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

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

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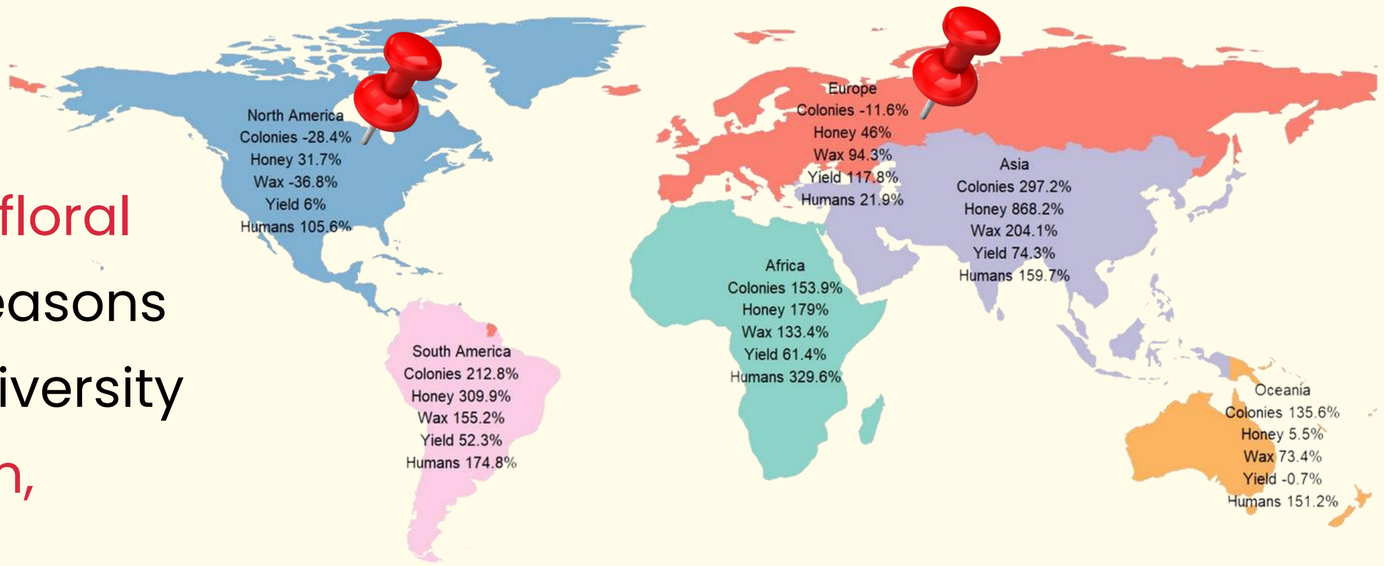
Introduction

The challenge of honey bee nutrition

- Honey bees are vital for global agriculture and ecosystems
- The deficiency of high-quality floral pollen, especially during off-seasons or in areas with limited plant diversity leads to a decline in bee health, population, and productivity



Phiri et al., 2022

Samuel Hartlib
1655

1958

There are likely over a hundred diet formulas published worldwide as of now!!

Reviewing the Efficacy of Pollen Substitutes as a Management Tool for Improving the Health and Productivity of Western Honey Bee (*Apis mellifera*) Colonies

Emily R. Noordyke and James D. Ellis*

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2021

Emily R. Noordyk

REVIEW article

Front. Sustain. Food Syst., 10 November 2021
Sec. Agroecology and Ecosystem Services
Volume 5 - 2021 | https://doi.org/10.3389/fsufs.2021.772897

There are a large number of experimental diet formulations.

These formulations often differ in composition and are frequently modified.

There is high variability in the environmental conditions where testing is conducted.

Results from laboratory experiments may not reflect real-world field conditions.

Many studies on pollen substitutes lack key elements in experimental design.

INSIDE THE HIVE TV

Commercially sold industrial products are rarely supported by scientific evaluation before market release

Perfect food?:

Palatability

Digestibility

Bioavailability

Plant protein

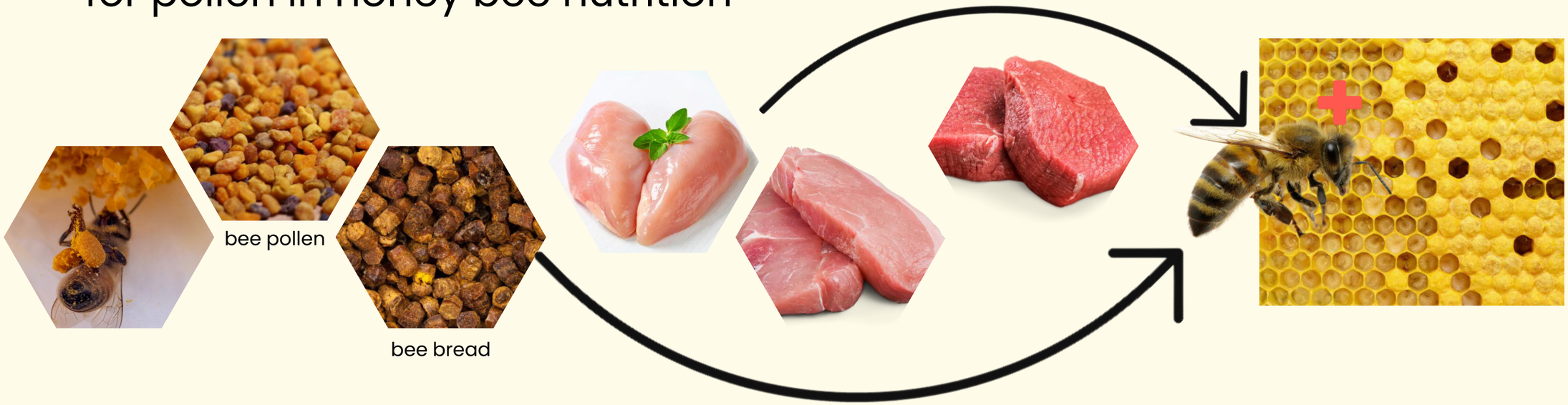
Animal protein

Hypothesis

Hydrolyzed chicken meat can serve as an effective protein source in artificial diets for honey bees and promote their health in comparison to pork, beef, and pollen

Objective

To evaluate the efficacy of animal-derived proteins as substitutes for pollen in honey bee nutrition



Materials and Methods

Pretreat meat

60°C for 3 hours

Sterilization

100°C for 15 mins

Homogenization

3-5 mins

Heat treatment

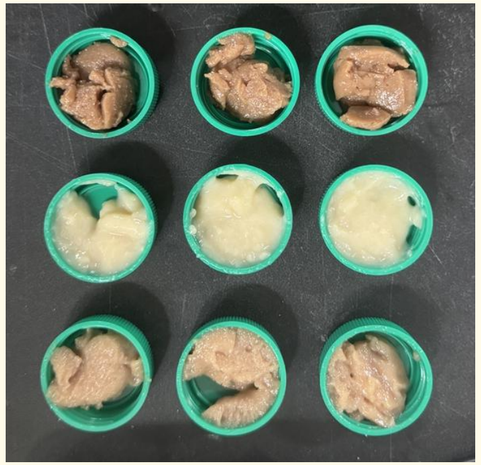
3 mins

Diet composition (w/w)

- hydrolyzed meat 60%
- sucrose 35%
- palm oil 3%
- xanthan gum 1%
- vitamin 0.5%
- mineral 0.5%

Experimental design

Control: maize pollen patty



Beef patty

Chicken patty

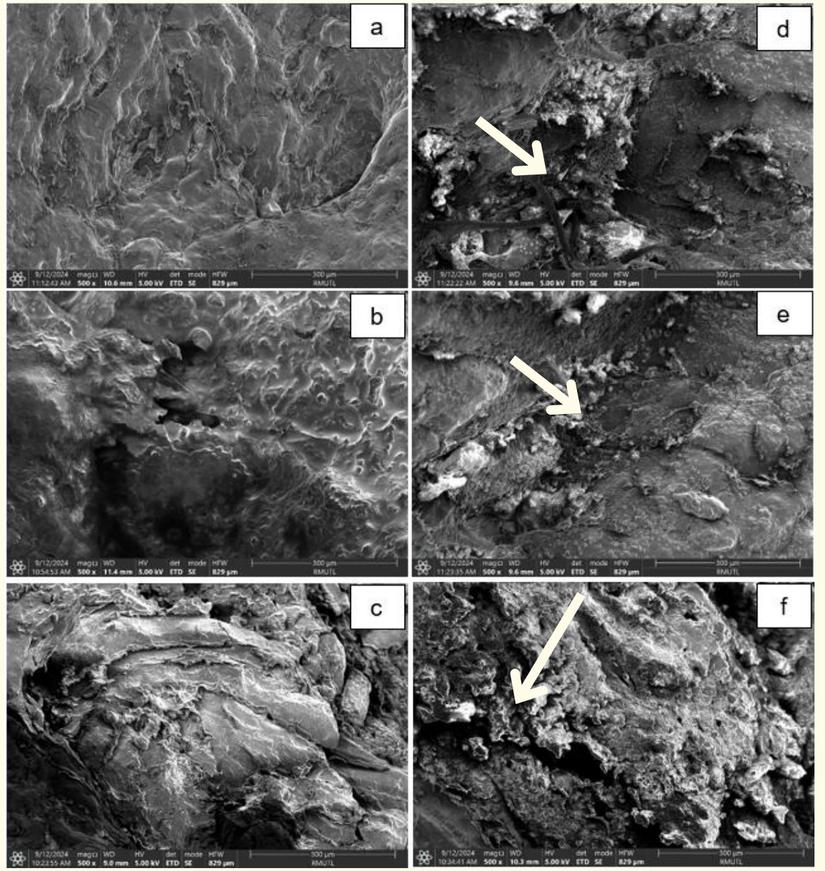
Pork patty

Materials and Methods

- Formulated diet
  - Structure under SEM
  - Nutritional composition
    - Proximate analysis
    - Amino acid profiles
- Honey bee health
  - Lifespan
  - Hypopharyngeal glands
  - Gut microbiome diversity

Results

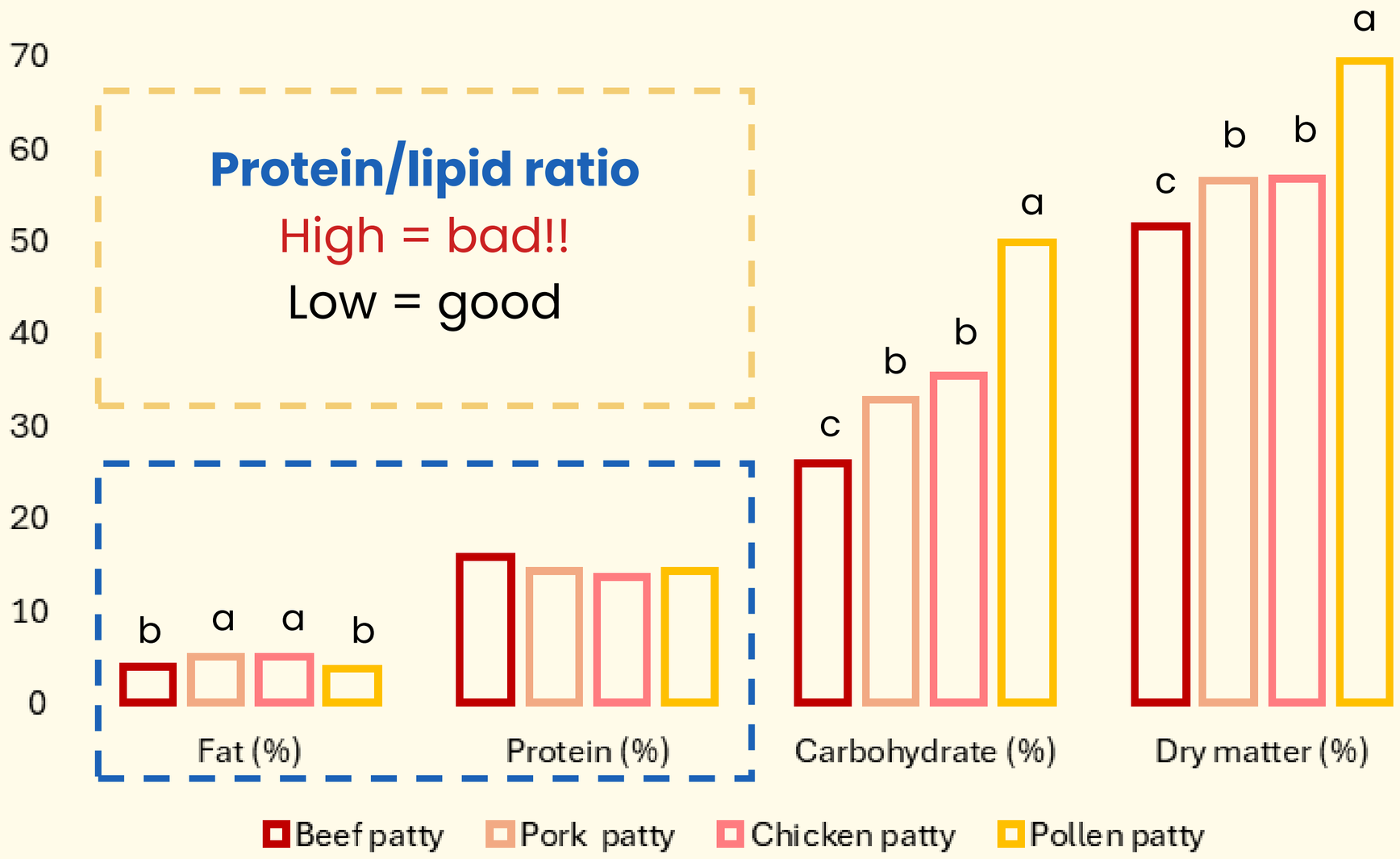
Diet structure under SEM



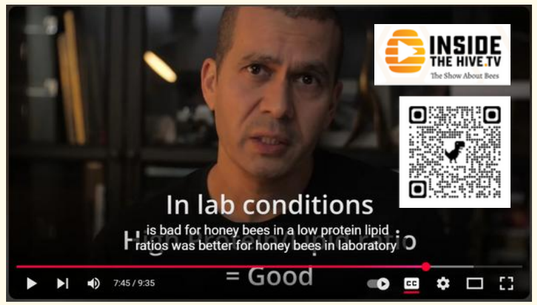
Pretreat

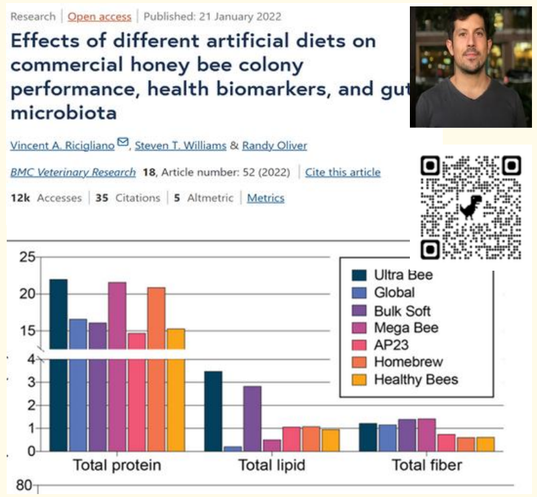
Scanning Electron Microscopy (SEM) images at 500x magnification of untreated meats: (a) beef, pork (b), and (c) chicken, and protease-treated meats: (d) beef, (e) pork, and (f) chicken, for 3 hours at 60°C.

Proximate analysis

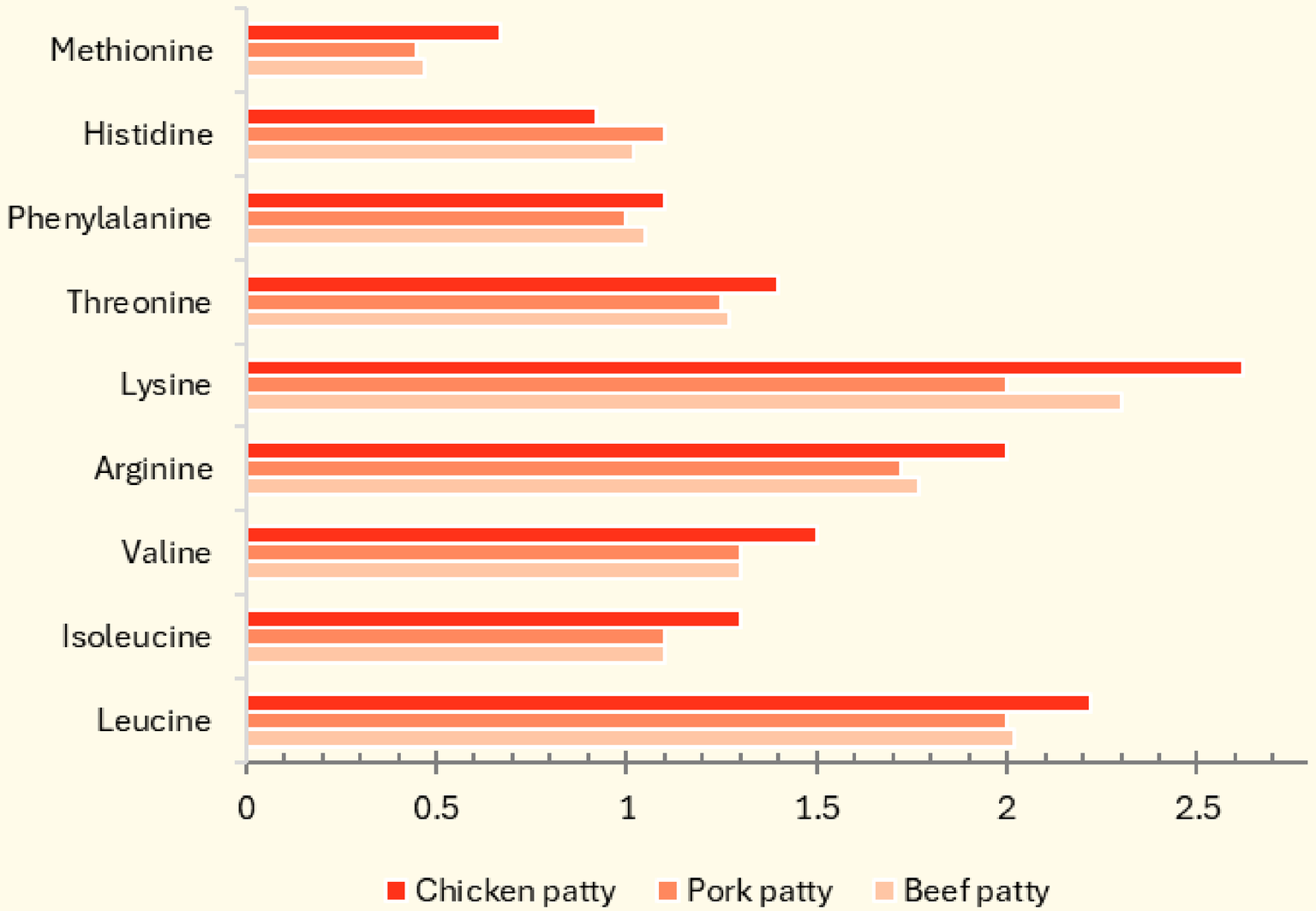


Dr. Humberto Boncristiani

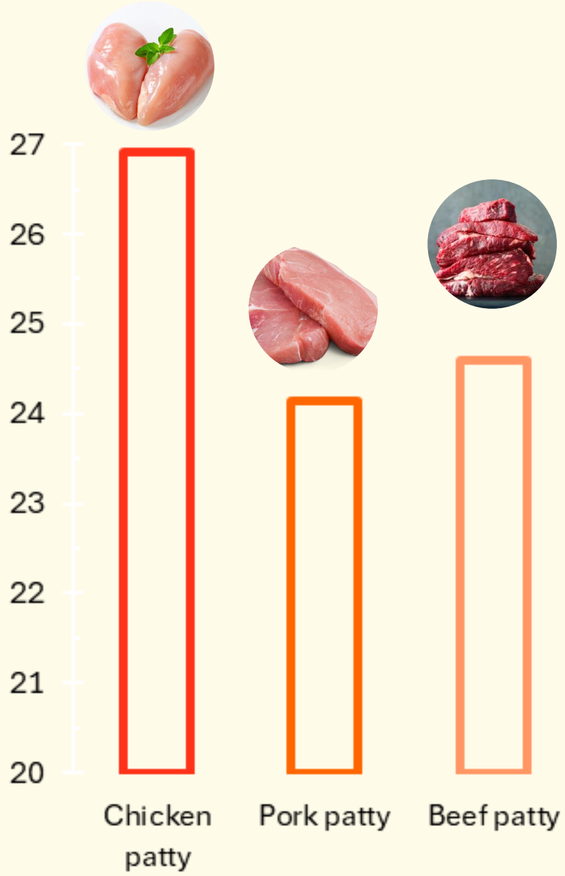




Amino acid compostion (%)

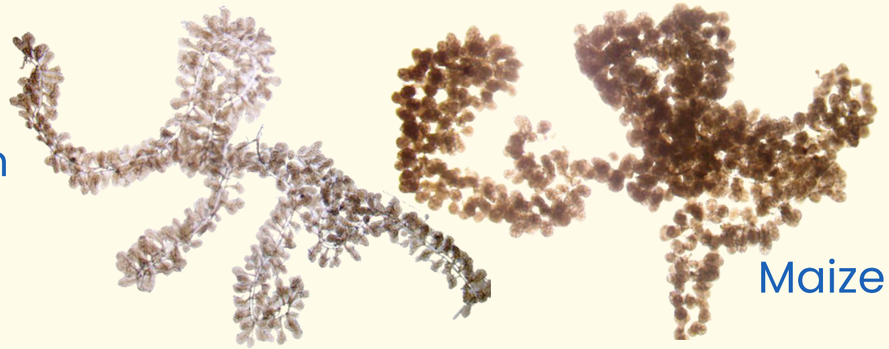


Total amino acid



HPG acini

Control
12.58 ± 1.49 µm



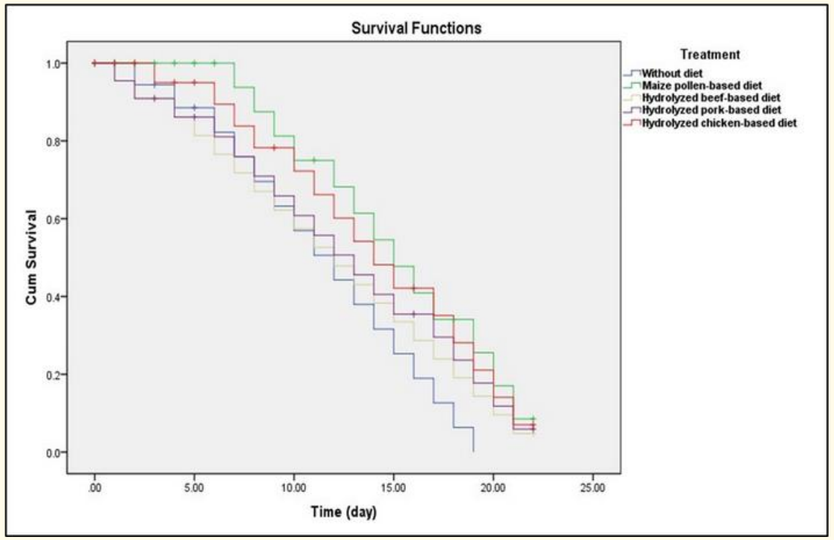
Maize pollen patty
22.50±2.38 µm

Beef patty
12.86 ± 1.98 µm

Pork patty
20.09±2.60 µm

Chicken patty
21.80±2.04 µm

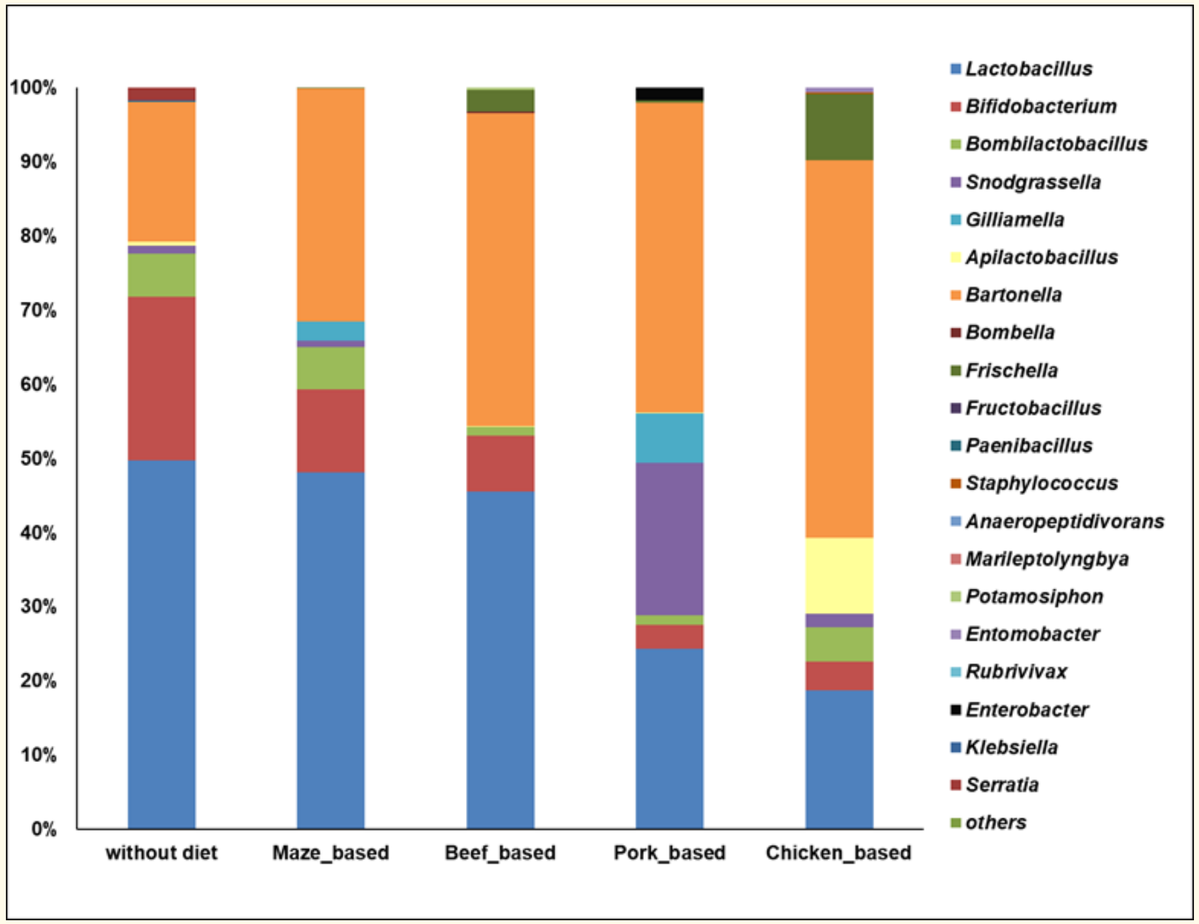
HPG acini in 7-day-old honey bees fed with four different diets



Survival of bees fed three different diets

Bees fed with chicken and pork showed the best survival compared to beef, maize pollen, and control

Gut microbial community



Changes in the gut microbial community at the genus level of honey bees across 5 experimental diets

Conclusion

pollen deficiency!!

supermarket

- Circular economy
- Long-term impact

Healthy bees benefit beekeepers' economies and the global environment

Meliponini and Apini

Thank you
Tak

MARL

ขอบคุณค่ะ

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MARLHoney2021