Are Honey Bees a Suitable Model for Fetal Alcohol Spectrum Disorder in Humans?

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Abstract

Last summer, I was fortunate in having the opportunity to work with the brilliant and talented individuals in the Pollinator Health Research Lab at the Western College of Veterinary Medicine under the supervision of Dr. Wood and Dr. Simko. I was exposed to many facets of science, had hands-on experience in apiculture, and met beekeepers from around the globe. I will always be thankful for the mentorship, friendships, and skills I gained over the summer, and I hope our research will serve as a basis for validating honey bees as a model organism for fetal alcohol spectrum disorder (FASD).

Keywords: Honey bees (*Apis mellifera*), fetal alcohol spectrum disorder, fetal alcohol syndrome, *in vitro* rearing, invertebrate model

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Research Snapshot

FASD is a continuum of neurodevelopmental changes caused by prenatal exposure to ethanol that affects ~4% of Canadians (Sask FASD network n.d.). Prenatal ethanol exposure is associated with a host of complications, which include cognitive difficulties, developmental delay, increased risk of miscarriage, smaller birth weight and brain size, as well as motor impairments (Wilhoit et al. 2017, 711-712; Sask FASD network n.d.; Nuñez et al. 2017, 121-122; Sundermann et al. 2019, 1612, 1614). It has been established that fruit flies (*Drosophila melanogaster*) are a suitable model for FASD as they exhibit many similar characteristics to humans with it, including morphological changes to the brain and developmental delay (McClure et al. 2011, 336-339). Honey bees (*Apis mellifera*) share many similarities to *Drosophila* as a research model, but with the distinct advantage of having highly social behaviour, making them more representative of humans.

In this project, we exposed honey bees to sublethal concentrations of ethanol throughout larval development and subsequently monitored their survival, developmental rate, and weight when they emerged as adult bees. We found that larval honey bees exposed to ≥ 6% ethanol experienced significantly higher mortality, delayed time to pupation, and a lower body weight at emergence.

Accordingly, our results, in combination with ongoing neurobehavioural analyses of adult bees exposed to ethanol as larvae, suggest that honey bees may be a suitable model for FASD. To validate the advantages of using honey bees over fruit flies as a model, we will need to explore the social and behavioural effects of ethanol exposure during the honey bee larval development. If their social behavior is significantly affected, it will be possible to conclude that honey bees may be an ideal model for FASD.

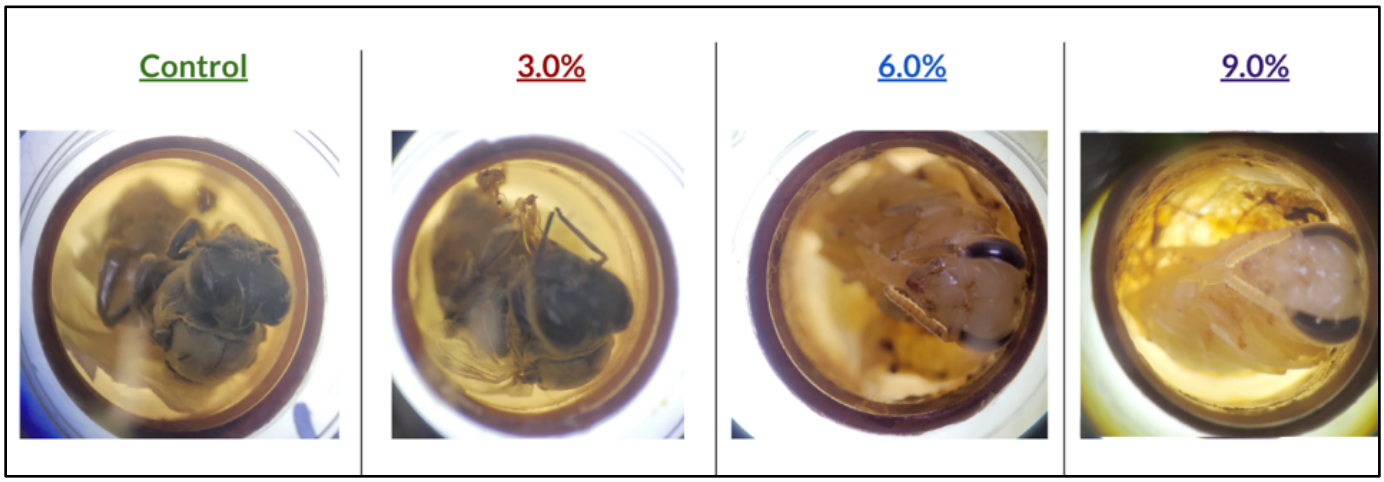

Figure 1: Larval ethanol exposure results in developmental delay. Age-matched honey bees exposed to incremental concentrations of ethanol demonstrate dose-responsive delays in development. Bees were grown in 48-well plates throughout their development. Each well is 1 cm in diametre.

Supervisor's Statement

Last summer, Breanne and her team made significant advances in developing honey bees as a research model to study FASD in humans. Through this important work, the students observed surprising similarities in brain development and social behavior between honey bees and humans, which may pave the way for future discovery of therapeutics to mitigate the effects of FASD in children.

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