Starvation as babies makes bees stronger as adults

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Short-term starvation as larvae actually makes honey bees more resilient to nutritional deprivation as adults. This suggests they have an anticipatory mechanism like solitary organisms do. These findings change the current understanding of colony collapse disorder and provide new avenues to study. Credit: Christofer Bang

A lack of adequate nutrition is blamed as one of many possible causes for colony collapse disorder or CCD—a mysterious syndrome that causes a honey bee colony to die. Parasites, pesticides, pathogens and environmental changes are also stressors believed responsible for the decline of honey bees.

Since bees are critical to the world's food supply, learning how bees cope with these stressors is critical to understanding honey bee health and performance.

In two new studies, researchers from Arizona State University's School of Life Sciences have discovered that the stress of short-term nutritional deprivation as larvae (baby bees) actually makes honey bees more resilient to starvation as adults.

"Surprisingly, we found that short-term starvation in the larval stage makes adult honey bees more adaptive to adult starvation. This suggests that they have an anticipatory mechanism like solitary organisms do," said Ying Wang, assistant research professor with the school and lead author of the two investigations. Wang said they found evidence of this mechanism in several areas such as behavior, endocrine physiology, metabolism and gene regulation.

The anticipatory mechanism, also called "predictive adaptive response," explains a possible correlation between prenatal nutritional stress and adult metabolic disorders such as obesity and diabetes in humans. Yet, Athese findings show for the first time that social organisms can have this mechanism.

Since most research on bee nutrition has focused on using adult honey bees, rather than their young, this new information changes the current understanding of colony collapse disorder and provides new avenues to study.

The findings are published in two papers appearing today in the *Journal of Experimental Biology*.

Interestingly, Wang and her colleagues also found that when bees experienced starvation as larvae, they could reduce their metabolic rate, maintain their blood sugar levels, and use other fuels faster than the control bees during starvation. This increased the probability of their survival under a starvation situation.

"These studies show how the fundamental physiology of animals separated by hundreds of millions of years of evolution maintain central, common features that allow us to learn more about ourselves from studying them and about them by looking to ourselves," said Rob Page, University Provost Emeritus and co-author of the paper. "They reveal key features of honey bee physiology that may help us find solutions to the serious problems of bee health world wide."

Managed honey bee colonies have declined worldwide, down to 2.5 million today from 5 million in the 1940s. This comes at a time when the global demand for food is rising to meet the nutrition needs of 7.4 billion people. Since multiple stressors are negatively impacting bee health, Wang's new findings may provide a different strategy to help solve the

problem of colony collapse disorder.

"Manipulations during development may be able to increase the bees' resistance to different stressors, much like how an immunization works," added Wang. "However, we are at a starting point with this new discovery and we will have many questions to be answered."

More information: Wang, Y., Kaftanoglu, O., Brent, C. S., Page, R. E., Jr and Amdam, G. V. (2016). Starvation stress during larval development facilitates an adaptive response in adult worker honey bees (Apis mellifera L.) *J. Exp. Biol.* 216, DOI: 10.1242/jeb.130435

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