements in AI-driven hive monitoring and testing methodologies, there remains a critical gap in ensuring honey purity throughout the supply chain. Fraudulent practices continue to exploit weaknesses in extraction, storage, and distribution, eroding the integrity of natural honey products.

METHODOLOGY:
This study introduces HiveKeepers' patent-pending closed-system technology, a pioneering solution designed to secure honey purity from hive to consumer. By integrating advanced harvesting mechanisms with traceability tools, we evaluate the system's ability to eliminate contamination risks, enhance transparency, and create a direct link between beekeepers and consumers.

Results & CONCLUSION: Our findings demonstrate that closed-system technology significantly reduces the risk of adulteration by limiting external handling and ensuring that honey remains unaltered from beehive to the moment of extraction. When combined with emerging traceability and testing advancements, this approach offers a scalable, industry-wide solution for safeguarding authenticity and restoring consumer confidence in honey products.

Practical Implications for Beekeepers:
By adopting secure harvesting tools and real-time authentication mechanisms, beekeepers can strengthen their market position, protect the value of their honey, and contribute to a more transparent and resilient industry. This shift represents not just a technological advancement, but a necessary evolution in how honey is produced, verified, and trusted in global markets.

PP-202 [Beekeeping Technology and Quality]
IoT-Based Hive Monitoring for Evaluating Colony Strength and Honeybee Pollination Efficiency

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The use of Internet of Things (IoT)-based monitoring systems is becoming increasingly important for assessing the strength of honeybee colonies and their role in pollinating agricultural crops. Intensive pollination by bees significantly contributes to increased crop yields.

However, establishing the relationship between crop yield increase influenced by bee pollination, the assessment of individual colony strength involved in pollination, and the evaluation of their pollination efficiency is a complex and time-dependent process, as results become evident only after flowering or, ultimately, during harvest.

Here, we demonstrate that homogeneous experimental data on hive weight, internal temperature, and humidity, transmitted hourly from IoT sensors in smart hives, enable the assessment of colony strength before and during pollination. This approach allows comparisons of colony strength and their specific impact on pollination efficiency.

The pollination ability of a bee colony can be determined by the daily weight assessment of the bee population that has left the hive, while its dynamics can be evaluated by comparing daily weight changes of bees that have left the hive.

Precision and uniform dispersal of environmentally friendly attractants over flowering agricultural plants using agricultural drones may enhance pollination efficiency by bees.

The evaluation of colony strength and its pollination ability based on daily weight assessments of foraging bees can be applied in both precision agriculture and precision beekeeping.

The obtained homogeneous experimental data may be suitable for applying machine learning methods to develop predictive models of bee colony behavior during the pollination of various agricultural crops across different geographical locations under changing climatic conditions.

PP-203 [Beekeeping Technology and Quality]
Solar-Powered Smart Hives Network for Beekeeping and Long-Term Research

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Scientific research on honeybee colonies in natural conditions increasingly relies on Internet of Things (IoT)-based monitoring systems. These systems enable simultaneous collection of internal and external hive parameters, improving data comparability and research efficiency. High-quality data allow the effective application of machine learning and predictive modeling to mitigate negative developments in honeybee colonies housed in smart hives with IoT-based monitoring. However, these advancements impose higher requirements for data quality, including homogeneity, continuity, standardization, completeness, and consistency. Additionally, IoT devices must operate autonomously under extreme climatic conditions while balancing energy consumption, digitization frequency of hive parameters, and long-term functionality. This study presents a practical, field-validated solution that has operated continuously for several years in harsh European and North American climates. We introduce an innovative smart hives network architecture, where permanently embedded IoT sensors function exclusively on solar energy while collecting high-quality, non-invasive data. The IoT devices remain in sleep mode most of the time, activating based on solar radiation. During periods of high solar availability, typically in spring and summer, the devices activate hourly for a few minutes to collect and transmit data. In autumn and winter, with minimal solar energy, they operate less frequently, usually every two hours. This adaptive cycle corresponds to the seasonal dynamics of honeybee colonies. Continuous non-invasive data collection is particularly valuable for monitoring overwintering colonies, where invasive methods are impractical. Tracking internal hive conditions, regulating humidity, and providing timely winter feeding contribute to successful overwintering and early colony development, essential for pollination, especially in early spring, for agricultural crops. Additionally, solar panel data from each hive serve as a supplementary, non-invasive information source, potentially influencing honeybee behavior during monofloral honey collection. Our continuously operating smart hives network provides high-quality, non-invasive data on honeybee life, enabling advanced long-term research and supporting both traditional and precision beekeeping while addressing sustainability challenges in the context of climate change.

PP-204 [Beekeeping Technology and Quality]
An armed concrete langstroth hive: a prototype to popularize on bail of a patent

Kodjo Logou Logou Agossou
Station Agro-apicole de Recherche et Production s/c Organisation pour la Promotion des Arts Apicole et Sylvicole

In modern beekeeping, the langstroth is both the most used hive and one of the models against which many tools and technologies are designed. The objective is to use reinforced concrete instead of the board for the body of such a hive. In fact, obtaining a board only occurs after you have cut down a tree. An action which either reduces the capacity of the flora to provide bees with food and medicinal substances, destroys the key factor of the ecosystem that the trees represent or in certain particular cases causes the disappearance of valuable plant varieties.The use of concrete is therefore designed to overcome this waste. This work required an original mold of my own design, a trowel, a tray then the following materials: gravel, sand, cement, water, 6mm reinforcing iron for respective quantities of 5478136 cubic millimeter, 3652091 cubic millimeter, 4 kilograms, 2 liters, 4420 millimeters for a whole body. The iron bar is cut into rewelded pieces to form a skeleton approximately reminiscent of the arrangement of the edges of a rectangular parallelepiped measuring 505 x 415 x 210 cubic millimeter. The concrete ingredients are mixed in the tank, then sprinkled well with water to be poured into the mold after the iron skeleton has been placed there. Ten hours later, the stripped formwork reveals a rectangular parallelepiped box with a cavity of 466 x 376 x 240 cubic millimeter and a wall thickness of 22 millimeters. This box takes ten frames with useful dimensions of 415 x 198 square millimeter and a span of 475 millimeters each. Two holes drilled in front of one of the small facades of the structure allow you to hang the pollen trap. Economically, it costs 4 euros. It weights twenty kilograms compared to seven for the wooden specimen. This model therefore combines ecology with economics and also helps to resolve other problems such as the deterioration of hive by termites, other organisms, vegetation fires and weather. For these reasons, we call for any form of partnership aimed at quickly obtaining intellectual property with a view to wide dissemination.

PP-205 [Beekeeping Technology and Quality]
Evaluation of the effect of fructooligosaccharides (FOS) on the honey bee microbiota and mycobiota

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The honeybee is essential for pollination and ecosystem maintenance. Beekeeping in Spain is an important industry, not only for its economic benefits but also for preserving biodiversity. However, climate change and drought are reducing the availability of flowering plants, forcing beekeepers to provide artificial feed supplements. Fructooligosaccharides (FOS), derived from sucrose, are low-calorie prebiotics that promote healthy gut microbiota by boosting organic acid production in animals. Key honeybee gut bacteria (Lactobacillus, Bifidobacterium, Gilliamella) promote pathogen resistance and digestion. This study evaluates fructooligosaccharide (FOS) supplementation on beneficial bacterial and fungal populations in Iberian honey bee colonies of the subspecies Apis mellifera iberiensis. Thirty hives were divided into three groups: control (standard syrup), 1% FOS supplementation and 5% FOS supplementation. The weight of the hives before and after the study was recorded to evaluate colony productivity. DNA extracted from worker bees was subjected to metagenomic analysis to characterize the microbiota and mycobiota composition according to operational taxonomic units (OTU). Alpha diversity was measured using different indexes to assess species richness, while beta diversity analysis with Bray-Curtis distance assessed changes in microbial community structure between treatments. Hive weights increased significantly in the 5% FOS group compared to the control, but microbiota analysis revealed no significant changes in bacterial populations due to FOS supplementation. Alpha and beta diversity analyses indicated that the composition of the microbiota changed naturally over time. The study concludes that while FOS does not modify the honey bee gut microbiota, it does have an effect on hive production. Similarly, mycobiota did not change significantly between control and treatments, but did change over time, in fact, mycobiota diversity decreased over time in FOS-treated honey bees, but not in control samples, which warrants further study. Beekeepers in Spain facing drought and reduced flowering plants can consider supplementing their colonies with FOS in sugar syrup to potentially boost hive productivity without negatively affecting honey bee gut microbiota. However, since FOS may reduce fungal diversity over time, it is recommended further studies to clarify its long-term effects.

PP-206 [Beekeeping Technology and Quality]
Bivouac traps: capture swarms within the apiary

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1Background
Bees swarm, despite swarm prevention practices; and swarms escape, despite swarm traps. Escaped swarms cause four problems. First, loss of a good queen – and half her genes. Second, loss of the workers producing the honey crop. Third, the risk of injury to the person attempting to retrieve the swarm. And fourth, the likelihood the swarm will take up residence in the walls of a neighbor's house.

Problem description
Bivouac traps are a means of capturing swarms that is used in Russia, where they are known as Russian Scions "Привой и роевня", but these are rarely used elsewhere and their efficacy is unknown. Preliminary research reveals that about half the swarms from a given apiary may choose the same bivouac site repeatedly. More study is needed to discover what makes bivouac sites desirable to swarms. Potential features include proximity, accessibility, shelter, safety, and structure.

Methodology
The proposed methodology is to analyze existing bivouac sites within apiaries, to rank the sites by their desirability to swarms, and to rank the apparent values of their features to swarms. Then, to evaluate these features one by one experimentally, as was done to determine bees' nest site selection criteria. And finally, to construct, deploy, and evaluae bivouac traps based on these features.
Also, as we evaluate bivouac trap attractiveness to swarms, we will simultaneously evaluate designs that enable easy swarm retrieval.

Results and conclusion
The first result will be an enumeration of the features and values that swarms desire in bivouac sites.
The second result will be a bivouac trap that swarms cannot resist and one that swarms are easily retrieved from.
How honey bees investigate and evaluate bivouac sites, and how they communicate the location of the selected site might also be observed during this study.

Practical implications for beekeepers
By using bivouac traps to capture swarms that otherwise would have escaped, beekeepers will retain their desirable queens and their valuable honey crop, reduce their risk of injury, and of irritating their neighbors.

PP-207 [Beekeeping Technology and Quality]

STUDY OF GEOGRAPHICAL INDICATIONS OF ORIGIN FOR THE PRODUCTION OF HONEY OF Myracrodruon urundeuva CHACO CHUQUISAQUEÑO REGION BOLIVIA – 2024

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INTRODUCTION
The added value at the source, emphasizing the diversification and differentiation of honeys, due to their geographic and botanical origin in the Bolivian Chaco region.

METHODOLOGY
The study is based on the survey of bee flora, on the spatial distribution of apiaries and their correlation with the altitudinal, bioclimatic, geomorphological and edaphic variables defined by (Navarro, G. and W. Ferreira. 2007). Throughout the territory, 28 apiaries were identified with 340 monitoring hives, with 56 permanent sampling plots PPMs, where all individuals were recorded from saplings with (dbh<5cm, h≤1.30m) in order to know the density of each species, observe the phenology and evaluate the natural regeneration per unit of vegetation.

The floristic comparison for the location of the sampling points in the 1 km libation area was carried out by mapping at pixel level of values and intervals of -1y1 of the chlorophyll content of the NDVI analysis = (Band5-Band4) / (Band5 + Band4) of the "LANDSAT_8" product SCENE_ID = LC08_L1TP_231074_20240818_20240823_02_T1. For the calculation of honey yields kg/hive, data were collected from probabilistic samples of hives during the season. For the estimation of pollen grain frequencies, samples were sent for melissopalynological analysis according to Louveaux et al. (1978).

RESULTS
Figure 1 shows the reference geographic coverage with the highest density indices of Myracrodruon urundeuva of 80 trees/ha with an average dbh of 27.4 and a yield of 8-16kg/col with an area of 2,500km2

The second vegetation unit of Schinus pilífera with an average density of 40 trees/ha with an average dbh of 32.1 and a yield of 9-14kg/col with an area of 545km2

Graphs 1, 2 and 3 show the volumes of differentiated honey production during the productive season.

Figure 2 has a certain predictive value of the beginning of flowering as a result of monitoring the PPMs.

CONCLUSIONS
The geographic origin can be established by the presence of pollen characteristic of the recorded species, limited to the libation area for each apiary and vegetation unit. The botanical origin can be deduced from the frequencies of the predominant pollens with more than 45% from a single species (monofloral honey).

PP-208 [Beekeeping Technology and Quality]
Characterization of Colombian propolis: Fingerprinting by electrospray ionization mass spectrometry

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Propolis is recognized worldwide and has been registered in the Chemical Abstracts Service (CAS) 9009-62-5, as a natural product elaborated by different genera of bees, from mucilaginous exudations, gums, lipophilic materials, latex and resinous plant material, which they bring to their hives and mix with glandular secretions from the hypopharynx and wax glands. Electrospray ionization mass spectrometry in the negative ion mode ESI(-)-MS was tested to compare ethanolic extracts of Colombian bee propolis selected for fingerprint characterization. Dry propolis extracts were dissolved in a solution of 70% (v/v) of methanol, 30% (v/v), deionized water and 0.1% ammonium hydroxide. The solutions of propolis were infused directly into the ESI source by means of a syringe pump (Harvard Apparatus) at a flow rate of 10 µL min−1. ESI(-)-MS. The propolis extracts presented different color shades. The ESI(-)-MS patterns represent the presence of secondary metabolites. The fragmentation are coincident for: caffeic acid (m/z: 116, 135, 179) and derivatives (m/z: 135, 179, 355, 399; m/z: 135, 179, 315), p-coumaric (119, 163), 2,2-dimethyl-6-carboxyethenyl-2H-1-benzopyran (m/z: 146, 160, 170, 174, 174, 185, 211, 229) and liquiritigenin (m/z: 119, 135, 255), quercetin (m/z: 151, 169, 179, 193, 211, 213, 229, 239, 257, 273, 283), the latter three also observed in red propolis, in addition to 4-hydroxy-3-3-oxy-3-acid (m/z: 174, 174, 185, 211, 229). 4-hydroxy-3-prenylcinnamic acid (m/z: 132, 187, 231), viscidone (m/z: 132, 133, 188, 233), pinocembrin and its glycoside derivatives such as pinocembrin-5-o-3-hydroxy-4-methoxyphenyl propionate (m/z: 309, 323, 401, 415 and 433), galangin (m/z: 169, 171, 173, 195, 197, 198, 199, 199, 211, 213, 223, 225, 227, 240, 241), isoramnetin (m/z: 300 and 315), caffeoyl isoprenyl ester (m/z: 135, 179 and 247). The ions (m/z: 299) and (m/z: 515). The negative mode ESI-MS fingerprinting method is capable of discerning distinct composition patterns to typify, to screen the sample origin and to reveal characteristic details of the more polar and acidic chemical components of propolis samples from different regions of the world.

PP-209 [Beekeeping Technology and Quality]
A chemometric approach: Characterization and classification of Colombian propolis based on Infrared spectroscopy

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Propolis is natural product produced by bees from resins collected from buds or plant exudates; it is used to seal cracks and reduce the risk of disease within the hive. The medicinal properties of propolis are well known, with antimicrobial, anti-inflammatory, anti-oxidative and cytotoxic qualities. Fourier transform infrared spectroscopy (FTIR) has become one of the most useful analytical tools because of its merits, including rapid detection, ease of operation and cost savings. It is based on changes in vibrational and rotational modes. The objective of the present work has been focused on the systematic and chemometric evaluation of ethanol extracts of Colombian propolis by means of attenuated total reflectance (ATR-FTIR) spectroscopy techniques. The evaluations proceeded by assessing the spectral signals of the extracts. All spectra were obtained in the range 4000 cm-1 to 600 cm-1. In the chemometric study, multivariate analysis techniques were applied, operating mainly in the spectral region of the fingerprint (1800 - 600 cm-1) operating also with the zero order, first and second derivative registers. ATR-FTIR, sample analysis has revealed, spectral patterns of ethanolic extracts of Colombian propolis, thanks to the use of spectroscopy techniques, leading to the establishment of differences and similarities between samples, the use of these tools allows applications for routine analysis.

PP-210 [Beekeeping Technology and Quality]
Profile of physicochemical parameters in the determination of authenticity and diagnosis of Colombian honeys: DSC as a complementary diagnostic tool

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Honey is produced from flower nectar and plant secretions, as well as from the excretions of sucking insects, which the bees collect, transform and combine with specific substances and ripen inside the comb. Amorphous water-sensitive systems can exhibit various changes in their physicochemical properties. DSC is a tool to evaluate this type of interactions, with interesting correlations associated with the quality of materials such as honey. Fructose/glucose and physicochemical parameters considered by the International Honey Commission were evaluated. Rotary power, thermal conductivity, heat capacity, viscosity, differential scanning calorimeter (DSC) and phase transition properties of the honeys were studied using instrumental methods. A glass transition, which must be associated with the amorphous dry solids in honey, was observed to occur at very low temperature, between -67.2 and -42.61°C, with Tg varying linearly with the water content of the samples. This study demonstrated that the variation of thermal properties DSC, sugar and rotary power are powerful techniques to characterize the behavior of honeys, reducing sugars, proportion and thermal parameters of DSC analysis allow the identification of groups of honeys, unifloral and honeydew. Principal component analysis contributes to the identification of fraudulent honeys.

PP-211 [Beekeeping Technology and Quality]
ESG realization considering safe bee venom production and animal welfare through a Korean bee venom collector

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The bee venom extraction process is directly related to the welfare of bees, and using a Korean bee venom extractor, you can safely obtain bee venom while minimizing stress and risks to bees. The Korean bee venom extractor is an innovative technology that simultaneously considers the welfare of bees and safe bee venom production, and this technology offers the following advantages: It can extract only bee venom with uniform ingredients without killing bees (bee safety). The death rate of bees during bee venom extraction is significantly low, and it does not significantly affect the physiological ecology of bees (improved animal welfare). High-quality bee venom is produced through high-quality bee venom extraction and purification technology (high-quality bee venom production). The production and use of bee venom using a Korean bee venom extractor is a technology that can create an animal-friendly bee venom production environment and contribute to the future-oriented development direction and realization that is in line with global ESG (Environment, Social and Governance) management. This technology can strengthen the competitiveness of the Korean bee venom industry and produce high-quality bee venom to provide to consumers.

PP-212 [Beekeeping Technology and Quality]

Comparing colony performance under standard and innovative varroa management concepts in a European experiment

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Beekeeping practices play a fundamental role in maintaining bee health, particularly in the face of global challenges like climate change or invasive pests. To ensure sustainability, modern beekeeping needs to focus on the implementation of natural curing mechanisms into productive management systems. Within this framework, the mite Varroa destructor remains a key challenge for beekeeping and bees. The BeeGuards project thus investigates effects of an innovative varroa-control concept on performance and resilience of colonies in comparison to conventional management standards. To assess this approach, 17 institutions across 12 countries are conducting a large-scale field experiment involving nearly 500 colonies. The conventional approach consists of the treatment most commonly applied in each respective region, whereas the innovative approach is characterised by an induced summer brood interruption with subsequent oxalic acid application and a threshold-based strategy for the eventual winter treatment. Mite infestation levels and colony development are continuously monitored and complemented by diverse sensing devices. To this end, a Pan-European Digital Apiary is formed by equipping 50% of test colonies with digital scales, in-hive thermal sensors and bee counters. Structure, methods and initial findings will be presented.

PP-213 [Beekeeping Technology and Quality]

Apisense: AI-Enhanced Sensors for Detecting Bee Pheromones and VOCs to Monitor Colony Health and Predict Varroa, Nosema, and Foulbrood Infestations

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Bee pheromones are crucial for colony communication, conveying information about health, environmental changes, and threats. Numerous research aims to assess colony condition based on in-hive air composition. However, precise disease identification remains challenging due to limited data availability.

In collaboration with Polish beekeepers and scientists, Apisense has developed an innovative solution that transforms bee pheromone signals into actionable insights for accurate colony health assessments. The Apisense device, equipped with an advanced volatile organic compounds (VOCs) sensor, is easily installed inside a hive where it monitors air composition continuously. AI-driven algorithms analyze the collected data and generate alerts about potential diseases. These insights are accessible to a beekeeper via a user-friendly web or smartphone application.

Currently, Apisense focuses on detecting three of the most serious bee diseases identified by the World Organisation for Animal Health: Varroosis (Varroa destructor), Nosemosis (Nosema spp.), and American and European Foulbrood (Paenibacillus larvae, Melissococcus plutonius). Conducted tests confirm the Apisense software's F-1 score effectiveness achieving over 86% accuracy in detecting Varroa and 88% accuracy for Nosema detection, with a false-positive rate of 11% and a false-negative rate of 14%. The most promising results were obtained for foulbrood detection, with accuracy reaching 98%.

With its ease of use and accessibility, Apisense supports both novice and experienced beekeepers. By providing early disease detection and real-time bee colony status monitoring it enables more efficient, data-driven beekeeping, and supports beekeepers to respond promptly. This 24/7 automated monitoring system reduces the need for manual inspections, improving hive management efficiency. The developed solution is the subject of a patent application, additionally highlighting its innovative approach to in-hive air composition monitoring and disease detection.

PP-214 [Beekeeping Technology and Quality]
Efficiency improvements in honey extraction rooms: shift management automated through Genetic Algorithms

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In the era of Industry 4.0, digitalization has become one of the main innovation drivers. In particular, for efficient beekeeping practice AI technologies may improve the organization of honey extraction rooms, especially when the seasonal demand increases abruptly. Therefore, we have designed a specialized Genetic Algorithm (GA) called ApiTurn. It is a shift management tool focused as a flexible, user-friendly application both for clients and managers of honey extraction rooms. It aims at maximizing productivity by means of an accessible online planning tool that supports the decisions that concern creating and managing shifts. The optimizer GA is methodologically inspired from population genetics. Every possible solution is represented by a "digital individual" and after the generation of an initial set of feasible solutions, individuals are randomly recombined or mutated. The resulting individuals undergo a process of natural selection, which favors the survival of the fittest (the best solutions). The evaluation is done by a fitness value, which scores some characterizing aspects, thus yielding the scheduling cost.The model was built by addressing the hierarchical structuring of the requests, which allows an easy effective identification of a client´s relevance through a file that helps to prioritize urgencies and key clients.
ApiTurn provides a shift management system that allows to minimize the number of equipment washings and to optimize the use of the extraction room in a working day. It is an innovative computational optimization tool for mobile phones and adapted to the reality of the beekeeping sector. It was exclusively addressed to a specific set of users and their cell phones. To make the structure elastic, it was conceived with two blocks: one where the client books his shift in a proposed schedule; the other one is for the manager, who accepts or modifies the request. Shifts were enhanced by a tree of additional data, like breaks for lunch, the distribution among several extraction lines and plant stops.
ApiTurn will support beekeeping decisions on changing problems that are not easily diagnosed in advance. Its modules can straightforwardly be adapted to local issues, thus contemplating significant cost savings in shift management.

PP-215 [Beekeeping Technology and Quality]
Tracing the geographical origin of honey using contemporary analytical methods and chemometric approach

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Honey is recognized from the past as high-quality food which is why it is more and more often target of different types of adulteration. Assessing the authenticity of honey is the goal of many scientists worldwide for which simple analytical methods have not been sufficient for a long time. One of the newer analytical approaches in determination of honey authenticity is usage the combination of stable isotopes and mineral composition together with chemometrics. In Croatia production of multifloral and different unifloral honey types is possible because of its diverse vegetation and climate. One of the well-known honey types, not only in Croatia but also more widely, are black locust (Robinia pseudoacacia L.) and lime (Tilia spp.) honey. Both of these plants could be found in continental and coastal region of Croatia. The aim of this work was to achieve distinction of honey samples of the same botanical origin produced in different geographical regions of Croatia by using stable carbon (δ13C) and nitrogen (δ15N) isotope ratio and mineral composition. Lime and black locust honey samples were collected in coastal and continental parts of Croatia. Stable isotopes (δ13C and δ15N) were determined in honey and isolated honey proteins by elemental analyser - isotope ratio mass spectrometer (EA-IRMS). Inductively coupled plasma - optical emission spectrometry (ICP-OES) was analytical technique for mineral elements (Al, As, B, Ba, Ca, Cd, Co, Cr, Cu, Fe, Hg, K, Mg, Mn, Na, Ni, P, Pb, S, Zn) determination, before which the microwave digestion of the samples was carried out. Taking into account the geographically relatively small distance of locations where honey samples of the same botanical origin were collected, quite successful differentiation was obtained according the geographical origin of these two honey types. PCA results showed that 87% of black locust honey samples from two regions were distinguished by using only IRMS parameters, while in combination with ICP parameters classification was completely successful. IRMS parameters were sufficient for lime honey samples classification according to region of origin. Combination of used analytical techniques together with PCA analyses could be useful tool in assessing honey authenticity.

PP-216 [Beekeeping Technology and Quality]
Systematic evaluation of a process for the production of meads based on Colombian monoflorals honeys

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Mead production plays a crucial role in the transformation of honey, offering economic, nutritional and cultural benefits, representing a dynamic process in a complex and valuable beverage. The growing craft industry is driving innovation in styles, flavors and production methods, making mead an increasingly popular choice among consumers worldwide. The objective of this study focused on optimizing Colombian meads using monofloral honey from eucalyptus (Eucalyptus globulus Labill.), encenillo (Weinmannia tomentosa L.f.) and matarratón (Gliricidia sepium (Jacq.) Walp.), from Villanueva (Casanare), Paipa (Boyacá) and Mariquita (Tolima), Colombia. The research focused on developing a value-added product by evaluating the physicochemical properties of the raw material and conducting pollen analysis to confirm its botanical origin. A batch fermentation system was used at room temperature with musts at 22 °Brix and three yeast levels (0.30, 0.40, and 0.60 g·L ¹) of Saccharomyces bayanus. Fermentation kinetics were analyzed using a Sigmoidal-Logistic model, assessing ethanol and carbon dioxide production through Levenberg-Marquardt logarithmic interaction. Results showed a decrease in soluble solids from 22.2 ± 0.40 to 9.10 ± 0.05 °Brix. Ethanol content increased with yeast concentration, ranging from 8.34 ± 0.22 to 11.2 ± 0.33 g·L ¹. Carbon dioxide production was highest in musts with greater yeast levels, accumulating between 17.4 ± 0.06 and 20.8 ± 0.70 g·L ¹ over 11 days. The final product was evaluated in terms of ethanol content, soluble solids, total acidity, volatile compounds, and carbon dioxide, providing valuable insights into the fermentation process and product development. Mead production is not just an alternative use for honey but a sophisticated transformation process that enhances its value, extends its utility, and contributes to both economic and cultural sustainability. Its rising popularity in the craft beverage industry further highlights its importance in modern food and drink markets.

PP-217 [Beekeeping Technology and Quality]
From hive to table: the promise of shotgun metagenomic to trace the honeys' journey

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The degradation of honey quality, along with the lack of traceability, are main concerns in the apiary industry. The globalization of trade markets has indeed led to large-scale exchanges of bee products, often with limited knowledge of their geographic origin. These long commercial channels make them furthermore particularly vulnerable to fraud. As a matter of fact, honey is considered to be the third most fraudulent food production worldwide. Due to the unfair competition with imported low-cost products, it represents a serious challenge for the beekeeping sector and its sustainability in many countries. The current state-of-the-art chemical and mellisopallinological methods aiming at detecting adulteration (e.g., mixing syrup with honey) or misdeclared geographical origin are still not sensitive enough to systematically highlight those frauds. To overcome these limitations, we propose to develop an alternative and more resolutive approach using a molecular technique called metagenomics. This method allows the analysis of shotgun sequencing data generated from the overall DNA content of an environmental sample (eDNA). Applied to honeys, it offers the possibility to access a large range of eukaryotic and prokaryotic species related to bees, including plants, fungi, and microorganisms. To be exhaustive, we analyzed sequencing data from 450 honey samples coming from a great diversity of geographical origins, combining data generated in our laboratory and those available in public databases. One of our first objectives was to evaluate the presence of bee DNA, which can be informative on the geographical origin of honeys. Our results highlight that we successfully were able to identify a fraction of DNA corresponding to honey bees in all the samples (mean = 12.76%). It should be noted that this proportion can vary widely from one honey sample to another (from 0.1% to 80% of all the reads sequenced). The next step of our analyses will be to continue this characterization, in order to identify the different plant species that could serve as biotracers to enhance honey traceability. The overall aim of our research is to determine whether genomic and metagenomic approaches will represent a promising strategy to address the current challenges facing the beekeeping industry mentioned previously.

PP-218 [Beekeeping Technology and Quality]
TrazAPI: Enhancing Beekeeping Efficiency and Traceability in Tropical Region

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Beekeeping in tropical regions faces unique challenges due to extreme climatic conditions, agricultural intensification, and the growing threat of honey adulteration. Bees suffer significant impacts from pesticide use and habitat loss, while beekeepers struggle with the lack of adequate tools to manage these issues effectively. In this context, TrazAPI emerges as a key solution. This comprehensive platform, combining an ERP and CRM system, optimizes the management of apiaries, inventories, and the commercialization of beekeeping products, with a focus on improving efficiency and usability.
TrazAPI stands out by integrating advanced tools such as georeferencing and remote sensing, enabling beekeepers to access real-time data about their apiaries' environmental conditions. This is essential in tropical areas, where conditions can change rapidly. The platform also incorporates IoT (Internet of Things) technology, allowing monitoring of variables such as temperature, humidity, and bee activity to improve productivity and protect the colonies. An innovative feature of TrazAPI is its AI-powered virtual assistant, providing instant support to beekeepers through a trained chatbot. This assistant answers questions about apiary management and inventory control. Additionally, it integrates with WhatsApp, making it easy for beekeepers to manage work orders and inquiries without the need for complex interfaces, significantly enhancing usability. TrazAPI also addresses honey adulteration with a complete traceability system that ensures the authenticity of each batch, building consumer trust and enhancing the competitiveness of beekeeping products. Furthermore, the platform enables consumers to learn more about the origin of the honey and the beekeepers behind the products, fostering a closer connection between producers and consumers. With the capability to manage inventories, medications, and essential resources, TrazAPI optimizes beekeepers' operations. This presentation will explore how TrazAPI is helping beekeepers overcome environmental and economic challenges by improving productivity, ensuring honey quality, and guaranteeing traceability across the supply chain. Additionally, we aim to help beekeepers maintain complete traceability and identify opportunities for improvement in their beekeeping business.

PP-219 [Beekeeping Technology and Quality]
Trapping queen swarms upon landing to overcome bottlenecks in royal jelly and queen production programs

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The in-vitro production of queen and royal jelly imitates the domestic bee ethology. However, finding larvae under seventy-two hours old at the right time is a real bottleneck, as is the transfer of these larvae. This document presents the simultaneous research carried out in our station to alleviate these difficulties. Indeed, when it comes to obtaining this age range of larva, the popular process using the insertion of an old comb between two brood frames suffers from many problems, including technical, biological and even meteorological. As for their transfer, problems of eyesight and dexterity of the handler are the common pitfalls. The larvae production equipment consists of a hive body acting as a swarm trap, a single-frame hive equipped to pick the queen, a piece of old brown comb with a worker cells mounted on a frame, an articulated light magnifying glass, a plastic laying matrix with removable cell bottoms. The latter will additionally serve alone to investigate transfer problems. At the honey flow, the traps are placed adjacently so that access to the hive body is subject to passage through the hive. The two adjacent doors of these traps are separated by a queen excluder. Also, when a swarm decides to adopt the hive body, the workers access it and the queen is retained. The latter will be completely caged there a few moments later. With regard to the first concern, the frame filled with empty comb is introduced into the hive after having lightly painted the comb with honey. In the case of both concerns, at the same time, the swarm is transferred to another hive after having introduced the queen into the laying matrix previously put in operating condition. Five days later, the two devices display tiny larvae at the bottom of the cells under magnifying glass. Additionally, the plastic cell bottoms come off, taking these larvae with them easily. Both protocols are conclusive.They appear to be real sure shortcuts of these phases of existing methods. It is unfortunate that we didn't have the optimal conditions in our langstroth hives the one which could capitalizing such achievement.

PP-220 [Beekeeping Technology and Quality]
Sensory profile of portuguese honeys with Protected Designations of Origin

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Honey is a product of high commercial value not only in the Portuguese market but throughout the world, with a growing demand for high quality and authentic products. The regulation of Protected Designations of Origin (PDO) is a European tool that provides consumers with safety and confidence in the origin. However, for Portuguese honeys with PDO, the registered specifications lacks information on the organoleptic characteristic, making this reference information necessary for evaluating the product and for validating compliance with the same. The evaluation of honey through sensory analysis methodologies, complements the physicochemical and pollen analysis and provides greater robustness in the categorization of whether its characteristics correspond (or not) to a given PDO. The aim of the work was to define the sensory profile of five Portuguese honeys with PDO, namely:Terra Quente, unifloral butterfly lavender – Lavandula stoechas honey, and Ribatejo Norte (4 subregions), with three multifloral and an unifloral rosemary – Rosmarinus officinalis honey. To establish these profiles a sensory analysis panel was formed. The participants were recruited from several fields (beekeeping technicians, consumers, producers and academics). The assessors were selected and trained according to ISO8586. The sensory profiles were defined by consensus method (ISO13299) regarding colour (intensity and tone), odour (intensity and description) and taste (intensity and description) attributes. A collection of several selected honey samples, with different pollen predominance, representative of Portuguese honeys was presented to assessors to adequate descriptors development. Honey samples from both regions, collected during 2-5 years period in different locations within PDO areas, were chosen to create the sensory profiles. Here we shown, it was possible to define the sensory profile of 4 out of 5 proposed honeys. In subtype of Ribatejo Norte (Albufeira de Castelo de Bode) the defined profile appears to be too broad, not allowing samples discrimination. More samples of honey are need to confirm or redefine the profile. The results obtained are of great relevance for the Portuguese honey sector, since the first step was taken in the creation of an important analytical tool for the sensory characterization of honey and verification of its authenticity and preventing fraud.

PP-222 [Beekeeping Technology and Quality]
DETERMINATION OF MINERAL CONTENT IN COLOMBIAN PROPOLIS SAMPLES FROM THREE REGIONS: BOYACÁ, CAUCA AND SAN ANDRÉS INSULAR

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Propolis is a resinous mixture made by bees from tree buds, sap exudates or other plant sources, which they then process in the hive for protection. More than 100 biological compounds with active principles have been detected in some propolis. It has antioxidant, antifungal and antimicrobial properties depending on the botanical species associated with its collection. Its composition is determined by several factors such as geographical location, botanical sources, collection season and bee breed, among others. Its form of commercialization is represented in droppers, liquid and capsules: Pure Propolis, Natural Propolis Extract, among others. In this research the minerals Magnesium (Mg), Iron (Fe), Zinc (Zn), Calcium (Ca), Selenium (Se), Manganese (Mn) and Copper (Cu) were analyzed in propolis from different regions of the country (San Andrés, Boyacá and Cauca), in order to determine if the geographical origin influences the mineral composition. Quantification was performed by flame mode atomic absorption spectrophotometry using Thermo 3000 equipment. According to the results it can be concluded that the mineral content in propolis is very variable and depends on many factors that determine its presence and concentration, so propolis can be differentiated according to its mineral content. As significant results, the content of Selenium in the propolis of San Andres stands out, which may be associated to botanical species of coconut and mangrove that are present in the area, being a significant source of this oligoelement.

PP-224 [Beekeeping Technology and Quality]
Installation applicable for testing the real level of Varroa mite (Varroa destructor) infestation and organic control in a honeybee colony

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Varroa mite is one of the leading causes of honeybee colonies losses. In order to apply an effective treatment strategy it is important to know the level of infestation with phoretic mites throughout the season, but also the effectiveness of new or existing treatments, including testing the resistance of mite to various treatment substances under standardized experimental conditions. Currently, the tools for assessing the mite population in a honeybee colony are based on estimation methods, mainly on powdered sugar or alcohol washing, starting from samples of several hundred bees. In order to increase the assessments accuracy regarding the phoretic mites number at colony level and monitoring the infestation level in apiaries according to international recommendations, we developed a programmable installation with a swinging drum in two cycles of two minutes each, for the homogeneous powdering of bees from a colony with 100-120g of powdered sugar/kg of bees (first cycle) followed by separation by sieving and collection of the entire mite population (second cycle) in order to count the parasites, but also to eliminate them. To test and optimize this installation, an experiment was organized in 2024 on 10 colonies in order to evaluate its effectiveness by quantifying the number of parasites collected immediately after installation use, as well as after 24 hours on mites fallen on the antivarroa bottom board. The effectiveness of installation was verified by applying the classic alcohol washing method on 50g bees samples collected from tested colonies. Based on the obtained results, it was found that the installation effectiveness and therefore the accuracy of monitoring the real level of infestation in colonies is between 80-90%. The factors that could influence the effectiveness of the installation are the swinging speed and the size of the powdered sugar particles, which could be further improved. This installation allows organic control which could be applied to any biological unit, during specific works when deemed necessary. The procedure also allows testing the effectiveness of used treatments and to monitor the infestation level, but also the detection of other parasites (e.g. Tropilaelaps spp.) for effective control strategies adapted to local conditions.

PP-226 [Beekeeping Technology and Quality]
An instant release royal jelly-cyclodextrin inclusion complex for skin and hair applications

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Royal jelly (RJ) is a yellowish-white, gel-like substance produced by the hypopharyngeal and mandibular glands of young worker bees. RJ offers numerous health benefits, including antimicrobial, anti-inflammatory, anticancer, antioxidant, antidiabetic, immunomodulatory, and anti-aging properties. Moreover, RJ has gained attention for its potential to combat skin aging as it is rich in key bioactive compounds such as 10-hydroxy-2-decenoic acid (10-HDA) and polyphenols that confers antioxidant and photoprotective activities on skin. However, their extraction and use are challenging due to their instability, as they degrade and change color when exposed to high temperatures. The present study intends to eliminate the stability disadvantages of RJ, offering an instant release of the 10-HDA and the polyphenols that it contains aiming to enhance its bioactivity in cosmeceutical applications. More specifically, we performed extraction and inclusion of bioactive components from fresh, untreated royal jelly into a β-hydroxypropyl cyclodextrin system, composed solely of natural and safe ingredients, which results in the instant release (IR) of the incorporated polyphenols and 10-HDA. This RJ-IR formulation was further incorporated in cosmetic formulas to evaluate the benefit from an instant activity. We show that RJ-IR incorporation in shampoo and hair conditioner reduces hair porosity of hair shaft, upon urban pollution stress or baseline conditions and restores hair integrity. Moreover, we demonstrated that RJ-IR incorporation in a face cream effectively repairs skin barrier function. Finally, we revealed modulation of stress factors expression in vitro in hair follicle dermal papilla cells (HFDPCs) treated with RJ-IR. Our results in total highlight the efficacy of our RJ formulation in cosmeceutical applications. This technological system offers numerous advantages to beekeepers, such as the possibility of life extension of RJ, the potential for exploitation of expired RJ as well as an alternative market such as the high-tech raw materials and cosmetic products.

PP-227 [Beekeeping Technology and Quality]
Indigenous honey bee Apis cerana Indica Intervention of modern movable frames in traditional wall hives and for sustainable ecosystem

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Indigenous honey bee Apis cerana Indica
Intervention of modern movable frames in traditional wall hives and for sustainable ecosystem.
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Indigenous honey bee Apis cerana beehives are a part of the architecture of mountain regions of Ghadwal, India. Wild colonies of A. cerana used to inhibit in wall hives known as Khadra. A Wall hive is a cavity left in the wall when the house is under construction; usually located at the height of about 150 cm from the floor. Wall hives are more suitable for temperature control in heavy rainfall/snowfall areas and the hives are also protected from wild animals and predators. Honeybees not only provide honey but also help in pollination of flowers to continue the progeny of plants. Thus placement of hives in an area had an important role for the sustainable ecosystem. Even though there is vast potential of flora for beekeeping in Ghadwal region, the bee population is declining due to destroy of the combs while honey harvesting. Decreasing population of A. cerana tends toward the loss of our social and cultural heritage. During current study efforts were made to design low cost, eco-friendly movable frames. Provision was made with wooden frames in Khadras. Natural fixed combs prepared by the bees are replaced to the movable frame. Inside the wall, frames are vertically hung parallel to each other. Extra frames are filled with sheets of wax foundation on which the combs are built by the bees. Scientific intervention in the indigenous method makes convenient for inspection of the colonies, pest management, swarm control and division of bee colonies. Honey is harvested hygienically in honey extractor, thus facilitates to get repeated honey harvesting in the season. Awareness was created and training is provided to the villagers to propagate A.cerana bee colonies, through the use of movable frames in wall hives. Thus improving of the bee population is possible for sustainable ecosystem.

PP-230 [Beekeeping Technology and Quality]
Erbel Bee Test App: New Data Collection Software For Performance Testing In Honey Bee Queen Selection And Breeding

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The genetic improvement of honey bee populations is a promising way to achieve more efficient and sustainable beekeeping because it allows for increased colony productivity, but also improves livestock manageability, helps bee populations adapt to changing environmental conditions, enhances disease resistance, and plays a key role in conserving different Apis mellifera populations. At the 1972 Apimondia Congress, new standards for colony performance testing were presented (Ruttner, 1972) and although adapted in many ways (Büchler, 2024), the protocol is still valid today. In 1989, the BLUP system used in livestock selection was adapted for honey bees (Bienefeld, 1990) and resulted in substantial progress by breeders organized through the web platform for genetic value estimation (https://beebreed.eu) provided by the Länderinstitut für Bienenkunde in Germany (Hoppe, 2020).
Despite the technological advances in big data processing of breeding data, most beekeepers participating in breeding and genetic improvement programs still use paper forms for recording performance data. This procedure leads to a certain percentage of data corruption through misread handwriting, loss of cards and transmission errors.
To avoid these issues and improve certain aspects of breeding programs, we developed an app called ERBEL Bee Test for recording queen testing data during selection. This app enables users to:
1) Collect data in an organized and clear manner,
2) Instantly upload data to the BeeBreed platform, avoiding errors,
3) Store historical data and download it when needed,
4) Validate the accuracy of recorded data and alert testers if any testing is being conducted incorrectly, as it allows real-time tracking of who is conducting the tests and how, and
5) Perform a pre-selection of queens halfway through the testing process.
By using this app, the collection of performance data is immediately improved, as testers' work can be monitored and they can be notified if an operation is not done correctly so that they can correct it. In this way, the breeding program itself also benefits immediately, with increased quantity and quality of the collected data.

PP-231 [Beekeeping Technology and Quality]
New potential freshness markers for Royal Jelly: Glucose oxidase and carboxypeptidase-A-like

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Royal Jelly (RJ) is a high value functional food in human nutrition due to its health-promoting properties. This has led to a growing interest by consumers and food industry towards this bee product so much so that several potential markers for freshness assessment have been tested and suggested. Implication of enzymatic activity involvement in RJ quality assessment during shelf life has been poorly investigated despite it can have potential affect on antimicrobial and antioxidant properties as well as in proteins degradation resulting in a loss of product quality. The aim of this study was to investigate the enzymatic activity of glucose oxidase (GOX) and five proteases (i.e. chymotrypsin, trypsin, N-aminopeptidase, carboxypeptidase A and B) in RJ under different storage condition (i.e. refrigeration at 4 °C and freezing at −18°) and times (i.e. Two months, one, two, three and for year of storage). Refrigeration determined a higher GOX activity in RJ after two months of storage that significantly decrease after one year. In refrigerated RJ samples also a higher carboxypeptidase-like A activity at two-months compared to other investigated time points was recorded suggesting a potential negative effect on RJ quality due to the proteolysis activity of this enzyme. Freezing did not determined variation in both GOX and carboxypeptidase-A-like activity in RJ samples stored for two months rather than after 1 year. However, frozen samples showed a higher GOX and carboxypeptidase-A-like activity after 1 year of storage compared to refrigeration. No variation in the activity of the other investigated proteases were recorded in both refrigerated and frozen samples. Therefore, the results obtained indicate that glucose oxidase and carboxypeptidase-A-like activity may be suitable markers of RJ freshness within one year at refrigeration condition. In addition, freezing may be a valid alternative storage method to improve preservation of the activity of these enzymes. However, further investigation to determine the timing of glucose oxidase inactivation/degradation under refrigerated conditions and the enzymatic activity trend under prolonged frozen conditions are desirable.

PP-232 [Beekeeping Technology and Quality]
Bees' activity through the lens: a new monitoring tool

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Bees are currently facing several man-made threats that endanger their populations worldwide (e.g. climate and land use change) [1, 2]. This, along with an overall lack of data concerning many species, calls for an intensification of monitoring efforts. Intrinsic downsides of classic techniques (e.g. time-consuming transects, indiscriminately lethal pan-traps) prompt researchers to find alternatives such as video monitoring [3, 4, 5]. Here, we present a new portable device running an ad hoc software [6] that allows to capture pollinators' activity in different contexts (e.g. foraging, at nest entrance), only detecting instances of movement, so that video elaboration time, storage and battery are saved. The tool has been tested to monitor bees' activity on flowers in high mountain sites, and its efficacy has been determined in terms of Precision and Negative Predictive Value (NPV). Assessed aspects also include monitored time cut by the software and number of records obtained (against that of transect records). The device ran for a total of 257 hours and automatically cut more than 50% of monitored time. Records obtained via the recordings account for 79% of all those collected during samplings and, despite the low Precision obtained (0.185), no false negatives occurred (NPV = 1). The proposed tool was proved to be useful in aiding in bee monitoring and, given its versatility, it could be easily repurposed to aid in honeybees' management.

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PP-234 [Beekeeping Technology and Quality]
Use of thermal camera to diagnose the location of Apis mellifera mellifera bee colonies in various urban structures

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In Bogotá DC, Colombia alone, with an average altitude of 2,600 meters above sea level and a temperature between 0 to 24 C, more than 10,000 swarms and colonies of bees (CoBee) occur each year in different places (roofs, facades, aqueduct covers, trees, poles, among others), being a risk and discomfort for residents. Due to the high incidence of swarms and the new beekeeping law that protects bees, they are no longer considered a pest and must be removed and relocated. COMAPIS, an innovative company, has implemented the use of thermal cameras (ThermCam) for the precise identification of CoBee in structures; This diagnosis is normally made by palpation, where the location of the brood was determined by the slight change in temperature in the hand, since it generates heat, but this diagnosis and the high flow of bees, the color of the spout was not enough to determine the exact point of the CoBee. A ThermCam was acquired, temperature range -50 C to 150 C, range of 30m, numerical temperature variation on the screen, in order to more accurately determine the location of the established CoBee, which generate a temperature range between 26 to 34 C, being the optimal temperature to locate with ThermCam. To use ThermCam, certain conditions are required, such as direct mid-day radiation, the variation is not differentiated, the best time to diagnose is late afternoon, due to the drop in temperature in structures; For CoBee established for more than 4 months, the thermal camera can show the honeycombs. The bee colony must touch the structure to generate heat and be detected by the ThermCam. The use of ThermCam allows the exact location and size of the CoBee to be detected, thereby reducing the cost of repair.

PP-235 [Beekeeping Technology and Quality]
Monitoring the response of honeybee colonies to external stressors with intelligent sensors

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BACKGROUND/PURPOSE: The biological characteristics of honeybees date back to ancient times, which is often overlooked in modern beekeeping, and bee colonies are exposed to various stressors. To improve the well-being of bee colonies in the future, a newly developed intelligent multi-sensors in combination with AI will provide new knowledge for bee protection.

PROBLEM DESCRIPTION: Beekeeper intervention in the colony, insufficient food sources, environmental pollutants, climate change, a high density of bee colonies in a particular location, pathogens and pests, all these factors cause stress in bees. A multi-sensory system has been developed to monitor the bees' response to various stressors and gain insight into the colony without the need for manual intervention. This will make beekeeping more efficient in terms of bee welfare.

METHODOLOGY: Twenty Carniolan honeybee colonies (Apis mellifera carnica) were placed at four sites with different impact of stressors, five at each site. Newly developed multi-sensors were installed in the colonies to measure temperature, relative humidity, air pressure and VOC (both inside and outside of a beehive), beehive mass, sound inside the beehive and to detect rainfall. We monitored the health status of the colonies and collected various bee-related samples for chemical analysis of pesticides and toxic metals. The bee colonies were exposed to varying degrees of beekeeper manipulation.

RESULTS AND CONCLUSION: By analysing sensor data using artificial intelligence methods, we were able to track events in a beehive more accurately than with just a single investigation. The analysis also included monitoring the harvest or lack of food and bee deaths during the winter. The sound analysis enabled the early detection of swarming and queenless colonies. With the current analysis of the sensor readings, we determine the degree of stress to which the bees are exposed due to various external factors.

PRACTICAL IMPLICATIONS FOR BEEKEEPERS: By using smart technology, beekeepers will be able to monitor and predict various activities of bee colonies with a lower level of human intervention. At the same time, bees will be less exposed to certain stress factors, which will have an impact on their well-being, health and productivity.

PP-239 [Beekeeping Technology and Quality]
Physicochemical Characterization of Apis cerana F. Honey from Thailand: Implications for Quality Standards

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This study presents a comprehensive physicochemical analysis of the honey produced by the Eastern Honey Bee (Apis cerana F.), sourced from local beekeepers in Southern Thailand during 2023-2024. A total of thirty-five honey samples were evaluated for various quality parameters critical to honey standardization. The moisture content of the samples ranged from 19.7% to 28.3%, while the ash content varied between 0.12% and 0.40%. Electrical conductivity was recorded between 0.28 mS/cm and 0.55 mS/cm. The color of the honey samples ranged from 14.0 to 108.3 mm Pfund, indicating a spectrum from white to amber. pH values were observed to be between 3.6 and 4.8, and free acidity ranged from 33.0 to 72.0 mEq/kg. Diastase activity varied from 1.16 to 12.15 DN. Sugar content analyses revealed fructose levels ranging from 33.83 to 48.54 g/100 g, glucose levels from 35.13 to 51.54 g/100 g, with sucrose detected in five out of the thirty-five samples. Notably, there has been a lack of reports concerning the physicochemical properties of A. cerana honey in Thailand, with only one previous study reporting a moisture content range of 18.5% to 24.5%, which aligns with the findings of the present study. These results provide critical insights into the unique physicochemical properties of A. cerana honey from this region, thereby contributing to the enhancement of quality standards and supporting the growth of the local honey industry in Thailand. Further research is recommended to establish specific standards for A. cerana honey to align with international benchmarks.

PP-240 [Beekeeping Technology and Quality]
Eucalyptus honey from the forests of Portugal. What is important to know? What remains to be done!

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In Portugal, Eucalyptus is a forest species of significant economic relevance, occupying about 25% of the total forest area. Eucalyptus forests are also a significant resource for bees, and specifically for Apis mellifera iberiensis, providing floral nectar, pollen and propolis in abundance. Monofloral honey from Eucalyptus spp. is particularly valued for its high pollen content, antimicrobial properties and high antioxidant power. However, the effect of climate change on beekeeping activity is being increasingly considered, whether due to problems associated with the ecosystem where apiaries are located, or due to the health of colonies and good beekeeping management practices. All this possible impact is reflected in the activity of bees, in the pollen they collect and in the honey they produce. This study aimed to evaluate the foraging patterns of A. mellifera iberiensis in eucalyptus forests, as well as the physicochemical, microbiological, and palynological characteristics of the honey produced. During 2024, pollen samples were collected from two hives in the same apiary was sampled biweekly and during the eucalyptus flowering season, capped honey samples were collected. Samples of eucalyptus honey were also collected from different areas of the country associated with the production of this honey. The flora associated with the sampled pollen was identified by pollen analysis and all honeys were characterized by microbiological, physical-chemical and pollen evaluation. The results obtained are presented here and the data are analyzed in relation to forestry and beekeeping practices and the honey produced and the impacts on both species, man and A. mellifera iberiensis, from the perspective of One Health and Planetary Health.

PP-241 [Beekeeping Technology and Quality]
Analysis of nectar production characteristics and quality of buckwheat honey in Taiwan

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Buckwheat honey is rich in protein and phenolic compounds, has high nutritional value and excellent antibacterial and antioxidant capacities, and is a functional food. In Taiwan, bee colonies lack nectar sources in winter, and beekeepers must feed them sugar to help them survive the winter. As a winter crop in Taiwan, buckwheat can provide a supplementary nectar source for bee colonies. This study compared the total flavonoid content and antioxidant capacity of Taiwan buckwheat honey with other nectar source of honey and explored the weekly changes in the number of flowers and nectar production during the flowering period of buckwheat, as well as the daily changes in nectar production, to evaluate the potential of producing buckwheat honey in Taiwan. The results showed that the total flavonoid content of buckwheat honey was significantly higher than that of lychee honey and Chinese tallow honey, and the antioxidant capacity was also better than that of longan honey, lychee honey, Chinese tallow honey, and Chinese chaste tree (Vitex negundo) honey. Buckwheat reached its blooming stage on the 50th day after planting, and the highest nectar production per plant was 35.71 μL on the 43rd day after planting. The average nectar production per flower was highest during the pre-blooming stage, and the morning period was usually higher than the afternoon, with nectar production varying with the flowering period and time. This study confirms that Taiwan buckwheat honey has nutritional value and commercial production potential, which can provide a reference for future beekeepers to utilize the buckwheat as a supplementary nectar source and produce buckwheat honey.

PP-242 [Beekeeping Technology and Quality]
Chemical markers in Italian propolis: Chrysin, Galangin and CAPE as indicators of geographic origin

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Bee propolis, composed of terpenes, wax and phenolic compounds, despite variations in its botanical and geographical origin, is widely known for its antioxidant, immunomodulatory and antimicrobial properties. However, these general properties are insufficient for its rational application in modern medicine and comprehensive research is essential to explore the chemical and pharmacological properties of propolis, focusing on its mechanisms of action, targets, and the unique phytocomplexes that vary with its geographical origin. The aim of this work, focused on Italian propolis, is to better investigate and to clarify the chemical composition of samples collected in different geographical areas, providing an insight into the current literature. It also aims to develop methods for the identification of chemical markers in Italian propolis and to determine their geographic origin to ensure the quality of propolis product. Analyzing 27 samples collected in the same year from various regions (Northern, Central, Southern Italy, Capraia Island and Sicily), the total polyphenol (TP) and total flavonoid (TF) content, alongside the quantification of pinocembrin, chrysin, galangin, and caffeic acid phenethyl ester (CAPE) were investigated. Additionally, DPPH assays were conducted to evaluate the antiradical activity of propolis samples. Our results revealed that TP and TF vary significantly in samples from different regions and that pinocembrin is almost always present in Italian propolis, although at different levels. However, a more precise differentiation of the geographical origin was achieved through the quantification of the sum of chrysin and galangin, and CAPE. Conversely, the DPPH assay showed largely uniform results lacking statistical significance.
This study contributes to the growing research on propolis by providing a more structured approach to characterizing its chemical composition by geographic origin. The results offer valuable insights into the development of more refined methods for distinguishing the origin of propolis, which may be useful for quality control, regulatory frameworks, and commercial evaluation. Building on this preliminary study, future research should aim to expand the scope by comparing sub-areas such as river regions, Apennine and Alpine propolis, as well as samples from inland hives. Additionally, significant efforts should focus on enhancing the analytical depth beyond the examination of major constituents.

PP-244 [Beekeeping Technology and Quality]
Beeswax Essentials

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Beeswax, a remarkable byproduct of the hive, has been cherished for centuries for its versatility, purity, and natural beauty. This oral presentation will briefly combine the history, science, and practical rendering of beeswax products, offering insight into its formation, extraction, and diverse applications. Geared to all types of beekeepers, the presentation will be of particular interest to the many small-scale, backyard beekeepers who want to dabble in the craft of wax making but have no idea how to begin. The talk will explore the step-by-step process of how to render raw beeswax, ensure its quality and preservation, and how to transform it into exquisite, handcrafted goods. Whether for personal use or commercial endeavors, beeswax remains a timeless, sustainable, and deeply rewarding material that continues to inspire beekeepers and crafters alike. The unique composition of beeswax, including its esters, fatty acids, and hydrocarbons, makes it a sought-after ingredient in health, beauty, and household products. Beyond its functionality, beeswax holds a special allure. The products of the hive, including honey, wax, pollen, and propolis, can be used for profit, yet it is beeswax—with its aroma, color, and purity—that has captured my heart, and I suspect many others as well.

PP-245 [Beekeeping Technology and Quality]
Synergistic Effects of Protein Diets and Management Practices on Health and Productivity of Apis mellifera Colonies

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Bees play a crucial ecological role as pollinators, yet various environmental stressors, including habitat loss and nutritional deficiencies, significantly impact their populations. This study aimed to evaluate the impact of protein supplementation and best management practices on the development of Apis melliferacolonies in three apiaries located in southwestern Brazil over an eight-month experimental period, spanning critical resource-scarcity seasons. The apiaries were categorized based on their management conditions: poor, recommended, and intermediate. In each apiary, colonies were divided into control and treatment groups. In addition to standard carbohydrate supplementation, treatment colonies received a newly developed protein diet, and management practices included queen replacement and comb renewal. Parameters such as brood area, food storage, and empty spaces in frames were assessed monthly. The results demonstrated that the combination of protein supplementation and proper management practices significantly improved colony performance, particularly in apiaries with recommended conditions. In Apiary 2, which included queen replacement and comb renewal, brood production increased significantly, reaching 70% of frames occupied in September, reflecting a stronger potential workforce. Apiaries under intermediate management also showed benefits, albeit less pronounced. In contrast, Apiary 1, under poor management, exhibited only modest improvements even with protein supplementation, underscoring the necessity of integrating nutritional interventions with management practices to achieve optimal results. The protein diet was highly accepted, with over 90% consumed by all treated colonies, corroborating previous studies that emphasize the efficacy of nutritional supplements in supporting colonies during resource scarcity. Management practices, such as comb and queen replacement, were critical in improving key indicators, including food storage and reducing empty cells, mitigating the impact of stressors like parasites and diseases. The study concludes that combining protein supplementation with proper colony management significantly strengthens colony resilience and productivity during critical periods of resource scarcity. These findings emphasize the importance of integrated approaches to promote bee colony health and resilience, essential for pollinator conservation and global food security. Moreover, they underscore the need to train beekeepers in sustainable practices to ensure effective implementation and foster the sustainable development of apiculture in ecologically and economically vulnerable contexts.

PP-246 [Beekeeping Technology and Quality]
Primal bee: a sustainable beekeeping solution for climate challenges

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Primal Bee

The honey bees' ability to thermoregulate their hive is a key adaptation for honey bee survival, especially in challenging climates. The ideal internal hive temperature is ~36 (96). Hotter or colder temperatures can negatively impact the queen's egg-laying production and the brood (eggs, larvae, and pupae). The honey bee has several behavioral adaptations to maintain this equilibrium including clustering and vibrating to warm the colony and fanning, ventilating and evaporating water to cool the colony. Thermoregulation costs energy needed to fuel water collection flights, fan wings, and thoracic muscles to cluster, vibrate and ventilate within the hive. The efforts of thermoregulation can be lost through dissipation of heat through cracks, seams or thin walls of the standard wooden hive. This can be very energetically expensive for the bees to heat, cool and maintain their hive. Many improvements can be made to the hive design to reduce this energetic cost through thermodynamic engineering and design. Since 2015, thermodynamics were compared through quantitative and qualitative measures in the Primal Bee Hive project. Innovative engineering provided an unexplored competitive advantage for honey bees. In a thermodynamic hive, bees expressed increased productivity due to perfect thermoregulation. This advantage created a better incubation process: better temperature control at lower energetic cost. The Primal Bee nest design was evaluated through extensive research and field testing in diverse climates—including Alaska, Australia, and the Israeli desert—the Primal Bee hive provides a solution to climatic challenges. Its insulative qualities and geometric design reduces heat loss and optimizes heat-efficiency. The thermodynamic hive helps mitigate extreme weather impacts on colony health resulting in less honey consumption and larger, healthier honey bee populations. Field results have demonstrated significant improvements, including a 500% increase in thermodynamic efficiency in thermodynamic hives compared to standard wooden Langstroth hives (insulated wooden Langstroth hives only increased thermodynamic efficiency by 35%). doubled bee populations and honey production, and reduced colony loss. The Primal Bee hive enhances colony resilience against climate-related stressors while promoting sustainability in apiculture. By bridging scientific innovation with practical beekeeping needs, the Primal Bee hive sets a new standard for sustainable beekeeping under climate challenges.

PP-248 [Beekeeping Technology and Quality]

"Magnetto": development and validation of a novel, easy-to-use reliable tool for fast and stress-free capturing of queens

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Background
The queen is arguably the most important individual in the honeybee colony: a vital young queen will lead to a strong and healthy population, her pheromone production will keep the colony together, and her genetics will shape the behaviour of the colony. Queens are also the only perennial animal of the colony, and as such more sensitive to intoxication from e.g. acaricides. Hence there are many situations and instances where it is desirable to be able to quickly find, capture and remove the queen from a colony in order to perform certain beekeeping practices.

Problem Description
We therefore set out to develop a tool which would allow to easily find the queen even in strong colonies without the need for lengthy inspection of individual frames.

Methodology
First, from a review of available sensor technologies, magnetism was identified as a robust and promising methodology to solve the research problem. Secondly, a new queen capturing device "Magnetto" was developed featuring the following key components: a) a rod like "queen scanner", with an optimized magnetic surface for covering the whole depth of a commonly used brood box (Dadant or other) b) a cage into which the queen can be released directly from the scanner and c) ferromagnetic plates for queen tagging.

Results and Conclusions
All components and the overall performance of Magnetto were tested in a series of field tests. Initially the metal plate type with the best capture-to-size ratio was selected. Queens tagged with these metal plates did perform indistinguishable to their conventionally tagged sisters. Next, a series of capture experiments was carried out to optimize the different parameters of Magnetto itself. Final tests showed that Magnetto allows to find and capture a queen from a strong hive within 4 minutes on average with a success rate of > 90%.

Practical Implications for Beekeepers
The use of Magnetto offers a series of intriguing benefits to beekeepers by facilitating their current practices: from fast queen caging or queen removal for improved varroa treatment to time efficient requeening a large number of colonies in professional operations or swarm prevention.

PP-249 [Beekeeping Technology and Quality]
Characterization of Bolivian Honeys from Honeybees and Stingless Bees

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Bolivia (South America) hosts a rich variety of bee species that contribute to honey production. While Apis mellifera honey is well-documented worldwide, the honey produced by stingless bees (Meliponini) remains relatively understudied. Given the increasing interest in the characterization of honeys from diverse botanical and ecological origins, studying the properties of both A. mellifera and stingless bee honey provides valuable insights into their quality, authenticity, and potential health benefits. Whitin the SANAPI project, designed to strengthen environmental management initiatives and safeguard production systems that promote forest protection in some Bolivian areas, we analysed honey samples collected by beekepers of rural communities across the country. The microbiological and nutritional quality of honey from stingless bees and honeybees were compared. The analysis of sugars, total aminoacids, proline, 5-(hydroxymethyl) furfural (5-HMF) was carried out by UHPLC-HR-MS. Minerals were analysed by ICP-MS, while total polyphenols (TP) by Folin-Ciocalteu method. Microbiological analyses for total microbial count, yeast and molds and sulphite reducing anaerobes were conducted according to ISO standards and Regional guidelines. The results refer to 23 honey samples from Meliponini bees and honeybees. Only for one sample from Scaptotrigona, the measured values were above the acceptability level for the European marketing of this product. Apis mellifera honey contained higher amount of fructose and glucose (above 64%) compared to stingless bee honey which content was below the quality criteria (at least 60%) reported in the Directive 2001/110/EC. Apis mellifera honey contained also more aminoacids (mainly proline), and minerals (potassium, magnesium and zinc). No difference was observed for the levels of 5-HMF that resulted below the legal limits (< 40 mg/kg; Directive 2001/110/EC). Finally, a wide variability in the TP content (range 50-2200 mg/kg) was documented within and between bee species, in line with the data of the literature. In conclusion, the preliminary findings have highlighted several differences in the nutritional content between bee honeys. The completion of the analysis will be fundamental for acquiring data useful for a better characterization of the different Bolivian honeys and towards the creation of a honey library.

PP-253 [Beekeeping Technology and Quality]
Target Group-specific Learning Success Optimisation of Beekeeping Learning Materials using Eye-tracking

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The number of new beekeepers in the EU is rising steadily - more than 100,000 new beekeepers were registered between 2019 and 2022. In Germany, small beekeeping businesses are predominant, many with a recreational focus. The increased number of new beekeepers results in an increased need for training courses, which are ideally designed for specific target groups. Target groups are, for example, young or old people and people with disabilities. There are a number of training programmes on offer, e.g. from adult education centres and in particular from regional beekeeping associations. For the latter, training courses require a great deal of time from volunteer members. The teaching and learning materials are equally diverse and not specific to the target group. This has shown that the materials vary greatly in quality, which is not necessarily conducive to efficient learning success. There is a need for improvement. Eye-tracking technology is available to analyse existing learning materials in terms of their learning effectiveness and to identify suggestions for their possible improvement. The eye tracker records a learner's eye movements and correlates them with the learning material presented. Analyses based on this can clarify, which areas of the learning materials were viewed with which duration, sequence or frequency and thus allow conclusions to be drawn about the didactic-methodological suitability of the learning material or provide information on necessary improvements. In the context of the present research project, an eye tracker has been implemented and the eye-tracking technique was applied to established learning materials for hobby beekeeping training. This revealed the extent to which selected learning materials were effective and what indications there were for improvement - possibly also for specific target groups. In view of the high number of new beekeepers from a wide range of target groups, the high demand for training and the high personal time commitment of local beekeeping associations, beekeeping teaching materials must be optimised in terms of didactics and methodology with regard to learning success. These optimisations can be carried out systematically using the eye-tracking method. They therefore make a major contribution to targeted and efficient beekeeper training.

PP-254 [Beekeeping Technology and Quality]
A flexible, responsive and low-cost IT-based DIY apiary and honey flow surveillance system for your local beekeeper association

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Honey flow information systems (HFIS) like TrachtNet allow the monitoring of honey flow and other honey flow-relevant parameters. Based on this data, beekeepers can quantify the honey production of an apiary and relate it to nearby or remote apiaries or to apiaries operated by other beekeepers. The data also allows identifying counter-productive weather conditions or the lack of adequate food
resources.

Although HFIS provide important information for efficiently managing bees, the availability of and admission to HFIS is quite restricted: the German TrachtNet has in total only about 210 monitored apiaries mainly located in South-Germany. Additionally, participation in TrachtNet is administrative-heavy and requires purchase and operation of only commercially available, cost-intensive, certified scales.

To overcome these drawbacks, we propose an easy-to-implement, low-cost HFIS based on our world-wide and publicly available geo-information system Guerilla Sensing (GS). Using GS, any single beekeeper or group (like a local beekeeper association) can realize a local HFIS or join an already existent HFIS in the GS universe. A participating beekeeper typically adds a so-called “Guerilla Box” (G-Box) to the system. Such a G-Box manages the sensors attached to it and forwards the measured data to the GS platform. At the platform, the data is persisted, visually presented and analyzed. The current system honors privacy, supports honey flow analysis, identifies swarming events, and detects vandalism. If a pre-defined event is detected, the GS-based HFIS, in real-time, sends notifications to single or multiple beekeepers, allowing them to react timely.

Although a wide variety of sensors can be attached to a G-Box, the core component is a beehive scale for monitoring honey flow. We developed a low-budget, high-quality DIY scale that can easily be realized by an average-skilled person. The implementation of a G-Box, serving as functional hub at an apiary, can easily interactively be configured using the GS system. Furthermore, guidance of how to connect the hardware components is given.

All these components put together allow beekeepers to easily implement and operate a local, low-cost HFIS that automatically persists, analyzes and visualizes sensor data like yield, identifies management problems and detects events like swarming and vandalism.

PP-255 [Beekeeping Technology and Quality]
European Honey Contest in Koper, Slovenia 2024

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Background/purpose
When consumers want to buy honey, they are faced with a wide choice. A study conducted by the EU Commission, published in 2023, revealed that 46% of imported honey is suspected of being adulterated. Beekeepers must find new ways to guarantee high quality and authenticity to sell their premium products at a fair price. International honey competitions, such as the European Honey Contest, offer an opportunity to showcase and verify the excellence of their honey.

Problem description
To ensure an objective and professional sensory evaluation of honeys from different European countries, an expert committee of experienced domestic and international honey assessors was assembled. The award-winning samples must exhibit the most characteristic sensory properties in their respective category and meet the high-quality and safety standards.

Methodology
The evaluation of honey was conducted by a 10-member expert committee in accordance with the Rules of the Board of the Slovenian Beekeepers' Association for the sensory evaluation of honey. The sensory assessment was based on scoring of the following criteria: appearance, odour, taste, and aroma correspondence to declared botanical origin; with a maximum total score of 30 points. Honey categories were not predefined; for a category to be evaluated, it had to include at least seven samples. If there were fewer than seven samples, the evaluation committee categorized them as either forest (honeydew) or multifloral honey based on electrical conductivity. All samples had to meet strict quality criteria, including a water content of less than 18.6% and a hydroxymethylfurfural (HMF) content of no more than 15 mg/kg.

Results and conclusions
A total of 114 samples from 11 European countries were submitted for evaluation. Five categories of honey were defined: acacia, multifloral, forest, linden, and chestnut honey. To highlight the best honeys, only the three best samples in each category were awarded gold, silver and bronze medals. Prior to the award ceremony, they were also tested for authenticity and the presence of acaricides.

Practical implications for beekeepers
The 15 award-winning beekeepers were presented with certificates for high quality and safety, which serve as an excellent marketing tool and guarantee of authenticity for consumers.

PP-256 [Beekeeping Technology and Quality]
The flex hive adapter: a practical design for accessible, ergonomic, and sustainable beekeeping

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Background/Purpose:
Traditional beekeeping, particularly Langstroth hive systems, presents physical and financial challenges due to high frame costs, heavy lifting, and colony management complexity. The Flex Hive Design offers an innovative solution, seamlessly transitioning between Langstroth and Horizontal Top-Bar Hive (HTBH) management. This system enhances honey and comb honey production flexibility while making beekeeping more accessible to individuals of all skill levels, physical abilities, and budgets.

Problem Description:
Langstroth hives require significant financial investment and physical effort, limiting accessibility. Beekeepers transitioning to top-bar management often struggle with colony transfer, as it typically requires comb cutting or complex modifications. A simple, adaptable hive system that enables a seamless transition while maintaining colony stability is needed.
Methodology: The Flex Hive Design integrates Langstroth frames into a horizontal hive setup using a custom adapter, eliminating the need for comb cutting or disruptive colony transfers. The waist-height design removes heavy lifting, while horizontal expansion follows the bees' natural instincts. This hive supports both liquid and comb honey production, giving beekeepers more flexibility in managing their colonies.

Results and Conclusion:
Field tests show that Langstroth colonies expand smoothly and naturally into the HTBH section, reducing conversion complexity and colony stress. Beekeepers report reduced physical strain, increased hive accessibility, and improved colony health. Additionally, the system enables dual production capabilities, allowing NUC producers to offer both Langstroth and top-bar NUCs to meet growing market demand.

Practical Implications for Beekeepers:
The Flex Hive Design bridges the gap between traditional and ergonomic beekeeping, making hive management easier, more adaptable, and more sustainable. Its five-minute Langstroth-to-HTBH transition offers beekeepers a scalable and accessible solution that reduces labor and expands market opportunities. By improving accessibility, flexibility, and sustainability, this hive system supports a more inclusive and practical future for beekeeping.

PP-257 [Beekeeping Technology and Quality]
Total phenolics and antiradical activities in honey powders obtained by two different drying procedures

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Background/ problem description.: Numerous studies support the existence of compounds in honey responsible for diverse biological activities that make it interesting compared to other natural or artificial sweeteners.
Powdered honey has many advantages in terms of handling, transport, storage and use compared to raw honey; however, the production process and properties of powdered honeys are still little studied.

Purpose. The aim of this work is to evaluate total phenols and antiradical activities against different free radicals in powdered honeys obtained using maltodextrin as Carrier by two drying techniques (vacuum drying and freeze drying) from 9 samples of honeys from 4 different botanical origins (multifloral, lavender honey, thyme honey and vetch honey).

Methodology. Total phenolics content was determined using the Folin–Ciocalteau reagent. The antiradical activities were evaluated against four radicals (ABTS•+, ROO•, •OH and O2•-) by the following procedures: TEAC, ORAC, AOA and SRS methods.

Results and conclusion. Most of the powdered honeys showed lower values for total phenols and antiradical activities against ROO• and O2•- radicals than the raw honeys, while the values for antiradical activity against ABTS•+ radical were higher in the powdered honeys.
Both the drying method and the botanical origin of the samples influenced the total phenolics content as well as the antiradical activities against ABTS•+ and ROO• radicals. The antiradical activity against the O2•- radical depended only on the botanical origin of the honey while neither the botanical origin nor the drying procedure significantly influenced the antiradical activity against the •OH radical.
These results show that the antiradical activities of powdered honeys against different radicals are also different and depend on several compounds, which may vary quantitatively or qualitatively from one honey to another and which may or may not be modified by the drying process.

Practical implications for beekeepers. The development of appropriate methods to obtain honey powder and the study of the functional properties of this product will expand the honey's market for food, pharmaceutical and cosmetic use, thus boosting the beekeeping sector.

PP-259 [Beekeeping Technology and Quality]
Bioactive compounds of honey from the Jaguari Valley region, Rio Grande do Sul, Brazil

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Honey is considered a natural food, with superior quality, presenting nutritional and therapeutic properties, originating from bioactive compounds. The Jaguari Valley, in the state of Rio Grande do Sul, is a national and international reference in the production of high-quality honey, being the third largest Brazilian producer. The Jaguari Valley Beekeeping Chain directly and indirectly benefits thousands of people, both during the production process and in the distribution, marketing and export of honey and its derivatives. Honey diversity is the result of the biodiversity of beekeeping flora, which includes native species from the Pampa Biome and the Atlantic Forest, providing pleasant sensory experiences, with flavors constructed in line with socioeconomic and cultural values and environmental conservation. Thus, the work in question aimed to analyze sixty samples of honey from the Jaguari Valley Region, which comprises nine municipalities in the interior of the state, regarding the levels of total phenolic compounds and total flavonoids, through analysis in a spectrophotometer. The total phenolic compound contents ranged from 182.6 to 814.2 µg EAG mL ^{1} of honey, for total flavonoids the variation was from 24.7 to 74.3 µg quercetin mL ^{1} of honey, representing an average of 518.7 µg EAG mL ^{1} of honey and 43.1 µg quercetin mL ^{1} of honey, respectively. The variation of these compounds can be justified due to the fact that they were passed from plants to honey, thus, each honey presents a profile due to its floral origin used by bees in the elaboration of the honey compound, indicating differences between the honeys of the nine municipalities in the region, being considered as seasonal and environmental factors. Although, due to the high presence of bioactive compounds in honey, its functional potential stands out, not just as an energy product.

PP-261 [Beekeeping Technology and Quality]
Fast, Simple, and Affordable: A Better Way to Analyse HMF in Honey

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The honey industry is essential to global agriculture, food production, and biodiversity, supporting millions of beekeepers and helping sustain ecosystems. Maintaining honey quality is crucial for consumer confidence and regulatory compliance.

A key indicator of quality and honey degradation is hydroxymethylfurfural (HMF), a natural by-product that forms when honey is overheated and poorly stored. Regulatory bodies such as Codex Alimentarius and the European Union have established strict HMF limits,with thresholds set at 40 mg/kg for most honey, 80 mg/kg for honey from tropical regions, and 15 mg/kg for honey with naturally low enzymatic activity. Exceeding these limits can compromise honey quality and consumer confidence, highlighting the need for reliable and accessible HMF testing.

Traditional methods like HPLC and mass spectrophotometry are costly, time-consuming, and require skilled personnel. This creates challenges for beekeepers, cooperatives, and small-scale producers, who need a simpler, more cost-effective solution.

Here, we present a rapid, easy-to-use, and highly accurate test kit for HMF analysis following AOAC Official Method 980.23. This test delivers excellent precision (<2% deviation), high sensitivity (2 mg/kg), and strong correlation with FAPAS reference values (94.3% and 99.5% recovery). Its linear range extends up to 100 mg/kg, allowing for accurate detection well beyond regulatory thresholds.

Unlike traditional methods, this test simplifies HMF measurement through a straightforward sample preparation process—users only need to dilute the honey sample before analysis. The dedicated PRISM analyser then performs automatic calculations and provides a user-friendly step-by-step guide, removing the need for extensive scientific expertise.

The reliability and accessibility of this test make it particularly valuable for industry professionals, enabling faster decision-making regarding honey processing, storage, and distribution. This practical alternative allows beekeepers and honey producers to ensure product quality, meet regulations, and maintain consumer trust while supporting the sustainability and economic viability of the honey industry.

PP-262 [Beekeeping Technology and Quality]
Smart Hive for the Preservation of Native Stingless Bees in the Face of Climate Change: Innovative Solutions for Enhancing Meliponiculture Sustainability

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Stingless bees (Meliponina subfamily) are critical pollinators essential for biodiversity conservation and agricultural productivity. However, they face significant challenges due to climate change, habitat loss, and pesticide use. These environmental stressors impact their survival, making it crucial to develop sustainable methods for their preservation. This project proposes a smart hive system that combines traditional beekeeping knowledge with modern technology to optimize the internal conditions of hives and ensure the health of native stingless bees. Sensors were utilized to monitor temperature, humidity, and bee flow within controlled hive environments, while a thermal control system—comprising a thermoelectric heat sink, dual-fan cooler, and Peltier module—was implemented to regulate internal temperatures. Data collected before and after the installation of the system revealed a significant reduction in temperature fluctuations and humidity instability, creating a more suitable environment for bee activity. The results demonstrate that technological innovation in hive management can mitigate the negative impacts of climate change, enhancing the sustainability of meliponiculture. This study aligns with the United Nations' Sustainable Development Goals (SDGs), particularly goals related to food security, biodiversity conservation, and climate action, highlighting the potential of technological solutions in preserving essential pollinators for future generations. This work, presented at COMBRAPI 2025, was awarded 1st place in the Scientific Papers category for its contribution to beekeeping and meliponiculture research.

PP-263 [Beekeeping Technology and Quality]
Evaluation of traps for collecting propolis by honeybees

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Propolis is the resinous product that honeybees produce after the collection of plant resins and their enzymatic processing. It has antibacterial, antifungal and antioxidant activity, among others. It is considered a very important beekeeping product but many aspects of it, such as composition, plant origin, optimization of collection methods, remain understudied. Although there are commercial traps for collecting propolis by beehives, there are very few evaluation studies about the quantitative collection and the qualitative composition of the collected propolis by alternative, low-cost traps. Three different types of propolis collection traps were applied on Langstroth beehives, a commercial one and 2 hand-cut screens with smaller square openings (1 x 1 mm and 4 x 4 mm). When one of the traps was filled with propolis, all the screens were removed, frozen and the collected propolis was removed and weighted. The quality of propolis samples was evaluated by performing several spectrophotometric tests. Total phenolics were determined using the Folin-Ciocalteu method, and in vitro antioxidant activity was evaluated using the DPPH, CUPRAC, and ABTS methods. For the results, ANOVA analysis was performed with a percentage of significance a=0.05. Results showed that the hand-cut screen with 1 x 1 mm openings had statistically significant differences with the one with 4 x 4 mm openings for the quantity of the collected propolis (p-value=0.0401<0.05). The commercial trap had not statistically significant differences with both the hand-cut screen 1 x 1 mm and 4 x 4 mm (p-value=0.8722 and 0.0984, respectively). In respect of the quality, there were not statistically significant differences between the traps tested. The current study highlights an important gap in the research related to the propolis collection traps and the possibility of improving existing commercial traps to optimize the amount of propolis collected. From a practical point of view, there is a proven cheaper and more efficient alternative for collecting propolis for beekeepers. As a result, production costs of propolis are reduced while production increases. These kinds of traps can be either commercially available or home-made by the beekeepers, which reduces costs even more.

PP-265 [Beekeeping Technology and Quality]
Methodology for estimating honey yield

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The current methodology for assessing national honey yield relies solely on the number of registered colonies and the average yields (including negative yields) from the hives in the observational network. We assume that these estimates are underestimated.

Numerous studies highlight the critical role of weather conditions in honey production, with weather factors explaining 50-80% of yield variability. Climate and weather conditions – especially temperature, relative humidity, rainfall, and solar radiation – are among the most important environmental factors affecting bees and beekeeping, and consequently honey yields. Together with other environmental factors such as topography, nectar source availability and land use, they create microlocations with distinct microclimates that vary in resilience to the increasing impacts of climate change which drive the intensification of extreme environmental conditions.

Therefore, considering these environmental factors is essential when assessing honey yields, especially in countries with high phytogeographical diversity, such as Slovenia, which lies at the intersection of the Alps, Dinaric Alps, Pannonian Basin, and Adriatic Sea Basin.

To determine a suitable method for assessing honey yield we, tested models like SARIMA (Seasonal Autoregressive Integrated Moving Average), which incorporated environmental data, including meteorological factors (e.g., temperature, air pressure, solar radiation, relative humidity, precipitation, wind), land use (agricultural, forest, urban areas, water), terrain (e.g., altitude, aspect, landforms), soil type and the density of bee colonies.

We identified a suitable method for estimating honey yield that incorporates key environmental factors from the available data. This method provides a more accurate and precise estimate of honey yield than the current one and contributes to a better understanding of the relationship between bees and the environment.

PP-266 [Beekeeping Technology and Quality]
The influence of Varroa mite treatments on the quality of propolis in Greece

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The honeybee (Apis mellifera L.) is a crucial agricultural pollinator, producing valuable beekeeping products such as: honey and propolis. Honey bees are significantly threatened by various diseases and pests, the most severe being the ectoparasitic mite Varroa destructor. In Greece, beekeepers apply acaricide treatments, such as amitraz strips, glycerin-impregnated oxalic or formic acid strips and oxalic acid administered through sublimation or instillation, in order to mitigate Varroa infestations; however, the impact of these treatments on the quality of propolis remain unstudied. In the current study, propolis samples were collected over a 65-day period from five stable beehives, where all -mentioned treatments were applied. Propolis samples were extracted with ethanol/water (70:30) and analyzed by GC-MS, showing the predominance of diterpenes. Furthermore, the analysis demonstrated that both oxalic acid sublimation and amitraz treatments resulted in significantly lower levels of glycerol residues in propolis, whereas the use of glycerol-impregnated strips caused a substantial increase in glycerol concentrations, when compared to all other treatment methods. Our findings strongly suggest that the application of glycerol-impregnated strips should be discouraged, when propolis is going to be collected from these same colonies later on, as they can have a detrimental effect on the quality of harvested propolis, which may affect its suitability for subsequent uses in nutritional or cosmetic products. Considering these results, it is recommended that National Authorities and Beekeeping Associations issue formal guidelines advising beekeepers to avoid the use of glycerol-impregnated strips in Varroa control practices before the collection of propolis in order to ensure the preservation of propolis quality. Further studies are needed to demonstrate for how long glyserin residues remain in the treated colonies.

PP-267 [Beekeeping Technology and Quality]
Chemical analyses of selected propolis samples from Latvia

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Propolis is among the most valuable honey bees' products, a complex resinous mixture produced by bees through the combination of beeswax and plant-derived exudates. Its chemical composition is highly diverse and influenced by geographical and seasonal factors, as well as the botanical sources available to bees. Due to its rich chemical diversity, propolis has been widely studied for its potential pharmacological, antimicrobial, and antioxidant properties. However, Latvia remains a relatively unexplored country in terms of propolis research. The current study aimed to investigate the chemical constituents of selected propolis. The samples collected from ten regions across Latvia, utilizing gas chromatography-mass spectrometry (GC-MS) for comprehensive analysis and comparison. Propolis extracts were prepared using a 70:30 ethanol/water solvent system, followed by silylation of dried extracts prior to GC-MS analysis. The results revealed that Latvian propolis is mostly primarily composed of phenolic acids, their esters, and flavonoids, aligning with the characteristic composition of European propolis, with samples from eight regions classified as aspen-type propolis, while the remaining were identified as poplar-type. The GC-MS analysis has enabled the identification of 49 distinct compounds, among which the presence of 2',4',6'-trihydroxy-4-methoxy dihydrochalcone, 2',6',4-trihydroxy-4'-methoxy dihydrochalcone, 2',6'-dihydroxy-4,4'-dimethoxy dihydrochalcone, 2',6'-dihydroxy-4'-methoxy dihydrochalcone, and 2',4',6'-trihydroxydihydrochalcone, as well as palmitic acid, benzyl benzoate, cinnamyl cinnamate, pinostrobin, pinostrobin chalcone, pinocembrin, and pinobanksin, was confirmed through isolation procedures. Given the limited studies on the chemical profile of Latvian propolis, these findings contribute towards interesting insights into the phytochemical diversity of propolis within this geographic area. The study enhances the understanding of the chemical composition of Latvian propolis and provides a foundation for further research on its bioactive properties, therapeutic potential, and potential applications in pharmacology, biotechnology, and the development of natural health products.

PP-268 [Beekeeping Technology and Quality]
A practical, simple and cost-effective methodology for preparing inverted syrup from table sugar

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Background
Sustainability and economic profitability are key challenges for beekeepers worldwide due to environmental and market challenges. Prices of honey are under increasing pressure from other sweeteners while factors like global warming, reduced biodiversity and intensive agriculture have led to a significant decline of natural forage and less resilient honeybee colonies. Therefore, efficient feeding is exceptionally important for smaller to medium sized beekeepers. Inverted sugar syrup in many ways would be an ideal feed. However, the readymade solutions offered on the market are often expensive, require large storage capabilities and transport of large volumes of liquid.

Problem Description
We set out to develop a methodology which allows beekeepers to produce their own invert syrup in a reproducible, simple and cost-effective manner from table sugar.

Methodology
Our developed solution for beekeepers is based on two components:
(I) a long shelf-life liquid formulation of a yeast extract with high invertase activity, called INVERTOFIX which efficiently converts a solution of table sugar into inverted syrup.
(II) a simple, cost-efficient, smart-tank system, called SyrupMaster, which consists of a food grade plastic tank, with a pumping and electronic regulation system which allows fast and efficient dissolution of sugar and provides the mixing for effective enzymatic conversion. The enzyme formula was optimized considering parameters like time, dosage, temperature and sugar concentration.

Results and conclusions
Adding INVERTOFIX at a fixed dose-to-sugar ratio reliably converts a solution of table sugar into invert sugar. The reaction proceeds at temperatures above 15°C to completion within 24h. SyrupMaster, is the only piece of hardware which is required for beekeepers to prepare their own invert syrup in scales of 65- 500L/batch in 24h. The herein described method reduces the costs of feeding by more than 50% compared to commercial inverted syrups, ensures flexibility, quality and freshness of feed (no HMF buildup). Feed generated with this methodology was successfully tested in apiaries in Austria, Italy and Romania.

Practical Implications for Beekeepers
INVERTOFIX and SyrupMaster acting together can have an important impact to apiculture by lowering costs for and improving the quality of bee feed for beekeepers in developed and developing regions.

PP-270 [Beekeeping Technology and Quality]
Honey from a protected area in Uruguay: potential discriminatory parameters for geographical origin

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Uruguay is among the top main 20 honey exporters in the world, with a production of nearly 12,000 tons, of which 90% is destined for the international market. Almost all exports are made in bulk and without differentiation, which has generated a considerable gap in prices when compared to other exporting countries. Paysandú Province is the second-largest honey-producing area in Uruguay, where one of the protected native forest areas, Montes del Queguay, is located. This protected area hosts a diverse range of ecosystems that influence the composition and quality of honey, enhancing its unique botanical and geographic identity. However, only limited studies have been conducted on the characterization of Uruguayan honeys, particularly those from protected areas. Therefore, this study aimed to explore the relationships between botanical origin, physicochemical properties, and mineral content in honeys primarily sourced from native species in Montes del Queguay.

Thirty honey samples were collected from georeferenced apiaries during 2022 and 2023 seasons. Their pollen composition, physicochemical parameters (ash content and electrical conductivity), and mineral content (K, Na, Ca, Mg, Cu, and Zn) were analyzed. Pollen analysis revealed that native species such as Scutia buxifolia, Blepharocalyx salicifolius, and Terminalia australis predominated in most samples. Ash content ranged from 0.362±0.028% to 0.795±0.015%, while electrical conductivity varied from 693.20±8.95 to 1,217.67±9.71 µS/cm. Most analyzed honeys exhibited high electrical conductivity (above 800 µS/cm), a property which may serve as a distinguishing characteristic of honey from this region.

Potassium (2702.56±17.15 mg/kg) was the most abundant mineral among those evaluated, followed by calcium (132.86±7.03 mg/kg), magnesium (84.86±0.44 mg/kg), and sodium (35.93±0.74 mg/kg). Additionally, copper (0.777±0,002 mg/kg) and zinc (≤0.4 µg/kg) were detected in all honey samples at low concentrations. The high potassium and calcium contents, as well as the low sodium concentration, could also be considered as discriminatory parameters of the honeys produced in Montes del Queguay. These findings help characterize honeys derived from native species in Montes del Queguay, offering valuable geographical origin indicators that can support Uruguayan beekeepers in increasing their products' value in the international market.

PP-272 [Beekeeping Technology and Quality]
Regional characteristics and food safety of honey collected in Japan

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Honey can contain radionuclides and heavy metals, making it a useful medium for assessing environmental conditions across relatively large areas through radioactivity and elemental analyses. Regarding the analysis of radioactivity in honey, previous studies have reported the detection of radioactive caesium originating from global fallout in the USA. Understanding the environmental distribution of radionuclides and assessing the potential health effects associated with honey consumption are important areas of investigation. In Japan, the TEPCO Fukushima Daiichi Nuclear Power Plant (FDNPP) accident, which occurred in 2011, released significant amounts of radioactive caesium (^{13} Cs: T1/2 = 30.2 y, ^{134}Cs: T1/2 = 2.06 y) and other radionuclides into the environment. Due to its long half-life, radioactive caesium persists in the environment. Following the FDNPP accident, radioactive caesium was detected in certain foods produced in Fukushima Prefecture. In this study, we analyzed honey samples collected across Japan to investigate their regional characteristics and food safety. Radioactivity analysis revealed the presence of ^{13} Cs in honey from Fukushima; however, the detected levels were below the Japanese food safety standard of 100 Bq/kg. Caesium-137 was also detected at low levels in honey samples from other regions of Japan. Given that honey is a food product, we also evaluated the potential health risks associated with daily honey consumption. The International Commission on Radiological Protection has established an annual effective dose limit of less than 1 mSv for the general public. The effective dose from consuming Fukushima honey was found to be well below this limit, indicating that it is safe for consumption. In addition to these findings, we present data on the radioactivity and elemental composition of honey samples from various regions of Japan, along with a discussion of their safety and regional characteristics.

PP-273 [Beekeeping Technology and Quality]
Antimicrobial activity of honeydew honey that caused larvae mortality (River Disease) in Uruguay

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Honeydew is the sugar-containing excretions of plants-sucking insects and it is very attractive to bees, resulting in the production of honeydew honey. This type of hive product presents difficulties for their commercialization as it has different physico-chemical and organoleptic characteristics to floral honey.

The River Disease (RD) is a honey bee health problem that kills the newly hatched larvae in Uruguay. The causal agent of larval death is the excretions of an aphid, Epormenis cestri, when found on Sebastiania schottiana trees near the hives. The bees collect these excretions, which end up as food for the larvae. The honey produced from this honeydew affects the larvae in their first days of life. The affected colonies produce honeydew honey which has no commercial outlet, and which contains compounds with potential biological activity and nutraceutical properties like xanthoxylin.

The aim of this work is to study and characterize the biological properties of this type of hive product and to generate strategies to valorize this product, which to date not only has no commercial outlet but also represents a loss for beekeepers.

10 samples of honeydew honey from colonies affected by RD were collected in different departments of Uruguay. Physicochemical characterization and quantification of peroxide content was carried out. Once it was confirmed that they were honeydew honeys, they were screened for antimicrobial activity in a Muller-Hilton diffusion plate assay and Minimal Inhibitory Concentration (MIC) was also determined. 50% w/v honey solutions were evaluated against Staphylococcus aureus ATCC6538P, Klebsiella pneumoniae CCMG12716 and Pseudomona aeruginosa ATCC 15442. MIC analyses were carried out in a microdilution plate with 96 wells containing Mueller–Hinton broth.

The samples presented high antimicrobial activity against all strains with MIC values below 20% w/v honey. No significant peroxide content was found in any of the samples, meaning that the activity is linked to other compounds in the honeys which is not common.

RD honeydew honeys are beehive products with novel antimicrobial potential. This study will continue by working on the correlation of the observed activity with the presence of compounds in this type of honey.

PP-275 [Beekeeping Technology and Quality]
Honeybees as biomonitors - Variability in the occurrence of heavy metals, a systematic review

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Background/Purpose, To collect data on environmental pollutants potentially harmful to human health (e.g. heavy metals, HM) over time, honey bees have been used as biomonitors due to their ability to accumulate air, soil and water pollutants within a specific radius during foraging trips.

Problem description, The aim of this study was to perform a systematic review that has determined and quantified (µg/g) the levels of heavy metals, Cr, Al, Li, V, As, Cd, Tl, Hg and Pb in honeybees samples, in different regions (Forest as a control, Urban and Rural areas).

Methodology, this systematic literature review summarizes the previous application of Apis mellifera bees in the monitoring of HM (µg/g) as contaminants in articles published during the period 1996-2024. Eighteen studies were included. For the literature search we examined databases, as PubMed, Scopus, etc, and used the following keywords: (bees OR pollinators or Honey bees) AND (biomonitor OR bioindicator) AND (contamination OR pollution) AND (Heavy metals OR minerals). The maximum, minimum, mean, standard deviation and coefficient of variation (CV%) of the results obtained were determined, as well as the study site Forest as a control, Urban and Rural areas.

Results, The concentration (µg/g) of Cr in general was 0.140±0.103,CV 73.88%; Al (7.17±.3.5; CV 48.8%), Li (0.020±0.0), V (0.050 ±. 0.058; CV 116%), As (0. 536 ± 0.307; 57.3%), Cd (0.265 ± 0.296; CV 112%), Tl (0.317±0.026; 8.29%), Cu (7.95±7.36; 92.5 %), Hg (590±0.0), and Pb (1.13±0.495, CV 43.8%). Only one study shows concentrations of Cr, Cd, Cu, Pb and Zn in forest areas, with respect to rural areas there is a lower concentration of heavy metals with respect to urban areas.

Conclusion, honeybees represent an avenue for continuous monitoring and provide quantitative information on specific HMs. The analysis revealed that the presence of HM in honeys present in forest areas is lowest, followed by rural and highest in urban areas. Further studies should be carried out to obtain a more solid database for more reliable results.

PP-277 [Beekeeping Technology and Quality]
Enhance the bioactivity of Royal Jelly via High Hydrostatic Pressure

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Royal jelly has been proven to have multiple benefits, such as enhancing immunity, promoting tissue regeneration, protecting cardiovascular health, and anti-aging effects. It contains antioxidants like phenols and flavonoids, which can provide antioxidant effects, delay aging, reduce inflammation, accelerate wound healing, inhibit bacteria, and control blood sugar levels. High Pressure Processing (HPP) is an advanced food processing method that treats food by placing it in a high-pressure environment. In this process, food is submerged in water and subjected to pressures ranging from thousands to hundreds of thousands of pounds per square inch. This high-pressure treatment significantly reduces the number of microorganisms in the food, thereby extending its shelf life. Additionally, the pressure can alter the activity of enzymes in the food, making it more suitable for specific uses or processes. High pressure can also cause starch gelatinization and protein denaturation, changing the texture and taste of the food. This study investigates whether the beneficial components of royal jelly, such as total phenols, flavonoids, and antioxidant capacity, are enhanced after being treated with HPP. The study also analyzes the characteristics of royal jelly from different pollen sources after various pressure durations, comparing their differences. The results show that HPP increases the content of 10-HDA (10-hydroxy-2-decenoic acid) and total phenolic flavonoids in royal jelly. After HPP treatment, the antibacterial ability of royal jelly is significantly enhanced, and it effectively kills cancer cells, reducing their survival rate.

PP-279 [Beekeeping Technology and Quality]
Characterization of Slovenian bee venom

Simon Golob
SIMON GOLOB

Bee venom is certainly one of the lesser-known and less-researched bee products, but it is a product with great potential. In recent years, the Slovenian Beekeepers' Association has carried out several in-house trials on the production of bee venom. Between 2020 and 2022, we carried out a research project on the optimization of bee venom production technology, and in 2023, we launched the Characterization of Bee Products study, which investigated the composition of Slovenian bee venom.

As part of the Characterization of Bee Products study, 20 samples of Slovenian bee venom were collected in 2023 and 2024. The samples were visually assessed, and analyses of bee venom for melittin, total protein, and dry matter were carried out by subcontractors of the Dr. Andrija Štampar Institute of Public Health in Zagreb for the purposes of the survey. The results showed that the range of melittin content, as a key quality parameter, was large, ranging from 30.4% to 71%, with an average melittin content of 59.85%. Interestingly, in 2024, in half of the samples of bee venom, the melittin content was higher than 60%, ranging from 69.4% to 71%.

Samples of dried bee venom often contain impurities and contaminants, depending on the production method. Larger particles are visible in the extracted venom, while smaller particles and various impurities give the dried bee venom an uncharacteristic color. The study showed a correlation between the visual assessment of bee venom and the melittin content as a key quality parameter. Bee venom samples with a lower melittin content also received fewer points in the visual assessment, while bee venom samples with a high melittin content usually received all points in the visual assessment. These samples were predominantly white or slightly grey-white in color and had no impurities. In the bee venom samples from 2024, the average melittin content in the eight samples that scored all points in the visual assessment was as high as 70.44%. The melittin content in these samples is extremely high, even in light of the findings of other studies.

PP-280 [Beekeeping Technology and Quality]
Volatile Organic Compounds Profile of Spanish Chestnut (Castanea) Honey

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BACKGROUND: Honey has always been the most important food product obtained by man from bees. Spain is the fourth largest producer of honey in Europe and this product has a great economic impact on the primary sector in some regions. Castanea is the taxon of interest to beekeepers, especially in inland areas from the north of the Iberian Peninsula. It produces unifloral chestnut honey of great value. This honey has very well defined organoleptic characteristics, due to its high Castanea content (over 70%), with only differences due to its geographical origin and the accompanying flora.

PROBLEM DESCRIPTION: There is little information available in Spain on the composition of the volatile organic compounds (VOCs) responsible for these qualities.

METHODOLOGY: For this reason, this study defines the volatile profile of 14 chestnut honey samples using the Headspace Solid-Phase Microextraction (HS-SPME) technique coupled with gas chromatography-mass spectrometry.
RESULTS and CONCLUSION: The volatile profile of chestnut honey showed a total of 39 VOCs. These VOCs belonged to 11 chemical categories: aldehydes, alcohols, ketones, esters, furanones and furans, carboxylic acids, phenols, quinoline and derivatives, polycyclic aromatic compounds and naphthalenoids, sesquiterpenes and terpenes, and other aromatic compounds. The most abundant compounds in all the samples were the aromatic alcohol β-phenethyl alcohol and the aromatic aldehyde cinnamaldehyde, (E)-, with an average relative concentration of over 10% and a maximum of over 20%. The aromatic aldehyde, p -anisaldehyde, also demonstrated high values, reaching 30.3% in some samples. Other aromatic compouds were: furan, 3-phenyl-; benzene, pentamethyl-; naphthalene, 1,2-dihydro-1,1,6-trimethyl-; hotrienol; benzyl alcohol; linalool oxide (fr. 1), benzene acetaldehyde and benzaldehyde. These compounds could define the volatile profile of unifloral chestnut honeys from Spain.

PRACTICAL IMPLICATIONS FOR BEEKEEPERS: This study values one of the highest quality unifloral honeys produced by Spanish beekeeping and contributes to the understanding of its volatile profile.

PP-282 [Beekeeping Technology and Quality]
Melissopalynological properties of Ivy (Hedera helixL.) honey

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Ivy honey (Hedera helix L.) is classified as a late season unifloral honey, characterized by a distinctive pollen spectrum that reflects the floral composition available to foraging pollinators during autumn. Melissopalynological analysis is crucial for verifying the botanical origin and authenticity of honey, as well as identifying secondary nectar sources that contribute to its composition. Therefore, this study aimed to investigate the melissopalynological properties of ivy honey. The study was conducted on 19 ivy honey samples collected directly from the beekeepers in Croatia during 2023. Samples were analyzed by qualitative melissopalynological analysis according to the method of Von der Ohe et al. (2004). Melissopalynological analysis confirmed the dominance of H. helix pollen (>45%) in all examined samples, with a pollen spectrum reflecting plant species flowering during the summer and early autumn period. The percentage of H. helix pollen varied between 51% and 98%, depending on geographical location, climatic conditions, and foraging behavior of honey bees. In addition to H. helix pollen, ivy honey contained pollen from other plant sources flowering during the same period, classified as accompanying (15-45%), secondary (3-15%), and rare (<3%) based on their relative abundance. The accompanying pollen group included asparagus (Asparagus spp.) pollen (23%) and alder buckthorn (Frangula alnus) pollen (21%). In half of the samples, pollen from the secondary pollen group was identified, with the most prevalent originating from the Asteraceae family, followed by Apiaceae, Fabaceae, Lamiaceae, Poaceae, Brassicaceae and Boraginaceae. Additionally, pollen from dogwood (Cornus sanguinea), asparagus (Asparagus spp.), sweet chestnut (Castanea sativa), and buckthorn (Rhamnus spp.), as well as sunflower (Helianthus annuus), was also identified. In the rare pollen group, alder buckthorn (F. alnus) was present at 2%, while pollen from false indigo (Amorpha fruticosa) and brown knapweed (Centaurea jacea) was found at 1% each. The variability in pollen composition suggests that ivy honey can incorporate nectar from a wide range of late flowering plants, depending on local vegetation. A well-defined pollen spectrum is crucial for honey authentication in terms of uniflorality confirmation, quality control, and the assessment of potential bioactive compounds derived from different botanical sources.

PP-283 [Beekeeping Technology and Quality]
Ensuring Honey Safety: Rapid Testing for Antibiotic Residues

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Testing honey for antibiotic residues is crucial to ensure it meets food safety standards and regulatory requirements. Antibiotic contamination can occur due to direct beekeeping practices or environmental exposure, raising concerns about potential health risks and the role of antibiotic residues in antimicrobial resistance. As a result, strict global regulations have been implemented to safeguard public health.

Current antibiotic residue screening in honey relies heavily on expensive and time-consuming confirmatory methods, such as liquid chromatography–mass spectrometry (LC-MS). While highly accurate, these techniques require specialised laboratory facilities, making routine and on-site monitoring impractical for many honey producers, exporters, and regulators. There is a growing demand for rapid, cost-effective screening methods that can detect multiple antibiotic residues efficiently while maintaining accuracy and compliance with regulatory standards.

Biorex Food Diagnostics have developed FlowSense, a range of single and multi-analyte diagnostic test devices utilising lateral flow microarray immunoassay technology. These rapid test devices employ a more sustainable strip format with no plastic cartridge along with a freeze-dried conjugate well and a simple, user-friendly protocol. The system incorporates green-based extraction methods that streamline sample preparation while ensuring high sensitivity and specificity. A portable test reader has been integrated to facilitate testing in various environments, including field operations and food production facilities. The reader provides semi-quantitative and quantitative results, minimising errors associated with visual interpretation.

The FlowSense antibiotic testing range delivers high sensitivity and specificity, with results available in just 10 minutes. The integration of a portable reader ensures consistent and accurate detection of antibiotic residues, allowing for efficient on-site monitoring. This innovation provides a practical alternative to costly laboratory-based analyses, offering a balance between affordability, accuracy, and ease of use. By improving accessibility to reliable antibiotic screening, FlowSense supports compliance with evolving food safety regulations while enhancing supply chain integrity.

Beekeepers benefit from FlowSense's rapid, portable antibiotic testing, allowing proactive monitoring before regulatory testing. This reduces the risk of non-compliance and market rejection. Early detection helps identify contamination sources, enabling better management practices to minimise antibiotic use, enhance honey quality, and strengthen consumer trust.

PP-284 [Beekeeping Technology and Quality]
The Swarm Line

Lars Jonsson
Lars Jonsson, Biodlarna The Swedish Beekeeper Association

The Swarm Line is a unique and much appreciated service for both the general public and beekeepers in Sweden.
When you spot a beeswarm, dial the Swarm Line number and you will automatically be connected to a swarm collector in the vicinity! The Swarm Line is linked to the online Swarm Map that illustrates the calls made to the Swarm Line across the entire country in real-time. For beekeepers, there is a portal where they can manage the geographical areas they wish to cover and switch themselves to on or off duty. As the map also indicates American foulbrood restriction areas, swarm collectors can easily decide whether bee inspection needs to be involved. The data collected by the Swarm Line and the Swarm Map can be used for monitoring and forecasting the swarm season and tracking changes over time. The Swarm Line and the Swarm Map were developed by the Swedish Beekeepers Association in 2020 and further developed with European funding through the Swedish Board of Agriculture. The number of visitors has increased from year to year, and both beekeepers and the interested public share the fascination of the swarming season, following the dots on the map.

PP-285 [Beekeeping Technology and Quality]
Developing an Objective Scoring System for Evaluation of Sustainability of Best Beekeeping Practices

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The implementation of Best Practices in animal production is essential for optimising economic outcomes, improving health management, ensuring high welfare standards, and reducing environmental impact. Best Beekeeping Practices were formally defined in Europe through the Horizon Europe project B-THENET. To support beekeepers and strengthen the EU beekeeping sector, a method was developed to assess the sustainability of these practices. A consortium of experts from 13 EU countries (Austria, Belgium, Croatia, Denmark, Germany, Greece, Hungary, Italy, Poland, Slovakia, Slovenia, Spain, and Sweden) participated in creating an objective scoring system based on three main criteria: (1) sustainability (including cost-benefit analysis, and scoring of the impact on honey bee health, human health, and impact on environment), (2) scientific validity, and (3) readiness for practical implementation. A total of 50 Best Beekeeping Practices covering the themes of Apiary and colony set up and management/maintenance (category “Good Beekeeping Practices, GBPs”), Varroosis, and American Foulbrood (“Biosecurity Measures in Beekeeping, BMBs”) were analysed.

The practices with the highest sustainability score in each criterion were: “Expanding the colony to give the colony space” and “Only transfer disease-free bees and/or frames to other colonies” from the GBPs category, and “Identification of the best moment for Varroa treatments according to the national climatic areas” and “Queen caging” for BMBs. A significant correlation was found between the scientific value of a practice and its reduced environmental impact. Interestingly, sustainability parameters such as “Human Health”, “Scientific Value,” and “Environmental Impact” varied across countries. The sustainability value of Best Beekeeping Practices can guide beekeepers towards practices that improve the resilience and profitability of their operations. Establishing such a framework provides a baseline, facilitating evidence-based decision-making in selecting and developing Best Practices. Additionally, a standardized evaluation tool enables cross-comparison of sustainability metrics across farmed animal sectors, particularly where theoretical frameworks are needed before practical application. This tool holds promise for integration into larger initiatives, such as the EU Farm Book project, to establish uniform sustainability benchmarks for the European agricultural sector.

PP-288 [Beekeeping Technology and Quality]
Navigating the beekeeping information environment: Facebook information cannot be a universal solution to beekeepers' problems

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The emergence of the Internet and social networks is a process of mediatization of the beekeeper's everyday life, that requires caution in identifying the right information. Bees and beekeepers are all over the world and do not always face the same problems, which means that one information cannot be a universal solution to all problems, so beekeepers should be careful when implementing information in practice.

Social networks such as Twitter and Facebook provide users with a dynamic and interactive environment where information can be shared, discussed, and disseminated quickly. Beekeepers can find a wide variety of information on social networks, which is not always true, even less verified, or even misleading, and this information is also often subject to the opinions, interests, and biases of individual users.

Academic articles, on the other hand, are the product of rigorous professional research and therefore provide reliable information. In the professional journal Slovenski čebelar (Slovenian Beekeeper), which is published monthly, we bring together academic and popular articles on current problems faced by beekeepers. Despite the professional complexity, we try to present the articles in a generally understandable way, which is also achieved through the long-standing and constant use of terminology by the Slovenian Beekeeping Terminological Dictionary. Although the Slovenian Beekeeper journal is often overtaken by information on social networks, the professional text seems to be the key, as it is often the only way to undermine potential misunderstandings of information on social networks.

Some problems require quick action by beekeepers, so sometimes printed trade journals are too slow to keep up with fast information due to their periodicity, in which case social media platforms seem to be the only effective ones. Solving beekeeping problems often requires fast, professional, and effective solutions, which means that beekeeping trade magazines and information on social media platforms should be going side by side.

PP-289 [Beekeeping Technology and Quality]
Innovative 4-in-1 Rapid Test for Screening Residues of Nitrofurans (AOZ, AMOZ, AHD, SEM) in Honey

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Honey is a widely consumed natural product subject to strict food safety regulations. However, contamination with veterinary drug residues, particularly Nitrofurans, remains a concern. These synthetic antibiotics formerly used in beekeeping, leave metabolites such as Semicarbazide (SEM), 3-amino-2-oxazolidinone (AOZ), 1-aminohydantoin (AHD), and 3-amino-5-morpholinomethyl-2-oxazolidinone (AMOZ), which are genotoxic and carcinogenic. Their use in food production is banned in many regions, but illegal use, cross-contamination, or environmental exposure can still lead to residues in honey. Conventional detection methods, such as LC-MS/MS and ELISA, are accurate but costly, time-consuming and require specialised training. A rapid, cost-effective on-site test is needed to support compliance with food safety standards.

Existing Nitrofuran screening tests are impractical for routine use by beekeepers and small-scale producers. Multiplex screening systems often require expensive analysers, while ELISA methods demand four separate test kits for comprehensive results. A simple, rapid, sensitive, and cost-effective method would improve monitoring and prevent contaminated honey from reaching the market.

Here, we present a multiplex lateral flow device (LFD) developed for detecting four key Nitrofuran metabolites in honey. The test uses specific antibodies with optimised detection chemistry and rapid sample preparation. A 2g honey sample undergoes acid hydrolysis and derivatisation at 60°C for only 15 minutes followed by solvent extraction and evaporation. The reconstituted extract is applied to a supplied microwell, incubated for 5 minutes followed by another 5-minute incubation with the LFD in place. The single test provides a visual result for all 4 antibiotics, with an optional semi-quantitative FlowSense reader measurement.

The test kit exhibits high sensitivity, detecting residues below regulatory limits. The visual detection limit (LOD) was 0.5 ppb, while the FlowSense reader improved detection down to 0.25ppb. Intra-assay precision ranged from 2.1% to 5.3%, confirming reliability. The FlowSense reader also shows potential for future quantitative testing.

This rapid, user-friendly test enables multiplex screening with an assay time of only 10 minutes, reducing reliance on costly lab tests. Beekeepers, exporters, and regulators can use it to ensure compliance, improve food safety, and enhance market confidence in honey products.

PP-290 [Beekeeping Technology and Quality]
B-THENET Thematic Network: Updates on the European Collection and Prioritisation of Best Beekeeping Practices

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The project B-THENET (https://www.bthenet.eu/) aims to promote sustainable beekeeping by collecting, defining and providing training on Best Beekeeping Practices in Europe. The development of practices is based on a bottom-up approach and methodology involves three phases. In the initial phase practices are collected and prioritised with the help of beekeepers. In the second phase practices are analysed to understand if they are suitable for discussion by researchers, advisors, and beekeeping associations. The final phase involves development, validation and dissemination of selected practices through the joint efforts of beekeepers, advisors and researchers. Here we present the results of the collection and prioritisation of practices carried out in the first three years of the B-THENET project.

4 776 Beekeepers and advisors from 13 European countries (Austria, Belgium, Croatia, Denmark, Germany, Greece, Hungary, Italy, Poland, Slovakia, Slovenia, Spain and Sweden) were surveyed and asked to identify the most relevant Good Beekeeping Practices (GBPs) and Biosecurity Measures in Beekeeping (BMBs). The themes discussed so far include: “Apiary set-up and management/maintenance”, “Colony set-up and management/maintenance”, “Bee feeding and watering” and “Record keeping” for the GBPs category, whereas BMBs comprise “Varroosis”, “American Foulbrood” and “European Foulbrood”. In the final year of the project practices on “Routine (preventive) hygiene practices” for GBPs and “Nosemosis, Small Hive Beetle and Vespa velutina” for BMBs will be discussed.

In the first year, 22 practices were identified as priority, of which, 13 were GBPs relative to “Apiary set-up and management/maintenance”, and 9 BMBs relative to “Varroosis”. In the second year, 28 practices were selected: 20 GBPs referring to “Colony set-up and management/maintenance” and 8 BMBs to “American Foulbrood”. In the third year, European beekeepers identified as most important 25 practices, including 19 GBPs relative to “Bee feeding and watering” and “Record keeping”, and 6 BMBs relative to “European Foulbrood”. The identified practices were developed and validated through collaboration with researchers, national beekeeping associations, and local beekeepers and advisors. The outcome is a comprehensive repository of GBPs and BMBs (https://www.bthenet.eu/repository-platform/), translated and tailored to the local conditions of 13 European countries.

PP-291 [Beekeeping Technology and Quality]
Analysis of Apitoxin Yield and Melittin Percentage According to the Use of Three Types of Traps

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Commercial apitoxin is obtained using an electrical current emitting device connected to traps that can be installed in different locations within the hive. The objective of this study was to evaluate the performance of three types of traps regarding the amount of harvested apitoxin and melittin concentration. The trial was conducted in December 2024 (austral summer) using 30 developed hives (population greater than 40,000 adult bees). They were divided into 3 groups of 10 hives (ET external trap, IT internal trap, RT rooftop trap). Extraction was performed in the morning for 30 minutes. The glass plates corresponding to each colony were identified, and the weight of the harvested apitoxin, as well as the percentage of melittin by HPLC, were quantified. Analysis of variance showed significant differences in apitoxin weight among the groups ($p = 0.021$): ET 62 mg, IT 83 mg, RT 107 mg. Tukey's post-hoc test indicated that the RT group showed a significantly higher yield than the ET group ($p = 0.015$), while other comparisons did not show significant differences. Regarding melittin concentration, ET 45.4%, IT 46.9%, RT 51.6% showed no significant differences among the groups ($p = 0.113$). This study confirms previous findings regarding the higher yield of RT traps in apitoxin collection, this time comparing traps under similar conditions, information that is important for those engaged in this field. Regarding the percentage of melittin in the collected apitoxin, no significant differences were found, unlike a previous study conducted in December 2022 comparing ET (62.4%) and RT (72.6%). We hypothesize that the difference may be due to the amount of open brood, which was low in 2022 due to the onset of a major drought and normal in 2024. As young bees produce royal jelly within the time window in which apitoxin components are synthesized, it should be studied whether open brood area affects the amount and/or composition of apitoxin.

PP-292 [Beekeeping Technology and Quality]
Differential melittin concentrations in apitoxin harvested from young versus mature honeybees

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Apitoxin is composed of a complex mixed of bioactive substances synthesized by honeybees and accumulated in the venom sac during the first three weeks of adult life. Different types of traps are used to collect apitoxin, which can be set up inside or outside the hive, allowing access to them by both younger and older bees. This raises the question of whether this could lead to a different composition of the collected apitoxin. Melittin is the major component of apitoxin, and its concentration must be known for commercialization. The aim was to quantify the percentage of melittin in apitoxin from young and mature bees from the same hive. The experiment was carried out in December 2024 (southern hemisphere summer), using 18 well-developed hives (40,000 to 50,000 adult bees). In the morning, the hives were identified and subsequently moved approximately 100 meters. In their place, hives containing only brood frames, feed and empty frames were left. These hives were populated by adult bees from the relocated hives, as they had fixed the original location of their colony. At dusk, the population of each hive was divided into two: the relocated hive with young bees and the hive installed in the original location with adult bees. At night, apitoxin extraction was performed using ceiling traps for 30 minutes. The apitoxin collected from each hive was stored in a marked container for later quantification of the melittin percentage by HPLC. A block design and analysis of variance were performed on the values obtained, revealing differences ($P < 0.001$) in the melittin concentration of the apitoxin from young (62%) and mature (47%) bees. This may be due to the fact that the components of apitoxin are synthesized at different times and/or rates. Therefore, the time and place in the hive where the traps are installed to collect apitoxin must be considered, since different compositions can be obtained from the same hive depending on whether young and/or mature bees access the traps.

PP-299 [Beekeeping Technology and Quality]
VARROMETER - Interactive Decision Support Tool for the Implementation of IPM for Varroa Control

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Varroa (V. destructor) is the most challenging biotic stressor to be managed in beekeeping. Beekeepers have several options for varroa control published in scientific or technical fora; the most extensive advisory efforts are dedicated to their control. However, despite today's information, many find it challenging to choose the strategy that best fits their reality and keep up-to-date with the market's available veterinary products. Varrometer is an interactive tool designed to assist practitioners in beekeeping and honey bee veterinary decision-making. It suggests measures tailored to the specific characteristics of each beekeeper for varroa control, based on the available options, legislation, climate and managerial preferences. The tool goes beyond selecting veterinary products and can be adapted to any existing beekeeping philosophy. Varrometer follows an Integrated Pest Management (IPM) approach, which involves different levels of varroa control measures. IPM protocols consider the context of the bee colonies, the beekeeper, and their practices (Level 0). They are based on preventive measures to maintain healthy colonies under optimal conditions to cope with potential stress factors (Level 1). By monitoring varroa infestation levels throughout the season (Level 2) and establishing their preferences, beekeepers obtain varroa control strategies and methods adapted to their reality (Level 3 [non-chemical approaches] and Level 4 [chemical approaches] or combinations of both).

PP-301 [Beekeeping Technology and Quality]
Machine learning-based bioacoustic detection of robber bees

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Most stingless bee species forage on flowers to obtain nectar and pollen, except some genera such as the cleptobiotic bees Lestrimellita, which steal food resources from other colonies. In Brazil, beekeepers know that some stingless bee species exhibit a defensive behavior as robber bees are attacking nearby colonies. One of these species is Melipona quadrifasciata in which its colonies are commonly integrated into meliponaries alongside other stingless bee species as a protective measure. However, this strategy is not always effective, as the defensive response does not completely prevent attacks. In this context, it is known that the defense responses of stingless bee species are triggered by pheromones in cephalic glands of both their nestmates and the robber bees. Additionally, studies in precision beekeeping have demonstrated that coupling audio analysis with machine learning techniques can detect behavioral changes in bee nests. In this study, we hypothesized that exposure to the contents of the cephalic glands to M. quadrifasciata triggers the defensive response of such bees against robber bees and that this response could be detected through acoustic analysis. To test this, we exposed a hive of this species to four treatments: (i) no disturbance (control), (ii) exposure to the solvent dichloromethane alone (positive control), (iii) exposure to the head extract of a conspecific bee diluted in dichloromethane, and (iv) exposure to the head extract of L. sulina using the same solvent. We recorded the hive's response, selecting five-minute segments from each condition, and extracted 12 Mel-frequency cepstral coefficients from 1,200 samples per treatment using the melfcc function from the TuneR package. The dataset was split into training and testing subsets to train a k-nearest neighbors (neighbors: 20) model using the knn function from the class package in R. The model achieved the highest F1 score when classifying responses to robber bees head contect exposure (0.96), followed by conspecific exposure (0.81), while the no-disturbance (0.61) and positive control (0.67) treatments had lower scores. These results demonstrate that presence of cleptobiotic bees can be rapidly detected using the tested techniques, advising beekeepers to implement protective measures, such as closing hives, to mitigate attacks.

PP-302 [Beekeeping Technology and Quality]
PoMS: The data standard of the pollinator community

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Standardising pollinator-related data is crucial for enhancing data interoperability, reproducibility, and accessibility across scientific, conservation, and policy-making communities. Pollinators, essential for ecosystem health and agricultural productivity, face increasing threats from habitat loss, climate change, and pesticide use. Comprehensive and harmonised data collection and sharing are imperative to address these challenges. The Pollinator Metadata Standard (PoMS), developed under the auspices of Apimondia Working Group 12 on Data Standardisation, provides a robust framework for standardising pollinator and beekeeping-related terms, ensuring consistency and clarity in data representation. PoMS evolved from the BeeXML standard (https://beexml.org/). It is designed to facilitate the integration of diverse datasets by defining a taxonomy of classes, descriptors, and units essential for accurate data comparison and analysis. The standard operates through a collaborative, software-based process, allowing registered users to propose, discuss, and approve terms traceably and counts already almost 8.000 terms. This process ensures that data elements are linguistically precise, scientifically accurate, and universally applicable across different languages and regions. Implementing PoMS within platforms such as the EU Pollinator Hub (https://pollinatorhub.eu) exemplifies its practical application, enabling the management of datasets through a structured and transparent workflow. PoMS ensures that pollinator data are consistently defined, translated, and updated, fostering global collaboration and data sharing. By adhering to PoMS, researchers, policymakers, and conservationists can more effectively monitor pollinator populations, assess threats, and implement targeted conservation strategies by bringing together data from different sources. This standardisation effort represents a significant achievement of Apimondia WG 12, advancing pollinator research and contributing to preserving biodiversity and ecosystem services.

PP-303 [Beekeeping Technology and Quality]
Honey Quality from the Caatinga of Pernambuco: Physicochemical Analysis and the Importance of Good Beekeeping Practices

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The Caatinga biome covers approximately 80% of the territory of the state of Pernambuco and stands out as one of the few regions in the world suitable for the production of organic honey, due to the presence of extensive areas free of the use of pesticides. Beekeeping activity has significant socioeconomic relevance in the region, with about 2,000 beekeepers involved in production, positioning Pernambuco as the fifth largest honey producer in the Brazilian Northeast, contributing with 5.5% of national production. However, challenges related to hive management, harvesting and honey processing directly impact the quality of the final product. In order to evaluate the quality of the honey produced in the Caatinga, 62 samples from 27 municipalities in Pernambuco were analyzed. The physicochemical analyses followed internationally recognized methodologies, including the protocols of the Adolfo Lutz Institute, the National Animal Reference Laboratory and the Association of Official Analytical Chemists (AOAC). Parameters such as color, moisture, reducing sugars, apparent sucrose, acidity, hydroxymethylfurfural (HMF), insoluble solids and ash were evaluated. The tests were carried out at the Laboratory of Analysis of Bees and Honey Products of the Federal Rural University of Pernambuco (LAMEL/CENAPESQ/UFRPE). The results showed variation in the Pfund scale between the shades of white, extra clear amber, amber and dark amber. Of the samples analyzed, 44 were in compliance with the standards required by Normative Instruction No. 11/2000 (Brasil, 2000) and Codex Alimentarius (2001), while 18 presented values outside the limits established by current legislation. Such findings reinforce the need to implement and strengthen good beekeeping practices, aiming to ensure the quality and appreciation of Caatinga honey, a product of high added value and potential for certification as organic honey.

PP-305 [Beekeeping Technology and Quality]
Honeybees, edge computing & AI, the connected hive journey continues beyond beekeeping

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Beefutures

IOT technologies applied to apiculture celebrate close to 20 years old anniversary. Two decades later, bees are still dying at an accelerated pace, and managing bees digitally has not yet delivered its promises.

The fight with the varroa mite continues, new enemies keep coming, our agriculture model has not fundamentally changed, and human living space keeps expanding... in the meantime, the globe´s temperature continues breaking new records and disturbing Nature and life each year more profoundly.

What if the promise of technology is not about managing honeybees more efficiently but helping us decode the reasons for the bee decline and the impact of environmental stressors on ecosystem health and biodiversity?

The technology has evolved massively for the just last 5 years; with the emergence of AI and more powerful computers, new doors are opening to monitor and comprehend the world of bees and their interaction with the environment.
Processing video and audio in real time on a small computer was not within reach 10 years ago, today it is. Powered with solar energy and connecting to cellular networks, now even accessible in remote locations, monitoring bee traffic from the entrance of a hive, listening to the surrounding of a hive, following the health of bee colonies and their response to climate incidents and human actions becomes possible at scale.
With spatially diverse and continuous data, a new era of ecosystem and biodiversity monitoring and reporting seems possible with honeybees. Data sampled from hives can now extend beyond just the bees, providing insight into floral abundance and diversity, surrounding birds diversity, pollinator pathogens and invasive species prevalence. Every apiary can become a monitoring station of the local ecosystem's health and biodiversity, empowering us to understand the macro and local challenges. New insights can help develop new rehabilitation strategies and assist growers and food brands in the journey towards regenerative agriculture.

PP-309 [Beekeeping Technology and Quality]
Preliminary results of the VASBEEP Project: Insights into Spanish Honey Production

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BACKGROUND: Spain is the EU country with the largest number of beehives, currently around 3 million. In northern areas apiculture follows the pattern of the Atlantic apiculture with small and stationary apiaries with Langstroth or Dadant type beehives in front of the mediterranean and southern areas where transhumance and an intensive production using mostly Layens type beehives is the common. In addition to its honey production capacity, the wide variety of honeys produced in the region is also noteworthy, mainly because it is one of the most biodiverse areas in the European Union.

PROBLEM DESCRIPTION: Currently there is no EU legislation on the requirements that the different honey types should meet, leading to gaps in labelling and food safety. On the other hand, although there is scientific knowledge of main honey types, much of the honey produced in Europe is little known regarding its botanical origin.

METHODOLOGY: This study presents the first results of a national research project (VASBEEP Project) aimed at enhancing the value of Spanish honey based on its properties and geographical origin. More than 600 honey samples from the 2023 and 2024 harvests have been analyzed using various analytical procedures.

RESULTS AND CONCLUSION: The initial results classify the samples according to their palynological, physicochemical, and sensory characteristics, as well as other relevant parameters such as antioxidant capacity and volatile compound profiles, among others. The sampling has revealed a wide variety of multifloral and monofloral honey as well as honeydew honey. Samples range in color from extra white and white to dark amber/black, with electrical conductivities varying accordingly. Antioxidant activities are also highly varied from high values normally in dark honey to almost 10% in the clearest. Some specific volatile compounds were identified in monofloral honey samples. Main honey types were honeydew, chestnut, heather, lavender, rosemary, eucalyptus, vipers' bugloss, carob, Calluna, Lotus, among others.

PRACTICAL IMPLICATIONS FOR BEEKEEPERS: This project aims to give value the wide variety of honey types produced in Spain, indicating their main characteristics.

PP-311 [Beekeeping Technology and Quality]
Honey Story: A Data-Driven and Blockchain-Backed Approach to Honey Authentication

James Wilkes, Max Runzel
HiveTracks

The beekeeping industry struggles with honey adulteration and mislabeling. Despite efforts to maintain authenticity, current lab testing methods are expensive and sometimes inaccurate, causing confusion among consumers and eroding trust in the honey market.

HiveTracks proposes a data-driven and blockchain enabled solution to establish a “honey story" - a digital identity for honey traceable from origin to consumer and accessible via QR codes. This approach aims to provide definitive proof of a honey's source by meticulously documenting bee hive locations and honey production timelines. The process involves identifying potential nectar sources within the foraging radius of the bee colony, considering blooming nectar sources based on date, weather, and climate. By correlating these data with the honey produced, a clear picture of the honey's origin can be established.

Digital documentation of the honey's journey is made possible through various technologies. These include photos with metadata, hive scales monitoring weight and honey production, and apiary management software tracking beekeeping activities. Data on weather patterns, land use, and satellite imagery are also incorporated, with crowdsourced data providing a multi-dimensional perspective. External authenticity information, such as DNA and NMR testing, and sensory and pollen analysis, can also be integrated into the honey's digital profile. This comprehensive approach, securely saved using distributed ledger technology, ensures the honey's story is verifiable, robust, and tamper-proof.

Corroborated by Honeytrail's third-party blockchain authentication, HiveTracks' honey identification methodology benefits the beekeeping community by enabling product differentiation, allowing beekeepers to showcase their honey's unique qualities and fetch a premium price. Consumers gain access to transparent and trustworthy information about the honey they purchase, fostering greater confidence in the product.

By presenting this framework and illustrating its application through real-world examples, HiveTracks aims to demonstrate how technology can combat honey fraud and enhance transparency in the honey market. This will safeguard the interests of beekeepers and consumers and rebuild the integrity of the honey industry.

PP-313 [Beekeeping Technology and Quality]
Beekeeping Flora in the "Bee Garden" Melliferous Flora Garden, Yunquera, (Málaga, Spain), in the Sierra de las Nieves National Park

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Background and PURPOSE: The "Bee Garden" Melliferous Flora Garden, located in Yunquera (Málaga, Spain) within the Sierra de las Nieves National Park, is dedicated to the conservation and promotion of melliferous plants essential for pollinators. This study aims to characterize the beekeeping flora of the garden and highlight its importance for environmental awareness and education, as well as for raising awareness among tourists in the region.

Problem Description: The decline of bee populations and other pollinators is a global concern affecting biodiversity and food production. Habitat loss and the reduction of food resources are key factors in this problem, compounded by the lack of public awareness about the importance of these insects.

METHODOLOGY: An inventory of the plant species present in the garden was conducted, evaluating their contribution to the bees' life cycle. Methods included direct observation and sample analysis to identify and classify the plants. Additionally, most visitors increased their knowledge of honey flora and recognized the need to protect pollinators after their visit to the garden.

Results and CONCLUSION: The results reveal a rich diversity of melliferous species in the garden, each providing vital resources at different times of the year. Key species such as rosemary, thyme, and lavender are highlighted. This garden is not only a refuge for pollinators but also an educational tool for public and tourist awareness on the importance of conserving these spaces. Most visitors increased their knowledge of melliferous flora and recognized the need to protect pollinators after visiting the garden.

Practical Implications for Beekeepers: Beekeepers can benefit from implementing similar gardens, fostering biodiversity and ensuring continuous food resources for their hives. Creating such spaces can help mitigate the effects of climate change and habitat loss, promoting the sustainability of bee populations and apicultural production. Moreover, melliferous flora gardens can attract ecotourism, providing an additional source of income and raising visitor awareness about the importance of pollinators.

PP-314 [Beekeeping Technology and Quality]
Hive Optimization: Using Designed Frames to Maximize Population and Production

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This article explores the innovation provided by designed frames in beekeeping, enabling effective population control that allows the creation of hives composed exclusively of queen bees and worker bees, without the presence of drones. This approach has the potential to amplify honey production while reducing resource consumption within the hives. The frames are designed in specific sizes to meet the morphological needs of workers and queens, optimizing internal space and reproductive efficiency. By eliminating drones, the hives can direct all the energy of the worker bees toward nectar collection and honey production, resulting in a significant increase in productivity. This configuration not only maximizes honey production efficiency but also reduces resource consumption, such as food and space, that would otherwise be used for drone rearing. The modular structure of the frames allows for customization that meets the biological requirements of the bees, promoting a more efficient working environment.

Moreover, the use of designed frames facilitates hive management, enabling beekeepers to extract honey directly in the apiary without the need for transportation to honey houses. This reduces operational costs and the time spent on maintenance, promoting a more sustainable and profitable beekeeping practice.

The proposal for hives exclusive to queens and workers, combined with the use of designed frames, represents a revolution in modern beekeeping. This approach not only improves efficiency and profitability but also contributes to sustainable beekeeping practices, minimizing environmental impact and enhancing the quality of apicultural products. With the implementation of this technology, it is expected that small and medium-sized producers can increase their competitiveness in the market, meeting the growing demand for high-quality honey and responsible management practices. This innovative method offers a pathway to a more productive and sustainable future for the beekeeping industry, benefiting both producers and consumers alike.

PP-316 [Beekeeping Technology and Quality]
Nuclear Physics and Beekeeping: Innovations Transforming Rational Beekeeping Management

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This article establishes a correlation between the fundamental principles of nuclear reactor physics and beekeeping, exploring how the forces of nature and intrinsic characteristics of both systems can be compared. The maximization of resources and efficient development are common principles that permeate both nuclear engineering and apicultural management.

In nuclear reactor physics, the three charged particles—protons, neutrons, and electrons—can be compared to the three types of bees within a hive: queens, workers, and drones. Each type of bee plays a crucial role in maintaining the colony, just as each particle is essential for the functioning of a reactor. The use of protective clothing in both fields—beekeeping and nuclear engineering—reflects the need for safety against risks, whether from bee stings or radiation exposure.

Additionally, the consideration of radiopharmaceuticals and recent studies on bees detecting cancer illustrate the intersection between biology and nuclear technology. Bees, with their ability to detect chemical compounds, can serve as bioindicators, similar to how radiopharmaceuticals are used for diagnostics in medicine.

The shape of hives can be compared to nuclear reactors, where design and structure are fundamental to efficiency. Nuclear fuel cells, which store and release energy, can be related to the size of honeycomb cells, determining which type of bee will be produced. Hives with larger cells tend to result in a higher quantity of drones, reflecting a system that may lead to losses, akin to neutron wastage in thermal reactors.

Finally, the comparison between rapid and thermal hives reveals that, just as thermal efficiency is crucial in nuclear power plants, the structure and management of hives directly influence productivity and sustainability. This article concludes that the intersection of nuclear reactor physics and beekeeping offers valuable insights into maximizing resources and promoting sustainable development in both fields.

POLLINATION AND BEE FLORA

PP-536 [Pollination and Bee Flora]
Honey bee Pollination beyond of the products

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Pollination are the most important factors that increase biodiversity and contributes to one-third of global crop production, but comprehensive and detailed benefits are still unknown. Hence, pollination is underestimated by international policies, which is particularly alarming in times of agricultural intensification and diminishing pollination services. This project was carried out in a research orchard containing two almond varieties in Iran. 3 cages containing 6 almond trees were placed in the orchard before flowering to evaluate the effect of Apis mellifera meda and Bumbus terrestris pollination. In this study, length, width, thickness and weight of fruit, percentage of fruit formation, percentage of empty and shriveled almonds, percentage of fat and vitamin E content were investigated. In this study, the fauna of pollinating insects in the orchard was also identified and also, the effect of pollination by A. mellifera meda and B. terrestris on the nutritional balance of almond plants was investigated using the DOP method in 10 orchards. The results showed that the highest fruiting percentage was related to bumble bee with 89.44, which was significantly greater than other treatments. No significant difference was observed between honey bee treatments (56.12) and positive control (59.82). Negative control treatment (9.62) was significantly lower than other treatments. According to the results the highest average length, width and weight of fruit was related to honey bee treatment, which was not significantly different from positive control treatment, but was significantly greater than bumble and negative control treatments. The percentage of empty and wrinkled almonds in negative control was significantly lower than other treatments. The results showed that pollination significantly improved the DOP indices in almond plants. Based on the results, a deficiency of boron, phosphorus and zinc was observed in the negative control trees, but all elements were in balance in the other treatment trees. According to the results, pollination by maintaining the balance of plant nutrition, improves productivity rate, fruit yield and quality and also absorption and transfer of nutrients from the soil that is improve soil condition and it can be an approach to deal with climate change.

PP-540 [Pollination and Bee Flora]
Main Pollen Structures Associated with the Botanical Origin of Honey from Huila, Colombia

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Honey production is an activity that utilizes vegetation without any direct negative impact, generating economic income for beekeepers. Studies on honey are of great importance, especially those related to its botanical origin, as they allow us to understand its quality and identify the plants that bees visit during the foraging process. The Huila department, in the southeast of Colombia, is one of the departments with the highest honey production in the country, ranking fifth over the past four years. In this context, the aim of this study was to identify the pollen types present in honey samples from this department and contribute to the mellisopalynological study of the country. Nine samples of Apis mellifera L. honey from seven different localities were palynologically analyzed. The samples were treated using the standard acetolysis technique, and counts of at least 500 pollen grains were made to establish the frequencies of the pollen types. In total, 36 pollen types from 25 botanical families were identified. Sapindaceae, Leguminosae, and Anacardiaceae were the families with the highest representation of pollen types (17.05%, 9.98%, and 9.81%, respectively). The highest pollen diversity was found in the sample from the Alto Piravante 2 locality, with eleven pollen types. Additionally, some pollen types were present in most samples and were very frequent in others—Melicoccus bijugatus and Cecropia peltata—highlighting the importance of plants from these species for beekeeping in the department. Other pollen types, such as Astronium graveolens and Mimosa sp., were also found with high frequency in the samples. The pollen diversity characterizes the analyzed honey samples as multifloral and reaffirms the importance of certain botanical families—Sapindaceae and Leguminosae—in honey production.

PP-542 [Pollination and Bee Flora]
Identification of native bees through buzz recognition: An App for blueberry pollination in Chile

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The blueberry requires bees to vibrate its flowers for effective pollination, due to its specialized floral morphology with poricidal anthers. Both in Chile and in other countries, its management has been through Apis mellifera hives and Bombus terrestris colonies. However, although B. terrestris contributes to good yields in blueberries, its introduction has generated serious problems for native pollinators. A. mellifera, on the other hand, rarely uses blueberry flowers as a source of pollen due to its inability to vibrate. Our study showed the role of native bees that vibrate, in the pollination of blueberry, through the determination of pollination yield per visit (stigmatic pollen deposition), the frequency of visit and the presence of the vibration behavior of floral visitors, in five blueberry crops in south-central Chile. Some native vibrating bees identified were Cadeguala occidentalis, Bombus dalhbomii, Ruizantheda proxima, Callistochlora chloris, Colletes cyanescens, Centris cineraria, among others. Despite these excellent results, the role of native bees that vibrate is still unknown to fruit growers and blueberry exporters in Chile. In this sense, another of our objectives of the study was to create an Application for cell phones (APP), which thanks to the typing of the buzzing of a bee could help the identification of the species, as well as provide information on its biology and ecology. For this, 518 audio samples of 15 bee species recorded during visits to blueberry blossoms in Chile were used, generating a prototype to be used on Android and IOS, which is currently being tested and is expected to help make native bees visible and their importance in the pollination of agricultural crops in Chile.

PP-543 [Pollination and Bee Flora]
Pollination in a changing climate: Effects of heat and water stresses on three canola varieties

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Insect-mediated pollination is an important ecosystem service with valuable contributions to the fertilisation of crops. However, environmental threats such as heat waves and drought threaten this mutualistic interaction and thus global food security. There is a dearth of studies that explore the underlying mechanisms shaping plant-pollinator interactions and yield production in cropping systems. We examined the influence of climatic pressures (heat and water stress) on flower phenology, floral display and rewards (nectar volume, concentration and flower size), and how variations in these attracting cues drive pollinator visitation rates and seed yield in three canola varieties in Lethbridge, Alberta, Canada. We set up two temperature treatments, each in two greenhouse bays (n= 4 bays total), and two irrigation treatments within each bay. The temperature conditions were: Ambient, 26°C:11°C, mimicking the average temperatures for the past 10 years, and Hot: 31°C:13°C, representing projected mean max and min temperatures for the year 2055 in the study region. The irrigation treatments were Well-watered: 64% water holding capacity (WHC) and Reduced-watered 21% WHC, mimicking ambient and drought conditions. We found an overall advancement in flowering onset, with plants reaching peak flowering earlier in hot compared to ambient treatments, while warming and water stress jointly influenced end of flowering. Plants under ambient conditions were more attractive to pollinators as they produced broader flowers with larger volumes of less concentrated nectar when compared to plants in hot bays. In addition, plants in well-watered treatments produced significantly higher number of pods and seeds compared to plants in reduced-watered conditions, while total seed weight was significantly influenced by both warming and water stress. We found that the number of flowers produced had direct positive influences on seed yield across all treatments, meanwhile pollinator visitation rate had direct positive effects on seed yields in ambient bays. In contrast, pollinator abundance was more important for well-watered plants in hot bays. In conclusion, our study elucidates the importance of climate-mediated influences on plant phenology and flowering rewards which may limit plant-pollinator interactions and consequently the ecosystem services they provide with resulting devastating effects on global food security.

PP-544 [Pollination and Bee Flora]
Melliferous plants visited by Apis dorsata during different climatic seasons in the Vidharba region of Maharashtra State in India

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Melliferous plants foraged by Apis dorsata bee-species have been physically identified in an exclusive survey undertaken during the summer, winter, and rainy seasons of 2019-24. The scope of study was kept limited to the A. dorsata rich pockets occurring in the forests and plains of Vidharba region of Maharashtra State in India. This species is noticed to be the versatile and voracious forager of wide variety of blooming vegetations that ranges from wild to the cultivated crops. Availability of nectar-pollen yielding flowers (quantity, quality and flowering spans) in different seasons have been noticed to be one of the key influencing factors for A. dorsata for deciding their migratory routs from mountains to the plains and vice versa in order to perform the breeding cycle. Actual photographs of foragers foraging on each plant's flower have been captured during the field visits. The A. dorsata) foragers have been observed to forage upon around 77 species of plants, that belonging to about 34 families. Amongst them, around 35% are the domestic plants (food- and fruit crops) while 65 plants are wild in origin. The identified plant species which are classified into families namely Asteraceae, Bombacaceae, Ceesalpiniaceae, Crassulaceae, Fabaceae, Lamiaceae, Malvaceae, Meliaceae, Mimosaceae, Myrtaceae, Poaceae and Verbenaceae are proven as the prime resource of nectar and pollen for A. dorsata. The floral spectrum for winter, summer and rainy seasons suggests that (A. dorsata) bees has the tremendous role in brining about qualitative and quantitative enhancement in the productivity, bio-diversity and richness in the varied vegetations of the region.
The data obtained is essentially important to the local traditional honey hunters, farmers, and forest officials to adopt scientific techniques of A. dorsatamanagement to conserve them for maintaining overall prosperity in the nature. In addition, the forest officials can also initiate the projects to cultivate identified wild plants under their social forestry programmes to increase the green cover with bee-loving plants. The floral calendar of various plants visited by A. dorsata has been prepared as per the seasons.

PP-545 [Pollination and Bee Flora]
Climate change may disrupt crop pollination in the Neotropics: rising temperatures lead carpenter bees to avoid pollinating passion fruit flowers

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Background/purpose - Global warming has been identified as a potential factor in compromising crop pollination due to thermal stress on pollinators. Problem description - Limited evidence has been produced for tropical regions, and there is a lack of information on whether bees can effectively pollinate wild and cultivated plants under even higher temperatures. Methodology - This study used thermal imaging and bagging/unbagging experiments to investigate how rising temperatures affect the foraging activities of the carpenter bee Xylocopa frontalis and fruit set in two cultivated species of passion fruit (Passiflora edulis and P. cincinnata), which have distinct pollination requirements. The study also determined the bee's critical and lethal temperatures through controlled temperature increments in laboratory experiments. Results and conclusion - The results revealed that the bees avoided foraging on passion fruit flowers as both ambient temperatures and their own body temperatures increased throughout the day. This led to a significant ($p < 0.05$) reduction in the number and duration of flower visits during the hottest hours of the day, as well as a decline in foraging activity from the rainy season (milder temperatures) to the dry season (higher temperatures). Consequently, a deficit in natural pollination was observed, resulting in fruit set, fruit weight, pulp weight, and seed number falling below the yield potential during the hottest period of the year. The study determined the critical (42.2 ± 1.31°C) and lethal (47.3 ± 1.79°C) temperatures for X. frontalis. These findings demonstrate that rising average temperatures during foraging under the sun, particularly during periods of the day or year when temperatures approach or exceed the critical threshold for X. frontalis, significantly affect the bee's foraging behavior on passion fruit flowers. This reduces its efficiency as a pollinator, particularly for P. edulis, whose flowers open at midday and have only a few hours in the afternoon to be pollinated. Practical implications for beekeepers – The pollination services provided by X. frontalis to P. edulis and P. cincinnata are already compromised during periods of higher temperatures. Beekeepers should be aware that potential increases in average ambient temperatures could compromise pollination services in the Neotropics.

PP-546 [Pollination and Bee Flora]
APIcité, a national label for pollinator-friendly cities

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Protecting bees and wild pollinators represents a major challenge for humanity and our fellow citizens are becoming increasingly aware of this issue. This awareness is the result of decades of relentless advocacy by bee defenders. Nowadays, many local authorities are getting involved in this process through concrete actions such as: requiring respect for biodiversity in public tenders, installing educational apiaries, or taking measures against pesticides. These actions reflect a strong social concern to environmental protection. Increasingly, for inhabitants a good living environment go hand in hand with a preserved nature. Honeybees taken as a communication medium are an outstanding symbol for local authorities in order to raise awareness among the population concerning biodiversity's threats. UNAF believes that it is important to highlight local authorities' actions which benefit honeybees, that's why the APIcité label was launched in 2016. APIcité' s aim is to promote to a national scale these local initiatives in order to be generalised and at long term, intend to influence national politics. In addition to being an official reward, the label is a real incentive to implement practices favouring honeybees and wild pollinators. Once a year, an award committee made up of UNAF members and representatives of partner environmental organisations examine candidatures. If a local authority deserves to be awarded, APIcité grants the candidature with 1,2 or 3 “Bees”. Candidatures are studied depending on items: Sustainable development; Biodiversity; park/green space maintenance; Beekeeping; Environmental awareness. Candidatures may come from all over France, from largest cities to small villages. When the award committee deliberates, some advisements are given to local authorities in order to improve their environmental politics. During the rest of the year APIcité' s team continues advising and helping awarded towns and villages. UNAF has already observed positive results on local policies thanks to APIcité. It represents an original way to bring together different interests and a combined action approach to defend honeybees and wild pollinators and Environnement.

PP-547 [Pollination and Bee Flora]
Floral visitors of endemic Centaurea lycaonica (Asteraceae) from Turkiye

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Most species of the genus Centaurea are pollinated by insects, especially bees, which are the main pollinators and nectar carriers of plants. Centaurea lycaonica is an endemic plants used in folk medicine that distributes in the rocky formation found between Konya-Seydişehir and on another rocky formation found between Konya-Beyşehir within the Phalolepis (Cass.) DC. section. The present study aimed to observe and determine the pollinators of C. lycaonica. The flowers of species is complicated because of both sterile and fertile flowers united in the same receptacle. The flowers have nectaries that attract the visitors. During the observations Apis mellifera bees are the most effective floral visitors for C. lycaonica are determined. The opening and closing hours of flowers in C. lycaonica were noted. This study provide the structure and functions of sexual units order pattern of pollen dispersal and admission of C. lycaonica which is rare and endemic plant species.

PP-548 [Pollination and Bee Flora]
Nectar resources in Japan Enhancing honeybee visitation

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Honeybees visit various flowers throughout the year, collecting nectar and pollen as essential resources. Understanding which flowers bloom when, where, and how much nectar they produce is valuable information for beekeepers harvesting honey. Additionally, farmers growing pollination-dependent crops should consider the availability of surrounding floral resources, as these can influence crop pollination. In this study, we comprehensively analyzed and compared the nectar volume, pollen quantity, fragrance components, and flower color of various wildflowers, crop flowers, and tree flowers. We also estimated nectar availability per unit area or per tree by combining data on nectar production per flower with flower density. Among these plants, we focused on Japanese apricot and Brassica plants blossoms, which serve as key nectar sources in early spring. The Japanese apricot, a winter-flowering fruit crop, requires mid-winter pollination. However, severe weather conditions, including low temperatures, restrict pollinator activity. We explored the use of Brassica plants, which bloom fully during the Japanese apricot blossom period, as additional flower resources to promote honeybee visitation.

PP-549 [Pollination and Bee Flora]
The Role of Invasive Plant Species – Benefits and Risks for Beekeeping and Biodiversity

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Invasive plant species are increasingly altering ecosystems, leading to biodiversity loss, disruption of native plant communities, competition for light, water, nutrients, and habitat, as well as hybridization with native species. Additionally, specific biochemicals released by invasive plants can negatively impact native species, threatening not only ecological balance but also agricultural productivity, forestry, and beekeeping. One of the most notable examples is black locust (Robinia pseudoacacia), a species that presents both benefits and challenges. While it provides valuable nectar for pollinators, it also poses a serious risk to ecosystems and beekeepers by aggressively spreading and outcompeting native vegetation. Understanding the characteristics of invasive plants is essential for both conservation efforts and agricultural strategies. Beekeepers and farmers must weigh the short-term benefits of nectar availability against the long-term ecological risks associated with the spread of invasive species. Effective management requires a balanced approach that supports pollinators while preserving biodiversity, ensuring that control measures do not inadvertently contribute to further invasion. Due to their high fertility, productivity, and rapid reproduction, invasive plant species can quickly establish monocultural stands, further exacerbating ecological imbalances. For beekeepers, these changes can result in significant losses, including reduced availability of diverse and high-quality forage, leading to lower honey yields and compromised nutritional value. The dominance of certain invasive plants may also disrupt traditional flowering cycles, causing nectar shortages at critical times. Furthermore, some invasive species produce nectar with altered chemical compositions, potentially affecting honey quality or even posing toxicity risks to bees. Over time, these factors can weaken bee colonies, reduce pollination efficiency, and negatively impact honey production and beekeeping sustainability. To address these challenges, this research focuses on developing sustainable strategies for invasive plant management that integrate their potential within the bioeconomy. By exploring their use in bioenergy production and functional applications, such as biomaterials and bioactive compounds, the goal is to control these species while minimizing losses for beekeepers. This approach ensures that invasive plants are managed effectively without disrupting pollinator forage availability, ultimately transforming them from a threat into an economic opportunity that supports biodiversity, beekeeping sustainability, and agricultural resilience.

PP-550 [Pollination and Bee Flora]
Prediction of the Flowering of Chilean Native Species and Honey Yield Using Machine Learning – An Approach to Climate Change Adaptation

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Honey production per hive in countries such as Chile has been irregular and has decreased to values below 20 kg per hive, mainly attributable to climate change. These conditions are largely associated with changes in the regularity and timing of temperatures, precipitation, and the phenological stages of native species. Therefore, this study develops predictive models for the flowering of Chilean native species of apicultural interest (Avellano, Corontillo, Litre, Peumo, Quillay, Tevo, and Tralhuen) and estimates hive honey yield weeks or even months before the main flowering events. To achieve this, climatic data such as temperature, precipitation, and humidity from the nearest station are used to predict flowering stages of native Chilean trees and honey yield per hive. This research employs machine learning algorithms including Random Forest, SVM, Logistic Regression, together with Bagging techniques and Neural Networks. Current flowering models have shown an error of about one week, with predictions made roughly one month in advance. This has been corroborated with phenological state models for the Quillaja Saponaria species (Quillay), predicting the timing of flowering transitions from the floral bud stage to the onset of flowering, peak flowering, and final flowering. Following the same approach, the method has been used to predict hive honey yield, with prediction errors of less than 10 kg and accuracy exceeding 80%. These findings demonstrate the feasibility of using climatic variables to forecast the flowering of Chilean native trees, as well as to predict apicultural yield. This technology is essential for developing information systems that help reduce uncertainty in beekeeping operations. The above information is now being used to build an expert system that beekeepers can utilize to optimize production decisions, such as controlling hive development and diseases during specific periods.

PP-551 [Pollination and Bee Flora]
BOTANICAL ORIGIN OF HONEYS COLLECTED IN ANDEAN ZONE OF MACIZO COLOMBIANO

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In the beekeeping process, the recognition of the floral offer in a zone or biogeographic area allows identifying not only the botanical origin of products such as honey, pollen and propolis. For this reason, in the present work, the identification of the floral offer and the biogeographic origin of honeys in two ecosystems associated with the Macizo Colombiano. Tha refers to a group of mountains in central-southern Andes, in Cauca, Huila and Nariño departments, (Altitud between 2600 and 4700 ovsl and 3268237 ha). The inventory of the flora of the study area was carried out in the municipalities of Almaguer (2136 ovsl, 16 ºC, and 4063 mm/year), and La Vega (2312 ovsl, 17.3 ºC, and 4064 mm/year). Simultaneously, a melisopalynological study of 36 honey samples was carried out to identify the dominant pollen structures. Simultaneously, a melisopalynological study of 36 honey samples was carried out to identify the dominant pollen structures. The analysis of the plant cover of the study areas revealed the prevalence of nectar and pollen producing species, the concentration of sugars in the nectar of the plants, was classified predominantly as medium range. The results of the melisopalinology, show a total of 103 taxa that were identified and distributed in 83 genera and 30 botanical families, being Asteraceae, Fabaceae, Rubiaceae and Malvaceae like the most representative. Multifloral honeys were identified as more abundant than monofloral honeys. The study of the botanical origin of the honeys allows us verify the authenticity of samples and contributes to the process of traceability and denomination of origin.

PP-552 [Pollination and Bee Flora]
Unmanaged wild bees and managed honey bees do not share pollen resources: investigation on interspecific trophic competition in three Italian National Parks

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Clade Anthophila, which is fundamental for the maintenance of healthy ecosystems and for the contribution in providing economic benefits to human society, is in severe decline worldwide since several years. In this context, expanding the knowledge of interspecific dynamics occurring among bee species for a conservation action plan in protected areas aimed to counteract Apoidea decline is of fundamental importance. A modest body of literature reports that honey bee density and some beekeeping activities could negatively impact wild bee populations, mostly through competition for trophic resource. In this study the interspecific trophic competition was investigated trough the still little exploited approach of the palynological analysis combined with metabarcoding analysis of pollen gathered by both managed honey bees and unmanaged wild bees in three Italian national parks. Out of a total of 20 captured and identified wild bee species (for a total of 31 individuals), 13 are not reported in any checklist of the entomofauna of the national parks investigated in this study. Despite the small sample size, the entire trophic network was highly specialised (H2'=0.933) and results obtained in this investigation suggest that locally wild bee species are sustained by different pollen resources from those of honey bees. A weak sharing of resources only between honey bees and Bombus pascuorum and Bombus terrestris was found. In natural populations species tend to minimize competitive overlap by a niche differentiation or by a niche complementarity, as a result of a co-evolution between wild bees and managed honey bees. An alternative hypothesis supporting the presence of trophic repartitioning is that the pollen breakdown could be the consequence of a local ongoing interspecific trophic competition, which leads species to differentiate their diets. National parks play fundamental role in the protection of animal and plant species, and conservation plans should focus on evaluating honeybee densities towards less intensive, a more traditional and sustainable beekeeping and on habitats protection to promote survival and reproduction of wild bee populations.

PP-553 [Pollination and Bee Flora]
Melittopalynological investigation of honey from sunderban ecosystem,India: way towards sustainable development

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Sunderbans is thickly populated by the wild honeybee species, Apis dorsata, due to the floral sources and good protection provided by thorny mangroves present in the swamps. In the present study, nectar sources to honeybees were studied based on microscopical analysis of honey samples collected in mangrove forest of Sunderbans, West Bengal, India. In all 12 honey samples were collected, 9 from Apis mellifera colonies and 3 from A. dorsata colonies. Qualitative and quantitative Melittopalynological analysis of the honey samples collected from A. mellifera showed that six samples were unifloral and three samples were multifloral. Ceriops decandra is predominant pollen type in 5 samples and Aegiceras corniculatum in one sample. The secondary pollen types were of Bruguiera gymnorrhiza, Sonneratia apetala and Bunium persicum. A total of 37 plant species served as sources of bee forage to A. mellifera. C. decandrawas predominant pollen type in two samples and as secondary pollen type in one sample of A. dorsata. Kandelia candel pollen is associated as secondary source in all the three samples of A. dorsata It is not found in A. mellifera samples.

PP-555 [Pollination and Bee Flora]
Managed and wild bees: enemies or allies?

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Many pollinators are currently declining, calling for appropriate mitigation policies to ensure ecosystem functioning, food security and human well-being. While there is consensus that some factors, such as pesticides and land management, play an important role in these declines, other potential stressors remain more controversial. In recent years, competition for resources with and pathogen transmission from managed bees have been increasingly considered as contributing to wild bee declines, generating conflicts among beekeepers, farmers, conservationists and scientists. We argue that scientific knowledge of the interactions between managed and wild bees is insufficient to resolve the conflicts through contextualized, evidence-based policies. Existing studies are correlational and limited in space and time. This prevents a high level of confidence in the potential effects of managed bees on wild bees and hinders the creation of contextualized mitigation measures. In addition, effects on wild bee population sizes and genetic diversity, which are key to assessing long-term impacts, were never estimated. Potential negative interactions between managed and wild bees also need to be weighed against other stressors known to affect bees, such as land management, pesticide use, and climate change. To prioritize mitigation efforts, we advocate increased communication and collaboration between stakeholders to co-create policies integrating ecological and socioeconomic dimensions. To work towards this aim, we propose combining modern molecular and modelization tools to better understand the interactions in different contexts with stakeholder engagement to reconcile managed and wild bee proponents for the benefit of all bees. The availability of more contextualized and consensual bee conservation measures will allow a productive and sustainable beekeeping activity aligned with the conservation of biodiversity.

PP-556 [Pollination and Bee Flora]
Assessing the impact of beekeeping on wild pollinators within the BeeGuards project

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Concerns have grown over the potential negative impacts of beekeeping on wild pollinators. While large numbers of honey bee colonies can create local-scale effects, current evidence doesn't indicate they are a major factor in wild pollinator decline. The actual occurrence and extent of competition for floral resources and pathogen spillover across different environments and honey bee colony densities remain unclear. Furthermore, the absence of standardised methodologies and long-term studies limits understanding of the broader ecological effects of beekeeping on wild pollinators. Addressing these gaps is especially critical in the light of recent measures implemented in several countries, where the introduction of honey bee colonies into certain protected areas has been prohibited to safeguard wild pollinator communities. BeeGuards (www.beeguards.eu), structured into 10 work packages (WPs), aims to equip the beekeeping sector with sustainable management practices and innovative strategies to adapt to climate changes while minimizing unintended consequences on the environment. WP8, "Analysis of Plant-Pollinator-Pathogen Networks to Assess the Impact of Beekeeping on Wild Pollinators", investigates the potential impacts of beekeeping activities on wild pollinator populations. It is dedicated to analysing the complex interactions within plant-pollinator-pathogen networks to assess how the presence of honey bees colonies might affect wild pollinators. WP8 is conducting a field study in multiple European countries and Argentina, comparing pollinator communities in areas with high and low honey bee colony densities. Pollinator biodiversity, abundance, and plant-pollinator interactions are monitored, and pathogen transmission between honey bees and wild pollinators is assessed. Historical data are analysed to evaluate the influence of honey bee colony presence on wild pollinator populations over time. Laboratory experiments examine the effects of pathogen infections on both honey bees and wild bees, measuring survival, behaviour, and overall health. A specific case study evaluates the impact of high honey bee colony density on bumblebee colony fitness. Finally, a citizen science initiative is implemented to engage beekeepers and the public in pollinator monitoring, to expand data collection efforts. WP8 will guide the development of sustainable practices to protect biodiversity, delivering scientific insights and practical solutions that foster coexistence between managed bees and wild pollinators.

PP-558 [Pollination and Bee Flora]
Effects on the Quality of Africanized Honeybee ("Apis mellifera") Colonies from Agricultural Pollination Services

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Pollination services are critical for both agricultural productivity and environmental sustainability. Approximately 73% of cultivated plant species worldwide depend on bee pollination to some extent. However, in Brazil, the commercial use of managed honeybee colonies for crop pollination remains underdeveloped, despite its estimated annual economic value of USD 12 billion. The limited adoption is mainly due to the lack of beekeeper training and the absence of a structured migratory beekeeping system. This study evaluates the quality of Africanized honeybee colonies (Apis mellifera) used in soybean (Glicine Max) pollination and assesses whether this practice strengthens colonies, potentially reducing the need for artificial supplementation. Thirty-three Langstroth hives with standardized brood and food frames were transported from a permanent apiary in Ribeirão Preto city, São Paulo, Brazil, to a soybean field in Anhumas city, São Paulo, where they remained for 12 days during the R2/R3 flowering stage. The hives were divided between two apiaries with different environmental conditions: one with partial shade and a nearby water source, and another exposed to full sun. Colony evaluations were conducted before and after the pollination period, analyzing brood frame numbers, stored food, and defensive behavior. Paired t-tests compared pre- and post-pollination colony conditions. All colonies showed significant brood frame growth post-pollination (open brood: $t = 6.3$, $p < 0.0001$; sealed brood: $t = 5.5$, $p < 0.001$). Colonies placed in shaded conditions exhibited greater sealed brood production (4.0 ± 0.0 frames) compared to those in full sun (3.35 ± 0.49 frames, $p < 0.01$), reinforcing the importance of shade and water availability. These results align with prior studies indicating that exposure to extreme temperatures negatively affects bee colony development. Soybean pollination strengthened Africanized honeybee colonies, potentially reducing the need for supplementary feeding during dearth periods. Providing shaded environments further enhanced colony performance. These findings highlight the benefits of integrating beekeeping with precision pollination strategies, emphasizing the need for structured migratory beekeeping in Brazil.

PP-559 [Pollination and Bee Flora]
Use of Jataí Bee Colonies ("Tetragonisca angustula") for Commercial Pollination of Strawberries ("Fragaria x ananassa") in Protected Cultivation

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Pollination is a key factor in improving the yield and quality of many crops, including strawberries (""Fragaria x ananassa""). Stingless bees, such as ""Tetragonisca angustula"" (Jataí), have been identified as potential commercial pollinators for protected cultivation systems. This study evaluates the impact of Jataí bee colonies on fruit weight, deformation rate, and sweetness in greenhouse-grown strawberries. The experiment was conducted in two identical greenhouses (1,638 m² each), containing 15,000 hydroponically grown 'San Andreas' strawberry plants under drip irrigation and biological pest control. Twelve ""T. angustula"" colonies were introduced in Greenhouse 1 during the flowering period, while Greenhouse 2 served as a control (without bees). The colonies remained in the greenhouse for three months, corresponding to the peak flowering period. A total of 166 fruits were collected from Greenhouse 1 and 133 from Greenhouse 2. Fruit weight, deformation rate, and sweetness level (°Brix) were compared between treatments. Strawberries from the pollinated greenhouse (Greenhouse 1) had a significantly higher average weight (15.1 ± 5.4 g) compared to those from the control greenhouse (13.4 ± 5.0 g; $t = 2.87$, $df = 297$, $p < 0.01$). The °Brix level was also significantly higher in Greenhouse 1 (8.7 ± 1.6°Brix) than in Greenhouse 2 (7.3 ± 1.0°Brix; $t = 4.07$, $df = 51.9$, $p < 0.001$). Fruit deformation was substantially reduced by 76.6% in the pollinated treatment, with only 4.2% of fruits showing deformities in Greenhouse 1, compared to 18.1% in Greenhouse 2 ($\chi^2 = 9.32$, $df = 1$, $p < 0.01$). These findings suggest that Jataí bees contribute to improved fruit quality and yield.The introduction of ""T. angustula"" colonies significantly increased strawberry fruit weight and sweetness while reducing deformities. This study demonstrates the effectiveness of ""T. angustula"" as a commercial pollinator in protected strawberry cultivation, emphasizing the potential for targeted bee deployment during flowering to enhance fruit production.

PP-560 [Pollination and Bee Flora]
Precision pollination: the use of artificial intelligence for optimizing applied pollination in coffee crops

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Pollination is a key ecosystem service for agricultural productivity, particularly in self-pollinating yet pollinator-responsive crops such as Arabica coffee (Coffea arabica). Despite evidence of yield gains exceeding 15% when managed pollination is applied, the scalability and monitoring of this practice remain challenges in large-scale coffee production. To address these challenges, this study evaluates two artificial intelligence (AI) applications that optimize Applied Pollination (AP) in coffee plantations: (i) an AI-driven system for automated hive inspections and (ii) a machine learning model for coffee yield estimation based on fruit counts at different ripening stages. The automated hive inspection AI, developed using deep neural networks (DNN/CNN), analyzes hive images to assess colony strength, brood health, and food reserves. This system enhances decision-making in hive management, ensuring that pollination units remain in optimal conditions. The AI-based coffee yield estimation model, trained with more than 3,500 field images, applies a YOLOv8 architecture to detect and classify coffee fruits at different maturation stages - green, ripe and overripe. Using a regression-based approach, the model estimates fruit density and subsequently the productivity of the area under analysis. The model achieved a mAP50 of 0.945 in the fruit counting, demonstrating high accuracy in predicting potential yields. These AI-driven technologies can significantly enhance pollination efficiency, providing farmers with actionable insights to optimize harvest timing, resource allocation, and pollination strategies. The integration of AI and AP represents a breakthrough in precision coffee farming, reinforcing sustainability and economic returns for the industry.

PP-561 [Pollination and Bee Flora]
Physiological stress and reproductive success of buff-tailed bumblebees (Bombus terrestris) in agricultural landscapes

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Pollination is a vital ecosystem service, yet agricultural intensification continues to pose significant challenges for insect pollinators. Our study investigated the effects of habitat quality on the physiological stress and reproductive success of the buff-tailed bumblebee (Bombus terrestris), focusing on variations in body elemental composition as indicator of stress. We placed commercially produced bumblebee hives in two contrasting agricultural landscapes - oilseed rape (Brassica napus) fields and apple tree (Malus domestica) orchards, throughout the flowering season. Our results revealed that reproductive output was significantly higher in oilseed rape fields compared to apple orchards, which was accompanied by an elevated carbon-to-nitrogen (C/N) ratio, a recognized stress marker. Bumblebees inhabiting apple orchards exhibited higher nitrogen concentrations, indicating lower physiological stress. These findings suggest that while more productive habitats enable increased reproductive investment, they do so at the cost of heightened stress levels. Our study underscores the importance of ecological stoichiometry in understanding the trade-offs between habitat productivity, pollinator fitness and stress, offering new perspectives for pollinator conservation in agricultural landscapes.

PP-563 [Pollination and Bee Flora]
Assessing the Impact of RF-EMF Exposure on Wild Bees Under Commercial 5G RF-EMF

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Electromagnetic radiation such as the one from telecommunication technology is a type of environmental exposure representing a possible stress factor for bees and other flying insects. The current study aims at investigating the effects of radio-frequency electromagnetic fields (RF-EMFs) on wild bees in Greece and Cyprus. In Cyprus, a field study is taking place using artificial wild bee nests shielded or unshielded from RF-EMF radiation. The nests consist of an outer PVC pipe (19 cm diameter and 38 cm length) and an inner pipe (12 cm diameter and 18 cm length) filled with dry reed stems, 17 cm long, 5-10 mm in diameter. RF-EMF shielding of the nests is achieved via covering the inner pipe with a fine metal (shielded) or a plastic mesh (unshielded control). Two trap nests, one RF-EMF-shielded and one RF-EMF-unshielded were placed on each of the 25 studied sites near commercial 3.4 GHz 5G-NR antennas at different locations on the island, in urban areas. Trap nests were placed out in the field in spring 2024 and monitored systematically for bee occupation. In addition, observations of honey bees and wild bees along a variable transect were carried out at each location once per month, during the main flowering period, while simultaneously the RF-EMF exposure pattern of each location was characterized using a specialized instrument for measuring environmental RF-EMF (ExpoM-RF4). We observed very low visitation rates of wild bees in both types of trap nests, as only a few reeds were occupied by bees. However, we noted exceptions in locations surrounded by parks, open spaces, and native plants, where we observed a significantly higher number of bees. The abundance and diversity of bees, both in nests and along transects at each location, will be analyzed in relation to the measured RF-EMF characteristics of each site to evaluate potential effects on wild bees. The study is part of the ETAIN project, funded by the European Union's Horizon Europe research and innovation funding program under grant agreement No 101057216.

PP-564 [Pollination and Bee Flora]
Urban and peri-urban challenges and opportunities for pollinator conservation in Sofia City, Bulgaria: Preliminary study

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Urbanization is reshaping ecosystems worldwide, threatening biodiversity but creating conservation opportunities through sustainable planning. Pollinators, which are crucial to ecosystem health and food security, face habitat loss. However, the potential for urban landscapes to serve as refuges for pollinators remains insufficiently explored. It is unclear whether urban environments can effectively support pollinator communities or how connectivity between urban and peri-urban areas might influence pollination. This study focuses on Sofia - a Balkan city with thousands of years of history, today the Capital of Bulgaria. The results are a part of urban flora-pollinators relationships study. Based on field work conducted in May 2024 at 11 sites (64m² plots, 30-minute observations) classified as Central Urban (inner city - densely built areas featuring significant green spaces like parks and public gardens), Residential (outer city - Lyulin District: high-rise buildings interspersed with green spaces), and Peri-urban (Dobroslavtsi Village: agricultural edges), we found that peri-urban areas supported approximately 60% more pollinators and nearly twice the species richness of central urban areas. A peri-urban site located at a hedgerow played a critical role in shaping these results, as it exhibited the highest pollinator diversity and abundance, highlighting its ecological importance. Statistical analyses confirmed these patterns, with ANOVA indicating a significant effect of area on abundance ($p = 0.043$), while GLMs showed significantly higher abundance in Peri-urban sites ($p = 0.0409$). Kruskal–Wallis tests supported significant differences in species richness ($p = 0.023$), reinforcing the role of site quality in shaping pollinator communities. While some abundance differences approached statistical significance, additional replication will be conducted this year to confirm these trends due to sample size limitations. These findings underscore the importance of outer city areas as stepping stones for maintaining pollinator populations across the urban-peripheral gradient. Strengthening ecological connectivity through green infrastructure - parks, gardens, semi-natural edges, and green linear corridors - could enhance pollination services and biodiversity. Effective landscape planning could improve habitat connectivity while balancing wild bees and Apis Mellifera L. populations to prevent competition for floral resources, ensuring diverse pollinator communities. This will benefit farmers, beekeepers, and urban agriculture, fostering synergies between conservation and livelihoods.

PP-566 [Pollination and Bee Flora]
Mapping and Monitoring Tree Species in Dense Forest Ecosystems for Apiculture in Greece Using AI and Satellite Imagery

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Apiculture plays a vital role in rural development and environmental sustainability by providing unique products while also enhancing biodiversity and crop production through pollination services. A large portion of Greek honey (over 65-70%) is derived from honeydew, primarily sourced from pine, fir, and oak forests. Identifying and mapping honeybee flora is essential for optimizing the deployment of honeybee colonies, improving honey production, and monitoring honeybee habitats. Bee habitats are vital indicators of environmental health and the impacts of climate change. The quality, availability, and diversity of these habitats reflect the state of ecosystems, as bees rely on specific flora and stable environmental conditions for survival. Changes in bee habitats, such as habitat loss, shifts in flowering patterns, or reduced biodiversity, often signal broader ecological imbalances caused by climate change, pollution, or human activity. Thus, accurate and temporal monitoring of these habitats can provide valuable insights into the resilience of ecosystems and the effects of environmental and climatic shifts.In this context, this study focuses on the region of Evia, Greece, and introduces a novel methodology for mapping major honeybee flora and tracking changes over time using Sentinel-2 satellite imagery and artificial intelligence (AI) models. Supporting this, a multi-year labeled dataset containing multiple hierarchical tree species is introduced to facilitate model training and evaluation. A Vision Transformer (ViT) architecture and a Transformer-based approach for time-series and spatial analysis are employed to classify honeybee flora, as well as to detect and quantify temporal changes. Experimental results for the Evia region demonstrate the effectiveness of the proposed methodology, achieving an overall classification accuracy exceeding 90%. A deeper understanding of the availability and density of honeybee flora is achieved through the spatial distribution maps generated by the above-mentioned approach, paving the way for beekeepers to identify optimal locations for colony deployment. The current study highlights the potential of combining Sentinel imagery with AI-driven classification frameworks to support sustainable apiculture practices, enhance honey production in Greece, and monitor honeybee habitats. The methodology can be further adapted for other regions, contributing to the broader goal of environmental sustainability and rural development.

PP-568 [Pollination and Bee Flora]
Composition and circadian dynamics of nectar sugar production in white and purple flowers soybean cultivars

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Plant–pollinator interactions have traditionally been assumed as a binary system, in which both partners should obtain a continuing benefit, as food resources on the pollinators´ side and reproduction on the plants' side. Nectar is the primary reward for pollinators visiting plants, and calories from nectar allow bee growth and development. Nectar pathway has a complex physiology and polygenic control, as well as strong environmental variability. The chemical composition of soybean flower nectar plays a critical role in mediating plant-pollinator interactions, by directly influencing pollinator visitation and plant reproductive success. Basically, nectar is a single sugars-watery solution that can easily be ingested, digested and absorbed, and thus it is a very cost-effective alimentary resource for a variety of animals. In long-living flowers, nectar is a refilled resource, secreted daily in the same flower, after being removed by pollinators (replenishment). This study investigates the hypothesis that nectar chemistry affects pollinator behavior by analyzing the sugar and amino acid profiles of soybean nectar under different conditions. The results revealed that soybean nectar is predominantly composed by sucrose, α-glucose, β-glucose, and fructose, alongside amino acids such as tyrosine and phenylalanine, which play complementary biochemical and ecological functions. Multivariate analyses, including Principal Component Analysis (PCA), highlighted variations in sugar composition between soybean cultivars and pollination scenarios, with higher sugar accumulation in the absence of bees. In contrast, sugar depletion in the presence of bees reflects the result of bee foraging activity. No significant differences in sugar composition were observed between white and purple flowers, indicating that floral color may not independently influence nectar composition, thus bee attraction and fidelity. These findings indicate the adaptive significance of nectar chemistry in shaping plant-pollinator dynamics and its implications for optimizing pollination efficiency in agricultural systems.

PP-569 [Pollination and Bee Flora]
Diversity and Coverage of Melliferous Plants in Northwest Bulgaria Across EUNIS Habitat Types

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Melliferous plants play a vital role in supporting pollinator populations by providing essential floral resources and contributing to both ecosystem stability and beekeeping productivity. Habitat fragmentation and degradation due to anthropogenic pressures threaten these floral resources. The lack of systematic, habitat-specific data complicates conservation strategies for pollinators, such as Apis mellifera L. In Northwestern Bulgaria, four representative regions (78 km² each), totaling an area of 312 km². Fieldwork was conducted in 2023 to gather data on melliferous plants in grassland, forest, shrub, and anthropogenic habitats. The Braun-Blanquet methodological approach was used for data collection. During the fieldwork, a total of 348 phytosociological descriptions were completed across the four areas, identifying 25 habitat types at EUNIS classification level 3. The results indicate that Semi-dry perennial calcareous grassland (R1A) and Southern European Mountain Betula and Populus tremula forest on mineral soils (T1D) support the highest diversity of melliferous plants. Temperate and sub-Mediterranean thorn scrub (S35) and Alnus glutinosa-Alnus incana forest on riparian and mineral soils (T12) provide the greatest vegetation cover. Shrub habitats function as ecological corridors, enhancing spatial connectivity and resource availability. In contrast, anthropogenic habitats vary in their floral availability, linked to management practices. Habitats dominated by invasive species and the transition of natural areas into continuous agricultural lands have been identified as significant threats to the long-term viability of melliferous vegetation. Analyses revealed significant variation in the richness of melliferous species across habitats. Visualization (in GIS environment) highlighting fragmented, high-value habitats as priority areas for conservation. Habitats such as R1A and S35 are particularly important for stabilizing seasonal floral resources, which directly impact pollinators and honey yields. Given these findings, there is an opportunity to target the protection of an abundance of floral resources by providing land managers with strategies to assist pollinators. Integrating habitat connectivity into land-use planning has the potential to further enhance ecosystem resilience and support pollinator populations.

PP-572 [Pollination and Bee Flora]
Floral resources for honey bees in the UAE and how they can be enhanced

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Beekeeping in the United Arab Emirates (UAE) presents unique challenges due to the harsh arid climate, characterized by extremely high temperatures, low annual rainfall, and vast desert landscapes, and free-standing water is scarce. The availability of bee forage is a significant constraint, as natural vegetation is sparse and highly dependent on irrigation. Beekeepers in the UAE primarily operate in two environments: mountainous regions, which offer slightly better forage conditions, and desert areas, where sustaining bee colonies is particularly difficult. Honey production in the UAE is concentrated during the winter-summer and summer-winter transition periods, when flowering plants provide sufficient nectar and pollen. However, outside these periods, beekeepers struggle to maintain colonies due to limited forage availability. Although nearly 200 flowering plant species in the UAE have potential as honey bee forage, most beekeepers rely heavily on Samar (Acacia tortilis) and Sidr (Ziziphus spina-christi), overlooking other valuable native and cultivated plant species. The natural vegetation of the UAE is adapted to local climatic, soil and biotic conditions. As such, it is dominated by arid zone species. Except for mangroves, most of this vegetation grows in wadis and only flowers after rain, which is infrequent and unpredictable. Nonetheless, native vegetation still provides a valuable source of forage for honey bees. This study highlights the most important native bee forage plants across different ecological zones, including coastal shorelines, desert regions, and mountainous areas. It emphasizes the need for a more sustainable beekeeping approach that prioritizes year-round forage availability. By integrating diverse forage sources and adopting sustainable management practices, beekeepers can enhance colony survival, improve honey yields, and contribute to the conservation of honey bee populations in the UAE.

PP-575 [Pollination and Bee Flora]
Precision pollination in intensive systems: technological opportunities for linking beekeeping and soybean production

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Biotic pollination is essential for food production but remains undervalued in intensive crops such as soybean. Despite growing evidence of the positive impact of pollinators on agricultural productivity, few technological tools are available to monitor their activity in real time and optimize their management in the field. The development of efficient methods to predict pollinators activity, is crucial to improve the integration of beekepers into production systems. Our study aimed to (1) evaluate the impact of biotic pollination on soybean yield associated with honeybee hives and (2) validate a Pollination Efficiency Index (PEI) to predict the frequency of bee visits in the crop. Experimental plots within a central Argentine soybean field were established to evaluate pollination efficacy. Treatments included pollinator exclusion (self-pollination) and exposure to Apis mellifera (biotic pollination), with hive-mounted sensors recording pollen flow and foraging behavior. In the afternoon, data about frequency of bee visits were calculated by visual observation. At the same time, we tested the IEP proposed by BeeVAI, which remotely calculating pollination efficiency using eight parameters (environmental and hive). Pollinator activity was analyzed using Generalized Linear Mixed Models (GLMM), taking into account the distance from each plot to honeybee hives. Our results showed that plots visited by A. mellifera produced 37% more soybean pods than excluded plots (GLMM: Z = 3.69, P = 0.0002). Increased bee visitation frequency resulted in increased pod formation (R^2 = 0.66; GLMM: Z = 3.59, P = 0.0003). In addition, the average/day values of the proposed IEP, showed a significant correlation with the average visit frequency recorded by field observations (R^2 = 0.57; GLMM: Z = 2.37, P = 0.0180), with a good fit observed up to 200 m from the hives. These results confirm the benefits of honeybee pollination in intensive agroecosystems such as soybean, which represents an opportunity for beekeepers. In this context, remote prediction of bee activity in different fields simultaneously is crucial to optimize logistics and activities during pollination services, and the proposed IEP is an effective tool for this purpose.

PP-581 [Pollination and Bee Flora]
Antioxidant and antibacterial properties of ethanolic pot-pollen extracts of Melipona beecheii and determination of main components

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Melipona beecheii pot-pollen is a natural product of high cultural value in traditional Mayan medicine but remains less studied than honey or propolis. It is considered nutritionally complete and contains metabolites with biological activity that may aid in the treatment of foodborne and oxidative stress-related diseases. Chronic and neurodegenerative diseases are global health concerns, often linked to oxidative stress (an imbalance caused by excess of reactive species). This imbalance is also related to gastrointestinal problems, it can also disrupt native bacterial microbiota and promotes foodborne bacteria that form biofilms and exhibit antibiotic resistance. These challenges require alternative antimicrobial and antioxidant sources as the ones found in nature. Ethanolic extracts were obtained from pollen samples from five sites in the Yucatan peninsula. The antibacterial activity of the extracts against Escherichia coli, Salmonella enterica serovar Typhimurium, Pseudomonas aeruginosa, Staphylococcus aureus and Listeria monocytogenes were evaluated. The antioxidant activity was also evaluated using a free radical scavenging assay (DPPH: 2,2-diphenyl-1-picrylhidrazyl) and reducing power of Fe III (RP). The main compounds were identified by gas chromatography-mass spectrometry (GC-MS). Among tested bacteria P. aeruginosa and L. monocytogenes were the most susceptible. Antioxidant activity was higher than previous reports. GC-MS analysis identified palmitic, linoleic, and linolenic acids along with their ethyl ethers in all samples. The pot-pollen extract from Mama, Yucatan exhibited the highest biological activity (MIC: 6-40 mg/mL, EC50 DPPH: 28 µg/mL, EC50 RP: 30 µg/mL), likely to its higher content of unsaturated fatty acids and their ethyl esters. The aim of this work is to contribute as far as possible to Yucatan peninsula's flora, influencing in the value-added perceived that has not been recognized until nowadays and that is linked to the vegetal species of this region. The discovery of valuable metabolites in studied and middle-known species contribute to the protection of ecosystems since their value and their biocultural diversity is attended and promoted its conservation.

PP-582 [Pollination and Bee Flora]
Evaluation of the antioxidant and antibacterial potential of phenolic compounds extracted from Melipona beecheii honey against Salmonella enterica Typhimurium and Listeria monocytogenes

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Melipona becheeii honey has been used since ancient times for its medicinal properties. This food is made from the nectar of flowers, which is transformed in the stomach of bees. This honey is mainly composed of monosaccharides and polysaccharides and also contains other minor molecules, such as proteins and phenolic compounds. The latter have demonstrated their ability to inhibit the growth of bacteria such as E. coli and S. aureus. To evaluate the antioxidant activity and antimicrobial activity of the phenolic compounds in M. beecheii honey against. Salmonella enterica Typhimurium ATCC 13311 and Listeria monocytogenes ATCC 15313. The honey was collected from Ticimul, Yucatán, Mexico. The extraction of phenolic compounds (PE) was carried out according to the method described by Ferreres et al., 1994. Using an amberlite XAD7HP column, and methanol as a mobile phase. Antimicrobial activity and minimum inhibitory concentration (MIC) were determined as described by Ramón-Sierra et al., 2020. The antioxidant activity of PE was carried out by the DPPH mechanism and reducing power (Shimada et al., 1992). Honey contains 50.17 ± 2.5 mg of gallic acid equivalent (EAG) per 100 g of honey. PE was shown to inhibit the growth of both pathogens evaluated, requiring a minimum inhibitory concentration of 111.5 ± 1.2 µg/ µL and 100 ± 1.2 µg/ µL EAG respectively for S. enterica Typhimurium and L. monocytogenes, showing a bactericidal effect. On the other hand, PE was shown to stabilize the DPPH radical by 50% (IC50) with a concentration of 3.18 µg/ µL EAG and 19 µg/ µL EAG to reduce Fe III. The phenolic extract of M. beechii honey exhibits antimicrobial activity against S. enterica Typhimurium and L. monocytogenes in addition to presenting antioxidant activity. This finding contributes to the understanding of M. beecheii honey as a functional food with bioactive characteristics, as well as its potential to promote health.

PP-584 [Pollination and Bee Flora]
Unifloral honeys from native plants produced at the protected area of Montes del Queguay, Uruguay: palynological characterization

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The pollen content of 41 honey samples from the main harvest of beehives located in the Montes del Queguay Area, Paysandú Department in Uruguay, was analyzed. This area was included into the protected area system (SNAP) in 2014, provoking a growing interest in the analysis of the products obtained within it as a way of seeking the sustainability of the ecosystems and the valorization of products there produced as the case of its honeys.. The Montes del Queguay area is characterized by containing a great diversity of environments, types of vegetation and the presence of priority species for conservation. Likewise, it includes one of the largest masses of natural riverside forests in the country. The samples here studied were harvested over 3 consecutive years (2022, 2023 and 2024), corresponding to the main production period in this region. For the pollen concentration, standard melissopalynological procedures with acetolysis were applied. From the total of harvested samples, 19 samples resulted unifloral from native plants. Thirteen (13) of the 41 honey samples were unifloral of Blepharocalyx salicifolius (3 on 2022, 2 on 2024 and 8 on 2024), 3 of Scutia buxifolia (2 on 2022 and 1 on 2023) and 3 of Terminalia australis (1 on 2022 and 2 on 2023). In 2024, Blepharocalyx salicifolius was the unique native species from which unifloral honeys were produced. Highest frequencies in unifloral honeys were 83.7 % for Blepharocalyx salicifolius, 58.1 % for Scutia buxifolia and 73.2 % for Terminalia australis. The three native species producing unifloral honeys along the studied years were present in the 100 % of the samples, their accumulated frequency varied between 65 and 98 %, being over 75 % in 89 % of the samples. On the basis of the data herein obtained, it can be assumed that the pollen characterization of unifloral honey samples from native species produced at Montes del Queguay Protected Area would be feasible from both botanical and geographical points of view. These results could stimulate producers to strength their beekeeping practices to harvest honeys with specific characteristics in order to search for an added value of their products.

PP-585 [Pollination and Bee Flora]
Automated monitoring of pollinator visitation in agriculture

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A significant proportion of agricultural crops are dependent on insect pollination, by both wild bees and managed honey bee colonies. These pollinators continue to face population pressures from a variety of stressors such as agricultural practices, climate change and diseases. Monitoring and measuring the presence, density and diversity of pollinators as well as their distribution in the crop provides further understanding of the dynamics of pollination communities in an agricultural context and how they affect crop yields. Furthermore, it can be used as a useful tool for increasing the efficiency when using managed honey bee colonies, both in terms of quantity and placement. Adapting technology originally designed to monitor in-hive acoustics, simple acoustic sensors are placed in the crop, collecting information about honey bee visits, ambient temperatures, humidities and light levels. Because the sensor is cost effective, hundreds of these sensors can be distributed through a single crop providing spatial and temporal information in real time and over large areas. This data is complemented by flight activity measurements from the hives, namely bee out counts and hive weight data which are transmitted together with crop visitation measurements back to the cloud for analysis and interpretation. Here we present the application of this technology to a wide variety of crop types: almonds, apples, blueberries, watermelons, sunflowers and oil seed rape, as well as hybrid seed production in onions, carrots and radishes demonstrating its ability to accurately map the pollinator activity in the field at any given time. From the perspective of a beekeeper offering pollination services, information in real time on bee activity in the crop enables timely intervention should more bees be required, the need for hives to be repositioned or excess bees to be removed. Lastly we discuss the potential for the use of the in-field sensing for monitoring pollinators in contexts other than agricultural settings. With the growing interest in agricultural biodiversity, this technology offers a reliable tool to monitor pollinator diversity and density in both agricultural landscapes as well as in surrounding land, supporting efforts aimed at pollinator biodiversity conservation and promotion.

PP-586 [Pollination and Bee Flora]
Insect pollination of wild and cultivated vanilla in Peru

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Vanilla is the second most expensive spice in the world. 98% of vanilla flavour used by the food industry is synthetic, the remaining 2% is extracted from cultivated vanilla. 100% of the cultivated vanilla is hand pollinated. Indigenous to Central and South America, insect pollinated wild vanilla is rare, impractical to harvest, and not commercially available. Insect-flower interactions typically revolve around basic needs like nutrition, oils, resins, shelter and warmth. Vanilla orchids tend not to offer nutritional reward but the flower's fragrance acts as a chemical signal that attracts male bees, which collect and use it to enhance their attractiveness to females when mating. The primary objective of this study was to identify the wild pollinator of Vanilla pompona, known for its large aromatic pods, allowing cultivation in its natural habitat, generating valuable income for indigenous communities who are stewards of this species' habitat. Working with an indigenous community in Ucayali region of Peru, we used chemical lures, sound recording equipment and camera traps to identify what we believe to be the wild pollinator of this plant - Eulaema cingulata. Second objective was to explore the use of honey bees as pollinators of cultivated vanilla at San Rocco (Junin region), the first and largest producer of Vanilla planifolia in Peru. The pollination mechanism of the vanilla flower is tightly dependent on the physical dimensions of the visiting pollinator as the removal of pollinia requires a set of specific movements by the visiting bee. Literature suggests honey bees may possess the appropriate physical attributes to trigger this pollination mechanism. However, worker honey bees lack motivation to visit these flowers due to the absence of a nutritional reward. Initially, sugar solution was used to attract the honey bees to the flowers but without success, so the experiment was performed using sedated and euthanised bees with supporting wires demonstrating that worker honey bees reliably remove the pollinia of the Vanilla planifolia. The next step is to train the bees to visit the flowers utilising the scent/reward system, originally used to locate land mines by the US military back in the 1990's.

PP-587 [Pollination and Bee Flora]
Improving the efficiency of almond pollination using fewer stronger bee colonies

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Managed honey bees are the primary pollinators of almonds in commercial agriculture, particularly in California's Central Valley, which produces 80% of the world's almonds.

Pollination accounts for up to 20% of grower's operating budgets and underpins commercial beekeeping in the USA, however beekeepers face significant challenges in maintaining an adequate supply of healthy colonies to meet this demand. Efforts to optimise almond pollination focus on maximising the efficiency of honey bee colonies to benefit both growers and beekeepers. This involves strategic management of colony health and strength, timing and configuration of hive drops and even hive orientation, all aimed at enhancing pollination efficiency and success. This study examines whether hive entrance orientation and hive strength influence the pollinating activity of honey bees in almond orchards. Working in conjunction with USDA, we assessed the various hive metrics across twenty-four colonies, half were situated with their entrances facing east, the other half facing west. Bee out counts and hive weight data were recorded continuously while colony strength was assessed on three occasions throughout the course of the study (libenfield method). East-facing hives started flight 44.2 min earlier than west-facing hives. The hive direction did not affect the timing of the cessation of foraging activity. The hive strength played a significant role: hives assessed as weak (≤3.0 FOB) facing east started flying up to 2 hours later than stronger hives (>3.0 FOB). Our study showed that, during almond pollination, both hive entrance exposure and hive strength have quantifiable effects on colony foraging behaviour and that these effects combine to regulate the overall foraging activity of the pollinating colonies. As choosing hive orientation is impractical in a commercial beekeeping environment, there is a strong argument for the use of stronger colonies for pollination. Furthermore, stronger colonies help mitigate the impacts of inclement weather and with more foragers the same amount of pollination can be achieved using fewer hives. This, in turn, generates significant savings on transportation and associated environmental costs, given over two million bee hives are currently transported to California each winter. The linearity of this relationship remains a topic for future investigation.

PP-589 [Pollination and Bee Flora]
Historical Agro-economic Analysis of the Relationship Between Commercial Pollinator Use and Lowbush Blueberry Yield in Québec Canada (2015-2021)

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Lowbush blueberry (Vaccinium angustifolium Ait.) production has the highest export value among all fruit crops in Canada. As blueberry flowers require insect pollination, blueberry farms rely on commercial pollinators to ensure productivity of their fields. Our study aimed to assess the impact of commercial pollinator density and diversity on lowbush blueberry yield using historical data, from 2015 to 2021, across various production contexts. The analysis included 178 blueberry fields were included in this study, representing approximately 3 500 ha and 12% of total Québec's total crop production area. Data on field size, berry yield, pollinator density/diversity (honeybees; Apis mellifera, bumblebees; Bombus impatiens, and alfalfa leafcutter bees; Megachile rotundata), establishment year, and management type were collected for each field. Additionnally, we examined data on honey bee hive strength, landscape structure, and meteorological factors influencing yield. Results showed significant yield increase with hive density, peaking at ~4-5 hives/ha when hive strength was considered. Yield was also improved with bumblebee densities above 4 colonies/ha, and leafcutter bee density exceeding 5 gallons/ha. The diversity of commercial pollinators used in the fields also increased yield. Key factors influencing lowbush blueberry yield included honeybee density, the year, snow cover duration in winter, field age, management practices, and precipitations during the fruit growth period. This study clarifies the relationship between commercial pollinators and lowbush blueberry yield, demonstrating that a combination of factors significantly impacts field productivity and that commercial pollinators significantly enhances field productivity. Our findings show that increasing pollinator density and diversity lead to higher yields for lowbush blueberry growers.

PP-590 [Pollination and Bee Flora]
Leveraging Beekeeper Data for Biodiversity Monitoring, Reporting, and Validation (MRV)

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HiveTracks

Terrestrial biodiversity and the vital ecosystem services it provides are fundamentally interconnected with the complex relationships between plants and their pollinators, including honey bees. These relationships are essential for maintaining ecological balance and ensuring the continued provision of food, clean water, and other essential natural resources. HiveTracks introduces a scalable and innovative model for assessing biodiversity by systematically monitoring these crucial interactions through a global community of beekeepers. This approach leverages the power of beekeeper communities to collect and analyze meaningful amounts of data, providing valuable insights into the state of biodiversity and ecosystem health. The HiveTracks platform facilitates the collection of typical beekeeping data and specialized primary biodiversity metrics, building out structured data collection methodologies for both plants and pollinators to extrapolate abundance and diversity metrics. This approach is powered by a community-based and user-friendly technology platform made up of mobile and web apps to crowdsource images of plants and pollinators and beekeeping data, including apiary locations, colony health metrics, harvest data, and images of hive configurations and brood patterns. Time and location-based metadata from image collection provide context for automated species recognition using AI tools. This data is further aggregated and enriched with third-party sources to generate comprehensive and localized biodiversity assessments. In addition, automated stratified sampling strategies, enabled through GIS-based site assessments, have been developed to allow for the calculation of species abundance and the Shannon diversity index (SDI) at specific sites. By systematically quantifying changes in pollination events, floral resources, and pollinator abundance over time, HiveTracks provides a robust, data-driven approach to tracking biodiversity trends at both local and global scales with participation of beekeepers around the world. The model also bridges the gap between macro-level desktop assessments and ground-truthed field assessments.

The HiveTracks platform and underlying model represents a significant advancement in the field of biodiversity assessment, monitoring, reporting and validation (MRV). The insights generated by HiveTracks can inform conservation efforts, promote sustainable land management practices, and ultimately contribute to the preservation of our planet's precious biodiversity.

PP-592 [Pollination and Bee Flora]
Pollinator Diversity and Forage Resources in Agroecosystems: Implications for Sustainable Beekeeping in the Philippines

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Pollinators play a crucial role in maintaining biodiversity and supporting agricultural productivity. However, there is limited data on pollinator diversity and forage resources in agricultural and agroforestry areas in the Philippines. This study aimed to assess the diversity of pollinators and their forage plants in the UPLB La Granja Research and Training Station (LGRTS) in Negros Occidental and the UP Land Grant in Pakil, Laguna. Pollinator populations are under threat due to habitat loss, pesticide use, and land-use changes. Understanding the local diversity of pollinators and their floral resources is essential for conservation and sustainable agricultural practices. This study sought to identify pollinator species and the floral resources they utilize in these agroecosystems. Pollinators were sampled using sweep nets, pan traps, malaise traps, and opportunistic flower observations between 07:00 and 15:00. Pollinator species were identified, and their behaviors were recorded. The floral resources visited by pollinators were also documented. In addition, stingless bee colonies were introduced to assess their adaptation and contribution to pollination. The study recorded a diverse range of pollinators, including native bee species (Tetragonula biroi, Amegilla sp., Xylocopa sp.), butterflies, beetles, and flies. Pollinators showed peak activity between 09:00 and 11:00 AM, correlating with floral anthesis. Key forage plants included Mangifera indica, Citrus maxima, Vitex negundo, and Tithonia diversifolia. The introduction of stingless bee colonies was successful, with some colonies expanding. The study highlights the importance of maintaining diverse floral resources for sustaining pollinator populations. Beekeepers can enhance honey production and pollination services by integrating native bee plants and promoting stingless beekeeping as an alternative livelihood, particularly in areas where traditional farming is declining.

PP-593 [Pollination and Bee Flora]
Impact of Integrated Beekeeping and Habitat Conservation Measures of Native Pollinators on Pollination and Rural Livelihoods in Apple Cultivation in Kullu and Shimla Districts of Himachal Pradesh India

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Apple cultivation in Himachal Pradesh, which is the second-largest apple producing state in India, faces challenges due to pollinator decline. The decline in pollinator populations and diversity is a result of monoculture plantations, chemical sprays, habitat loss, and to some extent, climate change. Pollinator protection initiatives in apple orchards of Kullu and Shimla districts, which are the largest apple producing districts in Himachal Pradesh, were initiated with the aim of conserving wild pollinators and Indigenous honeybee Apis cerana. Efforts were made to encourage integrated beekeeping of Apis cerana in apple orchards, on-farm bee habitat management and conduct research on its impacts on bee pollination in apple. Pollinator habitat and bee management were also integrated in trainings in Good Agriculture Practices in pollination management, conducted along with local government agencies. Besides, awareness about wild pollinators, importance of bee flora, judicious use of pesticides, importance of bee flora has helped farmers to understand these vital issues and integrate into their Good Agricultural Practices.

Conducted under the umbrella of German development cooperation with India under the Green Innovation Centres for Agriculture and Food Sector, the pollinator protection programme has empowered apple farmers and beekeepers by providing need-based skills, knowledge, exposures and strengthening linkages with the research institutes and line departments. The success of the programme is evident from the adoption of planned pollination and promotion and revival of A. cerana beekeeping. These measures have resulted into increased income through improved apple productivity and alternative livelihood opportunities through beekeeping along with improved ecosystem services of pollination. The success of the programme has multiplier effect and will contribute in climate-resilient food systems in mountain Agri-Horti-Forestry system. The process and outcome of the said project will be discussed in this paper.

BEEKEEPING FOR RURAL DEVELOPMENT

PP-486 [Beekeeping for Rural Development]
Chemometric Quality Assessment of Colombian Honeys Based on Physicochemical Parameters and Sensory Attributes

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Physicochemical properties refer to measurable, physical, and chemical characteristics of honey that affect its quality, stability, and authenticity, and sensory analysis involves evaluating honey through human senses, mainly taste, smell, and texture. It is essential for assessing the overall quality and consumer preference. The aim of this study was to assess the physicochemical properties, attributes, and characteristics of Colombian honey, sourced from Apis mellifera and Melipona species, collected from various biogeographic regions across Colombia. In accordance with the international standards set by the International Honey Commission (IHC), the following variables were measured in 34 honey samples: moisture, water activity (aw), pH, °Brix, total ionic solids (TCD, ppt), electrical conductivity (EC), density, refractive index, and ash content. Chromatic characteristics were determined using the CIELab system, and color was evaluated using the Pfund scale (mm). Principal Component Analysis (PCA) was performed on the physicochemical parameters to analyze the relationships between different groups of variables. Sensory evaluation was conducted through quantitative descriptive analysis (QDA™) and hedonic classification methods from the National Honey Board. 34 honey samples (from Apis mellifera and Melipona species) were provided by beekeepers from different regions of Colombia. The physicochemical properties were analyzed according to the methods established by the International Honey Commission, including measurements of moisture, conductivity, pH, free acidity, color (Pfund scale), °Brix, °Baumé, ash content, and water activity. Sensory properties were evaluated using the National Honey Board's guidelines. The physicochemical and sensory evaluation of honey ensures its quality and authenticity, facilitates its differentiation in the market, supports biodiversity conservation, optimizes production processes, and enhances the consumer experience. Furthermore, it provides valuable tools for certification and compliance with international standards, which are essential for the competitiveness and growth of the beekeeping industry.

PP-487 [Beekeeping for Rural Development]
Gastronomy as a key for market access and value chain development for honey. Case study in Dominican Republic

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The potential of gastronomy as a high-value market for honey and other bee products presents a unique opportunity to drive rural development and enhance market access. This presentation explores the role of gastronomy in the value chain development of bee products, based on a case study of Nucayni Honey in the Dominican Republic. By leveraging the culinary traditions and the growing demand for gourmet and organic products, gastronomy can serve as a catalyst for economic growth in rural areas.

Over the past four years, Nucayni has played a pivotal role in supporting the beekeeping community of Monte Plata province in Dominican Republic by providing a secure market for their honey. By partnering with more than 20 beekeepers, it has ensured that their products reach a wider audience, thereby increasing their income and promoting sustainable beekeeping practices. Additionally, Nucayni has successfully established relationships with over 40 restaurants, integrating high-quality honey into their culinary offerings. This collaboration has enhanced the visibility of local honey and created a stable demand, benefiting both the beekeepers and the gastronomy sector.

The case study highlights the integration of honey and other bee products into the local gastronomy scene, showcasing innovative culinary applications that elevate these products' market value. Through collaborations with chefs, restaurants, and specialty markets, honey is becoming a main ingredient in many restaurants, securing a market for beekeepers and promoting sustainable practices. The presentation will discuss the strategies employed to enhance the visibility and appeal of bee products, including branding, development of value-added products, and the creation of unique gastronomic experiences.

Furthermore, the presentation will address the challenges and opportunities faced by beekeepers in the Dominican Republic, such as market access barriers, quality control, and the need for capacity building. This presentation aims to provide a roadmap for other regions to harness the power of gastronomy in promoting bee products and supporting rural development.

In conclusion, gastronomy offers a promising avenue for market access and value chain development for honey. This presentation demonstrates how culinary innovation, and strategic partnerships can transform the beekeeping industry, fostering economic resilience and sustainability in rural communities.

PP-489 [Beekeeping for Rural Development]
Unlocking the Potential of Rural Honey Industry: A Market-Driven Approach

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The TRADE programme has been investing in Malawi's honey value chain since 2022. The programme aims at increasing incomes of rural people through commercialization. The biggest challenge in the Malawi's honey value chain is low production. Despite various interventions aimed at boosting honey production in Malawi, national output has remained stagnant at approximately 200MT annually. TRADE programme has introduced market-driven strategies, including business coaching, SmallHolder Empowerment and Promotion (SHEP) approach, and facilitated business meetings, to address this challenge. Initial findings suggest that direct market linkages significantly increase production, with some beekeepers reporting a doubling of their output in the first year. However, the specific mechanisms driving this growth remain unclear.

The lack of clarity on which interventions contribute most effectively to production increases presents a critical gap in knowledge. While some farmers benefit from market facilitation, others do not experience the same level of success. It was essential to identify which TRADE-supported services have the most significant impact on honey production and what factors influence their effectiveness.

This study explore the relationship between TRADE's interventions and honey production outcomes. By analyzing the effectiveness of business coaching, the SHEP approach, and business meetings, the research provided insights into the most impactful strategies for commercializing the honey value chain in Malawi. The study uses data from farmer-based organizations working with the programme and was analyzed using T-tests and multivariate regression.

The results revealed that the SHEP approach had positive significant impact on production, even in the face of external challenges such as prolonged heatwaves. While participation in business meetings and business coaching showed no significant effect.

Key patterns also emerged, groups led by women consistently outperformed those led by men. Services that provided long-term exposure and hands-on guidance especially those empowering farmers to find their own markets proved to be the most effective in stimulating honey production in rural areas. This study highlights the potential of smallholder beekeepers in accessing markets, increasing productivity, and fostering a more commercially viable honey sector by promoting women's leadership in beekeeping groups and expanding long-term hands-on training.

PP-490 [Beekeeping for Rural Development]
Care between Bees and Humans the Case of Beekeeping in Japan

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There is a growing global interest in animal welfare, but what are the issues when considering animal welfare in beekeeping? This paper examines the care relationship between humans and bees in beekeeping, based on recent discussions in the field of anthropology about care for animals. From the results of two years of participant observation and interviews, it is shown that semi-wild honeybees engage in mutual care with beekeepers through a “seductive” relationship. In the context of Japanese beekeeping, particularly with the Japanese honeybee and beekeepers, the relationship is not only one in which humans allure the bees for the purpose of beekeeping, but also one in which the bees allure the humans. This form of beekeeping, based on a seductive relationship, demonstrates not only care for the bees but also the potential for beekeeping to offer care for humans, suggesting a form of beekeeping that is not solely focused on extracting honey.

PP-491 [Beekeeping for Rural Development]

LocApiary: Restoring Wild Honeybee Populations for Regenerative Beekeeping Communities. Making wild populations a cornerstone for sustainable and regenerative beekeeping by promoting local ecotypes to support their long term health and resilience

Michael Thiele
Apis Arborea

Background/PURPOSE:
The LocApiary Program is a watershed-centric ecological restoration initiative fostering self-sustaining networks of wild, unmanaged honeybee populations within local ecosystems. This innovative approach integrates biomimicry and natural nest density principles, envisioning a collaborative relationship between landscapes, honeybees, and humans. The program aims to support wild, unmanaged honeybee populations as a cornerstone for sustainable and regenerative beekeeping.

Problem Description:
Recent data from the US reveal a stark contrast in survival rates between wild and managed honeybee colonies. Wild honeybees show an annual survival rate of around 80%, while managed colonies reported a record-low survival rate of 44.9% in 2024. This discrepancy highlights the need for new approaches to honeybee conservation and beekeeping practices.

METHODOLOGY:
LocApiary combines cutting-edge life sciences research with traditional practices. The program focuses on conserving locally adapted genetic stock and reducing the spread of pests and pathogens associated with industrial beekeeping. It prioritizes wild, unmanaged populations and integrates them into broader ecosystem management and small-scale beekeeping.

Results and CONCLUSION:
Collaborations between Apis Arborea, the University of Texas A&M, and Purdue University have documented the unique genetics of wild populations and their distinct characteristics compared to less genetically diverse industrial honeybee populations. These findings support the LocApiary approach of favoring local ecotypes and harnessing dynamic, evolutionary processes for long-term honeybee health and resilience.

Practical Implications for Beekeepers:
LocApiary represents a paradigm shift in apiculture. Once established, these apian networks allow local honeybee swarms to become the primary supplier for apiaries, minimizing the impact of industrial beekeeping practices on backyard beekeepers and the wider pollinator community. Apis Arborea is piloting integration programs with farms and communities across California, implementing lessons from the wild into cultivated ecologies. These systems are designed to align with local beekeeping regulations while fostering ecological integrity, offering beekeepers a sustainable and resilient approach to apiculture.

PP-492 [Beekeeping for Rural Development]
Api - Tourism Centre in Nashik, Maharashtra, India

Sanjay Bhaskar Pawar, Vishakha Sanjay Pawar
Baswant Honey Bee Park and Training Center

Api-Tourism Centre in Nashik, Maharashtra, India: A Unique Model for Sustainable Tourism

Sanjay Pawar, Vishakha Pawar

The Baswant Honey Bee Park, also known as the Api-Tourism Centre, located in Nashik, Maharashtra, India, offers a unique blend of education and tourism that highlights the vital role of beekeeping in agriculture and food security. Established in 2019 as India's first integrated Agri-Api Tourism project, it spans 15 acres and aims to educate students and the general public on the importance of bees, sustainable farming, and environmental conservation.

The centre features a variety of interactive experiences designed to educate visitors about the fascinating world of bees. These include guided tours of the apiaries and bee museums, where visitors can observe all species of bees. The bee floral and vegetable gardens showcase the plants crucial for maintaining healthy bee populations, offering visitors a deeper understanding of the interconnectedness between nature and agriculture. Additionally, visitors have the opportunity to taste and purchase honey produced on-site, learn about honey processing, and explore the medicinal and cosmetic uses of bee products. A key aspect of the Api-Tourism Centre is its commitment to promoting health and sustainability. Workshops on Apitherapy (bee-based therapy), beeswax candle-making, and cooking with honey offer visitors hands-on experiences. The museum also features exhibits on the growing interest in sustainable agriculture and the impact of urbanization on natural ecosystems, using art and monuments to convey these themes.

The Centre has seen a steady increase in visitors, with approximately 400 people attending on weekdays and around 800 on weekends. Till date more than 1,30,000 visitors have visited this project. This growth reflects the increasing demand for cultural and eco-tourism that preserves both natural and cultural values. Over the last five years, the Api-Tourism Centre has emerged as a leading destination for both domestic and international tourists, becoming a model for integrating education, sustainability, and tourism in a unique and impactful way.

PP-493 [Beekeeping for Rural Development]
Traditional knowledge in beekeeping: lessons from indigenous species. a case study at twifo praso, central region, ghana, west africa

Raymond Karikari
Association of Beekeepers

In the rural areas of Twifo Praso, traditional beekeeping practices are primarily focused on harvesting wild honey, often leading to bush burning that destroys crops and exacerbates environmental degradation. Simultaneously, the region experiences ongoing human-elephant conflicts, as elephants raid food crops, causing significant economic and food security challenges for local residents. A sustainable solution has been proposed that integrates beekeeping into conservation efforts, both to mitigate the destruction of crops by elephants and to enhance local livelihoods through modern beekeeping techniques. This approach aims to leverage the natural deterrent of bees, which elephants avoid, to protect crops from raids. Furthermore, the introduction of modern beekeeping practices will improve honey production, increase local income, and reduce the need for bush burning, promoting environmental conservation. The initiative also includes community involvement, where local residents are trained and empowered to adopt modern beekeeping methods. This model not only addresses the human-elephant conflict but also fosters sustainable agricultural practices and community-driven conservation efforts. Through collaboration with local farmers and conservationists, the project envisions a harmonious coexistence between people, wildlife, and the environment in Twifo Praso.

PP-495 [Beekeeping for Rural Development]
Establishing a Beekeeping Group in the remote tropical Cocos Keeling Islands with Islamic Cocos Malay women

Paula Jane Carnell
Paula Carnell

The Cocos Keeling Islands, a remote coral atoll in the Indian Ocean, provide a unique environment for beekeeping. The honeybee population was first introduced to the islands in the 1940s, and in recent years, we have worked to establish a sustainable beekeeping group among the Cocos Malay community. This initiative empowers local women through beekeeping while embracing both scientific and spiritual approaches to hive management. Guided by the teachings of the Quran, particularly the chapter 'The Bee,' our program teaches women natural and sustainable beekeeping methods. This holistic approach respects the wisdom Allah imparted to bees and integrates it into practical hive management. By observing bee behaviour, including their natural foraging patterns and the unique fact that they do not consume their own honey when nectar sources are abundant, we are gaining valuable insights into colony health and sustainability. One aspect of our work involves analysing the honey to determine which plants the bees are foraging from. This research helps us understand the ecological interactions between the bees and the island's native flora. The pristine environment of the Cocos Keeling Islands provides an excellent case study of how honeybees thrive without excessive human intervention, demonstrating that when bees thrive, the people connected with them also flourish. The Cocos Malay community, comprising approximately 450 people, faces significant challenges, including the threat of climate change. According to an Australian government coastal erosion report, the islands may be submerged within the next 50 years. Historically, the community descends from workers brought to the islands for the Clunies-Ross coconut plantations and was granted Australian citizenship in 1984. Today, through beekeeping, the women of the community are developing a sustainable source of income and self-sufficiency while reconnecting with nature and traditional wisdom. This presentation will share insights from our journey, highlighting the resilience of both the bees and the community. Through research into bee species, their history, floral nectar sources, and overall colony health, we aim to understand how bees can thrive naturally. This project serves as a model for other remote communities looking to harness beekeeping for ecological and economic development.

PP-496 [Beekeeping for Rural Development]
Sustaining Honeybee Populations in the Cocos Keeling Islands within an extreme environment for humans, yet perfect for honey bees, managed and living wild in the calophyllum and palm forests, using plastic beehives

Paula Carnell
Paula Carnell Limited

As a remote coral atoll in the Indian Ocean, presents unique challenges for establishing and maintaining a sustainable beekeeping project. Limited access to supplies, language barriers, and the uncertainty surrounding the islands' future make this initiative both complex and critical. Despite these obstacles, our project has demonstrated resilience, sustainability, and potential long-term benefits for both human and bee populations. The logistical difficulties of life on the atoll are considerable. Fresh food arrives only via air freight every two weeks, while essential supplies are transported by ship every eight weeks, often facing delays. There is no telephone network, and internet access is limited to WiFi-enabled buildings. The Cocos Malay community speaks its own variant of Indonesian, with younger generations more fluent in English, adding an additional layer of complexity to knowledge-sharing and training initiatives. Beyond these logistical challenges, the islands are under existential threat. According to an Australian government coastal erosion report, they are projected to be submerged within the next 50 years. Additionally, the planned expansion of the airport runway for military use has created widespread fears of forced evacuation. If the population is displaced, the world risks losing not only a unique cultural community but also an invaluable research opportunity into the thriving of honeybees in a pristine environment.
Our beekeeping project raises important questions: Could the existence of a healthy honeybee population, potentially producing medicinal honey, contribute to the argument for preserving and protecting the islands? Can this initiative provide a sustainable livelihood that justifies maintaining a human presence? With global honeybee populations under threat, studying bees in such an undisturbed setting offers critical insights into their natural resilience and their profound connection to human well-being. To address the challenges of extreme humidity and strong winds, we have implemented the use of plastic beehives, which offer better durability and protection for the colonies. This presentation will explore how beekeeping in the Cocos Keeling Islands serves as a model for sustainability under extreme conditions, how it fosters community empowerment despite political and environmental uncertainty, and how it may provide a compelling case for safeguarding this fragile yet remarkable ecosystem.

PP-498 [Beekeeping for Rural Development]
Increasing the value of beekeeping products by pollen surveys at indigenous tribes in Taiwan

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Taiwan's indigenous tribes are located in rural areas, and with the lack of job opportunities, young people tend to move to urban areas, resulting in challenges to preserving tribal cultures and sustainable development. Indigenous agriculture needs to be transformed to increase its value, with promising opportunities for young people to stay in their hometowns for careers. Traditionally, indigenous people keep bees for their consumption of honey. The mountainous areas where indigenous people traditionally reside are rich in botanical resources and have a low risk of pesticide residues, leading to a great potential for producing bee products. We surveyed the bee pollen resources of Baishou tribe in Shihtan Township which belongs to Saixia tribal. The area's most dominant bee pollen plant was Bidens pilosa var. radiata with 18.5-69.5% of the overall pollen collected during April-October, followed by Acacia confusa with 67% of the collected bee pollen during May. Although the pollen plants in the area are diverse, only approximately 240 g of bee pollen could be collected by five colonies every seven hours during the spring season (March to May). The production of bee pollen in the area is not recommended as a product directly, thus we assisted the indigenous youth in developing bee pollen-flavored pastries using low quantities of Acacia confusa and Rhus chinensisvar. roxburghii pollen. Traditionally, indigenous people used Acacia confusa and Rhus chinensis var. roxburghii to make agricultural tools, bark clothing, fuel, and salty seasonings. The newly developed bee pollen-flavored pastries successfully combined the plants with traditional wisdom stories and sold them at the local tourist attractions increasing by approximately 21.3% of the profit. This study demonstrated that combining tribal traditions with bee pollen resource surveys can enhance the added value of bee products and contribute to rural economic development.

PP-499 [Beekeeping for Rural Development]
Environmental and microbial drivers of nectar flows: the case study of sunflower (Helianthus annuus)

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In the last decade, beekeepers operating in southern European regions have experienced consistent problems in honey production. Among nectareous plants of interest for the sector, sunflowers (Helianthus annuus) are of particular interest: they are rich in nectar and pollen and can ensure substantial honey harvests for beekeepers. However, a drop in sunflower nectar secretions, and therefore, in honey production, has been complained by beekeepers since 2017 at least. This decline is mainly driven by heat waves and particularly intense dryness, but also other factors factor might affect plant performance: the decreased microbial diversity of soils in the agroecosystems, which does not allow the establishment of a beneficial “dialogue” between sunflowers and soil microbiome. Soil microorganisms are responsible for the solubilization of microelements useful for nectar secretion such as manganese and magnesium. Plant Growth Promoting Bacteria (PGPB) are soil-born microorganisms widely used as bio-fertilizers in agriculture to increase plant growth and resistance to environmental stress factors. However, it is currently unknown how PGPB can modify the plant physiological processes leading to nectar secretion, thus influencing the plant-pollinators network. To shed light on these aspects, a trial involving hybrid and non-hybrid sunflower varieties was established in Italy. Sunflowers were sown in soil plots, which were inoculated with different PGPB such as Bacillus and Lactobacillaceae. About 200 flowers were collected from the different experimental plots and analyzed for the gene expression of SWEET passive sugar transporters (RT-qPCR). Simultaneously, sunflower root samples were collected, and the epiphytic microbial community was sequenced on Illumina Hi-Seq. Results showed that the sunflower variety mainly drove the microbial colonization of the rhizosphere. Some of the tested PGPB significantly altered the expression of SWEET passive sugar transporters genes. These results represent a first step in understanding the role of PGPB on sunflower attractiveness to pollinators, giving an insight into how climate change may affect ecological niches that are apparently not correlated with honeybees' lives but actually may play a pivotal role in honeybees' performances. This research was carried out in the European Union Next-Generation Framework (PNRR – mission 4, component 2, investment 1.4 – D.D. 1032 17/06/2022, CN00000022).

PP-503 [Beekeeping for Rural Development]
From threats to solutions: meliponists perceptions and proactive practices in Brazil's meliponiculture

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Modern agriculture heavily relies on monocultures and intensive pesticide use, practices that harm not only the land but also pollinators, including native bees, which are essential for most crop plantations. In Brazil, integrating meliponiculture (stingless bee beekeeping) into rural properties can play a crucial role in promoting more sustainable land use while fostering rural development. However, meliponiculture faces various threats that impact bee health and productivity, requiring adaptive responses from beekeepers. Thus, this study analyzes rural meliponists' perceptions of threats in meliponiculture and the strategies they employ that address these challenges. A survey was conducted in 2022 with 252 rural meliponists across Brazil. Data covered threats in meliponiculture and questions about land use, bee management, and beekeeper training. Respondents identified deforestation, pesticide overuse, and mosquito fogging as the primary detrimental factors impacting meliponiculture. Half of the respondents highlighted the lack of knowledge about bees as a significant issue. Additionally, drought, winter conditions, and natural predators were noted as harmful, while colony theft and insufficient bee management expertise were considered highly detrimental. The perception of legal procedures as highly harmful was notably higher than that of the legislation itself, which was viewed as detrimental by only a small proportion of respondents. The vast majority of respondents reported having fruit trees and maintaining native forest on their properties. A minority use pesticides and four out of five have undergone some form of meliponiculture training. Finally, almost three-quarters indicated that they plant species for bee foraging and the majority check on the bees weekly, controlling predators and feeding them during periods of drought and winter. The findings indicate that despite the challenges, meliponists are taking proactive steps to mitigate the threats to the bees and meliponiculture. This study offers valuable insights for emerging rural meliponists, enhancing their understanding of threats to meliponiculture and effective mitigation strategies. It also underscores the importance of developing targeted management approaches and public policies to ensure the sustainability of meliponiculture in rural Brazil, thereby supporting its long-term viability and contribution to sustainable agriculture.

PP-504 [Beekeeping for Rural Development]
Honey tastings: a platform for bee conservation and market development

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This presentation will explore the potential of honey tastings to serve as an effective platform for raising public awareness about the vital role of bees in our ecosystem and stimulating market growth for beekeepers. While honey is a widely consumed product, consumer understanding of its origins, varieties, and health benefits remains limited. Furthermore, prevalent myths and misconceptions surrounding honey production and consumption, such as concerns about adulteration and overharvesting, often hinder market appreciation and growth. These misconceptions not only impact consumer confidence but also discourage sustainable beekeeping practices. By providing consumers with the opportunity to experience the diverse flavors and aromas of different honeys, well-organized honey tastings can effectively address these challenges. They can debunk myths and misconceptions about honey adulteration, promote responsible consumption, and emphasize the crucial role of bees in pollination and food security. Moreover, honey tastings can serve as a direct-to-consumer channel for beekeepers, enabling them to showcase the diversity of local honeys, promote sustainable beekeeping practices, and build stronger relationships with their customers, ultimately increasing sales and supporting beekeepers' livelihoods. The presentation will delve into practical strategies for organizing successful honey tastings, including careful selection and preparation of honey samples, the creation of engaging tasting experiences, effective communication of information about honey production and beekeeping practices, and fostering meaningful interactions between beekeepers and consumers. These strategies can be adapted and implemented in various settings, from local farmers markets and community events to educational institutions and culinary schools. By promoting honey tastings as a valuable tool for bee conservation and market development, we can empower beekeepers, educate consumers, and contribute to the long-term health of bee populations worldwide.

PP-505 [Beekeeping for Rural Development]
European apiculture sector policies - positive and negative elements for healthy market conditions

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Background/PURPOSE: The demand for beehive products, especially honey, in the European market is growing. However, while the beekeeping sector faces many challenges, including bee diseases, colony collapse disorder and climate changes, the market shows severe signs of malfunction. The market price for honey is declining in the EU, the self-sufficiency with honey is only about 63%, and much traded honey, especially the imported qualities are suspected of adulteration. The aim of our study was to analyze the relations between positive and negative elements of national policies including legal frameworks and indicators for the health of honey markets, via selected examples from some countries.
Problem description: Currently, the dysfunction of the honey market has a devastating effect on the beekeeping sector in Europe where there are considerable variations from country to country when considering the market health described by indicators. Since policies are made to regulate markets, it would be expected that positive and negative elements of national policies would have a relation to market health.

METHODOLOGY: A survey was spread via the BeSafeBeeHoney project, COST action 22105. Respondents were asked to point at national and/or international policies which are either beneficial or counterproductive to a thriving apiculture and could point at maximum three the most important policies of each type. In addition, indicators for healthy apiculture markets have been proposed. The pristine data collected via the survey was supplemented with literature searches according to relevance.

Results and CONCLUSION: Survey responses were collected from 12 countries (Albania, Bulgaria, Bosna and Hercegovina, Croatia, Denmark, Germany, Italy, Serbia, Spain, Slovakia, Türkiye and United Kingdom). Based on the analyses of survey responses and other information, it can be concluded that differences in national policies have a low relation to the health of the honey market, which is more influenced by other factors.
Practical implications for beekeepers: Policy initiatives on EU and international level are necessary to improve the European honey market including beekeeper business. The knowledge and experience of beekeepers are essential for sustainable apiculture and advocating the most suitable policy and regulations in the beekeeping sector.

PP-506 [Beekeeping for Rural Development]
Introducing children to beekeeping as a pathway to sustainable development

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In Slovenia, we are aware of the important role bees play in the environment, and for decades we have been trying to pass this awareness on to young beekeepers. It is a process that aims to change the way we think about sustainable development in the long term. It is crucial in this regard to create awareness and habits in the early stages of life. Learning about beekeeping starts in kindergarten, when we tell children interesting facts about the bee colony and explain the important role of bees for our environment. The introduction to beekeeping continues in primary school, where we organise lectures with workshops or full-day science days for children, tailored to the age group and duration of the visit. At the same time, the Beekeeping Centre of Slovenia, in cooperation with the Centre for School and Outdoor Education, organises science days. Students who want to gain more theoretical knowledge and practical experience in beekeeping can join beekeeping clubs in some primary and secondary schools. These clubs are led by beekeeping mentors and follow a specific curriculum that entails 40 hours of lectures. At the end of the year, the participating students test their knowledge by taking part in local, regional or national competitions on beekeeping. In some primary schools, beekeeping is also taught as an elective subject in the final three years. Students are encouraged to write research papers and, at university level, to write their bachelor's, master's and doctoral theses on this subject. Throughout the year, we organise a number of promotional and educational projects involving children, which also focus on planting honey plants and preserving biodiversity, e.g. participation in the Traditional Slovenian Breakfast, beehive panel painting competitions, singing songs about bees and theatre plays about bees with the aim of creating a positive attitude towards preserving the environment and bees. All these activities are carried out throughout the year, as they have a greater impact in the long term than if they were focused on a short period of time.

PP-508 [Beekeeping for Rural Development]
Tree beekeeping – beekeeping in a forest environment

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Background/PURPOSE: Honeybees have been associated with forest environments for centuries, where old trees provided safe nesting sites, and a variety of plants and trees ensured a steady food supply. Human intervention disrupted this balance by relocating bees to agricultural landscapes. Tree beekeeping returned to Polish forests in 2007 through the initiative of people, who learned this unique craft from beekeepers in the Urals, whose families have been breeding bees in tree beehives for at least seven generations.

Problem Description: Tree beekeeping reestablishes a symbiotic relationship between honeybees and forest ecosystems by enabling bees to nest in healthy, living trees. This practice also promotes the regeneration of melliferous plants and supports the conservation of bee-related fauna, which is critical for maintaining forest biodiversity.

METHODOLOGY: Our collected knowledge equips us to construct tree beehives in suitable trees, spaced appropriately in areas with good sunlight and protection from adverse weather conditions. Once the tree beehive has been constructed and occupied by bees, maintenance occurs during two key periods: autumn and spring. The autumn inspection, sometimes combined with honey harvesting, is conducted after the flowering season and involves checking honey reserves while securing the beehive for winter. Spring inspection takes place as plants begin to bloom, focusing on cleaning out dead bees from the hive's bottom and preparing the beehive for a new swarm in the event of colony loss.

Results and CONCLUSION: The reintroduction of tree beekeeping in Polish forests has demonstrated significant ecological and cultural benefits including (a) the reestablishment of bees in their natural environment, contributing to forest pollination and biodiversity; (b) creation of bee-related fauna and biodiversity hotspots; (c) socio-cultural knowledge passed down through generations fosters environmental stewardship and reconnects communities with their cultural heritage.
Practical Implications for Beekeepers: Tree beekeeping is more than a method of honey production; it is a practice that deepens our understanding of bees in their natural habitat. By integrating this ancient practice into modern forestry and conservation efforts, tree beekeeping offers an innovative and sustainable approach to safeguarding pollinators and enriching forest ecosystems.

PP-510 [Beekeeping for Rural Development]
Queen selection criteria adapted to the territory. Handling of live material and multiplication options

Geronimo Walter Muñiz
Reinas GW

- Do you know the biological cycle of bees?
- Do you know how much you gain or lose using mated queens, queen cells or letting your bees make their own queen?
- Do you have knowledge about the genetics that best adapt to your area?

Through more than 20 years as a queen breeder I have seen that in Argentina, we beekeepers have been changing the management of our apiaries and the environment has also changed.
That is why, through selection work, I went in search of a genetic line that adapts to the area where our hives are established.
In this work what is demonstrated is that, starting from certain points to take into account, such as productivity, hygienic behavior, tameness, winter and spring development; We select a phenotype that best adapts to our territory.
It must be taken into account that since Argentina is such a large territory and has different climates, this is very important, since it will give us better results. Also this work, what it aims is for beekeepers to know the biological cycle of bees and from there they can plan the tasks to be carried out at each moment of the year, focused in this case on the multiplication of the apiary and replacement of queens. For this, what is shown are the times needed to organize and place orders for queen cells or mated queens that will allow us to make a new colony or change an old queen, knowing that it cannot be done from one moment to the next. In a timeline we see the days required from when the cells or queens are ordered, introduction into the nucs, birth and beginning of lay. Finally, there are known results of losses and gains of making nucs with mated queens, queen cells or letting the bees make their own queen. Demonstrating with numbers and percentages which is the best option.

PP-511 [Beekeeping for Rural Development]
Urban beekeeping: benefits and detriments

Gorazd Trušnovec
Urban Beekeepers' Association of Slovenia

Urban beekeeping is an interesting activity, flourishing with the popularization of the world beekeeping in general. In some world capitals, this activity has experienced rapid growth over the last decade. It reminds us of the importance of living in healthy environments and green cities. Then there is the reminder of the importance of food self-sufficiency. Urban beekeeping and bee products can contribute to locally produced food with a low carbon footprint, no transport and, above all, a symbolic message about the importance of growing our own food in an environment free from pesticides and the poisons associated with intensive agriculture. Urban beekeeping can also be used for a wide range of educational activities in cities and can have a positive social impact. However, recent evidence shows that densifying and increasing the number of honeybee colonies does not only have positive effects. The carrying capacity of space is limited and as the number of hives has increased, honey yields have started to decline - partly due to climate change. There is increasing scientific research that says that too many honeybees mean a lack of forage not only for bees but also for other pollinators that are equally or even more important - and increasing and concentrating honeybees also helps spread different diseases faster. A “heretical” idea emerged in scientific circles that honeybees do not necessarily have only positive effects on biodiversity and that the limitless expansion of beekeeping is not the best thing we can do for nature conservation. Then there's also a topic that is still not talked about enough: the carbon footprint of beekeeping, which is far from neutral. As beekeepers, we should therefore behave responsibly and think about the number of bees we care for and the impact on the environment. The carrying capacity of space has its limitations and we cannot overcome biology with our ideology. Thus, urban beekeeping, which has experienced the fastest growth in the last decade, should be approached in a more holistic way. If we're serious about sustainability, this activity should be seriously considered from different perspectives.

PP-513 [Beekeeping for Rural Development]
STATUS OF STINGLESS BEES IN TANZANIA: ECOLOGY, PRODUCTIVITY AND MANAGEMENT

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BACKGROUND: Beekeeping activities in Tanzania have long been practiced using the western honey bee, ""Apis mellifera" L. However, only in recent years has beekeeping with stingless bees begun to gain pace. To date, there is limited documentation regarding their ecology, distribution, productivity, and management. This study explored the status of stingless bees in Tanzania, specifically focusing on species richness, distribution, hive designs, stocking techniques, and management practices.

METHODOLOGY: A total of 68 stingless beekeepers from 26 districts across 16 regions in mainland Tanzania and Zanzibar islands were visited and interviewed to gather information on the type of bee species they keep, the hive designs they use, their stocking methods, and their management practices.

RESULTS AND CONCLUSIONS: The findings indicated that "Axestotrigona" species were the most widely managed across the country, with the exception of coastal areas and Zanzibar islands, where ""Hypotrigona"" species were prevalent. Wooden box hives were commonly used, occasionally featuring vertical or horizontal partitions to separate brood and food storage chambers. Traditional hives were also observed, made from split and non-split logs, barks, straws, grasses, bamboo internodes, and baobab fruit shells. Four types of meliponary layouts were noted: tree, breast-height (or stand), house-eaves, and meliponary shades. Notably, house-eaves meliponaries were the most common across all districts. The primary technique for stocking stingless bees involved transferring established colonies from wild nests to managed hives. Although not common, colony splitting and trap-nest techniques were also utilized in some areas. The majority of respondents practiced stingless bee-keeping near their homesteads, allowing for easy and regular inspection. These findings highlight a significant growth in the stingless beekeeping industry in Tanzania, demonstrating a huge potential for income generation. Further research is needed to optimize the management of local stingless bee species and enhance sustainability of the practice in Tanzania and Africa at large.

PP-518 [Beekeeping for Rural Development]
Aging Dynamics in European Beekeeping: Trends, Causes, and Future Prospects

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The beekeeping sector plays a crucial role in European agriculture, not only in honey production but also in pollination and biodiversity conservation. However, a growing challenge is the declining participation of younger generations in both national and international beekeeping activities. The European beekeeping community is experiencing a demographic shift, with an increasing proportion of older beekeepers and fewer young individuals entering the field. This study discusses whether this aging trend poses a significant challenge to the sustainability and resilience of the sector and explores its potential long-term implications for agriculture.

To investigate this issue, a survey was distributed through the networks of the National B-THENET Centers across 13 European countries. The survey collected both official data on the age distribution of beekeepers and expert insights into the causes and consequences of this demographic shift. Expert opinions were gathered on challenges in attracting younger generations, and the impact of an aging workforce in the sector. Additionally, information on programs and initiatives aimed at supporting young beekeepers were collected.

The analysis of official data revealed a pronounced aging trend, with beekeepers under the age of 40 representing less than 15% of the total number of beekeepers in most countries. According to the experts, barriers to youth engagement in beekeeping include limited access to land, high start-up costs, and competition from alternative career paths, particularly in urban areas. Experts noted that many younger beekeepers tend to start as hobbyists or combine beekeeping with other professional activities, limiting the scale of their operations. These findings highlight the need for targeted policies and support mechanisms to encourage youth participation in beekeeping. Further research and discussion are essential to develop effective strategies that ensure the sector's long-term sustainability in European agriculture.

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PP-519 [Beekeeping for Rural Development]
Promoting Pollinator Friendly Landscapes in Rural India

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Pollination is vital for food security in India, yet habitat loss, agrochemicals, deforestation, and intensive farming threaten pollinators. When natural habitats decline, pollinators and their essential services diminish.

Under The Mango Tree Society (UTMT Society) India, through its Bees for Poverty Reduction Programme (operational in 282 villages), promotes pollinator-friendly rural landscapes by integrating sustainable beekeeping into smallholder agriculture. The initiative raises awareness in indigenous communities about the need to shift away from unsustainable honey-hunting practices and adopt sustainable beekeeping methods, ensuring that local pollinator populations are conserved and thrive. Sensitization campaigns have led to a 70% reduction in unsustainable honey-hunting and agricultural practices, improved pollinator presence (with almost 90% of beekeepers reporting an increase in local bees and pollinators), enhanced crop yields (for vegetables, oilseeds, pulses, fruits, and forests), supported biodiversity, and created supplementary income opportunities (with an average annual income increase of $315 per beekeeper from pollination-related activities).

Harnessing local knowledge, UTMT Society revives and leverages traditional understanding of indigenous bee species, helping build resilient agricultural ecosystems. This enables smallholders to maintain bee colonies that enhance natural pollination, reducing the reliance on chemical fertilizers and pesticides. In turn, this improves soil health, supports forest regeneration, and promotes growth of local flora.

Additionally, pollinator-friendly flora is promoted through the distribution and planting of seeds (sunhemp, pigeon pea, sesame, mustard, etc.) and saplings (mango, coconut, cashew, moringa, lemon, apple jujube, etc.), ensuring year-round forage availability for local bees. This boosts honey production, enhances and strengthens local ecosystems by supporting a diverse range of pollinators. Resource-poor smallholders (86% of whom find the initiative beneficial) benefit from harvesting readily available produce for self-consumption, while surplus crops are sold in local markets, improving food security and nutrition. The intervention also encourages beekeepers to cultivate fallow land, improving the green cover of the area by approximately 15%.

UTMT Society fosters a self-sustaining model, empowering rural communities to become stewards of their landscapes. The program demonstrates that pollinator conservation and rural livelihoods can go hand in hand, positioning beekeeping as a powerful tool for poverty alleviation and environmental sustainability.

PP-520 [Beekeeping for Rural Development]
Creation of the first sensory panel of honeys in Uruguay

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Uruguay is a country in South America known for its green landscapes and beach-lined coast. It is a major honey producer, with an annual production of approximately 13.000 tons, making honey the most economically important product derived from beehives. However, around 90% of the honey produced is exported in bulk, without differentiation. Despite Uruguay's comprehensive regulations and a traceability system, establishing protocols that allow our honeys to be presented in a differentiated way in the market is essential, given the significant economic impact of the production and export of this product. To strengthen the competitiveness of the sector, it is crucial to implement quality and differentiation standards in the marketing of honey. These standards include a sensory description of the product, which must be carried out by evaluators selected and trained specifically for this purpose. The main objective of this work is to develop and implement the first panel of judges trained in Uruguayan honeys, which will support research activities and provide services to the beekeeping sector, contributing to the characterization and valorization of honeys produced in the country. The development of the panel was carried out in several stages: Recruitment, through an open call for volunteers and an online survey; Selection, based on tests assessing basic tastes identification, odor recognition, color and texture ordering, and triangular tests; Training, where participants were trained in the use of specific vocabulary and evaluation scales to improve both the sensitivity and response of the group; Validation, involving periodic tests to assess the performance of the evaluators; and Evaluation of samples of interest, stage in which the evaluation of the selected samples is carried out. Commercializing and exporting honey with differentiated characteristics is crucial to obtain better sales prices and generate higher income for beekeepers, which plays a fundamental role in the development and sustainability of the beekeeping sector in Uruguay. Establishing this panel will allow to highlight the unique qualities of each honey, strengthening the positioning of Uruguayan honeys in markets.

PP-522 [Beekeeping for Rural Development]
Protected Geographical Indication Miel de Galicia: Preserving Quality, Identity, and Origin of honey

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BACKGROUND: Honey is an agricultural product closely connected to the geographical area of origin, since environment, flora, honey bee type and hive management determine its botanical, sensory and physicochemical properties. In addition to provide pollination services, beekeeping plays a vital role in the rural economy and the cultural heritage of many areas around the world. In the case of Galicia (Northwest Spain), it is an Atlantic beekeeping, with small apiaries, located mainly in mountainous and forest areas. Due to the significance of honey production in this area and the reputation given by consumers, the quality label "Mel de Galicia" was officially recognized in 1988. Since 2007, Miel de Galicia has been registered in the EU geographical indications system as a "Protected Geographical Indication (PGI) Miel de Galicia".

PROBLEM DESCRIPTION: Globalization promotes trade in undifferentiated products, favoring the appearance of frauds. Due to the healthy properties attributed to honey and the value of this product in rural areas, the establishment of geographical labels allows its valorization.

METHODOLOGY: This paper analyzes the role of the PGI Miel de Galicia in the beekeeping sector almost 40 years after its creation.

RESULTS AND CONCLUSION: The PGI Miel de Galicia protects the honey production of Galicia safeguarding this product against potential frauds. Currently, the PGI Miel de Galicia covers nearly 40,000 hives in almost 1,000 apiaries, 60 registered trademarks and 45 packaging companies, most of them small and medium-sized. Over the existence of this quality label, the beekeeping sector has undergone a transformation toward better technical capabilities and greater professionalization. This quality scheme has acted as a trigger for beekeeping, leading to an increase in production capacity, as well as an increase in the number of producers and packers. Furthermore, geographical indications promote clear and differentiated labelling, serve as a quality reference, protect against frauds in origin, promote the consumption of local foods and guarantee the traceability of honey, as well as preserving beekeeping traditions and contributing to rural development.

PRACTICAL IMPLICATIONS FOR BEEKEEPERS: This communication highlights the value of geographical indications (PDO and PGI) in enhancing the reputation of honey and promoting beekeeping.

PP-523 [Beekeeping for Rural Development]
Twenty-eight years of National Apiculture Programme - what has evolved in Portuguese beekeeping

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Beekeeping is an agricultural activity, but its marked specificity conditions its integration into Common Agricultural Policy. In fact, the aid provided by the CAP is linked to land use and is paid on the surface, which makes it impossible to create viable aid for the beekeeping sector: In Portugal, the majority of Portuguese apiaries are installed on other people's properties.

In 1997, the European Union, through Regulation (EC) No. 1221/97, established a specific support program for the beekeeping sector (three years), with the aim of (1) supporting consolidation as an economic activity that contributes to rural development, (2) reinforcing the production and quality of honey produced by European beekeepers, (3) balancing the European trade balance and (4) combating the spread of Varroosis in the Member States and the problems raised by this disease in the production of quality honey.

However, after implementing nine three-year programs, it is important to understand how they contributed to the evolution, transformation and modernization of the beekeeping sector in Portugal.

Twenty-eight years since the start of implementation of this support tool, we analysed data relating to (1) its financial and material execution, (2) the evolution of the sector (demography, structure and size of farms, diversification of production) and relating (3) the national, community and global honey market (production, price, trade balance, economic value).

This allow us to assess whether and what results were obtained:
– how Portuguese beekeepers are like today and what constraints they have at a technical level;
– what progress has occurred on honey quality?
– has honey production increased?
– Is Varroosis “under control”?
– Is the honey market more regulated?

The data collected, and the answers they provided, gave us tools to propose the readjustment of the objectives, measures and beneficiaries of the Portuguese National Apiculture Programme, to the current demands of the beekeeping sector and sectoral policy.

PP-524 [Beekeeping for Rural Development]
Enhancing Propolis Production: A Strategic Approach to Boost Beekeeping Profitability through Effective Mediation

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Beekeeping is widely recognized a sustainable activity, increasingly common in both monocultural and multicultural rural areas. The growing demand for more sustainable crops and products and health-concious, organically produced food of recognised and certified origin, has driven beekeeping diversification [1]. The establishment of bee farms offer several benefits: economic, by generating income for farmers; social, by creating rural employment opportunities and mitigating rural exodus; and ecological, because bees act as natural pollinators of native and cultivated species, thereby preserving biodiversity and maintaining ecosystems balance [2].

Recently, declining demand for high-quality honey has led many beekeepers to explore other hive products as new sources of income, particularly propolis production. This resinous substance gathered by bees from plant exudates has significant commercial value due to several bioactivities, such as anti-tumor, anti-inflammatory, antimicrobial and antioxidant properties [3].

Until 2012 in Portugal, propolis production was largely neglected due to limited production and low market demand. Stimulating propolis production within beekeeping operations can substantially increase profitability [4] by diversifying hive products and optimizing resource utilization. This study examines the benefits of enhancing propolis production through strategic hive management techniques, including specialized collection methods and selective breeding. It also highlights the critical role of a facilitator who bridges the gap between beekeepers and the industry, ensuring quality standards and facilitating market access. Recent research indicates a rising demand for propolis in pharmaceuticals and functional foods, emphasizing its economic potential [4]. By integrating propolis harvesting into beekeeping practices and employing effective mediation, beekeepers can achieve higher yields, improved colony health, and increased financial returns. Therefore, stimulating propolis production, supported by dedicated intermediaries, represents a promising strategy for sustainable and profitable beekeeping.

PP-527 [Beekeeping for Rural Development]
From honey hunting to beekeeping - Tamil Nadu, India

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Indigenous communities in Tamil Nadu, India, have traditionally practiced honey hunting as a key livelihood. However, increasing government-driven settlement policies and environmental concerns have prompted the need for a more sustainable alternative. This study examines the transition from honey hunting to beekeeping as a safer and more viable livelihood option for forest-dependent communities. Given their existing knowledge of honeybee behavior and seasonality, these communities can adapt to beekeeping with greater ease and success.

Honey hunting from wild colonies poses significant risks to both people and biodiversity. Lengthy forest treks, hazardous harvesting conditions, and habitat destruction endanger both honey hunters and native pollinators. Additionally, economic hardships limit access to education, particularly for girls, increasing the risk of child marriages. A safer, more sustainable source of income is needed to address these challenges.

SEEDS Trust, an NGO dedicated to nature conservation and sustainable rural development, has introduced beekeeping as an alternative livelihood. Their initiative promotes the domestication of "Apis cerana", supports community-run tree nurseries, and actively involves women in sustainable practices. These efforts not only provide economic opportunities but also contribute to environmental conservation.

Beekeeping offers a safer and more efficient method of honey production compared to traditional honey hunting. It reduces physical risks, provides a stable income, and enhances food security. The financial benefits enable families to invest in education and reduce poverty related problems. Furthermore, pollination by managed bees boosts organic crop yields, benefiting local agriculture.

By integrating beekeeping with conservation efforts, communities can achieve both economic stability and biodiversity preservation. The domestication of "Apis cerana" ensures sustainable honey production while supporting forest ecosystems, empowering rural communities—especially women—to build long-term social and environmental resilience.

PP-528 [Beekeeping for Rural Development]
The Environmental State of Beekeeping in The Solomon Islands

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The purpose of this experiment is to analyze beekeeping in the Solomon Islands, given the recent introduction of Asian honey bees, Apis cerana, and elimination of European honey bees, Apis mellifera. Since their introduction in 2003, Asian honey bees have eliminated European honey bees and thus, prevented honey production in most of the country. There are, however, some subsisting European honey bee colonies remaining. In this project, I will interview beekeepers in the Solomon Islands, and gather data regarding hive numbers, the population of each hive, and the history of their beekeeping operations. Because of the large loss of European honey bees, there is no systematic data of this kind, and the beekeeping operations that remain have little to work from. I will also study the lifestyle of beekeepers on the islands, looking into their motivations, history, and changes in practice to combat environmental changes and challenges regarding managing their bees. These data will inform the future of beekeeping on the islands, and lead to research-based suggestions on the most effective way for beekeepers to cope with environmental issues, such as logging or invasive species proliferation. These data can then be applied en masse to beekeepers outside of the Solomon Islands, focusing on highlighting which environmental factors are the most influential and making note of the best practices for resisting challenging environmental factors. By coordinating beekeeping practices with the needs of the environment, beekeepers can make their operations more effective and of a higher value, requiring lower maintenance and operating more consistently.

PP-531 [Beekeeping for Rural Development]
"Belacolmea": cosmetics to diversify and make beekeeping more profitable

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BACKGROUND: Beekeeping in Galicia (NW Spain) is currently undergoing a difficult situation due to several issues. The recent introduction of the invasive species Vespa velutina, the difficulty to control the varroa infestation rate and the impact of climate change, among other factors, are leading to severe economic losses and an uncertain future. Most apiaries depend economically on the sale of honey and therefore, the diversification of products can be an interesting alternative to increase family incomes.

DESCRIPTION OF THE PROBLEM: Some beekeepers were producing home-made cosmetics with high production costs and a lack of quality assurance. For this reason, the Agrupación apícola de Galicia (The main beekeeping Association in the area) decided to develop a cosmetic line serving as brand that could provide beekeepers with quality cosmetics helping them to increase their incomes.

METHODOLOGY: Different master formulas were created based on products from the beehive (honey from the PGI Miel de Galicia and propolis) and essential oils, thus creating a totally natural beekeeping cosmetic. These formulas were tested on volunteers to check their results and ensure that each product launched on the market is consistent, safe and effective.

RESULTS AND CONCLUSION: Nine different products have been launched on the market: natural soap with honey and propolis, face cream, body and hand cream, "apireparador" (a balsam for damaged skin, skin blisters and abrasions, different balsams (lips, feet) and a cream for local pain relief. Studies have shown that these cosmetics have very good results for their intended purposes, including skin moisturising and in the case of the facial creams the anti-ageing effect. The product line is on sale and the packaging associates the products with Galician beekeeping and Galician Honey. A new line of cosmetics has been created based on bee products.

CONCLUSION AND PRACTICAL IMPLICATIONS FOR BEEKEEPERS. This is an innovative project helping beekeepers to improve their income so that they can live in the countryside and from the countryside, settling the population in rural areas.

PP-533 [Beekeeping for Rural Development]
Fairtrade as a tool for development, sustainability and market access

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For more than three decades, Fairtrade has been making an impact on the way trade works. Every producer should have access to a better way of doing business, and a better way of living. Fairtrade is the most recognized and trusted sustainability label and a leader in the global movement to make trade fair.
CLAC is the Fairtrade producers' network in Latin America and the Caribbean. It has around 1,000 member organizations in 23 countries. They represent more than 500,000 producers and workers and their main products are: coffee, banana, cocoa, sugar, honey, fruits, flowers, grapes for wine, quinoa and others.

Small beekeepers' organizations face many challenges such as compete in the global market, strengthen its capacity to adapt to climate change, get fair prices for their honey and decent working conditions. To have a voice for genuine honey producers at a global scale and offer a better future for young people are also important issues that need to be addressed.

Fairtrade aims for a world in which all producers enjoy secure and sustainable livelihoods, fulfil their potential and decide on their future. To achieve these, the system works on 3 levels: economic, social and environmental.
Fairtrade sets minimum prices for honey, providing a safety net against market volatility and beekeepers receive the market price when it is higher. The system has a Fairtrade premium that is paid directly to producer cooperatives, who decide democratically how to use it. Also, it promotes sustainable trading relationships with pre-financing possibilities for the beekeepers' organizations. Compliance with International Labour Laws (ILO) and national laws, health & safety requirements, non-discrimination, gender equality and explicit regulations against gender-based violence, forced labour, and child labour.

Sustainable management of natural resources and good practices are promoted.
To embed fairness in trade policy, we unite our voice with farmers, the Fair Trade Advocacy Office and other organizations to push human rights and decent livelihoods higher up the political and economic agenda.
Fairtrade Standards support compliance with HREDD regulation, guiding supply chain actors to prevent and mitigate human rights and environmental risks.

PP-534 [Beekeeping for Rural Development]
Beekeeping and opportunities in a Patagonian prison

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There is a prison institution in Argentine Patagonia, in the city of Cipolletti, Río Negro. There, a beekeeping course-workshop has been held since 2018 where the beekeeping trade is learned. It began with just a swarm captured on the street, and from a pedagogical hive the quantity was multiplied, until there was one for each student. The first honey harvested, in February 2019, was sent to an international honey competition (Mercosur), obtaining the first prize in its category (dark honey). This recognition produced an attentive and focused look on the part of society, since prison is not always seen as a place of opportunities and good news. Learning and work are two pillars that can strengthen the self-esteem of a person deprived of liberty. In particular, in this northern area of Patagonia, the summer months allow one to go through the different stages of honey production, from the awakening of the hive in spring, until the arrival of autumn. The project is a great incentive to think about a more or less immediate future, for people who are released, or those who will spend a few more years inside. It has allowed those who learned and left prison as beekeepers to have a real trade and work. Also within the institution we have apiaries for prisoners who, thanks to their focus on production and the opportunities that this activity provides, have found a great investment of their time and dedication to a cause that dignifies them. Beekeeping as an activity has provided a real possibility for vulnerable people, who by having a trade and a job find tools for their own well-being, that of the human beings around them, that of the bees and also the environment itself. The honey harvest has been a beautiful and sweet symbol in a hostile place that, even in its most difficult side, finds hope in education and beekeeping production.

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