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Feeding drives the reproduction of Varroa destructor

Yao Liu, Shangning Yang, Qiulan Zheng, Huo Qing Zheng
College of Animal Sciences, Zhejiang University, Hangzhou, China

The reproduction of Varroa destructor, an ectoparasite with devastating effects on honeybees, is activated solely by freshly capped Apis mellifera brood. V. destructor mites initiate reproduction shortly after entering appropriate cells, yet the mechanisms that trigger their reproductive initiation remain poorly understood. Feeding is considered a major driving factor. To investigate how feeding affects the reproduction of V. destructor mites, we conducted artificial infestation experiments to compare reproductive-related changes between mites that invaded appropriate and inappropriate cells, and analyze the association between these changes and feeding behavior. The results showed that the changes in vitellogenin genes expression levels and gonopore size of mites introduced into freshly capped cells and therefore produced offsprings are associated with weight, i.e., feeding. All three exhibited an increased followed by a decrease during the reproductive period of mites. Weight loss occurred on day 8 after mites entered cells (when the last egg was laid), while vitellogenin genes downregulation started on day 2 (before the first egg was laid). Also, the first blood meal of the mites occurred within 1 hour after entering cells. Interestingly, mites introduced into cells 24 hours or more after capping, which did not lay offspring as a result, exhibited similar changes, albeit with less pronounced variation compared to fertile mites. Transcriptomic sequencing displayed that, compared to sterile mites, the transcriptomic profile of fertile mites underwent significant changes 6 hours after entering cells, with the activation of functions and pathways related to protein synthesis. However, proteomic sequencing revealed that there were only minimal differences in the endogenous V. destructor proteins between fertile and sterile mites. The more significant proteomic differences are attributed to exogenous host proteins, such as major royal jelly proteins, bee milk proteins, etc. Taken together, these results suggest that feeding may serve as a trigger for the initiation of reproduction in V. destructor, and the abundance of host nutrient-related proteins may promote the fertility of mites. Our research provides new insights into the interactions between V. destructor and honeybees based on feeding behavior.