Sensitivity of honeybee gut microorganisms to antimicrobial substances present in beekeeping

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Importance of honeybee gut microorganisms

- *A*ntagonize pathogens
- *P*romote weight gain
- *I*mprove metabolism
- *S*upport colony health

- Evans and Armstrong, 2006. Antagonistic interactions between honey bee bacterial symbionts and implications for disease
- Zheng et al., 2017. Honeybee gut microbiota promotes host weight gain via bacterial metabolism and hormonal signaling
- Budge et al., 2016. Identifying bacterial predictors of honey bee health

Bees eat microbes

“pollen-born microbes represent an important protein source for larval bees,
which introduces new questions
as to the link between floral fungicide residues and bee development”

Steffan et al., 2019. Omnivory in bees: elevated trophic positions amont all major bee families

Sensitivity of honeybee gut microorganisms to antimicrobial substances

- Long-term use of antibiotics
- Yet, antibiotics still cause dysbiosis in bees
- Not only antibiotics – fungicides, pesticides, etc?

- Tian et al., 2012. Long-term exposure to antibiotics has caused accumulation of resistance determinants in the gut microbiota of honeybees
- Raymann et al., 2017. Antibiotic exposure perturbs the gut microbiota and elevates mortality in honeybees
- Li et al., 2017. New evidence showing that the destruction of gut bacteria by antibiotic treatment could increase the honey bee's vulnerability to *Nosema* infection
- Kakumanu et al., 2016. Honey bee gut microbiome is altered by in-hive pesticide exposures

Major components of the honey bee microbiota and their locations in the bee gut or in the hive

Nancy A. Moran

Genomics of the honey bee microbiome (2015),
http://dx.doi.org/10.1016/j.cois.2015.04.003

Crop (honey stomach)

Few bacteria, including hive-dwelling bacteria such as *Lactobacillus kunkeei,* Acetobacteraceae

Hive and larvae

Beebread, nectar, larval guts share several environmental bacteria, including *Lactobacillus* species and Acetobacteraceae

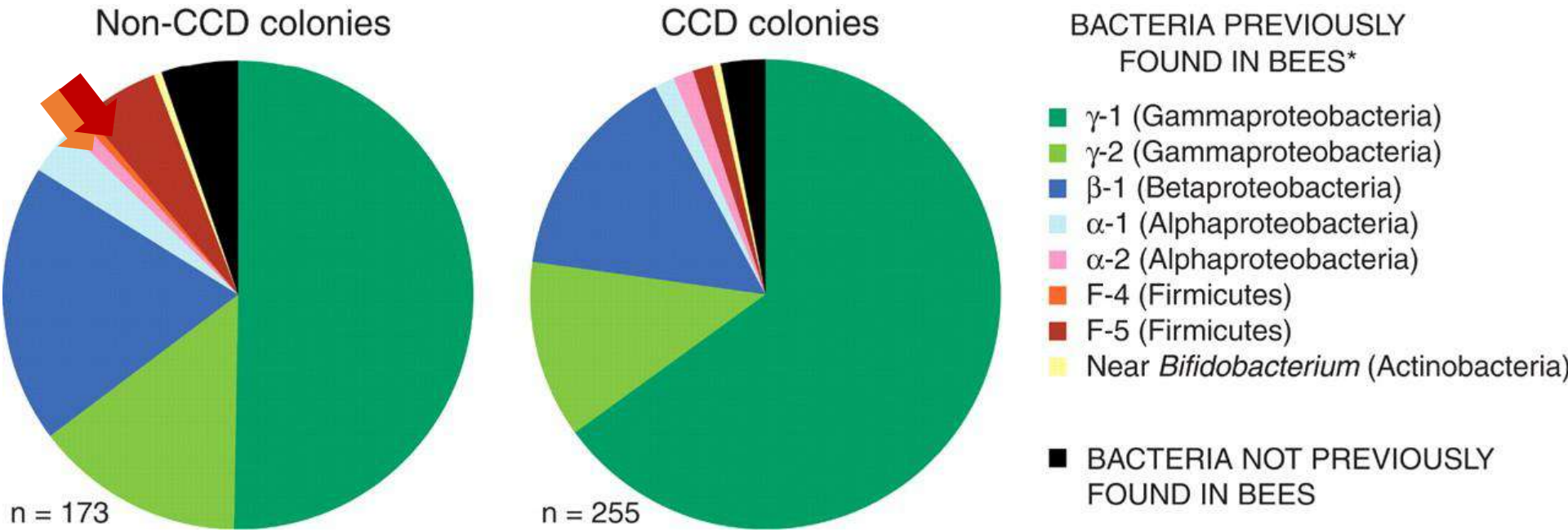
Ileum

Large dense bacterial community dominated by 3 characteristic species: *Snodgrassella alvi* (on gut wall), *Gilliamella apicola* (largely in proventriculus region), also some hindgut-adapted *Lactobacillus*

Rectum

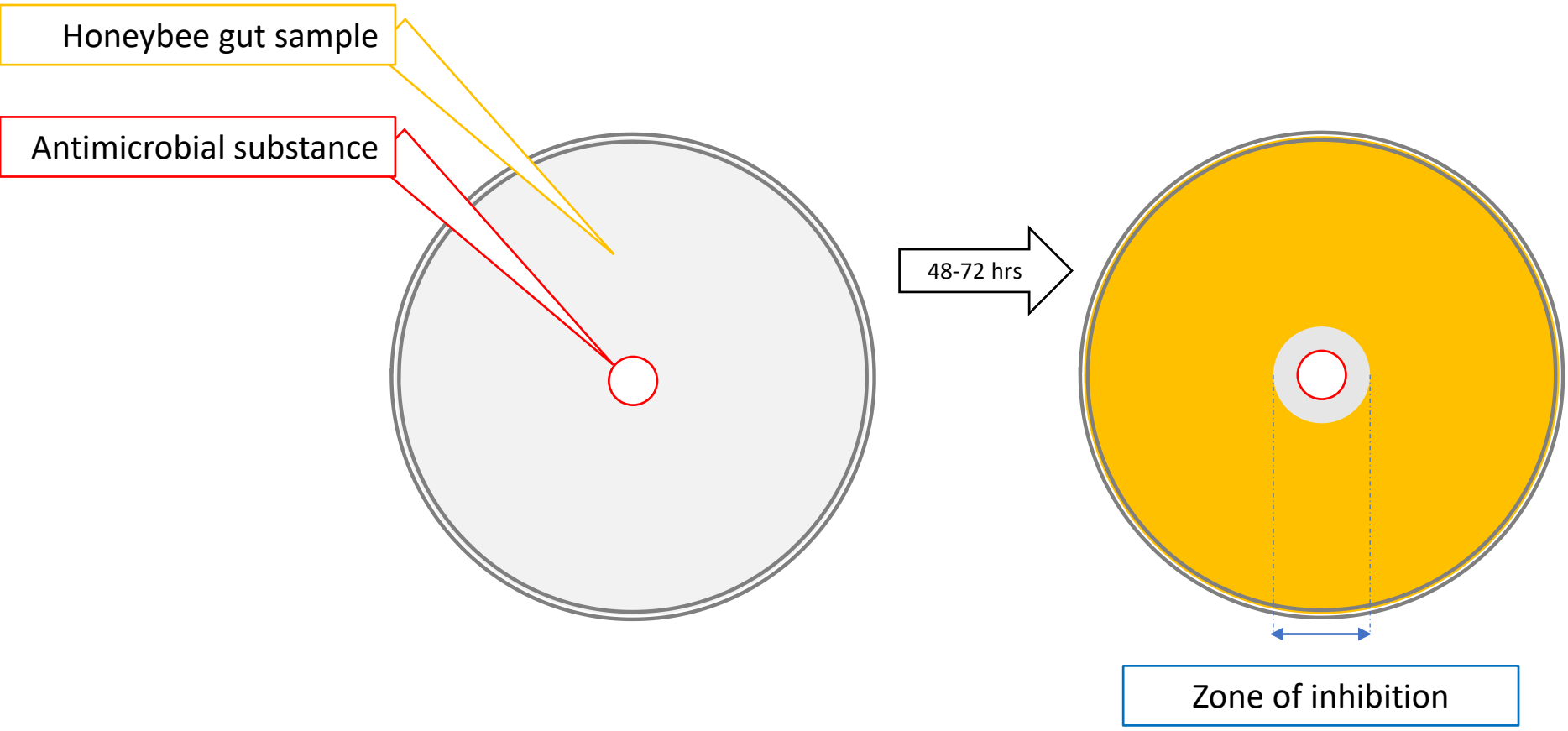
Large dense bacterial community dominated by 2 hindgut-adapted *Lactobacillus* and *Bifidobacterium*

Decreased *Lactobacillus* abundance in CCD hives



- Cox-Foster et al., 2007. A metagenomic survey of microbes in honey bee colony collapse disorder

Antimicrobial assays with microbial cultures obtained from honeybee gut



Antimircobial assays with microbial cultures obtained from honeybee gut

Antimicrobial assays with microbial cultures obtained from honeybee gut

Test substance	Zone of inhibition (mm)	Antimicrobial activity
Terramycin	20	high
Tylan	15	high
RoundUp ™	5	medium
Fumagillin	3	medium
Peppermint oil	2.5	medium
Honeybee Healthy ™	1	low
Amitraz	1	low
Garlic powder	0	low
Cinnamon	0	low
Wintergreen oil	0	low
Negative control	0	low

Thank you!
Strong Microbials