Abstract

Aging is a natural process that leads to a decrease in the metabolic activity of cells, tissues, and organs, which increases susceptibility to disease and ultimately leads to death. Despite numerous gerontological studies on humans and other vertebrates, this phenomenon is little understood among invertebrates. One such organism is the honeybee, which, as a significant pollinator, is exposed to numerous stress factors, that contribute to significant deviations from the natural aging process associated with age. The rate of aging is influenced by various factors, such as stress, disease, and poor diet. One of these factors is the common *Varroa destructor* mite, which shortens the lifespan of bees and causes colony losses. This parasite, lives on adult insects (in the phoretic phase), and feeds primarily on their fat bodies, which are responsible for protein synthesis (e.g., of immune proteins), energy metabolism, and detoxification. The bee's first line of defense is biochemical immunity mechanisms, composed of antioxidant and proteolytic systems, which depend on energy to operate. Therefore, the aim of this doctoral dissertation was to determine the activities of the antioxidant system (CAT, SOD, GPx, GST and TAC) and the proteolytic system (acidic, neutral, and alkaline proteases and their inhibitors), as well as the concentrations/activities of Krebs cycle compounds (acetyl-CoA, IDH, AKG, succinate, fumarate, $NADH_2$) and the respiratory chain (COX, UQCR, ATP) in the subcuticular fat body segments of healthy worker bees (aging naturally/physiologically; under natural conditions) and those infected with *V. destructor* (aging prematurely; under stressful conditions). Marked 1-day-old workers were placed in colonies without *V. destructor* and with mites. Workers were sampled from each colony every 7 days, and the fat bodies from tergite 3, tergite 5, and sternite were prepared for biochemical assays. The activities of antioxidant and proteolytic enzymes and energy metabolism compounds were lower in workers infected with *V. destructor* than in healthy workers. The activities of CAT, SOD, GST, GPx, proteases and their inhibitors, as well as the activities/concentrations of energy metabolism compounds, increased with age in the fat body of healthy workers until 21/28 days of age, and then decreased. In contrast, in bees infected with *V. destructor*, the values of these biochemical characteristics decreased with aging. The highest activities of the antioxidant and proteolytic systems were observed in the fat body of tergite 5. Tergite 3 was characterized by the highest levels of energy metabolism. Determining changes in biochemical characteristics in the fat body segments of bees aging naturally (physiologically) and prematurely (with *V. destructor*) is the first step towards better understanding the host-parasite interactions and preparing effective strategies for preventing and controlling mites, as well as developing therapies that improve the quality of life and immunity of these insects.

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