

EVALUATION OF THE EFFECT OF FRUCTOOLIGOSACCHARIDES (FOS) ON THE HONEY BEE MICROBIOTA AND MYCOBIOTA

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Honey bees play a vital role in pollination and ecosystem health. In Spain, beekeeping supports biodiversity and the agriculture, but climate change and drought threaten natural forage availability, leading to increased use of artificial feed. Fructooligosaccharides (FOS) are prebiotic compounds derived from sucrose that enhance gut health by promoting beneficial microbes and organic acid production. This study investigates the impact of FOS supplementation on the gut microbiota and fungal communities in the Iberian honey bee *Apis mellifera iberiensis*.

Thirty *Apis mellifera iberiensis* hives were assigned to three groups:

- Control (standard syrup)
- 1 % FOS supplementation
- 5 % FOS supplementation

Colony productivity was assessed by comparing hive weights before and after treatment.

Worker honey bee DNA was extracted for metagenomic analysis to profile bacterial and fungal communities based on operational taxonomic units (OTUs).

- Alpha diversity metrics assessed species richness.
- Beta diversity (Bray-Curtis distance) evaluated shifts in microbial community structure across treatments.



- Hive weights increased significantly in the 5 % FOS group, indicating enhanced colony productivity. However, FOS supplementation did not significantly alter bacterial gut populations.
- Alpha and beta diversity analyses showed that microbiota composition varied naturally over time, not due to FOS.
- Fungal communities (mycobiota) also showed no significant differences between control and treated groups.
- Notably, mycobiota diversity decreased over time in FOS-treated bees, but remained stable in control suggesting a possible long-term effect.

CONCLUSION

FOS improves hive productivity without major short-term impacts on gut microbial composition, though potential long-term effects on fungal diversity merit continued research.

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The honeybee is essential for pollination and ecosystem maintenance. Beekeeping in Spain is an important industry, not only for its economic benefits but also for preserving biodiversity. However, climate change and drought are reducing the availability of flowering plants, forcing beekeepers to provide artificial feed supplements. Fructooligosaccharides (FOS), derived from sucrose, are low-calorie prebiotics that promote healthy gut microbiota by boosting organic acid production in animals. Key honeybee gut bacteria (*Lactobacillus*, *Bifidobacterium*, *Gilliamella*) promote pathogen resistance and digestion. This study evaluates fructooligosaccharide (FOS) supplementation on beneficial bacterial and fungal populations in Iberian honey bee colonies of the subspecies *Apis mellifera iberiensis*. Thirty hives were divided into three groups: control (standard syrup), 1% FOS supplementation and 5% FOS supplementation. The weight of the hives before and after the study was recorded to evaluate colony productivity. DNA extracted from worker bees was subjected to metagenomic analysis to characterize the microbiota and mycobiota composition according to operational taxonomic units (OTU). Alpha diversity was measured using different indexes to assess species richness, while beta diversity analysis with Bray-Curtis distance assessed changes in microbial community structure between treatments. Hive weights increased significantly in the 5% FOS group compared to the control, but microbiota analysis revealed no significant changes in bacterial populations due to FOS supplementation. Alpha and beta diversity analyses indicated that the composition of the microbiota changed naturally over time. The study concludes that while FOS does not modify the honey bee gut microbiota, it does have an effect on hive production. Similarly, mycobiota did not change significantly between control and treatments, but did change over time, in fact, mycobiota diversity decreased over time in FOS-treated honey bees, but not in control samples, which warrants further study. Beekeepers in Spain facing drought and reduced flowering plants can consider supplementing their colonies with FOS in sugar syrup to potentially boost hive productivity without negatively affecting honey bee gut microbiota. However, since FOS may reduce fungal diversity over time, it is recommended further studies to clarify its long-term effects.