Scientists track gene activity when honey bees do and don't eat honey

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Gene activity changes in response to dietary changes in foraging honey bees, researchers found. Credit: Jon Sullivan

Many beekeepers feed their honey bees sucrose or high-fructose corn syrup when times are lean inside the hive. This practice has come under scrutiny, however, in response to colony collapse disorder, the massive—and as yet not fully explained—annual die-off of honey bees

in the U.S. and Europe. Some suspect that inadequate nutrition plays a role in honey bee declines.

In a new study, described in *Scientific Reports*, researchers took a broad look at changes in gene activity in response to diet in the Western honey bee (*Apis mellifera*), and found significant differences occur depending on what the bees eat.

The researchers looked specifically at an energy storage tissue in bees called the fat body, which functions like the liver and fat tissues in humans and other vertebrates.

"We figured that the fat body might be a particularly revealing tissue to examine, and it did turn out to be the case," said University of Illinois entomology professor and Institute for Institute for Genomic Biology director Gene Robinson, who performed the new analysis together with entomology graduate student Marsha Wheeler.

The researchers limited their analysis to foraging bees, which are older, have a higher metabolic rate and less energy reserves (in the form of lipids stored in the fat body) than their hive-bound nest mates—making the foragers much more dependent on a carbohydrate-rich diet, Robinson said.

"We reasoned that the foragers might be more sensitive to the effects of different carbohydrate sources," he said.

The researchers focused on gene activity in response to feeding with honey, high-fructose corn syrup (HFCS), or sucrose. They found that those bees fed honey had a very different profile of gene activity in the fat body than those relying on HFCS or sucrose. Hundreds of genes showed differences in activity in honey bees consuming honey compared with those fed HFCS or sucrose. These differences remained even in an

experimental hive that the researchers discovered was infected with deformed wing virus, one of the many maladies that afflict honey bees around the world.

"Our results parallel suggestive findings in humans," Robinson said. "It seems that in both bees and humans, sugar is not sugar—different carbohydrate sources can act differently in the body."

Some of the genes that were activated differently in the honey-eating bees have been linked to protein metabolism, brain-signaling and immune defense. The latter finding supports a 2013 study led by U. of I. entomology professor and department head May Berenbaum, who reported that some substances in honey increase the activity of genes that help the bees break down potentially toxic substances such as pesticides.

"Our results further show honey induces gene expression changes on a more global scale, and it now becomes important to investigate whether these changes can affect bee health," Robinson said.

More information: "Diet-dependent gene expression in honey bees: honey vs. sucrose or high fructose corn syrup," *Scientific Reports*, 2014.

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