Modifiers of Apis mellifera Flight Muscle Metabolism: A Field Study in a Working Apiary

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Current trends indicate a distressing worldwide decline in honeybees with disease/pests, pesticides and sub-optimal nutrition likely offenders. Optimal energy metabolism may support colony health by enhancing foraging ability or cold tolerance during winter. This project examines whether two key honeybee flight muscle enzymes (hexokinase and phosphofructokinase (PFK)) are altered by common beekeeping practices: artificial sugar feeding or varroa (Varroa distructor) infestation/treatment. Sixteen honeybee colonies in Irondale, Alabama were studied during the fall of 2014. Bees (forager, nurse) were hand-collected weekly and snap frozen in the field. Varroa mite levels were monitored weekly and 6 hives became infected. The local beekeepers treated the varroa and fed some hives with sucrose or high fructose corn syrup (HFCS). Enzyme activity was measured by spectrophotometry. Forager bees had 6-15% higher hexokinase and 15-19% higher PFK activity than nurse bees. Both enzymes increased 30% from week 3 to 5 (end of nectar flow). In the six varroa-infected hives, hexokinase activity was 14% diminished compared to healthy hives but PFK unaffected. Hive treatment for two weeks with a commercial agent increased hexokinase activity by 24-28% and PFK by 12%. Artificial feeding lowered hexokinase/PFK activity by 37-45% after 6 weeks with no difference between feed type. This field study, demonstrates that honeybee flight muscle enzyme metabolism is regulated by bee caste and nectar flow. Enzyme activity is diminished by varroa mite infestation and artificial feeding but improved with varroa treatment. The results suggest that beekeeping practices which maximize honeybee carbohydrate metabolism may benefit honeybee health and survival