



COMMENTARY

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The Role of Microbiome in Honeybee: Strategies for Sustainable Beekeeping and Pollinator Protection

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Description

Honeybees are not only essential pollinators in ecosystems worldwide but also vital to agriculture and food production. An often overlooked yet important aspect of their health is the honeybee microbiome, a complex community of microorganisms residing in and on the bees. This microbiome plays a significant role in honeybee nutrition, immunity, and overall well-being. Understanding the honeybee microbiome is essential for preserving bee populations and, by extension, the ecosystems and human agricultural systems that depend on them.

The composition of the honeybee microbiome

The honeybee microbiome consists of various bacteria, fungi, viruses, and yeasts. These microorganisms inhabit different parts of the bee's body, including the gut, glands, and even the hive environment. Key bacterial species in the honeybee microbiome include *Gilliamella apicola*, *Snodgrassella alvi*, and *Lactobacillus* spp., each playing distinct roles in the bee's health and digestion.

Gilliamella apicola: This bacterium is primarily involved in breaking down complex carbohydrates and polysaccharides from pollen, aiding in the bee's digestion and nutrient absorption.

Snodgrassella alvi: Located in the hindgut, this bacterium helps in maintaining gut health and protecting against pathogens.

Lactobacillus spp: Known for their role in fermentation, these bacteria help in producing beneficial compounds that enhance the bee's immune response.

Additionally, fungi like *Ascosphaera* APIs, the causative agent of chalkbrood disease, can also be part of the microbiome, highlighting the delicate balance between beneficial and harmful microorganisms.

Functions of the honeybee microbiome

The honeybee microbiome serves several critical functions that contribute to the overall health and productivity of the hive.

Nutrition and digestion: The microbiome helps in breaking down complex food sources such as pollen and nectar, converting them into nutrients that bees can easily absorb. This process is vital for the development of larvae and the energy requirements of adult bees.

Immune defense: The gut microbiota provides a protective barrier against pathogens by outcompeting harmful microorganisms and producing antimicrobial compounds. This natural defense mechanism reduces the incidence of infections and diseases within the hive.

Detoxification: Honeybees are open to various environmental toxins, including pesticides. Certain microbiome members can detoxify these harmful substances, thus protecting the bees from their adverse effects.

Communication and behavior: The microbiome influences the production of pheromones, chemical signals important for communication and coordination within the hive. These signals affect behaviors such as foraging, brood care, and defense.

Impact on bee health and colony survival

The health of the honeybee microbiome directly correlates with the overall health of the bees and the survival of the colony. A balanced and diverse microbiome enhances the bees' ability to digest food, fight off pathogens, and detoxify harmful substances. When the microbiome is disrupted, bees become more susceptible to diseases, malnutrition, and environmental stressors.

For example, studies have shown that colonies

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with a healthy microbiome have higher resistance to infections and better overall productivity. Conversely, colonies with disrupted microbiomes exhibit increased rates of disease, reduced brood development, and higher mortality rates. This link underscores the importance of maintaining a healthy microbiome for the sustainability of bee populations.

Strategies to preserve and restore the honeybee microbiome

Given the critical role of the honeybee microbiome, several strategies can be employed to preserve and restore its balance, thereby supporting bee health and colony survival.

Promoting biodiversity: Ensuring that bees have access to a diverse range of floral resources can help maintain a balanced microbiome. Planting a variety of flowering plants can provide bees with the necessary nutrients to support a healthy microbial community.

Reducing chemical exposure: Limiting the use of pesticides and other chemicals can help protect the honeybee microbiome. Integrated pest management strategies that minimize chemical use and promote natural pest control methods can be beneficial.

Probiotics and prebiotics: Supplementing bee diets with probiotics and prebiotics can support the growth

of beneficial microbes. These supplements can help restore microbiome balance, especially after exposure to antibiotics or environmental stressors.

Healthy hive management: Practices such as regular hive inspections, maintaining clean hives, and controlling pathogen spread can help maintain a healthy microbiome. Avoiding unnecessary antibiotic use and ensuring good hive hygiene are also important.

Research and monitoring: Continued research into the honeybee microbiome and its interactions with environmental factors is essential. Monitoring the microbiome can help detect early signs of imbalance and allow for timely interventions.

The honeybee microbiome is a complex and vital component of bee health and ecosystem stability. It plays essential roles in nutrition, immunity, detoxification, and behavior, directly impacting the survival and productivity of honeybee colonies. Understanding and preserving the honeybee microbiome is important for protecting these important pollinators and ensuring the health of ecosystems and agriculture worldwide. Through biodiversity promotion, chemical reduction, probiotic use, healthy hive management, and ongoing research, we can support and sustain healthy honeybee populations for future generations.