Forager bees 'turn on' gene expression to protect against microorganisms, toxins

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Forager bees, like this one feeding on lavender nectar, "turn on" genes that could help protect the hive and honey against microbes and toxins. Credit: Kathy Keatley Garvey

When honeybees shift from nurse bees to foragers, or from caring for the brood to foraging for nectar and pollen, the bees "turn on" gene expression with products that protect against microorganisms and degrade toxins, three University of California, Davis, scientists have

discovered.

Their findings on bee immunity and toxin metabolism are published today in *Scientific Reports* by the Nature Publishing Group.

"First, the results suggest that forager bees may use antimicrobial peptides—short sequences of amino acids with general activity—to reduce microbial growth in stored food resources," said Rachel Vannette, assistant professor, UC Davis Department of Entomology and Nematology. "This would be a largely unrecognized way that bees protect honey and potentially other stored resources from microbial spoilage. Second, this work shows that forager bees produce toxin-degrading enzymes in nectar-processing tissues.

"This may allow forager bees to degrade many different kinds of compounds in nectar, before it is stored," Vannette said. "Bees also vary in their ability to do this; foragers have a greater ability to degrade a variety of compounds than nurses. This may have implications for hive health and management."

The scientists found the change in the bees' nectar-processing tissues, but not in the gut. The scientists surmised that the exposure to bacteria or yeasts in the environment may trigger this change, but they did not examine it in the study.

"It had been well known that the division of labor in a honeybee colony is supported by extensive differences in brain gene expression between bees that perform different jobs," said Gene Robinson, director of the Institute for Genomic Biology and Swanlund Chair of Entomology, University of Illinois at Urbana-Champaign, who was not involved in the research. "This new research shows nicely that this genomic differentiation extends beyond the brain; different complements of active genes in a variety of tissues make each bee better suited for the

job it needs to perform."

The journal article, titled "Forager Bees (Apis Mellifera) Highly Express Immune and Detoxification Genes in Tissues Associated with Nectar Processing," is the work of senior author Brian Johnson, assistant professor, UC Davis Department of Entomology and Nematology; and co-authors Abbas Mohamed, graduate student researcher in the Johnson lab and a member of the Pharmacology and Toxicology Group, and Vannette, who joined the UC Davis Department of Entomology this fall after serving a postdoctoral fellowship at Stanford University. At Stanford, Vannette examined the role of nectar chemistry in community assembly of yeasts and plant-pollinator interactions.

Johnson, whose research interests include animal behavior, evolution, theoretical biology and genomics, recently began long-term research on the honeybee immune system and the causes and consequences of economically important diseases or syndromes such as colony collapse disorder.

The team plans to follow up with functional assays to examine the potential of these gene products to reduce microbial growth and degrade a variety of natural and synthetic compounds.

More information: Rachel L. Vannette et al. Forager bees (Apis mellifera) highly express immune and detoxification genes in tissues associated with nectar processing, *Scientific Reports* (2015). DOI: 10.1038/srep16224

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