



47th APIMONDIA

International Apicultural Congress

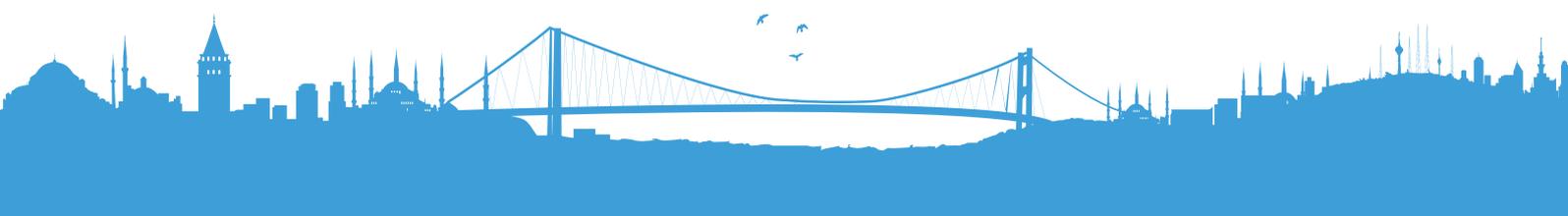
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ABSTRACT BOOK

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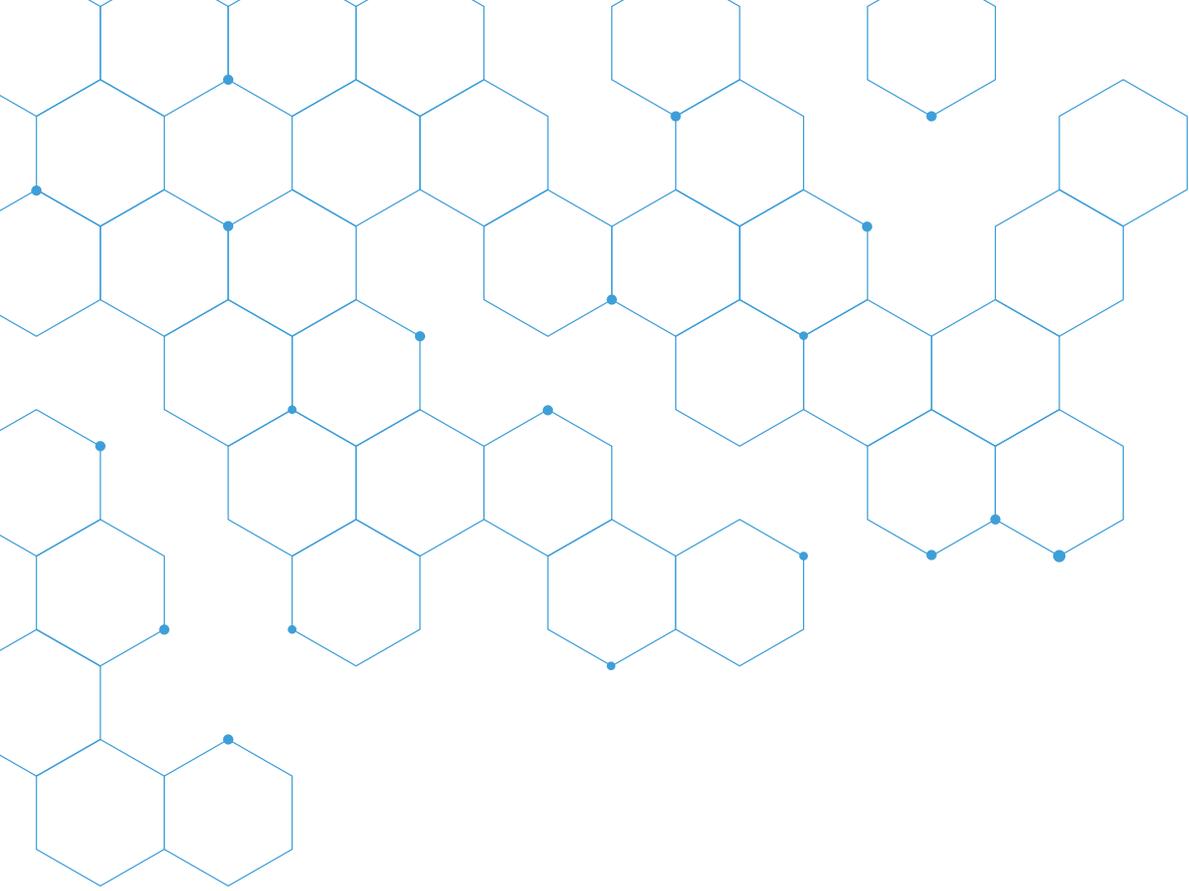
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ORAL PRESENTATIONS



Economic anomalies

Etienne Bruneau

Apimondia Federation

Few countries and operators are heavily involved in the international trade in honey. A detailed analysis of the honey on the marketplace is possible and can draw attention to elements that may be considered suspicious. These economic or statistical « anomalies » should draw the attention of potential buyers and controllers to the presence of potential problems for a particular source of honey. A honey fraud mitigation guidance include an evaluation of indicators like: less-than-market or unusually stable pricing, large price variation for honey from a country according to destination (quality) requirements, unexpected increases of exportation volumes (no correlation with the real potential of production) from a particular country or region, or high correlation between increasing imports and exports from a country. This presentation will illustrate few of these cases through several key operators.

Few countries and operators are heavily involved in the international trade in honey. A detailed analysis of the honey on the marketplace is possible and can draw attention to elements that may be considered suspicious. These economic or statistical « anomalies » should draw the attention of potential buyers and controllers to the presence of potential problems for a particular source of honey. A honey fraud mitigation guidance include an evaluation of indicators like: less-than-market or unusually stable pricing, large price variation for honey from a country according to destination (quality) requirements, unexpected increases of exportation volumes (no correlation with the real potential of production) from a particular country or region, or high correlation between increasing imports and exports from a country. This presentation will illustrate few of these cases through several key operators.

Pure and Authentic Honey in Human Health

Cristina Mateescu

Apimondia Federation

According to Codex Alimentarius “Consumers have the right to receive truthful information about the food that they are going to consume!” All the definitions make it clear that honey is a completely natural product. As such, the Codex specifies that no food additives are permitted in honey and even the product stored in the cells of the honeycomb when bees are fed sugar or syrups cannot be considered to be honey. Although some countries permit the sale of manufactured substitutes for honey so long as these are not deceptive, other countries specifically prohibit the sale of products described as “artificial honey” or “imitation honey”.

Then a simple question arises: “Do we know what we eat? How pure is the honey that we eat? The effects of adulterated honey consumption towards human health is not widely known and this is happening mainly due to lack of systematic and scientific studies and the low public awareness. The food label offers information about the ingredients and part of the food composition as salt, added sugars, total fat, saturated fats and cholesterol. Studies show that added sugars can be empty calories that increase the risk for obesity, heart disease, high blood pressure, liver diseases and even cavities. However, the usefulness of the information on the label, in order to choose the right food, depends on the consumer to have an education on the main concepts of food and nutrition and to read them. In general, and unfortunately, the nutritional value of a specific food product is not one of the main criteria on its election, the price, availability and sensory properties (flavor) of the product being the main ones.

More 300 types of honey are recognized today. These varieties are related to various types of nectar or honeydew collected by honeybees (bees). Pure and authentic such honeys have higher nutritional value, contain specific biological active compounds with stronger activities, while adulterated honey (irrespective of the type of adulteration) has a low nutritional value and sometimes unpleasant, even dangerous effects on human health. The beneficial effects of pure and authentic honeys vs. adulterated honeys will be discussed.

The Horizon 2020 B-GOOD project of the European Commission paves the way towards healthy and sustainable beekeeping within the European Union

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The B-GOOD project aims to test and implement a common index for measuring and reporting honey bee health status (= Health Status Index, HSI), which will aid risk assessors, authorities and the plant protection and veterinary medicines industries to measure health status in real time and across geographical locations, as well as evaluating the effect of (beekeeping) management decisions and actions. Data collection on colony (health) status related components occurs according to a 3-tiered process that spans three bee seasons. New innovative tools will soon be available and will provide additional information about, among other things, vibrational communication, gas composition in the hive and the genetic predisposition of resilience of the colony. Our socio-economic study has identified 18 key attention points for policy and strategy development. We have laid the foundation for a dynamic landscape model across the EU, capturing the major floral resources. We will soon be able to make the HSI operational capitalising on machine learning and modelling.

Tropilaelaps spp; Risk Assessment for Türkiye

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Tropilaelaps is an ectoparasite that does not survive long without honey bee brood which feeds and requires stay. The infestation and feeding activities cause honey bee brood mortality and reduce the lifespan of adult honey bees. Tropilaelaps agent was identified in 11 and Iran. As a result of its spread to the immediate neighbourhood of Turkey, the disease was included in the list of compulsory notifiable diseases in 2012. Given the presence of the disease in neighbouring Iran, and the potential for spread through the border, provinces bordering this country are at potentially high risk. A spreadsheet using RiskAMP add-in for Excel was constructed with a probability distribution for each route of introduction as per the adopted pathways; i) hazard identification; ii) identification of risk pathways; iii) assessing of risk for introduction with identified pathways; and iv) consequence assessment and assessing the risk that Tropilaelaps becomes endemic after introduction in Turkey. The simulation was conducted using the Monte Carlo method. The method is useful to count for the biological variability and diversity in health events.

According to the results of the simulation, the highest likelihood of introduction comes from bee plundering (9/15) and illegal introduction of infected colonies from infected neighbouring countries (6/15). The mean probability of introduction of Tropilaelaps infestation after 1000 iterations of the constructed model is 0.64 per 1,000 events/days (or 6.4 within 10,000 events/days i.e. 27 years).

Given the very similar characteristics of Tropilaelaps with Varroosis, the eventual introduction of Tropilaelaps in Turkey will result in slow but progressive spreading of the infestation throughout the country with very similar consequences which are currently assessed to be up to 100,000,000 US dollars. Control of Tropilaelaps is similar to the control of Varroosis except that insecticide cannot penetrate into the brood combs of the colonies which have brood during the winter, therefore the control is harder and with more consequences. Given that 80% of the apiaries are in warmer regions of Turkey, additional costs for insecticides will be required and are assessed as an additional about 10 million US dollars.

Are oxytetracycline – resistant isolates of *Paenibacillus larvae* circulating across Saskatchewan beekeeping operations?

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American foulbrood (AFB) is a fatal infectious disease of honey bee brood caused by the Gram-positive, endospore-forming bacterium *Paenibacillus larvae*. Disease transmission occurs when newly emerged honey bee larvae ingest *P. larvae* spores which germinate within the larval midgut leading to fatal septicemia. *P. larvae* spores are resilient in the environment and thus colonies showing clinical signs of AFB must be destroyed by burning to eliminate the disease. To prevent outbreaks of AFB, oxytetracycline (OTC) metaphylaxis is widely used in North America, resulting in the emergence of OTC – resistant *P. larvae* isolates. To the best of our knowledge, antimicrobial resistance (AMR) screening of Saskatchewan *P. larvae* isolates has not been performed. To determine if resistance to OTC is emerging across Saskatchewan commercial beekeeping operations, we performed a microbiological screening test on *P. larvae* isolates from previously collected library using media with 2 µg/mL OTC as a susceptibility cut-off. Additionally, isolates that exhibit resistance on selective plates were used to determine minimum inhibitory concentration (MIC) and minimum bactericidal concentration (MBC). We found that 65 out of 718 *P. larvae* isolates were resistant to OTC with MIC and MBC values ranging from 64 to 256 µg/mL and 128 to ≥256 µg/mL, respectively. Majority of OTC – resistant *P. larvae* isolates were found in Northeast Saskatchewan within a 240 km area, which could indicate their close clonal relationship. These results show the existence and circulation of OTC – resistant *P. larvae* isolates in Saskatchewan commercial beekeeping operations, despite the majority of tested isolates being susceptible. Furthermore, these results may reflect the potential for a decline in the efficacy of an OTC – based metaphylactic approach for the prevention of AFB. Further investigation will incorporate microbiological screening for tylosin and lincomycin as well as whole genome sequencing to fully describe the resistome of *P. larvae* in Saskatchewan.

International risk assessment tools: the FAO survey to investigate on antimicrobial resistance, antimicrobial use, the good beekeeping practices and the biosecurity measures in beekeeping

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The Food and Agriculture Organization of the United Nations (FAO) and the Istituto Zooprofilattico Sperimentale del Lazio e della Toscana “M. Aleandri” (IZSLT), in collaboration with the Appalachian State University, the International Federation of Beekeepers' Associations (APIMONDIA), and TECA, launched and disseminated through the FAO website, an international survey to investigate on antimicrobial resistance, antimicrobial use, the good beekeeping practices and the biosecurity measures in beekeeping worldwide.

The on-line survey is completely anonymous, available in the 5 FAO languages (English, French, Spanish, Arabian, Russian) and it is inspired by the FAO Guidelines on the responsible use of antimicrobials in beekeeping (<https://www.fao.org/documents/card/fr/c/cb6918en/>). It is organized in four sections: the first section collects some demographic information of the respondents, the second section will ask the beekeeper to assign some pictures to specific honey bee diseases and to indicate the level of usefulness of some good beekeeping practices, according to their experience. The last section of the survey will investigate the awareness of respondents on treatments, antibiotics use and antibiotic-resistance.

The survey is shared through FAO AMR, TECA, Apimondia, the Appalachian State University and IZSLT websites. Data collection will end on December 2022 and a statistical analysis will be performed. The final goal, in line with the FAO Action Plan on AMR 2021-2025, is to raise awareness on AMR among the beekeepers and promoting good practices and responsible use of antimicrobials in beekeeping.

Analysis of Pathogens Associated with Winter Colony Losses in Canada

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Canadian beekeepers report that high pathogen/parasite infestation levels, poor queen quality and severe weather conditions are the leading causes of elevated wintering losses. In order to replenish annual losses or maintain their operations, beekeepers in Canada face a unique and difficult situation for purchasing new queens or package bees. Scarce local supply drives local producers to import approximately 300,000 queens and package bees each year, predominantly from foreign sources. This large-scale importation of stock may contribute to the introduction of undesirable pathogens or genetics, and supply bees that have not been selected to survive and prosper in northern temperate climates, thereby influencing wintering success.

Honey bees act as a host for a multitude of pathogens and parasites. Nevertheless, the interactive effects that many of these pathogens, endoparasites and ectoparasites have on colony wintering success remains poorly understood. In order to better understand these interrelationships, we studied colony health and wintering success as a part of a national-scale study in Canada. In 2016 and 2017, we sampled 1025 and 520 colonies, respectively, across five Canadian provinces. During each experimental year (May through April), we collected pre-winter phenotypic data (fall colony weight and cluster size), and samples for pathogen analysis (*Nosema* spp., *Lotmaria passim*, DWV-A, DWV-B, BQCV, SBV, and phoretic loads of *Varroa destructor*) from colonies in all locations to investigate the main drivers of colony winter mortality. We also studied colonies wintered outdoors, as well as those wintered inside specialized wintering facilities. Although winter mortality was statistically similar between 2016 and 2017, indoor-wintered colonies had greater survival than those wintered outdoors (92% vs 77%). Irrespective of wintering method, consistent influences were seen across both experimental years, based on logistic regression modelling. Elevated levels of DWV-A, DWV-B, BQCV and fall phoretic mite loads increased the risk of colony death during winter, whereas higher fall colony weights, larger cluster sizes and increased sealed brood areas exerted positive influences on survival outcomes.

Effect of abscisic and p-coumaric acids as food supplements and stimulants of the cellular immunological system of Africanized hybrids of *Apis mellifera*

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Honey bee colonies determined as *Apis mellifera scutellata* haplotype A1 were administered with a food supplement of sugar syrup mixed with p-coumaric acid (CUM), to test its supposed antioxidant effects, abscisic acid (ABA), to test whether it promotes innate immunity in bees, the combination of both (ABACUM), and syrup as a control. During three months, the number of cells with brood, honey and pollen reserves, as well as the concentration of hemocytes in worker bees were counted. Besides, *Varroa destructor* and *Nosema ceranae* were monitored. At the concentration used, ABA and CUM had no effect on oviposition; however, there was a significant increase in the number of cells with brood or with honey and pollen reserves between the beginning and the end of the study. Regarding the monitoring of *V. destructor*, there were no significant differences between treatments; this mite did not cause obvious damage, seemingly because the experimental (Africanized) bees are considered tolerant to its infestation. There were no significant differences between treatments in infection by *N. ceranae*; however, there was a significant decrease in intensity, prevalence, and abundance of spores between the beginning and the end of the study, which was associated with the fact that the bees collected nectar, and this resulted in the development of colonies. The number of hemocytes did not show a significant difference between treatments, but there was a significant increase between the first and the last evaluation. Neither ABA, CUM or ABACUM produced the predicted effects on the experimental bees. The results found in africanized hybrids in Mexico differ from those reported in Argentina with European bees where the findings are significant in the development of the colonies, which suggests the resistance or adaptation of Africanized hybrids of honey bees to tropical regions.

Artificial rearing of “*Galleria mellonella*” and effect of polystyrene and two biopesticides on larval feeding behavior

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The Greater Wax Moth (GWM) “*Galleria mellonella*” is a pest of honeybees. It causes severe damages and losses if it is untreated. Viewing the difficulties encountered by the beekeepers when chemically controlling this pest, and the harmful effect on the brood and honey production, we have launched an artificial mass production of the local wax moth. Then we studied the effect of two biopesticides against this insect: Neem oil and “*Bacillus thuringiensis*” subsp “*kurstaki*” (Btk). We also evaluated the ability of the fourth larval stage of GWM to degrade polystyrene. Our results showed that at the level of the local GWM population, the complete life cycle was 36 ± 3.4 days at an average temperature of 31 °C and 33 ± 2 % RH. As for L4 larvae that were force fed with a diet treated with Neem oil, 60 % mortality was observed and the remaining 40 % developed into abnormal adults. Whereas larvae fed with Btk diet, 34 % mortality of L4 was induced, and the remaining 66 % did complete their life cycle normally. Furthermore, 91.5% of tested larvae ate an average of 15 % of their polystyrene diet cubes in 10 days and died after these 10 days. In the control group, 100 % of larvae continued successfully and emerged as adult moths in an average period of time of 20 days. These emerged female moths had deposited an average of 40 ± 3% eggs between cover edge and container, 30 ± 2 % eggs between covering mesh tissue and cover, 20 ± 2 % eggs in artificial diet dough and around it and 10 ± 1% eggs between polystyrene and plastic container edge. As conclusion, the diet has an effect on larval development and the biopesticides are effective on larvae even at advanced stage as fourth larval stage.

LAMP-technology: bringing molecular virus detection to the kitchen table

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Our team has recently discovered a trait that enables to identify honey bee colonies with resistance to virus infection. The trait requires the molecular detection of viruses in a sample of 10 eggs taken from the drone brood frame. It was demonstrated that absence of bee viruses in the egg sample is a good indication of the health status of the queen and of the potential of the colony to cope with viral infections. So far, the molecular detection of bee viruses is based on viral genome fingerprinting and demands a sophisticated laboratory with – among other things – a thermocycler that brings the sample through a series of repeated temperature cycles aimed to amplify a highly specific piece of the viral genome. We have recently developed a molecular virus detection tool that works according to the LAMP technology and thus can be performed at a fixed temperature. LAMP stands for loop-mediated isothermal amplification and is a low-cost single-tube technique for the amplification of DNA and RNA that requires minimal equipment. We have developed the tool for multiple bee viruses but in the context of breeding for resilient bees, the detection of deformed wing virus (DWV) was the most appropriate. In this presentation, we will demonstrate how the technique can be performed using simple household equipment. The tool allows to involve the beekeepers in the screening for queens with a genetic predisposition of virus resistance for only a fraction of the current price. This technique could give the breeding of resilient bees an important boost.

Pathophysiological Effects of the Microsporidium *Nosema ceranae* Infection on Worker Honey Bees (*Apis mellifera*)

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Nosema ceranae is an important stressor in honey bee colonies all over the world. *N. ceranae* infection can potentially cause serious economic damage in the industry if left untreated. We conducted a retrospective cohort study to investigate the associations between *N. ceranae* infection and pathophysiological traits occurring in the honey bee body. We used apiary level samples from the National Honey Bee Disease Survey (NHBS). First, we dissected and scored specific tissues of the bees. Next, we compared scores of bees coming and not coming from apiaries with high *Nosema* loads. By this, we found there is a subset of physiological traits with different manifestation patterns between apiaries that had high *Nosema* loads and the control apiaries. Our comparison demonstrated that bees coming from apiaries with *N. ceranae* exposure tend to have more discolored venom sacs, more melanized tissues, more white nodules, and more melanization on their sting glands. This suggests that associations between *N. ceranae* and physiological changes in honey bees can be discovered through a pathophysiological approach.

Chitosan-based gel application on model bees (*Apis mellifera* L.) for healing bite wounds caused by *Varroa destructor*

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Chitin is basically responsible for protecting the body of honey bees against external attacks due to its hard cellulose structure. The chitin-structured body of honey bees is destroyed by *Varroa destructor*, the world's most devastating pest of Western honey bees; causes honey bee decline. *Varroa* harms honey bees not only by feeding but also by the wounds it inflicts. *Varroa* bites cause a hole in the centre of the wound, which is a source of bacterial infection. In this study, the aim was to investigate the potential application of a chitosan-based gel to recover the chitin layer. The experiment was set up in eight cages. *Varroa* bites were artificially created on experimental bees called as model honey bees in cages. Different solutions of a chitosan-based gel at different doses were applied to the cages. Results revealed that *Varroa* bite wounds do not heal until day 9 in control cages. Healing of wounds by chitosan-based gel application on 1–3 and 3–6 days showed dose dependence. In addition, the gel prevented hair loss in honey bees, which was observed as a side effect of *Varroa* infestation. In addition, chitosan dissolved in organic acids is a key advantage for the treatment of *V. destructor* in parallel with wound healing.

American foulbrood risk assessment: Paradigm shift from an individual hive to a “herd health monitoring” in Canadian beekeeping industry

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The North American beekeeping industry is heavily reliant on antimicrobial metaphylaxis to prevent and control outbreaks of American foulbrood (AFB). The infectious spores of *Paenibacillus larvae*, are incredibly resilient and impervious to antimicrobials licensed for use against AFB in North America. Consequently, non-curative indiscriminate antibiotic use is frequently practiced to ensure industry profitability. In the face of growing international concern regarding antimicrobial resistance (AMR), North American beekeepers are inadequately prepared to reduce their reliance on antimicrobials without risk of significant economic losses to AFB. Current methodology to guide evidence-based antimicrobial use through AFB risk assessment relies on the sampling and testing of individual hives and is logistically impossible for large-scale, commercial beekeeping operations to implement.

To address this issue, we evaluated the use of spore detection in conveniently collected, pooled, extracted honey to determine AFB risk at an apiary or commercial operation level within antibiotic-reliant apiculture. Large-scale, commercial honey bee operations in Saskatchewan, Canada, with a history of antimicrobial use and recent outbreaks of AFB were clinically characterized and opportunistically sampled to compare the detection of spores and predictive ability of pooled, extracted honey to the current standard of samples (e.g. brood chamber honey and/or adult bees) collected from individual hives. We demonstrated that pooled extracted honey was predictive of the spore contamination identified through individual hive testing and appeared to have prognostic value in assessing the risk of AFB at the yard or operation level.

Accordingly, we expanded our testing of pooled extracted honey to 52 Saskatchewan commercial beekeepers representing approximately 75% of the province's 110,000 registered colonies. By correlating spore concentrations to the incidence of AFB, we established reliable prognostic threshold at 2 spores per gram of pooled extracted honey for low risk category of AFB. Accordingly, our study suggest that beekeepers who are at low risk of AFB (less than 2 spores/gr in pooled extracted honey) may temporarily cease antimicrobial metaphylaxis providing that ongoing monitoring and other AFB integrated management practices are implemented. Improved evidence-based antimicrobial use in apiculture will reduce the threat of AMR and will help to ensure the sustainability of the North American industry.

Does fungicide exposure or increased bacterial virulence predispose honey bees to European foulbrood during blueberry pollination in north america?

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Honey bee pollination is essential to the profitability of commercial blueberry production in North America. Unfortunately, blueberry growers face a scarcity of commercial pollination services, in part due to outbreaks of European foulbrood disease in blueberry-pollinating honey bee colonies, which can have catastrophic economic consequences for affected beekeeping operations. To understand the predisposing factors for European foulbrood during blueberry pollination, we used an *in vitro* larval infection model to investigate the effect of chronic fungicide exposure and bacterial virulence on honey bee larval susceptibility to European foulbrood. We found that larvae chronically exposed to a combination of four, formulated fungicidal products used in commercial blueberry production had significantly reduced survival, by 24% (p=0.0038), from European foulbrood relative to infected controls, while exposure of larvae to these fungicidal products individually, at the same field-realistic concentrations, did not decrease larval survival from this disease. Additionally, we isolated highly pathogenic strains of *Melissococcus plutonius*, the etiologic bacterium of European foulbrood, from both blueberry-pollinating and non-blueberry pollinating colonies, suggesting that increased *M. plutonius* virulence does not explain the empirical increase in European foulbrood associated with blueberry pollination. Future and ongoing work will characterize the pathogenicity of additional isolates of *M. plutonius*, as well as test the effect of fungicide exposure on larval susceptibility to European foulbrood using an *in vivo*, colony infection model of this disease.

Comparative study between four essential oils, chemical and physical treatments against “*Varroa destructor*” on “*Apis mellifera ligustica*”

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The effectiveness of four essential oils: jasmine oil, neem oil, black cumin oil, and sage oil and a chemical insecticide Apistan® (Fluvalinate 20%) and a physical method (sugar garlic powder dusting) were tested against the honeybee parasitic mite, “*Varroa destructor*”. Cotton stripes saturated with the tested substances were suspended between the middle combs in all treatments during the study and replaced weekly by newly ones. The experiment was carried out with seven groups of three hives containing “*Apis mellifera ligustica*”. Levels of infestation with “*Varroa destructor*” in both the brood and adult honeybees were estimated before and after the treatment, and the fallen mites were counted weekly. A significant difference between the level of infestation on adult bees among treatment groups and the control (p=0.000<0.05) was observed. The number of fallen mites increased weekly to reach a maximum rate of mortality in the fourth week in the different treated groups. However, Fluvalinate and sage oil induced the highest mortality rate between treatment groups (350-400 mites/week). The reduction percentage of *Varroa* mites ranged in descending order as follows: Black Cumin Oil (74%) = Sage Oil (74%) > Sugar Garlic Powder (73%) > Fluvalinate (55%) > Jasmin Oil (51%) > Neem Oil (33%). Therefore, efforts are necessary to optimize the use of these substances and to incorporate them, along with other measures for limiting mite populations, into an integrated pest management strategy for control of “*Varroa destructor*”.

Trans-generational immune priming in honeybees can be utilized to create vaccines against bee diseases

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Devastating diseases threaten honeybees and a deeper understanding of the honeybee's immune system is critical to help develop better tools to help protect them from diseases. Insects lack antibodies, the carriers of immunological memory that vertebrate mothers transfer to their offspring. Yet, it has been shown that an insect mother facing pathogens can prime her offspring's immune system. To date, little is known how insects achieve specific trans-generational immune priming despite the absence of antibody-based immunity. Here, we show that in honeybees fragments of bacteria bind to the egg-yolk protein vitellogenin and are then carried to eggs. This discovery has for the very first time shown the mechanism behind trans-generational immune priming in insects. This type of natural "vaccination" of the offspring via the mother takes place against different diseases. Furthermore, we show, that honeybee queens orally exposed to pathogen fragments can enhance the immunity of their offspring against diseases. This creates a powerful platform to develop vaccines for beneficial insects.

EUBP Platform: Collective approach to understanding pollinator trends and threats

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It is well established that insect pollinators' numbers, diversity and density have severely decreased over recent years in Europe and worldwide. These trends are worrying when considering that nearly 90% of flowering plants depend on pollination by animals to some extent, while more than 75% of leading global food crops do, and in Europe, more than 80% of food crops rely to some extent on invertebrates for pollination. Therefore, many sectors and actors depend on pollinators and pollination for their activity, ranging from beekeepers, providers of pollination services, farmers and the agricultural production of pollinators-dependent crops and related agri-food sector; to research on pollinators, pollination and assessment of the environment through them. As a consequence, bees and other insect pollinators are taking increasing relevance in the public debate and growing efforts have been put over the years to understand these trends and the factors that may affect them. Related data have been/is produced by different institutions and actors, with various purposes and in multiple formats, making it impossible to obtain a clear picture of the situation and more importantly, the possibilities to reverse the trends. In Europe, stakeholders came together to share data. The EU Bee Partnership was created and they are steering a consortium of partners developing an innovative technology in the field of information and communication applied to the environment: The EUBP Platform. The project includes activities of technical development (software and infrastructure development) and data and quality management (data acquisition, management, processing, integration, visualisation, security). The EUBP platform aims to transform segregated data into the reference tool for those seeking information or whose activity depends on pollinators and pollination, and need to adapt their activities to manage the drivers determining their fate.

Round Table Discussion - Asia

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Rationale:

Stingless bees, known as meliponine or kiwot and kelulut in some Asian countries are now being cultivated for pollination

services and production of valuable products such as honey, pollen and propolis. The honey from stingless bee has high nutritional and therapeutic properties. As a major producer of propolis, propagation of stingless bees becomes more profitable, as there is an emerging market for this product. Antibacterial and antifungal activity of propolis from a considerable diversity of meliponine has been evaluated (Sanchez et al. 2017)

In the tropical regions, pollination of native plants depends heavily on native species of social and solitary bees prior to the introduction of European bee *Apis mellifera*. Human activities are major threats to stingless bee and other native bee populations. Toledo-Hernandez et al. (2022) documented the impact of habitat loss, agrochemicals, competition for food resources, climate change, and the introduction of exotic species, including pathogens on the stingless bee population.

This discussion aims to highlight the potential threats to stingless bee-keeping and formulate the corresponding management practices to make it a sustainable enterprise for livelihood opportunities and pollination services. It will also craft standard for honey, which could be produced following the best bee keeping practices.

B. Title: Establishment of Standard for Stingless Bee Honey

Rationale

It has been documented that stingless bee honey has a different composition than *Apis mellifera* honey. Souza et al. (2014) proposed a quality standard for stingless bee honey from 152 stingless bee honey samples from Brazil, Costa Rica, Mexico, Panama, Surinam, Trinidad, Tobago and Venezuela. In the Asian region, we hypothesize that the diverse pollen and nectar sources for the stingless bees will greatly affect the physico-chemical properties of honey that they produce. The climatic condition will also impact the moisture content and other physical parameters of honey. In 2017, Malaysia established a standard for Kelulut (stingless bee) honey. We have compiled and reviewed recent scholarly publications on the characterization of stingless bee honey in the region and will harmonize with the existing Malaysian Standard.

Chromatographic Determination of Foreign Diastase Adulterated Honey by Harnessing the Enzyme-Origin Differences

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There is a number of studies in the literature that present plausible adulteration markers or assays such as quantification of AFGP, arsenic, detection of DFA, or C4-% (SCIRA) analysis for corn syrup identification to detect honey adulteration. There are also enzymatic assays and to name but a few are heat-stable diastase, foreign invertase and, beta/gamma amylase. The addition of an enzyme to honey with a foreign origin is carried out to increase the diastase (alpha-amylase) value, which is considered as a critical quality parameter. Typically, diastase assays use pure or dye-conjugated starch as substrate and measurements are made colorimetrically. These assays are not specific in terms of *Apis Mellifera* L. (honey bee) amylase and can produce false positiveness in the case of industrial amylase additions. The main objective of the study is to determine whether the measured diastase value comes from honey bee origin or not and to be able to report the enzyme addition in honey. Initially, honey proteins were first concentrated by serial ultrafiltration. Then, diastase and invertase enzymes were purified from this isolate. Natural and purified enzymes were monitored by the developed HPLC-UV method. In order to detect foreign enzymes chromatographically, authentic honey samples from different botanical origins and 107 commercially available honeys were gathered and analyzed by conducting the dilute and shoot protocol. The diastase activities of these samples were measured prior to foreign enzyme analysis by using phadebas procedure. It was observed that the presence of foreign diastase was correlated in samples with abnormally high diastase values. The distinct foreign enzyme peak was identified differently from natural enzymes and detected in all adulterated honeys. Industrial enzymes were also purchased and used for verification purposes. It can be said that the developed method can reliably detect the presence of foreign diastase qualitatively.

Identification of the Rice Syrup Adulterated Honey by Introducing a Candidate Marker Compound for Brown Rice Syrups

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Identification of honey adulteration is an important area to ensure product safety and quality. White rice syrups (WRS)

or brown rice syrups (BRS) can be used for honey adulteration. Up to date, qualitative analysis of 2-acetylfuran-3-glucopyranoside (AFGP) and the quantification of the arsenic residue are the commonly preferred methods to detect rice syrups (RS). We have figured out the BRS may have a very low amount of AFGP. Therefore, it was estimated that AFGP alone may not be a very reliable marker for BRS identification. We aimed at identifying a new marker compound for BRS and to develop a novel analytical method that allows simultaneous monitoring of this compound and AFGP to highlight the addition of RS from different origins. The characteristic molecule in BRS was identified as sorbic acid. A UHPLC-MS/MS method was developed by combining dilute & shoot sample pretreatment and 107 samples were analyzed. While 21 of the samples were found adulterated with BRS, 3 samples were found to contain WRS. We suggest using sorbic acid as a marker of BRS addition to honey. Within this research, it was hypothesized that fraud was mostly made with BRS, and adulteration may be overlooked applying the existing methodology.

OP-027 [Beekeeping Technology and Quality]

Honey Adulteration Testing Update

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Novel and sophisticated authenticity testing methods have been developed in recent years with the aim of detecting foreign sugars in honey. Besides the long established ¹³C-LC-IRMS method, Nuclear Magnetic Resonance (NMR) and High Resolution Mass Spectrometry (HRMS) emerged as the most powerful techniques, being capable of covering a multitude of adulteration parameters in a single run.

This presentation will first provide an overview about possible types of foreign sugars and its ways how they are introduced into the honey. The most important and requested analyses will be described, in the context of their individual advantages and disadvantages.

The fundamental base for these two techniques are databases, which are typically not disclosed and remain subject to intellectual property of the respective organization, raising concerns in the wider community of a lack of harmonization between the testing bodies. The presentation will outline the approaches to bring the results and assessments into accordance, and the current state will be discussed.

OP-028 [Beekeeping Technology and Quality]

Tackling honey fraud by identifying functional relationships between adulteration tests – a correlation analysis to improve efficiency and cost effectiveness

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Economically motivated adulteration in honey can occur in multiple ways. Most common is honey adulteration by direct or indirect addition of foreign sugars that are practically invisible in the honey matrix. These foreign sugar sources are often made through break-down of starch-based products or by inversion of sucrose. In case of high-priced honeys, such as Manuka, the addition of lower-priced honeys can be used to increase the profitability.

To detect the different methods of exogenous sugars addition a steadily increasing number of analytical procedures had to be developed.

Eurofins offers for example more than 20 analysis, which can be utilized to investigate the authenticity of honey. However, since the application of all possible tests is very expensive a selective choice of methods based on risk assessment for adulteration has become established.

Comparing data of different analysis might reveal additional information to the plain results of each single method and therefore allow a deeper understanding of authenticity testing in honey.

The main benefits are an improved overall authenticity verification with a simplified testing scheme, higher certainty and accuracy as well as a significant reduction in effort and testing costs.

Therefore, Eurofins Food Integrity Control Services GmbH has started to conduct a correlation analysis using about 10,000 samples on which different authenticity tests were performed to identify functional relationships between the single methods and their results.

OP-029 [Beekeeping Technology and Quality]

New untargeted evaluation techniques in honey by means of LC-Orbitrap-HRMS

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So far, liquid chromatography coupled to high resolution mass spectrometry (LC-HRMS) approaches mainly focus on identification of certain marker molecules. Subsequently, these markers are used for targeted screenings. This procedure has limited possibilities because it is impossible to find new, at this stage unknown, adulterations. Especially tailored sugar syrups, that are specifically designed for the honey to adulterate, often undergo continuous development. That makes it challenging to keep a marker-database up to date.

It is therefore a great advantage to use untargeted LCHRMS approaches to comprehensively analyze all measurable analytes in a sample including unknown markers. The obtained data is considered in total, comparable with an individual fingerprint of the sample. The application of multivariate machine learning methods with authentic honey samples as training data enables to detect differences and to classify unknown samples.

Furthermore, the data obtained with untargeted approaches is highly valuable regarding the determination of variety and origin, because bee products are strongly influenced by environmental factors. These environmental factors influence the metabolism of living organisms and the metabolic profile is represented in the untargeted LCHRMS data. Therefore, this approach allows to draw reliable conclusions about the genuineness of the honey samples. If required, it is possible to select marker molecules for the specific adulteration in retrospect from the entirety of the data.

Here we will present the capabilities of untargeted screening approaches for the classification of honey samples using multivariate machine learning methods to build prediction models. We see great potential as it is possible to benefit from the information obtained from already authenticated samples.

OP-030 [Beekeeping Technology and Quality]

Elucidating the False Positive Tendency at AOAC 998.12 C-4 Sugar Test for Pine Honey Samples: Modified Sample Preparation Method for Accurate ¹³C Measurement of Honey Proteome

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The majority of the authentic pine honey samples fail from C-4% sugar test. Pine honey is generally characterized by small-sized insoluble honeydew elements, and these substances can form an appreciable amount of precipitate during protein flocculation step. These substances may shift the protein-centric ¹³C (¹³C /¹²C) values inaccurately. In this study, honey proteins were isolated, enriched, and cleaned-up prior to flocculation by applying the optimized and validated ultrafiltration method. Authentic honeys were analyzed along with adulterated samples using both AOAC 998.12 and novel protocol. When the interfering substances were eliminated, most of the samples, which were interpreted as adulterated according to the AOAC method previously, were identified as authentic. It has been proven that inconsistent protein measurements may cause false positivity. These findings revealed that the developed method could correct the artificially high C-4% results and the proposed modification will pave the way for increasing the overall reliability of the test.

Analysis of volatile compounds – fingerprinting of mono-floral honeys

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Volatile compounds can have a significant influence on the quality and the organoleptic properties of honey. The composition of these compounds in honey is already well known and it can vary by the botanical origin, the geographical origin or due to influences during production or processing. However, there are only few techniques focusing on the volatile compounds in routine honey analysis.

In this presentation a new untargeted method using head-space gas chromatography coupled with ion mobility spectrometry for the analysis of volatile compounds in honey is introduced.

For this approach a broad range of different verified monofloral honeys were analyzed by this technique to obtain their 'volatile fingerprint'. These fingerprints were then analyzed by multivariate data analysis for differentiation and prediction of the analyzed groups.

This presentation will discuss the suitability of this approach for the determination of the botanical origin for monofloral honeys and will give further information about other possible application (off-flavor, process influences, carry-over) of this technique for honey analysis.

A robotized light microscope system for automated melissopalynology analysis of honey. Accurate and real-time pollen recognition powered by deep learning networks

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Sonicat Systems

Melissopalynology is a widely used science within the honey industry, which allows the geographic and botanical determination of bee products, based on the diversity and proportion of nectariferous and/or polliniferous pollen types (PT). Traditionally, the classification and counting of PT to characterize honey is manually carried out by expert palynologists through a light microscope. This technique is complex, labor-intensive, and usually presents low reproducibility and repeatability between measurements made by different technicians or laboratories, due it is subject to human error. The main objectives of Honey.AI are to automate and standardize the pollen analysis in honey, using a low-cost robotized optical microscope coupled with computer vision and an Artificial Intelligence solution. Honey.AI recognizes more than 30 nectariferous (countable) PT, more than 40 non-nectariferous (non-countable) PT, and non-pollen elements, such as fungal spores, plant parts, dirt, and bubbles. Each countable PT has been trained with more than 5,000 images, while the non-nectariferous ones, with at least 1,000. At the current stage of development, the system recognizes the main botanical species producing unifloral honey in Europe with high precision, such as *Calluna vulgaris*, *Castanea sativa*, *Ceratonia siliqua*, *Citrus* sp., *Brassica napus*, *Erica* sp., *Eucalyptus* sp., *Helianthus annuus*, *Lavandula* sp., *Prunus* sp., *Robinia pseudoacacia*, *Rosmarinus officinalis*, *Rubus* sp., *Thymus* sp., *Tilia* sp. and *Vaccinium* sp. inter alia.

In every test, the system counts at least 500 total pollen grains, 400 nectariferous PT, and 100 sites. It takes from 15 to 90 minutes. The percentage is presented considering the total pollen content, as well as the value corrected, considering only the nectariferous species. Technical validation showed a precision between 0.9 and 0.98 (varies according to species), a 1-2% variability regarding repeatability and a 3-4% regarding reproducibility. Since neural networks are continually being trained, the number of botanical species and the accuracy of the analysis improves both every day.

Finally, to obtain a better honey characterization, Honey.AI also performs yeasts analysis, and is able to quantify the crystallization percentage of the sample with great sensitivity. Other future updates of the system are currently under development, like Pfund scale color measurement, honeydew analysis, and starch detection.

Active and efficient honeybee probiotics against AFB disease

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The innovative aspect of the project is to obtain an alternative product, by obtaining a highly stable probiotic mixture that strengthens the immune system of the bee against many bee pathogens, existing in nature and in the intestines of bees, and by obtaining a microbial mixture with a high shelf life, ensuring the prevention or elimination of bee diseases. An important pathogen American foulbrood (AFB) is a highly lethal disease that affects honey bees (*Apis mellifera*). The causative organism, *Paenibacillus larvae*, attacks honey bee brood and renders entire hives dysfunctional during active disease states, but more commonly it is found asymptotically in hives as inactive spores that escape even from vigilant beekeepers. This spore-forming bacterium, which affects honey bee brood and causes AFB, infects honey bees during early development and releases secondary metabolites (which have antimicrobial properties against microbial competitors) and chitin-degrading enzymes (which allow degradation of the peritrophic matrix), allowing degradation of the midgut epithelium. can kill offspring.

An alternative method considered for the prevention of AFB is to supplement the colonies with beneficial bacteria such as *Lactobacillus* spp. Findings from model systems are illustrated in several important literatures that support this approach by various *Lactobacillus* species. In addition, it can be said that resistance factors that occur with antibiotic application will not occur with probiotic application. Long-term benefits to honey bee longevity have been observed following relatively short periods of probiotic supplementation and without the need for host colonization. Our aim is to produce this product effectively with technologies for bees and to prevent bee loss.

Extensive studies have been carried out to identify suitable probiotic bacteria specific to honey bees. The main purpose of this research is not to increase honey production, but to control diseases; however, a healthier colony will certainly produce more honey. It has been shown that lactic acid bacteria isolated from honey bees have positive effects on bee health and reduce the incidence of pathogens. With the use of effective bee probiotics, stronger and more resistant bee colonies and higher yield and better pollination. Minimized colony collapses will be achieved.

How EM® probiotic for bees influence on gut microbiota composition of honeybees?

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Multiple causal factors are considered to contribute to honeybee colony losses: parasites and pathogens, exposure to pesticides, diet quantity, quality and diversity, as well as unfavorable weather and forage circumstances. Also, health status of honeybee colonies is highly influenced by beekeeper's management practices. All these factors affect honeybee colonies individually or in various combinations, possible causing severe disturbance of honeybee intestines microbiota composition. Adult honeybee dysbiosis - gastrointestinal microbial imbalance is linked to lower body weight, deficient development, and early workers mortality. Furthermore, the altered microbiota is associated with host deficiencies when the environmental stressors could change gut bacterial balance and lead to visible manifestation of opportunistic diseases. Among them the increased number of *Nosema* spp. spores in midgut, premature foragers and immune suppression linked with oxidative stress were reported. Intestinal microbiota of honeybees can provide novel insights into the pathogenesis-related factors involved in pathogen infection. Hence, we investigated the comparison of intestinal microbiota communities in control and *Nosema ceranae* infected groups of honeybee colonies through high-throughput sequencing of the 16S rRNA. As a novel approach in therapy, we hypothesize that EM® probiotic for bees could potentially have an important therapeutic and immunomodulatory effect on honeybee colonies. The aim of our study was to evaluate its impact on gut microbiota composition of honeybees. The 25 major genera with a total of more than 1000 OTUs were detected, with *Lactobacillus* being the most abundant genus, followed by *Gilliamella*, *Snodgrassella* and *Bifidobacterium*. In EM treatment groups *Kluyvera*, *Klebsiella*, *Escherichia* and *Cedecea* concentrations were higher than in control groups. This result indicates that continuous EM treatments shall clearly change bees gut microbiome composition. *Snodgrassella alvi* was a major member of the honeybee gut microbiota and may be significantly increased by long-term EM treatment. According to those results, it would be possible with EM treatments protect honeybees from herbicide negative effects (e.g., Glyphosate) in agricultural fields, by improving microbiome and immune functions.

Plant derived molecules as alternative substitutes to control honey bee varroosis: Essential oils as a case study

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The western honeybee (*Apis mellifera* L.) is one of the most important insect species that, unfortunately, is being confronted with multiple biological stressors that threaten their existence. *Varroa destructor* is a serious ectoparasitic mite of this valuable species. To control the infestation due to this parasite, synthetic acaricides were used. However, their overuse resulted in the development of Varroa resistance and residues accumulation in honey bee products. This situation has forced researchers to look for more natural alternatives including essential oils. The main objective of the present study was to evaluate under laboratory conditions the acute toxicity of essential oils (EOs) extracted from three Moroccan aromatic and medicinal plants, alone and in combinations against *V. destructor* and *A. mellifera* using the mixture design approach. The GC/MS analysis indicated that the main chemical compounds of *Mentha suaveolens* subsp. *timija* EO were menthone (40%) and pulegone (19.22%), whereas *Chenopodium ambrosioides* EO is rich in -terpinene (34.08%), isoascaridol (13.6%), p-cymene (10.95%), thymol (10.26%), ascaridole (10.25%) and carvacrol (7.75%). *Laurus nobilis* EO is mainly composed with 1,8-cineol (37.5%) and linalool (14.09%). The obtained results have indicated that the three tested EOs displayed interesting toxic effects on *V. destructor*. The highest acaricidal potency was observed with the ternary combination (LD50= 1.560 µl/Lair, 95% confidence limits (CL) = 0.863-2.560 µl/Lair). According to the combination index (CI) calculated by CompuSyn software, ternary blend proved to possess high synergistic effectiveness with CI index of 0.343. All combinations have shown favorable dose reduction with DRI indexes greater than one. Results of this study suggest that these EOs and their combinations could present a promising solution to reduce the effective doses of EOs and constitute an alternative to the synthetic acaricides.

Heat treatment against Varroa in an autonomous beekeeping system

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Hive heat treatment against the parasitic mite, Varroa Distractor, is a method that has been practiced by beekeepers for a few decades and has been made available commercially by a few companies which developed designated products for applying such treatment in the field.

However, heat treatment has not become widespread due to practical limitations in commercial apiaries and mixed results in terms of effectiveness and colony health.

Beewise Technologies is developing an autonomous beekeeping system that can extract frames from the hives, identify their content, and apply various beekeeping procedures and actions. Such a system can allow for automated applications of heat treatment.

In this study, we test the possibility of thermal treatment for sealed brood frames.

We examined the effect of the treatment on both Varroa and brood (Varroa death as well as bee emergence and longevity). We identified a possible subset of treatment parameters (temperatures and duration) that are effective in terms of treatment and assessed their effect on brood health. In addition, we test the impact of such treatments over a large number of hives over a few months.

Efficacy of double-stranded RNA for the large-scale control and prevention of sacbrood virus in Apis cerana (Hymenoptera: Apidae) apiaries

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Sacbrood virus (SBV) infection in *Apis cerana* has caused tremendous damage in India, Thailand, Vietnam, and China since the 1970s. The disease caused by this virus results in serious colony losses in *A. cerana* and is also a devastating disease affecting *A. cerana* in South Korea apiaries. Therefore, control measures for this emerging threat are urgently needed. SBV RNA interference (RNAi) targeting *VP1* was prepared to test the safety and efficacy of protection and treatment in artificially infected larvae and in infected colonies in South Korean apiaries. The efficacy of *VP1* double-stranded RNA (dsRNA) was confirmed for the protection and treatment of infected larvae by increasing the survival rate in comparison with that in untreated larvae. Furthermore, an optimal application procedure was established for the large-scale RNAi treatment of SBV in apiaries. The protection of healthy colonies from SBV by RNAi was demonstrated in 100% of apiaries, and the treatment results showed that after five administrations, the SBV in infected colonies was mitigated to a safe level at which no symptoms of the disease were observed. Importantly, the low cost of dsRNA production in this study enables its application as a specific drug in large scale in South Korean apiculture.

Social and individual immunity following virus infection in honey bee (Apis mellifera)

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Honey bee colonies are a fertile substrate for the development of pests and pathogens, on the other hand they have several defense mechanisms, social-behavioral and individual-physiological. The parasitic mite Varroa destructor (Varroa) and multiple viruses it vectors are major drivers of colony losses. Breeding for hygienic behavior, one of the major social defense mechanisms, is considered a sustainable way to reduce the impact of Varroa on honey bee health. However, concern has been raised recently that hygienic behavior may facilitate the horizontal transmission of viruses in honey bee colonies. In our study we aimed to evaluate whether there is a tradeoff between the social and individual defense mechanisms or do they contribute additively to the colony health. To discriminate between these two possibilities, we compared the Varroa infestation and Virus load between high hygienic and low hygienic colonies. In addition, the samples of workers tested for viral load were also tested for the expression of immune genes from four major immune pathways by RT-PCR. We found significantly lower Varroa infestation and DWV load in high hygienic colonies. In addition, these colonies also had a significantly higher expression of genes from two immune pathways. Taken together, these data indicate that both social and individual immune responses are working together to the benefit of honey bee health at the colony level.

The Efficacy of Propolis Extracts as a Food Supplement in Patients with Covid-19

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BACKGROUND: The severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) pandemic has hit the world. Many agents and protocols have been tried and tested against the 2019 coronavirus disease (COVID-19). Propolis is a natural immunomodulator with anticancer, antiviral, and anti-inflammatory effects. Propolis may be considered as an agent in the supportive treatment of COVID-19.

METHODS: Forty-five patients who were hospitalized in our hospital and did not need intensive care were divided into groups of 15. 2 ml of water extract of propolis (WEP) (50mg/ml) was given orally 3 times a day for 1 week to one group of patients, and 1 ml olive oily extract of propolis (64 mg/ml) + 1 ml olive oily perga extract (120 mg/ml) (OEP) was given orally 3 times a day for 1 to another group in the randomized, controlled study. Hospital discharge times and changes in biochemical parameters were used as indicators of recovery.

RESULTS: When CRP, D-dimer, Troponin, WBC, and sO2 were compared before and after treatment, statistically significant improvement was observed in all parameters for each group. The WEP and OEP groups were found to have statistically significantly better D-dimer, CRP, and WBC results than the control group when the improvement in parameters between the groups was compared. Significantly different hospital discharge time in groups 1 and 2 was found compared to the control group.

CONCLUSIONS: The addition of propolis to the treatment as a food supplement has a positive effect on the recovery of patients with covid-19 and may shorten the treatment time.

OP-042 [Apitherapy]

Impact of intrauterine infusion of the honey/propolis mix in normal postpartum dairy cows: Preliminary study

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Uterine infection affects dairy cows during the postpartum period (PP) leading to poor reproductive efficiency and financial loss. The advocated treatment is intrauterine infusion of antibiotics. However, bee products have been widely documented for antimicrobial properties and therefore can constitute an alternative treatment for uterine infections. We hypothesize that honey is a good alternative to treat PP uterine infections in dairy cows. The objective of this preliminary study was to determine the acute clinical response of the endometrium to the intrauterine infusion of propomiel in normal postpartum dairy cows. In this study, 31 healthy cows with intact uterus were divided into 6 different groups: group 1 (n=6), 2 (n=5), and 3 (n=5) received an intrauterine infusion of 30 mL of propomiel, honey alone, and Cephapirin benzathine (Metricure, 640 mg, IU, Merk, Canada, positive control) respectively 30 to 50 days PP. In group 4 (n=3, negative control), cows were not infused. In groups 5 (n=8) and 6 (n=4), propomiel and honey alone were infused into the uterus of cows with more than 50 days PP respectively. Trans-rectal ultrasound (U/S), vaginal examination, cytological and bacteriological evaluations of the uterus were done at 0 h (before infusion), 48 h, 96 h, and 192 h. The cytological evaluation showed that the percentage of PMNs (polymorphonuclear cells) in the uterus reached the utmost level rapidly at 48h before returning to the initial level (time 0h) at 96 h in all groups with the exception of group 4 (P < 0.001, negative control) where no increase was measured. At 48h, the number of PMNs in cows of group 1 (53.8 ± 30) was significantly higher compared to groups 2, 3, 4, 5, and 6 with 12.6 ± 7, 16.8 ± 25, 0.3 ± 0.6, 15.9 ± 9, and 10.1 ± 8 PMNs respectively (P < 0.05). The results of the bacterial culture were negative and no changes were observed on U/S during the study (P>0.05). In conclusion, propomiel triggered a prompt and short innate immune response of the uterus and could be potentially advantageous in cases of PP uterine infection.

OP-043 [Apitherapy]

Clinical Trials of Propolis EPP-AF® - from Safety studies until COVID-19 hospitalized patients

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Humans have used bee products, especially propolis, as natural medicine since ancient times. However, propolis varies with bee species and with the flora that bees visit to collect bioactive exudates. In recent years, efforts have been made towards standardization of propolis, and some of the resulting products have been tested in clinical trials. Along this line, we present the results of safety and efficacy clinical studies done for EPP-AF® propolis. This includes an acute safety clinical trial with 14 healthy volunteers given 375 mg of EPP-AF® for 5 days. Antioxidant effects were evaluated with 34 healthy volunteers who received two different doses (375 or 750 mg/day) of EPP-AF® during 7 ± 2 days. Protection of renal function was also evaluated with a dosage of 500 mg/day, administered for 12 months to chronic kidney disease patients. Also, the time of hospitalization of COVID-19 patients after treatment with propolis was measured and compared with the control group. The results demonstrated that EPP-AF® is safe for human consumption and improved the values of HDL. EPP-AF reduced biomarkers of oxidative stress cell damage, with increased antioxidant enzymatic capacity, especially of SOD, and there was a notable reduction of membrane damage (8-ISO/8-isoprostanes) and of DNA damage (8-OHDG/8-hydroxydeoxyguanosine). In the evaluation of renal function protection, proteinuria, the biomarker used, was reduced, becoming significantly lower after 6 months of treatment, improving the condition of patients with chronic kidney disease. Finally, the hospitalization time of COVID-19 patients was reduced to 7 and 6 days, after receiving 400 and 800 mg/day, respectively, for 7 days, compared to 12 days for the control group, it means a reduction of 41.67 and 50%, respectively. These, and other clinical trials using propolis conducted around the world are increasing the robustness of the scientific evidence for propolis as a valuable and safe healthcare resource that doctors and other health professionals can use for patient care.

OP-044 [Apitherapy]

Bioavailability of polyphenols from poplar propolis in men

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Propolis is a resinous substance collected by bees from the buds of trees and shrubs. In temperate climates, such as in France, the main plant source of propolis is poplar. Propolis as a dietary supplement is recognized for its various activities such as antimicrobial, anti-tumor, anti-inflammatory or immuno-modulatory. It is recognized that these activities are mainly due to the presence of specific polyphenols contained in each of the vegetable sources at the origin of propolis. Poplar propolis is characterized by the presence of flavonoids and phenolic acids and their ester derivatives. The problem of the effectiveness of a propolis product lies in the ability to define the effective dose of active ingredients (and not of propolis) and to guarantee reproducibility in the content of active ingredients between different product batches. The objective of this work was to determine the bioavailability of specific polyphenols in humans from a standardized consumption of poplar propolis. 12 healthy volunteers were recruited to participate in this double-blind cross-over study. The volunteers randomly consumed either a propolis formula or the same propolis + piperine formula equivalent at 300 mg of total polyphenol. The kinetics of appearance of polyphenols in the plasma of volunteers was monitored during the first 4 hours and after 24 hours. Analyses of pinocembrin, galangin, chrysin and CAPE in plasma were carried out by mass spectrometry. pinocembrin, chrysin and galangin showed similar plasma appearance curves with a Tmax at 4h. We did not observe any difference in the areas under the curves between the propolis and propolis + piperine formulas. The relative bioavailabilities were 10.4±1.3, 44.9±6.9 and 44.0±5.6 ((µg*h)/L)/mg to chrysin, galangin and pinocembrin, respectively. Unfortunately, the CAPE content of our initial propolis extract was too low to detect the molecule at all sampling points and follow the kinetic. The addition of piperine in the formula did not improve the bioavailability of our polyphenols of interest. In conclusion, we were able to determine the bioavailability in humans of 3 polyphenols from a natural poplar propolis matrix.

OP-045 [Apitherapy]

Philippine stingless bee *Tetragonula biroi* (Friese) propolis lowers blood pressure through inhibition of the Angiotensin Converting Enzyme (ACE)

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Hypertension is the chronic elevation of systemic arterial pressures that increases risks of developing cardiovascular diseases such as stroke, myocardial infarction, heart failure, and peripheral arterial disease. Our current research investigated the blood pressure lowering activity of the Philippine stingless bee (*Tetragonula biroi* Friese) propolis by utilizing in vitro angiotensin converting enzyme (ACE) inhibition activity assay and in vivo efficacy testing using spontaneously hypertensive rats. Testing various concentrations of Philippine stingless bee propolis show that the highest ACE inhibition activity of 92.90% was observed using 0.8 mg/mL. The IC50 for the ACE inhibition activity of the Philippine stingless bee propolis was determined to be at 0.64 mg/mL. The in vitro ACE inhibiting activity of the Philippine stingless bee propolis was lower compared with the pure compound ACE blockers, enalapril and captopril. Interestingly, our preliminary in vivo test demonstrate that oral administration of Philippine stingless bee propolis in spontaneously hypertensive rats significantly and continuously reduced the mean systolic and diastolic pressures starting at 30-minutes post-administration and up until the end of the 4-hour observation period. This observed reduction in mean systolic and diastolic pressure with propolis treatment was comparable with the positive control enalapril. Collectively, our recent findings show that the Philippine stingless bee propolis lower blood pressure through inhibition of the angiotensin converting enzyme and can potentially be a good source of novel bioactive compound/s for the management of hypertension in humans and animals.

Does oral care with propolis affect the development of oral mucositis in pediatric oncology patients: a randomized controlled clinical study

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Cancer is a disease that can be seen at any age, and 2% of all cancers are childhood cancers in which multidisciplinary treatment consisting of chemotherapy, radiotherapy and surgery is applied. In chemotherapy, the target is cancerous cells, yet high doses of chemotherapeutic agents do not have selectivity. Intact tissue cells are also affected by this cytotoxicity and causes mucositis development in the patient, especially as a result of the mucosal cells being affected. Mucositis is a condition that is expected to begin on the third to fourth day following the start of high-dose chemotherapy, and to peak in terms of severity and depth between seventh and fourteenth days, and heals after 21 days. Treatment of more than one third of patients mire down due to oral mucositis. Furthermore, this condition cause increase of hospitalization time and mortality. In this study, it was aimed to determine whether oral care with Anatolian Propolis, which is anti-inflammatory, antibacterial, antifungal, antioxidant, antiviral and anticarcinogenic and has an immune-enhancing effect, prevents the formation of oral mucositis due to multiple use of chemotherapeutic drugs on pediatric oncology patients. The sample of the study was volunteered, non-smoker, at age of 2 to 18 years patients who undergo chemotherapy treatment for lymphoproliferative malignant disease (leukemia, lymphoma) or other childhood solid tumor such as central nervous system tumor, neuroblastoma, osteosarcoma, Ewing sarcoma, rhabdomyosarcoma, hepatoblastoma and germ cell tumors. The study was planned as a randomized controlled experiment in which there were three groups with 36 patients. The groups were categorized as patients who brush teeth with soft toothbrush, who use oral care solution with 20 drops of propolis extraction solvent and who use oral care solution with 20 drops of propolis produced by BEEO-UP at concentration of 15%, three times a day. In conclusion, it was determined that oral care solution including 15% water-soluble propolis was significantly effective on the prevention of mucositis.

“Clinical evaluation of a Sustained Release System based on a Propolis and natural oils biomembrane facial mask to treat acne”

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Acne is a disorder that affects, in Brazil, 18 million young people between 13 and 18 years of age - approximately 80% of the young population. Clinically, acne is manifested by the presence of non-inflammatory and inflammatory lesions. Free testosterone, promotes an increase in the production of sebocytes. The participation of Propionibacterium acnes is another critical factor in triggering and worsening acne. Aiming to contribute with the improvement of the quality of life of these patients, this project proposed the development of a sustained release system based on a biomembrane (facial mask) obtained from Acetobacter xilinum, with propolis and some other volatile and non-volatile oils, to control and reduce open and closed comedones, papules, pustules and nodules in acneic patients. In this sense, propolis extract EPP-AF® nanoemulsion with the oils were obtained and characterized to be clinically tested. Thirty patients with inflammatory (acne) and non-inflammatory profile (comedones) that follows within the inclusion criteria were recruited to be part of the clinical trial. All participants agreed and signed the free consentment term to be part of the study. The patients were evaluated before and after the product application. The mask was applied every day in the test area in the face during 28 days, the control was the other side of the face. After the treatment, both areas of the face, the treated and non-treated one were evaluated and counted considering closed and open comedones, papules, pustules and nodules. The oleosity level were also measured. The results demonstrated that 80% of the patients reduced the level of papules, 83% reduced the comedones, 17% reduced the oily level, 13% reduced the pustules levels. In conclusion, the propolis and natural oils biomembrane facial mask, demonstrated to be an effective agent to control and treat acneic process of the volunteers and can be offered as a clinical option to treat oily and acneic skin, improving the quality of life of the patients.

The potential of Madu Kelulut (Heterotrigona Itama sp Honey) as a Functional Food for Dopamine Booster and Depression Prevention

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Depression is a mental disorder characterized by at least two weeks of persistent low mood and loss of pleasure in normally enjoyable activities. Trauma and stressful life events alter the brain structure, chemistry and function leading to depression. In rodent modelling, chronic restraint stress (CRS) given to rodents leads to increased glucocorticoid hormone and low level of serotonin and dopamine in the blood that cause extensive damage to the brain, triggering the onset of depression. The crossover between glucocorticoid function and brain derived neurotropic factor (BDNF) has been suggested as one of the pathophysiology for depression. Stingless bee honey is an alternative honey producer found in most tropical and subtropical regions of the world such as Southeast Asia, Northern Australia, Africa, and Brazil. The madu kelulut (MK), a Malaysian name for stingless bee honey reported to give direct effects on the BDNF signaling pathway, enable for the MK to be explored as potential functional food for prevention of depression.

METHOD: In present study, adult swiss albino mice (N = 21) were given a CRS for 28 days and randomly assigned into 3 groups; untreated (G1), paroxetine (positive control) (G2) and the stress-treated with MK (G3) groups. The MK at 2000mg/kg was given daily to G3 from the first day of stress induction. The effects of the treatment were assessed on serotonin, dopamine and corticosterone level in the blood serum via ELISA method.

RESULTS: This study demonstrated that the blood serum serotonin and dopamine levels in the MK-treated groups were significantly increased (P<0.05), whilst corticosterone level was significantly low in the MK-treated mice as compared to the restrained untreated mice.

DISCUSSION: Findings directly revealed that MK possibly modulates antidepressant-like effects and potentially through the monoamine regulatory pathways. All effects observed were comparable to paroxetine. Paroxetine is an antidepressant selective serotonin reuptake inhibitor (SSRI) used as a positive control for pharmacological validation in this study.

CONCLUSION: Findings propose that MK can be an effective functional food for depression prevention via dopamine and serotonin enhancement. The honey also merit for further evaluation as treatment for depression disease.

Antibacterial activity – new honey qualitative standard reflecting biological properties of honey

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Honey is a functional food with health-beneficial properties and its potent antibacterial and antibiofilm effects are the major attributes of so called 'medical-grade honey' which is topically used for the treatment of burns, wounds and skin disorders. Whether ingested orally or applied topically honey must fulfill the requirements of international standards based on physicochemical characteristics. Nevertheless, the current set of honey quality parameters adopted in the European Union do not include its biological properties. Furthermore, in light of the accelerated growth of scientific evidence, there is an urgent need to revise current qualitative tools, and to establish and certify more effective honey quality control. The aim of the study was to evaluate the antibacterial activity of 36 commercial honey samples purchased from supermarkets and local shops with healthy food and compare the efficacy to 3 honey samples from local beekeepers and 3 types of medical-grade honeys. Furthermore, hydrogen peroxide (H₂O₂) content and the protein profile were assessed in all honey samples. Analysis of antibacterial activity of commercial honeys revealed that 44% of tested samples exhibited the low antibacterial activity, identical to activity of artificial honey (sugars only). There was a significant correlation between antibacterial activity and H₂O₂ content of honey samples. Honey samples from local beekeepers showed superior antibacterial activity in compare to medical-grade honeys. Antibacterial activity can vary from honey to honey but must not be identical to the activity of the honey sugar content. In most cases activity can be negatively impacted by thermal processing and long-term storage and is therefore a suitable and sensitive qualitative parameter. From a clinical point of view, we strongly advocate to solely use natural honey with minimal processing in order to preserve the full spectrum of biological activities.

Monitoring of some quality parameters of Bingol honey at different temperatures and in different storage containers for 12 months

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Honey has been used as a food for many years. However, it is widely used as an additive in various pharmaceutical and cosmetic industries and in the food industry. Honey is known as a source of healing in the formation of these usage areas and being the subject of many researches. Due to the high nutritional value of honey, it is in high demand by consumers. In addition, the natural production and consumption of honey, which is consumed for different purposes by many age groups for health, necessitates the storage of honey without major changes in quality parameters. Therefore, the type of container in which the honey is stored and the storage temperature also play an important role. In the study, the effects of honey at 4 °C and 18 °C and in different storage containers (glass, plastic and tin) in terms of humidity, Hydroxymethylfurfural (HMF), diastase and free acidity were investigated for 3 months and 12 months. Polyfloral flower honey was obtained directly from the beekeeper in the Bingöl region. All analyzes were repeated three times. Moisture analysis was carried out according to TS 13365, from 14.80% to 16.60% at 4 °C and from 15% to 16.60% at 18 °C; HMF analysis according to IHC (Ch. 5.1) from 2.24±0.07 mg/kg to 12.23±0.55 mg/kg at 4 °C and from 1.98 ±0.16 mg/kg to 16.66 mg/kg at 18 °C; Diastase Number analysis was performed according to the IHC Phadebas Method, from 23.10±0.41 to 26.85 at 4 °C and from 26.85±4.07 to 26.85±4.07 at 18 °C; Free acidity analysis was carried out according to TS 13360, from 21.02±0.01 meq/kg to 35.50±0.48 meq/kg at 4 °C and from 21.70±0.52 to 36.96±0.19 meq/kg at 18 °C was found to have changed.

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Single Pot In-Situ Aqueous Derivatization and Subsequent Determination of Streptomycin and Dihydrostreptomycin Residues in Honey by Means of Mass Spectrometry

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In beekeeping, there is a struggle against many pests, mites, and important insect-borne diseases. The beekeepers apply different techniques to protect their hives from these diseases and the usage of antibiotics is quite common among them. Using these medicines may cause residues in foodstuff and the insensible consumption of them through the food chain can affect human health negatively. Aminoglycosides (AMGs) are one of the most popular antimicrobial therapeutics used in beekeeping. In most cases, streptomycin (STR) and dihydrostreptomycin (DSTR) are the typically encountered residues in bee products. According to the legislation, there must not exist any antibiotic residues in bee products. This aspect has demonstrated the necessity of highly sensitive and specific quantitative monitoring methods for any authorized laboratories. There are various studies in the literature regarding the analysis of AMGs. However, these methods mostly involve impractical and low yield pretreatments such as ion-pairing agent-assisted extractions and SPE clean-up. The separation and quantification had been performed by capillary electrophoresis and liquid chromatography techniques equipped with UV, FL, or MS detectors. Costly ready-to-use ELISA kits are also in use. Unfortunately, the pretreatment processes of these methods are tedious and time-consuming. In this study, one-pot, aqueous in-situ derivatization was conducted as a novel and superior sample preparation approach. By using UHPLC-MS/MS system, a time and cost-efficient, versatile analysis method has been developed with high sensitivity, and more feasible sample preparation processes were introduced. The

developed method accomplished simultaneous quantification of STR and DSTR in 5 min with unprecedented ease of use. The mean recovery values were 102.65% for STR and 101.26 % for DSTR. In the precision study, RSD% values were calculated on average between 2.5% and 9.2% at intra-day and inter-day precisions. CC (5.69 µg/kg and 5.82 µg/kg) and CC (6.18 µg/kg and 6.40 µg/kg) values were found for STR and DSTR respectively. 500 honey samples were analyzed using a novel and validated method. Occurrence of STR and DSTR residues was highlighted by absolute quantification.

Determination of glyphosate, aminomethylphosphonic acid, glufosinate and its acetyl-metabolites in honey by IC-MS/MS

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The food industry shows a growing awareness of the importance of a healthy and balanced diet such as honey, one of the most natural foods that consumers can buy. Unfortunately, honey quality is not only determined by good beekeeping practice, it reflects the influence of our environment also. Due to the worldwide use of glyphosate honey can carry traces of glyphosate when bees collect nectar. To maintain quality and safety standards, the EU has set the maximum residue level for glyphosate at 0.05 mg/kg. An EU-wide ban of glyphosate is under discussion and a final recommendation from EFSA is expected in the second half of 2022.

As a consequence new analytical methods are required to offer reliable, accurate and rapid quantification of glyphosate, aminomethylphosphonic acid, glufosinate and its acetyl-metabolites in honey combined with high sensitivity and selectivity. Due to increasing concerns over the sensitivity and robustness of LC-MS/MS methods in quantifying traces of polar pesticides, the decision was taken to switch to a more analytically sensitive and better-suited method – ion chromatography (IC) coupled with tandem MS (IC-MS/MS). Moreover, the IC method doesn't require derivatization, making the sample preparatory steps simpler and shorter. This means sample preparation is straightforward and quick. The 'dilute and shoot' method used involves two simple steps: diluting honey samples with the extraction solvent followed by 5-minute centrifugation. Due to the inherent robustness of the IC column, it can handle over 1000 sample injections without performance loss. The validation protocol shows a high linear concentration range starting at a limit of quantification of 0.002mg/kg glyphosate in honey up to concentrations of 1mg/kg.

The benefits of implementing IC-MS/MS for honey analysis: Improved analyte separation and sensitivity, processing time reduced by a factor of 4, app.50% cost savings vs. LC-MS/MS.

Effect of Heat Treatment on Invertase, Diastase, and HMF (Hydroxymethylfurfural) in Honey Harvested in Turkey

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Turkey, the second beekeeping country in the world, has regulations regarding to prohibit any addition or removal of a substance to honey which can affect its natural composition. Heat treatment is also prohibited since it has the ability of inactivating natural enzymes, particularly diastase and invertase which are indicators of freshness of honey and cause to increase of HMF (5-hydroxymethylfurfural) amount. With this study, status of enzymes and HMF amounts and their variations in different temperature-time applications, in monofloral honey species Pine, Oak, Citrus, Sunflower, Cotton, Lavender, Chestnut, and Wildflower honey samples will be determined for the first time. Outcomes of the study includes more heat resistance of diastase over invertase enzyme and the fact that diastase number is insufficient to decide whether honey is heat treated or not without considering the invertase amount. Although citrus honey had the lowest invertase enzyme content at the beginning of the study, Pine and Chestnut honey were the honey varieties that showed the most resistance to heat treatment. While in general, invertase activity and diastase number of honey samples decreased, HMF amount increased. In particular, the amount of HMF rose less, whereas the invertase activity reduced rapidly. Compared to initial value at room temperature, invertase activity decreased 84.82% to 51.22 U/kg, diastase number decreased by 1-3-fold to 13.94 while HMF amount increased 1-4-fold to 22.86 mg/kg at 76°C, for all mean of all monofloral and multifloral honey in total 364 honey samples.

Advances in ISO standardization of bee pollen

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Standardization, although voluntary in many countries around the world, is extremely important for regulating the marketing of goods and services. The standardization of a product guarantees quality parameters not only in the production processes but also in the finished product, thus giving greater confidence to consumers.

Among the various hive products, bee pollen is an important source of macro and micronutrients for bees. Its chemical composition makes it good food or food ingredient due to the balanced percentages of proteins, lipids, and free sugars, and it also contains minerals, phenolic acids, flavonoids, and a variety of vitamins. As far as minerals are concerned, some are fundamental in metabolic mechanisms, so pollen consumption can be valuable food for humans.

All this implies the urgent need to strengthen bee pollen market with a product that is subject to rigorous quality control. The development of ISO Standards, currently in the final stages of elaboration, will certainly be a crucial tool for achieving this goal.

The technical subcommittee for apiculture products, ISO/TC 34/SC 19, was created in 2017 to improve and ensure the quality of these products, where quality, methodologies of analysis, storage, and transport standards are included. The present work summarizes the standardization work carried out, focusing on the "ISO/TC 34/SC 19 - Working Group (WG3): Bee pollen" and its importance in standardizing the requirements of quality parameters in the world market.

Within the scope of the work developed in WG3, six samples of bee pollen were subjected to different conservation processes (oven-dried, lyophilized and frozen) from six countries (France, Romania, Brazil, China, Turkey, and Portugal), and the interlaboratory test was carried out with the participation of 19 independent international laboratories from 10 countries (China, Germany, Turkey, Portugal, France, Belgium, Romania, Brazil, Italy, and Spain) in 2021.

The results achieved so far allow the definition of standardized analytical methodologies for bee pollen and the establishment of limits for the most critical parameters, as well as rules for traceability and origin of the product: labeling, storage, and transport. It is expected that the ISO Standard should be validated by the end of 2022.

A recommendation for chemical standardization of propolis and propolis-based products

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Propolis is intensively used in the medicine, cosmetics and food industries due to their healing properties such as antibacterial, antiviral, antifungal, anti-inflammatory, antitumoral, antioxidant, immunomodulatory, tissue regeneration, and anti-ulcer. The functional properties of propolis are dependent on its chemical constituents especially the high content of phenolic compounds (flavonoids and phenolic acids). Propolis and propolis-based products need chemical standardization that guarantees their quality, safety, and efficacy. Although some efforts are still given for chemical standardization of propolis, but there are no accepted and reliable criteria so far. In this context, the identification and quantitative determination of some individual phenolic compounds that have beneficial effects and are widely found in propolis might be useful for the determination of the quality of propolis and propolis-based products. For such reasons, the aim of this work was to evaluate and suggest quantitative determination of nine individual phenolic compounds which are widely detected in propolis in different countries for chemical standardization. 14 literatures for balsam/dried ethanolic/methanolic propolis extract, eight literatures for crude/raw propolis, and two literatures for ethanol-based and water-soluble commercial propolis products were evaluated for this research. The evaluated propolis results were from Turkey, Greece, Italy, Serbia, Croatia, Macedonia, Poland, Ukraine, Azerbaijan, Egypt, Algeria, Chile, Argentina, Brazil, China, and South Korea. Nine phenolic compounds were caffeic acid, naringenin, apigenin, kaempferol, chrysin, pinocembrin, galangin, caffeic acid phenylethyl ester (CAPE), and p-coumaric acid. This proposal might be useful for the chemical standardization of propolis and propolis-based products that can guarantee their quality, safety and efficacy.

Effect of different parameters on the antioxidant capacity of propolis extracted by ultrasound-assisted extraction (UAE)

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Arıcılık Araştırma Enstitüsü Müdürlüğü (Apiculture Research Institute)

Propolis is an important beekeeping product obtained by honey bees (*Apis mellifera*) by collecting the resin-like secretions of trees and plants then mixing them with their secretions. Propolis is used by bees for different purposes (such as cleaning, repair) in the hive. It has been also used by people throughout history due to its antioxidant, antimicrobial and immune system strengthening effects.

The structure and composition of propolis may vary depending on the plant source, climatic conditions, bee race and the needs of the colony. Generally, flavonoids, aliphatic and aromatic acids and terpenes are effective in the bioactive properties of propolis. However, since propolis has a resinous structure, these substances must be extracted and separated from the propolis. The classical maceration technique has been widely used for the extraction of propolis. Recently, different applications such as ultrasound-assisted extraction (UAE), microwave-assisted extraction and supercritical carbon dioxide extraction have been carried out to shorten the time, increase the amount of yield and reduce the use of solvents. In addition, each application has an effect on the content of the extract obtained.

The aim of this study is to compare the antioxidant capacities of propolis extracts subjected to different parameters and to determine the most suitable conditions. For this purpose, propolis samples were extracted by ultrasound-assisted extraction at different temperature, period, solvent concentration and propolis-solvent ratio. Total phenolic, DPPH and FRAP analyzes of the extracts were performed and their antioxidant capacities were compared.

Beekeeping development and potential of bee products in GAP Provinces

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The Southeastern Anatolia region has the potential for both traditional and organic beekeeping with its different climatic and geographical properties. Beekeeping is an important livestock activity in terms of its valuable products, economic and social role in rural development, and contribution of honey bees to nature. GAP Regional Development Administration is a leading institution within the scope of sustainable agricultural techniques, in determining the current socio-economic conditions of rural communities that cannot benefit from irrigation, their relations with the natural and social environment, and new income-source activities that are suitable for their potential. Within the scope of Rural Development Projects, a workshop was organized in order to determine the problems and solution proposals in beekeeping in the region, and an analysis of the current situation was presented. In addition to honey production, information and training activities were carried out for regional beekeepers in the production of other beekeeping products, care-feeding, and disease-pest control. A total of 89 beekeeping projects were supported between 2007-2019, 21 in Adıyaman, 3 in Batman, 9 in Diyarbakır, 2 in Gaziantep, 2 in Kilis, 8 in Mardin, 16 in Siirt, 2 in Şanlıurfa, and 26 in Şırnak. Supported beekeeping projects since 2019 in these nine provinces will be introduced in detail. It is aimed to develop beekeeping activities in the region, diversify beekeeping products, and increase the level of economic income, especially in rural areas. This study, it is aimed to compile and introduce the projects and supports given in nine provinces in order to develop beekeeping activities and diversify beekeeping products by the GAP Regional Development Administration.

Explain how our beekeepers cooperatives contribute to develop and fix poblation in the rural areas. We work every day to advance and adaptation to all the new situations. We buy togheter for more than 1.000.000 of beehives in Spain

Ramon Rodriguez Monje¹, Ramon Rodriguez Monje², Ramon Rodriguez Monje³, Ramón Rodríguez Monje⁴

¹Euromiel, S. Coop. de 2º Grado, Mérida, Badajoz Spain

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⁴Sierra Miel S. Coop., Torrecilla de los Angeles, Cáceres, Spain

We work together with our beekeepers to mantein and renew the ouwners of the beehives. We don ´t want to loss any beehive.

We grow every year more than 14% of the new beekeepers. Now we have 1600 beekopers with 700.000 beehives in our Region, Extremadura.

We have to start two new projects to start, "New methods to use the all medications that are authorized for varroa" and "course for new beekeepers".

Travel to the fairs more important in the world.

We organize the fair for beekeepers in our Region, the second weekend of november.

We buy the medicines for varroa, for more than 1.000.000 of beehives.

We buy per year more than 3.000 tons of Sugar and fundant of sugar.

We export of our products, honey and bee pollen, fresh and dry, beewax.

We organize training course for all the needs that beekeepers have.

We keep our beekeepers informed about the all the news.

The purpose of beekeeping in rural development

Janet Lowore

Bees for Development

The benefits of beekeeping to support rural livelihoods in developing countries are widely understood. However, the sector is replete with examples of projects which underperform. Too much effort is invested in how to do beekeeping, with a focus on 'improving' or 'modernising' and questions about the why people are attracted to beekeeping, are overlooked. This presentation draws on practical experiences and secondary literature about beekeeping projects, mainly in Africa.

One of the problems facing the sector is that too much attention is focussed on the beehive, in the mistaken belief that a beehive that theoretically affords advantages in colony management, can in practice deliver benefits. Meanwhile insufficient attention is paid to the needs of poor people.

This presentation will take a different look at beekeeping – asking not how to do beekeeping but why? Analysis of what attracts beekeepers to the activity reveals that one of the most motivating factors is the ability to derive an income, essentially 'for free', through careful utilisation of nature – bees, flowers and hive-making materials. Beekeeping is accessible to people rich in nature and poor in financial resources. Beekeeping technologies which alter this dynamic and make beekeeping more expensive, more time-consuming and more risky, do not fit with people's livelihood constraints.

Too often development workers carry out a study of existing beekeeping methods and find them sub-optimum according to pre-conceived notions of what constitutes good beekeeping. Many such studies lament the use of fixed comb hives, without measuring the labour and cost investments in relation to outputs. The cheapness of fixed comb hives is one of the main reasons why people make a profit. Changing the type of beekeeping to make it more capital intensive undermines these attributes. All development projects which aim to reduce poverty must look at the economics of beekeeping from the point of view of farmers. It is essential to remain mindful that many people opt for beekeeping because they can make money, without investing cash. Any departure away from this logic runs the risk of making beekeeping unfit to serve the needs of the poor.

Beekeeping as a source of income for rural women in Issyk-Kul region, the Kyrgyz Republic

Dilbara Ismailovna Muratova

Issyk-Kul regional branch of the Kyrgyz Union of Beekeepers, Karakol, Kyrgyzstan

At this time, habitants in rural areas of the Issyk-Kul region, especially women, have no opportunity to earn a livelihood. The natural and climatic conditions of the target regions of the project contributes to the successful development of beekeeping, with the help of which the tasks of increasing the income of families and increasing the yield of plants by bees pollination would be solved. However, in Kyrgyzstan there are no special training courses on beekeeping, there is practically no beekeeping literature in the Kyrgyz language. Therefore, our project allowed women to undergo training at the beekeeper and get a loan for bee colonies, advisory support.

Our project allowed women to increase family income, improve their social status in the community and the standard of living.

"Women-beekeepers" project exists after the financing, because women continue to receive income from beekeeping. They multiply bee colonies by 100% in this season. Therefore created women-beekeepers Cooperative continues to work and serves thus women get access to resources

Developing a beekeeping enterprise in select rural areas in the Philippines

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Beekeeping as a community-based enterprise was established in two provinces in the Philippines, namely Mindoro in Luzon Island and Lanao del Norte in Mindanao. Mindoro and Lanao del Norte are represented by an Indigenous tribe, Mangyan and Muslim community, respectively. Their economy is predominantly based on traditional agriculture. The bottom-up approach in extension was applied in this model. Stingless bee *Tetragonula biroi* was used in this project because of its sustainability. Being native to the country, the species is relatively resistant to pest and diseases, easy to propagate and good pollinators of local plants. The training strategies contributed to the success of the project. Site validation in the three communities were done prior to the setting up of the meliponary. The major criteria were the abundance of bee forage and accessibility. Initial training was conducted when the bee colonies were brought to the sites. The series of training engagements were done quarterly in a span of two years, until the participants acquired the skills in the management of stingless bees for pollination production of honey, pollen and propolis and processing of value added products. The community started generating income from the sale of bee products. A model for a sustainable beekeeping enterprise will be presented.

Bringing Back Bees & Beeks: Re-Initiating *Apis cerana* bee keeping with young beekeepers of Kerala (India)

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The state of Kerala is beautiful state with rich flora and fauna and tropical weather condition. The state is part of the Western Ghats and the landscape is famous across the world for the spices such as black pepper, clove, pepper, coffee & tea originated from the region.

Beekeeping in the state of Kerala was declining as it was not a profitable business for many professional beekeepers. Due to the changing farming practices and plantation activities, the natural bee population also declining and there was a need to start small scale beekeeping involving youngsters and native bee species. We needed to conserve the native bee species and also ensure that the tradition of beekeeping is kept alive in the community.

A collaborative project initiated between Tropical Institute of Ecological Sciences and Indianbees.org 'Bees 4 Life' is bringing new beekeepers into the profession. Under this initiative, we train and support new beekeepers including school students to become good beekeepers. The aim is to promote the conservation of *Apis cerana* - which is the native species of bees and sustainable honey production.

Under the project, we have developed nursery colonies of *Apis cerana* bees and started training potential beekeepers which has become a sustainable initiative with people from multiple background joining as 'beeks'.

New beekeepers and they are provide them with nucleus colonies, monitor the bee keeping activity, train them to collect and market honey in the local market and work together as a larger team.

The bees we use for beekeeping is the '*apis cerana*' as it is the native species of bees and the conservation of these bees in the landscape is important for the eco system & farmers of the region.

Young beekeepers are encouraged and we have trained few youngsters who were engaged in beekeeping during the COVID lockdowns and few of them are now expert beekeepers who train other beekeepers, sell honey using e-commerce platforms.

We are also promoting the use of stingless bees which produce one of the finest honey which is much sought after by people for medicinal purposes.

Evaluation of the effect of Anatolian propolis on Covid-19 in healthcare professionals

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No prophylactic treatment is available for individuals at high risk of developing COVID-19. This study, which was conducted between December 25, 2020 and January 25, 2021, is one of the first clinical studies to evaluate the efficacy of Anatolian propolis supplement against COVID-19. The aim was to obtain evidence on the prophylactic use of Anatolian propolis in individuals at high risk of developing COVID-19. This volunteer-based study was conducted in two centers. Study involved 209 healthcare professionals (physicians, nurses, medical secretaries) from Emergency Medicine Department of Medical Faculty of Ataturk University and Emergency Medicine Department of Rize Recep Tayyip Erdogan University. 204 participants meeting the study criteria were divided into two groups as experimental group and control group. The experimental group received 20 drops of BEE'O UP (BEE&YOU) 30% Propolis Drops twice a day during a follow-up period of 1 month. The control group received no supplement but was followed up. The participants showing symptoms during the study and all the participants at the end the study were subjected to PCR testing. The evaluation of the results of PCR testing at the end of the study has shown that 14 participants from the control group and only 2 participants from the experimental group, who received Anatolian propolis supplement, were reported as positive cases. It has been found that a statistically significant protection was induced against COVID-19 infection in 98% of the experimental group, who received Anatolian propolis, compared to the control group.

Effect of propolis on the treatment of subclinical mastitis in dairy cows

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Antimicrobial resistance is the main problem of today's health in human and veterinary medicine. Mastitis is a mostly bacteria caused disease of high-yielding cattle, which is usually treated with broad spectrum antibiotics. One of the possible ways to improve the situation of antibiotic resistance is the finding alternative materials for animal treatment against bacterial health disorders. One of considerable substances like that can be propolis. Due to its antibacterial, antifungal, antiviral, antiparasitic, anti-inflammatory, antiproliferative and antioxidant properties propolis can be applied. A clinical experiment was conducted to evaluate the efficacy of propolis in the treatment of subclinical mastitis in dairy cows. Ten, first lactation cows Lithuanian black and white not treated for mastitis or other diseases before and monitored under the herd surveillance program with diagnosis of subclinical mastitis were selected for the investigation. Five and ten % aqueous propolis emulsions were prepared. The cows were divided into two groups: 5 % propolis emulsion was used for the therapy of the first group and 10 % propolis emulsion - of the second. Five ml of propolis emulsion was applied to the udder quarters of cows affected by subclinical mastitis 5 days in a row 2 times a day after each milking. The samples of the milk (for bacteria count) and blood (for blood cells analysis) were collected and analyzed before and after treatment. The results of the study revealed that 5 % propolis emulsion reduced the number of bacteria isolated from cows' milk by 2.27 log CFU/ml (P<0.05). Meanwhile, the efficiency of 10 % propolis emulsion in reducing the number of bacteria was 0.89 log CFU/ml (P<0.05). The doubling of the eosinophil count in the blood of cows treated with 10 % propolis was also observed and due to that it can be suspected that 10 % propolis emulsion is sometimes able to cause hyperallergic reactions for cows. The results of the experiment revealed that 5 % propolis emulsion can be more effective in the treatment of subclinical mastitis in dairy cows and can be used as an alternative to antibiotics.

OP-066 [Apitherapy]

Brown poplar propolis titrated in polyphenol and Covid-19 in real life: What interests ?

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FRENCH SPEAKING SOCIETY OF APITHERAPY

AIM: We report and discuss the interest of a supplementation with brown poplar propolis titrated in polyphenol during the pandemic Covid-19 through a retrospective field observation of elderly individuals living in a seniors residence.

METHOD: 24 elderly individuals have supplemented their diet served in the residence with brown poplar propolis containing 400 milligrams of polyphenol taken twice a day over four consecutive weeks in April 2020 (propolis group PG). 35 other people from the same residence shared the same meals without supplementation (control group CG). PG and CG have been compared in terms of Covid-19 disease risk, lethal risk, clinical forms and blood cells counts.

RESULT: Propolis does not reduce Covid-19 disease risk (38 % PG vs 43 % CG - diagnostics based on PCR tests) and the lethal risk (8 % PG vs 9 % CG) but overall seems to favor asymptomatic clinical forms or the absence of Covid-19 contamination (71 % PG vs 43 % CG, $p < 0.05$ - er = 2,04 - non parametric T test). Propolis decreases the lymphopenia linked to Covid-19 and boosts the normalisation of lymphocyte counts.

DISCUSSION: Propolis appears to decrease Covid-19-induced inflammation and also boost the immune system in real life. Polyphenols appear to play an essential role in the immuno-modulation and the anti-inflammatory and the anti-viral actions of propolis.

CONCLUSION: This reinforces the interest of a propolis characterized on the botanical level and titrated in polyphenol for an effective action.

OP-067 [Apitherapy]

From the hive to the office. Uses if propolis in dentistry

Rafael Ernesto Felitti
Private practice: Montevideo. Uruguay

The use of bee hive products for human health is very old. For dentistry the first humans use it to calm pain tooth and to filling gaps and to seal carious lesions. Propolis we can use for treat different dental pathologies. In dentistry we use 5% uruguayn stabilized propolis alcoholic solution for different uses and treatments, the stabilized propolis is very important because we need the same quality of product along the year, We can use for root canal treatment, for irrigating the root canal and for intrasession medicament, in periodontal treatment we can use for coadjuvant irrigation in mechanical treatment and periodontitis treatment, deep carious lesions can be use for stimulate the stem cells of the pulp and generate dentin and other treatment like candidiasis treatment because propolis is an antimicrobial product. Uruguayan propolis have a high antibacterial activity and anti-inflammatory activity because the content of pinocembrin and caffeic acid.

OP-068 [Apitherapy]

The use of honey and propolis against xenobiotics -Induced Oxidative Stress and Hepato-renal Damages: a potential approach that warrants a clinical exploration

Badiaa Lyoussi
Lyoussi Badiaa, Laboratory SNAMOPEQ, University Sidi Mohamed ben Abdallah, Fez, Morocco

Bee products are inexhaustible sources of bioactive molecules. They are extensively used in folk medicine for the prevention of several diseases and has become actually the objective of many scientific investigations. Different biological and pharmacological effects of bee products have been referred to their antioxidant, anti-inflammatory agents and renal disease protection. Oxidative stress is believed to be responsible for the occurrence of several pathologies.

Phytochemical analysis of honey, propolis extracts showed the presence of several natural antioxidants belonging to different chemical groups: flavonoids, phenolic acids, flavonols, and stilbenes. These may be responsible for the documented efficacy of these extracts in protecting biochemical characteristics and enzymatic activities of kidneys and liver tissues from alterations induced by xenobiotics. Scientific reports from our laboratory have shown that bee products have a wide chemical composition and multi-functional properties. In this context, we investigated the antioxidant properties of

honey, propolis, 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 or propolis extract alone or in association prevented changes caused by xenobiotics 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.

Overall, it can be concluded that honey and propolis might be useful in the management of liver and renal diseases induced by xenobiotics. The possible mechanism of action is discussed. These results pave the way for controlled clinical studies and the use of their combination might potentiate their activities.

OP-069 [Apitherapy]

Descriptive study of propolis utility for obesity treatment

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Background

Obesity is a worldwide problem, associated with increased risk of diabetes type, cardiovascular complications, oncological diseases. Management of obesity is complex, aiming to decrease insulin resistance as well oxidative stress, which are commonly seen in obese people. Administration of propolis could have a positive impact on decreasing of oxidative stress and can be used as additional supplement in complex therapy of obesity management.

Aim of the study was to evaluate role of propolis in complex therapy of obesity management

Materials and patients. The study was performed in 25 obese patients (BMI > 30 kg/m²), of which 15 patients received treatment with 10 mg of empagliflozin, whereas 10 patients received 10 drops of 20% ethanol solution of propolis in addition to 10 mg of empagliflozin. All patients were instructed to have low carbon diet and to walk > 5000 steps per day. Follow up was 6 months. Measurement of BMI, serum insulin and glucose were used to calculate index HOMA before and after the treatment.

Results. The study group of patients taking propolis+empagliflozin had mean BMI at baseline 35,5 kg/m² and mean index HOMA 5,5 as compared to BMI 33,3 kg/m² and index HOMA 4,3 at follow up. The control group of patients taking only empagliflozin showed mean BMI at baseline 35,4 kg/m² and mean index HOMA 5,9 as compared to BMI 34,9 kg/m² and index HOMA 4,7 at follow up.

Conclusions. This descriptive study demonstrated utility of administration of propolis in complex treatment of obesity. Still, due to small sample size of this preliminary study is not allowed to draw any distinct conclusions, but results from this suggests further investigation of propolis utility as addition component for obesity treatment.

OP-070 [Apitherapy]

Investigation Of Potential Use Of Propolis Against The Infections Accompanied By Diaper Dermatitis (Rash)

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Propolis is a resinous substance that bees create by combining the secretions they collect from trees, leaves and buds with their own enzymes. Due to its antibacterial, antimicrobial and antifungal properties, propolis has been benefited for centuries in many ways, from embalming the dead. to the content of lip balms. Studies have shown that propolis has a therapeutic effect on wound healing, burn treatment, dermatitis, and many skin problems. In this study, the effect of antibacterial activity of propolis on the prevention of bacterial infections accompanying Diaper dermatitis, one of the most common skin diseases in infants, was investigated. During the experiment, propolis from Tunceli, Hakkâri and Bursa provinces, two bacteria Escherichia coli and Staphylococcus aureus commonly associated with diaper dermatitis, and a yeast Candida albicans

were used in clinical strains. iv Ethyl alcohol (99%) was used as an organic solvent for the extraction of propolis samples. In order to determine the antimicrobial activities of propolis samples antibiogram tests were applied on bacteria and fungi samples. In order to test the antimicrobial activity of propolis samples in diapers 100% and 50% extracts were absorbed into the inner midlines of the diapers. Swab samples were taken from the incubated diapers at the 3rd, 6th, 9th, 12th, and 24th hours with the help of a glass baguette, and smear was cultivated on NA for bacterial strains and PDA for yeast. The hourly microbial growth-based antimicrobial inhibition rates of propolis samples were determined by the pour plate technique. As a result of the study, antimicrobial effects were observed at different rates in all 3 microorganisms. The antimicrobial effect of propolis is found expected to be more effective in cases where the diaper is not changed for a long time. The most efficient method would be to put propolis-absorbed material on the top of the diaper as a separate layer.

[OP-071 \[Apitherapy\]](#)

An Investigation into the Effects of Ethanolic Propolis Extract on Blood Clotting Parameters

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Because of its high concentration of phenolic capacity, ethanolic propolis extract (EPE) may be used as a dietary supplement. But, a possible interaction on blood clotting parameters between blood-thinning medicines and some natural products having a high content of phenolic compounds has been claimed. To investigate this reality, we designed a preclinical study that included examining some blood coagulation parameters summarized as PT, INR, aPTT, and fibrinogen in rats using warfarin and EPE. The ethics committee of Karadeniz Technical University approved the study with 2019/15 protocol number. The animal experimentation methods were applied to 24 adult male Sprague-Dawley rats divided into 4 groups: Group 1 (G1-Control: 0.9% saline-1.0 mL), Group 2 (G2-Medical control: 0,15 mg/kg, bw, warfarin-1 mL), Group 3 (G3-EPE: 200 mg/kg, bw, EPE-1 mL), and Group 4 (G4-warfarin+EPE: 0.30 mg/kg, bw, warfarin-0.5 mL+400 mg/kg, bw, EPE- 0.5 mL). The EPE group (G3) did not influence coagulation markers considerably when administered alone. All blood coagulation parameters except fibrinogen level were found to be greater in the warfarin group (G2) and these differences were statistically validated ($p \leq 0.005$). Compared to G2 and G4, PT and aPTT levels of G4 neared the control group values even further. Due to the fact that not all parameters in the combination group (G4) increased and some even decreased when compared to G2, it showed that the used dose of EPE was not directly interacting with this drug. It may even be mentioned that it has a synergistic impact due to the fact that it reduces some parameters. Further research using propolis extracts at various concentrations is required to substantiate this claim. The current data published with 10.23751/pn.v24i1.12017 DOI number in Progress in Nutrition.

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[OP-072 \[Beekeeping Technology and Quality\]](#)

Challenges linked to Climate Change and his observe and projected Weather Extremes

[Etienne Bruneau](#)

Apimondia Federation

For several years now, there has been a growing awareness of what climate change can mean for beekeeping operations. The climate seems to be changing more rapidly than previously thought. The temperature increase threshold of 1.5°C has almost been reached north of the tropic, with all the consequences that this involves. The increase in temperature is almost constant and is reflected in the effects on beekeeping production, the changes in the seasons modify the biological cycle of our colonies, the availability of floral resources and the development of pathogens. In our daily lives, it is not the 1 or 2°C increase in temperature that will greatly disturb our bees, but rather the increase in the frequency of extreme events (extreme drought, heat peaks, devastating fires, tornadoes, torrential rain, etc.). These events have a direct impact on beekeepers, causing the destruction of colonies and mortality. These events, which make the headlines, can completely destabilise beekeeping activities.

We are beginning to realise today what tomorrow will bring and the challenges we face. Beekeeping is facing one of the most important challenges it has ever faced. This will require beekeepers to adapt if they want to maintain their beekeeping activity and remain sufficiently profitable. Possible measures will be proposed, some of which will be developed during the following presentations.

[OP-073 \[Beekeeping Technology and Quality\]](#)

How to improve biological resilience to climate change and pathogens?

[Coby Van Dooremalen](#)

Wageningen Research

All organisms are influenced by ever-changing environmental conditions, whether they live in a stable environment with small changes or in a highly fluctuating one. They need to cope with these changes on a day-to-day or seasonal basis within a lifetime or even across generations. The extent to which they can cope with changes and maintain their homeostasis, determines their resilience. Honey bees are superorganisms, and live in habitats with highly variable conditions. They are however extremely well adapted to e.g. changes in resources or temperature. But they too have their limits, as evidenced by high colony losses. To improve their resilience towards the future and optimize their chances in an environment with climatic changes and sometimes high pathogen loads, we first need to better understand what coping mechanisms they have and how stress impacts performance. Hence, I performed several large scale field studies in the last decade, where we exposed colonies to different stressors, such as pathogens, pesticides and extreme temperatures, and measured the impact on these colonies and the performance of their individual worker bees. From better understanding the resilience of colonies under stress within a lifetime, the next step is to gain more insight their potential to increase resilience across generations against the most challenging stressors. In a large field setup, we compared (test) colonies from multiple Dutch populations that supposedly survived >10 years without Varroa destructor treatment, with conventionally kept (control) colonies that were withheld of V. destructor treatment during the experiment. Even though the test colonies had all different origins and were kept and selected in different ways, they were all able to maintain their colony numbers over a period of >1.5 years, including two winters. In conclusion, honey bee colonies are indeed amazingly resilient organisms within a lifetime, but can increase resilience across generations. As beekeepers and researchers, we may consider trusting this resilience a bit more and leave adaptations to changing environments more up to the colonies, while facilitating them in the most basic sense: availability of resources, water, housing and few beekeeper disturbances.

[OP-079 \[Beekeeping for Rural Development\]](#)

Natural beekeeping for visitor attractions and public spaces

[Paula Carnell](#)

Paula Carnell Limited

Many organisations are wanting to incorporate a bee aspect into their visitor attraction, and are becoming conscious that natural, kinder methods are of more interest to the public. Using my personal beekeeping experience of treatment free, smoke free, and only feeding honey, I have developed a strategy for such organisations to include honeybee colonies in harmony with other pollinators. Key foundations are that no queens or packages of honeybees are introduced to the area. By using bait hives and working with honeybee preferences, local native colonies are attracted in and future colonies derived from these through splits and swarms. By ensuring the health and wellbeing of honeybees, no sugar is fed to them, leaving their honey in sufficient quantities to sustain them through the winter months. Propolis collection and grooming are encouraged and observed. Honey harvests are taken without queen excluders, smoke or stings! Developing alternative income revenue streams to support the investment in honeybee hives and extraction equipment, engages the public whilst educating them regarding the connection between humans and nature. Bee Safaris, honey tastings, and bee experiences inspire and open eyes to the world of honeybees and the important messages they are trying to share with humanity. Referencing the Quran and Buddhist beliefs that the honey bee is the highest level of reincarnation, and that God passed wisdom to the bees to pass onto humans, now is the time to start listening and learning from the bees. Working with The Newt in Somerset, a world class hotel and gardens, colonies now number between 15 and 20 from the original 2 wild colonies found living in the woodlands five years ago. Regular safaris, tastings and the construction of a Beezantium bee museum has put bees centre stage in the United Kingdom, attracting visitors to watch and learn from the bees. My methods are being used with clients across the UK, South Africa and the Lebanon. Training staff within these projects on kinder keeping methods engages an environment with greater understanding of our connections with our pollinators, and if our environment is affecting them, it's also affecting us.

Local experience: Concrete and cardboard for an ecological and economical hive

Kodjo Logou Agossou
OPAAS

The cardboard and concrete hives have been part of the setting of our farm for some time. The half-cardboard half-concrete hive of the last time, which we describe in the following lines, augurs a new beekeeping era. The cardboard used is a rectangular parallelepiped in shape with dimensions of 40 x 26.5 x 55 cm³ on the outside, 38.5 x 24.5 x 53 cm³ on the inside when the horizontal flaps are fully upright. Its walls are 0.75 cm thick. Khaki-colored with little paint on the outside, it weighs 600 g. To increase its load and water resistance, it was passed through hot wax in a dry heat water bath. To allow it to adapt to the use of frames, a waxed cardboard wafer of 24.5 x 3.5 x 0.75 cm³ makes it possible to create studs. The frames that can be used have a useful size of 32 x 25.5 cm². The base and the apex are closed by plywood of 38 x 23.5 x 0.5 cm³; each pierced with a central hole of 5.5 cm of diameter. Optionally without frames the bees build directly on the inner facade of the plateau from above. It is finally protected by a waterproof roof. Once full, it is placed on its concrete counterpart, made of a rectangular parallelepiped and a slab roof. The first is 49.5 x 47.5 x 32 cm³ outside and 40.5 x 38.5 x 30 cm³ internally, It weighs about 50 kg. the slab has the following dimensions 49.5 x 49.5 x 3.5 cm³. It also has a central hole of about 10 cm. They are all made of unreinforced concrete. This hive can be equipped with frames with the following useful dimensions 36,5 x 25,5 cm². Under conditions of use without frames, bees also build directly on the inner facade of the slab. Productivity per harvest: without frames: 15 kg of honey + 5 kg of wax. It is inexpensive, a fine example of recycling and garbage recovery. It promotes wax within the holding and dispels the aggressiveness of the African bee.

Mobile Honey: Open-source traceability for honey and beeswax in Ghana

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Beekeepers in remote and rural areas of tropical Africa can produce high quality, residue-free honey and beeswax. Furthermore, abundant wild populations of honey bees make beekeeping accessible and scalable. However, sourcing and consolidating produce from many small scale beekeepers, in remote areas with limited transport and communication infrastructure, poses complex logistical challenges. One common problem honey and beeswax trading businesses face in these situations is quality control. Extended, capillary supply chains make it very difficult to identify the source of any quality issues and therefore resolve these. Novel product traceability software solutions could help overcome this challenge, yet are priced well beyond economic viability.

We are therefore developing an open-source digital traceability system, with a view to supporting honey and beeswax trade in the Afram Plains of the Eastern Region of Ghana. Beekeeper registration, distribution of containers and records of transactions are managed using open-source data software suite Kobotoolbox. Quality control protocols are built into the data management system and supported by training and working with a network of honey collection coordinators and harvest support teams. We present the key features of this system and report on its first trial season in April – June 2022. We then reflect on its potential, how it can be adopted by others and how to take its development forward.

First detection of *Nosema ceranae* and black queen cell virus in Ghana

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As part of a support project for the bee industry in Ghana, a pilot study was conducted on the occurrence, diversity, and geographic distribution of honey bee pathogens, parasites, and pests in Ghana.

Honey bee colonies from 14 apiaries at different geographic locations in Ghana were clinically inspected and samples of bees, brood, debris and honey were collected during the inspection.

The samples were stored and transported to Slovenia. The real-time PCR analysis was performed for pathogens: *Paenibacillus larvae*, *Melissococcus plutonius*, *Nosema apis*, *Nosema ceranae*, *Crithidia mellificae* and *Lotmaria passim*; and brood samples were tested for varroa mite infestation. Bees were also tested for acute bee paralysis virus (ABPV), black queen cell virus (BQCV), deformed wing virus (DWV), sacbrood virus (SBV), chronic bee paralysis virus (CBPV) and lake Sinai virus (LSV).

All samples were negative for *P. larvae* and *M. plutonius*, *N. apis* and *C. mellificae*, ABPV, DWV, SBV, CBPV and LSV. This is the first time that *N. ceranae* and BQCV have been detected in Ghana. They were both found in low levels. Although there were no clinical signs of varroosis, samples of drone brood were heavily infested with varroa mites.

Honey bee health at the sites we inspected and sampled is currently very good, likely due to the very extensive beekeeping practises in Ghana. Because different management techniques can affect colony exposure to parasites and pathogens, bee health monitoring should always be included when changes in technology are introduced.

Report on the effectiveness of control measures in response to an outbreak of severe infestations of *Aethina tumida* in apiaries across Bono East Region, Ghana

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BACKGROUND: Ghana lies in the endemic distribution range of *Aethina tumida*, where beekeepers have considered it to be a minor pest that only threatens the survival of weak colonies and that has therefore not usually been subject to any control measures. Starting in March 2022, an increasing number of beekeepers across Bono East Region have been reporting severe infestations of small hive beetle (SHB) in their apiaries, associated with absconding and collapse of even strong colonies in large numbers.

OBJECTIVES: This paper offers a preliminary report on the impact of this outbreak and beekeepers' responses, with a focus on identifying and divulging effective control measures.

Research Questions: How and when have beekeepers in the region realised the need to control SHB populations in their apiaries? What control measures have beekeepers put in place? How effective have these control measures been in mitigating the impact of the outbreak?

METHODS: The research draws on interviews, interactions and correspondence with beekeepers conducted by Bees for Development staff and Master Beekeepers across Bono East Region of Ghana. Field trials were conducted to compare the effectiveness of mechanical traps (1) located inside and outside beehives, and (2) using different baiting materials.

RESULTS: Data collection and analysis is continuing. Preliminary results indicate limited effectiveness of mechanical traps in controlling severe infestations. Colonies in poorly constructed or deteriorating beehives are prone to higher SHB populations. Beekeepers are now also experimenting with neem-oil based insect repellent preparations applied to the outward facing side of top-bars, where the adult SHB population is concentrated in the proximity of strong colonies.

Promoting beekeeping and conservation in bioserve area in Turkey: A success story of Ali Nihat Gökyiğit Foundation (ANG)

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Turkey is on the intersection of three continents and also on the way of two important past paths namely Spice and Silk Road thus played a very important role bridging the Asia, Europe and Africa. In this vast geographical area, different topographical and climatological features shaped by the evolution make it favorable for the floral and faunal sources. Over 10,000 plant species create huge floral diversity and this is well reflected into great honeybee biodiversity. A total of five honeybee subspecies and also many ecotypes are found in this geography suitable for modern beekeeping. ANG Foundation (Ali Nihat Gökyiğit Foundation) carried out long lasting project since late 1990s for the selection, breeding and conservation of Caucasian honeybees in Macahel. After successive beekeeping training, candidate beekeepers learned beekeeping

and queen production in this isolated bioserve area. This initiative created awareness on beekeeping and promoting beekeeping in the region. The outstanding results at first increased the household income and also the number of women and young beekeepers. Secondly, high quality queen production filled the gap needed by the beekeepers all over the country to increase the colony yield. Thirdly attracted the attention of scientific community to work with indigenous bee namely *Apis mellifera caucasica*. This is followed by the registration of the honeybee subspecies by the Ministry of Agriculture and Forestry. After registration, the area is announced to be the first conservation area in Turkey. The number of conservation areas is still increasing since then. ANG Foundation still continues to support the local beekeepers and also beekeepers of the country by providing good quality queens and also bee colonies. ANG foundation extended successful initiative to another area Posof (Ardahan) for other Caucasus honeybee ecotype and also Central Anatolian honeybee, *Apis mellifera anatoliaca* in Kırkırca-Ankara. This continues support is not only promote beekeeping and conserve honeybees in Macahel bioserve area but all over Turkey.

[OP-086 \[Beekeeping for Rural Development\]](#)

Planning Migratory Beekeeping with a Genetic Algorithm Based Approach for Sustainable Precision Beekeeping

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One of the most important tasks for migratory beekeepers is to determine a suitable settlement for the beehive. There are some points to be considered while determining the place of residence; such as resource diversity of the destination region, whether plants in the region are in bloom or not, meteorological condition of the region, and bee population in the region directs the movements of migratory beekeepers. All these factors affect the income of the migratory beekeeper. The goal of the migratory beekeeper is to gain maximum profit with minimum cost. In this study, a solution was sought for the problem of finding suitable settlements for migratory beekeepers with the help of the traveling salesman problem by using genetic algorithms, which is a meta-heuristic approach. In this direction, by protecting the health of the bees and the maximum profit that the migratory beekeeper will gain, determining the correct locations according to the point where the migratory beekeeper wants to go, an application has been developed that gives the user the number of colonies to be placed for the best honey production according to the region. The city routes to which the migratory beekeeper should go are determined by following the genetic algorithm. Each route represents one chromosome and chromosomes create the population. Parents selected from the population are subjected to crossover and mutation processes to produce new chromosomes. This research can be considered as the traveling salesman problem. The creation of new chromosomes maintain until the best solutions are reached to establish the shortest and correct route. The application has been developed for approximately 5 million colonies and 60 thousand migratory beekeepers in Turkey. With this application, the problem of determining the settlement for the beehive, which is one of the biggest problems of the migratory beekeeper, will be eliminated with minimum cost and maximum profit. Thus, the accumulation of bee colonies in certain areas is prevented. It also contributes to sustainable agricultural activities by collecting the nectar in the regions as much as possible.

[OP-087 \[Beekeeping for Rural Development\]](#)

Sustainable Agriculture for Migratory Beekeepers Considering Urbanization Plans

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Beekeeping is an important agricultural activity in Turkey as well as all over the world. According to official records, the number of beekeepers in Turkey is around 57,897. These beekeepers have a total of 6.8 million bee colonies. Approximately 75% (42 thousand) of the beekeepers in our country are migrant beekeepers. Approximately 75% of bee colonies are exposed to migratory beekeeping, which corresponds to approximately 5.1 million colonies. Bees should be taken to places with suitable climatic conditions during the winter months. In a study conducted in 2021, wintering areas were determined for migratory beekeepers. These areas were determined as the middle Black Sea and Mediterranean regions. However, urbanization and industrialization continue in these regions. If urbanization and industrialization continue uncontrollably and suitable areas are not allocated in the regions designated for bees, winter accommodation areas of migratory beekeepers may disappear. This situation will cause intense loss of bee colonies during the winter months.

In this study, it is aimed to determine the areas where migratory beekeepers can both do beekeeping and meet their shelter needs. As a result of the data obtained for the coastal regions in Turkey, environmental and regional factors were analyzed. Environmental factors are temperature, sunshine status, humidity, wind, climate type and precipitation. Regional factors, on the other hand, are proximity to highways, distance to living areas, railways, proximity to high voltage lines, proximity to wetlands, lands suitable for agriculture. All variables were processed according to a common scale. For this purpose, fuzzy logic approach was used. With fuzzy logic, each variable in the range of 0-1 is represented as a membership function. In the fuzzy logic approach, the output function is the terrain suitability variable. The scale to be considered when selecting suitable areas;

1. Urban areas representing areas that are not suitable, (0) beekeeping is not possible,
2. Low (>0-0.4), limiting areas due to environment and infrastructure,
3. Areas where productivity is limited (>0.4-0.7),
4. If it is high (>0.7-1), it is the areas where beekeeping activities are most suitable.

[OP-088 \[Beekeeping for Rural Development\]](#)

Integration of Beekeeping into Acacia-Based Industrial Forestry: A New Perspective

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Acacia supplies necessities of life as a source of nectar and the trees also physically provide shelter for insects, including pollinators and honey bees. The management of industrial forestry on a broad and sustainable scale has also contributed to the development of honey bee farming in Indonesia, especially on Sumatra island. The integration into Acacia-based industrial forestry of beekeeping is considered a new and interesting knowledge to be systematically investigated. Industrial forestry with Acacia as the main tree may be designed to support the presence of honey bees and protection of beehives. The research was conducted through interviews with and direct observation to several beekeepers in Siak District, Riau Province, Indonesia. The integration of industrial forestry and honey bee farming activities produces honey bee products that increase income of local communities around the area. Since the beginning of 2020, with the Covid-19 pandemic and increased global awareness for better public immunity against diseases, the demand for honey has also increased. This has attracted more people who live around the forest areas to get engaged in beekeeping, leading to the steady growth of the number of beekeepers. Unfortunately, this increased demand for honey and the number of beekeepers is not followed by advances in technology and good market management. During the last 2 years (2020-2021), the estimated average of acacia honey production was quite high, reaching 35-45 kg per colony per year. However, it is feared that this productivity may decrease along with the emergence of ecological, economic and social problems, if it is not managed properly. The concept of honey bee management in industrial forestry areas is very important to generate economic benefits from forest areas without logging activities. Therefore, the sustainability concept in the integration of beekeeping into Acacia-based industrial forestry is a challenging topic worth further exploring.

[OP-089 \[Beekeeping for Rural Development\]](#)

Stationary microbeekeeping protocol improve a quantitative and qualitative properties of tropical honey

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Microbeekeeping protocol, a honey production methodology that provide consistently quantitative and qualitative properties of natural honey as taste, aromatic quality, colour, sugar contents as well as some medicinal properties by manage a honeybee flora within the foraging radius of the bees, was performed. The technology provides a model for small scale beekeeping to produce a consistently biological quality honey from Asian cavity nesting (*Apis cerana*) red dwarf honeybees (*Apis florea*) and 2 species of stingless bees, *Tetragonula pagdeni* and *Tetragonula laviceps*. This model combines with a landscape enhancing feature to improve the quality of the honey in Thailand. The pilot farm revealed a significant return from investment, including a 69.55 % increase in *A. florea* and 119.24 % increase in *A. cerana* and a 76.47 % increase in two species of stingless bees, *Tetragonula pagdeni* and *Tetragonula laviceps*. We have also identified fingerprint features of each variety of honey by investigating the physicochemical and biologically active quality identifiers. In pilot farm scale, 25 beekeepers have collaborated in this projects and potentially improved their quality of life - sufficiency and economic status. Finally, the unique tropical honey scenario developed to collectively improve a substantial quantity and quality of honeybee products as significant competitive items on the international market is suggested.

[OP-090 \[Beekeeping for Rural Development\]](#)

Climate change threatens the conservation of an endangered Brazilian stingless bee species

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INTRODUCTION

Melipona scutellaris is an endemic stingless bee species that inhabits a small area in the Brazilian Northeast whose biome (Atlantic Rainforest) is predominantly hot and humid. Its natural colonies were historically overexploited for honey production by local residents, and consequently, *M. scutellaris* is included on the Brazilian red list (endangered and locally vulnerable). Therefore, understanding impacts of climate change on its natural habitat may assist future conservation efforts.

OBJECTIVES

The main goal was to assess potential habitat loss under climate change for two periods (2021-2040; 2041-2060), under the CMIP6 SSP5-8.5 scenario. This scenario was chosen, among other things, due to the expected rise in global poverty after COVID pandemic, energy shortage encouraging the burning of fossil fuels, increase in fires, and agricultural intensification.

METHODOLOGY

Occurrence data of the target species were collected from Global Biodiversity Information Facility, SpeciesLink Network, and Brazilian scientific collections. The suitability area was modelled with five algorithms (GLM, GBM, GAM, RF, MAXENT) and five rounds (75% training, 25% tests) using 12 layers of environmental variables selected after the variance inflation factor. The model selection was achieved by True Skill Statistics (TSS>=0.75) and its final composition was based on the Ensemble Forecast of the Committee Averaging type.

RESULTS

We generated 375 models according to 207 exclusive occurrence points for *M. scutellaris*. Our findings suggest that, currently, this species has a suitable area of 230,000 km². Nevertheless, over the next 20 years, we expect a loss of 100,000 km² (or 41%) of suitable area. Similarly, within 40 years this loss is expected to increase further to 130,000 km² (or 55.8% of its current distribution).

DISCUSSION/ CONCLUSION

The main area loss will be in the Bahia state where *M. scutellaris* is currently vulnerable. Given its small occurrence area, the loss of nearly half of its current distribution may compromise its sustainable use as a honey producer and as a pollinator of wild and cultivated plant species in this region.

[OP-092 \[Bee Biology\]](#)

Adenosine signaling regulates the wingbeat frequency of *Apis mellifera* upon stress response

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Honey bees have historically been important pollinators, but they are currently facing many threats that are reducing their populations. Previous studies indicate that stress can damage the memory and learning ability of honey bees, eventually leading to declines in foraging and homing abilities. In this study, we try to explain the homing ability barrier from the aspect of energy supply. We believe that when worker bees suffer from stress, their energy supply may shift from movement to resistance, causing an imbalance which fails to provide adequate energy to the flight muscles, leading directly to reduction of wingbeat frequency, thereby impairing the flight ability of worker bees. We treated worker bees with imidacloprid, used

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a camera to record their wing beats, and then compared differences between treatments. We also measured glucose, glycogen, trehalose, and ATP content. Genes for energy metabolism and resistance were also analyzed. We subsequently added adenosine to test whether it could improve ATP content and help to recover the wingbeat frequency of worker bees. Preliminary results showed that wingbeat frequency and glucose content in worker bees treated with imidacloprid were significantly lower than the control group. This result is consistent with our hypothesis and demonstrates that energy supply imbalances can prevent worker bees from returning to their hives. We expect that energy production of worker bees can be increased by adding adenosine, and we assume that this method can promote resistance of honey bees and enhance the apiculture industry.

[OP-094 \[Bee Biology\]](#)

Evaluation under field conditions of the effect of genetic origin, environment, and time of year on the characteristics of collected pollen, produced bee bread and nutritional status of *Apis mellifera*

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Honeybees (*Apis mellifera*) depend on the environment to obtain the nutritional resources for their growth and development, being the pollen the main source of proteins, fatty acids, sterols and micronutrients. Honeybees transform the collected pollen into bee bread to have a better chance of survival during a dearth period. The bee bread has a higher nutritional value and different physicochemical characteristics than the natural pollen and depends on the initial pollen diversity and the microorganisms involved in the transformation. The objective of this work was to determine the influence of different genetic origins of *Apis mellifera* and two seasons on the characteristics of the collected pollen and the physicochemical properties of the bee bread produced and the nutritional condition of the individuals. Trials were performed in two apiaries composed of both European and Africanized colonies. One in a subtropical climate and one in a temperate climate. Samples were collected before and after wintering and consisted of natural pollen, bee bread, and bee´s haemolymph. Determinations included pH and concentration of soluble proteins of both collected pollen and bee bread. Also, concentration of soluble proteins in haemolymph was determined as a supposed indicator of the nutritional status of bees. In every case bee bread had lower pH and protein concentration than the pollen that originated it, which is consistent with the presence of a fermentative process. The physicochemical characteristics of both pollen and bee bread were significantly different in relation to the season, and for both cases the after-wintering period showed a higher pH and a lower protein concentration than the before-wintering period. Also, the bee bread produced by Africanized colonies had a lower pH than the one produced by European colonies. Protein concentration in haemolymph did not vary between sampling moments and genetic origins and was not related to protein content in bee bread; therefore, it would not be a sufficient indicator of the colony´s nutritional status by itself. This work is a first integrated vision of the process of pollen selection and bee bread formation, consumption, and assimilation under field conditions, which needs to be deepened in future works.

[OP-095 \[Bee Biology\]](#)

Vitellogenin gene: A powerful genetic marker for the determination of honey bee subspecies

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The western honey bee, *Apis mellifera*, is native to Europe, Africa, and Western Asia with a great diversity of subspecies. Subspecies can be classified into four different evolutionary lineages, mainly based on morphological characters and genetic markers: the M lineage of Eurasia, the C lineage of Europe, the O lineage of Western Asia, and the A lineage of Africa. Nuclear and mitochondrial molecular markers have been widely used to distinguish honey bee subspecies and reveal the evolutionary process of honey bee subspecies. Discrimination of subspecies by different methods is also important in terms of conservation of honey bee biodiversity. In this study, nuclear vitellogenin gene-*Vg* region encoding protein that affects reproductive function, behavior, immunity, longevity, and social organization in honey bees, was selected to understand the

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evolutionary history of honey bee subspecies. To investigate the pattern of genetic variation associated with *Vg* region of different subspecies and to reveal their evolutionary history, six variable *Vg* exon regions (*Vg*2-7 exons) of 16 subspecies were partially sequenced. The obtained sequences were combined with 5 subspecies that are available in the NCBI GenBank Database and the total number of subspecies analyzed reached to 18. Phylogenetic construction based on best tree resulted in four main groups. Subspecies were consistently clustered into previously recognized lineages. The median-joining network constructed using the haplotype datasets of the nuclear *Vg* region and yielded similar clustering with some admixture among different lineages. This admixture can be explained by the queen trade among different regions. Despite of having admixture, *Vg* region could be a valuable genetic marker to reveal phylogenetic relationships among honey bee subspecies.

OP-096 [Bee Biology]

Investigation of Bee Bread Use Efficiency in (*Bombus terrestris* L.) Before Social Phase

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Although bee bread contains higher levels of reduced sugar and digestive enzymes compared to the pollen from which it is produced, due to its high cost, it is not feasible to use it throughout the breeding process. Therefore, in the study, the effects of using bee bread in pre-social phase feeding were emphasized. Fresh pollens obtained from the poppy (*Papaver somniferum*) and cistus (*Cistus* spp.) plants are used extensively in bumblebee breeding and can be acquired as monofloral. In this study, fresh pollens of these two plants and the bee bread produced using the same pollens were used to feed the queens. Queens weighed after the diapause period were placed in individual boxes, and fed in a rearing environment with a relative humidity of 50 - 55%, and a temperature of 28 - 30 °C. A total of 90 hibernated queens were completely randomly divided into 6 groups with 15 in each group (1. poppy pollen, 2. cistus pollen, 3. pollen mix, 4. poppy bee bread, 5. cistus bee bread, 6. bee bread mix). In this study; the effects of bee bread on the quality parameters such as egg-laying rate (%), colony initiation time (days), and first worker emergence (days), which are calculated during the colony development period and also affect the colony development after the social phase, were investigated. Egg-laying rate (%) was calculated as 47%, 40%, 53%, 47%, 40% and 33% in the groups, respectively. The treatment groups were not significantly different in terms of egg-laying rates of queen bees (%) ($p=0.914$). There was no significant difference between the groups in terms of colony initiation time (days) ($p=0.849$) and first worker emergence (days) ($p=0.290$).

OP-097 [Bee Biology]

A new Acaricidal Compound Against *Varroa*

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Infestation of bee colonies *Apis mellifera* by varroa mites *Varroa destructor* is a significant cause of colony loss, particularly during the winter months in Canada. Currently, beekeepers have a limited number of tools available to treat bee colonies for varroosis. These mites have also quickly developed resistance to a number of registered compounds with acaricidal activity (i.e. fluvalinate, coumaphos, amitraz), while remaining treatment options often pose health hazards to beekeepers, require special devices for application, or have variable efficacy. As such, alternative control strategies are urgently required, particularly those that involve novel compounds. Based previous laboratory and field testing, we have discovered a new acaricidal substance, 1-allyloxy-4-propoxybenzene, referred to as 3c 3,6. In 2019, 2021 and 2022 we conducted large scale field trials in the southern British Columbia and northern Alberta to evaluate the efficacy of this acaricide under a range of environmental conditions, in comparison to a thymol-based treatment and untreated colonies. In 2019 and 2021, field experiments during fall months showed mite control efficacy levels of up to $81.1 \pm 2.9\%$, using a 4 week treatment period and release devices impregnated with either 4 or 5 g of 3c 3,6. These studies also showed no measurable negative effects of the active compound on adult bee or brood development. Results will be discussed comparing the efficacy of 3c 3,6 with variation in amount of active ingredient applied to colonies, the duration of exposure and the type application device.

OP-098 [Bee Biology]

Behavioural regulation of mineral salt intake in the adult worker honey bee

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Nutrient detection allows animals to select dietary chemical compounds required for survival and avoid harmful ones. Besides, animals attain optimal nutrition through the regulation of ingested nutrients. Mineral salts are micronutrients known to be limiting for phytophagous insects. Thus, balancing mineral intake can be challenging. We know that there is a relationship between salt concentration and foods' phagostimulatory power (palatability). Studies from mammals and insects revealed that low salt is attractive, but high salt deters feeding as it can become toxic. However, it is unknown whether this is the case for honey bees that obtain essential minerals mostly from pollen, which is highly variable in composition. Do all minerals have the same nutritional value? Moreover, what is high and low salt for bees? Here, we used two-choice feeding assays to assess whether young workers preferred mineral-enriched over mineral-free sucrose solutions. All eight prevalent minerals in pollen were tested at four levels of concentration each (salts: NaCl, KCl, CaCl₂, MgCl₂, metals: CuCl₂, FeCl₂, MnCl₂, ZnCl₂). Overall, bees perceived and preferred all sodium solutions and avoided ingesting solutions with high levels of metals to prevent intoxication. Only copper and iron solutions revealed feeding responses shaped by concentration. We show preference indexes, consumption responses, and bee survival for all eight minerals. These data indicate that adult honey bees regulate the intake of mineral salt diets and may display homeostatic mechanisms for regulating mineral intakes and attaining better nutrition. This study is the first to show that bees optimise their micronutrient intake and compare this form of behaviour in one organism for eight different micronutrients.

OP-099 [Apitherapy]

Proteomic studies and its antimicrobial activity of honeybee venom collected from *Apis dorsata*, *Apis cerana*, *Apis mellifera* and *Apis florea* species of Karnataka, India

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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 is known to contain many proteins such as the major protein melittin, enzymes such as phospholipase, hyaluronidase and other various proteins that has many medicinal values. These proteins vary in the concentration and composition between different bee species and also with respect to season. This can be analyzed with the help of proteomics. Amino acid variation in the proteins can make 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 dimension 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. Antagonistic activity was carried out to study the rate of inhibition against different pathogens.

OP-100 [Apitherapy]

Development of cream formulations enriched with honeybee (*Apis mellifera* L.) venom and bee products

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Bee venom is a substance that is produced in the venom glands of worker bees. Bee venom, which the European Commission defines as a firming and skin-protecting component in the cosmetics industry, contains pharmacologically

significant active ingredients. Although bee venom is a commonly used substance in apitherapy, it is challenging to come across bee venom creams. Since there is an increasing demand for natural cosmetics, creams with natural ingredients were produced in this study by making cream formulations; the active ingredient is bee venom. Many studies have proven that bee venom has many effects such as antibacterial, anti-inflammatory, nervous system regulator, pain relief, and antiaging. In this study, face, body, foot, hand, and articular cream formulations and prototypes with the mentioned effects of bee venom were developed, and stability, allergy, dermatological, and cytotoxicity tests were performed for each of them. The bee venom, royal jelly, and propolis used in creams were produced directly by contacting the beekeepers with a contract beekeeping model. Within the scope of the study, firstly, the preparation of the venom and the preparation of the infrastructure for the analysis, the development, and validation of the analysis methods were carried out. When the contents of 6 different bee venoms obtained from beekeepers were evaluated with HPLC-UV, the selected bee venom, was used to produce creams. Then, the necessary natural ingredients for production were provided, and nine different formulations were prepared for each type of cream containing different concentrations of bee venom. Prototype products have been created for five types of cream, based on the formulations selected from voluntary tests and sensory tests. The prototype creams of the selected formulas were tested for stability at room temperature and 40 °C. The creams that were found suitable based on the stability test results were subjected to various tests, including antioxidant, allergy, dermatological, and cytotoxicity tests carried out on volunteers. The data generated on five prototype creams showed the appropriateness of the developed formulations. This study produced prototype creams by developing face, body, foot, hand, and joint pain creams containing bee venom.

OP-101 [Apitherapy]

Immunomodulating Effect of water-soluble propolis extracts of green, red propolis and brown propolis (WEEP-GBR)

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Cytokines released from innate immune cells play key role in the regulation of the immune response. Propolis is known to show different ingredient composition of propolis and pharmacological effect depending on various factors, such as the geographical origin, types of plant sources, and season of the year. In this study, we examined the immunomodulatory effect of water-soluble propolis extract (WEEP-GBR, mixture of Brazilian green and red propolis and Australian brown propolis) on the regulation of cytokine release in mice and anti-inflammatory effect using lipopolysaccharide (LPS)-induced inflammatory response. The evaluations of immunomodulatory activity of WEEP-GBR was measured both in vitro assay and in vivo assay. The murine macrophage cell line RAW 264.7 cells were used and MTT assay was performed to measure the cell proliferation ability. The secretion of nitric oxide (NO), tumor necrosis factor- α (TNF- α), and interleukin-6 (IL-6) was measured in LPS-induced RAW 264.7 cells by ELISA. there was no cytotoxicity in the macrophage proliferation treated with WEEP-GBR compared to the control. The secretion of IL-6, and TNF- α was suppressed in a dose-dependent manner. In addition, we assessed the immunomodulatory activities of WEEP-GBR on cyclophosphamide (CY)-induced immunosuppressed mice. We revealed that mice treated with WEEP-GBR showed increased splenocyte proliferation. These results suggest that water soluble propolis extract with Brazilian green and red propolis and Australian brown propolis has immunomodulatory effects.

OP-102 [Apitherapy]

Propolis: Sustainability for the Honeybee - Sustainable Medicine for man?

James Townsend Fearnley

International Propolis Research Group

Propolis obviously has a major role to play in the honeybees immune defence. Propolis protects the colony physically, reinforcing every cell, creating a defensible entrance as well as an effective and adaptable ventilation system. Biologically, principally via the phenolic compounds, propolis prevents infectious agents from becoming dangerous when they join together by disconnecting and disabling bacterial and virus's, disarming rather than destroying. Propolis provides the honeybee colony with a key capacity or ability to sustain itself. It is the most powerful component of the honeybee's sustainability.

What propolis does for the honeybee, we are discovering, it can also do for human beings. The colony is a body, a superorganism without a skin. The temperature inside this superorganism is very close to that in the human body. Over the last 70 years research has illustrated the many anti - properties of propolis, anti-bacterial, anti-inflammatory, antiviral etc.

Modern pharmaceutical medicine, however, did not develop the disabling, disconnecting and ultimately sustainable model demonstrated by propolis but has focused instead on targeted synthetic, often single molecule actives often derived from plants and designed to directly destroy the bacteria, fungi, virus. The short-term benefits of this anti - medicines has been

dramatically positive, but has in the long term contributed to some major global health care problems - antibiotic resistance and iatrogenesis. The sustainability of modern pharmaceutical medicine is in question. Health consumers are turning in their millions to natural alternatives and medical scientists are developing the evidence base for therapies and products that have been used for hundreds if not thousands of years.

Propolis is emerging as one of nature's most powerful and most sustainable supports for the human immune system. But how can this new more sustainable medicine be developed itself sustainably. The honeybee is not a commodity to be exploited. We must find a new relationship with what we call medicine and a new relationship with those natural medicines that may well hold a critical key to the restoration of positive health.

OP-103 [Apitherapy]

Simultaneous Optimization of Extraction Yield, Phenolic Compounds and Antioxidant Activity of Moroccan Propolis Extracts: Improvement of Ultrasound-Assisted Technique Using Response Surface Methodology

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Propolis has given rise to refreshing interest in recent years in the field of conventional medicine. Its extraction represents an important process that requires optimal conditions, which strongly affect the yield of extraction, total polyphenols, flavonoid content, and radical scavenging capacity markers. The objective of the present study was to optimize the ultrasound-assisted extraction conditions of Moroccan propolis. The studied responses were the extraction yield, total polyphenols, flavonoid contents (TPC, TFC), and antioxidant activity of the extract evaluated by DPPH-IC50 and FRAP-EC50 assays. The response surface methodology (RSM) and specifically the Box-Behnken design (BBD) were used, taking into account three variables: sonication time (min), solvent/propolis ratio (mL/g), and ethanol concentration (%). After the realization of experiments and data analysis, optimal response values were 15.39%, 192 mg GAE/g of propolis, 45.15 mg QE/g, 29.8 μ g/mL, and 128.3 μ mol Fe2+/g for extraction yield, TPC, TFC, DPPH-IC50, and FRAP-EC50, respectively. Besides, optimal ultrasound extraction conditions were 15 min for sonication time, 30 mL/g for solvent/propolis ratio, and 40% for ethanol concentration. All obtained experimental values were in good agreement with the predicted values, suggesting that using an experimental design in the ultrasound-assisted extraction process and optimization was prudently chosen.

OP-104 [Apitherapy]

An important product in the development of effective alternative nanocomposites for use in medical and environmental areas: A honey bee silk

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Global trends are moving towards environmentally friendly materials and production methods for medical usage and the removal of pollutants from the environment. Therefore, natural fibre applications are attracting worldwide attention. Silk, a natural protein fibre, is one of the most critical materials used in the medical and textile fields nowadays. Silk is used medically in tissue engineering as a scaffold, drug delivery systems and implantable devices as a biomaterial application. Silk solutions have been used to form a variety of biomaterials, such as gels, sponges and films for medical applications. Both cocoon silk and spider silk are generally used in these applications, but honey bee silk is a lesser-known silk type. Honey

bee silk is composed of four fibrous proteins that, unlike other silks, are readily synthesized at full-length and high yield. The importance of the four protein complexes found in natural honey bee silk may lie in biological silk storage or hierarchical self-assembly. However, the amino acid composition and molecular architecture of the proteins are similar, suggesting that they may be more functionally efficient than others. Besides, honey bee silk membranes were analysed according to physicochemical surface topography, stability, biodegradation, and mechanical and biological properties. In vitro studies showed that the honey bee silk membranes were found cytocompatible, hemocompatible and acceptable immune response. Considering all these, this study aims to produce honey bee natural silk solutions and includes studying their composite fabricability for biomedical use. For this purpose, a procedure for the production of bee silk solution was developed and both Fourier transforms infrared spectroscopy (FTIR) and X-ray diffraction analysis (XRD) as a characterization experiment was performed. As a result of the study, a material containing bee silk with a stable structure was developed, and it was determined that it is suitable for medical and biological use. Besides, a composite product was formed by assembling honey bee silk solution with chitosan solutions of different concentrations. This study will pave the way for the usage of natural honey bee silk as a biomaterial for biomedical applications.

OP-105 [Apitherapy]

Current status of bee venom research and industrialization in Korea

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The therapeutic value of bee venom (BV) from honeybee to improve the quality of life of patients is acknowledged since more than hundred years in South Korea. The study of bee venom has been mainly studied in oriental medicine for the treatment of arthritis through clinical cases. The current study on the efficacy and mechanism of bee venom started with the development of a bee venom collecting device in 2005. Previously, there was no way to collect bee venom in Korea, so bee venom was a very expensive experimental material. In Korea, research on bee venom and industrialization were carried out in nine steps. The first step is to develop a bee venom collecting device. The bee venom collecting device is a device that collects only bee venom in large quantities without killing bees. The second step is to develop a purification method to maintain uniformity and high purity of the collected bee venom components. The third is a study on the use of bee venom for use as natural antibiotics instead of chemical antibiotics in livestock breeding. Fourth, research on various functions of bee venom was investigated in vitro, and fifthly, pharmacological efficacy of bee venom was investigated using animal models. In addition, the safety of bee venom for external and oral use was investigated. Eighth, in order to secure the reliability of bee venom, a manual for the production history of bee venom was developed. Lastly, we are conducting clinical trials with bee venom to develop an acne treatment drug. Currently, in Korea, bee venom is used as a raw material for oriental medicine, cosmetics, and detergents.

OP-106 [Bee Health]

The potential use of fermented bee pollen as a probiotic supplement for bees

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Antibiotics are often used by beekeepers for treatment of bee diseases which raised concerns about their overuse and antibiotic resistance, losses of beneficial microorganisms, and the risks of antibiotic residues identified in bee products. A new strategy to improve the health of honeybees is the study of their microbiome and the use of probiotics in the treatment and prophylaxis. The aim of this research was to use probiotic fermentation of bee pollen to obtain a product with high nutritional properties, increased bioavailability and with beneficial bacteria for bees' gut microbiota. *Lactobacillus plantarum* and *Lactobacillus acidophilus* were used for the fermentation process. The viability of lactic acid bacteria in the fermented product was tested. The bioaccessibility of the fermented bee pollen was examined using in vitro simulated digestion. Total carbohydrates were calculated by difference after determination of ash, protein and lipids, and the energy value of the fermented pollen averaged 429.12 kcal/100 g. Bee pollen fermentation has increased the total polyphenols in all tested samples. The total amount of polyphenols before fermentation was between 3.22-12.35 mg/g sample and after fermentation between 5.24-15.64 mg/g sample. Regarding the total flavonoid content, the results showed that the fermentation had a positive effect on their quantity. The amount of flavonoids prior to fermentation was between 1.18-6.23 mg/g sample and after fermentation between 2.11-8.98 mg/g sample. The statistical analysis of the obtained data confirmed that there are significant differences between the chemical composition of bee pollen samples before and after fermentation and that fermentation process has led to an increase value of bioactive compounds, such as phenolic compounds, which

are known to have antimicrobial potential. Further *in vivo* research is needed to evaluate the bioavailability of the probiotic bacteria from the obtained product and its beneficial impact on bees health.

OP-107 [Bee Health]

Breeding honey bees for low Varroa growth (LVG) in Canada

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The ectoparasitic mite *Varroa destructor* and the viruses it transmits are among the main threats to honey bee health worldwide. In Canada, *V. destructor* has been associated with more than 85% of the overwinter colony losses. Most beekeepers use synthetic miticides to control *Varroa* infestations, but the mites soon develop resistance against their active compounds, compromising their effectiveness. Therefore, it seems necessary to develop different control strategies. One alternative is to breed *Varroa*-resistant strains of honey bees for reducing mite infestation and deformed wing virus (DWV) levels in honey bee colonies. We are currently conducting a breeding program to select bees for low and high rates of *V. destructor* population growth (LVG and HVG, respectively), and monitoring infection rates of DWV. After three years of bidirectional selection, significant differences between the two genotypes were observed. LVG colonies had *V. destructor* population increases over the summer of 2 fold compared to 10 fold for HVG colonies. Additionally, LVG colonies had significantly lower mite infestation rates and 7 times more mutilated mites compared to HVG colonies. DWV prevalence and levels were significantly higher in HVG colonies than in LVG colonies. Winter mortality rates of colonies were significantly lower for the LVG genotype than for the HVG genotype. The results of this study thus far indicate that selection for LVG may result in colonies with lower *V. destructor* infestation rates, lower prevalence and levels of DWV, and higher colony winter survivorship. Future work will focus on determining what mechanisms are responsible for the genotypic differences, estimating genetic parameters, and conducting molecular analyses of the genotypes to identify candidate genes associated with resistance to *V. destructor* and DWV, that could potentially be used for marker-assisted selection of mite-resistant honey bee strains.

OP-108 [Bee Health]

Honey Bee Watch: an international scientific initiative for the protection of survivor colonies

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After humans, honey bees are the most studied animal on the planet, largely due to their critical role in maintaining biodiversity and food security. However, despite so much research on *Apis* species, wild populations are astonishingly underrepresented in the scientific literature.

Honey Bee Watch aims to address this lapse by building an international coalition and developing engaging digital citizen-science tools in order to collect data from around the world to better understand the biological, behavioral, and environmental traits that encourage free-living and untreated colonies to survive – even thrive – amid the threat of various pests, parasites, and pathogens.

Currently the overall status of *Apis mellifera* in the wild remains unknown, prompting the IUCN Red List's "data deficient" classification in 2014. Related, the statuses of the remaining *Apis* species (mostly in Asia) have not yet been assessed on a widescale. These circumstances, therefore, urgently call for more investigative efforts regarding the prevalence and health of wild honey bees globally to facilitate their future conservation, if deemed necessary.

To that end, Honey Bee Watch has launched an online mapping platform, which will collect extensive data on the presence and localization of survivor honey bees over the course of several years. Once such colonies have been identified, a network of regionally coordinated operators will be deployed to validate questionable cases, monitor nests' activity, and collect samples according to standardized protocols. Molecular tools and big data analyses will also be utilized to assess honey bee health and genetic diversity in relation to their surrounding environment, thus providing a more holistic perspective when considering conservation efforts.

Once sufficient data have been analyzed, Honey Bee Watch will then enter its second, concurrent phase: education and conservation. During that stage the objectives will be to increase general awareness about the importance of honey bees, provide ample data to IUCN to reassess the status of wild European *A. mellifera* populations and establish the statuses of native Asian *Apis* species, as well as roll out regional conservation campaigns in an effort to preserve survivor populations.

The nature of a survivor: population dynamics of Varroa destructor in a resistant, commercial honeybee (Apis mellifera) population over the active season

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Varroa destructor has been a central problem to European honeybees and beekeepers for decades, vectoring disease and increasing colony losses, but more and more beekeepers are finding ways to breed for resistances to this parasite. One such population in the Oslo region of Norway has been carefully selected now for more than twenty years, with mite treatments no longer needed to prevent significant colony losses. Here we sampled the mitefall continuously throughout the entire active season in 25 of these surviving hives and 25 control colonies sourced from a stock that was treated annually. The average mite loads in the surviving population did not tend to exceed 10 mites per day at any point in the active season, while control population loads grew from approximately 5 mites per day to an average of 35 mites per day with a large variation between colonies. Though there were some colonies in the surviving population that did have high late summer counts between 20-35 mites per day, the number was very few (16%), and no colonies exceeded 35 mites per day. The control population had many more colonies within and exceeding this mitefall range (48%) with some colonies as high as 100 mites per day. The results from this study show that this selected honeybee population manages V. destructor loads throughout the entire active season and extremely infested “mite bomb” colonies are absent from the population.

A review on genetic resistance to the Varroa mite in honey bees

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The western honey bee, *Apis mellifera*, is one of the most valuable pollinators worldwide. Over the last few decades, increased honey bee colony losses (Colony Collapse Disorder) have been reported, possibly as a result of a growing number of interacting threats, such as habitat losses, nutritional deficiencies, pesticides, pests and pathogens. In spite of the implementation of control strategies, the invasive parasitic mite *Varroa destructor* remains one of the main causes of colony losses in numerous countries. Indeed, after *Varroa* jumped the species barrier around the 1950s, from its native host *Apis cerana* (Asian honey bee) onto *Apis mellifera* (European honey bee) it spread globally. Currently only Australia and a few small, isolated islands are free of *Varroa*. The host-parasite interaction between honey bees (*Apis mellifera*) and the mite (*Varroa destructor*) is unusual and without acaricides, honey bee colonies typically die within 3 years of *Varroa* infestation. As a result, particularly in the Middle East, the constant use of acaricides is common and necessary. There are many available options to control *Varroa* mite populations in honey bee colonies and each option has advantages and disadvantages, but understanding the implications of each choice is an important part of decision-making. Doubtless, long-term application of chemicals significantly affects the colony and society health. An ideal option is using mite-resistant bees that can limit the reliance on chemicals for mite control. Genetic environmental factors have major effects on the survival of the *Varroa* destructor infested colonies and previous studies show that various bee stocks with mite-resistant traits have been developed. Literature suggests that honeybees may have the ability to respond to genetic selection programs. Therefore, it would be wise to design appropriate breeding programs for genetic resistance based on the relevant traits (e. g. grooming and hygienic behavior). Optimizing a selection program requires knowledge of the mechanisms underlying resistance that can be further developed or improved in selected stocks and identifying genes and genome-wide markers associated with mite resistance in honey bees.

Determination of Expression Levels of Some Candidate Genes Responsible for Grooming Behavior in Muğla honey bee (Apis mellifera anatoliaca) population bred against Varroa

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Grooming behavior in honey bees is a very important mechanism in terms of resistance to *Varroa* mite. In this study, 23 Muğla Honey Bee (*Apis mellifera anatoliaca*) colonies which was bred against *varroa* and 23 control colonies were used as material. Expression levels of *Hym*, *AmNrx1*, *CYP9Q3* genes, which are thought to be related to grooming behavior in the study, were determined in qPCR using Sybrgreen probes. As a result, it was determined that *Hym*, *CYP9Q3*, *AmNrx1* gene expression levels in breeding colonies increased by 496%, 472% and 382% compared to control colonies. In the study, statistical differences were found between the breeding and control colonies in terms of *Hym*, *Cypq3* and *Amnrx* gene expressions ($p < 0.01$). Based on this result, it can be said that breeding against *Varroa* increased the expression level of candidate genes thought to be responsible for grooming behavior, and therefore, grooming behavior also increased. This study was supported by TAGEM/HAYSÜD/Ü/20/A4/P5/1857.

Keep it simple: the power of ranking test results in the context of breeding for resilient honey bees

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Six years ago, a breeding program was set up in Flanders to improve the genetics of our honey bees. It is a three-year program that consists of motivated breeding, testing the performance of the colony in the second year and propagation by larvae grafting in the third year. We follow the internationally accepted test protocols, supplemented with some of our own protocols. For example, ‘suppressed in ovo virus infection’ or SOV is an important trait for resilience against viruses that we even use as an exclusion criterion for further propagation. From the start, we have chosen to keep the evaluation of the test results fairly simple and to move away from breeding value estimation. Instead, the test results are ranked from best to worst and divided into quartiles. By summation of the scores of the individual tests, we then obtain a global breeding rank. You could call it a simple mass selection. The advantage of this approach is that it is easily accessible and beekeepers can even participate if they only have one queen to be tested. Test results of previous years are not taken into account in the assessment. As a result, we saw the number of tested queens growing each year. After the winter of 2021-2022, we collected information about winter mortality among the tested colonies and calculated which parameters in the breeding program were related to this. The results show the importance of individual resilience traits on survival and which tests require further adjustments. Integrating traits related to productivity, such as honey production, reduce the predictive value of breeding rank regarding survivability. In the future, we should consider opting for a negative selection where the underperforming queens are excluded from propagation instead of positive selection of the best ranked queens. Negative selection also benefits the genetic diversity of the honey bee which is an important weapon against new threats such as climate change.

Monitoring internal conditions in honey bee colonies during the winter period in different apiaries in north-western Spain

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In recent years, monitoring beehives through technology has become a tool for a better understanding of the colony's behavior. These systems are used for different purposes: predicting swarming, health status of colonies, prevention of death, hive abandonment or quantification of nectar flow, among others. Monitoring systems are useful to anticipate decisions without having to move to the apiary or disturb the honey bee colonies. This is an important issue in the wintertime as the hives cannot be checked and it is unknown how is the status of the colonies. In this work, we have used hive monitoring systems to register the internal and external conditions of hives in apiaries. The aim was to predict the status of the colony in wintertime with monitoring systems interpreting internal parameters in the hives. The study was carried out under field conditions using four apiaries situated in different geographical areas of Galicia (NW Spain). Eight honey bee colonies were monitored from October 2020 to March 2021 using B-Keep monitoring systems. The strength of the colonies was measured following the methodology proposed by Delaplane et al. (2015) using ImageJ software. Temperature and relative humidity inside the colonies were related to temperature and relative humidity in each apiary. It was observed that the internal parameters of the stronger colonies were less correlated with the external parameters than those that were weaker. It has been seen that the daily thermoregulatory capacity of the colonies differs according to the status of each colony, being able to establish a direct relationship between this capacity for thermoregulation and the strength of the colonies. Hence, monitoring systems could help beekeepers to improve their understanding of the colonies in the wintertime by following the status by the internal parameters of temperature and relative humidity. Furthermore, it is a tool useful in order to synchronize the subsequent management of the colonies in relation to the following spring to increase the productivity.

Comparison of different preservation treatments and the effect on quality descriptor parameters in bee pollen

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Bee pollen corresponds to conglomerates of plant pollen that the honeybee *Apis mellifera* carries from the flowers to the hive in a cavity in the third pair of legs. It has been described as a product rich in nutrients, including various compounds that can confer important biological properties such as antioxidant capacity. The botanical origin of bee pollen is responsible for the nature and properties of the bioactive compounds.

The preservation of the original properties of bee pollen depends to a large extent on the treatments it receives after being harvested and on the storage conditions that ensure the quality of the product at the time of consumption.

In this work, samples of bee pollen from central Chile (n=10) were analyzed for quantification of routine quality parameters, pigment concentration and antioxidant activity. The samples were then divided into two equal portions to generate two sets of samples. The first set of samples was subjected to conventional dehydration, while the second set was subjected to ionizing radiation at three levels of intensity.

Finally, the quality descriptor analyses were repeated, and the values obtained in both pollen groups were compared with the baseline values previously recorded in the untreated samples. This study presents the results of the performance of both sets of samples against each of the treatments and the advantages, costs and benefits of both methodologies in terms of final pollen quality and post-harvest preservation times.

How ready are beekeepers for Precision Apiculture Systems (P.A.S.)? A pan-European survey

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Considering the relentless pace in which our personal and professional lives are being transformed daily by Information and Communication Technologies, Precision Apiculture could not stay behind for long. While beekeeping is still a mainly traditional sector compared to other agricultural ones, Precision Apiculture Systems (P.A.S.) and academic studies around it are on the rise.

As part of the European BeeConnected Programme, we carried out a standardised survey aiming at understanding to what extent beekeepers are willing or prepared to implement such technologies in their apiaries. The main objectives of the survey were to understand the reasons behind the use or disuse of such systems and which type of P.A.S. beekeepers would be more inclined to resort to in the future. The survey was translated in 4 languages (English, Greek, French and German) and spread over beekeeping networks in France, Germany and Greece. Overall, 538 beekeepers participated to the survey and about half of them had used some form of P.A.S. in their activities.

The results presented will highlight the factors and barriers that influence beekeepers decision on a P.A.S. installation in their apiary. Finally, we will provide insights for the efforts needed to be made from the market in order for those systems to be more accessible for a larger use by beekeepers.

Speaking of Bees

Ted Dennard

Savannah Bee Company

Ted Dennard worked with bees from a young age and upon graduation from university he served as a Peace Corps volunteer in Jamaica working with beekeepers and teaching beekeeping in schools for two years. His passion for bees and raising awareness about how important and wonderful they are led him to start Savannah Bee Company. It began with 50 beehives and sold tupelo honey, honeycombs, lip balms and beeswax candles. The company now sells all over the United States as well as operates 15 retail stores called Savannah Bee Company. There are hundreds of honeybee related SKUs sold that range from mead to bee books. The company employ around 200 people and has started a not-for-profit BeeCause Project that has put beehives in over 500 schools to raise a generation that loves and will protect the honeybees. The company uses the beehive as a symbiotic model for business where profits are tied into purpose, where the sales of products fuel more awareness of the role honeybees play.

In addition to giving meaningful purpose to and improving the economic health of individuals, he has worked to improve the health of our world, promoting honeybee awareness. By founding the Bee Cause project to inspire the next generation of beekeepers in 2014 and joining forces to bring vitality back to Exuma in the Bahamas by reintroducing honeybees into the environment, Ted has used local honey cooperatives to make the world a better place. His work in the Peace Corps set him up for a lifetime of servitude and honeybees have helped him fulfill this role.

Organic Beekeeping Businesses in Turkey: Economic Structure and Sustainability

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From production to consumption, organic beekeeping is a regulated and certified production model that uses only approved inputs and avoids the use of medications that are harmful to human health. In Turkey, 387 growers produced 70,385 colonies and 1,028 tons of organic honey in 2022. By conducting a face-to-face survey with 118 organic beekeeping firms in Turkey, this study aims to show the economic structure and sustainability of the enterprises. Migratory beekeeping accounts for 42.37 percent of organic production businesses, while stationary beekeeping accounts for 57.63 percent. According to the findings, variable expenses account for 57.78% of the costs of the investigated businesses, while fixed costs account for 42.22 percent. Income per colony, cost, honey sales price, and cost per colony decrease as the size of the enterprise grows. Honey sales account for 91.47 percent of the enterprises' revenue. According to enterprise types, although migratory beekeeping firms have a higher total cost per colony, stationary beekeeping enterprises have a higher total income per colony, honey production cost, and honey sales price. Economic sustainability is found to be low in 12.7 percent of assessed businesses, medium in 65.3 percent, and high in 22 percent.

Physical, Chemical Features and Mineral Substance Profile of Turkish Pine Honey

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A comprehensive research is planned to determine the chemical composition properties of Turkish Pine Honey and to introduce pine honey to the whole world in our country, where 92% of the total pine honey is produced in the world. For this purpose, 373 pine honey samples were collected from 47 honey production regions (33 different harvesting regions) in provinces where pine honey is produced. The main purpose of this project, which is carried out as a TAGEM project; In this project, the average humidity of pine honey is 16.07%, the average electrical conductivity is 1.37mS/cm, viscosity is 27.42 Pa.s, optical conversion is 1.06, free acidity is 18.57 meq/kg., proline 408.57 mg/kg, diastase number is 14.11, Fructose / Glucose ratio is 1.13, Fructose + Glucose is 54.28% in total, and the amount of sucrose is 1.84%. Maltose was not detected in 373 pine honey samples. Color parameters were also examined within the scope of the project. The average Hunter a value was 19.58, b value was 76.02, and L value was 58.62. Considering these values, it was determined that Turkish pine honey generally has a green, yellowish, medium dark color (light amber color). A significant part of the pine honey samples examined in terms of copper, zinc, manganese, nickel, lead and cadmium remained well below the analysis detection level. As a result of the research, the difference between provinces, districts, regions and years is statistically significant (p<0.01). It has been determined that Turkish Pine Honey is also an important source of potassium and iron. The absence of traces of maltose in any of the samples examined is considered an important output. With the project, it has been confirmed that the NHE/NTP ratio is not a sufficient criterion for the distinction between pine honey and flower honey, and that pollen analysis should be supported by optical rotation and electrical conductivity analyses. Honey does not pose any risk to human health. In addition, the results show that the C4 ratio in pine honey should not be considered as a food counterfeit and adulteration parameter.

The effect of Covid on the honey sales of the hobbyist beekeeper in Ireland

Eleanor Attridge

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Covid 19 closed down farmers' markets and changed the way consumers shopped and socialised. It effectively shut down the Irish economy during the lockdown period. Small food producers and hobbyist beekeepers were abandoned overnight and needed to come up with another avenue to market their goods in particular those who brought fresh produce to market.

The aim of this paper is to evaluate an alternative route to create a market for online honey sales on a local level for the hobbyist beekeeper and to evaluate the success or failure of the online sales from the beekeeper's perspective. The hobbyist beekeeper depends on local markets and corner shops. The compulsory closure of the local farmers' market was detrimental to all small producers. They are not in a position to supply a big supermarket chain nor do they have the expertise or marketing experience to set up their own online sales.

Data was harvested from a relatively new online portal "Neighbourfood" with pre-Covid figures and the overnight effect that Covid had on online sales for the hobbyist beekeeper as more depots opened across the Cork region to facilitate the "click and collect" online purchases of fresh food. Honey was one of the stable produce in their shopping baskets. There was an 800% increase in online honey sales, with consumer demands for new products increasing as people experimented with home cooking and new recipes. The demand for show quality beeswax blocks created a niche market as those at home entertained themselves by making zero-waste food packing in the form of beeswax wraps. The cappings wax is ideal for this product. Cut comb honey sales also grew by 150% during that period. The local corner shops also had 200-300% increase in honey sales and appear to have held on to that market share post-lockdown.

While the online market was a victim of its own success during the Covid lockdown it will fight to hold a market share with the post-Covid reopening of Farmers Markets. It will require substantial social media coverage and further investment to keep and hold a market share.

Breeding for Resistant Bees

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Apimondia Federation

The parasitic mite Varroa destructor is a major challenge to beekeeping industry worldwide. Since varroa appearance in Europe, beekeepers rely on the use of synthetic or organic substance for repeated treatment. The effect of using acaricides to control varroa mites has long been a concern to the beekeeping industry due to unintended negative impacts on honey bee health, the increased resistance of mite populations to acaricides, the residues in the bee products and the high costs and labour.

Long-time ago now, a well-known behaviour of the honey bees has been proven to be advantageous against the mites, named grooming behaviour, hygienic behaviour and Varroa Sensitive Hygiene, the recapping ability (Hawkins & Martin 2021), the size of the natural build comb, the post capping duration or reduced reproduction/ no reproduction of varroa mite and the suppressed in ovo virus infection.

A recent review described the existing Varroa-resistant populations in Europe and the regulatory mechanisms of the naturally surviving population. Probably there are also similar surviving populations in other parts of the world.

The questions to be addressed during this WS are:

- Do we know of populations showing resistance or tolerance to varroa mite? Have we tried to breed from those and disseminate queens to beekeepers?
- Is this feasible in a country level and not only experimentally and what is the time frame and the cost of such an attempt, from the time a laboratory or association starts this attempt till the time beekeepers could be benefited

Virtual Reality in Training of Beekeeping: Seeing Future Through Virtual Hives

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The honey bee, *Apis mellifera* L., is regarded as one of the most significant insects that have benefited humankind for medicinal and nutritional purposes. It plays a vital role in agriculture not just for honey production but also for plant pollination. Turkey ranks third in the world's hive count with approximately 8 million hives. However, the average honey yield per hive is significantly lower than the global average. The low yield per hive is due to a number of factors including bee diseases and pests, pesticides used in agriculture, climate change, beekeepers' wrong practices, and a lack of contemporary beekeeping practices. Other challenges in beekeeping include the lack of emphasis on beekeeping education and the average age of beekeepers in Turkey. Virtual reality (VR) is a method of visualizing items in order to observe 3D models of a specified environment. Additionally, mathematical models can be added to such items to enhance the immersive learning experience. Therefore, VR technologies provide opportunities to deliver practical education in ways not possible through traditional methods. Some research suggests that honeybees are well-known models for the study of visual learning. In this study, VR scenarios were created for practical training in beekeeping, utilizing honeybee morphology and biology. Sensory feedback, such as sound, was added to the scenarios to make them more realistic. The scenarios include beekeeping materials and their usage, monitoring of some bee diseases and pests, as well as drug applications in disease control. In this regard, a Virtual Reality Laboratory was created at the Department of Pharmacology and Toxicology, Faculty of Veterinary Medicine, Ankara University. Training has begun in this laboratory, and students have easy access to beekeeping practices regardless of the season. So far, it has been observed that it contributes to the creative learning process by facilitating students' interests and understanding. In the future, the laboratory will be open to anyone interested in learning about beekeeping.

Online blooming reporting system for beekeepers

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The blooming of flowers is essential within beekeeping regarding foraging and timing of beekeeping practices. It is discussed if climate changes influence blooming periods locally and geographical.

We developed an online reporting blooming calendar, a homepage (works like an app), where beekeepers report blooming of the most important bee plants. This makes it possible to collect and display information on blooming in different parts of the country and over the season.

The system consists of three basic functions.

1 Bee plant calendar. This is a list of the most important bee plants with information about blooming periods, pollen color, prevalence, and importance for the bees. The plants are ordered according to blooming time, making it easy to find the most important, currently blooming, bee plants. General information about the plants is restricted to a Wikipedia link.

2 The blooming reporting system. Here you just choose the plant and report whether blooming is just beginning, in full bloom or the late phase of blooming. As it is designed for use on the mobile phone, position, time, and date are known in advance. The user has free access to an overview of blooming reports for the different bee plants and how they are distributed over the country and over the season.

3 A pollen recognition system. As colors on electronic equipment are unprecise, we have combined our online system with a physical pollen field guide, which shows the precise colors. With this combination at hand, the beekeeper can place pollen pellets on a color scale and find the best matching color. By choosing this color in the online pollen recognition system, the most likely matches are shown. Matches are based on the pollen color, how relevant/attractive the plants are to the bees, their prevalence, and their blooming status.

Access to the system is completely free and can be found on www.biplanter.dk. It is designed for Danish beekeepers, but most text is also available in English. Other languages are planned to be included.

You must set up a user profile to register blooming of bee plants. It is free of use.

Effects of Different Levels of Chelated Mineral Supplement (Bonza®Bee) On the Population Size and Brood Rearing in Honey Bee Colonies (*Apis Mellifera*)

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In this study, the effects of chelated mineral supplement (Bonza®Bee) on the population size and brood rearing in *Apis mellifera* were investigated. This experimental was conducted in a completely random design with 5 experimental treatments and 5 replications (hive) for 90 days in summer. Experimental treatments include: control (without Bonza®Bee) and chelated mineral (Bonza®Bee) supplementation (2, 4, 6 and 8 g/L Bonza®Bee, respectively), which were diluted in sugar syrup 1:1 (50% water and 50% sugar) and provided to the honey bees for 90 days. Measurements of brood rearing and hive population size were performed. To measure the size of the population, the method of estimating comb full of bees or a fraction of a comb was used, and to measure the brood rearing, a comb divided by wire into squares of 5*5 cm was used. The results showed that there was a significant difference between treatments in mean brood rearing and population size in the whole experimental period ($P < 0.05$), so that the treatment of 4 gr of Bonza®Bee was the most (19% more laying). In terms of population size, the treatment of 4g Bonza®Bee had 20% more compared to control group. Therefore, Bonza®Bee supplementation in the feeding of honey bees, in the concentration 4 gr, positively effect on the population size and brood rearing in honey bee colonies.

Monitoring honeybees' health using environmental DNA (eDNA) contained in honey

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The difficulty in monitoring honeybees' health and their potential diseases lies, in part, in the numerous variables leading to their vulnerability; the lack of plant resources, their exposure to pesticides and contacts with pathogens species such as *Varroa*. Therefore, the development of effective methodologies to simultaneously and holistically capture as many of these variables is strongly required.

The increase availability of sequenced genomes and the decrease in prices for sequencing make the analyses of eDNAs through metagenomics more and more accessible. We are going to present the results of an optimized methodology to extract eDNA from honey and a bioinformatic pipeline for the characterisation of the species composing honeybee ecological niche.

The results of this work reveal that, over the seasons, it is possible to identify the foraged plants surrounding the apiary while characterising the honeybee diet adaptations subsequent to flowering changes. In addition, this approach allows the identification in honey of bacterial eDNAs constitutive of honeybee gut microbiome, which composition provides important insights in bee health. Finally, our study brings evidences that monitoring *Varroa* hive infestation can be also reveal by measuring eDNA in honey.

In conclusion, this study suggests that honey metagenomics has the potential to comprehensively described honeybee ecological niches and can be tested as a building block for large scale studies to assess bee health in the field.

Advances in palynological analysis of bee pollen loads

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The bee pollen trade has been increasing and is already a considerable source of income for many beekeepers. The botanical and geographical origin of bee pollen is a key factor in determining its quality and is highly relevant to its valuation. Therefore, the standardization of methodologies for accurately establishing this information is of special importance. There are a modest number of studies and a multiplicity of methods is used for estimating the botanical profile and even greater diversity for the criterion used to classify bee pollen into mono or multifloral. The latter is of particular importance to commercial companies as it influences the commercial price of bee pollen.

The performance of an Interlaboratory Test within the scope of the work of the "ISO/TC 34/SC 19 - Working Group (WG3): Bee Pollen", involving 11 laboratories, also showed a high variability of results, reinforcing the need for methodological adequacy and optimization in this area.

In order to test some of the potential factors causing the variability of the results obtained, some changes were implemented in the first proposed methodology, which improved reproducibility within and between laboratories. Preliminary results indicate the need to increase the pollen sample size to 5 g to improve its representativeness and count at least 600 pollen grains to reduce the fluctuation of results.

The size and shape of pollen grains are extremely variable depending on the botanical origin, so the value of the percentage of each pollen species in the bee pollen is not enough indicator to classify it as monofloral. It is proposed as a minimum criterion, that a given species should represent at least 80% of the volume of bee pollen grains, to be classified as monofloral.

The strenuous road toward honeybee stock self-sufficiency

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The beekeeping industry in Canada and many other countries relies on honeybee stock importation to replace winter mortalities and increase number of active colonies. These imports incur various risks (for example new pathogens, undesired or maladapted bee genetics) and undermine efforts of local breeding programs. The sustainability and self-sufficiency are major concerns of the Canadian beekeeping industry and various actions have been taken to reduce our dependence on honeybee stock importation. First, our research group is promoting the establishment of a breeding program using quantitative genetics and the BLUP model and secondly, we have developed a novel method to successfully winter large number of young, mated queens from September to April (queen banking). These banked queens are available early spring and can replace many of the imported queens. These actions contribute significantly to maintain local honeybee stock, improve colony performances, colony resistance to pathogens and overall increase sustainability and self-sufficiency of our beekeeping industry.

Effects of Various Mechanical Factors on Honeybee Sperm

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Many studies have been carried out on the cryopreservation of honeybee semen around the world. However, the desired level of success in the cryopreservation of bee semen has not yet been achieved. In this study, it was aimed to more effectively determine the effects of stress factors on sperm viability and some parameters during the cryopreservation and processing of honeybee semen. For this purpose, the effect of osmotic pressure change by short-term exposure of semen to a sucrose solution with an osmolality of 200, 250, 300, 400 and 500±5 mOsm/kg, repeated pipetting application 5, 10, 15 and 20 times and 600, 800, 1000 and 1200 "G" values were centrifuged and physical endurance tests were carried out. After the procedures, the groups were examined in terms of motility, plasma membrane integrity and mitochondrial membrane potential. The obtained data were evaluated statistically and the differences in spermatological parameters between the groups were determined by One-Way Analysis of Variance and Post Hoc Tukey method. According to the findings, at 300±5 mOsm/kg, the mean of motility, PMB and MMP were determined as 5/5, 83.66% and 83.33%, respectively, but high or low osmotic pressure negatively affected spermatological parameters. In addition, it was determined that the application of repetitive pipetting up to 800 G with centrifugation up to 5 times had an acceptable effect in terms of spermatological parameters. As a result, the effects of physical stress factors on spermatological parameters have been shown in in vitro studies with bee semen.

As a result, the effects of physical stress factors on spermatological parameters have been shown in in vitro studies with bee semen. Thus, some safe limits were tried to be determined by measuring the changes of honey bee semen, which has limited cryopreservation ability, against mechanical effects.

Comparison of the chromatographic and palynological methods used to identify the botanical origin of propolis: Which method is more reliable?

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Honeybees collect resins from plants (buds, leaves, branches etc.) to produce the miraculous substance named propolis. Propolis-type is defined based on the plant source with the highest proportion in its composition. Different propolis types are described in the world that botanically originated from *Dalbergia ecastophyllum* (L.) Taub., *Baccharis dracunculifolia* DC., *Populus nigra* L., *Populus tremula* L., *Macaranga tanarius* (L.) Müll. Arg., *Clusia minor* L. and *C. major*. In propolis studies, determining the botanical origin should be the first step since its main chemical composition is directly related to its botanical source. For example, green propolis originated from *B. dracunculifolia* and is rich in artemisinin C, whereas caffeic acid phenethyl ester (CAPE) is the main component of propolis from *P. nigra*. This chemical variation may also affect its pharmacological activity profile.

To determine the botanical source of propolis, two methods are mostly employed, i.e., chromatographical and palynological analyses. Since honeybees may gather resins from unopened buds (*Populus* spp.), identifying pollen grains by microscopy, i.e., palynological analysis, would not be a realistic approach to determine the botanical origin of propolis. This work aimed to comparatively analyze propolis samples obtained from different geographical regions of Turkey using chromatographic and palynological techniques and discuss their validity for identifying the botanical origin of propolis collected in Turkey.

[OP-132 \[Beekeeping for Rural Development\]](#)

Nature based beekeeping

Nicola Bradbear

President Apimondia Scientific Commission Beekeeping for Rural Development

The UN Food and Agriculture Organization (FAO) and many other voices world-wide are calling for Nature-Based Solutions for agriculture. This means working to protect, sustainably manage and restore natural or modified ecosystems – which can simultaneously provide benefits for human well-being and for biodiversity. Nature-based systems mimic natural processes and rely on ecosystem functioning to ensure food and livelihood security, healthier diets for people, and more inclusive rural economies.

Nature-Based Beekeeping is a solution that can deliver triple benefit: supporting agricultural production and resilience, mitigating against climate change, and enhancing nature and biodiversity.

During the past century, as a community, we beekeepers have done many things that have not been for the long-term benefit of the beekeeping sector. We have moved honey bees and other bee species around the world, with species and races of bees moved beyond their natural distribution and into new regions, diseases introduced far beyond their original distribution, with huge consequences for nature and biodiversity, and for the people that depend upon them for their livelihoods.

It is time to end this behaviour, as we begin to understand the irreparable havoc that we have caused.

It is time for a fresh approach. Nature-Based Beekeeping is based on knowledge of how bees live in nature, always using local populations of bees, and in many cases, looking again at local, Indigenous knowledge systems. To ensure food and livelihood security, healthier diets and more inclusive rural economies, beekeeping must be feasible, and must utilise local skills and materials to make and use low-cost hives and equipment.

During this Symposium we will consider the financial, social and environmental resilience provided by Nature-Based Beekeeping systems underway world-wide.

[OP-133 \[Beekeeping for Rural Development\]](#)

Nature-based commercial beekeeping in North America

Tucka Saville

Beekeeper, USA

In spring 2019, I caught eighty swarms of bees and started my business: Tucka Bee LLC. I now keep 300 colonies in South Florida and upstate New York, USA. Some aspects of my beekeeping appear very natural and others do not. This management style is my best attempt at a mutually beneficial relationship between myself, the bees in my care, the local ecosystem, and my human community. I provide queens, honey, candles, live removal and education at fair market prices and sometimes for free.

My business allows me to live simply but well. I now have the time and energy to support my friends in their agricultural and community projects. I host international apprentices and interns. I travel in winter to swap ideas with others who practice nature-based beekeeping around the world. My best advice in beekeeping and life? Observe and adapt to reality.

This talk will discuss my management style, survival strategies for bees and humans, and a network of inspiring individuals across North America who have shaped my understanding of bees, and with whom I continue to learn.

[OP-134 \[Beekeeping for Rural Development\]](#)

Nature-Based, commercial beekeeping in Europe

Sébastien Bonjour, Anne Bonjour Dalmon

Beekeeper, France

Beekeeping practices to improve colony resilience.

From Fukukoa's inspiration in agriculture, the objective is to interfere as little as possible with the honey bee colonies, with a respectful attitude towards the bees. Interventions are limited to aim at harmony. Climate change in the past 20 years has considerably impacted the available resources and decreased honey production. When a lot of beekeepers have chosen more intensive management to compensate for the losses, there is an opposite way to preserve the resilience of the colonies to these environmental changes.

A global own selection in a one health approach results in honey bees well adapted to their environment. Colonies that are not able to deal with the rarefaction of the resources will not be chosen for multiplication. From a patient observation of the colonies during two years, colonies are ranked according to the mean performance values of the apiaries. Then the

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reproducible performing colonies are splitted. Fecundations are done in isolated natural areas to preserve the genetic stock from outside inputs. Queens are never sacrificed and are naturally replaced by the colony. The large number of colonies allows to maintain a high level of diversity.

This management leads to colonies adapted both to their environment and to the practices of the beekeeper

[OP-135 \[Beekeeping for Rural Development\]](#)

Economic and environmental reality of nature-based beekeeping in Africa

Janet Lowore, Giacomo Ciriello

Bees for Development

Honey bees thrive in ecosystems characterised by semi-deciduous forests across tropical and subtropical Africa. We give examples of highly successful nature-based beekeeping from the montane forests of SW Ethiopia, the miombo woodlands of Zambia and the Volta basin of Ghana; where bee husbandry can be as simple as siting a hive, waiting days for a swarm to colonise it, and knowing when and how to harvest.

Beekeepers' main problems are, in common with beekeepers everywhere, dealing with changes in seasonal patterns, use of pesticides, deforestation and shifts in local farming practices. Beekeepers can overcome these problems to produce large harvests, however they then face the difficult task of negotiating a fair price with a reliable buyer.

The Projects Team at Bees for Development discuss the nature of environmental and economic challenges, and finding strategies to address them, drawing on experience of supporting beekeepers in these regions.

Looking at the economics of honey and beeswax trade from the perspective of beekeepers, packers and consumers, reveals information gaps which hinder value chain development. Well-targeted interventions that bridge such gaps sustainably, can deliver great benefits for people, forests and bees.

[OP-136 \[Beekeeping for Rural Development\]](#)

Nature based beekeeping in South America

Pablo Chipulina, G. B Schab, Marta Soneira

Beekeeper, South America

The impenetrable Chaqueño is an area with 3.5 million hectares of native forest, a territory crossed by the waters of the Tehuco Bermejo River, its unique flora and fauna due to its diversity giving rise to the creation of the El Impenetrable National Park. It is located in the northern area of the province of Chaco, Argentina.

It is an inhospitable area with 350km of dirt roads, with little communication, which means that its inhabitants, native and Creole peoples, have few job opportunities. Performing temporary jobs or dedicating themselves to raising goats and sheep.

Beekeeping production with organic certification enabled more than 74 families to find their way of life. They created the "Association of Young People of the Impenetrable Chaqueño", an organization that brings together producers in the area. They have 1,750 beehives in production which are managed jealously guarding the conditions established in the organic production protocol. The product is processed in 2 honey extraction rooms authorized by National Service of Food Health and Quality.

What allows guaranteeing the quality of the product, bringing all the flavor of the impenetrable area to the tables of the world's consumers. The 210 drums of honey marketed in the 2021-22 campaign highlighted the importance of discussing the "native forest" as a generator of sustainable income.

[OP-137 \[Beekeeping for Rural Development\]](#)

Treatment-free beekeeping

Fani Hatjina

Apimondia Federation

Nature-Based Beekeeping is based on knowledge of how bees live in nature, always using local populations of bees, and increasingly, relying on the inbuilt resilience and genetic integrity of honey bee populations to maintain bee health. The above statements also constitute the basis for Sustainable Beekeeping.

One of the major issues bothering the beekeeping community across the continents is the need of varroa treatment and

the possibility to cope without treatment, given that Varroa mites are the only pests for which an authorised treatment exists in most countries. At the same time, the effect of using acaricides to control varroa mites has long been a concern to the beekeeping industry due to unintended negative impacts on honey bee health, contamination of hive products and resistance of the mites to chemicals used. It is also known that chemical treatment covers the natural immunity or resistance of the bee populations. For all the above, treatment-free beekeeping is the alternative solution.

Untreated and survived colonies exist in several countries, some of which have been survived for more than 14 years. The natural resistance of these populations has been investigated and different hypothesis can explain this phenomenon, such as honey bees becoming resistant to the mite and its associated viruses, or the mites have evolved to be less virulent; a co-evolution between those actors in their typical biotopes could have been favoured. Specific traits of the honey bees such as the hygiene behaviour and the recapping of the uncapped cells have been associated with the varroa resistant populations. At the same time characteristic traits of the varroa mite, such as the reproduction ability, has also attributed to be responsible. It is very likely that these mechanisms do not operate alone but function in combination. The importance of specific adaptations may also vary across environments. Considering all the above as well as the need to keep the varroa mite loads as low as possible, mechanical interruption of the mites' reproductive cycle, or the removal of a significant number of mites, has also been suggested as a method controlling varroa, still keeping the colonies free from any treatments.

Nature based beekeeping with as less interventions as possible might be the way forward. Still the question to be discussed is the economical aspects of the approach, and the cost-benefit balance, especially when we are referring to commercial beekeeping or large scale beekeeping.

OP-138 [Beekeeping for Rural Development]

Inflation-free beekeeping

Dickson Biryomumaisho, Janet Lowore
Bees for Development

Inflation is real and is hitting the poorest people in the world hardest.

In Uganda the poor struggle to afford food, clothing, housing and healthcare. Using ingenuity and perseverance the poor draw on assets and means within their reach to build resilient livelihoods and this includes nature-based beekeeping, using free resources to make a living. Yet these solutions are sometimes viewed as 'ancient' or 'traditional', with no place in the 21st century. Too many projects promote instead expensive hives, purchased from equipment manufacturers. The World talks about resilient and sustainable livelihoods, but in practice promotes unsustainable solutions. Relying on external inputs and beehive donations is not sustainable.

As inflation soars the merits of nature beekeeping becomes even more evident. The inputs required - bees, forage and natural hive-making materials - are largely immune to current high inflation rates.

Beekeepers face challenges in getting their produce to market and in negotiating fair prices but their nature-based beekeeping systems are resilient, sustainable and inflation-proof.

It remains a constant frustration that too many beekeeping development projects focus their efforts and resources on changing these resilient beekeeping systems.

In this presentation we examine the underlying drivers which lie behind the never-ending plethora of beehive donation projects and discuss their impacts. We offer more appropriate solutions to maintaining and enhancing the contribution of beekeeping to sustainable livelihoods in Sub-Saharan Africa.

OP-139 [Beekeeping for Rural Development]

Importance of Nature-Based Beekeeping for Human Health

Cristina Mateescu
Apimondia Federation

Humans and bees have always had a strong and special relationship. This connection relies first on the fact that almost 2/3 of the plants on the planet are pollinated by bees, making these tiny delicate insects vital for food supplies. Bees are also very important for the high nutritional, medicinal and economic value of their products. Honey and the other products like pollen, bee bread, propolis, royal jelly, bee venom and beeswax are subject to intensive pharmacological and clinical research, but are still awaiting for confirmation and recognition in the medical world. Issued from nature-based beekeeping, raw honey has several health benefits in both internal and external applications. Bee pollen and bee bread are important for their nutritional qualities and their health relationship claiming antioxidant, antiinflammatory, antibacterial, heart and liver protecting activities. Propolis is an excellent „natural medicine” with antioxidant, antiinflammatory, antimicrobial, immune protecting and anticancer properties. Royal jelly may offer a good support both as food supplement in case of poor nutrition, but also for its health related effects on the nervous system which might prevent several neurodegenerative diseases. Bee venom, an unique product of the bees is a hope for many degenerative and inflammatory diseases, while beeswax has many applications in pharmaceutical industry and not only. To ensure that the whole spectrum of nutritional and therapeutic properties are properly harnessed, these products have to be free of any contaminant, being it a chemical agent, a bee medicine or pesticide residues. Practicing a nature-based beekeeping which requires a little capital and a low-cost maintenance, may provide, beside economic benefits, food security, an improvement of the quality of life and a beneficial effect on the environment. In terms of health, nature-based beekeeping may be also a real „mind and body therapy” for people practicing this old and noble occupation.

OP-142 [Bee Biology]

Advances in cryopreservation of honeybee embryos: Optimisation of the first steps

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Embryo cryopreservation is a valuable tool to conserve genetic biodiversity in Biobanks. However, in insects it is limited by technical difficulties. Indeed, the honeybee embryos are surrounded by two protections, the chorion and the vitelline membrane. Moreover, they contain important vitellus reserves. Here we present the technical progress achieved in our laboratory to prepare the honeybee embryos for liquid nitrogen vitrification.

Two experiments were performed. In order to have the best basic medium during bee embryo cryopreservation, we tested the in vitro embryo survival and the larval emergence in 3 commercial media: Grace', TNM-FH, and Schneider' Insect media. Next, in order to minimize the handling of the extremely delicate embryos, we reduced the number of steps during the cryopreservation protocol by doing the impregnation with the cryoprotectant at the same step than chorion permeabilization. All embryos used were collected from Apis mellifera ligustica breed in artificial cell plugs during spring. At the time of tests, they were up to 24 hours old. Our results showed that TNM-FH insect medium was the most suitable one (best larvae emergence rate: 62.4%, versus 47.1% and 53.3% for Schneider' and Grace' Insect media respectively, n = 250 embryos per group). We showed that it was possible to permeabilize the chorion by sonophoresis during the cryoprotectant impregnation step without reducing the rate of larval emergence (54.8% versus 53.5% in two separate steps, n=350 embryos per group). Further experiments, sustained by 'Lune de Miel' foundation, are currently running in our laboratory to continue improving the honeybee embryos cryopreservation.

Relation between seminal fluid proteins and semen quality in *Apis mellifera*

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INTA PROAPI's honeybee breeding program (MeGA) has focused on the selection, preservation, and improvement to obtained superior genetic materials, which have been maintained for more than 16 years in a closed population by instrumental insemination. The efficiency in inseminations in the different genetic origins is not constant along the beekeeping season, quality of the semen could be one of the factors responsible of this variation. The objective of this work was to evaluate the quality of semen in drones of the closed population at different times of the beekeeping season. Trials were performed in the INTA Balcarce Experimental Station's apiary (Buenos Aires Province, Argentina), where PROAPI Genetics is kept as a closed population, sampling at different times during the beekeeping season 2021-2022. Presumably mature drones were collected and placed in a stove at 34°C and 50% relative humidity, with food (honey) until semen extraction, which was carried out using a Harbo syringe, constituting a pool of each colony. The content of soluble proteins in the seminal fluid was determined using the Bradford method. Also, quality parameters of the semen were recorded: concentration (by counting in a Neubauer chamber with a 400x microscope), sperm motility and viability (by Eosin-Nigrosin staining) and plasma membrane functionality by Hypoosmotic Swelling test. No relationship was observed between seminal fluid protein and semen concentration or motility. A significant correlation was recorded between seminal proteins with the number of live spermatozoa observed with Eosin-Nigrosin ($r = 0.85$, $p < 0.0001$) and with the number of non-functional membrane spermatozoa obtained by HOSt ($r = -0.50$, $p = 0.0465$). These preliminary results show the importance of the parameters associated with the nutritional status in the viability of drone semen and the need to develop knowledge on this topic.

Validation of Calcein Violet as a new marker of semen membrane integrity in *Apis mellifera* drones

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Membrane integrity, most commonly assessed by double staining with SYBR[®]14 (SYBR) and propidium iodide (PI), is considered to reflect viability, which is routinely included in semen evaluation. Many fluorochromes emit in the green and red channels, limiting their possible combinations for multiple parameters analysis. Although previously suggested for that purpose, Calcein violet (CaV), a permeant viability dye that emits fluorescence after esterification of the non-fluorescent calcein violet acetoxymethyl into fluorescent calcein violet, has never been validated as a marker of semen viability in honeybee drones.

This is the first study that establishes CaV as a reliable marker for viability of drone semen using SYBR/PI as reference dye, heat-treated samples as negative control, and serial staining combinations. In all samples, dead spermatozoa were marked in red with PI and none of them showed violet fluorescence within the head and the tail. Live spermatozoa showed a decreasing violet emission from head to tail when single stained with CaV, or from the tail only when CaV was combined with SYBR.

Establishing CaV as a marker of membrane integrity by fluorescence microscopy is a decisive first step towards further development with flow cytometry. As CaV fluoresces in violet, it frees the green and red light spectrum channels and broadens the possibilities of combinations to expand the range of parameters simultaneously evaluated in a multiple parameters analysis of semen. This will be particularly beneficial for honeybee drones that have a very small volume of ejaculate and where sample size is an issue.

Cryopreservation of Honey Bee Semen

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Honey bee genetic diversity is under threat due to high colony losses and preference for and movement of a few select subspecies. Cryopreservation of honey bee semen could be a valuable method for long-term storage of gametes and contribute to the conservation of honey bee genetic diversity. Cryopreservation process consist of several stages including mixing semen with extenders and cryoprotectants then gradual freezing before long-term liquid nitrogen storage. The method has been successfully used for long-term storage of gametes from many important domesticated animal species. While comparatively few studies have been published on honey bee cryoconservation; there has been a flourish of successful methodologies published recently. However, the success rates of recovering fertilized offspring from cryopreserved honey bee semen remains low. Nevertheless, cryopreservation technique provides a precious way to preserve the honey bee diversity; and fortunately, there remains a great variety of potential solutions in the pursuit of increasing fertility of frozen/thawed honey bee semen.

New approaches in propolis extraction methods

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Due to the fact that bee products have bioactive components, both its use with other food products or alone are considered functional foods. Functional foods have become important in recent years because affect our health positively and protect them from diseases. The most well-known bee products are honey, pollen, royal jelly, propolis, bee venom and beeswax. The feature that distinguishes propolis from many other bee products is that although it contains many phenolic components, its direct use is not suitable for health. For this reason, different methods should be developed for the extraction of propolis and its different uses. In this study, water, DMSO, ethyl alcohol and propylene glycol were used as solvents. The effects of different solvents and extraction times on the dry matter and total phenolic contents to be obtained will be presented. One, fifteen and thirty days were determined as the extraction time. Although the extraction time increased in direct proportion to the amount of dry matter and total phenolic content, it was observed that it was not always directly proportional to the solvent used. Although the amount of dry matter obtained by water extraction at the same time was very low, it was determined that the total amount of phenolic substance was higher than that of other solvents.

Modelling relationships in honeybee colonies and populations with SIMplyBee

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Computer simulations are an important tool in animal breeding, used for in silico testing of breeding decisions and statistical methods. Simulators must incorporate quantitative genetics theory and be flexible enough to allow the user to simulate different breeding actions. We have developed such a stochastic simulator for honeybees called SIMplyBee as an extension of the AlphaSimR package. The simulator works in the R environment by simulating individual bees with their individual genomes and combining them into objects representing a honeybee colony. A set of colony objects can be further combined into a colonies object representing an apiary or any other population of honeybee colonies. In this way, the user can explore different quantities, such as relationships or quantitative genotypic and phenotypic values, at the individual, colony, or even population level. The simulator allows for the simulation of the complementary sex determination (*csd*) locus

and the removal of homozygous individuals. In this work, we demonstrate the use of SIMplyBee by exploring relationships and inbreeding within and between honeybee populations and subspecies. We simulated 10 years of closed mating within two purebred populations, *A. m. carnica* and *A. m. mellifera*, and hybridisation between them. The latter served to inspect the effect of importing genetic material on relationships and inbreeding. After simulation, we examined whole-genome relationship coefficients based on three sources of information: i) expected identity by descent by recording the pedigree of each honeybee, ii) realised identity by descent by recording recombinations of chromosomes within a pedigree of each honeybee, and iii) identity by state by recording alleles of each honeybee. We observed relationships between i) workers within colonies, ii) queens within subspecies, and iii) queens between subspecies. In addition, we monitored inbreeding at the *csd* locus and the effect it has on the observed and realized whole-genome relationships. We observed a major impact of the *csd* on the relationship coefficients, as the expected pedigree relationship exceeded the realised genomic relationship coefficients, due to pedigree theory not accommodating for strong selection at the *csd* locus. With this, we demonstrated that SIMplyBee is a powerful hypothesis testing tool for honeybee management and breeding.

OP-150 [Bee Biology]

Morphological Characterization of Selected Honey Bees (*Apis mellifera* L.) Originated from Western and Central Black Sea

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There are many races and their ecotypes adapted to different climatic and geographical conditions in Turkey. Genetic pollution has emerged in the region's bees due to migratory beekeeping activities and queen bee sales across the country. The supply of qualified breeding material to beekeepers will make significant contributions to the increase in yield.

In the study, 200 colonies obtained from the non-migratory beekeeping areas of the Western and Central Black Sea Region were selected between the years 2014-2022. Queen bee was raised and artificial insemination was done every two years. During artificial insemination, was taken not to inseminate queen bees with their relatives. Artificially inseminated queen bees were given all colonies and the population was completed to 200 again. Worker bee samples were taken during the swarming period from 50 selected colonies that completed the third generation, and morphometric measurements were made from 10 worker bees and 41 characters in each sample. Thus, it was provided to reveal the possibilities of comparison in terms of morphological characters with the Caucasian Bee (*Apis mellifera* caucasia), Anatolian Bee (*Apis mellifera* anatolica), Hatay Bee (*Apis mellifera* syrica) and Yığılca ecotype of Anatolian Bee. Linear discriminant analysis was used for this comparison.

According to the function values, three different clustering areas were formed in the coordinate system. The first area is to cover the Hatay Bee (*Apis mellifera* srica) and Anatolian Bee (*Apis mellifera* anatolica). The second area is to include Düzce-Yığılca genotype and breeding material. The third area is only having the Caucasian Bee (*Apis mellifera* caucasia) bee race.

Hatay Bee (*Apis mellifera* srica) samples were distributed in its own group at 100%. Anatolian Bee (*Apis mellifera* anatolica) 97%, Düzce-Yığılca Genotype 98%, Caucasian Bee (*Apis mellifera* caucasia) 100%, and 100% of our breeding material was distributed to its own group.

With the selection studies, quality breeding material with high yield level, good development and high wintering ability has been obtained. The morphological characteristics of the breeding material were determined. It is important to protect, produce and deliver this important material to producers.

OP-151 [Bee Biology]

Predicting distribution modeling of *Apis florea* F. in the world

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Climate change will markedly impact biology, population ecology and spatial distribution patterns of pollinator because of the influence of future greenhouse effect on insect development and population dynamics. The dwarf honey bee (*Apis florea* F.) is one of the most important pollinator species of tropical and arid regions of Iran and other countries. Considering the

importance of dwarf honey bee as an important pollinator in the world, the current study was carried out to the model spatial distribution and future distribution of dwarf honey bee in 2070 and to assess the effect of environmental factors on this species. For this purpose, 75 occurrence records and documented available were used for the modeling. Potential distribution map was created using maximum entropy (Maxent) model based on recorded data and eight different climate variables. The results of this study showed that the maximum distribution probability was that of the Palearctic region. Southern regions of Iran, Saudi Arabia, India and south eastern regions of Asia were found as the best regions for the presence of the species. According to the Jackknife test, the variables mean temperature of warmest quarter, precipitation seasonality and temperature seasonality showed the maximum contribution in the species distribution modeling. The results indicated that under climate change scenario (CCCMA, CSIRO), suitable habitats for *Apis florea* will increase towards 2070. Based on our results, it can be concluded that suitable places for distribution of dwarf honey bee will be increased in the future.

OP-152 [Bee Biology]

Morphometric Characterization of Cypriot Honeybee *Apis mellifera* cypriaca and Its Venom Cytotoxic Effectiveness against Cancer Cells

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Bee venom is a valuable bee product that has an important place in the health and cosmetics sector. Studies conducted in recent years showed that the composition of bee venom varies according to seasonal conditions, regional differences and pollen sources. For this reason, it is very important to determine the bee venom content in different geographical conditions and flora. With its productive characteristics, the Cypriot bee is a bee race whose characteristics are on the verge of disappearing with the hybridizations made over the years because of its aggressive character. For this reason, this study will provide basic information for obtaining data of Cypriot honeybee venom, standardizing bee venom and making it an apiceutical product. In the present study, venom samples were collected from different 2 apiaries of Cyprus (Mallidag (Magosa) Village and Lefkosa Center). The samples were kept in absolute ethanol. Additionally, venom samples were collected from each apiary with electroshock method. Venoms obtained after drying on the glass surface of venom collector by scraping. All samples lyophilized, stored in dry condition at +4 °C in amber bottles. Classification of bee races made by geometrical morphometry method. The venom samples of determined races and ecotypes compared with biochemical analyzes and with way, Cypriot honeybee venom profile tried to be defined. Venom protein contents were determined by BCA protein assay. A panel of cancerous (prostate, glioblastoma, cervix, lung, colon, breast, pancreas cells) and non-cancerous (healthy lung fibroblast cells) cells were screened for determining cytotoxic potential by MTT assay in order to carry out apitherapeutic application. The protein content estimated at 676.35 ± 26.09 µg/ml for Mallidag (Magosa) Village sample and 577.60 ± 73.25 µg/ml for the Lefkosa Center sample in 1 mg/ml lyophilized crude venom. IC50 values of the cells treated with Mallidag (Magosa) Village venom varied between 3.83 ± 0.55 µg/ml and 23.97 ± 0.53 µg/ml, while cells treated with Lefkosa venom had IC50 values approximately between 6.73 ± 1.38 µg/ml and 18.80 ± 3.09 µg/ml. Data obtained from the experiments proved that venom samples from Cyprus showed high potential against cancerous cells. Further experiments will lead the way in Cyprus for increasing the apitherapeutic applications with venoms that can easily found throughout the country and make a contribution to Cyprus economy.

OP-153 [Bee Biology]

A mobile phone application to survey and monitor the wild colonies of *Apis mellifera*

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Although *Apis mellifera* have been reared by humans for millennia, it remains a wild animal as reported by ancient authors and modern beekeepers and researchers. Until a few decades ago, wild colonies of *Apis mellifera* were largely common. However, since the early 1980s there has been a rapid and underestimated rarefaction of the «wild» colonies due to a parasite, the fearsome Varroa destructor mite. The effect of the Varroa mite on unmanaged colonies was so strong that today in Europe most of the survived honey bees live in hives managed by beekeepers. Indeed, for many years it has even been thought that in Europe wild honey bees were disappeared. Rather surprisingly, there are no scientific studies on this phenomenon and the only available information deals with the number and distribution of honey bees colonies owned by beekeepers. In recent years, reports and interest in wild honey bee colonies have increased significantly and today we can say that even in many areas of Europe these colonies are still there. The app BeeWild intends to survey and monitor these wild colonies through a typical citizen science action.

Morphometric investigation of the Saharan honey bee (*Apis mellifera sahariensis* Baldensperger, 1932) in southeastern Morocco reveals signs of hybridization

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The western honey bees (*Apis mellifera* L, 1758) are one of the most important insect species that are appreciated for their huge role as effective pollinators. Today, we recognize about 31 different subspecies that are grouped into 5 lineages. Unfortunately, high levels of honey bee colony losses have been registered around the world recently. One of the major reasons for these losses is the hybridization with non-native subspecies which leads to the loss of adaptation to local climatic conditions. Honey bee populations of Morocco are regarded as three distinct subspecies from north to south, *Apis mellifera major* (Ruttner, 1976), *Apis mellifera intermissa* (Maa, 1953) and *Apis mellifera sahariensis* (Baldensperger, 1932). This latter, is lately facing a serious threat due to the extensive hybridization with its neighbor *A. m. intermissa*. Thus, based on geometric morphometric approach, this study aims to evaluate the current status of conservation of the Saharan honey bee *A. m. sahariensis* and to visualize the wing shape variability of four populations within the natural range of the subspecies. The results obtained have indicated that our samples were significantly different from the two subspecies used as reference (*Apis mellifera sahariensis*, *Apis mellifera intermissa*) which could be explained by a hybridization phenomenon occurring in the study area. The four populations studied were significantly different in terms of wing shape. These differences were mainly due to the fragmented distribution of the study area. In this regard, there was a significant relationship between wing shape and altitude which is correlated with many environmental factors. On the other hand, there was an even stronger relationship between wing shape and longitude. Those spatial differences could be related to both evolutionary history and human intervention. Results of this study can be used in the planning of future strategies for the conservation of the Saharan honey bee in Morocco.

Discrimination of honey bee biodiversity by using wing area measurement

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Twenty nine honey bee breeds have been defined, each of them is adapted to a certain environmental characteristics, spreading all over the world except the Antarctic continent. Many morphometric characters have been used to classify honey bees from past to present. Studies have proven that front wing features are suitable characters to classify honey bees. In recent years, more partial and easy methods have been researched to classify honey bees through images of bee wings. In this study, a total of 3392 worker bee samples were collected from 143 colonies from 19 provinces in order to differentiate honey bee populations in our country. Measurements of 7 areas (A1, A2, A3, A4, A5, A6, A7) on the right front wings of honey bee populations distributed in Turkey were made automatically in the BAB Bs200Pro program. The photographs of the prepared preparations were taken with the BAB camera system connected to the BAB STR45 stereozoom microscope. The averages of the colonies for each population were taken and the results were evaluated with Discriminant Function Analysis (DFA) in the SPSS.15 package program. Area measurements of A1, A2, A3, A4 and A5 characters were determined to be marker characters in distinguishing Anatolian honey bee and Caucasian honey bee.

Bees and bee plants in UPLB La Granja Research and Training Station, Philippines: an inventory toward conservation of pollinators in an agricultural landscape

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A survey of pollinator species and bee plants was conducted in La Granja Research and Training Station (LGRTS) at La Carlota City, Negros Occidental, Philippines. The pollinators were randomly sampled using sweep nets usually from 0700 to 1500h. The foraging behaviors of floral visitors were closely observed if they were gathering nectar, pollen, or both. The plants the pollinators visited were noted and identified. The bee plants in LGRTS that were visited by the pollinators included native and fruit-bearing trees, such as *Mangifera indica* (mango), *Citrus maxima* (pomelo), *Nephelium lappaceum* (rambutan), and *Sandoricum koetjape* (santol); organically grown vegetables, such as *Abelmoschus esculentus* (okra), *Solanum melongena* (eggplant), *Capsicum frutescens* (chili pepper), and *Cucurbita maxima* (squash); and introduced and native ornamental plants, such as *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*. The pollinators identified during the sampling period were *Tetragonula biroi*, *Amegilla* sp., *Xylocopa* sp., and others belonging to family Halictidae, Vespidae, Formicidae, Chrysomelidae, Coccinellidae, Curculionidae, Nymphalidae, Hesperidae, and Pieridae. A database of the pollinator species will be created to have a baseline information on pollinator diversity.

Impact of agroforestry on pollinator diversity

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Agroforestry is a diverse ecosystem consisting of agricultural crops and tree species. The altitudinal and spatial heterogeneity in an agroforest contribute to pollinator diversity. A survey of pollinators and bee plants were conducted in an agroforest in the University of the Philippines (UP) Laguna Land Grant in Pakil, Laguna, Luzon Island, Philippines in 2019 to 2021. The UP Laguna Land Grant is an 8,000 hectares land composed of a lowland forest and agroforest. The identified pollinator species belonged to order Hymenoptera (*Apis cerana*, *A. breviligula*, *Megachile* sp., *Tetragonula biroi*, *Thyreus* sp., *Xylocopa* sp.), Lepidoptera (*Delias* sp., *Graphium agamemnon*, *Hypolimnas* sp., *Papilio rumanzuvia*, *Troides* sp., *Trogonoptera* sp., *Taractocera* sp.), Diptera (family Syrphidae), Orthoptera (family Phaneroptera sp.), and Coleoptera (family Chrysomelidae). A total of 39 plant species were identified and classified as sources of either nectar, pollen, and propolis. The dynamics in the pollinator-plant interaction in the agroforest was discussed in the paper.

SafeAgroBee project and Socioeconomic survey on beekeepers and farmers opinion on importance of pollination services

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The overall objective of SafeAgroBee is to contribute to adaptation and mitigation of the effects of climate change and other drivers negatively influencing the sustainability and the resilience of the agricultural system in the Mediterranean basin, ensuring the income of farmers and food security. In SafeAgroBee we focus on beekeeping and pollination provided by both wild and managed bees as important drivers in ruling food security and human existence. In order to better understand the knowledge, the opinion and the expectations farmers and beekeepers have from each other as well as from their business perspectives, under the concept of pollination services provided by bees, we conducted a large socio-economics citizen-science study. Two questionnaires were designed with similar questions for farmers and beekeepers and translated to 5 partners' languages. Additional to that, translations were made in 4 other languages and in total the questionnaires were finally disseminated in 11 Mediterranean countries. This is the first time this type of survey is conducted in Mediterranean basin Countries for registering the interaction and/ or collaboration between beekeepers and farmers. It is also very important as it highlights the need to a) increase awareness of both beekeepers and farmers for pollination benefits; b) increase productivity in the Mediterranean agroecosystems and c) develop measures to protect the bees.

Determination of bee foraging plants in honey of Northern Oman

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Present study is undertaken to determine the Omani honey floral sources and ecological origin. It was carried on 51 honey samples collected from 14 locations of Muscat and Al Batinah regions from *Apis mellifera* and *Apis florea* bee colonies. Acetolysis technique was used in the melissopalynological analysis. In 48 honey samples, 122 pollen types were identified representing 50 plant families. They were categorized as major and minor sources of nectar and pollen. Thirty-two honey samples were found unifloral and 16 multifloral. In Oman, the honey is harvested twice a year, i.e., in summer and winter. The results indicated that *Ziziphus spina-christi*, *Prosopis juliflora* and *Prosopis cineraria* constitute the chief nectar and pollen sources for honeybees in this area in winter and *Prosopis juliflora*, *Prosopis cineraria*, *Citrus sp.*, *Acacia tortilis*, and *Maerua crassifolia* in summer. In 249 pollen loads from 22 honeycombs, 74 pollen types distributed among 41 plant families were identified at different taxonomic levels. Sixty-seven pollen types were present in both honey samples and pollen loads. Their sources were categorized as nectar and pollen suppliers, while 7 pollen types merely were found in the pollen loads therefore their plants were categorized as pollen sources for the honeybees. Twenty pollen types were recognized in the honey samples thus their plants were classified as nectar sources only. Summer honeys exceeded winter honeys in the number of pollen types. Summer pollen loads contained more pollen types than winter pollen loads. The identified pollen/nectar sources reflect a wide range of foraging plant species for honeybees and encompass adequate potential for sustaining beekeeping ventures in Muscat and Al Batinah regions. Local pollen references were prepared to aid in the identification of pollen types. Out of 105 local pollen references, 74 were found matched with the pollen types of the honeys and pollen loads. The morphology and size of all pollen types were studied, and their light and scanning electron micrographs were obtained.

Seasonal Continuum of Honey Plants in the Central Region of Korean Peninsula

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Locating in the Far East with the mild-temperate climate, the Korean Peninsula is one of the best-fit places for beekeeping in the world. Recently, however, the Korean beekeeping industry has been experiencing very low honey harvesting, eg. only 30% and 20% of average normal years in 2021 and 2022 respectively. As like most of the temperate countries, the major honey source (more than 70% in Korea) is depending on the Black locust, *Robinia pseudoacacia* L. (Fabaceae) which is the exotic Nearctic origin. This is the reason why most beekeepers should migrate from south to north every year, following the blooming of black locust. However, due to the climate change, the blooming period has been seriously shortened, restricting the period of migrating honey production. Our recent study was conducted to investigate the native honey plants in the National Protected Forest in the central district, Inje, Korea. As the result, an model of year round continuum of honey plants is provided, including mostly native trees, eg. *Tilia* spp., followed by the chestnut, *Castanea crenata* Siebold & Zucc (Fagaceae) and *Kalopanax spp* (Araliaceae) etc.

The World of Pollinators - threats to an ecosystem service: pressures on pollinators in Slovenia

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In Slovenia we are facing an increasing threat to some insect pollinators, as their numbers and diversity are declining, so that in some places we are already seeing insufficient pollination. Their decline or loss could have profound economic and environmental consequences. Honeybees and solitary bees, bumblebees, wasps, flies, beetles, butterflies, and moths comprise the vast majority of our's pollinators. Many are crucial for the pollination of fruit, vegetable, oil, seed, and nut crops. They are crucial for human food security and health, and ecosystem function. We are presenting the situation in the field of pollination in Slovenia in a new book entitled World of pollinators in English, published this year by the Radovljica Beekeeping Museum.

In Slovenia, we are beekeeping with the Carniolan bee (*Apis mellifera carnica*), pollinators are also 35 different species of bumblebees and more than 550 species of other bees that have been found in our region. In the book we argue that multiple anthropogenic pressures, including land-use intensification, climate change, habitat fragmentation, pesticides use, aggressive agriculture and the spread of alien species and diseases (above all varroosis) are primarily responsible for insect-pollinator declines. We show that a complex interplay between pressures (such as lack of food sources, disease and pesticides) and biological processes underpins the general decline in insect-pollinator populations. It is important to raise awareness of how crucial pollinators are for the survival of many plants and animals, how important they are to humanity and to take action, which is also presented in the book.

Ozone air pollution affects crop pollinators and pollination

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Environmental changes induced by human activities can increase the concentrations of polluting reactive compounds in the troposphere, such as ozone and nitrogen oxides. These changes can lead to a loss of biodiversity and alter plant

physiology and plant-pollinator interactions, essential for pollination services, with potential consequences for agricultural production. Taking into account possible interactive effects with landscape quality, pesticide input and climatic conditions, we investigated how air pollution (ozone and nitrogen oxides) and other sources of nitrogen (industrial, agricultural) is related is related to pollinator visitation rate and their contribution to agricultural production in different counties of Europe. We showed that ozone modulates the effect of pesticide exposure on crop pollinators, increasing the probability of negative impacts on crop pollination. Our results suggest that air pollution may have unexpected consequences for food safety and highlight the need for more sustainable transport and manufacturing policies to help safeguard biodiversity and related food production.

OP-164 [Pollination and Bee Flora]

Effect of *Apis mellifera* (Hymenoptera: Apidae) on *Acacia crassicarpa* fruit production in seed orchards in Riau, Indonesia

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Acacia crassicarpa is a key forest species for wood production in the pulp and paper industry in Southeast Asia and productive seed orchards are essential for the sustainability of this culture by ensuring genetic variability and propagation capacity. *Apis mellifera* among other bee species plays a major role in flower pollination of *Acacia* species and conserving such insects around seed orchards may positively impact the fruit and, eventually, seed production. This study aimed to compare the fruit production in *A. crassicarpa* seed orchards with and without *A. mellifera* introduced colonies. The honeybee colonies were introduced, in collaboration between an industrial forestry company and beekeepers from the local community, between October and November 2021 next to five seed orchards, 360 beehives on three hectares each, in Riau, Indonesia. The orchards are composed of 8-year-old (average) *A. crassicarpa* trees in a total area of 79 ha surrounded by acacia, eucalypts, and palm oil plantations. Assessments were carried out in five randomly selected *A. crassicarpa* trees in each seed orchard. The number of flowers on five randomly selected branches was counted in late March 2022. Five weeks later, the number of young fruits was assessed. Seed orchards with no introduced bees were also assessed and the results were compared. The average number of flowers per branch was similar in orchards with and without *A. mellifera* colonies, 38.6 and 36.5, respectively (t-Test, P=0.123). However, the number of young fruits per branch, in seed orchards next to the honeybees was 252% higher than that in areas with no introduced colonies, 38.9 and 15.5, respectively (t-Test, P<0.001). Honeybees are effective pollinators of many *Acacia* species, including *A. crassicarpa*, as suggested by the findings in this study. Part of the pollen collected by the bees is transferred to other flowers, increasing pollination success, and fruit and seed yield at the same time as considerable amounts of honey are produced. In conclusion, the introduction of *A. mellifera* bees contributes to increased fruit production of 252% in *A. crassicarpa* seed orchards and should have a big positive impact on final seed production.

OP-165 [Pollination and Bee Flora]

Combination of bee pollination of strawberry with fungicide application

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The goal of the study was to investigate the effectiveness of the use of bees for fungicide treatment of plants during the pollination of strawberries. The work was carried out during July-August 2021 in the fields of remontant strawberries «Agrovesna» LLC within the project «Development of the market of controlled bee pollination in Ukraine», supported by the USAID's Agriculture Growing Rural Opportunities Activity (AGRO). The bee colony can serve more than 5 M flowers. The norm for controlled bee pollination of 1 ha of strawberries is 8 bee colonies, so for a day bees of this number of colonies can serve 40 M flowers on 1 ha of strawberries. At the same time, the number of flowers per 1 ha of remontant strawberries for the entire flowering period is only 1.5 M. Such ratios ensure repeated cross-pollination, which ensures a high quality of pollination. Pollination quality also depends on the successful placement of bee colonies, when the flight paths of bees cover the entire pollination area of the berries patch. In addition to pollination, honey bees can distribute powdered plant protection products. To do this, a special device is used. Earlier, we determined that one bee colony with the power of 6 honey combs can carry no more than 1 g of fungicide per day. The continuation of the experiment was the improvement of devices and use on 8 hives. The experiment was carried out on 1 ha of remontant strawberries for 10 days. As a result of controlled bee pollination, a single berry gained from 2 to 8 g in weight. The yield of bee pollination (by total weight of

70

berries) where bee pollination was conducted increased by 25% compared to last year, which was \$5,598 in cash equivalent. The number of small, irregular-shaped, one-sided, disease-affected berries (n=500) decreased by 58% as a result of the use of controlled bee pollination and bee-spread of the fungicide. The cost of applying the fungicide compared to the classic mechanized method is reduced by \$ 126.8 per ha of strawberries.

OP-166 [Bee Health]

Sublethal effects of imidacloprid on immune gene expression in the stingless bee *Melipona quadrifasciata*

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Neonicotinoids are among the pesticides that act on the nervous system of target insects, which may produce unknown consequences for non-target insects. This group of insecticides are related to the decline of bee populations around the world. The presence of residual amounts of pesticides in pollen and nectar may be able to alter the molecular mechanisms that control the fundamental functions of insect survivor. In the tropical region, stingless bees are very abundant, diverse (>500 species) and efficient pollinator group in natural and agricultural habitats. These bees are threatened by multiple stressors, including pesticides. In this work we investigated the effect of a sublethal concentration of the neonicotinoid insecticide imidacloprid on the expression of immune genes in foragers of *Melipona quadrifasciata*. Foragers from three colonies were exposed orally to field-realistic doses of imidacloprid for 72 hours in the laboratory. Abdomen fat body was used to investigate expression of the immune genes abaecin and prophenoloxidase by RT-qPCR. We observed different responses of the expression of these genes depending on the colony. In general, the expression levels of abaecin were higher in bees fed imidacloprid. On the other hand, bees fed insecticide from one colony showed downregulation of prophenoloxidase expression when compared to the controls (bees fed with no insecticide). Thus, sublethal doses of imidacloprid were enough to dysregulate immune gene expression. These results reinforce that the ingestion of insecticide causes damage to the immune system of bees.

OP-167 [Bee Health]

Determination of neonicotinoid and glyphosate residues in pollen samples from Croatia

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Use of pesticides in modern agriculture has major adverse impact on non-target beneficial organisms, such as bees. While exploring the environment surrounding the apiary, hives and activity of collecting pollen, honey bees (*Apis mellifera*) are possibly exposed to pesticide contamination. In this study, residues of glyphosate as the most widely used pesticide, and neonicotinoids, which received significant attention due to their negative effects on insect pollinators and were consequently banned for outdoor use in EU, were examined in honey bee fermented pollen samples collected from hives in Croatian apiaries. Because of the differences in physicochemical properties of these two groups of systemic compounds dual approach was required, regarding development of the methods for their determination by LC-MS/MS. Since the quantification of glyphosate poses a major challenge due to the great polarity and amphoteric nature of the molecule, low molecular weight, high solubility in water and a lack of chromophore, single-residue method was implemented, including optimized sample preparation steps (QuPPE and SPE cleanup) and instrument conditions (porous graphitic carbon as a stationary phase). On the other hand, neonicotinoids were routinely analyzed using QuEChERS technique for extraction of target analytes followed by reverse-phase liquid chromatography coupled with tandem mass spectrometry for simultaneous determination of 11 compounds. Developed methods proved to be sensitive, with LOD values ranged from 0.3 to 3.4 ng/g while LOQ values were in the range 1.1 - 10.9 ng/g. In total 44 samples of honeybee fermented pollen collected in 2020 and 2021 were analyzed. Among them 29 samples contained at least one pesticide residue above LOQ, which represents almost 66% of all analyzed samples. The highest frequency was associated with glyphosate (93% of positive samples), contaminating samples from a very low concentrations to a maximum value of 127 ng/g. These results reflect the intensive use of glyphosate worldwide and its diffusion in the environment. Although this herbicide does not appear as toxic to bees as some other systemic pesticides, it could be considered that the pesticide risk for honey bees can increase when some class of these chemicals act synergistically, amplifying the adverse effects of non-chemical stressors.

Are detoxification enzymes induced similarly across honey bee castes in response to neonicotinoid exposure?

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Toxicity assays in honey bees focus on the worker caste, possibly overlooking toxicity to the queens and drones. In an initial study, where bees of all three castes, of four age categories (larvae, newly emerged, young, and mature) were exposed to incremental doses of thiamethoxam (THI), a commonly used neonicotinoid, we demonstrated that THI toxicity is highly caste-specific. Namely, the queens were most sensitive to larval exposure, but most resilient after THI exposure post emergence. The objective of this study was to determine if there is a correlation between detoxification enzyme activity and the caste-specific susceptibility of honey bees.

We tested the induction of enzyme activity in bees in response to larval and/or adult THI exposure. Age-matched honey bee larvae received either water (control) or 25 ng THI through larval food contamination. At emergence, adult bees in these groups were further subjected to contact exposure of incremental doses of THI. Activity of esterase, glutathione S-transferase (GST), and acetylcholine esterase (AChEst) were determined at emergence and 48 hours post contact exposure.

We found that enzyme activity is highly caste-specific; however, THI exposure during larval and/or adult stages did not have a significant effect on enzymes activity. Enzyme activity was highest in worker bees, followed by drones, and then queens. Enzyme activity of esterase, GST and AChEst does not correlate with the differential caste survival in response to THI exposure observed in our previous studies. However, our findings highlight that enzyme activity is highly variable between castes, which may affect their susceptibility to insecticide toxicity and should be considered in future toxicity studies.

Study of the persistence of natural (formic and oxalic) and chemical (amitraz) acaricides in honeybees' body and in honey

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Varroa destructor is the most important reason of beehive collapse. A variety of acaricides are used by beekeepers in order to control the mite populations. However, the beehive productivity seems to be also affected in the long term, which indicates that residual effects of the acaricides may persist in honey and potentially impact the bee physiology.

The aim of this study was to compare and monitor the level of beehives intoxication after exposure to three different widely used chemical acaricides with various ranges of toxicity (Amitraz, Formic and Oxalic acids).

Using Mass-Spectrometry and colorimetric tests, these acaricides and their residues were measured before treatment and respectively 28 and 58 days after treatments across 8 hives and 366 individual bee guts and 16 honeys. In parallel, gene expression analysis using Oxford Nanopore Technologies was performed in brains of 54 bees in order to estimate their physiological state corresponding to their intoxication.

Our work provides valuable information for the beekeeping community in relation with the persistence of acaricides in beehive and honey. This work also provides fundamental insights into the molecular pathways targeted by each acaricide and a better understanding of the bee physiological functions affected by natural and chemical treatments.

Effect of Lithium on Locomotor Activity, Circadian Rhythm and Social Behaviors of Honey Bees

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Varroa destructor, an Acarid species, is the world's most harmful honey bee parasite that causes colony losses. It is well-known that various chemicals such as fluvalinate, flumethrin, coumaphos, and amitraz are widely used against Varroa. Frequent use of these substances has led to resistance to these chemicals in Varroa populations. Another problem is these chemicals leave residue in honey. These fat-soluble synthetic miticides accumulate in the beeswax and propolis. Because of that, usage of organic acids (formic, lactic, oxalic acid) and thymol-containing fragrant oils and usage of various herbs have become widespread. New solutions are being sought that will be more effective in the fight against Varroa. At that point, Lithium emerges as a new solution. In recent years, anti-Varroa effects of Lithium have been found. While a research team was trying to find an iRNA-based treatment for Varroa control, they surprisingly discovered the toxic effect of Lithium on Varroa. However, the effects of this new invention on bee health are uncertain and many studies only focus on the toxic effects of Lithium on honey bees. Studies on different animals show the effect of that chemical on behavior and the nervous system, which is also used as a treatment for bipolar disorder in humans. Therefore, it is necessary to determine the effects of Lithium on the nervous system and behavior of honey bees. Because the colony's survival is tightly dependent on the activity, and behavior of these social insects. The study aims to fill in this missing information. Also, using new methods for bee tracking and behavior determination performed by computer-aided imaging gives the possibility to investigate the changes in social behaviors. According to our results, we observe that Lithium has an effect on the locomotor activity of honey bees which shows variation depending on light and dark conditions. It affects circadian rhythm and also the social interaction of honey bees.

Bees under interactive stressors: the novel insecticides flupyradifurone and sulfoxaflor along with the fungicide azoxystrobin disrupt the gut microbiota of honey bees and increase opportunistic bacterial pathogens

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Apis mellifera has a relatively consistent gut microbial community that is thought to enhance host health and protect against parasites and pathogens. But the gut microbiome can be disrupted by pesticides and in-hive chemicals, putting honey bee health in danger. We used a controlled and fully crossed laboratory experimental design to test the effects of chronic exposure to field-realistic sublethal concentrations of two nicotinic acetylcholine receptor agonist insecticides (nAChRs) namely flupyradifurone (FPF) and sulfoxaflor (Sulf), and a fungicide, azoxystrobin (Azoxy), individually and in combination, on the survival of individual honey bee workers and their gut microbiota (fungal and bacterial diversity and composition). The gut microbiota was assessed by metabarcoding, targeting the fungal ITS2 fragment and the V4 region of bacterial 16S rRNA. We found more than an additive interactive effect between the insecticides FPF or Sulf and the fungicide Azoxy on honey bee survival. The fungicide Azoxy substantially reduced the Shannon diversity of fungi after chronic exposure for 10 days. The relative abundance of the top 10 genera of the bee gut microbiota was also differentially affected by the fungicide, insecticides, and fungicide-insecticide combinations. Pesticide treatments significantly impacted the microbial community composition and relative abundance. Gut microbiota dysbiosis was associated with an increase in

the relative abundance of opportunistic pathogens such as *Serratia* spp. (e.g. *S. marcescens*), which can have devastating consequences for host health such as increased susceptibility to infection and reduced lifespan. Our findings raise concerns about the long-term impact of the novel insecticides FPF and Sulf, particularly FPF, on pollinator health and recommend a novel methodology for a refined risk assessment that should include the potential effects of agrochemicals on the gut microbiome of bees.

OP-172 [Bee Health]

Changes in the lithium level in bee products as a consequence of anti-Varroa treatment

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The biggest threat to beekeeping is varroosis caused by the mite *Varroa destructor*. Chemicals available to treat this fatal disease may present problems of resistance or inconsistent efficacy. Recently, lithium chloride has appeared as a potential alternative. To date, the amount of residue lithium treatments may leave in honeybee products is poorly understood.

Honeybees were fed with 25 mM lithiated sugar syrup, which was used in earlier studies. The accumulation and elimination of the lithium were monitored in bees and their products for 22 days. Lithium concentration increased in the entire body of the bees to day 4 post-treatment and then recovered rapidly to the control level. Lithium exposure was found to affect uncapped honey in the short term (<16 days), but ripe (capped) honey measured at the end of the trial remained affected. On the other hand, lithium treatment left beeswax lithium-free. Based on these data, we propose that comprehensive research on harvested honey is needed to decide on the veterinary use of lithium.

OP-173 [Bee Health]

BEST PRACTICES AND INNOVATIONS FOR A SUSTAINABLE BEEKEEPING IN EUROPE: the B-THENET Thematic Network

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The B-THENET Thematic Network is an EU Horizon Coordination and Support Action funded by the European Research Executive Agency that involves 18 partners originating from beekeepers’ representatives and research institutions from 13 different EU Member States. The Network activities will start on the 1st of September 2022 and will last 48 months (31st of August 2026). B-THENET is the thematic network of European beekeeping, based on a multi actor approach to engage the entire apiculture sector: beekeepers, advisors, researchers, policymakers, industry, consumers, etc. Goal of B-THENET is to collect, categorize and validate in Europe best practices and applicable research innovations not sufficiently known, using a bottom-up methodology.

Goal of the B-THENET thematic network will be to modernize the EU beekeeping sector, sharing knowledge that is ready to be put into practice, while fostering innovation and digitalization. Beekeepers will be advanced toward more economically

viable and sustainable beekeeping through the knowledge sharing and training of useful and applicable Best Practices. The consortium’s partners (see above the name of the affiliations of the Authors) consists of a balanced mix provided by research organizations, universities, international and national beekeepers’ associations, European NGO, food chain safety office, specialized centre for advisors training, specialized centre for social sciences and humanities and specialized agencies on communication and dissemination activities. In the same time, other organizations will collaborate with the above-mentioned institutions as “Collaborating Partners” in the respective countries: national beekeeping associations (in Spain: Asociación de Apicultores de Guadalajara, Aula Apícola Sierra de Hoyo, Asociación de Veterinarios Especialistas en Sanidad y Producción Apícola de España and Fundación Amigos de las Abejas; in Greece: Federation of Greek Beekeepers’; in Croatia: Associations of Croatian Beekeeper; in Poland: Krakow Beekeepers Association; in Italy: Associazione Romagnola Apicoltori; in Belgium: Vlaams Vulgarisatiecentrum voor Bijenteelt; in Germany: Deutscher Imkerbund; in Latvia: Latvian Beekeepers Association; in Hungary: National Hungarian Beekeeping Association; in Austria: Biene Österreich; in Portugal: Portuguese Federation of Beekeepers; in Sweden: Swedish Beekeepers Association and Swedish Professional Beekeepers) and research institutions (in Denmark: University of Aarhus; in Slovenia: Veterinary Faculty of the University of Ljubljana and the National Veterinary Institute of Slovenia).

OP-174 [Bee Health]

Managing Bees without Chemical Inputs

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The parasitic mite *Varroa destructor* is a major challenge to beekeeping industry worldwide. Since varroa appearance in Europe, beekeepers rely on the use of synthetic or organic substance for repeated treatment. The effect of using acaricides to control varroa mites has long been a concern to the beekeeping industry due to unintended negative impacts on honey bee health, the increased resistance of mite populations to acaricides, the residues in the bee products and the high costs and labour.

Untreated and survived colonies exist in several countries, some of which have been survived for more than 14 years. Scientists and beekeepers all over the world are working to increase resistance or tolerance to varroa. At the same time efforts are made to find ways to fight varroa without the chemical use. Years of experience of particular beekeeping groups showed that the use of chemical treatments can be widely reduced by consequent application of different biotechnical measures

Our challenges are:

- To find effective ways to fight varroa without the use of chemicals
- To evaluate these methods in correlation with the colony productivity
- To ensure that any alternative is also sustainable
- To increase the use of organic acids instead of synthetic chemicals, if treatment is needed and to promote organic beekeeping

OP-175 [Apitherapy]

Propolis Isolated from Sulawesi Stingless bees have Promising Effects on Rat Endometriosis Model

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Endometriosis is one of the diseases that impact on women’s quality of life. Chronic inflammation and altered apoptosis activity in ectopic endometrial tissue are two primary pathologies disrupting pelvic organs anatomy and function. Sulawesi Propolis, a native Indonesian natural ingredient, is known for its anti-inflammation and pro-apoptotic properties. This study aims to investigate the anti-inflammatory and pro-apoptotic activity of Sulawesi Propolis active compounds in rat endometriosis models. The endometriosis lesion model was created in sixty rats by laparotomy. Rats were divided into four groups; negative control (NC), positive control (PC) using dienogest 0.25mg/day, propolis 50mg/kg BW/day (P50), and propolis 100mg/kg BW/day (P100). Each group was treated for a duration of 2, 4, and 6 weeks. After completing treatment, laparotomy was performed to determine endometrial lesion growth, apoptosis markers (Bax, Bcl-2, Bax/Bcl2 ratio, Caspase-3 mRNA expression), and inflammation markers (IL-1B, PGE2 mRNA expression, PGE2 in peritoneal fluid). Molecular docking was carried out to analyze the potential binding capacity of propolis’ active compounds to NFB and TNF-, estrogen, progesterone B, and prostaglandin E2 receptors. P50-6-week group showed the highest reduction in lesion area (40.47 mm² or 70.66% of the initial area). Apoptosis activity in P50-2 and 4 groups showed the most significant changes with the highest Bax/Bcl-2 ratio and Caspase-3 expressions. The most considerable reduction of inflammation activity depicted by IL-1B and PG-E2 mRNA expression was shown by the P50-4 group and PC-2 group, respectively. There was no change in the estrous cycle in the administration of 50 and 100 mg/kg BW, within all treatment groups (2, 4, and 6 weeks). Among all propolis groups, the best overall performance was reported in the administration of 50mg/kg BW for six weeks.

While in the P100 group, the best overall performance was reported in the 4 weeks of administration. Propolis also exhibits strong binding potential with NFB and TNF-, estrogen, progesterone B, and prostaglandin E2 receptors. Sulawesi Propolis showed its pro-apoptotic and anti-inflammatory effects in the endometriosis rat model. These properties of propolis appeared to be dose and duration dependent.

OP-176 [Apitherapy]

Arbutus Unedo Honey and Propolis ameliorate acute kidney injury, acute liver injury, and proteinuria via hypoglycemic and antioxidant activity in streptozotocin-treated Rats

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INTRODUCTION: Honey and propolis have biological and therapeutic effects in various pathological and clinical conditions such as diabetes. The study evaluated the protective effect of Arbutus unedo honey, propolis and their combination in streptozotocin (STR)- induced hyperglycemia, acute kidney injury (AKI), liver injury, dyslipidemia, and proteinuria in male Wistar rats.

METHODS: The study identified physicochemical characteristics, mineral and antioxidant content, and antioxidant activity in honey and propolis. Rats were assigned to five groups, with five rats in each group; control, STR-treated, STR-treated + honey (1g/kg/day), STR- treated + propolis (100 mg//day), and STR- treated +honey and propolis. On day 15, blood glucose, insulin, HBA1c, kidney function tests, liver enzymes, lipid profile, hemoglobin, and urine protein, creatinine, glucose, and electrolytes were analyzed. Liver, pancreas, and kidney tissues were studied histologically. The mineral component in honey and propolis was determined by atomic absorption spectrometry. Honey analysis was performed by HPLC. Chemical characterization of propolis was performed by LC/DAD/ESI-MSn. Measurement of blood and urine parameters was carried out with an automated analyzer (Architect c8000) and XT-1800i Automated Hematology Analyzer. Insulin concentration was determined by Elisa and insulin resistance was estimated by using HOMA-IR.

RESULTS: Honey and propolis contain a high quantity of antioxidants and exhibit in vitro antioxidant activity. In STR-treated rats, blood glucose, HBA1c, creatinine, blood urea, liver enzymes, and urine protein significantly increased compared to the control group (P<0.05), while insulin, hemoglobin, and body weight significantly decreased. Histological changes were evident in the pancreas, kidney, and liver tissues. These results indicated AKI, liver injury, and pancreatic injury, which was evident with reducing the number of the island of Langerhans and marked hyperglycemia. The use of honey and propolis significantly (P<0.05) attenuated liver and kidney injury, and proteinuria, and improved level of hemoglobin, HBA1c, and insulin toward the normal range. The combination of honey and propolis was more effective than honey or propolis individually (P<0.05).

CONCLUSION: the combination of propolis and honey can prevent STR-induced AKI, liver injury, proteinuria, dyslipidemia, anemia, hyperglycemia, and body weight loss, most likely by their hypoglycemic and antioxidant activities.

OP-177 [Apitherapy]

Effect of antioxidant-rich propolis and bee pollen extracts against D-glucose induced type 2 diabetes in rats

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The present study was designed to investigate the preventive effect of propolis, bee pollen and their combination on Type 2 diabetes induced by D-glucose in rats. The study was carried out by feeding daily two concentrations (100 and 200 mg/Kg BW) of propolis or bee pollen (or their combination to normal (non-diabetic) and diabetic rats for a period of 16 weeks. In vivo biochemical changes associated to diabetes are induced by drinking a solution containing 10% of D-glucose (diabetic rats). The in vitro antioxidant activity was also evaluated and the chemical composition of propolis and bee pollen extracts was determined by UHPLC-DAD. Phytochemical composition of propolis and bee pollen revealed the presence of several natural antioxidants, such as hydroxycinnamic acids, hydroxybenzoic acids, flavonoids, flavan-3-ols and stilbens. The major antioxidant compound present in propolis was Naringin (290.19 ± 0.2 mg/Kg) and in bee pollen was apigenin (162.85 ± 17.7 mg/Kg). These results have been related with a high antioxidant activity, more intense in propolis extract. In rats, the administration of D-glucose had induced hyperglycemia (13.2 ± 0.82 mmol/L), increased plasmatic insulin levels (25.10 ± 2.12 U/L) and HOMA-IR index (14.72 ± 0.85) accompanied with dyslipidemia, elevation of hepatic enzyme levels, and a change in both serum renal biomarkers and plasmatic calcium. The coadministration of propolis and bee pollen extracts alone or in combination restored these biochemical parameters and attenuated the deleterious effects of D-glucose on liver and kidney functions. Furthermore, these effects were better attenuated in the combined therapy-prevented diabetic rats. Hence, it is possible to conclude that propolis and bee pollen can be used as a preventive natural product against diabetes induced dyslipidemia and hepato-renal damage.

OP-178 [Apitherapy]

Investigation of drug interaction of propolis

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Phenolic compounds in foods reveal many biological activities. However, phenolic compounds such as naringin, naringenin, and hesperetin cause drug interactions by affecting Cytochrome P450 (CYP 450) enzymes. CYP P450 enzymes are essential for the metabolism of many medications and most foreign substances. Drug-drug or food interactions occur when two or more drugs or food react with each other. The interactions may cause you to experience an unexpected side effect by changing pharmacokinetic parameters. Propolis is a food potential that can cause possible food-drug interaction by affecting the CYP P450 enzyme due to the phenolic compounds. This study investigated whether or not propolis is affected pharmacokinetically. Enrofloxacin is an antibiotic and metabolized by CYP-450.5 experimental groups were formed in rats as IM Enrofloxacin + oral propolis, IM Enrofloxacin, oral Enrofloxacin+oral propolis, oral Enrofloxacin and control group. Blood samples taken from treated rats at 0, ¼, ½, 1, 2, 4, 6, 8, 12, 18, 24 and 36 hours were analyzed by HPLC-UV. Pharmacokinetic parameters were calculated using plasma density-time values with WinNonlin software. Propolis administration significantly increased the plasma level of IM Enrofloxacin, while oral administration of Enrofloxacin significantly decreased. Significant differences were detected in IM and orally administered Enrofloxacin in t_{1/2}, T-Max, C-Max, AUC, and AUMC pharmacokinetic parameters. Propolis almost doubled the t_{1/2} and C-Max of IM Enrofloxacin but decreased it in oral Enrofloxacin. These results demonstrated the potential of propolis to interact with drugs and alter its pharmacokinetics. The present study indicated that propolis could cause significant health consequences or toxications by causing changes in plasma levels. When consumed with medicines that have to be used regularly and narrow therapeutic index drugs.

The beneficial effect of fresh Moroccan bee pollen against blood, liver, and renal toxicity induced by methotrexate in rat

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BACKGROUND: Methotrexate (MTX) is an immunosuppressive drug widely used for the treatment of chronic inflammatory systemic autoimmune disease. Despite the wide range of its therapeutical effects, the effectiveness of MTX remains restricted due to several adverse effects associated with high doses and/or long-term use of this drug. **OBJECTIVE:** The present study aims to assess the protective effect of the hydro-ethanolic extract of Moroccan fresh bee pollen (BPE) against blood and hepatorenal toxicities induced by methotrexate (MTX) in albino Wistar rats. **MATERIAL-METHODS:** UPLC-DAD was performed to determine the phenolic profile of bee pollen, mineral content, polyphenols, and flavonoid content were used for its characterization. The antiradical activity was evaluated by the DPPH, ABTS, and FRAP assays. 16 albino Wistar rats were divided into 4 groups: the first group was a control group, the second was injected intraperitoneally with a single dose of MTX (20 mg/kg), and the third was a normal group treated orally and daily with BPE (500 mg/kg) only, and the last group was injected intraperitoneally by MTX and then treated orally and daily by EEPF. Whole blood samples were taken for complete blood count (CBC), and serum was collected to assess renal function (urea, uric acid, creatinine, CRP, protein, and albumin) and hepatic biomarkers (PAL, AST, ALT, LDH, and GGT). Lipid markers (TC, TG, HDL, LDL, and MDA) and blood sugar were also assayed. Fresh organs were removed to explore the enzymatic antioxidant status (CAT, GPx, GSH). The rest of the organs were used for the histological sections. **RESULTS:** The results of this work indicate that MTX injection induced blood, kidney, and liver toxicity characterized by anemia and increased liver enzymes, urea, creatinine, and lipid peroxidation, and decreased CAT, GSH, and GPx levels. Histological examination showed structural impairment and numerous hepatic and renal tissue lesions. However, treatment with BPE reversed these pathological changes by decreasing hepatorenal toxicity markers, correcting resulted anemia, and improved antioxidant status by increasing natural antioxidant enzymes.

CONCLUSION: These findings suggest that BPE alleviated MTX-induced liver, kidney, and blood toxicity by decreasing oxidative stress.

The effectiveness of propolis administration at the level of ring form, trophozoite, schizont, and merozoite parasitemia in mice infected with Plasmodium Berghei

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Introduction. Malaria is still a health problem in the world, especially in countries with tropical climates. The challenge above is the emergence of resistance to chloroquine, as a malaria drug. The material used in this research is Propolis. The resin contained in propolis contains flavonoids, phenols, and various forms of acids. One of the phenolic bonds in propolis is Caffeic Acid Phenethyl Ester (CAPE). CAPE is the active side of flavonoids which have antibacterial, antifungal, antiviral, antioxidant and anti-inflammatory properties. Propolis as a honey bee product also contains luteolin 7-O glucoside and chalcone. Luteolin 7-O glucoside inhibits type 2 and parasitic fatty acid biosynthesis and chalcone can inhibit hemolysis. This study used the analytical description method, One Way Anova to calculate parasitemia of parasites in red blood cells in the form of ring form, trophozoite, schizont, and merozoite stages. 30 samples of mice infected with "Plasmodium berghei" were divided into 5 groups, A. control group without propolis administration, group B given a single dose of propolis 100 mg/kg bw, group C given a single dose of propolis 150 mg/kg bw, group D given a single dose of propolis 200 mg/kg bw, group E was given a single dose of 250 mg/kg body weight of propolis. Giving propolis started on the second day. The results showed that the description of erythrocytes treated with a single dose of each from groups A, B, C, D and E was different. The highest parasitemia value was found on day 8 with a dose of 200 mg/kg bw which had an average value of 115 infected erythrocytes. Meanwhile, for a dose of 250 mg on days 2, 3, 6, 8, 9, and 10, there were no erythrocytes infected with "Plasmodium berghei". It was concluded that the peak phase was at the ring stage with a percentage of 97% while the schizont stage was 2.8% and gametocytes were 0.2% on day 8. In this discussion, East Java Propolis was found to be antimalarial depending on the dose and time of administration.

The effect of propolis extracts for neurodegenerative disease and its molecular mechanism

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Propolis is a typical beekeeping product produced by bees by mixing exudates collected from plant tissues with their own saliva. Bees use propolis to protect their hives from insects and microorganisms. Propolis has excellent therapeutic properties and has been widely used as a "natural remedy" from ancient to recent century. Alzheimer's and Parkinson's disease are typical degenerative neurological diseases and are known as serious diseases in human society. Alzheimer's disease is mainly caused by recognition dysfunction due to atrophy of the brain, and Parkinson's disease is mainly caused by decreased dopamine secretion due to abnormal accumulation of alpha-synuclein protein known as formation of Lewy body and muscle degeneration. There are many possible causes for such neurodegenerative diseases, one of which is abnormal expression of intracellular proteins caused by endoplasmic reticulum stress and overexpression and aggregation of proteins. The components that impart functional properties to propolis are caused by the abundance of plant diversity in the region where propolis raw materials are collected. Among them, the most functional components of propolis are flavonoid and polyphenols, which are used for various purposes, including immune regulation, antibacterial, anti-inflammatory, anti-tumor, and antioxidant effects due to their potential pharmaceutical properties. However, the molecular biological mechanisms of propolis on neurodegenerative diseases have not yet been fully identified.

Therefore, in this study, we investigated the effect of propolis on neurodegenerative diseases using PC12 and SH-SY5Y cell line. Propolis inhibits the hyperphosphorylation of tau, a major protein marker for Alzheimer's disease. In addition, propolis inhibits endoplasmic reticulum stress-mediated microtubule disassembly and inhibiting apoptosis. In Parkinson's disease, propolis suppresses overexpression of -synuclein by MPTP as Parkinson's disease inducer. By Western blotting, propolis inhibits the phosphorylation of ERK and SAPK/JNK signaling molecules. Through these results, we confirmed that propolis has a functional effect on neurodegenerative diseases and show that it can be applied as an effective functional food for neurodegenerative diseases.

Relationships between Bee Pollen Biochemical Properties and Chronic Immobilization Stress in Rats

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In addition to anxiety, depression, and cognitive impairment are all possible consequences of chronic stress. Bee pollen offers a wide range of medicinal properties because it is well-known as a potent source of bioactive compounds. On the basis of this information, we explored the association between the use of bee pollen and the treatment of depression and anxiety, both of which are neurological problems. After taking approval from the Local Ethics Committee of Recep Tayyip Erdogan University with the number 2020/23, twenty-four male Sprague Dawley rats were divided into three groups for this study: the control group, the stress group, and the bee pollen+stress group. During a ten-day period, rats that had been exposed to physical stress received 200 mg/kg/day of bee pollen. Before euthanizing the rats, open field tests (OFTs) and forced swimming tests (FSTs) were administered to observe behavioral changes. The levels of brain-derived neurotrophic factor (BDNF), interleukin 1 beta (IL-1), tumor necrosis factor-alpha (TNF- α), malondialdehyde (MDA), and glutathione were determined in the brain tissue. According to the findings of the behavioral tests, bee pollen was shown to lower anxiety-like behavior but had no effect on depression-like behavior. As a result of the data of the biochemical analysis, it was found that bee pollen suppress neuroinflammation in hippocampal tissues, while simultaneously lowering oxidative stress and lipid peroxidation. Accordingly, we think that Anatolian bee pollen may be a promising therapeutic agent in the prevention or mitigation of stress-related behavioral deficits. The findings of our preclinical research have been published with the DOI number 10.1016/j.neulet.2021.136342 in Neuroscience Letters.

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Anti-quorum Sensing, Anti-biofilm and Anti-swarming Activities of Anatolia Propolis Extracts

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Propolis is one of the natural products with the highest antimicrobial activity. This bee product contains various polyphenols, and volatile oils has wide biological active properties is frequently used in complementary medicine. Raw propolis is usually dissolved in 65-70% ethanol and used in complementary agent. In this study, the antimicrobial activity of ethanolic commercial propolis was investigated. The aim of this study is, will propolis be a cure for increasing antibiotic resistance? Antibiotic resistance, which has increased rapidly and poses a great threat to public health. The inadequacy of existing antibiotics has increased the need for new effective and less toxic antibiotic raw materials or antibiotic derivatives. The antimicrobial activity of a commercially produced ethanolic propolis extract has been extensively studied. Antimicrobial activity was investigated against *Staphylococcus aureus*, *Mycobacterium smegmatis*, *Chromobacterium violaceum* and *Candida albicans* was by agar well diffusion assay. Anti-quorum sensing, anti-biofilm and anti-swarming activities were investigated against *Chromobacterium violaceum* ATCC31532, *Chromobacterium violaceum* ATCC 12472 and *Pseudomonas aeruginosa* PAO1 respectively. The ethanolic propolis samples were showed high bactericidal activity, and high anti-biofilm and high anti-quorum sensing activity

Identification and Characterization of HIV-1-Reverse Transcriptase Inhibitors from Propolis Extracts

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The pharmacological effect of propolis against many viral infections has been revealed. Used for medicinal purposes since ancient times, propolis has more recently been shown to have broad-spectrum antimicrobial activity, including activity against opportunistic pathogens associated with acquired immunodeficiency syndrome (AIDS), but the source/compounds of this activity have not been clarified. Inhibitors used for the treatment of HIV virus cannot be used effectively enough. This increases the need for new inhibitors.

In the research, it was determined that the aqueous propolis extract inhibited the HIV reverse transcriptase activity, which plays a key role in the replication mechanism of the HIV virus and is responsible for the conversion of single-stranded virus RNA into double-stranded DNA. In this study, unlike the literature, the phenolic content of the aqueous extracts of propolis samples taken from Turkey was determined. It was investigated whether 18 phenolic compounds in 2 kDA fractions and therefore less than 2 kDA inhibit HIV-1 RT enzyme by ELISA method. IC50 values of 18 phenolic compounds were determined by ELISA method. The IC50 values of 9 phenolic compounds were found to be less than 1 mM. The IC50 values of these compounds, Luteolin, Quercetin, Fisetin, Tannic acid, Pinocembrin, Mrycetin, were 0.11; 0.41; 0.92; 0.58, 0.023 and 0.09 mM. The inhibition properties of 6 phenolic compounds with IC50 value less than 1 mM, binary and 6-fold combinations with IC50 value were measured, it was determined that most of the combinations showed a synergistic effect, especially the 6-way combination was equivalent to Nevirapine used in the treatment of AIDS today. At the stage of the research findings, in vivo, animal trials, pre-tests Clinical and clinical studies are needed to be conducted to determine whether Luteolin, Quercetin, Fisetin, Tannic acid, Pinocembrin and Mrycetin and their combinations in propolis, which is a natural bee product and widely used in the public, can be used in the treatment of AIDS patients. Luteolin, which is in the content of widely used propolis, can be suggested as the first candidate for in vivo study as a possible drug candidate because of the low IC50 and high SI (selective index).

The Investigation of The Effects of Nourishment With Drone Bee Larvae (Apilarnil) on The Reproductive Performance and Body Composition of Blue Streak Hap Broodstocks (*Labidochromis caeruleus* Fryer, 1956)

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In the present study, the effects of nourishment with apilarnil on the reproductive performance and body composition of blue streak hap broodstocks (*Labidochromis caeruleus* Fryer, 1956) were examined. In the first part (30 days) of the study, female and male fish of which average live weight was 3.62±0.05 g were put into aquariums separately. 1st and 2nd groups (KD and KE) were fed with dry fodder as three times a day during the experiment. 3rd and 4th groups (AD and AE) were acquired performance for the second part of the experiment by being fed with drone bee larvae (apilarnil) as the 3rd meal accompanied by two dry fodder meals. In the second part (60 days), the groups were formed by putting the male and female fish together as KD+KE, KD+AE, AD+KE, and AD+AE. In this process, all of the groups were fed only with dry fodder. At the end of the 1st and 2nd parts, the difference between all of the groups in terms of weight and length was not statistically significant ($p < 0.05$). After the second part, the eggs (Y) that were taken with vomiting method in every 15 days, observed egg (GY), food-sac larva (BKL), and fry (YA) were classified under these 4 categories and counting was performed according to these categories. According to the reproductive performance results, while KD+AE (198) group was the first group when the total number of living creatures was examined, AD+AE (125), AD+KE (110) and KD+KE (75) groups followed this group respectively. While there wasn't a difference between the groups in terms of humid and protein from the body composition of the fish, it was determined that the difference of ash value at the start of the experiment and the ash values between the KD+KE and AD+AE groups were significant ($p < 0.05$). While the highest fat ratio was observed in the KD+KE group, a statistically significant difference was determined between the beginning of the experiment and the AD+AE group.

Morphometric Characterization of Bee Races *Apis mellifera* L. from Different Regions of Turkey and Their Venom Potential for Apitherapy According to Geographical Differences

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Bee venom is one of the most important bee products used in apitherapy. Besides market of bee venom is not yet sustainable. Studies in recent years draw attention to the difference in the amount of bee venom collected from different regions in different seasons. Considering the geographical structure and flora diversity of Turkey, it is clear that environmental conditions will have a significant impact on the amount and quality of bee venom in different geographical conditions. For this reason, this study will provide basic information for obtaining data on a regional basis, standardizing bee venom and making it an apiceutical product at an advanced stage. In the present study, 58 bee samples were collected from 43 provinces and almost all over Turkey. The samples were kept in absolute ethanol. Additionally, venom samples were collected with electroshock method. Venoms obtained after drying on the glass surface of venom collector by scraping. All samples lyophilized and stored in dry condition at +4 °C in amber bottles. The samples taken from the right front wing of the worker bees collected from 53 apiaries transferred to the computer by using the geometric morphometry method, the landmarks marked and analyzed. The venom samples of the determined races and ecotypes compared with biochemical analyzes, in this way, national honeybee venom profile tried to be defined. Venom protein content was determined by BCA protein assay. A panel of cancerous (pancreas, colon, glioblastoma, cervix, breast, lung, prostate) and non-cancerous cells (healthy lung fibroblast cells) were screened for cytotoxic potential by MTT assay in order to carry out apitherapeutic application. The protein content was estimated from $378.30 \pm 63.78 \mu\text{g/ml}$ to $1128 \pm 96.16 \mu\text{g/ml}$. The IC50 values of the cells that are treated with the venoms varied between $1.52 \pm 0.52 \mu\text{g/ml}$ and 114.35 ± 6.01 . To our knowledge, this is the first extensive investigation of the cytotoxic activities in bee venom samples from Turkey. These results indicate that venoms of the bees from Turkey show great potential for apitherapeutic applications. It is suggested that further studies on venom are conducted to understand the components of the venom which cause such cytotoxic effect on cells.

Glucose oxidase, a bee-derived enzyme, as an important factor determining the antibacterial activity of bee pollen and bee bread

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Bee pollen (BP) and its fermented version - bee bread (BB) - have attracted great attention due to their health-promoting properties. Both honeybee products exhibit distinct biological activities including antibacterial activity. However, the mechanism of antibacterial activity is largely unknown. Therefore, we aimed to characterise the antibacterial effect of BP and BB aqueous extracts against selected bacterial pathogens and identify the key compound(s) responsible for this effect. Here we demonstrate that both BP and particularly BB aqueous extracts display antibacterial activity which is significantly increased in the presence of glucose. Immunoblot analysis of extracts revealed the presence of MRJP1 in all analysed BP and BB samples and the enzyme glucose oxidase (GOX) in the majority of BB samples. Treatment of extracts with catalase resulted in the restoration of bacterial growth but only in those samples where glucose supplementation caused the enhancement of antibacterial activity. However, the level of hydrogen peroxide did not correlate with the antibacterial activity of any of the samples analysed regardless of bacterial species. Our findings provide a deeper understanding of antibacterial activity of BP/BB which is mediated, for the most part, by the enzymatic activity of bee-derived GOX. It is obvious that honey, royal jelly and BP/BB share the same mechanism of antibacterial effect based on proteinous content secreted from bee hypopharyngeal glands.

Analysis of the Effects of Propolis on Male Infertility Based on Sperm Count Using Experimental Animals

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Background of the problem

Infertility is defined as the failure to conceive within a period of time. One of the causes of infertility in men is oxidative stress, which will affect the fertility status of men. Oxidative stress itself is influenced by the number of pro-oxidants or free radicals, most of which are destructive reactive oxygen species (ROS), which exceed the body's natural antioxidants. Propolis is believed to function as an antioxidant that can suppress the number of free radicals in the body and also has a protective function against male infertility.

Research purposes

The purpose of this study was to analyze the effect of propolis ethanol extract on sperm count of male mice (*Mus musculus*) with infertility models.

Research Methods

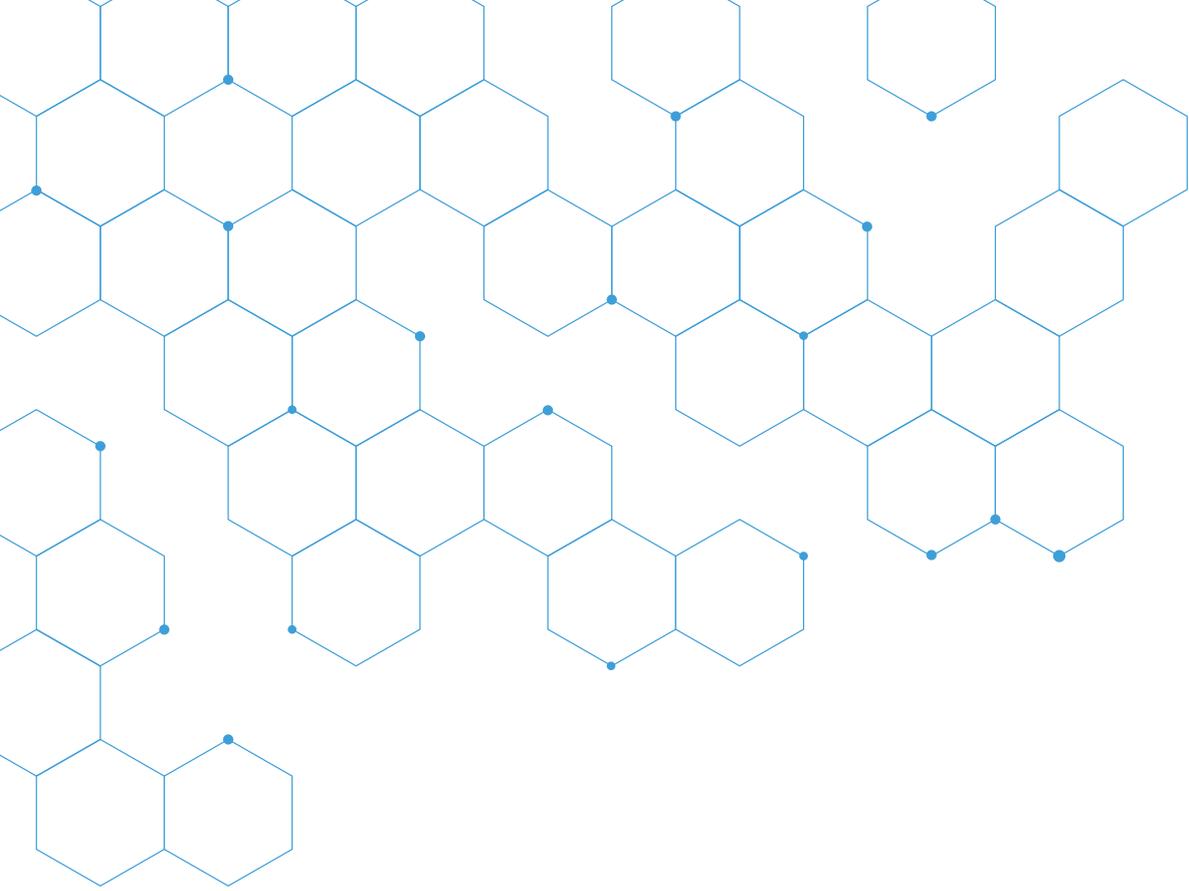
This study is an experimental laboratory study with the post test only control group design using 28 male mice which were divided into 4 groups, Spermatozoa count using a nebauer haemocytometer, viewed through a microscope with a magnification of 10 x 40 in five fields of view. The research data were analyzed using the One-Way ANOVA test.

Result

Spermatozoa count (Mean + Standard Deviation) for each group K1 $2,921,429 \pm 690,927$ /ml, K2 $2,021,428 \pm 501,561$ /ml, K3 $5,342,857 \pm 2,523,791$ /ml, and K4 $5,371,428 \pm 554,419$ /ml. OneWay ANOVA test showed p value < 0.001, indicating that there was an effect of giving Propolis on the sperm count of mice with male infertility models.

Conclusion

The results of the research that have been carried out by the authors indicate that there is an effect of giving propolis a dose of 50 mg/kgBW/day on the spermatozoa count of male infertility models of mice. The propolis dose of 100mg/kgBW used did not give a significant increase in effect when compared to the dose of 50mg/kgBW propolis. Further studies are needed using varying doses and duration of treatment including other variables associated with male infertility.



POSTER PRESENTATIONS



Determination of physicochemical properties of naturally obtained bee venoms from anatolian honeybee (*Apis mellifera anatoliaca*)

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Bee venom is a pharmacologically relevant bee product. There are numerous studies on the determination of its physical properties and characterization of the chemical components of bee venom. However, there is no information available on the characterization and standardization of bee venom contents obtained from the Anatolian honey bee. Therefore, this study represents the first data about Anatolian bee venom according to our knowledge. This study exhibits a comparison of the chemical contents of two types of samples; fresh bee venoms obtained from the Anatolian honey bees and the commercial bee venoms. Three bee venom samples were collected from beekeepers in Denizli, Malatya, and Manisa, and two commercially available samples imported from China and Bulgaria were purchased. The moisture content and sugar profiles of the samples were determined using a moisture analyzer and HPLC-RID. Melittin, apamin, and phospholipase A2 contents were analyzed by HPLC-UV method. The results showed significant differences in the chemical contents of two types of samples. Commercial samples were found to contain lower amounts of apamin and melittin in the range of 0.91-1.60% and 18.76-25.35%, respectively. On the other hand, the Anatolian samples showed higher amounts of apamine and melittin in the range of 2.09-2.63% and 36.95% -43.51%, respectively. Similarly, bee venom phospholipase A2 activity was found to be higher in samples produced by beekeepers in Turkey than that of commercial samples. In local bee venom samples, phospholipase activity was in the range of 10.52-11.00%, but 6.90-9.08% in imported samples. The phospholipase A2 activities of the bee venom samples produced in Turkey were found to be significantly higher. Also, the moisture contents averaged 11.81% and 9.64% in imported samples and bee venom samples of Anatolian bees, respectively. Sugar profiles of the samples showed no significant difference in samples except that the sucrose content was higher in samples produced by the beekeepers in Turkey.

Investigation of nutritional and antioxidant properties of Anatolian bee bread

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Bee bread is a bee product produced by bees in which they combine pollen with their digestive enzymes and place them in the comb cells. In this study, it was aimed to evaluate the nutritional and antioxidant properties of Anatolian bee bread and present an examination of regional differences. In order to emphasize the bioavailability of bee bread and to determine its phenolic, flavonoid content, antioxidant activity and nutritional quality, ten samples were collected from different parts of Anatolia. Seven of them were from Muğla (prominent city in terms of honey production), one was from Van representing the Eastern Anatolia region, one was from Sivas representing the Central Anatolia region and one was from Kırşehir. Ten samples were analyzed for total phenolic, flavonoid, antioxidant and moisture content, and the mixture representing ten samples were analyzed for nutritional content (carbohydrate, fat, saturated fat, fiber, protein, salt, ash, iron and zinc). Total phenolic content, flavonoid, antioxidant content and moisture content of the samples were determined as 11.90-14.77 mg GAE/g, 1.30-6.30 mg CE/g, 20.03-35.43 mg TEAC/g and 10.13-18.10%, respectively. The highest phenolic, flavonoid and antioxidant content was observed in Muğla² samples. The study's results were compared to results found in literature, and it was concluded that Anatolian bee bread has high antioxidant content and nutritional value, especially, in terms of carbohydrates, iron and zinc.

Application hints for treating Lyme disease

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Lyme disease, caused by spirochete *Borrelia burgdorferi* and accompanied by a number of other pathogens. Whereas the short-term symptoms seem to be in good control the long-term effects are difficult to diagnose. Patients suffer heavily from a lot of non-specific symptoms such as fatigue or arthralgia and are often desperate. Apitherapeutically bee venom (BV) is used successfully in improving the status of the long-term patients. In this contribution we want to highlight the development of long-term Lyme with case studies. Special aspects are how difficult is to find the right dosing, how well is the BV received and what co-factors have to be taken respect. What can be achieved with a TCM (Traditional Chinese Medicine) approach. Apitherapy is a good approach to cure long term Lyme. The experience shows that it needs sufficient time and patience. The time scale are normally years not months. In the end propolis, Royal Jelly and especially BV are a successful remedies.

Production of minerals enriched honey

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Honey is one of the foods that is 100% absorbed by the body metabolism, so the minerals in it are better available for the body and will be better absorbed. Clinical research has also shown that the human body will absorb higher minerals by consuming natural foods containing minerals than by taking supplements and pills. Therefore, minerals enriched honey will be very important for people who are deficient in them. In this work, using the techniques available in bee feeding and using minerals, enriched honey will be produced, which leads to a very high absorption of minerals by the body. In the present study, in addition to feeding on medicinal plants, bees will be fed with minerals as a supplement. To feed, natural honey syrup / cake with a specified dose of minerals is used, also in order to get a better result from feeding, a special bee breed (Karnika) has been used, because this breed is more interested to be in the hive and use honey syrup and pollen cake than to look for nectar in the desert. As well as, to reduce the rate of bee exit from the hive, a special type of hive was used (open floor) and to increase the space of the hive, frames with pupae and larvae were changed with the empty ones. More presence in the hive and consumption of syrup and pollen cake increases the amount of minerals in the produced honey and the results show that the minerals (Iron and Calcium) enhanced twice in comparison with the common productions.

Investigation of potential properties of ethanolic propolis extracts for COVID-19 treatment

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The aim of the study is to investigate the potential of ethanolic propolis extracts to bind to ACE-II receptors and compare with classical ACE-II inhibitors. For this reason, the study is based on Anatolian propolis composition which is analysed by HPLC-UV and to calculate in silico ACE-II binding constants of some flavanoids present in the propolis extract. In this molecular modeling for ACE-II (S, S)-2-1-carboxy-2-[3-(3,5-dichloro-benzyl)-3h-imidazole-4-YI]-ethylamino-4-methyl-pentanoic acid (MLN-4760) is used as positive control. The angiotensin-converting enzyme (ACE)-related carboxypeptidase, ACE-II, is a type I integral membrane protein of 805 amino acids that contains 1 HEXXH-E zinc binding consensus sequence. ACE-II has been implicated in the regulation of heart function and also as a functional receptor for the coronavirus that causes the severe acute respiratory syndrome (SARS). In this study, the potential of some flavonoids presents in propolis to bind to ACE-II receptors was calculated with in silico. Binding constants of ten flavonoids, caffeic acid, caffeic acid phenethyl ester, chrysin, galangin, myricetin, rutin, hesperetin, pinocembrin, luteolin and quercetin were measured using the AutoDock 4.2 molecular docking program. And also, these binding constants were compared to reference ligand of MLN-4760. The results are shown that rutin has the best inhibition potentials among the studied molecules with high binding energy– 8.04 kcal/mol, and it is followed by myricetin, quercetin, caffeic acid phenethyl ester and hesperetin. However, the reference molecule has binding energy of – 7.24 kcal/mol. In conclusion, the high potential of flavonoids in ethanolic propolis extracts to bind to ACE-II receptors indicates that this natural bee product has high potential for COVID-19 treatment, but this needs to be supported by experimental studies.

Synthesis Process of Aram 97 Honeybee Strain, as the First Native Livestock Breed in Iran

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According to the latest statistics by the FAO in 2020, Iran is the third largest producer of honey in the world after China and Turkey. Iranian honeybee, *Apis mellifera meda*, was known among the honeybee races of the world as an aggressive and high swarming race. Therefore, in the Iranian Honeybee Breeding Program, improvement of aggressive behavior, swarming behavior and also honey production were considered. Following 23 years of research during the Breeding Program, in 2021 Aram 97 strain was introduced and registered, as one of the achievements of this project. This strain is in fact the first improved livestock breed in the country that has been officially registered. The aggressive behavior of honeybee colonies was evaluated by moving the black leather ball in front of their flight entrances for one minute and counting the number of stings left on the ball. The average number of stings in two rounds (aggressive behavior), the number of queen cells (swarming behavior) and honey production were used to select the best colonies. Finally, according to the evaluation of all the mentioned traits, 40 superior drone producer colonies and 100 maternal colonies were selected and used to establish the next generation. Assessment of the aggressive behavior of Aram 97 strain were compared with the control queens of the private apiaries in different provinces of Iran. The obtained results of the comparison in different years showed that the bred colonies were significantly superior to the control colonies in terms of aggressive behavior. Results of comparing the first three generations and the last three generations leading up to the seventeenth generation in the colonies of the Iranian Honeybee breeding Program showed the average number of colony stings in 700 colonies of the project has decreased from 13.96 to 0.63 over 17 generations. On the other hand, after the 10th generation, the number of sting fluctuations also decreased and this trait has reached relative stability. The results proved the correct orientation of the Iranian Honeybee Breeding Program, as the aggressive behavior of the colonies during the last 17 generations has improved.

Anti-inflammatory effects of honey from the Philippine stingless bees (*Tetragonula biroi* Freise) on carrageenan-induced hind paw edema in ICR mice

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Carrageenan-induced hind paw edema model in mice was used to assess the anti-inflammatory activity of honey from the Philippine stingless bees (*Tetragonula biroi* Freise). Intraplantar injection of the phlogistic agent, -carrageenan, into the hind paw of ICR mice induced inflammation evidenced by hyperemia and swelling. Oral pre-treatment of Philippine stingless bee (PSB) honey significantly attenuated gross hind paw edema at 6 hours and was sustained up until 24 hours after induction of inflammation. Microscopically, significantly reduced dermal edema and dermal thickness were observed in PSB honey pre-treated mice. These gross and microscopic improvements were comparable to those seen in positive control diclofenac sodium (DS) pre-treated mice. Similarly, DS and PSB honey pre-treated mice had comparably reduced plasma pro-inflammatory cytokine levels relative to distilled water (DW) pre-treated mice. Philippine stingless bee honey pre-treated mice had 38.46%, 36.75% and 63.38% lower levels of plasma (IL-1), IL-6 and tumor necrosis factor (TNF-), respectively, compared to those measured in DW pre-treated mice. These results indicate that the Philippine stingless bee honey possess potent anti-inflammatory activity through inhibition of IL-1, IL-6 and TNF-sufficient to substantially attenuate hind paw inflammation in mice. The findings exhibit the potential development of these indigenous bee-derived substances as new biomedical products for the treatment of acute inflammatory conditions.

Changes in antioxidant capacity and exin layer of pollen fermented with kombucha and green tea

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Bee pollen is an important bee product that honey bees use to feed their young larvae. After the bee pollen is brought to the hive and stored in the honeycomb cells, it undergoes lactic acid fermentation and is made ready for feeding. The exine layer of the pollen is resistant to high temperatures and pressure. It is known that fermentation causes breaks in the exine layer of pollen and the nutrient content of the pollen comes out. Therefore, in this study, it was aimed to determine the changes in the antioxidant capacity of pollen fermented with different products in the laboratory environment and the changes in the exine layer. For this, green tea infusion (1%) and hibiscus tea infusion (0.5%) were prepared in boiled water and sugar and pollen were added to the pollen fermentation at 28 °C. Antioxidant activity was determined by the phosphomolybdenum method by taking samples at different time intervals (0, 1, 3, 5, 7, 9 days) and the exine structure of pollen was examined by electron microscopy. The antioxidant activity of the control, green tea and hibiscus group samples was determined between 31.15-57.07, 35.90-113.50 and 12.25-42.66 mgAAE/g, and a significant increase in antioxidant activity was observed in the green tea group. As a result of fermentation with green tea and hibiscus, it was determined that there were breaks in the exin structure. These results showed that the fermentation of pollen with green tea can be a good option to obtain fermented products.

Apitherapy in Lithuania: past, present and future perspectives

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The beginning of apitherapy in Lithuania dates back to year 1962 when prof. A. Lukoševičiūtė and assoc. prof. A. Eviltis started studying the effects of fresh royal jelly in patients suffering from heart diseases at Kaunas Clinics. Production of ethanol extract of propolis and royal jelly tablets was started at Kaunas Pharmaceutical Factory "Sanitas" in 1966. The first Lithuanian bee venom ointment "Apitrit" was developed in 1967. Research work of propolis was started in 1971 by then pharmacist A. Gendrolis defended his dissertation on the research of eye drops for industrial production in 1974. In 1975 M.D. doctor L. Mackevičius was the first in Lithuania to use bee venom (stings) for treatment and developed an original device for this purpose. Finally, Lithuanian Apitherapy Association was founded in 1991. Today a lot of medics, biologists, scientists, veterinarians etc. carry out research with bee products in various fields. Lithuanian Apitherapy Association also belongs to the International Federation of Apitherapy (IFA) that was established in Passau City in 2012. By the way in 2016 the second IFA Congress was held in Kaunas, Lithuania.

Apitherapy is one of the offshoot of Complementary and alternative medicine. For a long time apitherapy has not been regulated in Lithuania and finally after the activity and a lot of preparatory work of Lithuanian apitherapists on 14-Jan-2020 the law on complementary and alternative healthcare (CAHC) of the republic Lithuania was adopted. Apitherapy is the one of 15 specific services classified as CAHC in this law such as hypotherapy, phytotherapy, hirudotherapy etc. Qualification requirements for a person seeking a licence as a specialist in CAHC apitherapy are specified. Two types of specialists could provide licence apitherapy services: "Complementary and alternative healthcare specialist for apitherapy" and "Assistant specialist in CAHC apitherapy". The staff of a CAHC establishment must hold valid licences of specialists in CAHC apitherapy; requirements and protocols for the provision of CAHC apitherapy services; a CAHC apitherapy establishment must hold a hygiene passport, a civil liability insurance and a licence for a CAHC apitherapy establishment. Training courses for complementary and alternative healthcare specialist for apitherapy are being prepared.

Gentle beekeeping and bee apitherapy a holistic health method that is the result of 40 years of research and has proven its effectiveness on human health

Catherine Flurin

Apitherapist, Reasearcher, Beekeeper and Founder of Ballot-Flurin Company

Gentle beekeeping is a method and a set of specifications that optimize the production of propolis, honey, venom and wax for human health. The techniques of gentle beekeeping amplify the content of active ingredients and the number of measurable photons in the apitherapy products. These measurements are performed by recognized laboratories. Catherine Ballot Flurin, apitherapist, researcher who has devoted her whole life to bees and health, has developed techniques for harvesting and preparing propolis, venom and all the products of the hive for a perfect efficiency. And especially allowing the respect of the bees which are sacred and are the future for the health of the humans. The hive of soft beekeeping is made of polarized wood without plastic. The venom is harvested without killing or stressing the bees. Photos of these devices will be shown.

We also treat by the presence of bees with new devices like polarized bee chambers, specific skin care through direct contact with bees. These care devices are intended for hospitals, medical practices and wellness centers. Children and adults can be treated regardless of their age and problems. Here, too, scientific measurements show excellent results with the improvement of stress and the human metabolism. They are addressed to patients and caregivers.

Catherine Flurin's experience is offered to all those who want to move from classical apitherapy which considers bees as simple production animals to a conscious apitherapy which is much more efficient because it brings the true vibratory signal of bees for holistic health.

Effect of Anatolian Propolis on COVID-19

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The virus which emerged with respiratory symptoms such as fever, cough and shortness of breath in China at the end of December 2019, named as COVID-19, caused a pandemic and continues to affect the whole world with its new variants. There has been a significant increase in the mortality of COVID-19 on the elderly and those with chronic disease comorbidities. Therefore, it is significant to strengthen the immune system to get protected from COVID-19 and to minimize symptoms. Propolis is a natural bee product with numerous studies showing its positive effects on immunomodulatory activity and on the COVID-19 disease severity and transmission. Inhibitory effects of caffeic acid phenethyl ester, hesperitin, caffeic acid, quercetin, pinosembrin, galangin flavonoids found naturally in Anatolian Propolis have been shown in molecular modeling for the binding of SARS-CoV-2 to the ACE-2 receptor. The binding of viruses was blocked; thus, development of infection was inhibited. In the first COVID-19 case report, use of Anatolian propolis in the treatment of a 38-year-old patient with a positive corona test were reported. Daily consumption of 20-80 drops of Anatolian Propolis as a support to existing medical treatment reported to provide relief in breathing on the third day. On the 7th day, the patient was transferred from intensive care unit. The first control of patient after treatment for 10 days in normal service unit with Anatolian propolis support showed that there was significant healing. On the 15th day, it was reported that his lungs were completely healed. The first clinical study evaluating effects on healthcare workers with prophylactic purpose against COVID-19 was carried out with Anatolian propolis. In the study with 204 healthcare professionals, in group of 102 participants consuming Anatolian Propolis (30%), only 2 participants were found to be positive, while there were 14 people with PCR positivity in the control group of 102 people. In result, 98% of individuals who took Anatolian Propolis were protected against COVID-19 compared to the control group. In conclusion, consumption of pure Anatolian propolis containing at least 20% extract, at least 80 drops per day for adults is recommended to get protected from COVID-19.

Acute inflammation attenuated by topical administration of Philippines stingless bee propolis through reduction of the pro-inflammatory cytokines, Tumor Necrosis Factor-alpha(TNF α), Interleukin1 (IL-1), and Interleukin 6 (IL-6)

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The anti-inflammatory activity of topically applied propolis from the Philippine stingless bees (*Tetragonula biroi* Friese) was investigated using the -carrageenan-induced hind paw edema inflammatory model. Intraplantar injection of -carrageenan in mice induced severe swelling and hyperemia of the right hind paw starting at 15 minutes post-injection in the different treatment groups. Repeated topical administration of diclofenac sodium and propolis every 8 hours for 24 hours significantly reduced edema grossly at 6-24 hours and 3-24 hours post-injection of the inflammatory agent, respectively. Plasma tumor necrosis factor (TNF-), interleukin 1B (IL-1B), and IL-6 levels were then measured after the 24-hour observation period. Both propolis and diclofenac sodium were found to significantly reduce plasma TNF-, IL-1B and IL-6 levels. These results show that the anti-inflammatory activity of Philippine stingless bee propolis can be attributed to its ability to down-regulate pro-inflammatory cytokines such as TNF-, IL-1B and IL-6. Altogether, it strengthens the potential development of these indigenous bee-derived substances as new biomedical product for the treatment of acute inflammatory conditions.

Anti-nociceptive activity of Philippine stingless bee (*Tetragonula biroi* Friese) honey: Alleviation of neurogenic and inflammatory somatic pain but not cutaneous and visceral pain

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The Philippine stingless bee (*Tetragonula biroi* Friese) honey was examined for its potential anti-nociceptive or anti-pain property against inflammatory somatic, visceral pain, and cutaneous pain using sexually mature male ICR mice. Pre-emptive oral administration of honey at 500 mg/kg body weight induced significant anti-nociception on the formalin test which was evidently seen as reduced pain responses of licking and biting in treated mice. Honey displayed a higher percentage of analgesia of 72.88% and 79.48% compared with the 52.88% and 57.90% analgesia of the positive control indomethacin treated mice during the 1st (neurogenic) and 2nd (inflammatory) phase of the formalin test, respectively. Honey treatment did not induce significant anti-nociception in the acetic acid induced visceral pain writhing test and tail immersion test induced cutaneous pain based on low number of writhes and short latency time displayed by treated mice, respectively. These findings demonstrate the Philippine stingless bee honey has a potential as an anti-nociceptive or anti-pain substance for inflammatory somatic pain which may probably involve blocking the synthesis, release and/or action of inflammatory mediators.

Propolis EPP-AF[®] loaded microcapsules – development, characterization and biological activities

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Organic food comes from sustainable and ecofriendly production, while functional foods provide health benefits. The organic and functional food market grows every year. Bees produce propolis from plant exsudates aiming to protect the hive and its inhabitants. Various biological activities for this material have been described, justifying interest in this product for health promotion. However, propolis generally is presented in alcoholic solution, has poor bioavailability, as it is relatively insoluble in water. Its most common form of presentation has the disadvantages of ethanol content and a strong and striking taste. Consequently, technological alternatives that can increase solubility with efficacy and safety, and that meet organic production specifications, are a challenge. We examined the possibility of organic propolis-loaded microcapsules as a functional health-food ingredient attending the organic criteria. So, microcapsules were obtained using spray-dryer technology, with an emulsion based on propolis (EPP-AF[®]) and acacia gum (40:60). The propolis-loaded microcapsules were characterized using FT-IR, SEM, TGA, HPLC and spectrophotometric techniques, along with the determination of antimicrobial, antioxidant, antitumor, anti-inflammatory, and antihypercholesterolemic activities in vitro models. Propolis-loaded microcapsules were successfully obtained, with spherical shape and encapsulation efficiency of 93.7±0.7%, presenting IC50 of 2.654±0.062 and 7.342±0.058 µg/mL by FRAP and DPPH antioxidant methods respectively; they had superior antimicrobial activity against gram-positive strains. Antitumor activity was calculated based on the concentration that inhibited 50% of cellular growth (GI50) in AGS, Caco2 and MCF-7 strains, giving results of 154.0±1.0, 117±1.0 and 271.0±25 µg/mL, respectively. Propolis-loaded microcapsules reduced the permeation of cholesterol by 53.7%, demonstrating antihypercholesterolemic activity and gave an IC50 of 59.0±0.1 µg/mL for NO production in RAW264.7 cells. These results demonstrate the potential of this new propolis presentation to be offered as a food and pharmaceutical ingredient, though additional studies are recommended in order to validate the safety of proposed dosages.

Bee pollen samples from Turkey and Slovenia: A comparative study on their phenolic profiles, antioxidant, and anti-inflammatory activities

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Turkey is located at the intersections of European-Siberian, Iranian-Turan and Mediterranean phyto-geographical regions harbouring a rich flora of over 1,750 plant taxa. Turkey links Asia to Europe and contributes to exchanging plant species between the two continents. Slovenia is situated in Central Europe at the midpoint of Mediterranean area, Alpine region, and Pannonian plain. Beekeeping is one of the oldest and most traditional agricultural activities in both countries. Among the bee products, bee pollen is composed of floral pollen with nectar or honey, enzymes, wax, and bee secretion. It is used in apitherapy and diet due to its highly health-promoting components. It is recognised as “the only perfectly complete food” because it includes all the essential amino acids required by people. However, its chemical composition is directly related to the plant source around the beehive. This study aimed to comparatively investigate the chemical and bioactivity profiles of thirty bee pollen samples from Turkey and Slovenia. Initial palynological analysis demonstrated that twenty samples were monofloral bee pollen originating mostly from *Castanea sativa*, *Salix* sp., *Bellis* sp., and *Hedera helix*, and the rest were multifloral. Besides, thirty compounds were screened by HPTLC method and the most common phenolics in bee pollen samples were determined as caffeic acid, chlorogenic acid, rutin, kaempferol, quercetin, hyperoside and luteolin. HPTLC-MSn analyses resulted also in identification of unknown compounds. In bioactivity testing, the monofloral bee pollen sample from *Castanea sativa* showed the highest antioxidant activity by DPPH, CUPRAC, and FRAP methods. Moreover, the bee pollen samples at non-cytotoxic concentrations showed concentration-dependent anti-inflammatory activity through the nitrite inhibition in LPS-activated RAW264.7 cells. This study was supported by The Scientific and Technological Research Council of Turkey (TÜBİTAK; Project No: 119N569) and the Slovenian Research Agency (ARRS; research core funding No. P1-0005 and the bilateral project BI-TR/20-23-004).

Mineral infused honey's effect on nutrient deficiencies

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92% of the global population has a mineral deficiency. Approximately 20% of global population has an Iron deficiency. As honey is a pure glucose, you absorb 100% of its contents within the first 5- 10 minutes of consuming it. Not only that, but raw honey is full of tons of healthy enzymes which can act as a digestive aid when consuming complex foods. When bees are fed a surplus of healthy minerals and vitamins, the nutrients aren't fully metabolized by the bees and it gets directly integrated into honey. We found that using this methodology was able to make the vitamins and minerals more bio-available for humans when consuming. In our short trials, our intervention group (n=40) were able to help treat their iron deficiencies after 1 month of daily consumption. The lab results before and after consumption confirm the recovery of mineral deficiencies by +/- 75%, even though the level of the consumption was 50% less than the recommended dosage. In this presentation we are going to talk about extraction, method of production, case studies and clinical trials to confirm the efficacy of these revolutionary products.

The Effect Of N-Chromosome Royal Jelly, Queen Wax, And Bee Venom On Eczema And Psoriasis

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Psoriasis and eczema are considered an auto-immune disease that causes red, itchy, scaly patches on the skin. These symptoms are caused from a weak immune system. By combining N-Chromosome Royal Jelly, Queen Wax, and Bee Venom, our case studies done on our invention group (n = 172) found 80% of people fully recover after 1 month of consumption and topical application (in the form of cream, lotion, or mask). Those who only participated in the oral consumption saw better results than those who only participated in the topical utilization, as those who strictly used the lotions would need to re-apply every 8 months to a year's time. Upon every successful application of the two products, the symptoms of the disease would reduce. After 8 years of conducting these case studies, based on the reports from the patients, there are no more symptoms caused from the disease returning from over 90% of the patients. This shows that the main causes of these diseases is an internal issues. The results from these case studies are quite promising and we will be proceeding with further clinical trials. In this presentation we will be discussing the method of production, extraction, and method of application to help treat eczema and psoriasis.

Covid-19 and Anatolian propolis: a case report

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As an age-old folk remedy, it is widely accepted that propolis has natural anti-inflammatory properties. Anatolian propolis is a different form among bee products group. Propolis has taken its current place as a food supplement during the pandemic period and new studies on propolis against COVID-19 have gained momentum. 38-year-old male patient, who served as a medical secretary, first complained of a tickling in his throat. RT-PCR was requested from the patient who presented with this complaint and was in the high-risk profession. The routine blood values and Thorax CT results of the patient whose test was positive were normal. Medical treatment recommended in the Ministry of Health guidelines was initiated for the patient. The patient's complaint got worse on the 5th day. The patient was hospitalized and after 72 hours, the patient's fever continued. The patient started respiratory failure and his general condition worsened. It was decided to follow the patient in the intensive care unit (ICU) and tocilizumab. Although 2 days passed, the patient's oxygenation and clinic status did not improve. For this reason, BEEO'UP (bee&you) 30% Anatolian propolis 80 drops / day was applied to the patient. At the end of the third day, improvement began in the patient's oxygenation, blood parameters and radiological findings. For 5 days, the patient was followed up with IV moxifloxacin, 60 mg steroid, CPAP, inhaler treatments, low molecular weight heparin (LMWH) and BEEO'UP (bee&you) 30% (bee&you) Anatolian propolis. The patient's clinic improved and the patient was taken to the service on the 7th day of his admission to the ICU. The patient was discharged on the 10th day of hospitalization. At the health check-up 1 month later, the patient had no complaints except for forced exertion dyspnea, blood parameters normalized and abnormal radiological findings in Thorax CT completely regressed. As a result, Anatolian propolis can be added to the existing treatment protocol in patients diagnosed with COVID due to its easy, safe and low cost.

Effect of propolis on wound healing in sacrococcygeal pilonidal disease: a randomized controlled clinical trial

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Wound healing and recurrence are the leading problems encountered in sacrococcygeal pilonidal sinus disease. Propolis has a place in both traditional and complementary medicine, and in vitro and in vivo studies have reported its anti-inflammatory, anti-oxidant, anti-bacterial, anti-fungal and immunostimulant properties. In the present study, we discuss the effect of propolis on wound healing in sacrococcygeal pilonidal diseases treated with marsupialization. Patients who were admitted to our clinic with sacrococcygeal pilonidal disease were analyzed prospectively, with a total of 33 patients divided into study and control groups. All patients underwent marsupialization surgery, and the wound areas were analyzed post-operatively, on the 0, 7th, 14th, 28th days and on the day of complete recovery. An acceleration of wound healing was observed from the first week that was found to be even faster between days 14 and 28. The complete recovery score in the study group was significantly lower. Propolis can be used to accelerate wound healing when the marsupialization method is preferred in patients diagnosed with uncomplicated sacrococcygeal pilonidal cyst due to its low cost, good patient compliance, low side effect profile, lack of toxicity and high efficacy.

Apitherapy in Bosnia and Herzegovina

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In recent decades, the use of bee products in B&H has transformed. Most used bee products are honey, royal jelly, pollen and propolis and more recently wax, bee venom and api air have been recognized. Two bee product which is mainly preparing are propolis and pollen, and their mixtures with honey. In B&H pharmacies only few bee products, such as royal jelly and propolis extracts, are present. Only two B&H pharmaceutical companies pack royal jelly-based mixtures, mainly from import raw materials. In addition, apitherapy did not recognized from official medicine and pharmacology. There are 5 to 7 thousand beekeepers, and 10 to 20% of them prepare apitherapeutic products. The use of apitherapy products in B&H is still at an unsatisfactory level. Although in B&H, there are numerous preparations of apitherapeutic

products, based on folk medicine, the products are not standardized, and their sale is mostly done on the doorstep. There are no official clinics that use treatment methods based on apitherapeutic preparations. Also, there are no official certification schemes of Apitherapists, nor is this branch regulated by legislation. There is no legal regulation regulating the use of these preparations. The by-law on honey and other bee products issued by the B&H Food Safety Agency is outdated and does not cover the field of apitherapy and the use of bee products for medical purposes.

Intensive work to raise awareness of the usefulness of the use of apitherapeutic preparations for the prevention and treatment of various diseases is important both for public and beekeepers. Increasing the use of apitherapeutic preparations can be a good basis for reducing chemistry in healthcare. A significant segment in the application of apitherapy products is certainly the establishment of product standardization, which in BiH is still at a very low level due to the lack of BiH standards or legislation covering this area. In recent years, through the Congress on Beekeeping and Bee Products, established in 2016, the importance and significance of standardization and application of apitherapy products in B&H is slowly rising.

PP-005 [Apitherapy]

Effect of propolis extract on genital warts

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Propolis or bee glue is the sticky parts of bee hives that made by honey bees. This valuable product plays an important role for the human health. One of them is the antibiotic effect of propolis that was evaluated and confirmed.

Genital wart is one of the most important challenges in recent years and is very difficult to treat. This viral disease can cause uterine cancer in women and many other diseases in men. In a clinical study that was conducted in Iran at 2021, an ethanolic extract of propolis (7%) was used to remove genital warts.

For this research, propolis extract was mixed with sesame oil (1:1) and used for five patients with the age 35 to 45. One month and twice a day was the period of applying this mixture (EPP and sesame oil) only on the points that genital warts were located. Three cases were treated only with sesame oil without propolis extract as a control. The trend of warts (shape and numbers) was checked every week and the data were recorded. Also, the final results at the end of the treatment were evaluated. The results showed that propolis extract, due to its antiviral properties, significantly reduces the number and size of warts and cures them after a while (95>0). This study showed by increasing the number of people tested, examining different doses and side effects of the bee product, a drug to treat genital warts can be obtained in this way

PP-006 [Apitherapy]

New method for treating Lyme disease with honey bee sting

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Lyme disease caused by a spirochete bacterium called *Borrelia burgdorferi* comes from the bite of a blacklegged tick or deer tick (*Ixodes scapularis*). The symptoms of a bite are bullseye rash (erythematous migraines), fever, chills, headache, fatigue, muscle and joint aches, and swollen lymph nodes. Antibiotics are the usual treatment if caught within the first thirty days. If the disease is left untreated, Lyme will spread through all organs of the body to create MS, Parkinson, and more, and affect all nervous systems of the body. After 30 days, bee venom therapy is required to kill the spirochete bacteria. For this reason about 10 patients with different level of symptoms were treated. Once established to be non-allergic to bee stings, the patient began with two bee stings on either side along the spine, starting at T1 between the vertebrae, about ¾ inches from the center of the spine, during the first session. A week later, two stings are done on either side of the spine between the next two vertebrae, down from the first set of stings. The next week, four stings, two sets of stings, are done between the next two vertebrae on both sides of the spine. Four days after the third week of sting therapy, four stings were placed down from the last stings. The fourth week, six stings were done. Stings were increased until three times a week, ten stings per session are tolerated; for a total of 30 stings per week. Stings are always done down the spine and not up the spine. Once L5 is reached, stings were started at T1 again. It may take up to two months to build up to the ten stings and may continue for up to two years, or more, to kill the spirochete bacteria. The healing is determined by the patient's immune system and any other co-infections involved. The clinical results (reducing and removing the initial symptoms such as fever, fatigue and swollen lymph nodes) show that this method can treat Lyme disease after 2 years with high significant level (p<0.05).

PP-007 [Apitherapy]

Relationship between the antibacterial capacity of Ulmo honey with the contribution of *Eucryphia cordifolia* pollen: the Active Patagonia Factor (APF)

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Chile is one of the world hotspots that can produce a range of honey diversity. The two great mountain chains along the country, the Andes Mountain and the Coastal Range, generate very diverse geomorphology, where almost half of the vascular flora is endemic, giving a unique character to the honeys. The production of unifloral honeys from endemic species arises in two geographical Chilean regions. The first corresponds to the Central Zone, with a semiarid Mediterranean climate, while the second correspond to the south and Patagonian region. Some of the unifloral honeys produced in these two regions are originated from *Escallonia pulverulenta*, *Cryptocarya alba*, *Quillaja saponaria*, *Caldcluvia paniculata*, *Gevuina avellana* and *Eucryphia cordifolia*.

A phytochemical screening of Ulmo honey *Eucryphia cordifolia* was developed by several methods. The total phenolic content was evaluated by Folin-Ciocalteu assay and total flavonoids were determined using the aluminum chloride method. The scavenging activity was determined using the DPPH and ABTS+ radical scavenging assays. An ABSciex triple Quad 4500 mass spectrometer equipped with an electrospray interface coupled to an autosampler system was used to identify polyphenols. Quantification was performed with calibration curves using commercially available standards. The antibacterial activity was evaluated by agar diffusion test and the non-peroxide capacity was evaluated by the reactivity catalase enzyme. The antibacterial activity of Ulmo honey was tested with various percentages of pollen from *E. cordifolia*, against *Echerichia coli*, *Staphylococcus aureus*, and *Salmonella enterica*. The presence of gallic, caffeic, coumaric, abscisic and chlorogenic acids as well as pinocembrin, chrysin, quercetin, luteolin, apigenin, and rutin was detected in the samples of this honey.

The results showed a positive relationship between the amount of floral pollen from *Eucryphia cordifolia* and the greatest antibacterial activity of the honey. It was also observed that the antibacterial activity of Ulmo honey can have values like Manuka 5+ and Jarrah honeys. Based on the activity of more than 500 honeys from Chile, the Active Patagonia Factor (APF) seal was created. The APF factor indicates different levels of antimicrobial activity of the honeys, controlling the growth of these pathogenic bacteria.

PP-008 [Apitherapy]

Vibratory and airborne-sound signals of bee impact mood of human: What interests ? A pilot study

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AIM: Bees emit "sounds" audible to the human ear. It would, however, be misleading to denominate these "sounds" exclusively as "acoustic" in terms of human experience because it is the sensory world of the humans which has to be considered. What we humans perceive as "sound" is not necessarily limited the physical aspect of the signal perceived by the individuals: bee sounds seem to impact the human mood but it is not well known. It is the reason of this pilot study.

METHOD: 24 healthy individuals have been randomly distributed in two groups of 12 before they experienced listening to an inside beehive bee sounds record (IHS group) or to an outside beehive bee sounds record (OHS group). Each individual had to fill in specific standardized mood questionnaires TEIQue-sf and POMS-sf before listening to bee sounds record and POMS-sf immediately after listening to bee sounds record, in order to study the mood's modifications in terms of emotional abilities, anxiety, anger, sadness, alertness, mental fatigue and confusion. Heart rate and skin resistance have been recording too. IHS group and OHS group have been compared before and after listening to the bee sounds records. Statistics: Shapiro test and ANOVA

RESULT: IHS group and OHS group are not different in terms of age, sex-ratio and emotional abilities (p>0,05). Anxiety is less in both IHS group and OHS group after the bee sounds bath (p<0,05). After the bee sounds bath, anger is less in IHS group and confusion is less in OHS group (p<0,05). Heart rate and skin resistance are not modified.

DISCUSSION: Low frequencies like that of the bee sounds have a soothing effect on individuals. Bee sounds baths (both inside and outside records) appear to decrease anxiety but inside and outside records seem to play various different actions on the other component parts of human mood. More work is required to disentangle these sources of variability to better understand what drives the observed trends.

CONCLUSION: Vibratory and airborne-sound signals of bee show a very positive effect on human mood. Further work is required.

Quantitation of the Myo-Inositol and D-Pinitol Levels as Promising Bioactive Constituents of Pine Honey and Elucidation of the Pathway by Analyzing Phloem of *Pinus Brutia* and the Secretion of Insect *Marchalina Hellenica*

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Pine honey is valuable honeydew honey and its production is mainly produced in *Pinus brutia* forests. Turkey has an important advantage in beekeeping in terms of floral diversity and mild climate conditions. The fact that *Pinus brutia* is most common in Turkey in the world brings great wealth in terms of pine honey production. For this reason, Turkey is the leader in the production of pine honey. *Marchalina hellenica* uses secretions of *P. Brutia* (phloem secretion) instead of flower nectar. *M.hellenica* changes these secretions with various biochemical metabolic reactions and then *Apis Mellifera* L. (Honey bees) produces pine honey by using these secretions (Basra secretion) as nectar. Thus, while *M. hellenic* lives on *P. brutia* and feeds on *P. brutia* secretions, it also contributes to the production of pine honey by honey bees. Literature survey showed that; up to date there are limited reports on the chemical composition of secretions of *P. brutia* and *M. hellenica* along with pine honey. In this study, a non-targeted based analytical investigation was applied to the abovementioned samples. Discovery mode GC-MS analysis indicated predominant concentrations of Myo-inositol and D-Pinitol levels in samples. Chemical components were characterized according to their retention times and using library data NIST07. Secretion and pine honey samples in this study were collected from Muğla province during the pine honey production season (October 2021). Absolute quantification of the purposed cyclitols in pine honey and secretions (Basra and phloem) which plays a key role in producing pine honey was performed by utilizing LC-MS analysis. According to foreseen metabolic pathway, as expected higher levels of both Pinitol and Inositol ingredients were found at phloem followed by Basra secretion. Lower concentrations of Myo-inositol (180 mg/kg) and D-Pinitol (1160 mg/kg) were observed in pine honey in comparison to secretions. Nevertheless, the detection of a high concentration of cyclitols content in pine honey revealed that pine honey can be consumed as a food supplement and that it can offer alternative health benefits as well as its phenolic content rich in bioactive components.

Air condensate composition of bee nest

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The aim of our work was to study the composition of the air of the bee nest. The work was carried out at the National University of Life and Environmental Sciences of Ukraine during 2018-2019. The microclimate of the bee nest has been studied significantly from the point of temperature, humidity and in a lesser extent its gas composition. We designed and manufactured the device «Condensation frame», consisting of: a screen anodized aluminum sheet with thermoelectric cooler attached on the back side; water heat dissipation system; condensate tray; power supply unit. The device was placed inside the bee nest in the hive individually for each colony. The device is operated using the network 220-240V/50 Hz. Cooling the screen of the device to +10 C makes it possible to obtain condensate of hive air. Studies of the obtained condensate samples were performed in the laboratory of In Consulting LLC (Ukraine) by gas chromatography with mass spectrometry (Agilent 6890 GC 5973N GC / MSD 7683 Autosampler, B-225, 30 m x 0.25 mm x 0.25 nm, carrier gas - helium). Phenol, 2,4-bis(1,1-dimethylethyl); Dodecanoic acid, methyl ester; Methyl tetradecanoate; Methyl 13-methyltetradecanoate; Methyl 12-methyltetradecanoate; Pentadecanoic acid, methyl ester; Tetradecanoic acid, 5,9,13-trimethyl-, methyl ester; Pentadecanoic acid, 14-methyl-, methyl ester; Hexadecanoic acid, methyl ester; Hexadecanoic acid, 15-methyl-, methyl ester; Hexadecanoic acid, 14-methyl-, methyl ester; Heptadecanoic acid, methyl ester; Octadecanoic acid, methyl ester; Octadecanoic acid, 10-methyl-, methyl ester; Nonadecanoic acid, methyl ester; Eicosanoic acid, methyl ester; Heneicosanoic acid, methyl ester; Docosanoic acid, methyl ester; 1,2-Benzenedicarboxylic acid, mono (2-ethylhexyl) ester; Heneicosane, 11-decyl-; Heptacosane; Tricosanoic acid, methyl ester; Heptacosane; Tetracosanoic acid, methyl ester; Eicosane; Nonacosane; Hexacosanoic acid, methyl ester; Heneicosane, 3-methyl-; Tricosane; (2-Methyl-[1,3] dioxolan-2-yl)-acetic acid, phenyl ester; Cyclotrisiloxane, hexamethyl-; Hexacosane; Octacosane; 1,2,4-Benzenetricarboxylic acid, 4-dodecyl dimethyl ester; 1H-Indole, 1-methyl-2-phenyl-; 5(1H)-Azulenone, 2,4,6,7,8,8a-hexahydro-3,8-dimethyl-4-(1-methylethylidene)-, (8S-cis)- were identified in the hive air. For further scientific work the substances were studied using electronic resources <https://pubchem.ncbi.nlm.nih.gov/> and <https://webbook.nist.gov>. The results can be used in apitherapy or to regulate the climate in the bee nest.

Development of health nutrition programs based on bee products for people during the post-COVID period

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According to the WHO definition, post-COVID syndrome is a condition after COVID-19 that occurs among people with a likely or confirmed SARS-CoV-2 infection, usually three months after the onset of symptoms. During this period, a person may experience new, temporary or even prolonged health problems that require a comprehensive approach to treatment and rehabilitation. Diseases of the gastrointestinal tract, respiratory and hepatobiliary systems are most often attributed to the manifestations of post-COVID syndrome. Long-term changes in intestinal microbiome are possible due to the increase of pathogenic strains and reduction of beneficial bacteria. Therefore, it is a mistake to use antibiotics that can aggravate the intestine condition. Instead, healthy nutrition should be applied to the basis of natural probiotics and substances that restore the microbial balance of the human body, strengthen the immune system and contain bioavailable substances. These include all bee products, including secondary products such as wax moth extract. They are widely used to improve the physical, biological and functional properties of food products. In particular, as non-traditional ingredients with certain treatment and preventive characteristics (propolis), natural products with a full composition (bee pollen) or able to restore human microbiota (bee bread). Formulations for new food products have already been developed by many scientists. For example, a new formulation of a dough base for a dessert product based on dry confectionery mixtures with the addition of a tincture of propolis and royal jelly has been developed. Rheological and organoleptic studies of dough prefabrications show an increase in biological value of the new product without changes in its viscosity and organoleptic parameters. Similar formulations especially based on propolis, bee pollen, drone larvae homogenate, royal jelly are many around the world. However, in our opinion, it is important to develop nutritional programs in accordance with the needs and health of the population. Therefore, we founded a new project, including experimental research, to organize the development of health nutrition programs for different groups of the population, given their difficulty of work, to reduce the negative impact of SARS-CoV-2 infection on the body and the rehabilitation of people during, and after post-COVID syndrome.

Use of a standardized poplar propolis powder in the treatment of chronic diarrhea in dogs and cats

Philippe Garcia

Association Francophone d'Apithérapie

:Chronic diarrhea in dogs and cats is a frequent reason for consultation and a real therapeutic challenge. Conventional therapies are often disappointing over time and have significant side effects because, depending on the case, they resort to immunosuppressive treatments and/or long-term antibiotics. These treatments are also often extremely expensive and, in the case of antibiotics, contradict national and WHO recommendations in the fight against antibiotic resistance. As part of our daily veterinary practice, the use of a standardized powder of poplar propolis with 21% total polyphenols, seemed relevant to us to treat this type of pathology, because of its antimicrobial and anti-inflammatory properties. Our work aimed to evaluate the impact of a poplar propolis powder standardized in total polyphenols on a small number of individuals with chronic diarrhea. We have set up a supplementation protocol for animals suffering from chronic diarrhea after the most precise etiological diagnosis possible. The animals receive a treatment based on standardized poplar propolis powder at the rate of 2 to 4 mg/kg of standardized powder three times a day for 30 days. Animals are monitored regularly during and after treatment. Our results show a clear improvement with sometimes an almost total disappearance of symptoms from the fifteenth day of treatment. In conclusion, this study of observational cases seems to show beneficial results of supplementation with a standardized extract of poplar propolis on chronic diarrhea in dogs and cats. However, protocols need to be further refined and more clinical cases need to be recruited.

Use of bee venom in the treatment of locomotor pathologies in dogs

Philippe Garcia
Association Francophone d'Apithérapie

Locomotor disorders in dogs are a frequent reason for consultation in dogs. Whether in the context of a trauma or in the context of the evolution of an osteoarthritis process more or less associated with a degenerative myelopathy, the conventional therapies put in place are often no longer effective after a few months of treatment. As part of our daily practice, we wanted to verify the effect of bee venom in dogs, due to its anti-inflammatory, anti-nociceptive and anti-degenerative properties. We have selected dogs for which conventional treatments were no longer giving

RESULTS:

- A polytraumatized dachshund dog following a road accident. The animal one month after surgery was very difficult to get up despite the medical treatment put in place.

- Several large breed dogs over the age of 13 who presented with multiple osteoarthritis lesions, particularly on the hindquarters, sometimes associated with degenerative myelopathy. These dogs no longer responded sufficiently to the anti-inflammatory treatment put in place.

We have adapted the protocol of Dr. Jorge CORREDOR, namely, 7 subcutaneous injections of 3 IU of bee venom next to acupuncture points. The injections were spaced one week apart for 3 weeks and then an injection a month later. The dogs were reassessed weekly and then one month later. We were able to observe a beneficial effect, in almost all cases except one for which a new diagnosis of thoracolumbar spondylodiscitis was made. In two cases the result was described as spectacular by the owners, these two animals are regularly evaluated and have not to date presented a relapse. In conclusion, in agreement with the observations of Dr. Corredor, bee venom therapy seems interesting in dogs. However, larger-scale, double-blind studies are needed to confirm these observations. The biggest difficulty in France is the lack of medical grade venom. The use of bees, although possible, is less easy in a veterinary clinic and requires the prior mowing of the injection areas

Physicochemical characterization and in vitro evaluation of the antioxidant and anticandidal activities of Moroccan propolis

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Human mycotic infections are one of the major health problems worldwide. Prolonged use of antimycotic drugs has contributed to the development of resistance in pathogenic fungi. This study was conducted to examine antioxidant and anticandidal activities of Moroccan propolis.

Two ethanolic extracts of Moroccan propolis were evaluated regarding the following physicochemical parameters: Yield, pH, total carbohydrates, total proteins, total lipids, minerals, total phenolic content, total flavonoid content, and antioxidant activity using ferric reducing antioxidant power (FRAP) and (ABTS) assays. In addition, we assessed the in vitro anticandidal activity against vulvovaginal candidiasis strains, that is, *Candida albicans*, *Candida glabrata*, *Candida parapsilosis*, and *Candida krusei*, using the broth micromethod according to the CLSI/M27-A3 reference guidelines. The sample from the Oued Amil area (OAPEE) contained high levels of resin, balsam, moisture, total carbohydrates, and total lipids: 59.8%, 0.71%, 2%, 1.01 gGlcEq/g, and 120 mg/g, respectively. Moreover, the sample from the Sefrou area (SFPEE) was richer in total proteins and minerals, with values of 2.5 g/100 g and 1.84%, respectively. The total polyphenol and flavonoid content in the propolis extracts were 117.38 and 194.68 mg of gallic acid equivalent/g, and 17.45–27.79 mg of quercetin equivalent/g, respectively. Regarding the antioxidant activity, the most effective propolis extract was the sample from the Sefrou area, at 72.5 µg/mL and 118.78 µmol Fe2+/g for ABTS-half-maximal inhibitory concentration and FRAP-half maximal effective concentration, respectively. The analysis of phenolic compounds using high-performance liquid chromatography with a diode-array detector revealed the presence of 13 polyphenols. The main compound in the OAPEE sample was epicatechin (310 mg/g), whereas in the SFPEE sample was apigenin (410 mg/g). Regarding the antifungal activity against *Candida* species, the minimum inhibitory concentration and minimum fungicidal concentration of the Moroccan propolis ethanolic extracts ranged between 31.2 and 62.5 µg/mL and 62.5 and 125 µg/mL, respectively, comparable with fluconazole (as a reference antimycotic). This study suggests that Moroccan propolis (31.2 and 125 µg/mL) may be an important source of bioactive molecules with anticandidal activity. Propolis may be a promising naturally-occurring candidate for the development of antimycotic drugs.

Keywords: antioxidant activity, propolis, total flavonoids, total polyphenols, vulvovaginal candidiasis.

Antioxidant potential of different honey varieties compared to BONUM HONEY

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Antioxidant potential of different honey varieties compared to BONUM HONEY

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Honey exhibits strong antioxidant potential. Several chemical methods were used for determination honey antioxidant capacity (ABTS, FRAO, DPPH, ORAC, PCL assays).

The aim of the study was to evaluate the antioxidant potential of honey as an indicator of variety. Material for the study consisted of four honey varieties: nectar-honeydew, knotweed (*Polygonum L.*), manuka 550+, and BONUM HONEY with OPC Complex Plus(proanthocyanidins and essential oils complex) based on knotweed honey as a bee feed.

The total phenolics content (TPC) was determined through the Folin-Ciocalteu method. The content of condensed tannins was determined using the vanillin-HCl method. The antioxidant potential was investigated using ABTS, DPPH, and FRAP assays.

The content of total phenolics ranged from 43.1 mg gallic acid equivalents/100 g (nectar-honeydew) to 207.1 mg gallic acid equivalents/100 g (BONUM HONEY). The lowest result of ABTS assay was obtained for nectar-honeydew (108.5 µmol Trolox equivalents/100 g) and the highest for BONUM HONEY (1221 µmol Trolox equivalents/100 g). The same tendency was found for the results of FRAP assay (250.0 µmol Fe2+/100 g - nectar-honeydew; 2400 µmol Fe2+/100 g - BONUM HONEY) and DPPH assay (46.6 µmol Trolox equivalents/100 g - nectar-honeydew; 811 µmol Trolox equivalents/100 g - BONUM HONEY). The presence of condensed tannins (37.1 mg catechin equivalents/100 g) was confirmed for BONUM HONEY.

CONCLUSION: Application of APC COMPLEX PLUS as addition to bee feed increase very strong the honey antioxidant potential.

Keywords: honey, antioxidant potential, phenolics compounds, tannins, ABTS, FRAP, DPPH, OPC COMPLEX PLUS, BONUM HONEY.

Toxicological and antimicrobial evaluation of BONUM HONEY

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Toxicological and antimicrobial evaluation of BONUM HONEY

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Polish honey enriched in proanthocyanidins and essential oils (OPC COMPLEX PLUS) – “Bonum” was analyzed for its antibacterial and toxicological potential. Antimicrobial potential against five species: *E. coli* (n=3), *S. enterica* (n=3), *S. aureus* (n=3), *E. faecalis* (n=3) and *L. monocytogens* (n=3) were tested with microdilution method on 96-well plate with absorbance measurement. Toxicological evaluation were determined by repeated dose 28-day oral toxicity study on female Wistar rats based on Organization for Economic Co-operation and Development (OECD) guideline No. 407. Obtained results showed that 25% concentration of honey inhibited growth of gram-negative bacteria in range of 94.87%- 98.53%. Slightly lower inhibition against gram-positive (72.95%-92.22%) were observed. The highest average inhibition - 96.58% were noted against *E. coli* strains. The toxicological assessment of “Bonum” honey showed that its intragastric dosing of 0.17 g / kg b.w. for 28 days it did not cause adverse changes in the body of female rats. Investigated honey showed promising antimicrobial potential and is highly likely to be safe for consumers.

Influence of processing procedures on the antibacterial activity of bee pollen and propolis on some pathogenic bacterial strains

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BACKGROUND: Bee products are increasingly growing in interest among consumers due their already proven nutritional properties and biological effects. However, it is a known fact that some of them like bee collected pollen (fresh or dried) and propolis are not completely absorbed and digested to due to their structure (bee pollen) and composition (propolis) that lower bioavailability of some of their main compounds. Several processing methods have been proposed in order to increase their potential beneficial effects.

PURPOSE: to determine the antibacterial activity of fermented polyfloral pollen in SCOBY consortium, ultrasonic treated solution of fermented polyfloral pollen, brown propolis tincture and (hydro-ethanol extract) the ultrasonic treated tincture and dehydrated honey and 50% ethanol as blank solution.

MATERIALS-METHODS: bee pollen fermented in a SCOBY consortium in kombucha (fermented green or black tea), brown propolis, have been treated using ultrasound technology which can improve the fermentation of Kombucha culture and organoleptic characteristics, including the content of nutrients such as polyphenols, flavonoids and flavoring compounds. Powder honey was also tested. The prepared solutions were tested against some pathogenic bacteria: *Bacillus cereus*, *Salmonella typhimurium*, *Staphylococcus aureus* and *Escheria coli*.

Results and CONCLUSIONS: *B.cereus* was strongly inhibited by the propolis tincture both normal and ultrasonicated, fermented pollen and ultrasonicated solution of fermented pollen showed very strong inhibitory effects on *E. coli* while *Salmonella enterica* and *S.thyphimurium* were strongly inhibited by the same solutions as well as honey. *Pseudomonas aeruginosa* was not sensitive to any of the solutions. Although propolis is known for its strong antibacterial activity, it is possible that the level of ultrasound used could not yield the expected results. The results obtained for fermented floral pollen in SCOBY consortium are promising for extending the use of this new ingredient in keeping a balanced healthy condition of the human body.

Honey vinegar improves plasma antioxidant status and plasma lipids in mice

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BACKGROUND: Recently, an increasing interest is paid to bee products obtained as a result of the fermentation process. Some of them can be consumed directly (bee-collected pollen, honey, bee bread etc.), while others are the result of lactic and/or acid fermentation (honey vinegar and honey wine). As result of honey acetic acid fermentation, honey vinegar is obtained. The aim of this study was to assess the impact of honey vinegar consumption on plasma antioxidant status and lipid profiles in mice healthy.

METHODS: This study was conducted to evaluate the effects of water supplementation by honey vinegar on the plasma antioxidant status and lipid profiles in mice. A total of 20 mice were divided into four groups. Treatments were included: tap water with no honey vinegar (Control), and water containing 2.5, 5 or 7.5 ml/100 ml honey vinegar. Animals consumed a basal mice diet. The feeding and drinking was ad libitum for 60 days. Blood samples were analyzed for MDA levels and activities of superoxide dismutase (SOD), catalase (CAT) and glutathione peroxidase (GPx) and lipid profiles. Aroma compounds of honey vinegar were extracted by solid phase micro-extraction, separated, and analyzed by GC-MS.

RESULTS: Compounds were identified, including acids, esters, alcohols, aldehydes, ketones, phenols, and hydrocarbons. Mice receiving the water supplementation by honey vinegar exhibited higher (P<0.05) plasma activities of superoxide dismutase, catalase and glutathione peroxidase as well as lower (P<0.05) plasma levels of malondialdehyde compared with the control group (tap water with no honey vinegar). Also, animals receiving water supplementation by honey vinegar had lower (P<0.05) plasma levels of triglycerides, total cholesterol, and LDL-cholesterol as well as higher (P<0.05) plasma levels of HDL-cholesterol compared with the mice in control group.

CONCLUSIONS: Our results suggest that water supplementation with honey vinegar could improve the antioxidant status and lipid profile of mice.

Gibberellic acid alters feed intake, morphology and vitellogenin (VG) gene expression in Africanized *Apis mellifera* bees

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The effects of adding gibberellic acid (GA3) on the performance, morphology and expression of the vitellogenin (VG) gene in Africanized “*Apis mellifera*” were evaluated in this study. For this purpose, newly emerged workers were divided into 25 cages with an average population of 150 bees. A diet containing feed with different concentrations of GA3, water and sucrose solution was fed for seven days. There was a reduction in feed intake, combined with epithelial damage in the midgut, morphological changes in the enocytes and changes in the stages of the pericardial cells. However, this behavior did not follow a regular response when added higher concentrations of GA3 in the feed, denoting a possible detoxification capacity of this compound, depending on the concentration used. The results suggest that regardless of the concentration, this compound can cause cell damage in the intestine and fat body, in addition to reducing vitellogenin (VG) gene expression levels.

The permeability of cell cappings to gases, volatiles, pathogens and acaricides

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Honey combs are essential for the lives of bees. They serve as a place for bees to gather, as a telecommunication device, as a storage system for honey and pollen and as a safe microenvironment for rearing honey bee brood. All the pupal development occurs in the sealed space of the honey comb cells. As the developing bee metabolizes its nutrient stores it produces CO₂ and consumes oxygen. It is presumed that the lid of the capped cell is penetrable to gases so as the pupa can breathe but there is a scarce evidence of how this is achieved.

We compared the structure of the brood comb and honey comb cappings by electron microscopy and microphotography to detect any permeable pores present. We also compared the cap wax composition by GC/MS and we measured the diffusion coefficient for CO₂ with the LI-COR gas analyzer.

We show that the wax composition of cappings is very similar. However, bees must use a different technique to build the cappings. While there are no pores present in the cappings of sealed honey cells, there are many pores in the brood cell cappings, reaching between 10-40 µm in diameter. Such big pores are easily permeable to gases but potentially also to pathogenic bacteria or fungi. The diffusion coefficients we measured confirmed high permeability of brood cappings for CO₂. On the other hand, the honey cappings were nearly gas impermeable.

Our finding elucidate the different structures of the brood and honey cappings. Both are built from similar material but their permeability differ enormously in order to perform different functions in the colony. While honey cappings seal tightly the honey stores, the brood cappings allow communication of the developing larva with its environment. The pores in the brood cappings that we identified allow gas exchange in the comb cells, including the exchange of the pheromones and other volatiles present within the hive. Importantly, the pores could also be the points of entrance for pathogens and for chemical contaminants used by beekeepers to combat these pathogens.

What makes the royal jelly *Apis cerana koreana* different from *Apis mellifera ligustica* honey bees in water-soluble protein compositions?

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Royal jelly (RJ) is produced by the pharyngeal glands of the worker bees. It protects from diseases, determines the development rate of honey bee colonies, and stimulates the cell regeneration of other organisms. These functions are provided by a molecular composition, which includes proteins. However, we still don't have a good molecular understanding of the existence of these functions. Therefore, we focused on the water-soluble (WS) proteins of the RJ at the *Apis cerana koreana* and compared them with data of the *Apis mellifera ligustica* honey bees bred in the Republic of Korea. The analysis of the proteins in non-denatured (native) and denatured conditions was carried out by the native SDS PAGE, 2 DE methods. We investigate that the number of proteins RJ of *A. c. koreana* were lower at 34 % in denatured and at 5 % in native conditions than *A. m. ligustica*, which can contain the key differences in the biological function of RJ. So, this data supposed the less complexity of the structure of some proteins RJ *A. c. koreana* which could not split into parts by denatured treatment compared to *A. m. ligustica*. Next, LC-MS/MS analysis was done of the four spot locations on the gels after 2DE. The 54 proteins of RJ *A. c. koreana*, contained the 20 proteins found in the other animal species and honey bees, but they were not annotated as proteins of RJ. The last 14 proteins were detected in various animal species and were not found in the annotations of the honey bee proteins. According to their functions in the database NCBI, the newly detected proteins had an immune function of 14.7% of cases. Furthermore, in the NCBI and PDB databases, 63% of detected WS proteins were not annotated as RJ proteins. The RJ of two species of honey bees have different protection functions from infection due to the dissimilar protein compositions, studied in this research, probably by activating the diverse genes. This study highlighted unique protein characteristics that will aid future research into the molecular base of RJ protective activities that promote to implementation of human health products.

What we know so far and where to go further in the research of honey bee cellular immunity

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Nowadays, bee specific parasites, pathogens and pesticides used in the agriculture are endangering beekeeping, making great ecological and economical losses. Investigating the immune defense of the honey bee *Apis mellifera* is a key component to cure this issue. The immune system consists of humoral and cell-mediated responses. In the humoral responses soluble molecules are produced and organized into regulatory pathways. The effector cells of the cellular responses are the hemocytes, which phagocytose microorganisms, form capsules around large intruders in the haemocoel, produce matrix proteins and AMPs. As a eusocial insect bee immunity also contains communal defense mechanisms, like grooming, hygienic behavior or the use of antimicrobial materials for nest construction, thus their immune system may have special elements.

In the beginning of investigating the field the effector cells of the cellular immunity were distinguished by basic morphological, lectin binding and functional characteristics in microscopic and flow cytometric experiments. Later on, monoclonal antibodies were produced and in combination with functional tests three main blood cell classes were identified. The phagocytosing granulocytes eliminate the microorganisms. The oenocytes are melanizing cells secreting prophenoloxidase (AmPPO), which initiates the melanization cascade. The plasmatocytes are involved in aggregation of the haemolymph and produce the Hemolymph (AmHml), which has human von Willebrand factor homology domains characteristic for proteins involved in coagulation and platelet aggregation. In the past few years it even became available to test the immune cells in an ex vivo cell culturing system. With the help of these techniques the researchers could identify differences in the composition of blood cell populations according to development, different infections and even upon neonicotinoid treatment, which underlines the importance of the cellular immune responses.

However, the comparative analysis of the eusocial honey bee and the solitary *Drosophila melanogaster* cellular immune reactions reveals significant differences between these two species, highlighting the complexity of social organisms' defense barriers.

Improving the available and so far, undiscovered toolkits in the research of honey bee cellular immunity will help us to better understand the immune system and defense reactions against the harmful effects leading to colony losses. Support comes from the Hungarian Beekeepers Association.

Determination Of Genetic Variation Using Morphological Methods in the Local Honey Bee (*Apis mellifera*) Breed in Hatay Province

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Genetic differences or similarities in honey bees are made by morphological or morphometric measurements. In this study, honey bees, which are common in Hatay province, were identified by morphological methods. Morphological characterization of 41 characters in 15 worker bees of each colony, taken from a total of 40 colonies representing the bee populations determined in Kırıkhan, Yayladağı, Altınözü, Reyhanlı and İskenderun districts of Hatay Province, was performed.

Significant differences were determined between the morphological features of the bee genotype of Hatay province in the experiment, in terms of many characters. When the values were obtained from the districts, compared with Duncan multiple comparison test in terms of morphological characters, hair length, fourth tergum (bright background) width, tomentum index, tongue length, femur length, tibia length, hind leg length, third tergite width, fourth tergite width, body size, third sternite width, distance between wax mirrors, sixth sternite length, wing length, wing width, cubital a wing vein length, cubital index, N23. J10. K19, D7, E9, G12. J16 and O26 wing vein angles, second tergite color, third tergite color, fourth tergite color and scutellum color, fourth tergum (felt band) width, metatarsus length, metatarsus width, metatarsal index, wax mirror length, wax mirror width, sixth sternite width, cubital b wing, vessel length different from each other at 1% significance level (P<0.01), B4 and L13 wing vein angles were different from each other at 5 % significance level (P<0.05, P>0.01), while, sixth sternum index and A4 wing vein angles were similar to each other (P>0.05).

In the study, it was also determined where the bee samples were located in the coordinate system in terms of morphological structure with Canonical Discriminant mapping. When the coordinate system is examined, it is seen that the samples taken from Kırıkhan and Reyhanlı districts are clustered close to each other, Yayladağı, Iskenderun and Altınözü are located close to each other in a separate place.

Bee farm

Catherine Flurin
Apitherapist, Reasearcher, Beekeeper and Founder of Ballot-Flurin company

In the Pyrenees in the south of France near Spain, we are fortunate to have more unspoiled areas than in other parts of Europe; the mountains and forests offer abundant nature for our bees. At the same time, much of the region is or has been used for extensive commercial agriculture, often contaminating areas used for human habitation. This leaves gaps where there should be life. To counter this, Ballot-Flurin Beekeepers have developed a site called the Free Bee Farm, the first in the world, which recreates the natural microbiome previously lost to human usurpation. This differs from rewilding in that the goal is to reconnect humans with the land and the bees, rather than further isolating ourselves. To overcome the inherent tendency toward protective separation, we have developed plant and land management techniques that allow the creation of communities based on symbiotic needs, rather than reinforcing the space between us. Danielle Heijboer, researcher, beekeeper, and agronomist will present our site with photos and diagrams as it exists today, where we are going, and how we can recreate the same concept in different ecological zones.

She will present the forests and meadows that feed the bees. As well as sanctuaries left wild. Soils are regenerated through agronomic techniques such as permaculture, biodynamics and syntropic plantings. Bees and other pollinating insects find all the necessary conditions to face climate change.

Beekeeping and geobiology

Catherine Flurin

Apitherapist, Reasearcher, Beekeeper and Founder of Ballot-Flurin company

Man has always tended to orient things towards practicality in the most basic sense: the simplest physical ways, the easiest facilities, systems that attenuate thought to create unreflective ways. However, by focusing on this accessibility more than anything else, we have filled our society with things that forget the flows and energies of nature, replacing them instead with materials and processes that help us above all else. In beekeeping, this can be particularly destructive, as the sensitivities of the living hive are still a mystery to most people. It is therefore crucial to learn the intrinsic nuances of the spaces and materials used in beekeeping, in order to better understand how to provide complete support to each colony. Olivier Raud will present his work on hive and wood polarity, energetic positioning and environmental flow, and their link to conscious beekeeping.

Through concrete examples and photos, he will show how to place hives in a space by detecting the precise location of underground water networks and faults to form a coherent whole and make the bees more resistant and productive. He will explain how the wood of the hive can be assembled according to the natural magnetic fields contained in the material for a noble habitat that gives the bees their sacredness. He will also explain how he has created toroids to house bees and humans in the same space and thus promote inter-species connection.

This work is now highly regarded as the cutting edge of geological science.

Olivier Raud, beekeeper, researcher and master of feng shui, CEO of the company Ballot Flurin

The complete mitochondrial genome analysis of *Apis mellifera jemenitica* from Saudi Arabia

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The complete mitochondrial genome analysis of the Arabian Honeybee *Apis mellifera jemenitica* from Saudi Arabia has been characterized for 142 samples, twenty out of them were collected from feral mountainous colonies within Alhijaz region (Almadinal almunawarh and Tabuk), the rest of the samples were collected from non-migratory apiaries. Prior to mtDNA sequencing, all samples were morphometrically identified and 132 samples were characterized as *A. m. jemenitica*. Genomes ranged from 16,352 to 16,445 bp, Each comprising 13 protein-coding genes, 22 transfer RNAs, two ribosomal RNAs, and one control region. Based on analysis of coding regions results revealed 14 new mitogenomic haplotypes (MT745900-915) of the Arabian honeybee from Saudi Arabia, and 32 new haplotypes for non-coding intergenic region (P and Q elements) (MT704140 - MT704171). The highest intra-subspecies variation was reported in ND5 and Cytob genes, while the lowest intra-subspecies variation was in COII, ATP8, ND4 and ND3 genes. Phylogenetic analysis of the mitogenomes revealed 3 distinct haplogroups with a valid geographical correlation. Mitogenomes were very closely related to *A. m. syriaca*, *A. m. lamarckii*. Results of this project could be used in local honeybee preservation plans within Saudi Arabia.

Development of an effective pretreatment method for the isolation and enrichment of honey enzymes using pine honey and the hypopharyngeal glands of *Apis mellifera* L

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A versatile sample pretreatment method for the honey matrix is still needed for any proteomic-based investigations. Invertase and diastase are the most important enzymes in the maturation of pine honey and the origins of these enzymes are attributed to the bee's hypopharyngeal glands (HPG). In our study, we aimed to isolate and enrich these enzymes as model proteins representing the honey proteome in an efficient and practical way. As authenticity comparison, isolating the same enzymes from HPG samples was also accomplished. For yielding pine honey crude protein isolate, as a tandem two-step approach, stirred cell ultrafiltration followed by centrifugal ultrafiltration (CUF) protocol was determined after experimental optimization. HPGs were dissected from the *Apis mellifera* L. and proteins were extracted by using a bead beater followed by concentration using CUF. Protein profiles of pine honey and HPG were compared by SDS-PAGE. The resulting protein concentrations, enzyme activities, and the cleaning efficiencies of the applied techniques were evaluated and optimized using the Bradford assay, modified enzyme activity assays, and sugar profiling method developed at HPLC-RID. The novel pretreatment method provided invertase at 1055.1 U/kg activity and diastase at 693.3 Shade U/g activity with yields of 900.9% and 2432.6%, respectively. The final crude protein isolate can be interpreted as reference material at any authenticity and quality assays of honey. The obtained crude protein extract will pave the way for high throughput proteomic investigations at the honey matrix. Furthermore, this template methodology could be scaled up in the industry for natural enzyme production.

Therapeutic properties of *Apis florea* honey on *Helicobacter pylori*

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Helicobacter pylori is a major cause of gastrointestinal cancer in Iranian men. The existing methods in the treatment of this bacteria have not been very effective, so finding effective methods in controlling this species is very important. Honey is a natural food product that has been proven to have antimicrobial properties against a wide range of pathogens. The purpose of this study was to compare the antimicrobial activity of 15 *Apis florea* honey samples collected from different floral and geographical origins against *H. pylori*. The antioxidant activity of honey samples was measured through FRAP, DPPH, and ABTS methods. In addition, antibacterial activities were assessed by in vitro and in vivo studies in gastrointestinal tract of mice. Statistical analysis exhibited that there was a significant positive correlation between antioxidant and antimicrobial activities in the honey samples. In vitro evaluation revealed that all samples had antimicrobial activities especially jujube honey from Bushehr. The differences in antioxidant and antimicrobial activities observed among honey samples were most likely related to plants flora and also geographical regions differences which honey samples were collected. Obtained results clearly indicated that the *A. florea* honey especially jujube honey had a high ability to prevent and cure infection and inflammation in the gastrointestinal tract caused by *H. pylori* bacteria and along with other available methods, can be used in *H. pylori* control.

Deformed wing virus infection affects the neurological function of *Apis mellifera* by altering extracellular adenosine signaling

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Deformed wing virus (DWV) infection is believed to be closely associated with colony losses of honeybee (*Apis mellifera*) due to reduced learning and memory of infected bees. The adenosine (Ado) pathway is important for maintaining immunity and memory function in animals, and it enhances antiviral responses by regulating carbohydrate metabolism in insects. Nevertheless, its effect on the memory of invertebrates is not yet clear. This study investigated how the Ado pathway regulates energy metabolism and memory in honeybees following DWV infection. Decreased Ado receptor (Ado-R) expression in the brain of infected bees resulted in a carbohydrate imbalance as well as impairments of glutamate-glutamine (Glu-Gln) cycle and long-term memory. Dietary supplementation with Ado not only increased the brain energy metabolism but also rescued long-term memory loss by up-regulating the expression of memory-related genes. The present study demonstrated the regulation of the Ado pathway upon DWV infection and provides insights into the mechanisms underlying energy regulation and the neurological function of honeybees.

Performance evaluation of 14th- 18th generations of Iranian honeybee (*Apis mellifera meda*) bred queens and their comparison with control queens in different private apiaries of Iran

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During recent years' climate change have affected the world beekeeping industry, in Iran, in addition to dust phenomenon, disrupting rainfall, temperature and beekeeping season, and the economic crisis due to sanctions, problems in marketing and export of honey, beekeepers' access to improved queens is a necessity of sustainable Beekeeping. The current study was aimed to evaluate the performance of the 14th - 18th generations of breeding improved queens in Iranian Honey Bee Breeding Program, and their comparison with control queens kept in private apiaries. To evaluate the queens, specific questionnaires were designed and completed by beekeepers in their apiaries based on the performance of queens in private apiaries. Obtained results showed that the improved queens had better performance than control queens in terms of swarming and honey production ($P < 0.05$), aggressive and calmness behavior ($p < 0.01$) in comparison of control queens in private apiaries. According to the results of variance analysis, the effect of queen type (bred queen and control queen of beekeepers) on calmness, aggressive, swarming behavior and honey production were significant but had no effect on overwintering. The obtained results and desirable improvement of calmness, aggressiveness, swarming behavior and honey production, showed that to protect the Iranian honeybee as a valuable genetic resource, while preserving the superiority of genetically improved queens and genetic stabilization of improved traits, prevention of sex alleles homozygosity which have direct effect on decreasing colonies performance, additional novel investigations against new problems of beekeeping industry are required.

Infertility of Varroa destructor and Iranian honeybee (*Apis mellifera meda*)

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In the present study, the infertility of Varroa mite were compared in resistant (VSH) and control colonies of Iranian honey bee in Animal Science Research Institute of Iran. One frame from each experimental colonies (16 treatment and 16 control colonies) containing about 400 larvae cells randomly transferred to natural Varroa- infected colonies for 48 hours to get infected. After capping the cells, the infected frame removed back to the experimental colonies. Then, a number of 200 cells were uncapped at two days of 0 and 10. At each stage, infection rate, the percentage of fertile mites, the percentage of infertile mites, the number of cells containing mite eggs, the number of protonymphs and deutonymphs were counted. The percentage of infestation in resistant and control colonies were 6.2 ± 0.9 and 10.9 ± 1.2 respectively showing a significant difference between the groups ($p < 0.05$). Moreover, 56.3 % of the resistant colonies and 37.50% of the control colonies showed hygienic behavior (VHS). Resistant colonies showed hygienic behavior (VHS) regarding the removal of infected pupas compared to control colonies and reducing the infection in colonies. The total mean of infertility in resistant and control colonies are 1.4 ± 0.4 , 1.1 ± 0.3 respectively. The total mean of eggs, protonymphs and deutonymphs in resistant and control colonies were respectively 0.06 ± 0.01 , 1.3 ± 0.4 , 2.6 ± 0.8 and 0.2 ± 0.03 , 3.1 ± 0.8 and 4.6 ± 1 . Finding suggest that VSH behavior in adult bees reduces the rate infection to Varroa in pupas.

Comparison of Improved and Control Iranian Honeybee (*Apis mellifera meda*) Queens in Qazvin Apiaries

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Taking advantage from genetically modified queens that have desirable productive traits and behavior is an important factor in beekeeping. The current study was aimed to evaluate the performance of breeding improved queens in Iranian Honeybee Breeding Program, and to compare them with control queens kept in Qazvin apiaries. To evaluate the queens, specific questionnaires were designed and completed by beekeepers. The results showed that the breeding improved queens had better performance than control queens in terms of calmness, defensive behavior and overwintering in comparison to queens kept in private apiaries. In other words, the bred colonies were significantly different from control colonies ($P < 0.05$). According to the results, in spite of comparative advantage, there was no significant difference between the bred queens and control queens in terms of honey production and swarming. In general, the result of study showed the improvement of these traits and the superiority of the modified queens in compared to control queens in Qazvin province.

The color of honey

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Federal State Budgetary Scientific Institution Federal Scientific Centre of Beekeeping

In our country, beekeeping is an ancient trade and a favorite occupation of people, a profitable and entertaining business. Beekeeping as a branch is necessary in agriculture, as it produces important bee products for humans, such as honey, propolis, wax, bee venom, royal jelly, etc.

At the same time, consumers today face a number of problems in the market of natural honey. Studying the problems of improving the quality of beekeeping products requires a systematic and integrated approach, therefore, organoleptic (sensory) analysis makes it possible to have an idea of the naturalness of honey and be able to identify it, as well as timely detect its falsification. Knowledge of the physical characteristics of honey is an important success factor in its production (collection, processing, storage, crystallization and decrystallization). Let's consider one of their essential characteristics of honey-color. The color of honey is an important aspect for trade and in determining its final use.

Material for research there were 20 samples of natural honey collected in 2021 of various botanical origin, as well as various shades from transparent (like water) to dark.

The method for determining the chromaticity of honey is based on photometric measurement of the percentage of transmission of a beam of light, followed by identification of the intensity of honey coloring on the Pfund color scale. The studies were carried out using a photoelectric photometer KFK-3, a certain wavelength range from 420 nm to 560 nm was selected. In the literature there are data for determining the optical density of honey when using the photoelectrocolorimeter FEK-56M (Chepurnoy I. P.), which are consistent with our indicators when using KFK-3.

Based on the data obtained, it should be concluded that the coincidence of chromaticity in comparison with the Pfund scale gives a certain optical density on the KFK-3 photometer at a wavelength = 560 nm.

Peculiarities of hygiene of bees on the background of other biological signs

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Selection of bee colonies with the best hygienic behavior is a promising area of research, which should help improve the epizootic situation in apiaries, reduce material costs for their maintenance, intensify the production of organic products. As a result of research to determine the level of hygienic behavior of Ukrainian steppe bees, it was found that they are characterized by the removal of 76.8 ± 2.9 (lim 68-100) damaged larvae in 24 hours. This indicator was optimal for bees of families of the original group. Bees selected for improved hygienic behavior removed 22% more damaged brood. The bees cleaned the cells most intensively in the first 12 hours (77-78% of dead larvae were removed). The established time interval is predicted to be optimal for assessing the hygienic behavior of bee colonies.

Last year's seasonal gross health productivity averaged 44 ± 0.81 kg per family. The rate is not very high, but within the total sample of apiaries (277 families) selected families with more hygienic bees in terms of productivity by 25.5% exceed the average apiary rates. Reconstruction of honeycombs by selected bees of the Ukrainian steppe breed with high hygienic behavior is 15.9 ± 0.19 on average per family. This is almost 34% more than the apiary average. The difference between the rates of bee infestation of varroa in experimental families is an important and significant result. In May last year, it was between the original and selection groups - 11%, in July - 20% in favor of the selection group compared to the original group. According to the results of the study, it can be assumed that the reduction of apiary infestation by Varroa destructor mites is possible provided that bee colonies with a high level of sanitation are kept. Since bees prone to thorough cleaning of their nests are able to actively remove the source of infection, thereby restraining the rate of spread of infection, so breeding and breeding work aimed at identifying, maintaining and improving hygienic bees is advisable.

PP-059 [Bee Biology]

“Progen” probiotic specific to honey bees

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Probiotics are living organisms that are eaten with the aim of altering the gut microbiota. The honey bee gut microbiota is composed of a wide range of bacteria, including multiple lactic acid bacteria (LAB) of the genus *Lactobacillus*, *Enterococcus*, as well as bacteria of the genus *Bifidobacterium*. Intestinal microbiota protects honey bees against pathogenic infections by lowering pH, competing with pathogens for nutrients and space, and producing organic acids, antimicrobial peptides (AMPs), and bacteriocins. Therefore, feeding on these bacteria and strengthening this community of microorganisms through supplementation with probiotics, in addition to helping to increase digestion and absorption of food, increase population and bee production, help prevent or treat microbial imbalances caused by disease or antibiotics. “Progen” is the first probiotic specific to bees in Iran and is licensed by the Veterinary Organization of Iran and is composed of bacteria of the genus *Lactobacillus*, *Enterococcus* and *Bifidobacterium*. According to field studies, “Progen” in increasing population, honey production and reducing the number of *N. ceranae* spores. Also play an important role in increasing the lifespan of bees.

PP-062 [Bee Biology]

Systemic aspects of breeding

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The bee species *Apis mellifera* *rossimai* is widespread and recommended for use in Ukraine. The range of Ukrainian steppe bees covers a large area of the Steppe and Forest-Steppe of Ukraine with their characteristic features of natural and climatic conditions. Systematic studies of *Apis mellifera* *rossimai* have been conducted since 1975. The first stage of selection work was to obtain lines of bees on the basis of purebred breeding, the maximum use of their genetic characteristics to achieve the greatest economic effect. An express method for assessing the breeding qualities of record-breaking families, ways to increase honey and wax productivity of families have been developed and introduced into production, 8 lines of Ukrainian steppe bees have been selected. From 1990 to 2014, intra-breed types Novoukrainsky and Sagaidatsky were created. Selection to improve hygienic behavior in bees is a promising area of research. As a result of ten years of work, a high percentage of bee colonies has been cleaned. Selected bees of the Ukrainian steppe breed are able to completely remove damaged brood from nesting hives in 12 hours. Steady transfer of properties for several generations, stabilization of indicators of hygienic behavior testify to the positive influence of selection on this basis. Carrying out further research using classical methods of purebred breeding: mass and individual selection, reproduction of bee colonies with the required biological characteristics, provided an opportunity to develop a target standard of intra-breed type “Hadyatsky” Ukrainian steppe bees with high sanitation. Its characteristics include the following indicators of economic, useful, behavioral and anatomical features: - productivity per family of bees: honey - more than 50 kg, reconstruction of honeycombs - 8-12 pieces; strength of bee families before the main honey harvest (mid-June) - more than 18 frames (435x300 frame); egg production of queens - more than 1800 eggs per day; winter hardiness - weakening up to 15%; peacefulness - typical of the breed; fertility - typical for the breed; exterior indicators - typical for the breed; hygienic behavior - enhanced by 15-20%. Typical removal of 90-100 damaged brood pupae from cells in 24 hours.

PP-063 [Bee Biology]

Fifty shades of grey in Carniolan honey bee population

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The Carniolan honey bee (*Apis mellifera carnica*) was first described as a subspecies on the territory of nowadays Slovenia at the end of the 19th century. However, its native range includes the north-western part of the Balkan peninsula and the eastern part of the Alps, bordering with the areal of *A. m. ligustica* on its south-western side. Slovenia’s SW edge thus is putatively within a contact zone between these two subspecies, where a certain degree of hybridization might be expected.

One of the most prominent morphological characteristics of Carniolan honey bees is the distinct grey coloration of the abdomen. Slovenian beekeepers assume that workers with yellow abdominal tergites are hybrids with Italian honey bees (*A.m.ligustica*) whose workers have yellow abdomens. However, there is no scientific evidence to confirm this claim. To clarify this question, we genotyped 424 individual worker bees of *A. m. ligustica* and *A.m.carnica*, of mixed origin, and with varying abdominal pigmentation, using a 4400 SNP array. To acquire the full range of variation, we collected worker samples from all over Slovenia, Croatia, Hungary, Bosnia and Hercegovina, and Montenegro and obtained reference *A. m. ligustica* material from central Italy. We sampled individual grey and yellow workers from colonies in which a fraction of workers exhibited yellow coloration. We also sampled grey workers from colonies without yellow workers. For each genotyped sample we also assessed the abdominal coloration on the scale from 1 to 4. When plotting first two principal components, we saw a clear separation of Italian honey bees from Carniolan honey bees. We also saw stratification within the Carniolan honey bee population. Plotting first and fifth principal component, we observed samples of Carniolan honey bees separated by the color grade. We will use the obtained SNP data and information associating genomic data to the coloration levels for further investigations of introgression levels of Italian honey bees into Carniolan honey bees. We will also evaluate the reliability of coloration as an indicator of introgression.

PP-064 [Bee Biology]

Immunity And Physiology Of Mixed-Aged Worker Bees (*Apis mellifera carnica*, Pollm. 1879) Fed Protein Candies

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The protein substitutes and pollen supplements, including several home-made and commercial candies with additives (pollen, protein, vitamins etc.) are used in beekeeping operations to supplement honey bee colonies in early spring and during the lack of natural sources in late summer. In order to assess immunological changes and physiological properties, we will establish series of experiments to feed spring and summer worker bees of known age with different candies in cages. Besides survival and consumption, the weight of head (food-glands development) and midgut histological changes will be conducted. We will collect haemolymph and analyse protein and sugar contents. Our previous trials with syrups and sugar candies that were fed same-aged bees resulted in different effects on worker physiology and survival. We hypothesize that the addition of pollen or protein in bee feed can increase immunity parameters and survival in caged bees. However, the additives could affect the bees’ physiological status and/or shape immunological responses differently concerning the age and tasks of bees. From this aspect we aim to find differences in groups of mixed-aged bees in comparison to same-aged bees in laboratory conditions.

PP-070 [Bee Biology]

Analysis of Slovak population of Carniolan honeybee by whole-genome sequencing technology

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The Carniolan honeybee is considered to be an indigenous Slovak subspecies with original range of distribution covering southeastern Alps, the northern Balkans and the Danube basin. For a comprehensive assessment of genetic diversity, sampling was carried out in 7 approved breeding stations in Slovakia and one isolated feral colony without human intervention. The Slovak population of the Carniolan bee has been studied only via microsatellites or morphometric methods, whole-genome sequencing technology aligned to the reference *Amel.HAv3.1* is used for the first time here. Analysis of structural variants (SVs) and subsequent analysis of their density distribution described on individual chromosomes was performed in BreakDancer 1.4.4. Copy-number variation was calculated for all lines in CNVnator V0.3 and annotated in ANNOVAR. The results of the analysis of genome-wide variance showed that one of the studied lineages (HB-04) showed a major difference in the region of chromosome 11 in which mainly in the LOC724287 region there were major differences in the formation of variability compared to other lineages studied in Slovakia. The identified variable region shows variability in the gene *Romboid*, which acts as a membrane receptor probably responsible for social behaviour. Study was supported by the Operational Programme Integrated Infrastructure within the project: Sustainable smart farming systems taking into account the future challenges 313011W112, cofinanced by the European Regional Development Fund.

Benefits and functions of the bee gut microbiome

Waldan Kwong

Instituto Gulbenkian De Ciencia

Social bees, including honey bees and bumble bees, harbour a highly specialized and conserved gut microbial community. Over the past 10 years, we have been working to discover the composition, function, and benefits to the host of these microbes. Here, I will highlight previous milestones in this work, and outline future directions where we are taking this new model system. I will describe projects currently underway that use cutting-edge “-omics” technologies to probe the relationship between bees and their microbes. For instance, we are using proteomics to identify secreted proteins of the bee microbiome which may be involved in mediating bacterial interactions. We will also perform single-cell transcriptomics to identify the cell types in the bee gut and to characterize the types that respond to the presence of the microbiome. I will also outline how our work integrates findings across scales, to understand not only the mechanistic basis of microbial interactions, but also how they evolve and vary across host populations, by using metagenomics approaches to both taxonomically and functionally describe the composition of the gut microbiome.

Foraging activities of stingless bee, *Tetragonula pagdeni* on rose flower, *Rosa damascena* Mill

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As demand for stingless bee honey is increasing, meliponiculture is getting more interest. The availability of nectar and pollen resources has been considered as one of key factor of meliponiculture success. Here we present the foraging behaviour of *Tetragonula pagdeni* on rose, *Rosa damascena* as a potential floral resources. The number of forager bees leaving from and returning to the colonies were recorded from 06:00-17:00 h. Observations of forager activity were recorded from the areas planted. Five x 1 m² quadrates of 3 orchards were sampled and the number of foragers counted for 1 min, at 15 min intervals, from 06:00-17:00 h. Quadrates were randomly selected for each observation interval. *T. pagdeni* foragers became active around 06:15 h at rose flowers. Flight activity reach peaked between 07:30-09:00 h and continued foraging but at a lower rate. The mean number of foragers was 9 ±8.50 individuals m² quadrate per 15 min observation interval period with a range of 0-21 individuals. However, there was gradually decreased in the number of honeybees in the afternoon, this was significantly different. *T. pagdeni* forager only active on *R. damascena* in morning and far fewer forager bees visited flower after 12.00 hr of the day. The use of *Rosa damascena* for landscape design for meliponiculture has suggested and discussed.

Complete mitochondrial genome of Carniolan honeybee (*Apis mellifera carnica*) from Slovenia and insight into phylogenetic relationships based on complete mitochondrial sequences

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Apis mellifera carnica, the Carniolan honeybee, is native to southern Central Europe and parts of the Balkans, with the locus *classicus* in Slovenia. It is also widely popular with beekeepers in parts of Central and Northern Europe and other parts of the world, including the USA, Canada, and New Zealand. In Slovenia, *A. m. carnica* is protected by measures to conserve the subspecies' autochthonous domestic population in place.

We sequenced and annotated the complete mitochondrial genome of a specimen from Slovenia. The complete mitochondrial genome was acquired in two contigs from WGS data and annotated. The newly obtained mitochondrial genome is a circular closed loop of 16,447 bp. It comprises 37 genes (13 protein coding genes, 22 tRNA genes, and 2 rRNA genes) and an AT-rich control region. The order of the tRNA genes resembles the order characteristic of *A. mellifera*. This is the first completely covered mitogenomic sequence obtained from a specimen from the native Carniolan honeybee area, where the *Apis mellifera carnica* population is legally protected, and measures are applied to minimise the anthropogenic

gene flow of this subspecies from abroad, as well as the presence of hybrids and non-native subspecies. The sequence was deposited into GenBank repository under accession number MW811175 and included into NCBI Reference Sequence database (RefSeq) under the accession number NC_061380.1.

The comparison with previously published sample of *A. m. carnica* from Austria and the closely related Italian honeybee *A. m. ligustica* show several features unique to the new mitochondrial genome. We also analyzed phylogenetic relationship between our sequence and other publicly available *A. mellifera* mitochondrial sequences. The acquired placement of the sequenced *A. m. carnica* from Slovenia on the phylogenetic tree deviates from the expected position and brings new evidence for close relationships among C and O lineages and reflects their recent historical matrilineal ancestry. Such genomic information is essential for this local subspecies' conservation and preservation as well as its future breeding and selection.

Grooming behavior in the Iranian, Carniolan and hybrid bees

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There is much ongoing research on honey bees over the last 100 years, mainly due to vital role of honey bees in our society, especially in agriculture, economics, food security, medicine and even computing technologies. Our knowledge is growing faster than our ability to absorb it. Low reproduction level and inefficient production of Iranian colonies, resulted in importation of a variety honey bee breeds. The most common and prominent honey bee species in Iran is the western honey bee, *Apis mellifera*, which includes the Iranian honey bee, Carniolan and Iranian×Carniolan hybrids. The objective of this study was to identify effects of crossbreeding on the grooming behavior in the Iranian (*Apis mellifera meda*) bees. In the beginning of March 2021(the end of wintering season of colonies), eight colonies of each three bee breeds were selected randomly and uniformed based on the honey and pollen storages, number of brood frames, initial population and type of the hives (Langstroth hive). The tested colonies did not receive any chemical treatments during the experiment period. Data collection and recording of egg-laying rate and brood rearing were performed weekly during the spring 2021 at the Honey Bee Research Centre, University of Kurdistan, Sanandaj, Iran (35.27788; 46.99562). Results indicated that Carniolan (*Apis mellifera carnica*) bees exhibited proper and favorable performance for grooming behavior, significantly(p<0.05). However, hybrid bees were more efficient in comparison of indigenous bee, indicated positive heterosis of crosses and complementarity between breeds. It is clear that grooming behavior could improve pest and disease resistance of the colonies. Controlled use of the higher performance lines in terms of pure or hybrid types, will improve the efficiency of the honey bee colonies and recommended.

Attraction of primary and secondary swarms by spray and cream applications of advanced attractive lures

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Swarming control is a topic of major importance for beekeepers worldwide. Many techniques and manipulations have been applied for the limitation of swarming tendencies by colonies and, more importantly, for attracting and catching swarms after their departure from an apiary.

In order to test different modes of application for swarm attractants, experiments were conducted in Spring 2022 at the area of Chalkidiki, Greece. An apiary of 90 healthy colonies, placed in 3 rows of 30 colonies each was used. For the attraction of swarms, three different products were prepared by the beekeeping equipment company ANEL: A paraffin jell (J) and two different sprays (S and SD). All applications contained a blend consisted of 18.75 mL of geranic acid, 28.75 mL of citral, 25 mL of geraniol and 1.25 mL of rose oil, diluted in 26.25 mL of pure ethanol. The SD spray contained the double dose of the blend. The products were conducted in 3 poles of 2m placed in front of each row of colonies (total of 9 poles at the apiary). Additionally, empty hives were placed also at the base of each pole, containing each attractant and an empty frame. The same number of empty hives and poles without lures (control) were also placed in front of colonies' rows.

A total of 81 swarms departed, consisted of 46 primary and 35 secondary swarms. Lures attracted a total of 75 swarms (93.83%) while only 5 swarms (6.17%) were found in control positions. The jell application was the most effective with a total of 69.13% attraction, followed by the double-dose spray (14.81%) and single-dose spray (9.87%). The jell also attracted significantly more primary and secondary swarms (80.43% and 54.28%, respectively). Trials showed that tested lures were very efficient on attracting bee swarms.

Breeding and Selection of Local Carniolan Manzala honeybee (Apis mellifera carnica) in respect to hygienic Abstract: ctHoneybee diseases are particularly important problem for beekeeping. Hygienic behavior (HB) of the honey bees is considered to be

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Breeding and Selection of Local Carniolan Manzala honeybee (Apis mellifera carnica) in respect to hygienic

ctHoneybee diseases are particularly important problem for beekeeping. Hygienic behavior (HB) of the honey bees is considered to be a potential characteristic associated with resistance to bee disease and many pathogens. With the present study, artificial selection for HB of honeybees of Manzala, Meet Salseel and Al-gamalea districts in Dakahlia governorate of Egypt was carried out. To determine the performance of HB of the bees in Manzala, Meet Salseel and Al-gamalea districts, pin-killing method was used for evaluation of the hygienic behavior of bees applied to 27 colonies. Observation were made of each of the following characters: number of capped cells, empty cell, punctured cells, uncapped cells, cells with brood partially removed. The frequencies of the various sequences of the characters were calculated for the hygienic colonies and non-hygienic colonies. According to the results, HB of these colonies were detected in 6, 12 and 24 h. The best performance in the HB of three colonies was observed and they were selected breeder queen for artificial insemination and natural mated. The results of this study Concerning the other 12 h after perforation the highest value (83.0) was found in colonies headed by queen produced Artificial insemination (second hybrid Mq carniolan queen from Manzala xNd carniolan drone from New valley). on the other hand, the lowest value (47.50) was found in local carniolan from New valley.

Hygiene of hive and beekeeper equipment, fight against varroa, support to increase productivity by improving queen bee and its colony and sharing our field studies with the participants in comparison with relevant international publications

Ahmet Emre Alp, Hızır İlyas Turna, Musa Hamarat
Beykoz Kimya Sanayi Anonim Şirketi, Istanbul, Turkey

First Part

Preventing colony losses and hive abandonment due to environmental factors threatening bee health, ensuring hygiene of honey, hive and beekeeping equipment, product studies, field applications of products and sharing comparative results with international publications.

Second Part

Varroa causes colony losses, therefore it increases the financial losses of investors and plays a role as a worrying factor in investments in beekeeping. It reduces the economic value of colony and bee products, which are exposed to the effects of chemicals used for precautionary purposes and their residues.

We will share field applications of Varroa control products and sharing comparative results with international publications with our participants in order to support organic beekeeping, prevent producer losses and ensure consumer safety.

Third Part

Sharing the comparative results with our participants with product studies, field applications and international publications used to increase the development of the queen bee and its support to the colony, to support the increase of bee brood, to increase the development of the colony, to increase immunity against diseases and to increase the life of the bee.

Developing the first national diagnosis of the drought impact on honey production in Chile

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Precipitation reduction in Chile is generating large changes in the environmental conditions for agriculture and reducing water supply in the most populated regions of Chile. The drought effects on apiculture have appeared in recent local media and in some technical studies. However, there is scarce scientific literature on the effects of the recent drought on honey production or beekeepers' response in Chile.

Gajardo-Rojas et al. (2022) carried out a primary diagnosis of the beekeeping situation during the mega-drought using information from 34 beekeepers, which is a small sample compare to the eight thousand beekeepers registered in Chile. The results of this primary diagnosis are alarming, honey production was reduced by up to 80% in some areas. This decrease in productivity reduced honey exports since 2010, accounting for the chain effect of the drought in the national environment and international markets. To face the drought, beekeepers have developed various adaptation actions and strategies across different geographical areas. These results have been helpful to inform discussions on adaptation practices of beekeeping to climate change in Chile within the National Beekeeping Commission and the Office of Agricultural Studies and Policies (ODEPA). These and other instances with beekeepers and public services have reinforced the importance of expanding and improving the diagnosis of the impact of drought on beekeeping at the national level. Identifying and describing productive impacts in each geographical area has been raised as an essential issue. Other relevant matters have been the evaluation of the implementation of adaptation practices and the regulatory and knowledge gaps or technological resources that exist in this area to face the drought. This national diagnosis would allow the development of concrete actions to support the sector.

As a response to this emergency, supporting by the National Agency of Research (ANID) in Chile, we are currently developing the first national diagnosis of the drought effect on the apiculture in Chile. In this context, here we will explain how we are developing it, our ongoing finding and challenges in the different geographical areas. We expect to share this information to create international networks to improve this diagnosis in Chile.

Generating Brood In Every Month

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Brood production is directly related to the level of nectar and pollen that bees are scavenging and bringing into the hive. Even if pollen and capped honey is stored in the hive, bees will not consume it if they cannot find any in their environment. We have to be sure they can either source those nutrients or we have to provide it artificially. Bees require the Pheromones from the queen laying eggs to begin consuming their nutrients, however, the queen will not lay eggs unless the hive has a surplus of their nutritional requirements to continue to support the egg production. If there is no pollen consumption, the bees stop producing royal jelly from their mandibular glands, and then the queen stops laying eggs, and then the eggs stop releasing Pheromones, and the Pheromones stop signalling the bees to consume more pollen. By supplementing the bees with pheromones, we can ensure they are consistently producing brood in every single month of the season. As a result, continuation of the brood production at end of the season will ensure young bees in the colony and will ensure higher survival rates in a cold winter or dry summer. This will consistently maintaining the health and population of the hives.

COLOSS 3.0: A Platform For Global Collaboration in Honey bee Science

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COLOSS (prevention of honey bee COLony LOSSes) is a non-profit association of scientific professionals dedicated to high quality of honey bee research and extension activities worldwide with the goal to improve the well-being of these pollinators. All researchers who support and work towards the missions of COLOSS are welcome to join the network. Due to a novel grant scheme, our association can now implement new activities and strengthen ongoing ones. These new activities include the creation of new Task Forces aiming at addressing the role of nutrition in bee health and at the mapping of honey bee diseases worldwide. As part of the continued effort to standardize methods of honey bee research, a new chapter on the invasive wasps *Vespa velutina* will soon complete the BEEBOOK and previous chapters are being updated. Moreover, a fourth Volume of the BEEBOOK on “Standard methods for *Apis cerana* research” has also been initiated. Our organization, through its outreach activities, has recently substantially been strengthened. In particular, fostering local activities, regular annual meetings in each member continent will supplement our annual general conference. These will be in addition to the regular and well attended COLOSS workshops and seminars. To further foster our global networking via participation at events, COLOSS travel or project awards will be bestowed each year primarily to early stage researchers, based on scientific excellence of the applicants.

An overview on recent developments including a COLOSS excellence award and network broadening will be given to further improve bee science and solutions in apiculture practices globally.

First proven case of resistance of the Tellian bee (*Apis mellifera intermissa*) to the Varroa parasite (*Varroa destructor*) in Algeria

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The parasite *Varroa destructor* presents a major harm to honey bee colonies. Its introduction in Algeria has caused serious damage in apiaries. Algerian beekeepers, like most beekeepers in the world, still use synthetic and/or natural products in their fight. Currently some bee populations of different races have developed resistance against *Varroa*, in several countries of the world. In Algeria, colonies of Tellian bees have survived more than 14 years without treatment. Thus, in 2006, a sedentary apiary of 175 colonies of Tellian bees was set up. The colonies did not receive any anti-varroa treatment, neither chemical nor biological, nor did they undergo any particular operation to limit the parasite population. Visits to the apiary were limited to feeding the colonies and harvesting honey when necessary. Between 2006 and 2016 there was a loss of 79.42% of colonies. The remaining colonies (n=36) are assumed to be resistant because they have not been treated

for more than a decade. The infestation rate of these colonies was regularly monitored and compared to other varroa-susceptible colonies (regularly treated with acaricides). During these observations, we recorded a lower varroa infestation rate than in the susceptible colonies. It seems that the survival of 20.6% of the flock over a long period of time (14 years), is probably due to resistance or tolerance to *Varroa*. Currently, Studies were conducted on these same colonies to understand the mechanisms of this resistance. The results showed that the grooming rate in these resistant colonies is ten (10) times higher than in susceptible colonies (Dadoun et al., 2020). Other unpublished results on hygienic behavior and Suppressed Mite Reproduction (SMR) also showed that these colonies have a more developed hygienic behavior than sensitive colonies. The SMR is 16 times higher than in susceptible colonies.

Prevalence of *Nosema* species infections in managed honey bees *Apis mellifera* in Northern provinces of Iran

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Nosemosis caused by the microsporidian parasites as *Nosema apis* and *Nosema ceranae* which is one of the most common diseases and has been associated with colony losses in several studies. It also has been considered as an important factor for high rate of colony losses in north area of Iran.

A total of 455 colonies from 97 apiaries located in north regions of Iran were sampled during the September-January,2021 to monitor the prevalence of nosemosis on managed honey bee colonies. In each apiary, a minimum of five colonies were randomly sampled. Each sample includes 100 adult bee which examined by microscopic, morphological and polymerase chain reaction (PCR) methods to detect the presence of *Nosema* spore. each sample includes 100 adult bees examined by microscopic and polymerase chain reaction (PCR) methods to detect the presence of *Nosema* spore. In order to estimation of infection intensity, spores were counted in positive samples by hemocytometer. and to estimate the intensity of infection by estimating spore counts in positive samples. The results of the microscopic examinations showed that 66% of apiaries were infected with *Nosema* spp. Based on the results, *Nosema* was detected in 173 (38.02%) of sampled colonies. The result of molecular and morphological methods showed that all positive samples were infected with *Nosema ceranae* that coincided with previous reports. It seems that *N. ceranae* has an important economic role in the occurrence of colony losses and decreased production for beekeepers.

Potential treatment from natural sources against nosemosis

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Honey bees (*Apis mellifera*) are pollinators of significant global economic value and are responsible for the pollination of many agriculturally and ecologically important crops. In recent decades, it has been reported that honey bee colonies have declined significantly in Europe and the United States. This decline is of increasing concern because of the critical role that honeybees play in feeding humans and livestock. Several environmental factors appear to be linked to this decline, such as pesticide exposure, environmental and migratory stress, and poor diet. In addition, parasitic and pathogenic infections also contribute to colony losses. Among the parasites, *Nosema ceranae*, an obligate intracellular microsporidian parasite, has been described as a key factor in bee mortality and has been correlated, in some cases, with colony losses. Currently, no treatment is available for nosemosis in Europe, and resistance to fumagillin (the antibiotic used in beekeeping) is frequently observed elsewhere. The research of our group has selected and evaluated different flavonoid compounds from plant extracts on nosemosis. Our preliminary data have shown that some compounds exert an anti-microsporidial activity in honey bees by reducing the spore load in the midgut and by increasing the survival rate of *N. ceranae*-infected bees. These natural molecules could therefore be considered as dietary supplements to improve bee health.

Effect of high protein diet on the develop of the hive and the honey production in warm and cold climates

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The aim of this study was to compare the effect of feeding with 15% of protein on the weigh of hive and the honey production in warm and cold climates.

The experimental study was carried out in two locations in Spain, Murcia (warm climate) and Soria (cold climate) from November 2019 to August 2020. Average temperature ranged between 1.8-17.9 °C in Soria and 11.7-24.7 °C in Murcia. Twenty hives were randomly placed in each climate; control group without feeding was made up by 8 hives whereas feeding group included 12 hives. These were fed with sugar paste, 15 % protein (yeast) and vitamins (B1, B2, B3, B4, B5, B6, C and K) from 27th November 2019 to stimulation time, two weeks before flowering. Stimulation during 2 weeks and using 2 kg Apimix® per hive, started on 11th February 2020 in warm climate and 21th March 2020 in cold climate. All hives were weighed before and after feeding and honey of each group was weighed after extraction.

Consumption of total protein was lower in warm climate (899 g) than in cold climate (2810 g), because of the flowering was later and the feeding time was longer in cold climate. The protein consumption/hive/week was higher in cold climate (11.2) than in warm climate (7.9) possibly by the same reason. After the feeding time, the weight of hives fed with high protein diet increased (1.02 kg) while the weight of control group decreased (4.98 kg) in cold climate. However, the weight of fed hives in warm climate decreased 2.15 kg although the decrease was less than in control group (4.92 kg). The control group didn't survival in cold climate and the honey couldn't be extracted. The honey production of fed hives in cold climate was higher, while there weren't significant differences between groups in the warm climate. In conclusion, the high protein diet is more effective in cold climate where the natural feeding is limited during long time due to harsh weather conditions.

Real-time monitoring of radioactive contamination of the environment through a complex system of interconnection between an intelligent device for detecting ionizing radiation and bees as biological sensors of environmental pollution

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The aim of this work was to design an intelligent, energy-efficient radioactive particle detector that interconnects silicon sensors and computer networks that process information about the presence and nature of ionizing radiation and send alert messages in the event of radioactive contamination with domestic bees as biosensors of environmental pollution, as future solutions based on artificial intelligence for environmental protection. The intelligent radioactive particle detector contains a local network of computers with ionizing radiation sensors (GM and SiPM), a weather micro-station module used to estimate the direction of movement of radioactive particles, a GPS module used to obtain information about the geographical location of the detector, a GSM module used to transmit alert messages in case of radioactive danger, a photovoltaic power supply module used to ensure energy autonomy. The local computer network is based on embedded Linux machine with ARM processors. Bees, as biological sensors of environmental contamination, are spread over large geographical areas, in 20-frames (440 x 340 mm) Layens hives and with a bee population of over 70,000 individuals. "This work was supported by a grant of the Romanian Ministry of Research and Innovation, CCCDI – UEFISCDI, project number 471/2020, within PNCDI III".

Prevalence and pathogen detection of Varroa and Tropilaelaps mites in Apis mellifera (Hymenoptera, Apidae) apiaries in South Korea

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The honey bee is an important pollinator of wild plants and crops and provides various useful products for humans. Infestations by honey bee mites damage the honey bees' health, decrease their lifespan, and increase their viral susceptibility. In this study, surveys were conducted throughout South Korea in 2019 to investigate the status of honey bee mite infestation. Mite samples were collected for species identification, and estimation of infestation levels from 47 apiaries in 12 regions was conducted. Mite species were identified by morphological characteristics and genetic analysis using cytochrome c oxidase subunit I (*COXI*). The results showed that 93.6% of the apiaries were infested by honey bee mites, of which 85.1% and 76.6% of the apiaries were infested by *Varroa* spp. and *Tropilaelaps* spp., respectively. Furthermore, 68.0% were co-infested by both honey bee mites. Additionally, 82.5% of the apiaries with *Varroa* spp. showed infestation rate with >3 mites per 100 bees, the infestation level could result in winter losses of honey bee colonies. Species identification revealed that all mites from the apiaries in South Korea were *Varroa destructor* and *Tropilaelaps mercedesae*. Importantly, these two mite species were determined to be vectors of one to nine honey bee pathogens in real-time polymerase chain reaction detection. The most prevalent pathogen was the deformed wing virus, followed by the Israeli acute paralysis virus and chronic bee paralysis virus. The results of the surveys are important for estimating the economic losses caused by honey bee mites and establishing a possible strategy for controlling mites and mite-borne transmissible pathogens in South Korea.

Prevalence of honey bee pathogens and parasites in South Korea: A five-year surveillance study from 2017 to 2021

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Honey bees play an important role in the pollination of crops and wild plants and provide important products to humans. Protecting honey bee colonies from parasites and pathogens is of great concern for researchers and beekeepers. A nationwide monitoring of 14 honey bee pathogens, including parasites (phorid flies, *Nosema ceranae*, and *Acarapis woodi* mites), viruses, bacteria, and fungal pathogens, were conducted from 2017 to 2021 in South Korea. The infection rate and the trend of development of each pathogenic agent were determined. A total of 830 honey bee samples from *Apis cerana* (n = 357) and *A. mellifera* (n = 473) were examined. *N. ceranae* (35.53%), deformed wing virus (52.63%), sacbrood virus (SBV) (52.63%), and black queen cell virus (55.26%) were the most prevalent honey bee pathogens, and their prevalences rapidly increased from 2017-2021. The prevalence of *Paenibacillus larvae*, Israeli acute paralysis virus, *Ascosphaera apis*, *A. woodi*, *Melissococcus plutonius*, and chronic bee paralysis virus remained stable during the surveillance period, with infection rates ranging from 5.26% to 16.45% in 2021. Other pathogens, including acute bee paralysis virus, phorid flies, Kashmir bee virus (KBV), and *Aspergillus flavus*, had low infection rates that gradually declined during the detection period. Of these, only *A. flavus* and KBV were detected in 2021, with infection rates of 0.66%. The development of honey bee pathogens peaked in July. SBV was the most common pathogen in *A. cerana*, whereas *N. ceranae* was predominant in *A. mellifera*. This study provides information regarding the current status of honey bee pathogens and presents the trend of the development of each pathogen in South Korea. These data are important for predicting outbreaks of honey bee diseases in South Korea.

Examination of Varroa destructor and Nosema spp. along with the detection of ABPV, CBPV and DWV-A in honeybees lost during the winter season 2020/2021 in Slovakia

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Examination of Varroa destructor and Nosema spp. along with the detection of ABPV, CBPV and DWV-A in honeybees lost during the winter season 2020/2021 in Slovakia Filipova M., State Veterinary and Food Institute, Slovak Beekeepers Association The main goal of this study was to determine the range of infestation or infection in dead bees by five selected pathogens and to consider how much the obtained results contributed to the beehive losses.

The Slovak beekeepers, who recognised large mortality or high weakness in their apiaries during the season 2020/2021, had possibility on voluntary basis to participate in presented study. Parasitic mite Varroa destructor and microsporidia Nosema spp. were examined by macroscopic and microscopic method respectively. Beside of them, presence of three bee viruses (ABPV, CBPV and DWV-A) was verified using semi-quantitative real-time RT-PCR and the incidence of which were expressed as negative or high (+++), mid (++) and low (+) positive. Sampling was done by beekeepers themselves with exact instructions from concerned diagnostic laboratory. For investigation, defined number of honeybees together with winter debris was required to be sent. In case of loss of more than one beehive per apiary the mixed sample was prepared (with the maximum of 25 beehives per sample).

Totally 50 beekeepers from different regions of Slovakia participated in this study. The mortality rate in their apiaries ranged from 7,41 to 100 %. V. destructor mite was presented in small or high numbers depending on whether or not the treatment was performed in the end of year. Spores of Nosema spp. were found in 25 samples. Regarding the viruses, ABPV was more frequently detected and in higher levels than CBPV (14, 20, 6 vs. 4, 5, 10 for high, mid and low level of positivity). Apart from it, DWV-A was absent in almost all samples. Two samples did not possess neither Nosema spp. spores nor RNA of tested viruses. The simultaneous presence of all searched pathogens occurred in one sample. The study will go on in the future and the goals will be supplemented by species discrimination of Nosema spp. together with DWV-B detection.

Investigation of Parasitic Diseases of Honeybees in Marmara Region of Turkey

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Honeybees are important for the development and maintenance of natural ecosystems in all of the countries. The aim of this study was to investigate parasitic diseases of Honeybees in Marmara Region of Turkey. Marmara is a region in northwest Turkey that connect Europe and Asia across the sea of Marmara. Varroasis and Nosemosis are huge factors in declining honeybee health and cause major losses to the beekeeping sector in this region.

Bee materials used in this study was selected from the samples submitted to Pendik Veterinary Control Institute. A total of 83 samples of dead bees were examined for parasitological analysis in Parasitology Laboratuvarı. Varroasis and Nosemosis were detected in 49.39% and 30.12% of samples respectively. No *Tropilaelaps* mite and *Aethina tumida* and *Acarapis woodi* were found in these samples.

Results of our study showed that Varroasis and Nosemosis are widely present in honeybees in this region. Diagnosis of these infections as early as possible and taking immediate action is a great importance for development of control strategies. In our opinions more field study and laboratory examination is still needed to clarify the status of honeybees parasitic infection in this region.

Investigation on different dietary supplements with the aim of Apis mellifera carnica pannonica health protection

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Prebiotics and probiotics are often used as feed supplements to maintain the health of various farm animals. Only a few studies have reported the use of pre/probiotics in the case of honeybees, and the effect was not always clear. In this study we investigated the effect of inulin (a commercial prebiotic) on the gut microbiota of the honeybee (*Apis mellifera carnica pannonica*).

Two colonies of equal strength per treatment were fed with sucrose syrup or inulin supplemented syrup at different dosages. Bee samples were collected at the beginning of the experiment and then every two weeks until the end of the study. To investigate the effects of feed supplements on intestinal microbiome the intestinal tracts of five bees per treatment were isolated and homogenised in 1% tripton containing saline. The colony forming units (CFU) of several microbial groups (total aerobic and lactic acid bacteria; and *Snodgrassella*, *Gilliamella* and *Frischella*; *Bifidobacterium*) were determined and the abundance of the bacterial communities were estimated using high-throughput sequencing on the Illumina MiSeq platform. We found that the inulin has no detectable effect on the composition of gut microbiome by culture based methods in the case of lactic acid bacteria, *Bifidobacterium* spp, *Snodgrassella*, *Gilliamella* and *Frischella* sp. The analysis of metagenome data also confirmed this RESULT: there was no significant difference in the intestinal microbiota composition of the treated and untreated groups. This result supports the hypothesis that commercially available pre- and probiotics may not be applied uniformly to all groups of animals.

Monitoring of environmental pollution using honey bees

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INSIGNIA-bee aimed to design and test a non-invasive, scientifically proven citizen science (CS) environmental monitoring protocol for detection of pesticides, and pollen diversity, using honey bee colonies.

Pesticide residues were fortnightly sampled non-invasively using the novel in-hive passive APIStrip, which were analyzed for residues of 307 authorized and unauthorized agricultural pesticides, veterinary products and varroa control products.

In nine countries: Austria, Belgium, Denmark, France, Greece, Ireland, Italy, Latvia and the UK, we found 174 different

compounds. Hives commonly contained one to four pesticides, with a range from zero to 19. By country, significant differences were found both between apiaries and over time. On average, 63% of the compounds were authorized, but 37% were unauthorized. This may have been due to unapproved use, but contamination of beeswax was also detected. Furthermore, the soil is a large archive of pesticides, and due to land disturbance, these compounds can be spread and released respectively. Possible other sources could be the drift of nanoparticles, water collection, or undefined. All this was recorded in the hive, and in eight of the nine countries, the most common compound was a varroacide.

Pollen was trapped for one day every two weeks, and was molecularly identified to family. The four most common families were consistent in the nine countries, together with 10 to 15 less important families which changed over time. The pesticide and pollen data, combined with Corine land use data and pan European weather reports were the input for a random forest model to predict exposure risks for pesticides and pollen diversity both spatially and temporally.

INSIGNIA-bee is being followed by INSIGNIA-EU which started in December 2021. In this new project the targets are not only pesticides and pollen diversity, but also: microplastics, and the air pollutants PAHs, VOCs, and heavy metals. Its outcome will provide the first standardized EU-wide monitoring of environmental pollutants using honey bee colonies, achieved through a pan European network of CS beekeepers, sampling their colonies and making a valuable contributing to science.

The INSIGNIA-bee guideline, together with scientific and popular articles and notes is available on the Insignia website www.insignia-bee.eu.

PP-100 [Bee Health]

Education Of Beekeepers For The Control Of Varroasis In Marmara Region Of Turkey

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Varroasis is considered to be one of the most common and dangerous diseases of honeybees in many parts of the world. Varroa are ectoparasites that feed on the hemolymph of immature and adult honeybees. Affected bees suffer reduced lifespans, impaired flight and navigation ability, and failure to return to the hive. One of the serious problems caused by Varroa is the transmission of viruses to honeybees which cause deadly diseases. Varroa mites cause significant damage on bee health, production of bee products, and pollination of plants.

Creating education and awareness activities is an important step in the development of beekeeping. In order to develop a better strategy for controlling of this parasite we organized education activities for the beekeepers with support of beekeepers association and also relevant regional veterinarians in 12 cities (Balıkesir, Bilecik, Bursa, Çanakkale, Düzce, Edirne, İstanbul, Kırklareli, Kocaeli, Sakarya, Tekirdağ, Yalova) in Marmara Region of Turkey in 2020. Detailed information about the biology of the Varroa mites and correct drug application at the right time against this mite was shared during meetings held. Effective varroasis control programs and collective struggle were explained and problems of beekeepers were discussed. In conclusion it is important that beekeepers develop skills and knowledge to manage honeybees effectively. We emphasized that these education activities were very beneficial for the beekeepers and further studies are needed for control of varroasis in this region.

PP-102 [Bee Health]

MEDIBEES: Monitoring the Mediterranean honeybee subspecies and their resilience to climate change for the improvement of sustainable agro-ecosystems

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Beekeeping provides subsistence to hundreds of thousands of beekeepers in the Mediterranean area. This activity is supported by a range of different native subspecies, adapted to highly diverse and harsh conditions of the region. Actions directed to the conservation of *A. mellifera* subspecies in the Mediterranean are expected to promote the quantity and quality of crops, increasing food availability in an efficient, cost-effective, and sustainable way.

Climate change is expected to increase the stress factors affecting the bees, especially in this region, reducing both pollination efficiency and production potential. Unfortunately, our ability to tackle this problem is limited by our incomplete understanding of the natural adaptation mechanisms developed by the different subspecies, and so the basic knowledge needed for future selection programs aiming to improve bee stocks for environmental changes. The MEDIBEES project includes 9 partners from 8 Mediterranean countries on the three Mediterranean shores, covering 10 local *A. mellifera* subspecies, which are a remarkable and poorly understood proportion of genetic diversity.

The project aims to: a) unravel the differential genetic background of the Mediterranean subspecies, b) understand their adaptation to the local conditions, and c) characterize their resilience to climate change. To reach the objectives, both phenotype of colonies belonging to local honey bee subspecies and environmental conditions will be studied by covering survival, sensitivity to pests/pathogens, behaviour, physiology, and reproduction using gene expression and transcriptomic assays. The whole genomes of the samples from field and laboratory assays will be sequenced for finding genes putatively implicated in adaptation and to develop new genetic tools to characterize the honey bee populations for their resilience to environmental stressors. This effort will encourage the use of local subspecies, hinder the import of foreign breeds, and establish the basis for future selection programs.

Besides, the valorization of honey by both promoting its use and developing Quality labels, and the evaluation of beekeeping by-products as modifiers of soil fertility and biota are also approached to help the beekeepers improve the sustainability of their farms in an economical and environmental sound manner.

This project is part of the PRIMA programme supported by the European Union.

PP-103 [Bee Health]

Main Practices, Challenges and Expected solution identified in the Mediterranean Beekeeping Industry (MEDIBEES project)

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Globally honeybees are threatened by a plethora of biotic and abiotic stressors. One factor of great concern is climate change due to its direct impact on wild and agricultural ecosystems. Indeed beekeeping, with its symbiotic interdependence with vegetation, is an industry that will be strongly affected by climate change. Although the Mediterranean is a region that is highly vulnerable to climate change, no study has comprehensively analysed the possible effects on honeybees. The MEDIBEES project aims to remedy this situation by studying the honeybee subspecies native to the Mediterranean region and their resilience to climate change, in an attempt to safeguard the beekeeping sector. In this framework, the following approaches were adopted to determine the common Practices, Challenges and Problems in the region and to identify scientific gaps and solutions expected by beekeepers:

- Review of the effects of biotic and abiotic stressors on honeybee colonies as well as legislation in the MEDIBEES consortium to identify common threats.

- Study of current challenges, priority areas considered by beekeepers as important to survive as an industry, beekeeping practices and existing resources in each country to determine common trends and challenges across the Mediterranean.

- Analysis of the responses to a questionnaire distributed among 1160 beekeepers to obtain information on stakeholder practices, challenges faced and the main problems encountered.

In this way, a profile of beekeeping activity and beekeepers in the region was obtained. The main challenges and problems identified were: a) changes in weather patterns that could be affect colony dynamics, production losses and increasing mortality; b) of incidence of pathogens in the area (*Varroa destructor*, *Nosema ceranae*, SBV and DWV) and the lack of training programmes to control them; c) agricultural insecticides and acaricide residues. As main areas of interest, beekeepers pointed out the possible existence of adapted ecotypes, the need for training to distinguish between hybrids and purebreds, and the study of the effect that climate change will have on phenology and plant availability and on changes in the distribution areas of pathogens in the area.

This project is part of the PRIMA programme supported by the European Union.

Effectiveness of using powdered sugar to decrease of varroa infestation in bee colonies

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Varroa (*Varroa destructor*) is globally widespread with the honey bee. It seems to be the main vector of various bee diseases. Activity of varroa results in bee colony weakness and loss. Numerous methods and preparations are used for elimination of negative influence of this serious parasite. The aim of the study was to treat the bees by powdered sugar dusting and evaluate its effectiveness on varroa control in bee colonies. Totally, the experiment was performed with twelve bee colonies for three years. Bees were treated by powdered sugar two times per month during the June and July and three times per month during the August and September. After each treatment, the varroa fall was recorded. After the last treatment, values of varroa fall were counted for the whole season. In broodless period, bee colonies were treated with amitraz-based acaricide and subsequently, control evaluation of another varroa fall was recorded. Varroa fall after treating the bees by powder sugar was compared with the value of varroa fall after fumigation by amitraz. Average effectiveness of powdered sugar was calculated on the base of the results of falls. The effectiveness of the method was 14.87%, 14.17% and 32.01% during the three years of the research. The observed efficiency of this method is very low and insufficient for relevant varroa elimination in bee colonies. Based on our results, we do not recommend the assessed method to beekeepers for an effective treatment to varroa control.

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Comparison of Iranian, Carniolan and hybrid honeybee colonies on foraging behavior and preference of poisonous sources

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Popular interest in the biology of the common honey bee (*Apis mellifera* L.) has surged in recent years due to the stark population decline of this important pollinator. Despite the value of honey bees to the agri-food industry, their populations cope with natural- and agriculture-induced stress, resulted in recent increases in reported mortalities. While honeybees have the remarkable ability to learn to associate floral cues, like flower color and odor, with food rewards but beekeepers have long recognized that honeybees may be susceptible to some natural plant toxins. Pesticide exposure is one of the main factors can provide a universal explanation for the apparent decline of honey bee populations. Moreover, the risk of pesticides to honey bees is especially alarming due to their long half-lives and presence in food and honey. The objective of this study was to compare the performance of *Apis mellifera* meda, imported *Apis mellifera* carnica and hybrid honeybee colonies (A. m. meda x A. m. carnica) in northwestern of Iran for detecting poisonous flowers. Study was conducted in the mountainous region of the Marivan, Kurdistan (35.7550° N, 46.5250° E). The location has an altitudinal average of 2050 m with an average annual rainfall of 800 mm. Data on foraging behavior and preference of pollen sources were collected during 2020 spring. Quality control and calculation of descriptive statistics was performed using the GLM procedure of the SAS statistical program. The results of the analysis of variance showed a significant difference between different genetic groups ($p < 0.05$). Based on the mortality and foraging behavior analysis, Carniolan and Hybrid honey bee colonies showed better performance for detection poisonous flowers. The possible reasons for the advantage of the hybrid colonies could be due to heterosis and breed complementarity. Results suggests that honeybees may have the ability to react to toxins, but that this ability may mainly be after they have ingested the toxins. Therefore, it would be wise to design how to improve and conserve the local bees beside of focusing on crossbreeding of *Apis mellifera* meda drones with exotic Carniolan queens.

Beekeeping and Climate Change: Impacts and Adaptation in Chile

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Climate change is having a widespread impact on honey production in Chile. The country is going through a long drought of more than ten years that has affected much of the country, affecting vegetation vigour, nectar availability and forest ecosystem services. In Chile there are still very few studies showing the relationship between climate change and its effect on honey production over time. In this context, historical records of honey production and its relationship with precipitation and temperature variables were analysed in the Mediterranean and Temperate climate regions where most of the country's beekeepers are concentrated. In addition, the perceptions and adaptation practices that beekeepers have implemented to mitigate the impacts of climate changes on their production were analysed through questionnaires and interviews. The results indicate a reduction in honey production over the last decade, mainly related to reduced rainfall and increased temperatures in both regions. These variations have affected the honey production of 82% of the beekeepers who participated in this study, of which 80% implemented adaptation practices. The Mediterranean region has been most affected by the drought, which has led to increased transhumance of beekeepers to the temperate region as one of the main adaptation practices. We hope this study will provide a foundation to generate actions that help beekeepers to confront multiple climate change impacts in Chile.

Natural disasters as a major driver of honey bee colony losses in Iran (2019-2020)

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The findings show that despite the increase in honeybee services demand (pollination services to agriculture and production of honey, pollen, royal jelly, etc.), the supply capacity of this insect has decreased. Management of honey bee colony losses as a necessity can improve the mentioned gap. Natural disasters as a negligible driver is likely to impact a significant effect on occurrence of honey bee colony losses and decreased production for beekeepers. The aim of this study was to determine the rate of colony losses due to natural disaster (flooding, dust storms, droughts etc.) in Iran. A total of 1573 beekeepers with 233296 colonies participated in a cross-sectional study based on an international standard survey (COLOSS survey for colony losses). The results showed a high rate of colony losses due to natural disaster for Iran (5.9%, 95% CI: 5.3-6.6) This survey revealed that larger beekeeping operations with more than 200 colonies experienced significantly lower losses due to natural disaster ($p < 0.001$), suggesting that hobby beekeepers need education and training on how to be prepared for natural disasters. According to the value of the total losses due to natural disasters that was calculated as a sum of the value of the lost honey bee colonies and their production (except pollination services), economic impact of this rate of colony losses was estimated to be about \$M87.

Although this rate is only for one year and has to be interpreted with caution, and colonies lost by natural disaster may have different analysis from biological causes for colony losses, but, it seems to be an alarm and need to be considered as an important factor contributing to colony losses. However, the usage of advanced technologies such as smart hives and applying pre-incident alert system might help beekeepers to relieve this issue significantly.

Preliminary results on honey bee health in the Kingdom of Saudi Arabia

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The FAO Saudi Arabia, in collaboration with the Ministry of Environment Water and Agriculture of Kingdom of Saudi Arabia, established a team of international and national experts with the goal to assess honeybee health in the KSA. Hive inspection visits and sampling activities were carried out in three different Regions of the Kingdom: Madinah, Makkah and Jazan. The total number of apiaries inspected were 24 (7 from Madinah, 9 from Makkah, 8 from Jazan), that were all breeding the local autochthonous bee: *Apis mellifera yemenitica*. The number of adult bee samples taken was 107 (7 from Madinah, 9 from Makkah, 8 from Jazan). Overall, 74% of the colonies were housed in traditional hives, while only 26% were kept in rational/modern hives. The average mortality rate (declared by beekeepers) was 44.1%, mainly occurred from November 2011 to April 2022, highlighting the presence of health issue. The preliminary assessment indicated that the varroa management practices of beekeepers were non adequate, as 38.8% of the apiaries had too high infestation levels of the mite. In many apiaries we observed clinical signs of Nosemosis. Laboratory analysis will confirm the clinical suspicion. A quite spread use of antibiotics by beekeepers was observed in three regions as a disparate attempt to control the bee mortality. A quite strong lack of awareness was detected on the impact of the medicines used at the apiary level and on the consequences concerning safety of the bee products (residues) and on the development of antimicrobial resistance (AMR).

The following recommendations were identified: to change housing of bee colonies, from traditional to rational beehives; provide beekeepers with registered veterinary medicines against the main honey bee diseases, particularly varroa and nosema; regulate the use of imported medicines; propose alternatives to the use of antibiotics with low environmental impact medicines and training on the prevention of the diseases adopting good practices and early diagnosis methods; identify a specialized laboratory in KSA dedicated to the bees; regularly monitor prevalence and incidence of the main honey bee diseases.

The use of encapsulated essential oils against Varroa and Nosema

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Essential oils have been used against Varroa and Nosema for a long time in beekeeping. To stabilize the active compounds of the essential oils of several aromatic plants and to slowly release their desired properties a process called encapsulation was used. Using this process, the essential oils of regano, lavender, fennel and clove, in equal parts, were encapsulated in nanoparticles and they were used against Varroa and Nosema, after fed to the honey bee colonies. Initially, 40 honey bee colonies were used per treatment group as follows: 3ml and 5ml of the active mixture diluted in 100 ml of sugar solution were administered to 20 honey bee colonies by trickling (4 times in weekly intervals), 3ml of the active mixture dilute in 1Lt of sugar solution was provided as feed to 10 honey bee colonies and untreated sugar solution was fed to the rest 10 colonies, used as control. The first results showed that the trickling of the 3ml/100ml of syrup or the 5ml/100ml of syrup were more effective in keeping the Nosema spores per bee in low numbers, compared to feeding the mixture in feeders containing the 1 Lt of syrup, while no effect was observed on varroa mortality. No significant difference was detected between the two above concentrations, although more experiments and repetitions are needed for secure conclusions. Lower concentrations (e.g. 2ml/100 ml of sugar solution) also used by trickling was not proved to be effective against Nosema parasite. This project has been financed by the Prefecture of West Macedonia of Greece, started in 2020.

Comparative honey production and hoarding capacity of two native honey bee subspecies in laboratory condition

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We aimed at the comparison in laboratory cages, the hoarding capacity and honey production of “*Apis mellifera intermissa*” (AMI) and “*Apis mellifera saharensis*” (AMS) two endemic honey bee subspecies from contrasted climatic conditions. The experiment was carried out during the period April-May of the 2021. Bees of both subspecies were collected from colonies in experimental apiary. One capped brood frame for each breed was incubated at 34-35°C and at 70% RH. Emerging workers were transferred within 24 hours in a 12 × 10 × 4 cm cages endowed with transparent and removable sides and ventilation holes. Each cage had two gravity feeders containing a syrup consisting of sucrose solution (50% w/w) and water respectively as well as open surface feeder on the floor containing a pollen paste. Was added to each cage a piece of comb of known dimension and weight. Cages were maintained in 35°C incubator at 50% humidity. Consumption of syrup was recorded daily and the final honey storage capacity of each subspecies was estimated by subtracting initial and final weight of each piece of comb. Results indicate that the onset of honey deposition in the wax cells started after 10 and 16 days for AMI and AMS respectively. AMS consumed more syrup than AMI: 32.12±3.34ml against 28.44±2.35ml. During a period of 14 days, AMS stored 16.20±1.88g of honey, averaging 22 mg/bee/day. Whereas AMI stored during a period of 20 days, 14.27±1.44g of honey, with an average of 14.2 mg/bee/day. Our result indicates that under laboratory conditions production of honey was similar (F 0.231) for both subspecies, whereas the hoarding capacity was more important for AMI than AMS (F 0.491). The most interesting observation is that AMS with five days delay in the onset of honey production (F 0.001) has eventually yielded the same honey quantity than AMI.

Field evaluation of honey bee materials resistant to Varroa destructor in a production system in the north of the province of Santa Fe, Argentina

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Varroa destructor is a threat to the health of *Apis mellifera* worldwide. This ectoparasitosis is associated with high winter mortality of honey bee colonies, mainly in Europe and America. Varroa-resistant *A. mellifera* populations have been detected worldwide and different bee behaviors involved in survival have been documented. In Argentina, *Apis mellifera* colonies that can survive the parasitosis without chemical treatment have been reported. From these selected materials, daughter colonies established in the Transition Chaco eco-region (Reconquista, Province of Santa Fe) were evaluated to assess their productivity and parasite loads in subtropical climate.

Three groups of 11 daughter colonies each were evaluated. Two groups correspond to colonies selected for high grooming behavior and another group corresponds to a local commercial ecotype. Six measurements were carried out between October 2018 and October 2019. In each measurement, parameters of population strength, phoretic Varroa (PV), Varroa in brood (VB) and honey production in the two seasons were recorded.

The average PV levels per apiary and per colony within the year did not exceed 3%, and honey yields were within the local averages for each season. The selected materials showed similar productivity to the local ecotypes. The autumn Varroa levels of the 3 groups would indicate that it is possible to assume the risk of going through the winter without the application of acaricide treatment. The introduction of selected materials in a conventional production system constitutes an important step oriented to visualize management strategies to reduce the use of acaricides.

Hygienic behavior in the local honey bee *Apis mellifera* intermissa

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Hygienic behavior is considered an important factor in resistance of the honey bee mite *Varroa destructor*, Hygienic bees have the ability to detect, uncap, and remove diseased brood from the nest before the causative organisms reach the sporulating stage. Hygienic behavior in the honey bee, *Apis mellifera* L., is highly variable among and within populations and subspecies. The objective of this study was to determine the frequency of this criterion in the local race *Apis mellifera* intermissa.

A study on the selection of local bee colonies *Apis mellifera* intermissa is carried out on 50 colonies in the arid steppe zone of Djelfa, the apiary has not been treated against varroa for 5 years. During these years, the resistance criterion was evaluated 4 times a year by the method of Marla Spivak. The study points out the importance of this criterion in the intermissa breed to resist varroa. Out of 50 colonies, 20 hives remain characterized by a hygienic behavior which exceeds 90%. A queen breeding was carried out on these colonies, swarms were installed in three apiaries. Another evaluation of this criterion shows that this behavior is still present and constitutes a good basis for the selection of colonies resistant to varroasis. The study of the dynamics of varroa populations in the colonies studied shows a very weak development. The results show that hygienic behavior and temperature are two factors that limit the growth of the mite in this region. The only problem is the availability of honey and nectar resources all year round in order to have a good production of honey.

Developing of *Varroa destructor* mite in the local bee colonies *Apis mellifera sahariensis* in the Saharan zone of Algeria

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Varroasis is a very dangerous pathology that threatens beekeeping in Algeria; it is caused by the parasitic mite *Varroa destructor*. Population dynamics of *Varroa destructor* were studied for two years (2019– 2021) in 20 *Apis mellifera* sahariensis colonies located in Bechar (south of Algeria). The number of bees, the amount of open brood and capped, daily natural mortality, level of infestation of adult bees and level of infestation of the brood, was monitored. The brood cycle and behavior of reproduction in *Apis mellifera sahariensis* is set by exceptional and seasonal contrasts in climate: dry summer (June to September), with an almost complete stop brood. Autumn, relatively wet causes a second peak of activity and brood development. The values of the infestation rate of brood and bees show peaks in August, this period when there is the minimum amount of both bees and brood in the colony. In all colonies, the population of *Varroa* presented during the spring curve of exponential growth, which is explained by the continued presence of brood. In the growth phase, followed by a collapse of populations of mites, which in our experimental conditions, occurred from early summer, along with a weakening of colonies phase. Successive brood cycles allow the population growth of *Varroa*, while the absence of brood during the summer months has the opposite effect of reducing populations of *Varroa*. It appears that the level of *Varroa* infestation in colonies varies according to climatic conditions (seasonal) and internal conditions of each colony.

Environmental impact of antibiotic treatment with oxytetracycline on honey bee colonies: preliminary results

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Antibiotics can be used on honey bees to control infectious diseases, mainly American foulbrood, European foulbrood and Nosemosis. A field trial, on almond orchard, was performed to assess the environmental impact of the oxytetracycline

hydrochloride (OTC) treatment on hives. The impact on the environment was evaluated focusing on OTC residues in flowers and on the presence of antibiotic resistance genes OTC-related (AMR), in different hive matrices, flowers included. After placing 8 hives in the proximity of almond trees, 4 hives were treated with OTC (1.68 g/hive). The following matrices, pre and post OTC treatment, were sampled: live adult bees, dry swabs from the entrance of the hives, comb honey from the nest and almond flowers. OTC residues were found not only in the untreated hives, but even on the almond flowers (up to 0.967 ug/kg). AMR genes were discovered too and results are still under investigation.

This preliminary study confirms the negative effects of treating bees with antibiotics, not only concerning the risks of contamination of the hives that are in proximity to the treated ones, but even for the environmental impact due to the appearance of resistance AMR genes. Further analysis are still in progress.

Survey of Honeybee Viruses in Apiary Insects From Tekirdag, Western Turkey

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Honey bees with increased global economic importance lives go in natural harmony with apis or non-apis insect species. But the most viruses have been detected in honey bee colonies threatening colony health can cause high economic losses. Some of these do not prefer only honey bees to ensure in the apiaries. This investigation focused on the presence of some honeybee viruses (ABPV, BQCV, CBPV, DWV, IAPV, KBV, LSV, SBV) in some non-apis species and insects (wasp, pollinators, ladybugs, ants, etc.). The obtained results were summed using pathogens-specified PCR and sequence analysis methods. Research analyses will light new perspectives on colony health.

Contract Production as a Risk Management Strategy in Beekeeping

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Beekeeping has made significant progress in Turkey in recent years and has become a sector that ensures the sustainability and efficiency of agricultural production and the balance of nature. Beeswax, pollen, propolis, royal jelly, bee bread, apilarnil and bee venom are some of the most valuable products of beekeeping along with honey. Seed and food production also depend largely on pollination by bees. However, as in other branches of agriculture, risks and uncertainties associated with production, marketing, finances, and human-related risk factors in beekeeping lead to instability in beekeepers' income. To ensure the sustainability of the beekeeping sector, these risk factors must be controlled through appropriate risk management tools such as product diversification, beekeeping insurance, spreading sales over time, etc. On the other hand, contract production is considered an effective tool to manage beekeepers' marketing risk. Contract beekeeping is a form of production and marketing between companies and beekeepers, which refers to the production and harvesting of a specific beekeeping product, where the company agrees to buy the product under certain conditions, while the producer must carry out the production. This study was conducted to provide a framework for the contract apiculture model based on the literature review. Thus, it is a guide for the beekeeping sector and future research.

An Online Survey to Determine Breeding Activities and Main Issues in Turkey's Beekeeping Enterprises

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This study was conducted online survey between November 2019 and January 2020, with the objective of determining the production characteristics and sectoral issues of beekeeping enterprises in Turkey. According to the survey, the Black Sea region accounts for 28% of the total; the Central Anatolia region accounts for 18%; the Marmara region accounts for 17%; the Eastern Anatolia region accounts for 13%; and the Aegean region accounts for 9%. It was conducted with a total

of 200 participants, 8.5% of which were beekeepers from the Mediterranean region and 6.5% from the Southeast Anatolia region. 82% of the participants are for income; 18% of them are involved in production activities for backyard purposes. The enterprises have an average of 140 colonies and produce 17.29kg of honey per colony; 31.5% of the enterprises consider beekeeping to be their first job, and 49% use the migratory beekeeping model. 67% of them attended beekeeping classes. The enterprises collectively produce 90.5% extracted honey, 56.5% comb honey, and 23 % natural honey comb. 37% of them work with Caucasian or crossbred bees, and 32.5% with Anatolian bees. It has been determined that 63.0% of enterprises meet their queen bee demands solely via their own operations, and 60.6% of enterprises are exposed to the varroa infection. According to our findings, one of the most important concerns for enterprises in the industry is marketing, which accounts for 24%. Following issues, accommodation (17.7%), diseases and pests (15.7%), safety (15.7%), transportation (10.4%), and pesticide applications (7.1%).

PP-128 [Beekeeping Economy]

Comprehensive value chain development of natural resources for economic diversification: The Apiculture Approach

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The present economic challenges in Nigeria call for a serious sustainable environment-friendly agricultural enterprise with a great potential that improves export earnings. It is our fervent believe that the contribution of the Apiculture sector to its sustainable human development and specifically increases the income of beekeepers and traders of bee products through improved commercialization of quality bee products in Nigeria which will in turn lead to a drastic increase in the GDP of the nation. The overall goal of the Nigeria Apiculture Value Chain (AVC) Development Program is to contribute to an increase income of beekeepers and other actors on the AVC through increase in production capacity, stimulate the efficiency and competitiveness of the AVC products by improving standards, processing capacity so as to access higher value niche markets through Fairtrade International (FLO) certification or organic certifications and to achieve a total sales value of over \$5 million by 2035 (Sustainable Development Goal SDG) target on Food Security. Apiculture provides highly desirable products such as honey, comb/wax, pollen, propolis, bee venom, royal jelly, apilarnil and apilanil prop, value added products and pollination services. It is of note to stress the need to urgently embrace the use of modern techniques in keeping honeybees for industrial development of Nigeria and also to enhance exportation of the products to earn growth in the Nigeria's GDP by diversifying the monolithic economy that is presently based on crude oil exportation.

PP-129 [Beekeeping Economy]

Competitiveness Analysis of the Honey Sector: China- New Zeland Example

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According to Trade Map 2021 data; 764,200 tons of honey was exported worldwide and 2 billion 673 million dollars of revenue was obtained. China has gained 230 million 257 thousand dollars of income by exporting 128.618 tons of honey. The main countries to which China exports honey are; United Kingdom with 32.151 tons, Japan with 27.445 tons, Belgium with 14.232 tons, Poland with 13.045 tons and South Africa with 5.385 tons. In terms of foreign exchange income, Japan ranks first with 59 million 637 thousand dollars, while followed by United Kingdom with 48 million 403 thousand dollars, Belgium with 24 million 383 thousand dollars, Poland with 21 million 544 thousand dollars and Spain with 8 million 927 thousand dollars. New Zeland has gained 327 million 135 thousand dollars of income by exporting 13.823 tons of honey. The main countries to which New Zeland exports honey are; USA with 2.500 tons, Chine with 2.455 tons, United Kingdom with 2.141 tons, Australia with 1.812 tons and Germany with 1.314 tons. In terms of foreign exchange income, Chine ranks first with 62 million 697 thousand dollars, while followed by USA with 62 million 52 thousand dollars, United Kingdom with 42 million 170 thousand dollars, Germany with 33 million 317 thousand dollars and Japan with 27 million 843thousand dollars. The pupose of this study is to measure export performances of Chine and New Zeland via the designated indexes of honey and compare the obtained results. The Comparative Export Advantage Index and the Comparative Export Performance Indices were measured between 2011 and 2021 using the export rates of the two countries and the honey sector in the world.

PP-131 [Beekeeping Economy]

Complementing HATIE Method for Authenticity Screening of Heterotrigena itama Honey: A Comparison to Physicochemical Parameters

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Validating the authenticity of honey has always been a challenge in the industry. The growing demand for honey in the global market further motivates the production/formulation of fake/adulterated honey that is screening-proof. Continuous improvement in analytical methods is able to distinguish differences between genuine and synthetic honey, however, it's neither cost nor time effective. Booming production and demand of stingless bee honey in Malaysia, in particular from Heterotrigena itama species is facing a similar threat of fraud in this industry, thus the urge for a rapid-screening test. Honey Authenticity Test by Interphase Emulsion (HATIE) is a qualitative rapid-screening method used to identify genuine honey that has huge potential to be utilised as a screening method at a regional honey collection centre since its both cost and time effective. In this study, 8 samples of fake/adulterated honey (validated via UPLC) and 32 samples of genuine Heterotrigena itama honey collected from four different localities in northeast peninsular Malaysia were compared using the HATIE method in addition to enzyme activity, pH value, HMF content, Brix number and moisture content. Every 32 samples of genuine honey utilised in this study conform to the accepted range for pH value, HMF content, Brix number, moisture content, enzyme activity and the HATIE method. Meanwhile, 8 samples of fake/adulterated honey were found to only conform to the accepted range for pH value, HMF content, Brix number and moisture content. HATIE method and enzyme activity test were able to detect the fake/adulterated honey utilised in this study. The study indicates the potential of the HATIE method as a rapid screening for authenticity for Heterotrigena itama honey.

PP-132 [Beekeeping Economy]

Transformation of Kelulut Honey Supply Chain for Income Generation in Borneo via Innovation for Community (INNO4C) Structured Programme

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Honey business has become an important income generation activity for the economic development in rural particularly biodiversity-rich country like Malaysia. However, the hygroscopic nature of honey pairs with the high humidity of the tropical climate in Malaysia resulting in honey with higher moisture content that directly affected its quality and reduces its shelf-life. Limited standard operating procedures (SOP) for rearing and post-harvest management in honey production also affect the honey quality. Thus, the value of honey depreciates resulted in reduces interest among the stingless bee beekeepers. In an attempt to rejuvenate and transform the industry, Unit Peneraju Agenda Bumiputera (TERAJU) of the Prime Minister Department in collaboration with Bahagian Jaringan Industri & Masyarakat (BJIM) of Universiti Sains Malaysia (USM) established the Innovation for Community (INNO4C) project in 2019 targeting six rural communities in Sarawak, Malaysia namely; Lundu, Kampung Alit, Batang Maro, Beladin, Maludam and Pusa. A total of 90 stingless beekeepers were trained and 450 colonies of Heterotrigena itama were supplied throughout the project. The project aims to promote a sustainable stingless beekeeping practice, production of high-quality honey through proper SOP and instil an entrepreneurship mindset among participants. In order to empower the stingless bee cultivation practice and hygienic post-harvesting management, the Mustafa-Hive was utilised as a standard rearing system. The community honey centre (CoH-C) was then developed within the targeted communities as a honey processing laboratory. The moisture content of honey harvested is reduced in the CoH-C down to 20% utilising the Honey Industrial and Dispenser Apparatus (HILDA) system, minimising fermentation and stretching the shelf-life of honey. Honey produced through this supply chain was then engaged with several off-takers to market the honey where continuous engagement has enabled the honey to penetrate the export market, entering the United States, Saudi Arabia and Australia. Following the export market penetration, the price of raw honey produced by the targeted communities has increased from RM40 (€8.50) to RM100 (€21.30) per Kilogram with secured 800Kg of annual demand until 2025. The structured program implemented through the INNO4C project paired with innovations from USM has revitalised the stingless bee honey business in Borneo, Malaysia.

Projection Study for the Future of Beekeeping in Turkey

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The study, it was aimed to estimate the number of beehives, honey production (tons) and beeswax production (tons) for the years 2022-2023, and 2024 in Turkey. For this purpose, the number of beehives, honey production, and beeswax production data of the Turkish Statistical Institute for the years 2004-2021 were evaluated. By using different models for future prediction in time series, the models with the highest statistical significance were preferred. It was determined that the cubic regression model ($R^2=91.2$) for honey production, the cubic regression model ($R^2=50.2$) for beeswax production and the cubic regression model ($R^2=98.8$) for the number of hives variables were found to be the most appropriate model. As a result, it is estimated that the number of beehives, honey production, and beeswax production will decrease in the next three years. It is predicted that the number of beehives will be 8 338 599 in 2022, 8 138 410 in 2023, and 7 823 319 in 2024. Honey production is 89 985.93 tons in 2022, 79 030.68 tons in 2023, 65 098.03 tons in 2024, and beeswax production is 3 477.61 tons in 2022, 3 228.56 tons in 2023, and 2024 tons. It is predicted that it will be 2944,55 tons. Among other farm animals, the honeybee is the most dependent on the environment and the most affected by environmental conditions. It is predicted that the drought and climate changes that have emerged in recent years will also affect the production of other bee products, especially honey. However, for the demand for bee products, especially honey, beekeeping practices are recommended to increase honey production per hive rather than increasing the number of hives.

The Effects of The Coronavirus (Covid-19) Pandemic in Turkey on The Consumers' Honey Consumption Preferences

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World Health Organization (WHO) SARS-CoV-2 (severe acute respiratory syndrome-Coronavirus-2) Covid 19 disease first appeared on January 13, 2020 in Wuhan, China. From here it spread to all countries of the world. Our study was designed to determine the change in honey preferences of consumers during the global epidemic period. For this purpose, a face-to-face survey was conducted with 730 consumers to represent our region between February 1 and April 1, 2021. Male participants made up 69% of the consumers who participated in the survey. 97.6% of the participants stated that they consume honey and the average annual consumption per household is 8.172 kg. 37.5% of the participants declared that their honey consumption increased during the pandemic process. The majority of consumers declared that they obtained honey from beekeepers both before and after the pandemic. 39.5% of the participants stated that honey prices increased during the pandemic period. In terms of consumption, filtered honey took the first place with 59.5%. Before the pandemic, 88.33% of consumers stated that they consumed honey for nutritional purposes and 9.41% for health protection purposes. In the pandemic period, it was determined that the rate of use for health protection and treatment (16.44%) increased.

A Revival of Georgian Traditional Beekeeping – JARA Beekeeping

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Wild beekeeping techniques are rare these days, but Georgia, the homeland of the well-known Caucasian Mountain Grey Bee, is one of the few places in the world that has preserved it in remote dwellings. Jara is an ancient beekeeping tradition which is an excellent example of the mutually beneficial coexistence of wild nature and humans (www.jarahoney.com). This unique way of life was particularly practiced in the subtropical and alpine zones of Western Georgia. There is no evidence for when exactly Jara appeared. However, several local folktales note that ancient inhabitants found the bees in a tree hollow and they called this place in the forest 'the bee tree'. Later, locals started collecting of swarms of wild bees and settling them into hollowed wooden logs and then placing them high up in trees to protect them from bears. Such wooden logs were called Jara. After the invention of frame beehives in the 19th century, Jara hives were increasingly replaced by modern beehives and the practice almost died out.

Jara honey, with its history, production in a bio-diverse environment and natural honeycomb have great potential to compete in the international market as a unique niche product. Jara beekeeping has begun a slow revival since 2014. In 2018, for the first time ever, twenty Jara producers have sold their entire crop of Jara to a commercial enterprise. It brought hope and a feeling of pride to those beekeepers who have been continuing or were starting to take Jara beekeeping up. Since then, the number of Jara beekeepers has already increased by 44% and Jara honey production has increased by 132%. Jara honey has been branded, granted cultural heritage status and has been successfully certified as Bio and been exported beyond Georgia to US and Canada, the Gulf States and Japan. This presentation will showcase success story so far of the revival of Georgian Jara beekeeping and its prospects going forward through the lens of the Georgian Beekeepers Union (<https://geobeekeepers.ge>, <https://jarabeekeepers.org>)

Farming of Stingless Bee (Meliponines) to Recovery Indonesian and Global Economy

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COVID-19 pandemic creates a negative impact, namely the increasing of unemployment in Indonesia. According to BPS data in February 2021, the number of unemployment was 8.75 million people and it increased 1.82 million people by more than in 2020. Since December 2021, Indonesian government opened G20 Presidency on the slogan Recover Together, Recover Stronger. The goal is for Indonesia to be able to encourage all countries to work together to achieve a stronger and more sustainable world recovery due to the impact of the COVID-19 pandemic on all sectors, especially the economy.

One of the agribusiness efforts in the context of economic recovery that is easy to do is stingless bee farming as the type of this bee is very environmentally friendly, adaptive to extreme weather and also has high economic value honey production.

Bank Indonesia (BI) as the central bank which has the responsibility to maintain the stability of rupiah has sponsored the research on economic recovery through beekeeping in Islamic boarding schools that we conducted in three provinces in Indonesia, namely Bengkulu, South Sulawesi and West Nusa Tenggara. The result of the research, seen from the economic side, shows that on average, Islamic boarding schools that received assistance from 100-200 stingless bees valued at Rp. 153,585,000 has a payback period of 2 years and 1 month, ARR 167.87%, IRR 65.76%, NPV Rp. 376. 314,692 and Profitability Index (PI) 3.78%. All show that it is feasible to be developed in a sustainable manner. Islamic boarding schools are able to produce honey to sell for Rp. 20,000,000 per month.

If it is developed more widely, this stingless bee farming business will create jobs and improve the economy of the community nationally because the demand for honey in Indonesia is still wide while production is still low. Moreover, if it is able to meet export needs for health and cosmetic needs made from bee-derived products, it will have a positive impact not only on increasing economic in Indonesia but also in the world.

Value Chains-Commercial, Honey vinegar

Marisol Juárez Rueda

Kao Tárkat Company, C.O.

Mexico is the 9th honey producer worldwide and 13rd place in honey exports. Despite the export reaching 90% of honey production, the per capita consumption is very low. Local producer revenues are too low. Eight years ago, the diversification proposal of hive products had outgrowth into six lines: food, honey, gourmet, apicosmetic, health and teas.

This small company is located at the state of Veracruz, where the fields is characterized by microflorations, with an impressive biodiversity and a wide variety of climates. Those conditions let unique types of honey like "marangola", "chayote" "campanita", "tarai", "mulato", "jonote", "mozote", "azahar de naranjo" (orange blossom), "mielatos", "multiflora" (multiflower), "pimienta" among others. Usually this honey is homogenized for export. Kao Tárkat has covered the MEXICAN government and commerce requirements; it is a registered trade mark.

In the most uncertain environment for the year 2020 we decided to take the innovation challenge. We produced the first honey vinegar to be sold in retail stores and supermarkets in Mexico. In November 2020 was the first shipment of honey vinegar sent to the supermarket chain with stores in 5 states of México. It is worthy of note this is the first Mexican honey vinegar sold in retail that competes against others from Spain, usually found in specialty stores.

This artisan honey vinegar is matured and clarified after a double fermentation process, and is very suitable for gourmet food, no sulfites added. And only the purest and finest honeys are selected for this product. In conclusion, Kao Táxkat covers the unique market for the local development thru diversification where the added value is at least 50% the value of the raw materials.

PP-124 [Beekeeping Economy]

Evaluation of plant origin of honey based on pollen evidence in some prominent honey-producing zones in Iran

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Melissopalynology is one of the most important scoped in applied palynology that identifies and evaluates pollen in honey to quality control as well honey classification. This valuable approach connects academic researchers with manufacturers, exporters, and industrial units. This study is the first pioneering study in the world that has been performed for the first time in the field of melissopalynology using scanning electron microscopy (SEM). This study consists of two parts: field and laboratory studies. In the field section, by direct examination of beehives and direct sampling of honey, the amount of 300 g of unrefined and non-clay honey was collected from 93 beekeepers, which was done in different geographical, geomorphological and climatic regions and a suitable statistical population. The samples were placed in sterile containers and stored in a cool place until they reached the laboratory. In the laboratory, pollen grains were extracted from honey samples by the method (Louveaux et al. 1978) and after preparation were imaged by scanning electron microscopy. Pollen grains were identified based on standard palynology references and their quantity and quality were evaluated according to the standard table (Louveaux et al. 1978) after analysis. 57 samples of honey (61%) had the standard pollen grain content. In the results of this study, 41 plant families and 53 genera were identified, with the highest presence of Asteraceae - Fabaceae - Rosaceae - Apiaceae - Apocynaceae families, which is similar to the results of some other studies. All honeys collected from the study area were Polyfloral honey. Honey samples were collected in 7 altitude intervals, which according to the results, it seems that the highest density of pollen grains in honey samples collected in the altitude range of 1000-1500 meters. The results of our studies show that studies to palynology criteria, about 30% of the honey samples studied are counterfeit.

PP-130 [Beekeeping Economy]

Each beekeeper needs book about beekeeping. The findings in the book are from the monitoring of 10,000 hives around the world from Australia, Japan, New Zealand, all European countries, but also from the USA and Canada

Peter Kocalka, Stanislava Horcikova
Bee Hive Monitoring S.R.O., Jelka, Slovakia

I wrote this book because the circumstances allowed me to discovered something fascinating. Something I had no idea about until them, and maybe I was slightly looking for. My character allowed me to look at reality objectively and also forced me to try new things before I could be marked by the old ones. By this I mean old practices, prejudices and myths, which have been accumulated in huge numbers in the beekeeping industry. It allowed me to discover a lot of to then unknown, and each touch discovery shifted perception as if a child is learning to perceive its surroundings, as long as it can skill defend itself against the warnings of adults who force it into a stereotype of running tracks. I was blessed to be allowed to take care of hundreds of hives early enough so that I didn't make false logic conclusions for look of data. I was also fortunate to study mathematics and computer science, where I was thought how to filter truth from myths and evidence from assumptions. Last but not least I was blessed whit the ability to create electronic devices and program computers which allowed me to acquire objective data that cannot be acquired by human senses, even with the best of intentions.

The love of bees, which gradually grew into a project that monitors tens of thousands of hives, allowed me to confirm or refute all discoveries. And here I must note that such an interplay of circumstances could not have arisen if several people had not been mentally prepared for it, but also technology. Thanks to all the people who took a part. Despite the fact that

there were thousands of them, most of them don't even realize it. I wish everyone who reads this book to take it as an adventure, to inspire him to discover new ones, and to force him to return to his childhood when skill had the courage to ask the questions WHY?

PP-137 [Beekeeping for Rural Development]

Reserves for increasing honey production in the conditions of the saratov region - the experience of introducing small-format types of bees

Dmitry Maslov

Ministry of Agriculture of the Saratov Region Livestock Development Department Public Committee on Beekeeping Problems Saratov, Russia

The article describes in general terms the technology of working in the hives of the Dadan system of a low-pharm type - for six and eight frames, which allows to increase the profitability of apiaries in the conditions of the Saratov region due to the additional collection of spring honey. The main conditions for this is the selection of low-speed and productive lines of Buckfast bees (Buckfast), the use of carnica bees is allowed.

The goal of our four-year work was to find the optimal solution to this difficult problem. In our region, the flowering of garden trees, shrubs, including acacia, and maple coincides with the period when bee colonies reach overgrowth, the number of nurse bees in them exceeds the needs of the bee colony and such colonies enter the swarm state. When choosing bees, we were guided by the initial selection of the least swarming, but quite hardy. Such requirements are successfully met by the bees of the Bakfast breeding group, adapted through subsequent selection and breeding work in our bee industry. We used lines B 98, B51, B276, B46 with our selection code MDL. During the spring build-up. bees in 6 or 8 frame hives made of modern materials quickly reach the stage when they accumulate nurse bees in excess form, but instead of entering them into a swarm state, such bees begin to actively process the nectar obtained from collecting bees, we limit the nesting part with a Hahnemann dividing grid and then put a store extension with a frame of 145mm for collecting commercial bio honey, then in the section between the nest housing and the first store extension, we give the second housing. Thus, according to our data, the introduction of such a technology on the territory of the Saratov region will increase the yield of commercial spring honey, which will increase the profitability of such apiaries in difficult market economy conditions. Carrying out diversification is more affordable - it is enough to divide the twelve-frame hive of the Dadan system in half and add a second hole.

PP-138 [Beekeeping for Rural Development]

Breeding business in Russian beekeeping in 2021

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One of the most relevant topics - the state and prospects for the development of Breeding in our country over the past year has been raised many times at various venues, mostly interactive, largely due to restrictions due to the Covid 19 pandemic. As a direct participant in the most significant of them, I will allow myself, among other things, to call for further joint actions. Together with the biologist - ecologist S.G.Springer, we considered the publication of the article "To create a vector of development For Beekeeping" in the oldest specialized printed publication - the journal "Beekeeping", where we sent the article. The ultimate goal is to reach the level of scientific controversy for common goals - the preservation of the gene pool, rethinking a number of rash steps taken by official scientific thought. Why are the Germans, Austrians, Americans, etc. purchasing Far Eastern bees, as well as Central Russian, why did the Poles buy gray mountain Caucasian, and the Belgians, Austrians buy more bees in Liguria and Morocco? We also received an answer - in these countries many years ago, due to their own short-sightedness and prohibitions, the gene pool of local bees eventually narrowed and their vitality fell to a level below average. And at the moment they are improving it, expanding it precisely due to such importation. Foreign colleagues, through research, establish such positive effects at the level of bee populations, yes, there is a count beyond the threshold of the number in order to prevent excessive infusions from outside. Thus, purebred bee populations have their own rational use, there should be as many of them as possible, it is impossible to focus only on a few breeds, albeit of national importance. A new combinatorial type of bee breeding based on economically useful traits, where bee morphometry is one of the main and insignificant tools in bee breeding, necessary at the stage of identifying special traits.

Poisoning of bees with chemicals from the fields is one of the main problems of the existence of beekeeping in Russia

Dmitry Maslov

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The death of bees, unfortunately, is a regular phenomenon for a number of reasons and exists in all countries. In Russia, this is, first of all, the winter death of bees due to the long winter during metesation and due to improper chemical processing. In 2016-2017, many bees died in the regions: in Bashkiriya - 40, in Orenburg - 60%.

Previously, there was no summer death of bees in Russia. Why? Because our traditional crops - buckwheat and soft wheat - are not needed by anyone abroad. At the moment, the Russian agro-industrial complex is reaching the level of the oil industry and is able to extract really serious money for the country. And that is why farmers sow marginal crops, in particular, rapeseed, but the literacy and culture of farmers leave much to be desired. Instead of one chemical treatment, four are produced, for example.

In Ufa, where the Apimondia Congress will be held, one of the sugar processing plants is closing. All beet growers were gathered and told: guys, we need to grow rapeseed. To which the answer came: "Then release us from responsibility to everything, aviation processing of fields now does not require, as before, coordination with the federal executive authority, agricultural airfields can be placed closer than three kilometers from settlements. During the processing of woodlands and agricultural crops, according to the previous edition, selective laboratory control in accredited laboratories for the content of residual amounts of pesticides in the atmospheric air at the border of the sanitary gap zone (300 m) should have been organized, respectively, according to the new edition, no laboratory studies. The main cornerstone of the new edition is the permission to carry out chemical treatments of fields outside settlements during the daytime, and night processing is left only within settlements. It is obvious that in the current conditions, without a global association of beekeepers at all levels and the subsequent development of protective measures.

The reform of the Veterinary Service for the beekeeping industry is the most important step in the elimination of bee diseases

Dmitry Maslov

Ministry of Agriculture of the Saratov Region Livestock Development Department Public Committee On Beekeeping Problems Saratov, Russia

We have joined forces based primarily on the results of our own scientific research, which reveal the problem in mass distribution as long-known (varroaosis, nosematosis) and there are few studied viral diseases of bees in the territory of the Russian Federation, which for several years lead to fatal consequences - a reduction in the number of bee colonies in the Russian Federation, a shortage of products both at the level of amateur and professional apiaries. We were tasked with finding a faster and at the same time radical solution to the problematic issues raised. This will be possible with the approval of the beginning of the reform of the veterinary service in relation to the beekeeping industry. The main mechanism of the reform was discovered in the works of Professor O.F.Grobov, this is the creation of a service of regional veterinary experts in beekeeping, whose main task will be comprehensive veterinary and sanitary maintenance of apiaries. The creation of a well-thought-out network of veterinary services for apiaries in the country will allow. The establishment of the institute of veterinary experts on the territory of the Russian Federation will be more effective if a number of conditions are met - the ban on the import of cellular bee packages from Central Asian countries into the territory of the Russian Federation, which actually carry a huge burden in the spread of diseases of both adult bees and their larvae. As well as the speedy creation of courses on licensing of regional veterinary experts.

Ban on the importation of bees from Uzbekistan as a basis for the development of Russian beekeeping

Dmitry Maslov

Ministry of Agriculture of the Saratov Region Livestock Development Department Public Committee On Beekeeping Problems Saratov, Russia

By now, it is possible to formulate the main problems of beekeeping in Russia, which have developed due to the importation of bees from Central Asia.

1. The absence of a regulator on the market in this matter, represented by the Ministry of Agriculture of the Russian Federation, has led to the fact that the production of bees for the purpose of their subsequent sale in the form of four, six frame bee packages in the Southern Federal District, the Volga Federal District has decreased to catastrophic figures

2. Bees from Uzbekistan, initially selected for pollinating characteristics - Cotton was the main crop for their use, are metalworked, with a high tendency to swarm, and often with increased malice. Their spread across the territory of the Russian Federation, natural reproduction - swarms annually cause huge, irreparable damage to the breed gene pool in the Russian Federation.

3. The lack of proper control when importing bees from Central Asia - the quarantine measures prescribed by the legislation by the Veterinary Service of Russia every year leads to a massive spread of quarantine infections. In turn, as a tool that will help the development of "Batch beekeeping in Russia" to the regulator represented by the Department of Animal Husbandry at the Ministry of Agriculture. The CX of the Russian Federation offers two options for assistance in this matter

To allow the import of bee packages from Central Asia only in the form of cell-free frames - cell-free packages. This is a generally accepted world practice - batch beekeeping in Australia, the USA, and Europe has a place to exist at this level. Mainly due to the fact that in this case, at the same time as a positive factor, the risk of possible introduction of quarantine infections that spread together with cellular frames is minimized. Bees in this case can also be subjected to special preventive treatments. Such goods are less in demand, mainly due to lower payback, technically more difficult to transport, in this case the final selling price will not be low, there will be fair competition with Russian bee producers

Does experiential learning at the beehive improve the beekeeper's ability to recognise and diagnose diseases through community learning for the hobbyist beekeeper?

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Previous EU research highlights a lack of good bee management practices, an inability to follow directions for veterinary medications and poor disease recognition skills as a hindrance to hobbyist beekeepers. This paper evaluates a "train the trainer" workshop using beekeepers to train/teach other beekeepers, using a systematic method and making printed learning material available to guide them. The data was collected in the Republic of Ireland on a small scale, a low-cost initiative that could be repeated and expanded in any beekeeping setting.

A group of beekeepers that had a recent high level of theory-based knowledge through beekeeping exams came together and designed the printed resource booklet: "Brood Diseases of Honey Bees in Ireland". Instructions on identifying brood issues were delivered through practical, peer-to-peer demonstrations to other beekeepers, using the printed resource as a reference guide. All beekeepers were asked confidence base questions on their knowledge, skills and abilities before and after the workshop. An online quiz in the form of photographs of potential hive problems was made available to both participants and the public (other beekeepers) to measure the improvement, if any, in the perceived level of knowledge and skill.

The online quiz was available to the public as well as the beekeepers being trained. The target group of beekeepers who undertook the workshop achieved an improvement in their skillset of 27%, scoring on average 9% higher on the quiz than the beekeepers who did not attend the workshop. The beekeepers who designed the printed resource reported an even larger improvement in their skillset: 100% found an improvement in their skills and abilities in disease recognition. This additional learning may be due to the research completed in order to design the printed booklet (e.g. they had to go out and identify and photograph diseases and problems to include these for the booklet).

This is a low-cost solution to a major problem that can easily be repeated nationally / internationally with some coordination and booklets. Initial feedback has been very positive with a perceived improvement of disease recognition across all beekeepers who took part (either online or in the workshop).

Honey bee population differentiation under a developing beekeeping and colony marketing in Tigray, northern Ethiopia

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Ethiopia is a country of broad ecological diversity, located in the northeast Africa, and has rich tradition of subsistent beekeeping with strong connection between honey bees and human beings since ancient time. It has been recently transforming this traditional beekeeping aiming to enhance productivity by introducing improved beehives, which is pronounced in northern Ethiopia's Tigray region where the demand for colonies was increased and colony marketing developed. Here, we assessed the regional beekeeping progress, status of colony marketing and genetic differentiation of honey bee populations. Annual honey production, yield per hive, number of beehives, and percent increase were summarized from annual reports of Ethiopian Central Statistical Agency from 2004 to 2020. In addition, colony market survey was conducted by interviewing a randomly selected 120 buyers and sellers to determine ecological and spatial re-distributions of colonies and drivers. Furthermore, highland and lowland population differentiations were compared in areas involved and not involved in colony marketing by analyzing sequence data of a nuclear gene fragment associated with adaptation to habitat elevation. The results showed that substantial progress was achieved in the regional beekeeping. Growth from 1% to 23% movable frame hives (cf. 3% national), which gave significantly higher honey yield (19.9 kg, cf. 10.7 kg traditional), increased the annual honey production (3x) and number of colonies (90%; cf. 65% national). Colonies were produced by a few highland beekeepers, sold to honey producers and transported widely with significant changes in ecological ($X^2=6.27$, $P=0.044$) and spatial ($X^2=104.56$, $P < 0.01$) distributions due to the buyers' preferences for colour (73.3%) and source area (88.3%), lack of skill to reproduce their own stock (60%) and limited access to buy or trap locally. This resulted in a uni-directional flow of colonies and genetic erosion as clearly observed between highland and lowland bees in an area of active marketing, Mugulat, (FST=0.0; Nm=17.87) compared to significantly differentiated highland and lowland populations in Werie area (FST=0.219; Nm=2.23), where beekeepers locally trap swarms. Therefore, development initiatives should focus on enabling honey production for colony sellers in the highlands and creating for the buyers local access to colonies.

Multiplication of honey bee (*Apis mellifera Adansonii* L.) colonies using three different low-cost model nucleus hives design in two main vegetation zones of Nigeria

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In Nigeria, there is a growing need for additional honeybee colonies to satisfy the demand for pollination services and compensate for high colony mortality through bush burning, vandalization and pesticide poisoning. The objective of this study is to multiply honeybee colonies using different models of nucleus hives. This research is poised to build beekeepers capacity in the use of "Waste to Wealth" forms of nucleus beehives to maximize production of hive products and pollination services. The study evaluates the preference of different nucleus hive to the establishment of colony and how to mitigate the effect of pest and diseases in the apiary. This was carried out in the two main agroecological zones of Nigeria (i.e. forest and savanna). The study sites were the Teaching and Research Farms of Faculty of Agriculture, University of Abuja (8.98070N, 7.18050E) and Obafemi Awolowo University (7.49680N, 4.51720E) in the savanna and forest vegetation respectively. The data collected includes the rate of colony establishment, number of incoming bees, colony weight, brood length, incidence of pest and infestation of diseases as well as colony abscondment rate at week intervals. The experiment at the two locations was layout using Randomized Complete Design (RCBD, data collected were analyzed using SPSS Version 22. A total number of 24 nucleus hives made from different low cost model of materials were deployed in the two agroecological zones. The result shows that the bamboo and the carton hives ("Waste to Wealth" hive type) gave similar result with the conventional wooden hives. The findings from this study portrayed that bee farmers in Nigeria can adopt the use of low cost materials of bamboo and carton to raise nucleus hives for establishment of colony in modern beekeeping practice. This will help the commercial bee farmers to increase their colony in a short time without the use of wooden hive and in turn lower pressure on the demand for planks for building hives and in the shortest time reduce deforestation and assures a healthy global environment.

Knowledge Management Strategy in the Network for the Development of Beekeeping in Latin America and the Caribbean (REDLAC)

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In order to promote the "collective mode of innovation" developed in REDLAC and to incorporate learned lessons, an adequate management of codified and tacit knowledge is essential, through the active exchange of information and experience in the territories, where the use of ICT's plays an important role. The proposed strategy makes it possible to socialize the scientific information generated in the project, combining it with the experience of technicians and beekeepers, generating a new level of knowledge applicable and adjusted to the reality of each territory, to promote the innovation through a agile and economic process of knowledge management. The challenge is to make the knowledge generated by the research team be available to the small organized beekeepers in an equitable way, while capturing the experience accumulated by the beekeepers themselves in the territories through the active participation of extensionists. The proposed strategy combines virtual tools with face-to-face ones, working at three levels: a) Training of extensionists through an university formal career in virtual mode; b) Several courses using the MOOC Platform; c) Permanent Plan for the Professionalization of Beekeepers. The proposed knowledge management strategy is being implemented and a series of successful experiences have been developed. The course of the Degree in Beekeeping for Development was completed. 43,600 people were reached in three MOOC courses. The Permanent Plan for the Professionalization of Beekeeping has been initiated, a joint proposal of the Beekeeping Program of INTA Argentina and the National University of the Center of Bs.As. (UNICEN). This Plan allows putting the "collective mode of innovation" into action, involving a team of 12 researchers, 48 technicians and 690 beekeepers, linking in two components: virtual and face-to-face, and certifying the professional skills of beekeepers from INTA and the University. Progress was made towards a community of practice by expanding the team significantly. The knowledge management strategy is underway and the collective construction of knowledge allows quick and timely responses to the challenges faced by the beekeeping sector.

Over 100% expected honey yield increment for the African Honey Industry- The case of promoting and adopting the use of a book-like frame that allows honey harvesting without comb destruction

Abraham Allotey
Resource Management Support Centre, Forestry Commission, Ghana

INTRODUCTION:

Africa is a net importer of honey even though African has a fairly large population of bees with variable materials for all types of hive construction.

Low honey yields are due to

1. Failure to recognize beekeeping as a viable business compared to other enterprises
2. Honey harvesting methods that destroy the comb
3. Inadequate skills for Queen rearing and colony multiplication

All the above inadequacies could be solved by the adoption of the following which can be done by wood, metal and food grade plastic

1. Honey comb brace

1. Honey comb brace is a book-like mechanism in which foundation combs are inserted and placed in hives similar in function to the Langstroth frames but very simple to use. Its width could be varied to enable the current top bars with honey-laden combs to be inserted and their honey extracted without combs destruction in a tangential extractor. The brace does not use top bars but an alternative feature and it enhances faster honey production and in higher volumes.

With these innovations efficiency in honey harvesting will improve and honey yields will increase by over 100% as compared to the current status. This will attract investments into the bee industry to enhance its business nature in Africa. The brace will also enable all the benefits of Langstroth frames by way of queen rearing and pollination services provision to be implemented to provide revenue to the beekeepers. These innovations will enable the entry into the bee industry to be affordable, stress-free, attractive and financially rewarding as compared to other enterprises as the honey production will be faster in terms of volumes and quality.

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Framework Hive Concept –An affordable sustainable Beehive that combines all the advantages of standard hives

[Abraham Allotey](#)

Resource Management Support Centre, Forestry Commission,Ghana

INTRODUCTION:

Africa is a net importer of honey even though African has a fairly large population of bees with variable materials for all types of hive construction.

Low honey yields are due to

1. Failure to recognize beekeeping as a viable business compared to other enterprises
2. High cost of bee keeping inputs eg. Beehive
3. Honey harvesting methods that destroy the comb
4. Inadequate skills for Queen rearing and colony multiplication

High cost beehives challenges could be solved by the adoption of the Low tech and efficient Framework beehive concept which can be done by wood, metal or food grade plastic

1. Framework hive

Framework hive concept is designed according to the peripheral shape and size of all standard hives with the body of the hive having openings to be covered with various materials such as bamboo, raffia, rattan, scrap wood, woven basket etc. This makes beehives to be constructed with available local materials at reasonably very low cost.

Bees can freely form their combs on branches of trees thus the covering of the hive is to provide 'privacy' and help in maintaining conducive internal conditions. Thus the Tanzanian Framework hive will be cuboid in shape with the top bars weight resting on the frameworks.

With these innovations beehives will be affordable as compared to the current status. This will attract investments into the bee industry to enhance its business nature in Africa and also create the needed green jobs. These innovations will enable the entry into the bee industry to be affordable, stress-free, attractive and financially rewarding as it will promote innovativeness of beekeepers to reduces the cost of beehives.

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The Contribution of Kastamonu University Forestry and Nature Tourism Specialization Coordinator to Beekeeping

[İlknur Şahin](#)

Kastamonu Üniversitesi

Since 2015, 5 university is specialized by Higher Education Institution (YÖK) in Turkey. Kastamonu University is specialized with "Forestry" and "Nature Tourism" at second stage of specialization of YÖK at 2018. In 3 years, Forestry and Nature Tourism Specialization Coordinatorship (OTTI) has actualized many mission in terms of regional development. In that sense, Forestry and Nature Tourism Specialization Coordinatorship educate beekeepers and earn job. OTTI has certified beekeepers for next years. By the way, Forestry and Nature Tourism Specialization Coordinatorship organized trainings for beekeepers in 2021-2022. Firstly, "Production of Chestnut Honey" education has given to "Kastamonu Province Beekeepers Association" in 02.10.2021 and then "Beekeeping and Bee Products Workshop in Kastamonu" at 03.11.2021. Another contribution of the coordinatorship is "honey forest" project in Kastamonu region. With this project, the coordinatorship aimed to have regional development by supporting beekeepers. Also, the protocol has signed with Kastamonu University and "Kastamonu Province Beekeepers Association" to analyze honey for commercialization.

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Guardians of the Forest, beekeepers as stewards of natural forest

[Milan Wiercx van Rhijn](#)

Facing Bees Foundation, 8Bees

In South West Ethiopia there is wild abundant Flora and Fauna. A stark contrast between the other areas that exist in the country – where we find degraded land in the north, we find lush and strong ecosystems in the South West. Beekeepers here are key actors keeping this richness of biodiversity intact. The beekeeping practices are transferred through generations, the local bees are freely available, as well as the materials are sustainably sourced. The bees are healthy and thriving, where natural selection ensures that only those that are the fittest survive. As they practice extensive beekeeping, their hives are scattered around the forest and ensure not only a perfectly balanced repartition of honey bee colonies, but also creating a form of stewardship. The forest beekeeper are guardians of the forest: they take care of their forest, actively protecting against illegal logging, while their livelihood is directly correlated to its health.

A case study of forest beekeeping in South-West Ethiopia.

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Funding for beekeeping projects, new mechanisms for a new era

[Milan Wiercx van Rhijn](#)

Facing Bees Foundation, 8Bees

Beekeeping development projects are one of the most cost-effective means to alleviate poverty in a sustainable way while providing a net-positive result for the environment. In recent years we have seen a drastic reduction of development budgets of governments, where even running projects had to be stopped mid-project due to this change of policies. Is government funding for development projects something of the past?

For many project beneficiaries and organisations governmental budget cuts have come at a great cost. What is next? What alternatives have taken the place of these lost streams of funding? Shifting to other means like finding (and the challenge of engaging with) individual donors, building corporate partnerships for sponsored projects, and leveraging the potential of trade for possible funding. Are these more sustainable? How are organisations leveraging different methods to still deliver beekeeping projects and strengthening livelihoods? We will address these questions and more, while also looking at new innovative ways and their pitfalls that come with.

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Rural Beekeeping Program for Uganda

[Prince Kimbugwe Edward](#)

Prince Kimbugwe Foundation Beekeeping Research and Training Centre Uganda

Beekeeping has been identified as one of the economic activities with very high potentials such as abundance of natural resources, easy integration in crop production, low technology requirements and indigenous knowledge and skills, a rich variety of bees e.g. Apis mellifera scutellata, Apis mellifera adansonii and A. mellifera monticola. However there are constraints to the developments of beekeeping e.g. lack of policy and legislation, training and information, quality of honey and other hive products, limited market and limited access to production credits. Implementation of the NAADS programme is planned to assist the women beekeepers/farmers to invest in beekeeping through organised viable and sustainable groups development to enable them to produce and sell honey, to negotiate realistic prices and be able to raise tradable volumes of honey and other hive products. This will be realized through the development of special unifloral honey, promotion of organic quality products and marketing organisation for reduction of the household Poverty.

Local Skills

Beekeeping is a widespread activity with a wealth of existing local knowledge and skills. The addition of a little technical information, however, can lead to greatly improved harvests of honey and beeswax. There are many ways to assist honey hunters or beekeepers to build on their resources to create more income by harvesting and processing honey more skillfully, and to obtain better prices by saving and selling beeswax and by making secondary products. We impart skills to target groups to handle post harvest handling, modern hives making and value addition, our sustainable, profitable, dependable, marketable & transferable skills development program for the rural poor has increased on beekeeping practice in Uganda.

Local Experience

Our rural people know a lot about bees, but they lack advanced technology in queen rearing, post harvest handling, book keeping and learning the bee calendar. 80 youth have been training by us in appropriate beekeeping in January 21 now they have over 20 hives each.

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Empowering underprivileged groups: beekeeping in Slovenian prison

[Gorazd Trušnovc](#)

Urban Beekeepers' Association of Slovenia, Ljubljana, Slovenia

Urban Beekeepers' Association of Slovenia is since 2020 part of international EU consortium FoodE, which is focusing on food chains and sustainability, and within this we're leading a pilot project "Prison Honey" - empowering the imprisoned persons through teaching them how to keep the bees within the perimeter of the institution on the periphery of Ljubljana. The pilot is building on the existing »rent-a-hive« initiative to develop a new service involving the long-term prisoners undergoing rehabilitation. The pilot is focusing on regional detention centre, but with the ambition of spreading the model throughout Slovenia in the future. Beehives have been set up within the prison system and we've started with education of the inmates through workshops involving social workers and beekeepers in 2021. The aim was to provide the prisons with their own honey and other bee products (pollen, propolis, pure wax), create more humane and socially inclusive conditions within the penalty system, and provide the prisoners with the possibility of a new career/jobs after the end of their incarceration. We've created new job opportunities and have involved more than 100 local stakeholders attending training and dissemination workshops so far, divided into smaller groups (around 12 persons in each group for greater effect),

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more than 1000 citizens that participate in the dissemination and promotional events, online international dissemination. In short, the objectives of the project were to go beyond business opportunities and food production as such, as they also include social activation in its core. In fact, the project offers a way to rehabilitate and empower underprivileged groups of society, to create more human and socially inclusive conditions within the penalty system. The pilot project could also be implemented in different care facilities (for the elderly, persons with various disabilities, etc.), with the aim to provide users with opportunities for quality social inclusion, active working life, personal development, developing independence and social networks. In the future, we hope to turn the pilot into an example of good practice and show the therapeutic potential of beekeeping as a craft, vocation, or occupation, not only in Slovenia but also abroad.

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International Photo Competition - Bee Press Photo 2021

Michal Petruška¹, Marie Šotolová², [Teresa Kobjalka](#)³, Marko Borko⁴, Robert Brodschneider⁵

¹Magazine for beekeepers Dymák, Slovakia

²Magazine for beekeepers Moderní včelař, Czech republic

³Magazine for beekeepers Pasieka, Poland

⁴Magazine for beekeepers Slovenski čebelar, Slovenia

⁵Magazine for beekeepers Bee World, Austria

International photo competiton called Bee Press Photo 2021 - the aim of the competition was to present and evaluate photos with a beekeeping theme. The best photos evaluated by the jury were then organised to the exhibition showed through the schools and cities around the Central Europe to promote key role of *Apis mellifera* in pollination.

Many people have took a chance to discover more about pollinators and their role in our everyday life. They discovered also the work of beekeepers standing behind their lifes. There were two thematic categories of the competition: the first called “Bee in all its stages of life and activities” and the second “Working and relaxing at the apiary”.

Age categories were adicted for adults and youth separalely.

The photo competition Bee Press Photo was supported by beekeeper´s magazines from Slovakia, Czech, Poland, Slovenia and international magazine Bee World. More than 200 pictures was collected and now we have some 30 best photos prepared to by shown at 47th Congress od Apimondia.

The one of our winners pictures you could find on the title of Bee World, Volume 98, Issue 4 (2021)

All awarded photos by a jury you can find at magazin Dymak website here <https://www.dymak.online/bee-press-photo-2021/>

Another pictures of exhibition were choosen by editorial board od magazin Dymak.

The pictures can by shown as a solo exhibition for guests and participants of the Apimondia, but we can also provide short speech about the competition and our success and goals for next year.

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Foundation Of Women Beekeepers

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⁹Bogomolets National Medical University; Public Organization Foundation of Women Beekeepers, Kyiv, Ukraine

NGO «Foundation of Women Beekeepers» is the first, currently, the only registered in Ukraine, a non-profit women’s public organization which promotes awareness of the importance of bees for food security, conducts current research and implements them in beekeeping practices, spreads the culture of beekeeping and protects bees. Organization implements vital strategic research, educational and social initiatives that protect honey bees and beekeeping, promote the introduction of bee pollination, increase food security, promote rural development. At the end of 2021, we united 60 women of Ukraine. As of 2022, 44 members of the organization are active due to the war and economic situation in Ukraine. Organization includes women practising beekeeping, scientists, teachers, apitherapists from towns and villages from 18 regions of Ukraine, including from the territories where the fightings were actively conducted. 13 women are involved in scientific or educational activities, including 9 PhDs in the fields of agriculture, biology, veterinary science, medicine, social sciences and 1 doctor of biological sciences. Our women practitioners are engaged in the production, processing of bee products, including organic, apiproducs, biologically active supplements, cosmetics, apitherapy, apitourism, production of wax and equipment for beekeepers. There is also an apitherapist and 5 certified api-advisers. During the 2021 season, the women of our organization produced 75 tons of honey, 1726 kg of wax, 1266 kg of bee pollen, 92 kg of drone larvae homogenate, 88 kg of bee bread, 52 kg of propolis, 29 kg of wax moth larvae for the production of extract, 4 kg of royal jelly. 1,229 queen bees and 685 nucleus were also produced. However, given the economic and social situation in the villages and towns of Ukraine, where apiaries are predominantly located, not all women work legally and can meet international requirements for safety and quality of production processes. Thus, 69% of women work illegally, 19% of them have no registered apiaries and do not register bee colonies at all. And only, 22% of women work as sole proprietors, 3% as farms, 6% as LLC. This leads to the need for social and economic support for the development of women beekeeping in Ukraine.

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Women, bees, and sustainability: the case of a meliponiculture course

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A meliponiculture course can be an efficient way to encourage the practice of sustainable activities as a source of supplementary income and, at the same time, provide moments of self-knowledge and social reflection for women, especially those in rural areas. Here we report the experience of a female inclusion project using “native stingless bees” as a motto. The project involved the creation of a multidisciplinary group for course planning, production of methodology and didactic material, as well as the identification of the target audience and how to access it (women primarily farmers and at risk). The course was offered online, due to the COVID-19 pandemic, with monetary and pedagogical assistance to the most needy students. Twenty-two women were enrolled and the 40 h course was developed for 3 months in the first semester of 2021, with presence in synchronous activities around 80 to 100%. The physical material produced was collected directly from IFSULDEMINAS-Campus Poços de Caldas (Minas Gerais, Brazil) or sent via regular mail. The course was divided into 5 modules of 8 h: 1. The most important animal on Earth; 2. The history of the relationship between humans and bees; 3. The relationship between bees and flowers; 4. Breeding native bees; and 5. Management of stingless bees. In all topics, it was possible to discuss and integrate the biology and management of bees with social aspects of the students and the community where they live. Seventy-four percent of the students who took the course considered beekeeping a viable activity and intend to work with bees in the short or medium term, suggesting that the activity can be adopted as a sustainable and possible activity. Furthermore, delving into the biology of social bees, which is based on a predominantly female organization, was an effective instrument for the discussion of various social issues related to feminism, self-knowledge and personal and historical appreciation. We conclude that the development of meliponiculture courses should be encouraged in communities in Brazil and in other countries where the role of women in society and the quality of life and the environment are deteriorated.

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Beekeeping Role in Preserving Altai Biodiversity and Improving Public Health

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Beekeeping can become nature conservation factor. In order to confirm the assumption, “Natural Pasture Biodiversity Conservation and Restoration” project was conducted on the territory of the “Katon-Karagai” State National Nature Park. The National Park is located in the Kazakh Altai, where the borders of four states (Kazakhstan, Mongolia, Russia and China)

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converge. According to historical data, it is considered the origins of the Turkic people. The landscape of the area presents an extremely rich variety of flora and fauna. Most of the plant species growing in the area are good honeybees.

The main occupation of the local population is cattle breeding, the number of which increases every year, which affects pastures overgrazing, and highly edible plants vanishing. To restore biodiversity, program of comprehensive development of beekeeping and agrotourism with apitherapy elements is launched.

Bees were first brought to the region in the 17th century from Kyiv Province. Over the centuries, they have survived without mixing with other bee species and developed genetic set of adaptations to the harsh environment, cold long wintering, diseases, and honey collection in a short summer period. Bees collect honey with its unique pleasant taste and smell, which is highly demanded.

To expand beekeeping, we have organized supplies of bee packages for new bee farms. The state subsidizes the breeding work, assists maintaining bees breed purity with the characteristics of *Apis mellifera mellifera*. Our specialists have developed product tracking system applying digitalization and QRs. We put apicabins in recreation areas. All these give farmers more income than traditional cattle breeding. Therefore, the population reduces cattle number and switches to beekeeping and agrotourism. The new area also improves beekeepers health. Eventually, during the pandemic there was not a single case of severe Covid-19 disease among beekeepers and their families in the East Kazakhstan.

To summarize, beekeeping is multifaceted activity that contributes to the nature conservation, improving people's health, increasing the well-being of the population, especially in rural areas.

Our further plans include studying the unique characteristics of local honey quality and local bees breeding work. So we invite fellow scientists to Kazakhstan to participate in our projects.

[PP-154 \[Beekeeping for Rural Development\]](#)

Making of a 5th Gen Beek: The story of a 14-year young female beekeeper from India

[Jose Louies](#)

IndianBees.org is affiliated to the Tropical Institute of Ecological Sciences in Kottayam (Kerala State), India

The state of Kerala is beautiful state with rich flora and fauna and tropical weather condition. The state is part of the Western Ghats and the landscape is famous across the world for the spices such as black pepper, clove, pepper, coffee & tea originated from the region.

Beekeeping in the state of Kerala was declining as it was not a profitable business for many professional beekeepers. Due to the changing farming practices and plantation activities, the natural bee population also declining and there was a need to start small scale beekeeping involving youngsters and native bee species. We needed to conserve the native bee species and also ensure that the tradition of beekeeping is kept alive in the community.

As part of a Beekeeping Project "Bees for Life", we have trained a few young beekeepers during the Covid lockdown phase. They were not attending regular schools or using mobile phones as their classrooms. This case study is about Michelle, a 14-year young enterprising girl who became an expert beekeeper and also started selling pure raw honey to more than a hundred happy customers across the country.

Michelle learnt the first lessons of beekeeping from her father who kept one beehive at home as a hobby. She started with assisting her father and had her own beehive in 2019.

During the COVID lockdown (2020-21) she expanded her beehives into a dozen beehives and also helped three adults to setup apiaries at their homes.

Today she sell honey to more than hundred customers where the honey is either from her beehives and also buy from other beekeepers.

She has already attended international workshops, participated in online workshops in national and international workshops

The future of sustainable beekeeping depends on new beekeepers who will take the practice of ethical beekeeping forward where they ensure the conservation of bees and also ensure the production of honey for the people.

[PP-157 \[Beekeeping for Rural Development\]](#)

LIFE VAIA: Valuing Afforestation of damaged woods with Innovative Agroforestry

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The LIFE VAIA project (Valuing Afforestation of damaged woods with Innovative Agroforestry) stems from the need to

restore forest areas and increase the ecological, economic and social resilience of forest ecosystems damaged by extreme climate events, such as the VAIA storm that hit North East Italy in October 2018.

The objectives of the project, to be pursued in 16 pilot sites (of about 2.5 hectares each) in Italy, Spain and France, are in line with the European Union's environmental strategy aimed at protecting forests from damage caused by climate change, strengthening local ecosystems and protecting biodiversity.

With a duration of five years and a total budget of €6 million, of which €3 million has been allocated by the European Commission, the LIFE VAIA project aims to develop an innovative approach based on the application of "temporary" agroforestry measures (15/20 years). This strategy makes it possible to invest in the production of sustainable and low-impact products, increasing biodiversity and the sustainable use of resources. The main actions financed by LIFE VAIA concern the reproduction and cultivation of wild blueberries and other "wild" small fruits, food and medicinal plants in forest ecosystems, as well as the enhancement of beekeeping production in forest areas destroyed by storms and other extreme climate events. The forestry strategy pursued by the project will make it possible to limit the economic damage suffered by local communities and to develop innovative silviculture and value-added products.

[PP-158 \[Beekeeping Technology and Quality\]](#)

Apivox Varroa Eliminator. A new method of beekeeping and a new beehive, the task of which is to suppress the development of Varroa mites population

[Serjio Glebskij](#)

Research Dept. Apivox Project, Barcelona, Spain

In the frameworks of Apivox Varroa Eliminator project, the possibilities of suppressing the development of the Varroa mites population in bee colonies were studied. It is well known that it is the development of these mites and the associated viral infections that ultimately lead to the collapse of bee colonies. For today this task is of global importance!

For three years of work, we managed to find such a way of keeping bees, which made it possible to reduce the intensity of mites reproduction, which, together with simple zootechnical methods, made it possible to suppress the development of mites in experimental families. Of course, we do not completely destroy the population of mites, but every year their population is getting smaller and smaller.

Within the frameworks of the project, after analyzing dozens of works by well-known world-famous scientists, a new method of keeping bees was developed, and a new design of the hive was created for any frame standards, which allows keeping bees in accordance with the new requirements. The 2019-2021 seasons were a test season for a new method and a new hive. The results to date are promising!

Experimental colonies with initially different numbers of Varroa mites and different amounts of early brood ended the season with the number of mites, confirmed by alcohol wash, in the amount of 0.8-2 %% to the number of bees. At the same time, the control colony with a large amount of spring brood showed a result of 20.3%. At the same time, no chemicals were used.

The design of the hive is simple and can be used almost anywhere. The hive does not require additional maintenance work from beekeepers. The bees showed good performance in it, having given marketable honey a month and a half after settling in the hives in the form of standard packages with three brood frames. During the entire season, there were no manifestations of viral infections in new hives, while the same package in a standard hive developed into a family affected by Varroa mites and wing deformation viruses, etc.

[PP-159 \[Beekeeping Technology and Quality\]](#)

Apivox Smart Monitor - an unique device for quick determination of the state of bee colony without opening the hive

[Serjio Glebskij](#)

Research Dept. Apivox Project, Barcelona, Spain

Within the frameworks of the Apivox Smart Monitor project, we carried out analytical studies of more than fifty works of well-known world-famous scientists and on the basis of their work, we were able to develop the theoretical foundations of acoustic control of bees. Further, several years of practical research in an experimental apiary made it possible to gain an understanding of the true processes taking place in the hive, which are reflected in the acoustic signals of bees.

It turned out that in fact, what was previously considered to be the true signals of bees and that those who had been engaged in acoustic control before us tried to analyze and use, turned out to be only the sounds of the wings of bees engaged in various works in the hive. It was found, that it is almost impossible to analyze using FFT instruments and

algorithms, and very difficult to use, true signals of bees, which have been studied by all scientists, due to their short duration and rare use.

This knowledge helped us to create a device that took into account the shortcomings of all its predecessors. The capabilities of the device (application + smartphone based on Android OS) are quite wide - these are: obtaining a general picture of the state of a bee colony, obtaining data on the relative amount of open brood, on the possibility of swarming, on the state of the queen, on her location in a divided colony, on the possibility of obtaining a commercial honey from a family of bees in the current conditions. Our device has been operating for three years in experimental apiaries, as well as apiaries of beekeepers in the USA and Europe, and shows good results.

Despite this, there is still potential and techniques for investigation of true acoustic signals of bees. We also do not exclude, in the future, the possibility of controlling bees using these signals.

PP-165 [Beekeeping Technology and Quality]

Antioxidant, phenolic and flavonoid contents of propolis extracts produced by the Western honey bee and stingless bees in Thailand

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Bee propolis is a natural resinous substance collected by foraging bees from various plant species. Chemical compositions and properties of propolis depend on plant sources, bee species, and climate in the region where the bees collect the propolis. We investigated the antioxidant activity, the total phenolic and flavonoid contents of propolis ethanolic extracts produced by the western honey bee ("Apis mellifera") and three "Tetrigona" native stingless bees from Thailand, that were collected from seven different locations. Our findings show that the total phenolic content of the investigated samples varied from 6.13 ± 0.13 to 82.85 ± 1.85 mg GAE/g. Flavonoid content ranged from 0.32 ± 0.01 to 19.31 ± 0.15 mg QE/g. The highest radical scavenging effect was observed in the stingless propolis extract collected from the central region of Thailand, which was $IC_{50} = 0.68$ mg/ml. In general, the content of phenols and flavonoids from propolis extract of both honey and stingless bees was very high and it varied based on location. The results obtained from this study suggests that propolis extract from both honey and stingless bees can be used as an antioxidant treatment for a number of applications.

PP-166 [Beekeeping Technology and Quality]

Carbohydrates characterization of honeys from Reunion Island by ion chromatography

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Reunion Island is a French overseas territory located in the Indian ocean. It owns a rich indigenous and endemic biodiversity, including several plants listed in the French pharmacopeia. While the local beekeeping industry has been flourishing for decades, no mention of Reunionese honeys characterization could be found in the scientific state of the art. Thus, a European project was launched to describe the physicochemical composition and biological properties of honeys produced on the island. The presentation will introduce the carbohydrates characterization. These essential molecules inform about the crystallization rate and the botanical origins of honey.

For this project, 54 Reunionese beekeepers gave 156 honeys produced within the last 2 years. These samples were named after the main sources of Reunionese honey: Pink pepper (Schinus terebinthifolius), Lychee (Litchi chinensis Sonn.), Forest, and Multifloral. Their carbohydrates composition was determined by High-Performance Anion-Exchange Chromatography with Pulsed Amperometric Detection. 16 carbohydrates were quantified: fructose, glucose, and 14 minor oligosaccharides (turanose, isomaltose, kojibiose ...). The 156 honeys were analyzed, then the dataset was processed with descriptive statistics and Principal Components Analysis (PCA). It appeared that lychee honeys were significantly different from all others, and crystallized the fastest.

These results began to fulfill the lack of knowledge on Reunion Island honeys. The next step will be to carry on the chemical and biological characterization of the samples. This complete description will highlight the best sources of honeys: the ones that provide the most exceptional biological and dermatological properties. This work could also promote the Reunionese beekeeping industry and lead to prosperous economic development.

PP-171 [Beekeeping Technology and Quality]

Investigation of semi-volatile organic compounds and persistent organic pollutant residues in honeybees, honey and pollen

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Honeybee and bee products are among the bio-indicators for monitoring environmental pollution, as they carry out intense foraging activities in places near their hives. As a result of these activities, honeybees both take many semi-volatile organic compounds (SVOCs) and persistent organic pollutants (POPs) into their bodies and carry them to bee products such as honey and pollen. While polycyclic aromatic hydrocarbons (PAHs) are in the class of SVOCs, polychlorinated biphenyls (PCBs) and organochlorine pesticides (OCPs) are in the class of POPs. These three pollutants cause global concerns due to their persistence in the environment, their volatility, their accumulation in different matrices, and their ubiquity. Although there have been many studies on the detection of pollution in honeybee and bee products recently, there are limited studies on the detection of several pollutants at the same time. The aim of this study is to determine the PAHs, PCBs and OCPs concentrations in urban and semi-urban areas in the honeybee, honey and pollen samples and to determine the differences between sampling points. The total of 14 PAHs ($\Sigma 14$ PAHs) concentrations measured in the honeybee, honey and pollen in the urban area were 267.7 ± 74.2 ng/g, 650.2 ± 97.6 ng/g, and 304.3 ± 184.7 ng/g, respectively. Similarly, the $\Sigma 14$ PAHs concentrations in the semi-urban area were 109.1 ± 19.9 ng/g, 464.3 ± 57.9 ng/g, and 329.6 ± 154.2 ng/g, respectively. The $\Sigma 14$ PCBs concentrations in measured in the honeybee, honey and pollen in the urban area were 6.3 ± 2.9 ng/g, 13.0 ± 4.8 ng/g and 8.7 ± 3.6 ng/g, respectively. Similarly, the $\Sigma 14$ PCBs concentrations in the semi-urban area were 5.7 ± 2.1 ng/g, 17.4 ± 4.0 ng/g and 7.7 ± 2.2 ng/g, respectively. Finally, The $\Sigma 10$ OCPs concentrations measured in the honeybee, honey and pollen in the urban area were 39.1 ± 11.1 ng/g, 41.8 ± 1.6 ng/g and 21.7 ± 4.4 ng/g, respectively. Similarly, the $\Sigma 10$ OCPs concentrations in the semi-urban area were 39.9 ± 7.1 ng/g, 39.2 ± 3.9 ng/g and 19.8 ± 2.9 ng/g, respectively. Overall, although no external additives were added to the hives at the sampling points in this study, higher pollution levels were detected in the hives located in the urban area. In this study, it is suggested that beekeeping activities should be done less in urban areas due to high pollution levels.

PP-172 [Beekeeping Technology and Quality]

Chemical characterization and fatty acid composition of different Iranian propolis

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Propolis is a natural resinous mixture found in beehives. It has pharmacological and biological properties related to its chemical composition. In the present study, the chemical composition of ethanolic extract of Persian propolis was determined based on Iranian National Standards methods through spectrophotometry and gas chromatography. The Folin-Ciocalteu method was used for the determination of total polyphenols. The total polyphenol content was investigated and compared with the other countries. The results showed that Iranian propolis is a good source of polyphenol components (1.5-13.5g/100g) compared to the other countries.

Also, we investigated and compared the fatty acid composition of ten samples of honeybee propolis collected from different regions of Iran with different floral sources. After lipid extraction, total fatty acids were converted into their methyl esters and analyzed by gas chromatography, coupled to a flame ionization detector according to Iran's National Standards methods. Because no additional data is available on Iran propolis fatty acid composition, we have tried to determine the percentage composition of 37 fatty acids. The primary fatty acids identified were Palmitic Acid (44.5%), Oleic Acid (18:1 Δ 9cis, 21.6 %), Linoleic Acid (18:2 Δ 9-12cis, 13.36%), Heneicosanoic Acid (4.86%) and Stearic Acid (2.2%).

Botanical origin and the effect of Native Endemic Species in the antioxidant activity pattern of honeys after ionizing irradiation treatments

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In Chile, honey may be produced from several native species with interesting biological properties owing to the presence of phenolic compounds inherited from specific floral sources.

However, climate change has determined several alterations in the flowering calendar of melliferous species, causing a decrease in the availability of food for bees due to the reduced floral supply. In that way, an increase in the prevalence of diseases such as American foulbrood *Paenibacillus larvae*, whose spores are highly resistant, has been detected. Similarly, there are markets that demand spore-free honeys, making it more difficult to export bee products.

In this work, honeys samples of native species (n= 35) produced in northern, central and southern Chile were analyzed for botanical origin, physicochemical patterns, total phenols, antioxidant and anti-radical activity. Honeys with and without spores were subjected to ionizing irradiation at three levels of intensity. Afterwards, the presence of spores and the effect on phenol bioavailability, antiradical and antioxidant activities were measured again.

This study shows the validation of the method for irradiating honeys, besides the most remarkable results of the positive correlation obtained between the presence of native endemic species in the samples analyzed and their capacity to resist this process, without altering the natural attributes of origin.

Digital Twin Approach for Monitoring and Management of Beehives

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In this study, a digital twin application was implemented to manage and monitor beekeeping activities that can be considered within the scope of sustainable and sensitive agriculture. A digital twin is an approach that involves creating a digital model of any physical object to facilitate, optimize and sustain the underlying physical process. Digital twins are promising to make agriculture smarter, more productive and sustainable. A digital twin is the digital equivalent of a real-life object that encapsulates its behavior and state in the digital environment throughout its lifetime. Although it has been stated in the literature that the digitization of beehives is difficult (because the bees and their behaviors are complex and sensitive), testing this situation with digital twins formed the research question and hypothesis of this study. Internal variables such as digital twin hive temperature (°C), humidity (%) and colony weight (kg) and meteorological (temperature (°C), humidity (%), rainy days (number), wind speed (km/h), cloudy days (number)) were generated with external variables. There are three important layers in the method determined for the digital twin extraction of the beehive. These layers are Device Layer, Digital Twin Layer and Solution layer. The device layer consists of objects whose digital twins are to be produced in the system. In the method applied for this layer, the object whose digital twin is to be removed is the beehive. Sensors are placed on the beehive for the physical quantities to be measured. The task of the digital twin layer is to create the digital twin according to the incoming sensor information, to store and process the data and to provide a connection interface to the solution layer. In the solution layer, the communication between the digital twin and the physical twin and the monitoring of all physical twins are provided in the proposed digital twin architecture. In addition, business processes such as adding/deleting/replacing new digital twins were also managed in this layer. The management of the physical twin is provided with the alerts created for the physical twins in the user interface.

Evaluation of different graft cell materials and frame position for royal jelly production of *Apis mellifera*

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Royal jelly is a nutritional reservoir for the growth and development of larvae of honeybee (*Apis mellifera*) queen and it is secreted through hypopharyngeal and mandibular glands of worker bees. In present study evaluation of royal jelly from different type of grafting cells and position of grafted frame were done for the first time in Pakistan from queen right colonies with plastic queen cups. The experiment was performed at Apiculture Research Farm Koont, Rawalpindi during 2022. Standard Langstroth hives were used for the experiment with 12 frame bees which are converted to nine bee frames to induce swarming impulse. Royal jelly production was evaluated on the basis of acceptance of grafted cells production per cell. Data obtained from experiment were analyzed by using the analysis of variance (ANOVA) and the means were compared by Least Significant Difference test (LSD). According to the results there was non-significant difference between the acceptance rate of white cell bars (73.83%) and brown cell bars (73.29%). However, the royal jelly per collected per cell was higher in white cell bars (0.377gm) as compared to brown cells bars (0.282gms). Similarly, the acceptance rate was higher when the royal jelly graft frame was placed at position seven in the single chamber colony, which was reduced when graft was placed at position six (60.65%) or eight (53.84%). These studies may be useful for the local beekeepers interested to produce royal jelly from their hives at commercial scale.

Color Index of Turkish Propolis Collected from Different Geographical Regions

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Propolis is a valuable natural substance that is collected and produced by honeybees (*Apis mellifera*) and it is widely using for its antibacterial, antifungal and anti-inflammatory properties since ancient times.

Propolis is a sticky natural substance which is collected by the honeybees from the barks of trees, resin and leaves of plants and it is obtained after mixing with their saliva. Propolis is used by honeybees in hives in many processes such as disease protection, cleaning and closing hive walls and honeycombs, covering the insects that die in the hive to prevent them from producing harmful bacteria and microorganisms, shrinking the hive entrance, and closing the holes in the hive. Propolis has wide-spectrum effects due to the compounds in its structure. Propolis has many uses especially on human and animal health; in the pharmaceutical, cosmetic industry, apitherapy and food industry.

Propolis can be classified on its physicochemical properties like color, texture, and chemical composition.

Color of propolis should be considered as one of the main factors determining its acceptability. Color of propolis varies depending on the botanical origin. It can have a wide color range from brown-yellow, brown -green or brown -red to dark-red.

In recent studies, it is determined that there is a significant correlation between the phenolic composition, the antioxidant activity, and the color.

In this study, 41 propolis samples that belong to 39 different locations in Turkey were investigated for cytotoxic, iNOS inhibition, antiviral, and antioxidant activities along with phenolic, flavonoid, triterpene contents using LC-HRMS. The volatile compounds' composition was also examined by GC-MS. Propolis samples collected from each region was photographed and a color table was created, and it has determined that content changes depending on the colors.

Production, Analysis and Evaluation of Fermented Honey Extract

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Honey (especially containing fructose and glucose monosaccharides) is a sweet product obtained by bees. Honey nectar is very rich in sugars (70-80% by weight), mainly sucrose, fructose and glucose whose ratios are influenced by the botanical origin of nectar. Honey is an ideal raw material for the production of fermented products with its many health benefits.

Recently, it has become increasing attention to bee products that are obtained as a result of the honey fermentation process. Some of them can be consumed directly (pollen collected by bees, honey, bee bread, etc.), While others are the result of lactic or acidic fermentation. On the other hand, fermented foods and beverages are an essential part of the nutrition culture of any society in the world and have the cultural history of ethnic communities. Also, honey processing has always been considered by food industry experts to produce high value-added products. The purpose of this study was to produce fermented honey extract by special honey fermentation method. The process of lactic fermentation of pollen is caused by microorganisms that are present spontaneously in the beehive, used under anaerobic conditions to produce a fermented extract of thyme honey (natural and organic) in the Kurdistan region of Iran. In the production process of fermented extract, control of ambient temperature and natural yeasts produced by bees have been used. In this process, honey sugars decompose over time and at specific controlling temperatures. The amount of fungal material was also controlled during the process. The whole process of producing fermented honey extract took 4 months. The volatile properties of this product have been extracted by the Chemistry Laboratory University of Tabriz. The results showed that the main components of this product included: (47%) geranyl acetate, neral (23%), geranial (12%), geranium (7%), nerol (5%), farnesol (3%). Due to the percentage of compounds in this extract, it can be used as a medicine, food additive and perfume industry.

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Investigation of the Status of Monofloral Sidr honey in the Middle East

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Sidr tree is one of the oldest native trees in the Middle East, which is very sacred and valuable in these areas. The genus Ziziphu has more than 100 species in the world. The most important species of this genus are Ziziphus spina-christi, Ziziphus mauritiana, Ziziphus Nummularia and Ziziphus jujuba. Ziziphus species are in the form of trees and evergreen shrubs with a height of 2 to 15 meters. This plant is thermophilic and its geographical distribution is in Morocco, North Africa, Saudi Arabia and warm parts of Iran to India. Indigenous areas along Z. spina-christi include the Persian gulf, Egypt, Syria, Palestine, Lebanon, Jordan, Iraq, Iran, Afghanistan, Pakistan and India. In recent centuries it has spread to other parts of North, Central and East Africa. The flowering season is late summer to early autumn, and several million bee colonies migrate from the surrounding areas to the Sidr forests each year. Honey production from each Sidr tree is estimated at about 3 kg and 750 kg per hectare. Sidr honey is one of the most well-known and high-quality honeys in the world, which is also known as Manuka honey of the Middle East. Annual Sidr honey production worldwide is estimated at 5,000 tons and the highest Sidr honey production is in Iran, Yemen, Saudi Arabia, India, Pakistan, Egypt, Algeria, Oman, Libya, Sudan, Ethiopia, Iraq and Kuwait, respectively. Sidr honey has a very high customer value due to its medicinal properties and unique sensory analysis. The active ingredients of Sidr honey include minerals, organic acids, amino acids, flavonoid compounds and a variety of glycosidic and steroidal saponins, especially the Christinin A compoiund. The most important benefits of Sidr honey are regulating the immune system, high antibacterial effect, antioxidant, anti-inflammatory and healing wounds and infections. Sidr honey as a monofloral honey of arid and tropical regions in the world, is of great importance in terms of quality indicators and health, and the need for further research on the active ingredients of the drug and its quality grading is felt in global markets.

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Assessment of the floral origin of some Turkish honeys by volatile composition and physicochemical parameters

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Twenty four honey samples with eight different botanical origins were collected from different regions of Turkey. Color, diastase activity, electrical conductivity, optical rotation, moisture, glucose, fructose, proline, total phenolics, and total flavonoid contents, FRAP antioxidant capacity, DPPH radical scavenging activity were measured for the studied honey samples. Identification of 103 volatile compounds from different chemical classes was carried out using SPME/GC/MS. The traditional reference method for honey classification, melissopalynology, requires expert's a great deal of experience. Therefore, this study aimed to evaluate the markers including various physicochemical, biochemical and also volatile compounds instead of melissopalynology in honey characterization. All data for authentication of honey type was statistically processed using the principal component analysis. Based on the two principal components explaining 98.10% of the total variance, honey samples were classified into eight distinct origins as astragalus, chaste tree, chestnut, rhododendron, lavandula, polyfloral, oak, and pine honeys. Some specific volatile compounds were found as useful markers in origin characterization and, volatile profile appears to be promising to use in routine quality control of honey.

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Beeswax foundation as a new method of transporting organic therapeutic agents for bee disease control

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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. For the first time in the world practice of beekeeping we have proposed a mechanism of delivering/transporting the protecting components to a bee family. It is worth noting that the therapeutic and preventive substance is introduced into the wax foundation to perform 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 main 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 Askosphaeraapis, Aspergillusflavus making 85-95%.

As a result of the work carried out, a serial production of “Propolis beeswax foundation” has been established.

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Modified Langstroth Frame

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The Langstroth Frame (L.F) fundamental functions has always been

1. Honey production

2. Honey bee queen rearing and colony multiplication

Since its invention in 1752

To improve on its functions, the LF has been modified to provide three (3) additional functions have been innovated through the development of a groove feature that easily enables accessories to be attached or fixed on to the LF

The slit or groove-like components along the ‘legs’ or height of the LF allows for fixing horizontal accessories such as

1.U-shaped pipes on the LF as feeder

2. Inserting of propolis mesh on the LF for commercial prop[olis harvesting

3. Fixing multiple small beetle traps on the LH

The groove is a two-omega shaped mechanisms with one inverted and placed under the normal omega shape feature. This allows for a slot and lock-in system to be created for other accessories to be attached

This innovation will enhance the functions of the current LF and will allow for further innovations to be fixed on the LF to improve on its productivity

Effects of Feeding Advanced Chelate Technology-Based Trace Minerals, Bonza®Bee, to Adult Honey Bee Workers (*Apis Mellifera L.*) Under Laboratory Conditions

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BACKGROUND: Honey bees require macronutrients and micronutrients for optimal growth and productivity at different stages of the lifecycle. Mineral elements are essential for honey bees in relatively small quantities. Advanced chelate compounds technology is a novel field for synthesizing efficient chelated mineral supplements for the livestock industry.

AIMS: This study aims to evaluate the effects of a new chelated mineral supplement on several nutritional and physiological values of worker honeybees. This feed supplement, named Bonza® Bee, is synthesized based on Advanced chelate compounds technology by Sodour Ahrar Shargh Company (SASh Co.) and contains the elements of calcium (6000 ppm), phosphorus (5000 ppm), magnesium (3000 ppm), iron (300 ppm), manganese (200 ppm), copper (150 ppm), zinc (150 ppm), selenium (0.3 ppm), chromium (0.1 ppm) and cobalt (0.1 ppm).

MATERIAL-METHODS: The impacts of the Bonza® Bee supplement on nutritional indices, hypopharyngeal gland growth, energy content, and tolerance to a toxicity dose of sublethal dimethoate have been studied on a laboratory bench-scale.

RESULTS: Relative growth rate, relative consumption rate, and efficacy of conversion of ingested food significantly increased by Bonza® Bee administration. The maximum growth of hypopharyngeal glands was observed in the bees have been fed with Bonza® Bee. Adding Bonza® Bee increased the protein, glycogen, and lipid content. More tolerance to the insecticide dimethoate was observed on bees fed with Bonza® Bee.

CONCLUSION: Bonza® Bee, a chelated mineral supplement, can improve the nutritional and physiological values of the honey bee.

Sensory analysis of polyfloral honey from different regions in the Republic of North Macedonia

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The increased demand for honey on the market imposes the need for adequate and continuous monitoring of the quality of honey available on the market.

Determination of honey quality involves complex examinations of organoleptic and physicochemical properties using appropriate methods.

Sensory analysis allows the determination of organoleptic indicators of honey using a descriptive method. Honey is described visually and via tasting. It is also important because it can detect some defects of honey such as: fermentation, impurities, external odors, atypical taste and etc.

This type of analysis is most often used when organizing exhibitions to promote and popularize beekeeping, honey and other honey bee products.

The honey samples (n=17) that were subject to this sensory analysis were taken from beekeepers from five different regions in the Republic of North Macedonia.

Sensory analysis of the samples was performed in the Beekeeping laboratory of the Faculty of Agricultural Sciences and Food in Skopje by five tasters. The sensory characteristics (purity, clarity, smell, taste and additionally the percentage of water) were evaluated according to a five point scale (1-5) and multiplying the grade by a factor of influence for each characteristic (0.5 for purity, 0.5 for clarity, 1.0 for smell, 1.6 for taste and 0.4 for percentage of water). Analyzed samples were grouped in five quality categories according the total number of points scored (average of the evaluations of the five tasters).

The analysis showed that 59 % of the analyzed honeys belong to the first two categories of quality (excellent and good), 30 % are of average and still acceptable quality and 11 % are of unacceptable quality.

Evaluation of the Effect of Using Bonza®Bee Chelated Mineral Supplement on Functional Traits, Intestinal Bacterial Population, and Immune System of Honeybee

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Minerals play a very important role in the metabolism and safety of all fauna, including honeybees. Despite the importance of minerals in the body's metabolism, their use in bee nutrition has not been given much importance. The use of chelated mineral supplements in bee nutrition has not been common due to its unaffordability. Based on advanced chelate compounds technology, for the first time, a chelated mineral supplement called Bonza®Bee has been specially synthesized for honeybees. In the present study, the effect of different levels of Bonza®Bee supplement administration on colonial functional traits, intestinal bacterial population, activity of digestive enzymes, intestinal morphology and honeybee mortality has been investigated. This experiment was performed in a completely randomized design with 6 treatments and 7 replications for 60 days.

In order to reduce the error, sister queen and peers were used. The results of this study showed that at different levels of Bonza®Bee, honey yield increased by 100% on average compared to the control group. In addition, with the use of this supplement, laying rate and hive population increased significantly compared to the control at the level of 1% (p<0.01). The population of *Lactobacillus* and the population of intestinal coliforms were significantly higher and lower than the control, respectively. Phenyl oxidase and hemocyte levels were also significantly higher (p<0.05) in Bonza®Bee group. In general, in the present study, the administration of Bonza®Bee in syrup increased honey production, brood breeding and hive population, improved gastrointestinal bacterial population and strengthened the bee immune system. Due to the significant increase in honey production, this supplement is recommended as a cost-effective additive for the beekeeping industry.

Comparison of total phenolic content and antioxidant activity of Indonesian propolis extracted with various solvents

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Propolis (bee glue) is a sticky material collected by bees from plant resins. It has been proven to possess numerous beneficial pharmacological properties, such as: antibacterial, antiviral, antioxidant, anti-inflammatory, immunostimulant, hepatoprotective, cytotoxic, etc. Nowadays, propolis is a popular remedy all over the world, and is available in either pure form or combined with other natural products in over-the-counter preparations, cosmetics, and as a constituent of health foods. Propolis has a variable chemical composition due to the fact that honey bees collect it from a variety of plants in various phyto-geo-climatic zones. To produce high-quality and cost-effective propolis products, selecting the appropriate extraction method is critical. Ethanol is commonly used as an extraction solvent of propolis. However, ethanol leaves a strong aftertaste and causes alcohol intolerance for some consumers. In this study, virgin coconut oil (VCO) and Natural Deep Eutectic Solvent (NaDES) were investigated as propolis solvents. Some of the NaDES used were choline chloride-propylene glycol (CCPG), choline chloride-glycerol-water (CCGW), and citric acid-propylene glycol (CAPG). *Tetragonula sapiens* beehives were taken from north of Luwu district, South Sulawesi Province, Indonesia. Extraction was carried out by maceration with a 1:5 m/V ratio of propolis and solvents, followed by homogenization at 355 rpm for 8 hours at room temperature. Total phenolic content was determined by the Folin-Ciocalteu method, and the antioxidant activity was determined by the DPPH assay. The TPC of propolis extract in ethanol, VCO, CCPG, CCGW, and CAPG ranged from 136.17±27.9 to 693.03±91.09 mgGAE/g. The antioxidant activity IC50 values ranged from 4.625 to 550 mg/mL. Comparatively, CCPG propolis extract has the highest TPC content and antioxidant activity with the lowest IC50. It found that CCPG-based NaDES solvent was the best for propolis extraction. NaDES is a prospective solvent to be used in Indonesian propolis. It could be used as both an extraction medium and a formulation component. The solubility and bioactivity of propolis compounds will need to be studied further.

BeePlant Image Processing Royal Jelly Machine

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Many different products, especially honey, are obtained from honey bees. One of these is royal jelly, whose weight is 60 times more valuable than honey. Royal jelly is secreted from the glands of young worker bees and used for feeding bee larvae. However, its production is arduous and can only be done in a limited time frame. Although royal jelly is very valuable, the main reasons for the low production are that the production process of royal jelly is a difficult and long process, and the need for good organization, more than one experienced beekeeper and milking workshop. The most time-consuming process in production is the transfer of larvae and royal jelly milking by humans. In order to accelerate this process and increase the production of royal jelly, human labor should be reduced. For this, the ideal size for the production of royal jelly in the honeycomb cells, the larvae between 1.5-1.8 mm should be detected and transferred to appropriate thimbles and hives. The BeePlant royal jelly machine analyzes the hives with image processing and determines the position and characteristics of the healthy larvae in the honeycombs by image processing, automatically collects the larvae without any damage, transfers them to the thimbles, and provides royal jelly. BeePlant is a mobile hive that requires experience, provides difficult and expensive royal jelly production in accordance with industry 4.0 standards, with high efficiency and quality. By providing the necessary larvae transfer and harvesting with image processing technology, it is aimed to reduce the intensive work of an average of 5 beekeepers for 100 days by at least 72% and to increase the royal jelly yield by 2 times. Thanks to BeePlant, we aim to select the beehives to be selected during the preparation phase of beekeepers starter, feeder and breeder colonies with an accuracy rate of up to 85% with the image processing method, and to prepare and harvest bee thimbles untouched by the larva transport system. With the product and method we will develop, we aim to reduce the production costs of quality royal jelly by 40% while protecting bee health.

Methods to detect wax and honey fraud

Kodjo Logou Agossou

OPAAS

Fraud is the attempt to make an abnormal object appear to be in conformity. The effectiveness of its detection, depends on two parameters, namely the sharpness of the characteristics of the reference object and the precision of the comparative analysis of it with a sample. What are the characteristics of honey, that of capped wax comb cells loaded with nectar and/or honeydew derivatives; rays of course from the genetically unmodified honeybee. What is the status of wax of this same species? What would be the appropriate methods for their recognition? As regards honey, it is very complex to define its physical or even chemical characteristics. Indeed, any nectar plant can have its honey just like any honeydew. Now, each plant has a given expression in a given ecology while the ecosystems are very varied. And as much as there is a combination of nectars there will be honey as these sweet solutions are the seat of enzymes and chemical molecules specific to each species and therefore likely to interfere. This is demonstrated by the fact that in the same hive the bees take care to separate even during the same honeyflow according to the colors.

Are there molecules of enzymes or organelles of the bee's intestinal microflora that would be found in honey? If so, at what rate? If the answer to these questions is found, it would be the main characteristic of model honey which must be demonstrated using methods integrating chemistry, electrophoresis and detection using living beings among others the bee itself and other animals consuming honey derived from natural substances. As for wax, its characteristics would be easier to define because it is a secretion of the bee's glands. However, care must be taken to ensure that all bee breeds produce similar wax; if not, try to have the characteristics such as the melting point, the average density of the wax specific to each breed by tests on several samples and add to it the biological detection based on the fact that the boiling wax brings out the bee from nowhere.

Monitoring beehive in the main flow of nectar by IOT based system

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Our knowledge of honey bee life is not sufficient, so 24-hour monitoring of the hive helps find many vague points of the honey bee's life cycle. To reach this purpose, data such as temperature, humidity, sound frequency, and weight are collected by an IoT board (named Kandoo1pluse) that transmits data to our mobile application wirelessly. Moreover, colony activities are recognized by analyzing these monitored data. Since the activity of the hive system is changed during the nectar time, the nectar collecting process and honey production can be detected by analyzing the diagram of the specific events, such as reducing the egg-laying and brood volume that provides combs for storing nectar. Furthermore, it is possible to detect the exact time of nectar flow by comparing the analyzed data with field observations. This method is so accurate that it can narrow down the detected time to the day and part of the day. These analyzed dates are used to estimate the amount of the nectar, the best time of migration, and the standing time of each area. It also determines the best honey harvesting time.

Determination and comparison of the sugar profile of honey produced in Bingöl-Turkey and some other regions by HPLC method

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Honey has a complex chemical structure consisting of sugars, proteins and lipids, vitamins, minerals, phenolic and volatile compounds. Although the chemical composition of honey varies according to its geographical and botanical source, there are more than 150 components in its structure. Therefore, honey consumption is very important for human nutrition. People have used honey for both nutritional and therapeutic purposes since ancient times. In addition to being among the main components, sugars in honey are an important parameter for the detection of possible adulteration. Therefore, determining the sugar profile of honey is an indispensable part of quality control. In this study, it was aimed to determine and compare the sugar profile of honey produced in Bingöl-Turkey (B) and two other regions (D and E) by HPLC method. The determination method is HPLC analysis with refractive index detection and requires a refractive index detector (RID). The method allows the determination of the four main sugars of honey (fructose, glucose, sucrose and maltose). As a result of this study, the mean and standard deviation of honey samples (B, D, E), respectively; for fructose B: 37.862±0.76%, D: 38.014±0.67%, E: 36.725±0.72%; for glucose B: 32.146±0.54%, D: 33.895±0.71%, E: 32.249±0.63%; for sucrose B: 1.324±0.49%, D: 2.824±0.55%, E: 2.197±0.67%; for maltose B: 2.513±0.81%, D: 1.118±0.79%, E: 2.139±0.83%. The results found in the study are compatible with the literature data.

UHS Bee App: An innovative digital tool designed for a complete solution on beekeeping for better world

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Several "Smart Phone Bee Apps" have been developed around the world with varied degrees of success to benefit apiculturists. But all these apps do not provide a complete solution about scientific beekeeping and lacks a real time solution and communication in consultation with Subject Matter Experts. In this direction, the efforts has been made to design and develop "UHS Bee App" (University of Horticultural Sciences, Bagalkot Bee App) with unique features covering all the information related to beekeeping under one umbrella at University of Horticultural Sciences, Bagalkot during the year 2021-22. The methodology applied to development "UHS Bee App" was explained and compared with the existing Bee Apps. The data was subjected to SWOT (Strength: Weakness: Opportunity: Threat) analysis for various parameters. The content in the App is divided into seven headings, such as 1) Fundamentals of Beekeeping (History, Importance, Morphology,

Anatomy, Physiology, Taxonomy and Genetics), 2) Applied beekeeping (Traditional Beekeeping, Modern Beekeeping and Migratory beekeeping), 3) Scientific beekeeping (Bee management, Bee products and value addition, Bee economics, Bee health, bee diseases, Bee poisoning, Bee flora, Bee pollination, Bee park, Bee museum), 4) Advanced technology (Bee Breeding & Mass Queen rearing, Bee decline assessment and restoration, Honey testing laboratory, disease diagnostic laboratory and Integrated Beekeeping Development Centre), 5) Success stories of beekeepers, 6) Real time communication with bee experts and 7) FAQ's. The results revealed that UHS Bee App scored five-star ratings with more than 75 percent acceptability by the end users as compared to the other popular bee apps. The Results indicated that UHS Bee app supports in upgrading the existing apiary methodologies and creating awareness on scientific beekeeping, capacity building of farmers with modern beekeeping techniques, bee breeding, multiplication of nucleus colonies and providing pollination service for sustainable production and productivity of both agricultural and horticultural crops. Further, this will also help to prioritize researchable issues and identification of new areas which needs immediate attention by scientific institutes and policy makers alike. Therefore, UHS BEE-APP is a ready reckoner to provide a complete solution on beekeeping for a better world.

PP-223 [Beekeeping Technology and Quality]

Features of Development of Urban Beekeeping in Ukraine in Present-Day Realities

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Ukraine is one of the five world leaders in honey production. Ukraine produced 68,000 tons of honey in 2020 according to the UN FAO information. 99% of Ukrainian honey is being producing on private farms.

Almost all bee colonies in Ukraine are concentrated in rural areas. There are isolated cases of small apiaries in cities. In order to develop the recommendations for the sustainable development of urban beekeeping in Ukraine, in May 2021 we created an experimental urban apiary on the roof of a 27-storied building (110 m above the ground and 285 m above sea level) in Kyiv, Ukraine.

Bee colonies were placed in polyurethane foam hives, equipped with a unique BeeData smart system (which monitors weight, temperature, humidity, sound and flight activity of bees). Additional surveillance IP PTZ camera is also installed. From May 2021 to May 2022 our experimental apiary has been constantly monitored while performing regular routines and tests on bee colonies.

During this time effects of high and low temperatures on the bee colony, effects of excessive winds, city noise and especially effects from civilian fireworks and hostilities explosions have been spotted and carefully analysed.

Thus, we have developed recommendations for:

- prevention of possible risks of apiary placement in settlements;
- minimizing specific urban and high altitude (above ground) location risks and negative factors
- prevention of uncontrolled swarming;
- providing high-quality spring development of bee colonies;
- honeycomb management;
- preparation of bee colonies for wintering and arranging wintering process itself;
- amendments to the applicable national legislation.

The samples of honey collected on our experimental urban apiary were tested for the content of 18 agricultural and urban contaminants (including pesticides, heavy metals and radionuclides). The species composition of pollen grains was determined separately. Conclusion is as follows – honey collected in the experimental urban apiary is suitable for human consumption. Moreover - by some quality and safety indicators this honey is cleaner and better than one collected in rural areas.

Results obtained are especially valuable for further researches on sustainable development of urban beekeeping and biodiversity care in Ukraine.

PP-224 [Beekeeping Technology and Quality]

The effects of bee venom production techniques on venom quality and amount

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The aim of the study was collection of bee venom samples from front of the hive and inside of the hive with two different bee venom collectors in Anatolian honey bees (*Apis mellifera anatoliaca*), to determine collected bee venom amounts, analyze of the samples for apamin, phospholipase A2 and melittin, and to evaluate obtained results. Totally, 20 bee venom samples were collected consist of eight of honey bee samples were collected from front of the hive, and 12 bee venom samples were collected from inside of the hive for 30 minutes. The samples were collected between 6-8 May of 2022 in Kazdagları mountain located at 800 meters in spring time in Turkey. The surface areas of bee venom collectors were 280 cm² and 480 cm². Bee venom samples analyzed by HPLC-DAD system for apamin, phospholipase A2 and melittin. The mean level of the five samples that collected from front of the hives (280cm²) was 36,7±14,2mg and was 42,5±13,7mg for inside of the five hives (480cm²). The mean levels of apamin, phospholipase A2 and melittin (n:5) were %0,7±0,1, %2,9±0,9 and %13,2±2,8 for front of the hives; were %1,2±0,4, %4,0±1,5 and %18,2±6,0 and totally (n:10) both front and inside of the hives were %1,0±0,2, %3,5±0,8 and %15,7±3,2 respectively. As a result, however the amount of bee venom samples from front of the hive (280cm²) was generally lower than inside of the hive (480cm²). However the mean levels of apamin, phospholipase A2 and melittin collected front of the hives were lower than the mean levels of apamin, phospholipase A2 and melittin collected inside of the hives, this situation was not important statistically (p=0,690 for apamin, p=0,841 for phospholipase and p=1,000 for melittin). Totally (n=20), levels of apamin, phospholipase A2 and melittin were generally lower than the levels of similar research results. Many factors can affect honey bee venom production and its quality such as; honey bee race, age of bees, colony strength, season of collection, feeding supplies, race, and its defense behavior.

PP-227 [Beekeeping Technology and Quality]

The effect of production time and season on the harvesting amount of bee venom collected from Yiğilca ecotype of *Apis mellifera anatoliaca*

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Honeybee venom is an exocrine secretion that is secreted by the venom sac to protect their colonies and injected into the target organism through their sting apparatus. Honeybee venom is a considerably new product that medical importance and usage areas are developing day by day with new scientific researches. The increasing market demand for this product due to its enlarging use in both cosmetics and health, opens a new market to the beekeepers. Honey bee venom became one of the most commercially valuable products with the prices varying from \$30.00 USD up to \$300.00 per gram. For this reason, it is important to determine the most productive season and time in terms of production amount and sustainability. In our study, Yiğilca ecotype colonies, which are endemic to the Yiğilca district of Düzce, Turkey, and under field protection, were used. The study was carried out with colonies of equal strength with sibling queens. In the study carried out between July and September 2021, the groups were divided into three different groups morning, noon and night, with 8 colonies in each study group. A total of 120 samples, 40 samples from each group, were evaluated. As a result of the statistical analysis, no difference was detected between the months, but the highest harvest quantity among the harvesting time groups was detected in the nighttime with an average of 0.09 g/hive. When the results of the study were evaluated, the highest amount of venom was obtained from the night groups, regardless of the month during the nectar flow season. Whether there is a difference in terms of colony welfare between the time difference groups with future studies should be investigated and evaluated in terms of sustainable production.

The Effect Of Apimix On Covid-19

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Royal jelly, propolis, and bee pollen are used for different purposes all around the world according to their anti-inflammatory, antioxidant, and antimicrobial activities. Given that Coronavirus 2019 (COVID-19) is a viral condition accompanied by a dysregulated inflammatory response in the body, we intend to evaluate the effects of natural supplementations on the disease course. A randomized, open-label, controlled trial was conducted among 50 definitive cases of COVID-19. These patients were randomly assigned into control and intervention groups. Royal Jelly, propolis, and bee pollen were prescribed to patients in the intervention group (n = 24) in addition to conventional treatment; while the control group only received the standard treatment (n = 26). At the end of the study, functional class improved in both groups, but this change was more pronounced in the intervention group (p < 0.05). In this presentation we are going to be discussing the method of production, extraction and creation of api mix products and the beneficial effects it has on the COVID-19 virus.

Invention of honey bee safety intelligent system and honey increasement (Apis mellifera) and the effect of temperature control on bee behavior

Hassan Azimi¹, Hossein Yegane Rad², Mona Delfanian¹

¹Igoonniroo Nameh Company

²Caspian Company

like other insects, the life of bees depends on temperature and they react differently to temperature changes. Therefore, by controlling the internal temperature of the bee's hive, their different reactions to temperature changes can be evaluated. The safety intelligent and honey increasement (SIHI) system were registered with the patent number 91139 at 25/01/2017, the international classification code A01K 47/06, Iran. The SIHI system has been popular among beekeepers from 2016 and its consumers are constantly increasing. This system based on the regulation of the hive's temperature leads to an increase in bee's products. The SIHI system can greatly reduce the consumption of winter honey in the hive and increase their honey production in spring due to their extremely high population compared to another hive. This system also reduces the reproduction time of the queen bee and the drone bees by controlling the hive behavior. Reports showed that beekeepers who used the SIHI system in the winter were able to maintain the hive temperature within a certain temperature range. So that, the bees spent the winter without any stress and had a great spring start.

Oxalic acid to cold steam conversion system for controlling and destroying Varroa mites with the highest efficiency without harming the hive and honey population

Hassan Azimi¹, Hossein Yegane Rad², Mona Delfanian²

¹Hassan Azimi, Mona Delfanian

²Hossein Yeganeh Rad

As a bee parasite, the Varroa mite is very important in the global beekeeping industry as it causes a lot of damage to beekeepers. Beekeepers spend a lot of money every year to deal with this pest, which unfortunately does not have a good long-term effect on future control and treatment, as so far we have seen a very high, growing resistance to mite control strips and other chemical methodologies.

One of the best possible methods to control and destroy Varroa mite is to use oxalic acid by cold steam, which is the first methodology in the country with patent number 101158 dated 28/02/1399 (17/05/2020). International classification A01K51 / 00. The device converts oxalic acid into a cold steam by converting the solid acid into very fine particles. With the help of blowing air, the oxalic is transferred by the system in the form of a cold steam to the system outlet, which is connected to the hive flight valve. The use of oxalic acid by cold steam method kills the largest number of mites compared to other methods and leaves no toxic residue. Also, this method does not increase Varroa Mite's resistance due to its contact agent.

Invention of the frequency system of bee venom collector (Apis mellifera) and determination of melittin in venom collected from different regions of Iran

Hassan Azimi¹, Hossein Yegane Rad², Mona Delfanian²

¹Hassan Azimi, Mona Delfanian

²Hossein Yeganeh Rad

Bee venom is one of the most valuable products of bee colonies, as it is used in the treatment of various diseases. So far, various machines have been developed to collect bee venom, but this new device with patent number 97676 dated 2019/01/13 and with international code A01k 59/00 causes the highest quality venom collection on the market. In this device, the voltage factor has been eliminated, and instead it uses frequency to shock the bees. The shock in the device is created by converting the 12V DC voltage to the "tens frequency" and transmitting it to the panel via the AUX cable, which causes the bees to sting a glass plate. Frequency shock significantly reduces the mortality rate of honeybees at the time of venom collecting, while reducing aggressive behaviors of the bees, minimizing impurities in the collected venom, ensuring no loss in the bee's life span after venom collection, and shortening the amount of time needed for venom collection to 20 minutes. The amount of venom produced by this device averaged between 100 mg and 375 mg per venom collection. The most important factor when assessing the quality of bee venom is the amount of Melittin present. The amount of melittin of venom collected in different regions of Iran by the above mentioned device was between 58% and 75% in 2018 and 2019, which is significantly higher than previously reports. According to the evaluation of the venom extracted, it can be stated that the new device has increased the quantitative and qualitative amount of the venom produced at the lowest economic cost. The results also showed that the venoms produced in different regions of Iran are of high quality and are very suitable for producing different products from bee venom.

Robotic Replicants for Improving Queen Bee Health and Persistence of the Honey Bee Colony

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The worldwide honey bee population is threatened by increased pesticide use, diseases, and climate change and has been in decline. Since the queen bee is the only individual that reproduces in the colony, the existence of the entire colony depends on the health of the queen bee. The RoboRoyale project aims to improve the queen's health and productivity through novel micro-robots that mimic the behavior of the worker bees attending the queen's court, which are responsible for feeding, grooming, and transferring the pheromones. The robotic system interacting with the honeybee queen will consist of micro-robotic agents connected to a manipulator equipped with high-fidelity cameras. The manipulator will continuously follow the queen in the observation hive and analyze her behavior and interactions through computer vision and machine learning methods. While the Roboroyal actuator will move the manipulator in a plane parallel to the observed combs, keeping it over the queen, a magnetic field-based end effector will control the movement of several micro-robots across the observation hive glass. These micro-robots, created from biocompatible materials, will perform the tasks of the worker bees attending the queen's court. By affecting the queen's behavior in an informed and optimal manner, the project aims to influence the colony activity to improve its health and mitigate the effects of adverse environmental factors on the honey bee population.

*The authors were alphabetically ordered.

The effect of different propolis extracts on biological activities

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Propolis is a resin-like material that bees make using plant materials such as poplar and buds. Bees use it to keep their hives hygienic and may contain hive byproducts. Propolis is known to be effective against bacteria, viruses and fungi. It may also have anti-inflammatory effects and help the skin heal. Propolis is not found in its pure form and is usually obtained from beehives. People use propolis as a dietary supplement in many diseases such as diabetes, herpes and swelling and wounds in the mouth. It is also used for burns, canker sores, genital herpes and many other conditions, but there is not enough scientific evidence to support these uses. In addition, although there is no definitive evidence to support the use of propolis for COVID-19, there are many studies. In this study, antioxidant and antimicrobial activities of propolis samples collected from different regions and their extracts will be presented. In the studies, it was determined that the vegetation in the areas where propolis was taken, the extraction method, the solvent used and the extraction times were effective on the activities. The dilution method was used for the determination of antimicrobial activity. The dilution method can be done in two different ways: broth dilution and agar dilution method. As a result of the antimicrobial test, it was observed that propolis has a very good inhibitory effect on some bacterial species. It was observed that the inhibitory effect against *Bacillus cereus* in the extracts obtained with water and DMSO was less than the extracts obtained from ethyl alcohol and propylene glycol. When the optical density of the control group grew by 1.7 Mcfarland in the ethyl alcohol extract, it was measured that *Bacillus cereus* grew by 1.2 Mcfarland. In the extracts obtained from DMSO and propylene glycol, the control group grew by 5 Mcfarland and *Bacillus cereus* by 1 Mcfarland. It was observed that the pH values varied from 3.55 to 6.97 depending on the extraction solvent used and the time. It was determined that the pH value was directly related to the increase of phenolic substances in the extraction.

The Utilization of Honey Bee Pheromones

Mackenzie Nielsen¹, Hossein Yeganehrad², Mahmoud Kiakojouri³, Pooyah Pish Bahar⁴, Zahra Azarae⁵

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In the animal and insect kingdom, all behaviours are directly regulated by pheromones. As queen bee pheromones regulate the majority of honey bee behaviours, when extracted, we can influence the behaviours of bees to focus on what is important to their survival, like consuming nutrients and raising healthy brood. By supplementing bees with micro doses of pheromones from drone, worker, and queen larva, we can improve our re-queening programs to 95% acceptance, combine populations without experiencing conflict, increase their consumption, fix nutritional deficiencies, and reduce the amount of chemical intervention needed when conducting disease & pest management control. This way, you can ensure your final product is a non-chemical residue honey. When comparing our control group (n = 100) and our intervention group (n = 100), we found that queen acceptance was as high as 95%, the fertility of drone bees from 40% to 99%, and no eggs were being discarded due to nutritional deficiencies.

Physicochemical properties and authenticity of honey samples obtained from the world market

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The quality of honey is an important grading factor for the international honey market. The classical approach to verify the origin of honey is based on pollen analysis, sensory analysis, physical and chemical methods. In this study, 50 honey samples which had been purchased from different shops in the world were investigated on the basis of their physicochemical, chemical and antioxidant properties. Moisture, conductivity, diastase, proline, acidity, HMF, invertase, sugar profile, C4 plant sugars parameters were studied according to standard analysis methods. Total phenolic, flavonoid contents, total antioxidant capacities of the samples were analyzed with spectrophotometer. The pollen types of the samples were also investigated with microscopic analysis. It has been determined that many samples do not comply with the criteria specified in the standards. It is the most significant step to ensure that consumers are correctly informed about the products. Moreover, honey standard should be re-established to prevent unethical competition in the market. Parameters that will both prevent the sale of non-authentic honeys and to categorize the honeys in the market according to their quality should be added.

Introduction Of Caspian Solution for Queen Production

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The efficiency of queen production, queen introductions, mating, and level of semen production is directly related to the level of nutrition that is given to the bees. There are few factors that impact this besides nutrition, such as disease and other environmental factors. Our studies in Iran, Turkey, USA, Mexico, and Canada have researched in commercial and hobby applications to finalize the cause of supersedure and to improve the quality/ performance of aging queen's in changing / new conditions. With the Caspian Method, we provide access to nutrients for the drones, and as a result they will have higher fat deposits and we can improve their fertility and keep them for the entire season. As queen acceptance is an expensive duty for beekeepers, Caspian Solution enables an effective, scalable system for queen production. The supplementation of Caspian Solution will bring queen acceptance rates for 60% to 95%. In this presentation we are comparing the conventional method's with the Caspian Method and teaching people optimal techniques for queen production.

AI-Driven climate-smart beekeeping (AID-CSB) for women - lessons learned from localizing a hive management app across Ethiopia, Uzbekistan, and Lebanon

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Healthy plant-pollinator relationships are essential for local food systems across diverse landscapes. Globally, honeybees are one of the most important providers of ecosystem services and are managed locally to support agri-food systems. The health of honeybees is an indicator of environmental health, and deteriorating honeybee health can be traced back to changes in land use, climatic conditions, and input-intensive agricultural practices. Hence, keeping track of the health of honeybees, which offers value to stakeholders beyond beekeepers, has become an essential component of the beekeeping activity.

Digital hive management applications have been proposed to track honeybees' health over time and reduce losses through improved management decisions for beekeeping operations. However, these solutions often lack a user-centric design approach or operate in a silo, disregarding the potential benefits from augmenting primary beekeeping data with secondary data sources, including weather, community activity, and blooming data.

While beekeeping is an essential part of most cultures worldwide, women beekeepers are often underrepresented. Technology offers an opportunity for women to increase their participation in beekeeping as the benefits of technology-powered beekeeping enable more efficient beekeeping by increasing the ability to make better hive management decisions and facilitating the communication within the local beekeeping community while decreasing the overall time required to manage healthy hives. However, women are often not involved in the design and development process of technology-powered products in general and in agriculture-related fields in particular. Hence, developing technology in an inclusive and participatory manner has the potential to increase both the adoption of technology and the data uptake that is required to monitor and evaluate plant-pollinator interactions in agri-food systems locally and regionally.

AI-Driven Climate-Smart Beekeeping is an initiative that brings together partners from the private and public sectors to localize and customize a hive management mobile app working with women beekeepers in Ethiopia, Lebanon, and Uzbekistan. The results and recommendations from the two-year project enable policymakers, technology companies, and international organizations to draw valuable lessons for gender-transformative and participatory technology development across cultures with the goal of increasing data uptake on plant-pollinator interactions by beekeepers.

Digital advisory and extension services for beekeepers - how beekeeping experts can leverage technology to share region- and season-specific recommendations with the help of an app in Lebanon and the United States

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The increase in pressure on honey bee health accelerated by changes in land use, the frequency and impact of adverse climatic events, and input-intensive agriculture render adhering to good beekeeping practices ever more important and ever more complex. Notably, the need for timely, localized, and personalized beekeeping advice continues to amplify the limitations of extension services and traditional mentorship relationships. This is of particular importance across the Global South where the impact of a changing climate and the lack of funding are significant. We present two examples of leveraging digital technology solutions to deliver timely and geographically relevant advisory and extension services for beekeepers.

Funded by USDA-SARE, HiveTracks collaborates with the University of Minnesota BeeSquad to make digital beekeeping mentoring a reality. With a mobile, offline-capable hive management app and a web-based platform for staff and volunteer mentors, the project goal is to enhance existing educational and mentoring activities by enabling experts to send personalized, actionable recommendations and text-based notifications to nudge people to adhere to region season-specific best practices. The web-based admin portal allows the BeeSquad to observe and interact with target beekeepers in a given area who experience a particular disease, fall behind on their beekeeping schedule, or request advice.

Simultaneously, the admin portal is being tested and developed further with input from experts at the Lebanese Agricultural Research Institute (LARI) in cooperation with regional beekeepers to ensure its functionality across geographies and language boundaries (Arabic/English). This project uses an iterative, co-participatory development process that involves stakeholders and accounts for regional differences and requirements by continuously evaluating the user interface and experience, and the handling of potentially sensitive data like apiary locations and management practices.

These projects offer valuable lessons for decision-makers across private and public sectors within the beekeeping industry. Combining a mobile, offline-capable app and web-based expert capabilities shows tremendous potential to further the digitization process of advisory and extension services. In doing so, it addresses the need for the more efficient administration of beekeeping-related advice from governmental and non-governmental organizations vis-à-vis tighter budget constraints while addressing beekeepers' needs for timely and localized beekeeping advice.

Data-driven authentication of varietal honey for improved product differentiation - the example of sourwood honey

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Honey authentication persists as a global challenge to the beekeeping industry despite advances in lab testing with NMR and other lab techniques as well as increased awareness from regulatory governmental agencies, and more discerning honey buyers and consumers. Following is a use case demonstrating how existing data can be used to validate and authenticate a specific honey varietal by creating a digital identity that can be used by the beekeeping community and honey markets to improve product differentiation in a producer- and consumer-friendly way.

Sourwood honey is a highly sought-after varietal honey with a unique flavor profile produced from the nectar of sourwood trees in a very limited geography in the Appalachian mountain region of the US. The beekeeping management required to produce varietal honeys like sourwood honey requires experience and attention to detail as well as access to apiary locations that produce a good varietal crop while not mixing with other nectar sources. As for most varietal honeys, these constraints mean there is a lower supply of authentic sourwood honey relative to the demand. The price per pound for sourwood honey compared to others is in the 1.5-2x range in the same market and even higher in specialty markets. This environment provides an opportunity for selling mislabeled or adulterated honey as sourwood honey.

To date, common testing methodologies have proven to be costly, cumbersome, and ineffective in the case of sourwood, while an abundance of digital information already in place has failed to produce a coherent system that authenticates honey origin and veracity in a producer- and consumer-friendly way. The case study presented offers valuable lessons learned around how the aggregation of beekeeper data, including management actions, weather data, and IoT data, into a coherent digital honey profile, can facilitate cost-efficient and user-friendly product differentiation. This work has the potential to benefit beekeepers of varietal and specialty honeys around the world and facilitate accessing new markets and achieving higher margins while lowering the costs of authentication.

Non-intrusive monitoring of hive population and brood levels using temperature and audio sensors

Yonatan Nathan, Paz Kahanov, Inna Goldenberg, Hallel Ilan Schreier

Beewise Technologies LTD

Population and brood levels are key parameters for measuring hive development and health. Beekeepers usually perform invasive visual scans in their hives to assess traits such as brood and adult bee population levels. Ongoing manual monitoring is labour intensive and stressful for bee colonies. Therefore, commercial beekeepers typically limit monitoring frequency to once every couple of weeks per hive, and avoid inspection altogether when weather conditions are not favourable. Such sparse monitoring often results in late identification of diseases and other stress factors which can be detrimental to the colonies' health. Recent years have shown an increase in non-intrusive hive monitoring solutions, both in academic research and in the private sector. However, such attempts have often shown insufficient results, due to limited or non-standardized data acquisition processes. In this study we equipped 22 Langstroth hives in the field with audio, temperature, humidity, CO₂ and VOC (volatile organic compounds) sensors, and continuously measured them for 6 months. We coupled these measurements with detailed weekly assessments that included population, brood, honey, pollen and varroa mite levels to obtain a large and accurately labelled dataset. We then preprocessed the data and trained several Machine Learning models to predict hive traits over time. We found that using the sensor data can significantly improve the prediction of population and brood for unseen hives compared to a baseline average. However, we didn't (yet) find a way to reliably predict honey and varroa levels using these sensors. In this talk we will discuss the data logging system, the data preprocessing and the modeling results.

The Beehome System by Beewise Technologies LTD

Hallel Ilan Schreier, Eliyah Radzyner, Saar Safra, Yossi Sorin, Boaz Petersil

Beewise Technologies LTD.

Pollination is crucial to life on the planet. Bees and other pollinators have thrived for millions of years, ensuring food security and nutrition, and maintaining biodiversity and vital ecosystems for plants, humans, and animals. Globally, three out of four crops producing vegetables, fruits, seeds and nuts for human consumption depend on pollinators for sustained production, yield and quality. Recent decades have seen heightened concern about honeybee mortality rates in many regions of the world. The seemingly unpredictable loss of bee colonies exacerbates the shortage of pollinators leading to concerns that pollination deficits limit crop production. Recent studies have identified the causes of the widespread declines in pollinator diversity across Europe in a combination of agricultural intensification, habitat degradation, diseases parasites and climate change (defined as the four P's: Pests, Pesticides, Pathogens, Poor nutrition). Some of the main factors in protecting bee colonies are beekeepers' experience and practices. Improving beekeeping technology, early identification of disease, climate control, and monitoring have all been identified as key factors in reducing colony loss.

The Beehome platform, developed by Beewise Technologies LTD, is a modular commercial AI-powered apiary composed of hardware and software that automates beekeeping. The solar-powered system can manage up to 40 hives and streamline their operation such as pollination, honey-production, and reproduction.

The system includes an automated robotic brood box management system, a computer vision-based monitoring system, an automated honey harvesting system, and an automated system for pest control, feeding, and thermoregulation. In this short presentation, we shall present the technological achievements and the advantages of the system as well as the challenges and disadvantages we encountered.

Decontamination of beeswax pesticides residues, description of results

Alejandro Planet Guerrero

Quality control department, Apicasfer, S.L., Salamanca, Spain.

Beeswax retains pesticide residues from authorized veterinary treatments to combat varroa destructor. Through an industrial purification system based on filtering substances, we have managed to reduce the pesticides in the wax after this process to minimum levels. This study will analyze the results of seventy (70) batches of two thousand kilos of beeswax from Spanish beekeepers and beekeeping companies. The pesticides with the greatest presence in the wax under study, Tau-Fluvalinate, Coumaphos, Amitraz (inc. Metabolites), Cypermethrin, Chlorfenvinphos, Chlorpyrifos (-ethyl), Acrinathrin, Permethrin (Sum of all isomers), Propargite and Pentachloroanisole, all of them with high rates of elimination around 79,49% for Coumaphos, 85,06% Amitraz, and 76,33% for Chlorfenvinphos. As beeswax is a product that is recycled, and that houses the active substances that are used in varroosis treatments present a double danger if the wax is not filtered, it will produce a continuous accumulation of active substances that only stops with the cancellation of authorizations for active substances. On the other hand, it will produce a dissemination of the environment favorable to the appearance of resistance in other Varroa destructor that inhabit or invade other hives where the wax sheets recycled unfiltered end up. If filtration does not occur, it is obvious that, if you continue with the veterinary treatments, the active substances will continue to be concentrated in the wax, promoting the emergence of resistance and the danger of migration to honey.

Model for selection of the apiary location

Aleksejs Zacepins, [Olviija Komasilova](#), Vitalijs Komasilovs, Armands Kviesis, Nikolajs Bumanis
Latvia University of Life Sciences and Technologies, Faculty of Information Technologies

Idea of the Precision Apiculture is to monitor the main bee colony parameters in real-time and make on-time decisions. One of the important managemental decisions for the beekeeper is to select the best location for the apiary. Usually beekeepers select the location for the apiary based on previous knowledge. Sometimes the location and number of colonies is not optimal for the best foraging experience. This can be explained by different flowering periods, variation of resources at the fields and by other factors. Optimal location will allow bee colonies to forage on higher amount of the resources with minimal energy consumption. This scientific research presents a model for comparison and evaluation of apiary locations, taking into account resource availability estimation in different surrounding agricultural fields. Authors propose a model for real agricultural field location digitization and evaluation of possible apiary location by fusing information about available field resources. To develop model, several steps have to be completed, such as selection of fields of interest, converting selection to polygons for further calculations, defining the potential values and coefficients for amount of resources depending on type of crops and season and calculation of harvesting locations. For the model operation several parameters and assumptions are made. As the outcome of the model, heat map of possible apiary locations is presented to the end-user in the visual way. Based on the outcome, beekeepers can plan the optimal location of the apiary and change it in the case of need. The Python language was used for the model development. Model can be extended to use additional factors and values to increase the precision for field resource evaluation. In addition, input from users (farmers, agricultural specialists, etc.) about external factors, that can affect the apiary location can be taken into account. In the future, the model presented in the previous section will be integrated in a more general system. This research is conducted within the Horizon 2020 FET project HIVEOPOLIS (Nr.824069 – Futuristic beehives for a smart metropolis). To find out more visit the project website <https://hiveopolis.eu/>.

Comparison of architectures for the real-time bee colony monitoring

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Remote bee colony monitoring can provide useful information for the beekeepers and aid them in their apiary management. The main parameters of the bee colonies are temperature and weight. Such a monitoring system is a practical tool in Precision Beekeeping. Honey bee colonies can be monitored by applying various kinds of monitoring system architectures. This research focuses on different automatic monitoring system architectures for real-time bee colony temperature and weight monitoring, comparing their advantages and disadvantages. Various communication technologies (WiFi, IoT SIM, ESP-NOW) for data exchange were tested and compared. Measurement systems based on ESP8266 microchips were developed to monitor honey bee colonies and enable data transmission capabilities. In order to use mobile networks for data exchange, IoT SIM cards were provided by the company INCE. For data analysis and collection, a data management infrastructure was used that incorporates MQTT as the main messaging protocol to guide the data flow to databases like InfluxDB or other dedicated systems/services. This research is conducted within the Horizon 2020 FET project HIVEOPOLIS (Nr.824069 – Futuristic beehives for a smart metropolis). To find out more visit the project website <https://hiveopolis.eu/>.

Traceability and Provenance Implementation on a decentralized platform for honey international trading

[Ignacio Tomas Imperatrice](#)

Founder, Managing Director Hunitro

Consumers want to know exactly what they eat and where it comes from. It is well established that traceability is complex for every party-role: beekeepers, traders and consumers. The history of the product must be built with information that flows over documents created many times and over various systems creating duplicated, lost data and chaos of information

This study aims to determine how to build trust without revealing confidential information. Specifically, we designed and implemented a system platform securing information in blockchain technology. Documents are created only once and transferred over an encrypted network that provides data consistency.

To test the benefits of blockchain we tested over an international trade shipment. In a two step solution: a website and a qr code stamped to the drums of the shipment.

This website includes: the lot number tracker, the beekeeper profile (1 profile photo, 1 floral source photo and 2 videos of his beehives), the exporter and importer details and a dedicated section with the laboratory analysis and product certification documents (.pdfs) time stamped using the decentralized, publicly auditable, Bitcoin blockchain, removing the need for trusted authorities.

The results suggest that digital information is trusted when it is auditable instantly. On this basis, to create simpler business processes and reduce misinformation, blockchain should be taken into account when designing traceability networks.

HIVEOPOLIS project – Futuristic Beehives for a smart metropolis

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Honeybees are important pollinators and support important ecosystems with their ecological services. As a result of analyzing current situation a conclusion was drawn that beekeeping sector is in decline. There are several reasons for this like land-use intensification, pesticide poisoning, colony diseases, parasites, wild fires and adverse climate. These changes, especially, cause disruptive disturbances of their habitats which are endangering honeybee colonies around the world and incurring an immense financial toll. Apiculture needs regular income to cover high investments costs. Therefore unforeseeable costs and colony losses put the enterprises on the brink to bankruptcy. The anthropogenic interferences are acting too fast to allow natural evolution of honeybees to cope with them, thus we aim to help the bees in coping with these adverse environmental factors by establishing technologies in and around a futuristic honeybee colony that allow the colony to perform well in very challenging environments. This project aims to make technologies available to honeybees that are naturally inaccessible for them (internet, databases, satellite data, and robots) and to feed information collected by bees through these channels back to us humans and also to other hives. This collection of hives, technologies and humans is called HIVEOPOLIS in our concept. HIVEOPOLIS technology will be integrated in a way that it provides a synergistic added value to the colony, to its owner and to society in general. It will be sustainable from the ecological point of view (materials and fabrication of the hives are based on biological processes such as 3D printing and fungal mycelium) and also from the intellectual point of view (open software, open hardware, open data), so that it will be accessible from the beginning. Our society will benefit from the pollination services and other bee-derived services and products, in a more stable and controllable way, even in harsher ecological conditions. Ultimately, HIVEOPOLIS will bring honey bee societies into a new future and will integrate them into the hearts of our own future smart cities.

Project HIVEOPOLIS has received funding from the European Union's Horizon 2020 research and innovation programmes under grant agreement No. 824069.

Acacia tortilis honey is the major unifloral honey in Oman

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In Northern Oman, bees produce true *Acacia* honey from *Acacia tortilis*. This native wild plant is one of the most common trees throughout the country, abundant in the plains, wadies and foothills. It's flowering and fruiting period is from April to June, hence it is an important source for summer honey in Oman. *Acacia* honey is very famous and popular in the country and called *Sumr* locally. It is characterized by its dark color, thick texture and strong aroma and taste. It has many medicinal values. Because of the significant importance of *Acacia* honey in Oman and neighboring regions, the present study was undertaken to evaluate and characterize Omani *Acacia* honey by using botanical, physicochemical, and antioxidant analysis. The analyses were carried out on 200 honey samples from *Apis mellifera* and *Apis florea* colonies collected from nine governorates of Oman. The following physicochemical properties of *Acacia* were studied: *Acacia* honey samples showed the mean of pH 4.83, moisture content 16.75%, electrical conductivity (EC) 1.82 mS/cm, free acidity 95.30 meq/kg, diastase activity 12.00 DN and invertase activity 141.07 U/kg. These values are on par with the permitted specifications except electrical conductivity and free acidity, which were elevated. The EC of *Acacia* honey samples were found to correlate significantly and positively with pH, moisture content, free acidity, diastase and invertase activities. This may point out at the influence of these parameters in raising the EC of this honey indicating the richness of *Acacia* honey with mineral and organic acid contents. This can increase its nutritional and medicinal values. The antioxidant parameter values of *Acacia* honey were recorded using spectrophotometer. Dark amber color was dominant in the 79% of *Acacia* honey samples. In *Acacia* honey samples the mean values of color Pfund was 133.41 mm, color intensity ABS560 nm 0.21AU, proline content 91.03 mg/100 g, total phenolic content 45.20 mg GAE/100 g, RSA value 59.39% and IC50 16.07 mg/mL. It was concluded that sample set of 80 *Acacia* honeys is adequate to make the generalization that these types of honeys exhibited overall better antioxidant properties which may reflect its potential of therapeutic activity.

SNP (Single Nucleotide Polymorphisms) validation for honey production in Africanized *Apis mellifera* Honeybees

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Conventional beekeeping sometimes did not use programs for breeding selection, having colonies with different genetics in commercial apiaries affecting the honey production. The aims of this research was validate a set of Single Nucleotide Polymorphisms (SNP 's), previously identified on Africanized Honey Bees (AHB) populations with high and low honey production, genotyping commercial colonies from São Paulo State, Brazil. The experiment was conducted at UNESP, Botucatu, Sao Paulo, Brazil. Two hundred AHB colonies were technically managed for honey production, during eucalyptus, orange and wild blossoms. Honey production was evaluated individually and larva from worker bees was collected and DNA extracted. Real time PCR using Taqman probe was performed for six previous SNP 's selected associated to honey production by using ddRADseq(Double Digated RAD Sequencing) technique and then sequenced by Illumina technology (DNA-Seq). All data were analyzed at Rstudio. SNP 's with MAF(Minor Allele Frequency)<0.1 or absent data rate >10% were removed from analysis.The generalized linear model of the binomial family that presented the best score for AIC (Akaike Information Criterion) was the $\ln(\text{Prod}/(1-\text{Prod})) \sim x_1\text{SNP1} + x_2\text{SNP3} + e$ model, given that Prod is the probability of the occurrence of the high honey production phenotype, is the intercept estimate, SNP1 and SNP3 are the estimates of the regression coefficients for the respective genotypes, x_1 and x_2 are the genotypes observed for the respective SNPs, given that they are represented by the dose of the lowest frequency allele (0, 1 and 2 for homozygous for the highest frequency allele, heterozygote and homozygous for the lowest frequency allele, respectively) and e is the residue. The model presented $p\text{value}=0.56$ ($X^2=0.34415$, $DF=1$) for the Hosmer-Lemeshow test (GOF Test, Goodness of fit). Estimated linkage disequilibrium between SNP1 and SNP3 was $r^2 = 0.032$. Therefore, a homozygote for the lower frequency allele of SNP3 (GG) is likely to have the high-honey phenotype, on average, two times more than homozygote for the higher frequency allele of SNP3 (AA), despite SNP1 having no statistically significant difference in probability. In conclusion, we can use two SNP 's to genotype AHB colonies that can be used for accelerate honeybees breeding programs.This research project was supported by FAPESP Process Number 2020/09231-9.

New propolis collecting device

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There is a need to improve existing propolis production technologies, improve sanitary and hygienic conditions of production, increase productivity and economic efficiency, mechanization and automation of the production process. The goal of the work was to develop a new propolis collecting device. The work was carried out as part of the implementation of the dissertation research on the topic «Scientific and technical support of the propolis production process and equipment» during 2020-2022. A new experimental device consists of a set of gear trains; lower and upper pairs of shafts, the projections of which enter into each other; an electric motor; holes for insertion of grids with propolis; an outlet; an electric power supply cable and a switch; a protective chamber of moving mechanisms; metal frame. The design of the built-up shafts of the device consists of a pair rotating opposite each other and retracting grid for propolis collection (EVA, Stanz Press) independently. Operating principle of the device: the grid that is covered with propolis during the passage through the upper pair of shafts is bent in a wave-like way, wherein the same section is bent outwards, and when passing through the lower pair of shafts it is bent inward. This solution provides improved grid cleaning taking into account the ethology of bees during propolis accumulation in the grids that we have observed. The grid speed is 2.5 m/min. The surface of the shaft elements in contact with propolis is 19.32% of the grid area in the shaft area. The contact of one shaft element with propolis in the grid is 40 mm². This ensures that propolis grids are cleaned at +20-25°C without the need to clean the shafts from propolis. Therefore, the grids should be cooled at +5°C for 60-90 min. The noise level of the device at idle is up to 72 dB. The weight of the device is 8 kg, which ensures its mobility. The device is powered by a household network 220-240/50 V/Hz. The use of the device makes it possible to obtain propolis without mechanical impurities.

Development Of A Multiplex Method For Screening Of Pesticides In Honey Using Biochip Array Technology

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Introduction

There is growing global demand for the detection of pesticides in food commodities, such as honey. This is due to the widespread use of a broad range of pesticides and because of an increased focus on food safety. The ideal pesticide would destroy its target pest without causing any harm to humans, non-target plants, animals or the environment. However, their use has been shown to have a negative impact on all of these, and in relation to human health there is evidence of a connection to diseases such as several types of cancer, including leukaemia and non-Hodgkin's lymphoma, and various respiratory conditions like asthma.

Of particular interest to those in the honey industry, are the neonicotinoids and varroacides. It has been well documented that neonicotinoids are toxic to bees and other pollinators, which has contributed to a decline in the global population of bees and this in turn has an adverse effect on the economy and the biodiversity of an area. Varroacides are essential for controlling Varroa mite populations to ensure beehive colonies are healthy and productive. However, their use inside beehives can lead to direct contamination of honey and ultimately cause harm to human health.

Methodology

Pesticides Array I (PAH I) Evidence Investigator™ kit (EV4395) employs simultaneous immunoassays for the multi-analyte determination of pesticides in honey on the semi-automated bench top Evidence Investigator analyser (EV3602).

Results

A single generic sample preparation allows the detection of 14 common pesticides simultaneously, in up to 48 honey samples, in less than 4 hours. Accuracy of the PAH I array has been demonstrated through participation in multiple third-party proficiency testing schemes.

Conclusion

Pesticides Array I (PAH I) Evidence Investigator™ kit (EV4395) employing Biochip Array Technology (BAT), uses a single generic sample preparation allowing the detection of common pesticides simultaneously, in up to 48 honey samples in under 4 hours. Accuracy of the PAH I array has been proven through participation in multiple third-party proficiency test schemes. This innovative biochip array will support those in the honey industry in determining potential causes of bee loss and assist with compliance with food safety legislation.

Simultaneous Analysis of Antibiotic Residues in Bee-Pollen by the Novel Cost and Time Effective Multiclass UHPLC-ESI-MS/MS Method

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Bee pollen serves various macro and micronutrients for human health. Therefore, the bee-pollen is a complete natural supplement and can be mentioned as a superfood. However, besides its functional properties, it may also contain xenobiotics and other contaminants. Indicated contamination may arise from beekeeping mispractices or from environmental conditions. The majority of pollens face antibiotic contamination and this devalues the curative properties of the product. Honey and other bee products must be free of residues. There are several analytical methods for determining the antibiotics using chromatographic techniques equipped with PDA, FLD, or MS detection. Immunoassays were also evaluated. The study has aimed to develop a rapid and efficient method for simultaneous analysis of macrolides, tetracyclines, fluoroquinolones, and sulfonamides in pollen samples using UPLC-MS/MS. The amount of the sample and extraction solvents were optimized. Sample extraction was made by means of EDTA-McIlvaine buffer and ACN mixture. Abundant pigments in the resulting supernatant were removed using hexane by liquid-liquid extraction. The injection volume was 15 µL and the oven temperature was maintained at 30°C. + ESI was preferred and SRM acquisitions were generated for antibiotics. The run time was 7 min and the chromatographic resolution was accomplished using a reversed-phase UHPLC column and by employing water and ACN/MeOH gradient. Regarding method validation, it was found that the matrix-matched calibration curves were linear at concentrations between 5 µg/kg and 50 µg/kg. R2 was a minimum of 0.99 for each substance. The mean recoveries were found between 89.7% and 109% at 3 concentrations. The LOD and LOQ values were determined as 4.3 µg/kg and 5.2 µg/kg respectively on average. In the precision study, mean values of 7.2% and 9.2% were obtained for intra-day precision (RSDr%) and inter-day precision (RSDR%) respectively. 8 pollen samples from the market were analyzed employing novel method. The results showed that most of the samples contained Oxytetracycline, Sulfamethazine, and Anhydroerythromycin-A residues at varying levels. This research comprises ease of use analysis methodology for pollen with a comprehensive library. It was seen that the novel method has a major impact to enlighten the concern about the quality of bee pollen.

Quality aspects of tropical 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 aspects of Reunionese honeys.

The Reunionese beekeeping industry gathered around this project. 70 beekeepers gave 330 samples of monofloral and polyfloral honeys. Among those are exotic plants: Pink pepper (*Schinus terebinthifolius*), Lychee (*Litchi chinensis* Sonn.), and endemic plant: Tan Rouge (*Weinmannia tinctoria*). Their physicochemical parameters (% humidity, free acidity, hydroxymethylfurfural, pH, conductivity...) were measured with official methods and compared to standard criteria specified by The International Honey Commission.

These measurements revealed that more than 80% of our samples meet the quality standard requirements. It proved 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.

The next step of our project will be to carry on the chemical and biological characterization of the samples. This complete description will highlight the best sources of honeys: the ones that provide the most exceptional biological and dermatological properties. It could also promote the Reunionese beekeeping industry and lead to prosperous economic development.

Unraveling the chemical composition, antioxidant, -amylase and -glucosidase inhibition of Moroccan propolis

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In the present study, seven propolis samples collected from different areas of Morocco were evaluated for various potential attributes. Physicochemical parameters (moisture, pH, soluble substance, insoluble substance, ash content, conductivity, organic matter, resin, balsams, total carbohydrates, total proteins and mineral content), structural characterization by FTIR, phenolic and flavonoid composition and some biological activities (antioxidant, and -glucosidase and -amylase inhibitory activities) were determined. The analyzed physicochemical parameters showed the following values: moisture (3.3–5.2%), pH (4.1–5.5), soluble substance (66.1–75.4%), insoluble substance (23.8–33.7%), ashes (1.6–2.3%), conductivity (1.5–2.5 mS/cm), organic matter (97.70–98.4%), wax (19.7–51.5%), resin (46.8–75.2%), balsam (1.5–3.1%), total carbohydrates (1.5–2.0 mg Glceq/g), and total proteins (1.7–6.2 g/100 g). Calcium, sodium, potassium, and magnesium were the most predominant minerals present in propolis samples. The phytochemical composition indicated the presence of phenolic acids, flavonoids and stilbens compounds described as having a high antioxidant capacity and potential -amylase (IC₅₀ = 195.09–963.79 µg/mL) and -glucosidase (IC₅₀ = 90.99–876.24 µg/mL) inhibitory activities. Moreover, FTIR spectra showed that the samples are structurally different between them, validating the results of the physicochemical analysis. The outcome of this study provides relevant information about Moroccan propolis composition and quality standards.

Proline content of Persian Sidr honey

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Sidr Honey, the mono-floral honey which comes from the bees that feed exclusively on the nectar of the wild Sidr tree. In this study, the proline content of a total of 20 samples of Iranian honey was investigated. Proline is the most abundant amino acid in honey and about 50 to 85% of all amino acids in honey are proline. This amino acid originates from nectar, pollen and salivary secretions of bees and is one of the important indicators of quality for distinguishing natural honey from counterfeit honey. In this study, samples were obtained directly from beekeepers located in the southern regions of Iran and all information about honey samples including harvest location, honey processing time, bee breed and nectar-producing plants of the apiary location were recorded. All samples were examined by sensory evaluation experts in terms of organoleptic indicators by markers method in terms of color, odor, taste, aroma and taste and finally scored. In this test, only honeys with a score greater than 70 out of 100 points were selected for the proline test. The proline content of all honeys was measured by spectrophotometry High-performance liquid chromatography (HPLC) and finally the proline content of Iranian honey was reported in the range of 388 to 690.5 with an average of 515. Based on this study, a positive correlation was observed between sensory evaluation score, quality and amount of honey proline. It is suggested that the total proline content of this study be used as a qualitative indicator to evaluate honey.

Investigation of Physicochemical Properties of Gavan Gaz Honey From the Western part of Iran

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Astragalus is the most significant and diverse plant species on the Iranian plateau, and according to the latest studies, more than 844 species of Astragalus grow in Iran, of which 620 species are endemic to Iran. Species diversity and high density of astragalus species have led Iranian botanists to call it Astragalus paradise. Astragalus species in Iran is the most important source of nectar for bee colonies in Iran, which occupy about 15 to 17 million hectares of rangelands in Iran. Astragalus adscendens is the most important nectar-producing species of the Zagros vegetation region in Iran, producing one of the most important mountain honey in Iran. Gavan gaz (*Astragalus adscendens*) honey is one of the most important Monofloral honey in Iran, whose annual production in Iranian apiaries is estimated at 1500 to 2000 tons. This study aimed to determine the physicochemical indices of 22 samples of *Astragalus adscendens* honey produced in 10 different regions in western Iran. Honey samples were evaluated for moisture content, reducing sugars before hydrolysis, reducing sugars after hydrolysis, sucrose, proline and HMF according to the instructions of the Food Codex. In terms of parameters, the studied samples complied with the values defined in the Codex standard and the national standard of Iranian honey. The results showed that the moisture content of honey (17.8-17 and mean 16.2), reducing sugars before hydrolysis (72.8-77.2 and mean 74.8), reducing sugars before hydrolysis (75.5-80.4 and mean 77.6) sucrose (1.3-5.6 and mean 2.8) proline (403-1203 and mean 650) and hydroxymethylfurfural (0-16.92 and mean 1.8). Analysis of the results of this study shows that the physicochemical parameters of *Astragalus adscendens* honey depend on the location of bee colonies, climatic conditions, and breed and beekeeper management. Determining the value of each of these indicators depends on further studies in the future. This study is the first comprehensive report on the physicochemical indices of "*Astragalus adscendens*" honey as one of the indices of the Iranian plateau in the Zagros vegetation region.

Native and Endemic Chilean honeys: its biological and sensory properties

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Chile is one of the world hotspots that can produce a range of honey diversity. The presence of two great mountain chains along the country, the Andes Mountain and the Coastal Range, generate very diverse geomorphology with different valleys and microclimates, allowing that almost half of the vascular flora is endemic, giving a unique character to the honeys. The production of unifloral honey from endemic species arises in two geographical Chilean regions. The first corresponds to the Central Zone, with a semi-arid Mediterranean climate, where the Evergreen Sclerophyll Matorral is the dominant vegetation. Unifloral honeys produced from this plant community are botanically originated from Litre (*Lithraea caustica*), Corontillo (*Escallonia pulverulenta*), Arrayán (*Luma apiculata*), Sauce (*Salix humboldtiana*), Corcolén (*Azara petiolaris*), Tevo (*Retanilla*

trinervia), Peumo (*Cryptocarya alba*) and Quillay (*Quillaja saponaria*). The second biogeographic zone correspond to the south and the Patagonian region, with a humid Mediterranean climate where the Temperate Forest or Bosque Valdiviano dominates. In this Patagonian region honeys from Tineo (*Weinmannia trichosperma*), Avellano (*Gevuina avellana*), Tiaca (*Caldcluvia paniculata*), Ulmo (*Eucryphia cordifolia*), Guindo Santo (*Eucryphia glutinosa*) are produced. Also, we could find native unifloral honey of Chañar (*Geoffrea decorticans*) at the desertic region of Chile.

The main biological properties such as antimicrobial and antioxidant are described as well as their sensory aspects related to their chemical compounds. The results will be discussed comparing with other emblematic honeys of the world.

PP-198 [Beekeeping Technology and Quality]

Properties, Production Technology And Efficient Use Of Beeswax Foundation With The Addition Of Propolis (BEE GLUE)

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Vital functions of honeybees depend on many internal and external factors, including the state of the brood nests. The quality of raw beeswax for producing foundation and the honeycombs rebuilt on it has a subsequent effect on the processes associated with the development, productivity and spreading of diseases in the brood nests. We have set the goal to ground theoretically and experimentally the efficiency of applying the additives of bee glue fractions in producing the wax foundations, as well as to improve the equipment and technology of their production and study the efficacy of their application.

At the first stage, by applying conventional techniques, we conducted microbiological, physical, biochemical research of the wax foundation samples produced in a traditional way (control group), and the samples obtained from raw beeswax to which we have added various bee glue fractions. At the second stage we made a comparative evaluation of beeswax samples directly in bee-colonies using zoo-technical and ethological research methods.

Microbiological studies have shown that the wax foundation with additives of the bee glue fractions inhibits the growth of microorganisms during the first five days, including *Ascosphaera apis* (by 85-95%) and *Aspergillus niger* (by 75-90%) and increases the survivability of bee-families in winter, when the reduction of bee wastes in winter due to a decrease of fecal load of colon and absence of excrement traces in the nest are observed. In cases of expansion of brood nests it has been determined that compared to the control group, the number of bees was in 3,6-5,8 times higher on the experimental beeswax, and bee-families were rebuilding their honeycombs faster and more actively. Through using conventional and experimental wax foundations in the commodity apiaries in different regions of Ukraine the increase of productivity of honeybee-families within the experimental group by 16.2 kg for 5 years, compared to the control group ($P < 0.01$), has been set.

Given the inhibiting effect on pathogenic microflora, stimulating influence on the development and performance of the bee-families, the experimental beeswax is recommended for widespread use in beekeeping.

PP-207 [Beekeeping Technology and Quality]

How safe is honey bee feed? The methodology and monitoring of honey bee food supplements and substitutes

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The nutritional status of a honey bee colony is recognized as a key factor in ensuring a healthy hive. A deficient flow of nectar and pollen in the hive immediately affects its development, making room for pathogen proliferation and, consequently, for a reduction in activities and strength of colony. It is therefore urgent for the beekeepers to use more food supplements and/or substitutes in the apiary management, allowing to address colony nutritional imbalances according to the beekeeper's desired results. In this context, the commercial market for beekeeping products is growing rapidly due to low regulation of animal food products and of the beekeeper's willingness to guarantee healthy colonies. There are numerous products (bee food additives) currently available on the worldwide market, with a highly variable and

sometimes even undefined composition, claiming a set of actions at the level of brood stimulation, energy supplementation, queen rearing support, reduction of varroa reproduction levels, improvement of the intestinal microflora of bees, nosema prevention, improvement of the health of hives infested by American foulbrood, among others.

To address this issue, the members of COLOSS (Honey Bee Research Association), NUTRITION Task Force, for the first time propose an action on honey bee feed control and monitoring, setting the four main OBJECTIVES:

1) Elaborate methodologies to study bee aliments (protocols, good laboratory practices), and to implicate different stakeholders to clarify the type of analyses depending on their needs (e.g. organic or legal framework);

2) Create and coordinate a network of laboratories able to use the proposed methodologies (ring tests, evolution of the methods with new technologies);

3) Apply the methodologies to a large set of bee aliments at a worldwide scale; and

4) Elaborate guidelines to support and assist food companies and regulators to proceed the effective control of the quality and safety of supplements and substitutes for honey bees.

Globally, this action will allow more information to the stakeholders via monitoring and set the basis for regulation of products to reach the minimum standards for quality, effectiveness, and economy of honey bee feed, and finally guaranteeing the quality of the bee products.

PP-208 [Beekeeping Technology and Quality]

Quality of drone brood from Slovak *Apis mellifera carnica* bee colonies

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Bees of *Apis mellifera carnica* have the largest representation in terms of bees kept in Slovakia. This bee's subspecies is perfectly adapted to Slovak climatic conditions. Colonies are characterized by gentleness and low defensive behaviour. Moreover, *Apis mellifera carnica* is preferred for high disease resistance and good production ability. In Europe, drone brood is one of the less frequently used products. Although, drone brood can be the source of numerous bioactive compounds. The aim of our study was to find the content of main nutrients, amino acids, and vitamins in lyophilized drone brood of Slovak *Apis mellifera carnica* for the purpose of next use in supplementary nutrition for humans or animals. Experiment was performed in four individual apiaries. Drone brood was obtained from drone combs by washing out of larvae at the age of 7±2 days. Obtained drone brood was subsequently frozen, lyophilized, homogenized, and analysed. In the samples, protein content was detected from 35.6% to 46.3 % of dry matter. Content of crude fibre was very low, but fat content was quite high (20.5-22.5 % of dry matter) as well as total sugar content (15.3-18.3 % of dry matter). Total content of amino acids ranged from 34.8 % to 43.9 % of dry matter. The highest content was found for glutamic acid, aspartic acid, leucine, proline, and lysine. The lowest concentration was determined for cystine. From the vitamins, drone brood is valued mainly for high content of B vitamins. From them, the highest content was found for niacin (16.3 mg/100 g) and pantothenic acid (4.8 mg/100 g). Instead of B vitamins, we found high content of vitamin C (21.7 - 30.3 mg/100 g) in drone brood. Content of evaluated compounds showed relatively high variability in terms of different apiaries. Nutrients in drone bee can be determined by age balance of obtained larvae as well as influence of environment. Based on this study and various others, drone brood seems to be the perspective nutritional product with a high potential for human and animal health.

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PP-209 [Beekeeping Technology and Quality]

How IOT tech could help to keep honey bees as a hobby

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Urban Beekeeping as a new hobby is becoming widespread globally, which benefits everyone. Keeping honey bees is a challenge that needs knowledge. The main part of beekeeping is inspecting the hive, which can be facilitated by IoT technology, so ordinary people are also encouraged to keep honey bees in their environment as a hobby. The IoT technology uses sensors' data like temperature, humidity, sound frequency, and weight for this aim. Data are managed by an IoT board (named Kandoo1pluse) that transmits them to the mobile application wirelessly. The collected data are sent to the server and scrutinized by experts. Then, the results are replied to the mobile application, and the proper action is suggested to the beekeeper. In other words, the Kandoo1pluse is a professional remote assistant that takes care of honey bees. It is also possible to have an early warning for the main challenges of beekeeping, such as swarming, which is critical for urban beekeepers, by adding artificial intelligence.

Impact of sorghum honeydew on the authenticity of Argentine honeys

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At the beginning of 2021, the finding of a large number of positive LC-IRMS tests on Northeast Argentine honeys resulted in many commercial conflicts regarding honeys authenticity. Public entomological reports indicated the presence of the yellow sugarcane / sorghum aphid in sorghum (*Melanaphis sacchari / sorghi*) in the north of the country and expanding towards the south. Aphids feeding on the sorghum (C4 plant) leaves produce honeydew that attracts several species of insects, including bees.

More than hundred of honey samples of 2021 crop from different northerneast provinces were tested by EA-IRMS, LC-IRMS, NMR, pollen analysis and other characterization tests such as color, moisture, HMF, F/G, sucrose and conductivity. Collaborative trials were carried out with two external laboratories with addition of LC-HRMS test. In January 2022, honeydew samples in sorghum leaves were collected in Chaco and Entre Ríos provinces. The pure honeydews as well as Entre Ríos honeys spiked with 1, 5, 10 and 50% of honeydew were studied by LC-IRMS and NMR. Honeys of 2021 crop studied showed variable deviations for LC-IRMS while negatives for EA-IRMS, NMR and HRMS. The characterizations of honeys showed that higher LC-IRMS deviations (Dmax. and presence of oligosaccharides) were correlated with higher colors, conductivities and F/G rates quantifications. The LC-IRMS results for pure honeydews and spiked honeys reproduced the deviation of the assay. Pure honeydews showed the nature of C4 sugars and a large amount of trisaccharides and oligosaccharides, which could explain the deviation of the test with very small amounts of honeydew. Different compositions between the Entre Ríos and Chaco honeydews were found. The study of the pure honeydews suggests the link between the presence of this new sorghum pest from northerneast Argentine and the positive LC-IRMS findings in honey. Analytical capacity together with field work made it possible to quickly detect this new honeydew, hence avoiding big economic losses due to a failure in the authenticity testing.

Phytochemical Constituents, Antioxidant and Antimicrobial Activities of the Ethanolic Extract of Brown Propolis collected in Zacatecas, Mexico

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Propolis is a complex mixture of natural sticky and resinous components produced by honeybees from living plant exudates. Globally, research has been dedicated to studying the biological properties and chemical composition of propolis from various geographical and climatic regions. However, the chemical data and biological properties of brown propolis produced in the North of Mexico are scant. The antioxidant activity of the ethanolic extract of propolis (EEP) sample collected in Zacatecas, México and the isolation of the main components is described. The antibacterial activity was tested using the minimum inhibitory concentration (MIC) assay. Two major known flavonoids (pinocembrin and chrysin) were isolated and identified by nuclear magnetic resonance spectroscopy (NMR). Additionally, the volatile compounds were identified by means of headspace-solid phase microextraction with gas chromatography and mass spectrometry time of flight analysis (HS-SPME/GC-MS-TOF). The main volatile compounds detected include nonanal (10.82%), -pinene (7.74 %), thymol (4.29 %), and -terpineol (4.39 %).

Botanical origin and total phenols in corbicular bee pollens from different regions of Chile

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Corbicular pollen is a mixture of collected pollen and salivary secretions that the bee kneads into small balls and transports on the third pair of hind legs to the hive, where it is collected by beekeepers with pollen traps before the bees enter through the entrance. It is well known that bee pollen has a high nutritional value, since it contains proteins, carbohydrates, essential amino acids, vitamins and minerals, nutrients used not only by the hive, but also by man, who increasingly consumes this product as a food supplement, which is also a potent antioxidant, whose high content of polyphenols and flavonoids, gives it antibacterial and antifungal properties. This study presents the palynological analysis to determine the botanical origin of fourteen samples of fresh frozen pollen applying the Chilean Norm (NCh 3255, 2011). Additionally, some physical and chemical properties were determined to differentiate and valorize the fresh pollens from different geographical areas of Chile.

Phytochemical Constituents and Biological Activities of the Ethanolic Extract of Mexican Geopropolis

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Geopropolis is produced by stingless bee species such as *Scaptotrigona mexicana* and consists of a mixture of plant resins, salivary secretions of the bee, wax, and soil. This study evaluated the antileishmanial activity in vitro, cytotoxicity and chemical composition of geopropolis produced by *Scaptotrigona mexicana* in the Totonacapan region of Veracruz, México. The geopropolis extract was obtained through maceration using ethanol. The ethanolic extract of geopropolis yielded a mixture of alfa/beta-amyrines y 3-O-acethyl-alfa/beta-amyrines, cicloart-23-ene-3 ,25-diol and lupeol. Volatile compounds analysis was performed by gas chromatography-mass spectrometry. Antileishmanial activity was evaluated against promastigote of *Leishmania mexicana*. Cytotoxic was realized in BALB/c mice peritoneal macrophages. The geopropolis inhibited the *L. mexicana* promastigotes growth and was effective in reducing the infection of murine macrophages since the number of internalized amastigotes were smaller in cells treated with the geopropolis extract in relation to the untreated group. The ethanolic extract was the most active and showed the highest index of selectivity as antileishmanial product. The geopropolis from *S. mexicana* had an antileishmanial effect, mainly after the obtention of the hexanic fraction that improved the activity without increasing the cytotoxicity against murine macrophages. These results suggest that the antileishmanial activity of geopropolis is related to the presence of derivatives of triterpenes and sterols.

Physicochemical and Antioxidant Properties of Stingless bee *Scaptotrigona mexicana* Honey from Totonacapan Region of Mexico

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The physico-chemical properties of stingless bee honey are diverse according to origin of geographical or botanical and fruit or flower season. These factors result in production of honey with different colour, pH, ash and water content although the bee species is similar. To date, the physicochemical properties of honey from Mexican *Scaptotrigona* species are poorly studied. Therefore, determination of physicochemical properties of honey from stingless bee is crucial for Mexican researchers in order to analyze the purity of the honey. 54 honey samples were used for the current study. The physico-chemical characters were evaluated for the moisture content (A), total acidity (B), reducing sugar (C) and hydroxymethylfurfural (D). The study results showed that the mean values of parameters for honey samples were: A (26.0% ± 1.6), B (95.2 mEq/Kg ± 33.8), C (67.9% ± 3.8) and D (18.6 ± 9.2 µg/g). The values were compared against the standard physicochemical parameters of *Apis mellifera* and these values significantly varied for moisture content and total acidity. The color of stingless bee honey varies based on observation or absorbance assay.

The presence of feral honeybee colonies in putative mating sites detected during BeeConSel project

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Many European countries have established their own honeybee breeding programs. However, one crucial element - mating control - is often missing. Consequently, the genetic gain is not as desired, prompting beekeepers to consider purchasing queens from non-local populations or even commercial hybrids which are less suitable for local conditions. EEA and Norway Grants Fund for regional cooperation project Joint Effort For Honey Bee Conservation and Selection – BeeConSel - aims to establish tailor-made effective mating control in beneficiary countries (Croatia, N. Macedonia, Slovenia). The most common approach is an isolated mating station, but the inability of sufficient isolation of the station itself is also the most common weakness.

Several putative mating station locations were proposed in beneficiary countries in geographically different situations. These locations were supposed to be free of any other managed honeybee colonies as well as any feral honeybee colonies. Additionally, at one location the set-up also included Joe Horner method in which the time of the nuptial flight of the queen is delayed enabling control over mating. Our goal was to determine whether the proposed area is semi- or completely isolated that is clean from interference from other colonies to provide successful controlled breeding.

During season 2021 these locations and approaches were tested in the absence of their own drone producing colonies installing only virgin queens in mating nucs at each location. Successfully mated queens and their brood were sampled for genetic analyses. The number of patrilines present in mated queens at each location was estimated using microsatellites.

Using queens as samplers during their nuptial flight we identified various numbers of patrilines per location. The locations differed both in mating success rate and the number of identified patrilines per queen differed between locations showing various success rates in nuptial flights. The relationship between both parameters is discussed.

In this contribution we show the preliminary results and discuss the utility of genetic tools in estimation of patriline composition. We also present the new evidence of the existence of feral honeybee colonies in the areas tested for potential to become mating sites.

Evaluation of quality parameters of Chilean honey

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Chilean honeys contain active compounds with anti-oxidant and antibacterial activities. These characteristics are a reflection of the rich composition of phenolic acids and flavonoids they possess, which vary depending on the geographical area from which they are obtained. Therefore, the main physicochemical characteristics of one hundred Chilean honeys (botanical origin, color, acidity, pH, total sugars, conductivity, diastase index, HMF content, humidity) and their antioxidant and antibacterial characteristics (total phenolic content, ferric reducing antioxidant power assay, diameter inhibitions against *S. aureus*, *E. coli* and *S. enterica* sv.typhi) were determined. The results obtained were analyzed in search of correlations between these parameters; In addition, Raman spectroscopy was used to identify these parameters with non-invasive methods. All the honeys complied with the standards established by the Chilean regulations and the Codex Alimentarius for honey quality. Positive correlations were observed between several of the determined parameters. The analysis of the spectroscopic signals added to the principal components analysis (PCA) allowed to differentiate the honeys by botanical origin.

Some Queen Bee Quality Parameters

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The queen bee is the most important individual among the queen, worker and drone bees that make up a colony. The queen bee is responsible for colony organization and management. When evaluated in terms of the activity of the queen in the colony, the queen bees should be replaced every year or at least once every 2 years. In order to increase yield and quality in the colony, young and high quality queen bees should be used.

When queen bees are not productive under natural conditions, they are replaced by worker bees. When bred poor quality queens are given to the colonies, it may cause difficulties in accepting the new queen bees. This causes irreparable losses for the beekeeper and the colony. Since the queen bee directly affects the colony management and characteristics, instead of managing the colony by growing in a random natural process in the colony, it should be raised from a superior breeder under controlled conditions to increase the yield and quality of the colony.

The queen bee is a genetic resource that carries all hereditary characteristics that affect colony performance. The quality of the queen bee is affected by many genetic and environmental factors. In the formation of the quality parameters of the queen bee, in addition to environmental factors such as the season in which it was raised, the breeding technique, the age of the transferred larva, the characteristics of the starter and finisher colonies, genetic factors such as being a suitable breed are also important. Physical characteristics such as queen hatching weight, egg laying time, sperm sac volume and spermatozoite quantity are factors that occur under genetic and environmental conditions and affect the quality of the queen.

The pheromones secreted by the queen bee positively affect the honey yield, wintering ability, calmness, colony strength and egg-laying performance of a colony. It positively affects the reproductive potential of the qualified queen bee in terms of its genetic structure. It is important for the colony that the queen bees are young and of good quality.

Preliminary investigations on propolis collected by honey bees on *Cannabis* light in Italy

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In recent years in Italy there has been a spread of the cultivation of some varieties of hemp known under the name of "Cannabis light", due to the multiplicity of uses that can be made of it. "Cannabis light" is the generic name that refers to *Cannabis* varieties in which the quantity of the active ingredient delta-9-tetrahydrocannabinol (THC) is low while the content of its metabolite, cannabidiol (CBD) is high, which has various positive effects on human health. The hemp plant is an invaluable source of bioactive compounds with important pharmacological and nutraceutical properties: an oily resin is secreted and accumulated within the glandular trichomes of female inflorescences, consisting of cannabinoids and terpenes. Interest in the therapeutic use of Cannabis and its derivatives is on the rise, since the scientific literature, which has become increasingly extensive in recent years, supports its effectiveness. The propolis collected on the resin of *Cannabis* light by the bees could provide a very interesting product.

To evaluate the presence of THC and CBD on propolis collected from bees, a preliminary study was conducted by bringing some hives to a *Cannabis* light cultivation and preparing them for the propolis harvest.

The analyzes conducted on the collected propolis indicated that THC in this propolis was below the limits established by Italian law while CBD was present. These results indicate that propolis produced near *Cannabis* light crops can be a very interesting product from a therapeutic point of view. Further investigations are needed to confirm the collected data.

Two models of pollen trap in Jumbo type beehives during two flowering periods and the technology transfer process with a group of beekeepers in Mexico

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Two types of pollen traps were evaluated in the Highland region of Puebla and the coffee region of Xico, Veracruz, Mexico, in Jumbo-type hives during autumn-winter 2014-2015 and spring-summer 2015. Two groups of six hives each were used, where six entrance Anel model traps and six Colombian type OAC floor traps, modified by the authors, were placed. Both groups were standardized for the bee population and breeding brood comb to have similar strengths. Results obtained in the Highland region with modified Colombian OAC-type floor traps were significantly higher (727 g/hive) than those obtained with the entrance Anel model trap (271.5 g/hive). Although the productivity in both types of traps was lower in the coffee region compared to the Highland region, production in hives with modified Colombian OAC type floor trap was significantly higher (423 g/hive) than in hives with the entrance Anel model trap (79 g/hive). The Colombian OAC-type floor modified traps, adapted for Africanized bee hybrids from the study region, yielded significantly higher production than the entrance Anel model traps. The latter is used mainly for European bees, morphometrically larger than the Africanized hybrids in Mexico. The modified OAC-type floor traps were evaluated and transferred in a technological package to a group of beekeepers between 2016 and 2020 in the Highland region of Guerrero, Mexico. Productivity increased from 1.2 kg/hive/year to 20.5 kg/hive/year, improving the group of beekeepers' economy.

Digital bee colony twin is the most comprehensive monitoring system for more than 30,000 beehives worldwide. Scientific data contains 15 billion data samples

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The Digital Twin Hive is a comprehensive monitoring system for more than 30,000 hives worldwide. Scientific data contains 15 billion sensory data samples and millions more are added every day.

Technology is interconnected and supported by artificial intelligence. Measurements and data recording are performed every 10 minutes. The data, we measure record the change in hive weight, the number of bees flying out of the hive, the number of bees returning to the hive, recording and analysis of beehive sound, indoor and outdoor temperature, indoor and outdoor humidity, air pressure, CO2, altitude, gps position of hives, automatic photos. The beekeepers can also make detailed notes on the control of hives, honey extraction, age and queen line, hive strength or diseases and reproduction. The system identifies and predicts the swarming of beehives, the presence of the queen, rabbits, the theft of hives.

From the measured scientific data, we created a digital twin of beehives that can accurately model the development of beehives on a daily basis throughout the year in details such as the number of eggs laid, the number of open and closed fetuses, the number of bees born but also the number of varroa destructor in the hive and its development. The digital model can also simulate different methods of healing the beehive and predict how many varroa destructor will remain in the hive after treatment and how it will develop further.

The digital twin system consists of the following parts: hive weight, hive heart, bee counter, gsm gateway, 10 cloud servers, meteo sensor, online camera, artificial intelligence system, online beekeeper support, beehive simulator

Sugar Profiles of Stingless Bee Honey sampled from North East Peninsular of Malaysia: Trehalulose as Potential Marker for authenticity

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Honey is a natural food that is mainly composed of sugars such as glucose, fructose, sucrose and maltose. Other constituents include minerals, organic acids, amino acids, polyphenol compounds, vitamins, essential oils, and other active substances. Sugar properties of honey are responsible for such as energy value, viscosity, hygroscopicity, and granulation important factors related to honey quality, low insulinemic index, low glycemic index and highly active antioxidant. Recent study has identified a unique trehalulose sugar in stingless bee honey (SBH). The finding sparks a new interest in honey, particularly in Malaysia which is produced nearly 150 metric tons of SBH yearly. The objective of the study was to determine major sugar composition of SBH from North East Peninsular Malaysia especially trehalulose. Further, Hydroxy-methyl-furfuraldehyde (HMF) level was also determined to ascertain the freshness of honey samples. A total of 50 samples were collected from 50 farms and tested for fructose, glucose, sucrose, trehalulose and HMF using ultra high-performance liquid chromatography (UPLC) techniques. The various sugars in the 50 honey samples were found in SBH starting with fructose range (37 to 48 g /100 g) and glucose (37 to 43 g/100 g). The UPLC analysis also revealed the presence of trehalulose ranging between 15 to 25 g/100 g. Furthermore, Fructose + Glucose (F+G) (77 to 84 g/100 g), Fructose/Glucose (F/G) (0.8 to 1.3). HMF values range from 3 mg/kg to 13 mg/kg. Results showed that sugar and HMF values meet the Malaysian Standard for SBH MS2683:2017 Specification. The chromatographic results showed the presence of the trehalulose in all stingless bee honey samples

Trehalulose detection of stingless bee honey via in silico bio-computational analyses using DNA-Aptamer as a novel synthetic affinity bioreceptor

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Adulterated honey in market has been the biggest hindrance in the utilization of honey as medicinal therapeutic in hospital setting as well as natural supplementation. Evaluation of honey quality and authenticity at present are rely on the laboratory-based detection such as chromatographic analysis which commonly expensive, laborious and not widely available. Hence, a more economic and user-friendly alternative detection tool of adulterated honey is imperative. Aptamer, a synthetic DNA-based bioreceptor that can be designed by bio-computational approach, has the potential to be used as a detection probe of trehalulose in developing biosensor for honey quality and authenticity detection. Trehalulose, is a unique sugar found in stingless bee honey and potentially use as a biomarker to detect the adulterated honey. The present study focused on evaluating the potential of DNA-Aptamer as a novel affinity bioreceptor in detecting trehalulose and other sugars present in stingless bee honey for identification of authentic honey. The molecular binding mechanism of DNA-Aptamer targeting trehalulose and sugars in stingless bee honey was evaluated using the in-silico bio-computational modelling. The specificity binding of DNA-Aptamer in distinguishing trehalulose compared to other sugars was investigated using AutoDock tools and Vina analyses. Quantitative analyses showed that the DNA-Aptamers bind with high affinity and specific towards trehalulose compared to the other sugars. Cross reactivity binding analysis of anti-trehalulose DNA-Aptamers against other sugars present in the stingless bee honey showed that the DNA-Aptamers bind selectively against trehalulose in the presence of other interferences. Therefore, the anti-trehalulose DNA-Aptamers have the potential for used as novel affinity synthetic bioreceptor in developing portable biosensor for honey quality and authenticity detection in stingless bee industry.

Pollinator Diversity in Litchi Orchard and Effect of Pollinators on Litchi Yield

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The study was conducted in a litchi orchard at Iswardi of Pabna district to keep a record of the diversity and relative abundance of litchi flower-visiting insects and to see the yield of litchi with and without pollinators in the year 2021. Without netting condition the maximum number of inflorescences per branch was 8.01 where as the number of inflorescences per branch was 8.03 at netting condition. The percentage of male, female, and hermaphrodite flowers was respectively 28%, 40%, 32%. It was observed that different kinds of insect species visit the litchi flower i.e. honeybees, ants, different flies, and other insects. The most visited pollinator was Honeybee (49.72%). The foraging time of the honeybees was the highest at 6.00am to 8.00am and 4.00 pm to 6.00 pm. The butterflies were found from 10.00 pm to 2.00 pm. However, the ant and the flies were noticed almost throughout the day. In the netting condition, the flies, honeybees, butterflies, beetles and other foraging insects were not able to enter through the net but ants were seen inside the net. The yield difference between the netting and without netting conditions was significant. In the netting condition, the yield was 8% (0.11 kg/branch) whereas without the netting condition it was 92% (1.28kg/branch). Pollinators are a crucial factor in our environment. From this experiment, it was revealed that the importance of pollinators and their role in Litchi yield.

Introduction of controlled bee pollination of Actinidia in Ukraine

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Actinidia arguta is an introduced plant in Ukraine. For the production of Actinidia fruits in industrial-scale production, it is grown in the south of Ukraine. Actinidia is a dioecious liana for which cross-pollination is very important. To produce fruit, 10-15 female lianas need a male one and effective controlled pollination. The goal of the research was to introduce for the first time controlled bee pollination of a Actinidia in Ukraine. The research was carried out during May-June 2021 in the conditions of CHORNOMORSKIY ALLIANCE LLC (Odesa Oblast, Ukraine) within the project «Development of the market controlled bee pollination in Ukraine», supported by USAIDs Agriculture Growing Rural Opportunities Activity (AGRO). Actinidia was grown on 23 hectares under a protective net against severe weather conditions. 80 bee colonies were used in the study. The results were as follows: a contract for the provision of controlled bee pollination services between the beekeeper and the farmer (taking into account climatic and economic needs) has been developed, which meets the current legislation of Ukraine; the selection of technology for the use of bees in the application of protective nets has been carried out with the creation of bees' flight routes along the rows of Actinidia; a scheme for housing bee colonies for efficient pollination has been developed; a cyclogram for feeding use and bee training to stimulate bee flight activity has been developed; support for the provision of controlled bee pollination services has been provided; actinidia yields due to the use of controlled bee pollination has been recorded; the commercial quality of the berries has been improved as a result of the use of controlled bee pollination.

Quality of Actinidia berries after controlled bee pollination

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Actinidia arguta is a dioecious liana that is grown in Ukraine to produce berries for the food industry. Actinidia controlled bee pollination was first introduced in Ukraine in 2021 within the project «Development of the market of controlled bee pollination in Ukraine», supported by the USAID's Agriculture Growing Rural Opportunities Activity (AGRO). The goal of the research was to determine the influence of controlled bee pollination on the quality of Actinidia berries. The harvest took place in September-October in the conditions of CHORNOMORSKIY ALLIANCE LLC (Odesa Oblast, Ukraine). The Faculty of Food Technology and Quality Control of Agricultural Products conducted quality research. The yield of Actinidia due to the use of controlled bee pollination was about 8 t/ha of total fruit mass or 184 t of total area. During the harvesting, the difference between the quality of the berries in places close to the hives (area 1) and remote areas from the bees (area 2) was observed. To assess the quality of the berries, comparisons were made for a number of indicators, namely, quality, defects, mass, size, ripeness and organoleptic indicators. The average sample was 268 fruits per area. It has been established that controlled bee pollination have an overall positive effect on increasing Actinidia yields and improving berry quality. Namely: this increases technical suitability (quality) of fruit by 13% and reduces the number of berries of technical crop by 7%, which allows to increase profit by 24.22 thousand UAH with each ton of yield; this reduces external defects of berries by 16% for extra quality and 34% for first quality; this reduces the number of internal defects of the berries by 100% for extra quality and 20% for first quality; this improves the organoleptic properties of the berries by 33% in extra quality and 13% in first quality; this increases the weight of conditioned berries of the extra quality by 23.39%; this increases the size and roundness of the berries, the average transverse dimension of the fruit increases by 0.24 mm, and longitudinal by 0.53 mm.

Comparison of controlled pollination efficiency by bumblebees and honeybees of commercial varieties of high blueberry

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Cultivation of *Vaccinium corymbosum* L. as a high blueberry is widespread in Ukraine. There is ongoing controversy about the effectiveness of high blueberry pollination by various insects. The goal was to compare the effectiveness of controlled pollination of bumblebees and bees of high blueberry commercial varieties. The research was carried out in May-June 2021 within the project «Development of the market of controlled bee pollination in Ukraine», supported by the USAID's Agriculture Growing Rural Opportunities Activity (AGRO). 42 bee colonies and 13 bumblebee colonies were brought to the fields at LLC «NIKDARIA» (Zhytomyr, Ukraine) for comparative research. The yield of blueberries as a result of controlled bee pollination increased by 1.94 t/ha, bumblebee pollination increased by 1.27 t/ha, the combination of two insect species on the Duke variety increased by 2.66 t/ha, the combination of an attractor with bees increased by 0.72 t/ha and an attractor with bumblebees by 0.95 t/ha. Without the use of any means to improve pollination, the yield was lower than planned by an average of 0.4 t/ha. However, Spartan did not respond to the lack of pollinators. Controlled pollination leads to an increase in the net profit, namely: 211.0 thousand UAH/ha for bee, 134.5 thousand for bumblebee, a combination of bee and bumblebee is 289.9 thousand, a combination of bee and an attractor is 74,0 thousand, combination of bumblebee and an attractor is 98.4 thousand UAH/ha. Incomplete yield to the planned one due to the absence of any pollination methods differs depending on the variety and ranges from 0.29 to 2.24 t/ha, resulting in a decrease in profits from 31.9 to 246.4 thousand UAH/ha. Increasing of yields does not always mean increasing of the efficiency. The use of bees increased yields by 49%; bumblebees by 33%; combination of bee and bumblebee by 33.25%; bee and wild insect attractor by 18%; combination of bumblebee and an attractor by 47.5% (indicating that the attractor has an effect on bumblebees, but not on honeybees). The highest economic efficiency in the combination of bee and bumblebee pollination, in which the increase in the net profit is 289.9 thousand UAH/ha.

Contribution to melissopalynological characterization of Moroccan thyme honey

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In order to maintain the health of bees and the pollination of forests, it is crucial to elucidate which plants the bees visit for the production of honey. Thus, pollen analysis of honey (melissopalynology) was carried out. Twenty unpasteurized thyme honey samples collected during three consecutive years (2016, 2017 and 2018), provided by beekeepers from Ijoukak region which is a rural commune in Al Haouz Province of the Marrakech-Tensift-ElHaouz region of Morocco were analysed. The quantitative analysis showed that Moroccan thyme honeys of the studied area are characterized by their low number of grains of pollen (NPG) ranging from 10100 to 17750 in 10g of honey. The qualitative analysis revealed that the best-represented families are Apiaceae, Fabaceae, Ranunculaceae, Rosaceae and Rutaceae, while the most frequent families found are: Fabaceae, Apiaceae, Lamiaceae, Fagaceae, Myrtaceae, Asteraceae, Oleaceae, Amaranthaceae, Cistaceae, Papaveraceae, Poaceae, Brassicaceae, Boraginaceae, Rhamnaceae, Rosaceae, Plantaginaceae, Euphorbiaceae and Lythraceae. Using melissopalynologie, authentication of honey according to plants visited by bees may be facilitated, a fact that could lead to honeys of higher commercial value, which is prized by consumers.

Hiveopolis - Enhancing migratory beekeeping practice using the digital flowering calendar

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Beekeeping is an important agricultural activity globally that contributes to sustainable rural area development in two main ways—economic (income) support and ecological support from honey bees activities. Apiculture has gained worldwide interest because of its contribution to economic incomes, sustainable environmental conservation and, in the view of this, migratory beekeeping, as a high-yielding technique, is extensively adopted.

One of the most important tasks for beekeepers is selection of a good foraging location for bee colonies, especially for migratory or traveling beekeepers. Optimal location will allow bee colonies to forage higher amounts of resources with minimal effort from bees. The lack of pollinated plants, as well as their non-optimal distribution between colonies, can lead not only to a decrease in the productivity of bees, but also to starvation and even death.

To make the apiary location planning more predictive and efficient, information about the crop and plant flowering can be used. One of the usable solutions would be to create and visualize a flowering calendar. To make the flowering calendar more user friendly and simplify the application of this tool, it can be combined with spatial information and GIS data. To complete this task, several steps should be taken, starting from the preparation of the flowering data then selecting the area of interest and converting this area into polygons, which correspond to plant fields and, finally, assigning the plants to target fields.

The proposed solution provides flowering simulation, when the fields are encoded by color, based on flowering information throughout the weeks of a year. Having information about the potential amount of foraging resources in specific locations, beekeepers can select and plan foraging places.

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Impact of climate and land management in Ukraine on the feed resources of honey bees

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In Ukraine over the past twenty-five years, the number of bee colonies has decreased 1.4 times from 3,525.7 to 2,487.1. Diseases, pesticides, loss of genetic diversity and loss of habitats (feed resources) lead to the death of bee colonies. The problem of loss of bee habitats is particularly acute. It is caused by two factors. It is the climate crisis and human economic activity. As a result of the conducted studies, it was found that the effects of the climate crisis and management in Ukraine on bee feed resources are:

a decrease in the diversity of honey plants, high plowing, destruction of forests and steppes; reduction of diversity and areas of cultivated honey plants because of the decline of animal husbandry and the spread of monoculture; reduction and change of terms of the growing and flowering of natural honey plants because of the climatic crisis, and cultural due to the use of precocious varieties; reduction of nectar production and quality of nectar of cultural honey plants due to the development of self-pollinating, precocious and drought-resistant varieties. Therefore, for the local solution of the problems of the honey reserve, beekeepers need: to protect and improve honey plant resources; to use bee colony transportation and develop pollination; to breed local ecotypes of bees; to engage in self-education and to be socially active in stimulating the state to solve the problems of feed resources. However, in order this problem globally, a number of actions need at the state level, such as: reducing carbon emissions; rational use of land and reduce its plowing; developing animal husbandry; to introduce scientifically based crop rotation and reduce the share of monoculture; to improve the legislation on the improvement of bee feed resources; to conduct selection work in beekeeping aimed at sustainability and adaptation to changing climatic conditions; to carry out scientific research on the preservation and improvement of honey plant resources in the climate crisis; to develop and implement state programs of preservation and improvement of honey plant resources; to conduct educational work on the problems of feed resources of bees and ways to solve it.

Role of honeybee in pollination of canola

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The economic value of bees for pollination in different countries is estimated between 60 and 141 times the value of its direct production per year. Canola is a self-pollinating crop, but in the presence of pollinating insects, especially bees, its yield increases significantly. Agriculture in Iran is mostly retail owner and most farmers do not have enough botanical information about how to fertilize plants, which has led to low production of agricultural products per unit area. On the other hand, not paying attention to the role of bees in increasing agricultural products, including Canola, has caused the presence of bees in these fields is not welcomed. Therefore, according to the projects done and the effect of 20 to 30% of bees on increasing canola production, a promotional research project including treatment isolated by netting with bee pollination (T1) and treatment isolated by netting without pollination by bees (T2) on the yield and yield components of Canola cultivar Hayola 50, in the cropping year 2018-2019 at Gavdasht station of Mazandaran Province. The results showed that the controlled use of bees (T1) has a significant role in increasing grain yield. In this regard, the grain yield of the studied cultivar in T1 and T2 treatments was 3170, 2290 kg / ha, respectively. Thus, in the controlled pollination treatment, compared to the isolated conditions without bees, the grain yield increased by 28%. Estimation of grain yield components also indicates that controlled pollination treatment increased the number of pods per plant along with increasing the weight of 1000 seeds, which ultimately increased grain yield. Due to the fact that the number of seeds per pod is mostly due to genotype and mainly under genetic control, so this trait was not affected by different pollination treatments. In general, the results of this study emphasized that bee pollination has a prominent and significant role on Canola yield.

Perennial energy crops as “environmental islands” in highly modified agricultural land – bioenergy plantations as a source of benefits for pollinating insects

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Declines in wild pollinator species in the last decades are well documented. They are driven primarily by habitat loss and a decrease in floral resources resulting from agricultural intensification. Large, monocultural crops, devoid of herbaceous plants don't provide nectar and pollen throughout the all growing season. Negative ecosystem changes have sparked a debate on sustainable agriculture, the main assumption of which is to implement solutions that are beneficial both from an economic and environmental point of view. Landscape mosaicism increase is one of them. It can be achieved by incorporating extensively used plantations in industrial agriculture areas. Some of the most beneficial for this model are perennial energy plants. They can be grown on marginal land, of little use for other types of agricultural production, and also require a small amount of agrotechnical treatments. The most popular energy plants in Central Europe today include willow (*Salix* spp.), giant miscanthus (*Miscanthus×giganteus*), virginia fanpetals (*Sida hermaphrodita*) and cup plant (*Silphium perfoliatum*). Based on a literature review, they were assessed for suitability for pollinating insects. The following factors were taken into account: the use of pesticides and the number of agrotechnical treatments on the plantation, the presence of herbaceous plants, the usefulness of the plant itself as forage, and the potential for invasiveness. Conventional miscanthus plantations have been shown to be of little use for pollinating insects. The value of this plant, however, can be increased by intercropping with melilot (*Melilotus officinalis*). Flowering perennials – cup plant and virginia fanpetals were evaluated much better. However, they have a high invasive potential, which should be taken into account when introducing them into the environment. Additionally, they do not provide nectar in drought conditions. The greatest number of publications concerning willow, which was assessed positively as a source of forage. Additionally in the preliminary study, carried out in Leginy (north-eastern Poland) the cup plant and virginia mallow plantations have been observed during the flowering period. The abundant presence of bumblebees (*Bombus* spp.) and honey bee (*Apis mellifera*) have been indicated. Supplementary photographic documentation was prepared.

The controversial importance of *Robinia pseudoacacia* L. for beekeeping in Northwestern Bulgaria

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Melliferous alien species are an integral part of the modern floral resources of Bulgaria, but their importance is a controversial and ambiguous topic for the beekeeping community. The public focus is mainly on the potential of *Robinia pseudoacacia* L. to generate high yields of bee products. Outside the immediate public interest, however, remains the important economic question of the long-term effect of the impact of alien species on the structural diversity of natural and cultivated melliferous vegetation in the relevant geographical conditions and the risk of losing species of value to this economic sector. Alien species have been identified as the second cause of species extinction from natural biodiversity (Genovesi & Shine, 2004).

This study presents the results of successive field surveys (2018–2022) on the diversity of melliferous species in the habitat structure of Northwestern Bulgaria (Vratsa region), which confirm this potential danger. In areas of 95 ha occupied by *Robinia pseudoacacia* L. in the central parts of the municipality of Krivodol (representative for Northwestern Bulgaria), only 11 species of melliferous plants were found, with an area dominance of *Robinia pseudoacacia* L. of 95%. In habitats unaffected by alien species, the number of melliferous plants found in habitat E1.222 Moesio-Carpathian steppes is 64 species, and in habitat G1.7A1 Euro-Siberian steppe *Quercus* woods - 30 species. Within lowland areas (Danube Plain, northern Bulgaria), the process of aggressive self-propagation of alien species leads to periods of the year when pollinators (including honey bees) experience a shortage of nectar and pollen. This causes additional interventions by beekeepers, such as feeding during the active period of colonies and combating swarming (based on the author's observations and discussions with other beekeepers).

Sustainable beekeeping depends on a steady flow of nectar and pollen from floral resources and a tailored spatial habitat structure to support pollinator movement during the active period. The results presented here aim to provide research data (part of a PhD thesis development) on habitats in Northwest Bulgaria to contribute to the discussion of long-term perspectives for the beekeeping community in Bulgaria on improving pollinator activity and establishing sustainable beekeeping practices.

Chaos Project: a bee- friend viticulture: a case of study

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The honey bee is considered an excellent bioindicator as with its foraging activity it is able to sample a very large area. Pollen represents an excellent matrix for assessing the quality of an environment. On the contrary, bees not belonging to the genus *Apis* have a more limited flight activity and can therefore give us more point-like information. Therefore, the combination of the information provided by honey bees and other Apoidea can give us an indication of the sustainability of the activity implemented.

As part of the Chaos project, two apiaries were installed at the company, one was associated with a holistic apiary, for educational and recreational use; the other was functional for carrying out pollen sampling monthly. The pollen collected was analyzed both from a botanical point of view and from the point of view of the presence of residues. The Pollen Hazard Quotient was calculated for each pollen sample. Pan traps were monthly positioned for monitoring Apoidea in two transects located in vineyards with a different grass management. Bee hotels were also installed in the vineyards. The data obtained from the pollen analysis revealed how the sowing used for green manure was used by bees for the supply of pollen and nectar. The data obtained by residual analysis indicate that the PHQ for honey bees is medium-low. Apoidea non-*Apis* belonging to the family Altitidae and to the genera *Andrena*, *Antophora*, *Bombus*, *Ceratina*, *Eucera*, *Osmia*, *Xylocopa* were collected.

Synergy of farmer and beekeeper in organization of sustainable crops pollination in order to maintain health of bees and increase crop yields

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Ukraine is one of the ten largest grain producers in the world.

Ukraine needs at least 5.2 million bee colonies to pollinate major oilseeds. This means that the potential of the beekeeping industry in terms of the number of bee colonies may be significantly increased. As of 2020, 2.6 million bee colonies have been registered in Ukraine.

Twofold increase in a number of bee colonies will have a significant impact on the sustainable development of rural areas and on increasing employment in such areas.

In 2020, we launched a project to conduct field trials to study the impact of additional bee pollination on crop yields of commercial oilseed rape and sunflower.

The peculiarity of the project is that all work is carried out using the most advanced digital systems (precision farming system, smart bee colony monitoring system BeeData) and using large areas of rapeseed (600 ha) and sunflower (1042 ha).

This approach enables us to explore:

- influence of bee pollination on yield, morphological characteristics of the plant and biochemical and technological indicators of seed quality at different distances from hives
- the impact of a change of soil properties (physical and chemical properties of soil) on the land plot on the yield indicators
- methods of preserving bees for the period of treatment of rapeseed and sunflower with insecticides and fungicides
- flight activity of bees during the day and migration of bees between hives
- the effect of the direction of sunflower rows in relation to bee-entrances of the hives on increase in the distance of effective pollination.

According to the results of field tests in 2020, we observed:

- increase in yield of Sherpa rape hybrid at a distance from hives: 200 m - 22.9%, 500 m - 4.3%, 730 m - 6.2%.
- increase in yield of SI Eksperto sunflower hybrid at a distance from hives: 280 m - 27.4%, 720 m - 11.1%, 1220 m - 0.7%.

We have recorded that plants on land plot with better physical and chemical properties and soil respond better to additional pollination by bees.

The project continues, please join



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