

Yeast communities related to honeybees: occurrence and distribution in flowers, gut mycobiota, and bee products

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State of Art

A balanced ecosystem provides relationships among biotic and abiotic factors that collectively ensure benefits for environment and for all living species, including humans. One of the most important ecosystem services is pollination, which is carried out by pollinator insects, such as domestic and wild bees that are responsible for approximately 70% of the pollination of all plant species on the planet, contributing to about 35% of global food production.

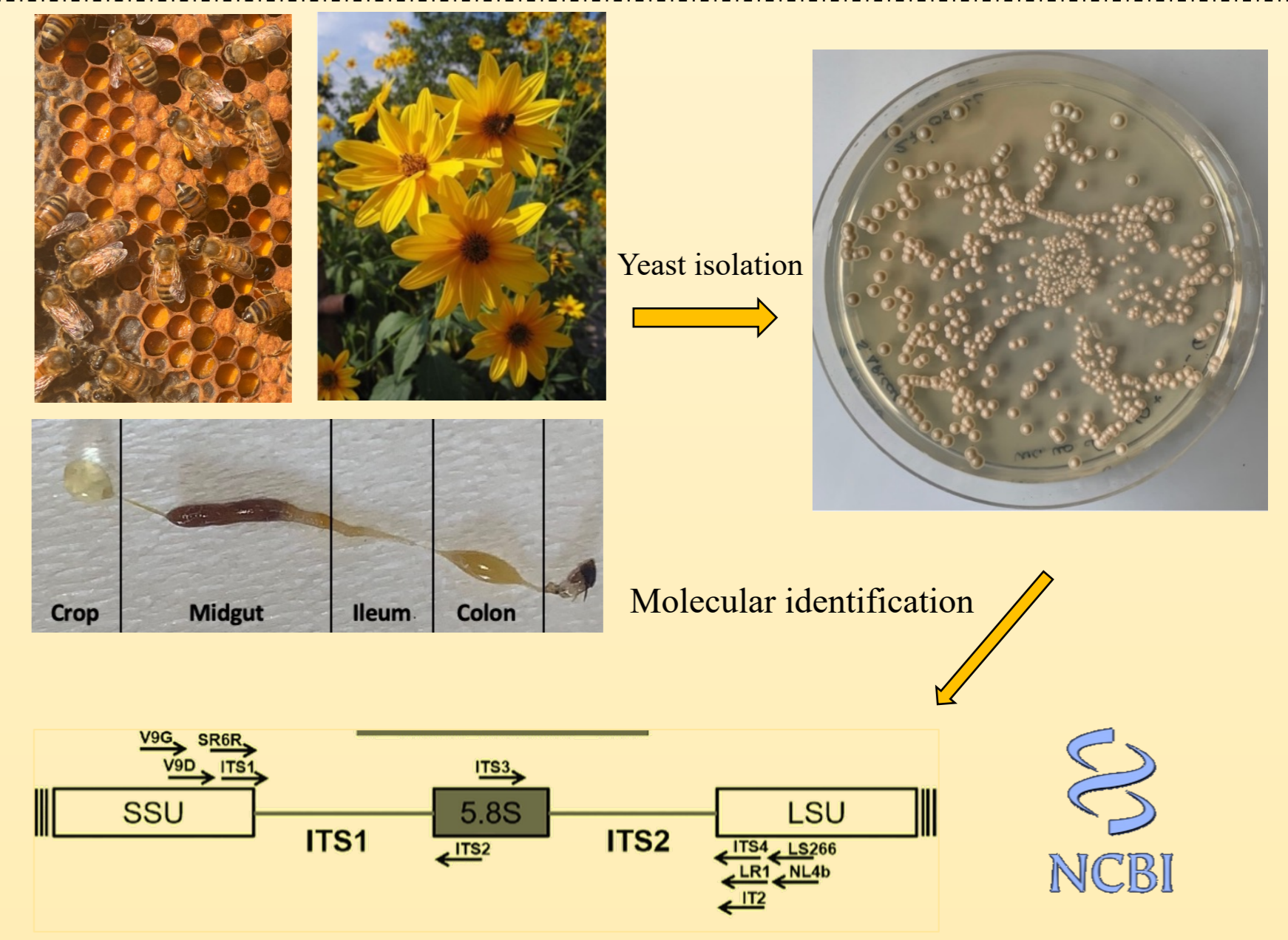
Honeybees are social insects that live in large perennial communities and so they have developed a strong and extensive microbiota that supports itself in every stage of its development. This microbiota is responsible for multiple functions similar to those of the human intestinal microbiome.

In the last decade, many researches has started to focus on the role of the gastrointestinal microbiome of honeybees: most of them on the bacterial communitie, but also on yeasts. Due to the widespread presence of yeasts in nature, especially on high-sugar substrates such as flower nectar, the primary food source for honeybees, the importance of eukaryotic portion of the honeybee microbiota (mycobiota) was seen.

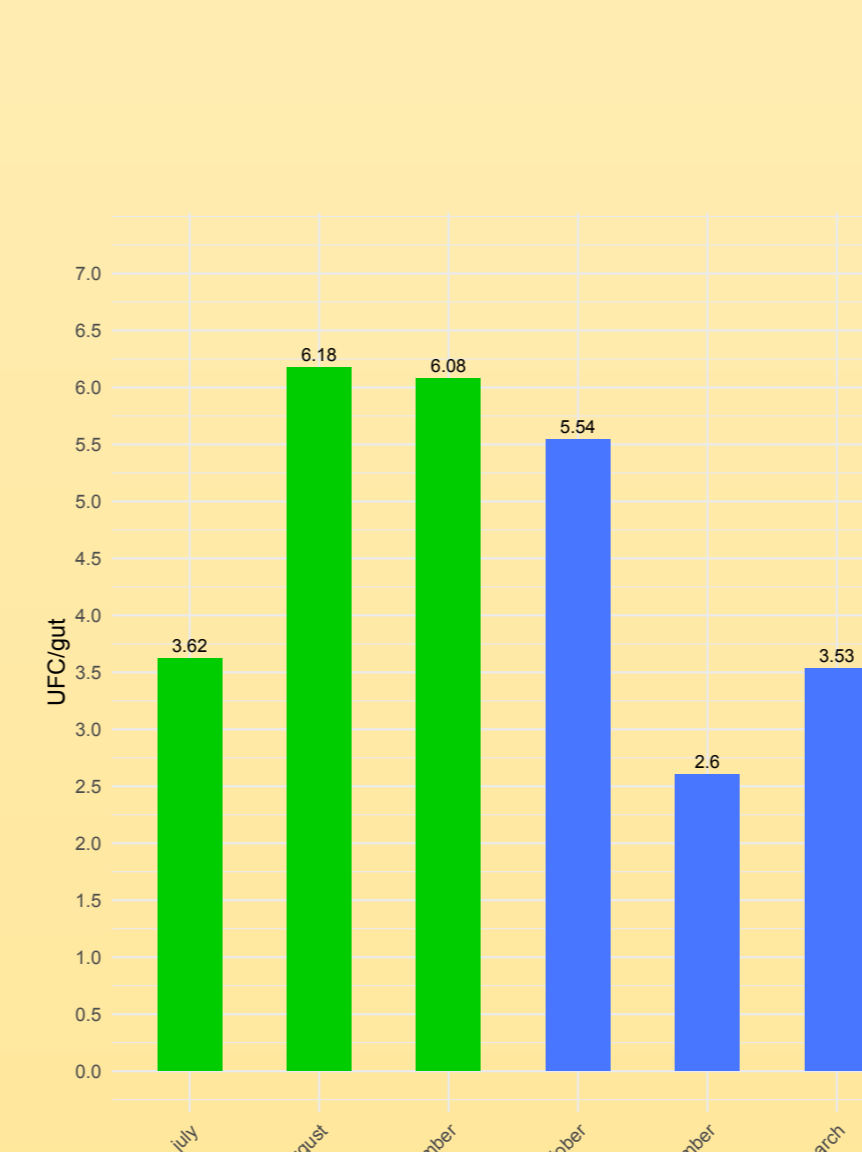
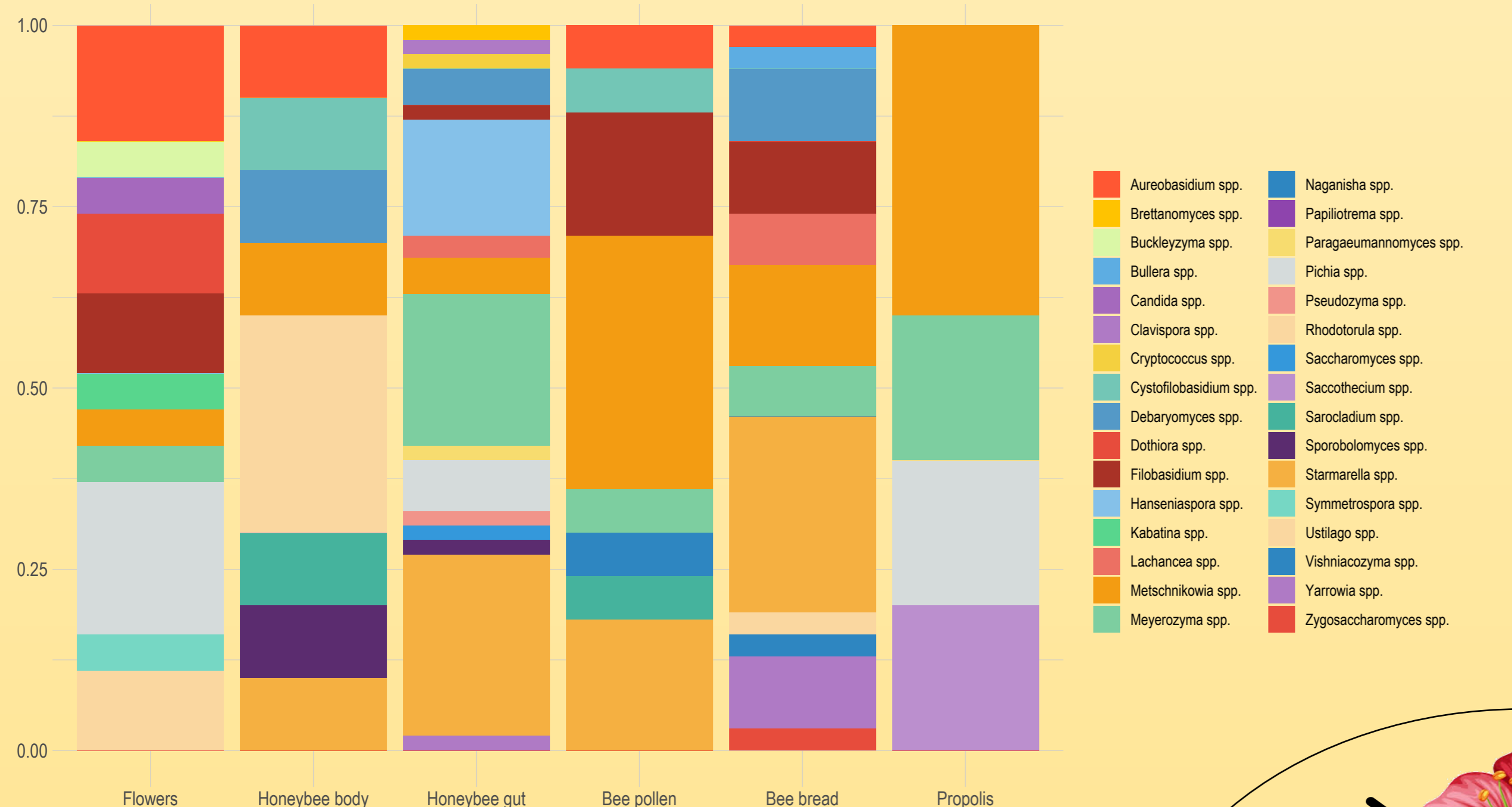
Aim

The aim of this study is to enhance the knowledge on yeast populations related to the honeybee system. A systemic approach by sampling flowers, honeybee guts, and hive products such as bee pollen, bee bread, and propolis, was applied. Special emphasis will be placed on investigating yeast populations as a stable component of the honeybee gut.

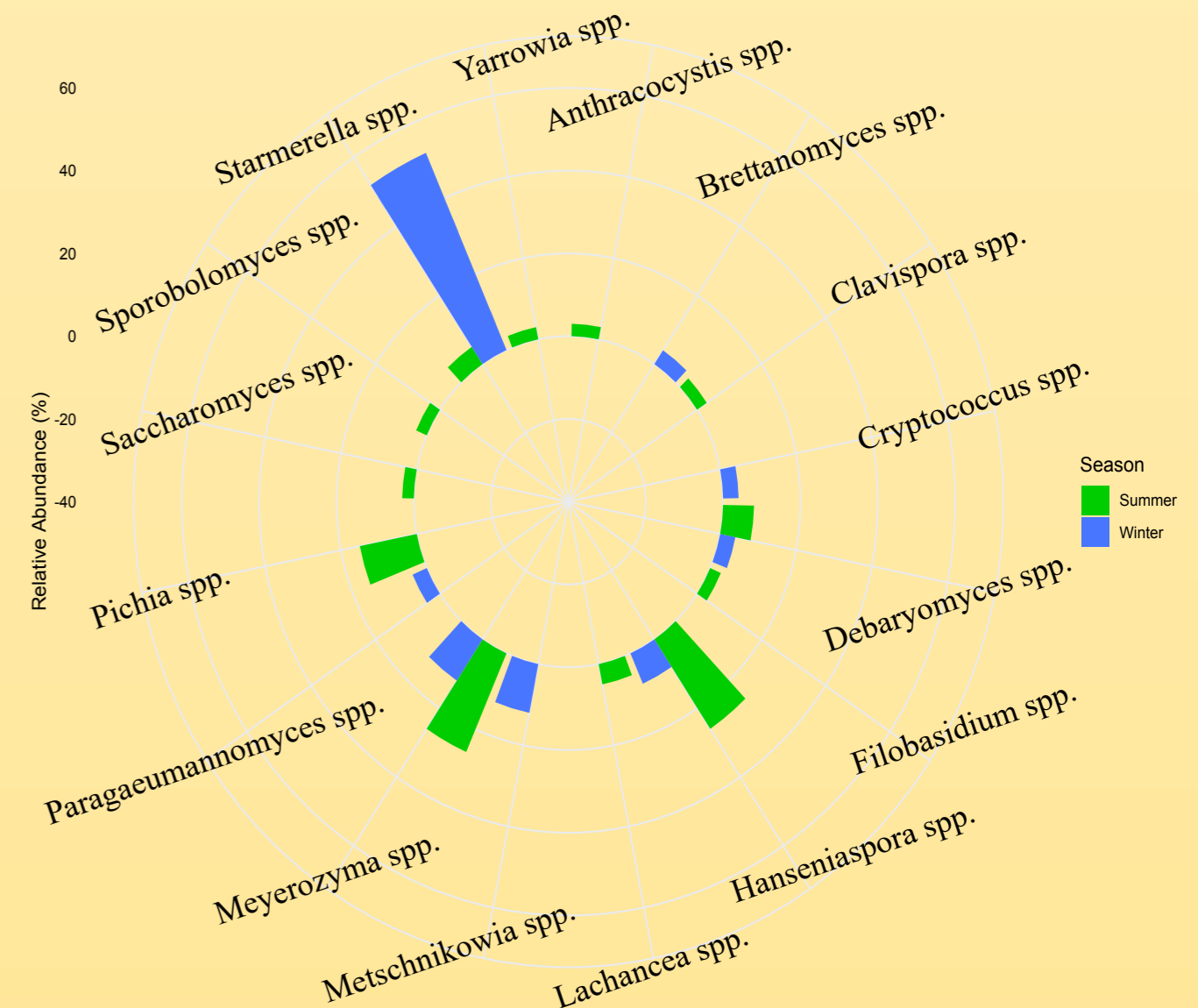
Material and Methods



Results



Stagionality of honeybees mycobiota



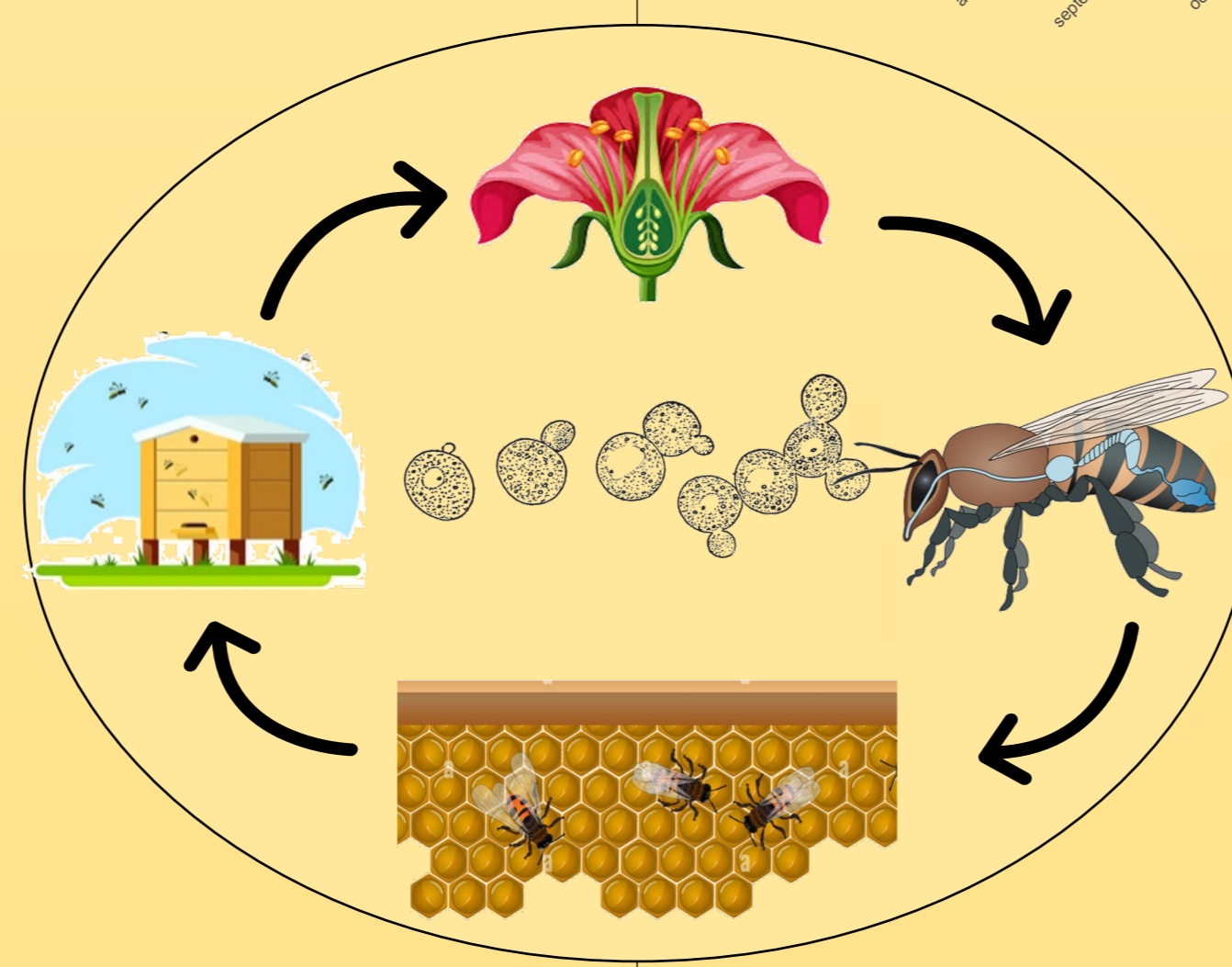
Overall, 27 genera and 51 species were identified:

i) in flowers, a prevalence of *Basidiomycete* family, typical of the floral mycobiota, was observed, in all other samples, a shift in trend was noted with a greater presence of *Ascomycete*;

ii) Samples from bee body showed a variety of species related to floral mycobiota and bee environment, with *Rhodotorula sp.* as prevalent ubiquitous yeast, while in the bee gut, there was a clear prevalence of the genus *Meyerozyma spp.*, followed by *Hanseniaspora spp.* and *Pichia spp.*;

iii) the hive products (bee pollen, bee bread, and propolis) showed *Starmerella spp.*, *Metschnikowia spp.*, and *Meyerozyma spp.*

The yeast genera *Aureobasidium spp.*, *Filobasidium spp.*, *Meyerozyma spp.*, and *Metschnikowia spp.* were detected in all environments, likely due to their extensive metabolic capabilities typical of fungal species.

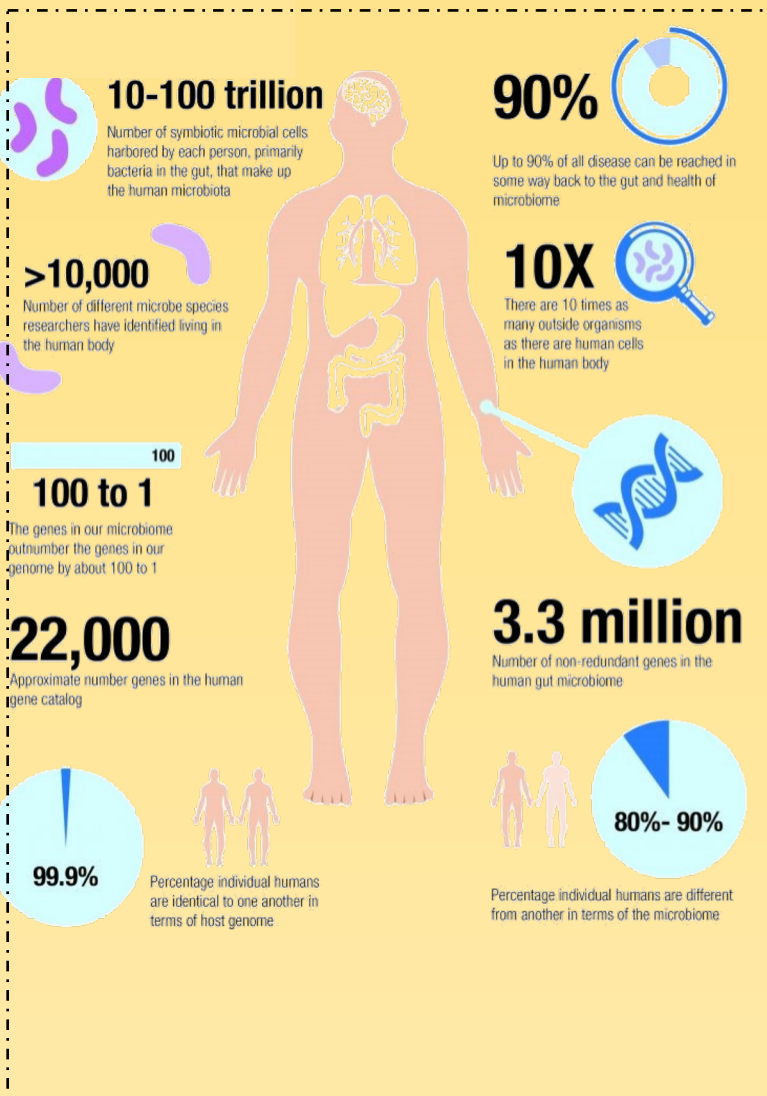


• Considering the harvest campaign carried out during all season and repeated in to years, there is a greater presence of yeast species in the summer mycobiota than in the winter mycobiota indicative of their transient stability related to the bee's greater contact with the external environment.

• The yeasts genera *Debaryomyces spp.*, *Meyerozyma spp.*, *Starmerella spp.* and *Hanseniaspora spp.* are isolated in both summer and spring seasons: they could represent a stable population.

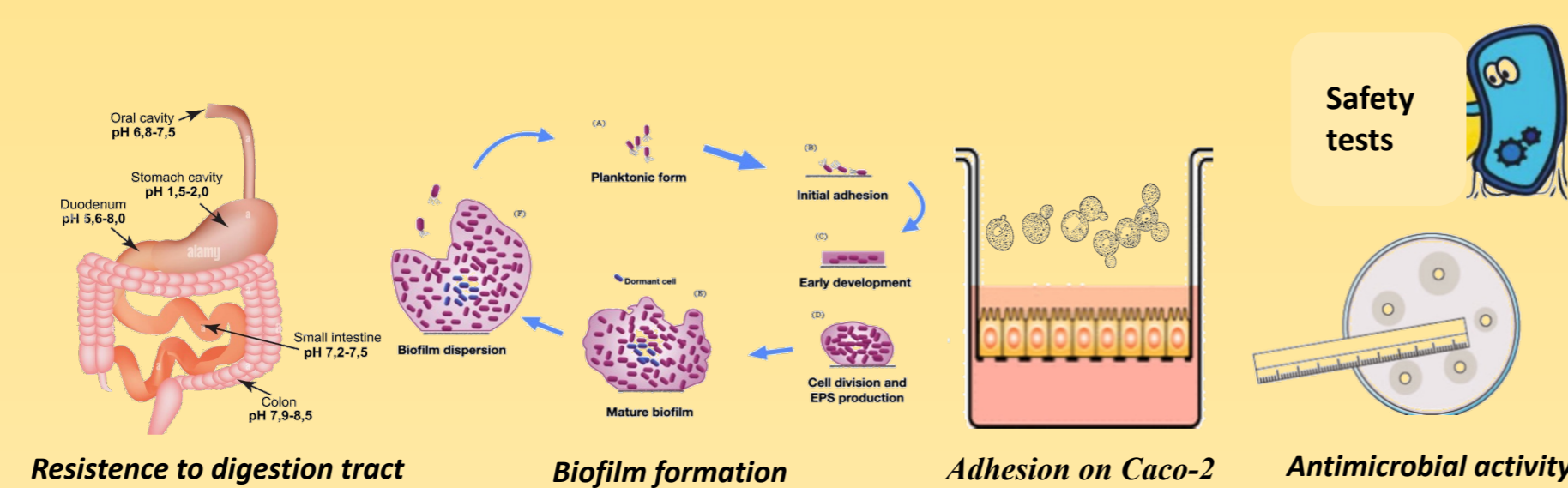
• Some of the hypothetical stable yeast (recovered in each season) such as *Starmerella spp.*, *Meyerozyma spp.* genera, seem to be increased in bee bread, as result of a natural fermentation process inside the hive, starting from pollen, strongly suggesting the active role of yeasts.

Future prospective



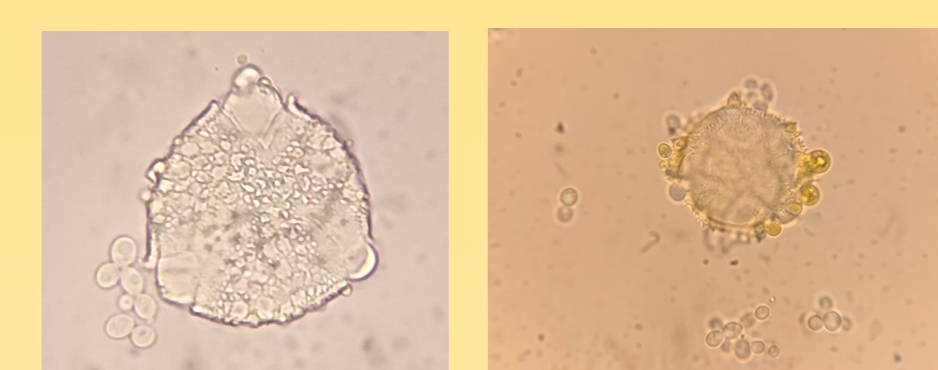
Recent research has shown how the gastrointestinal tract of honeybees and their products are new and potential sources of **probiotics** and prebiotics that can support human health through the enhancement and maintenance of those beneficial microbial species that are part of the human microbiota.

In vitro screening of potential probiotic strains



Bee bread is a fermented product from bee pollen, a mix of plant pollen, nectar and bee saliva containing microorganisms and enzymes.

Bee bread could be considered a **superfood** due to its high nutritional value; at times, it's even claimed to surpass bee pollen and honey in nutritional content. However, the difficulty of removing it from the hive and its reduced availability in nature, drive researchers to focus their attention on the conditions and microorganisms involved in the natural fermentation process, with the aim of simulating artificially fermenting beebread.



Zygoccharomyces siamensis adhered to the exine of the pollen grain isolated from fresh bee bread.

Bibliography

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