

Respiration Rates and Factors which Influence the Levels of Carbohydrates and Lipids in Honey Bee Eggs (*Apis mellifera* Linnaeus).

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RESPIRATION RATES AND FACTORS WHICH INFLUENCE THE LEVELS OF CARBOHYDRATES AND LIPIDS IN HONEY BEE EGGS *Apis mellifera* Linnaeus (Hymenoptera: Apidae)

Abstract

Respiration rates and changes in the amount of nutrients in queen-laid and worker-laid eggs of the honey bee, *Apis mellifera* L., were determined for the 3 days of embryonic development. Respiration was quantified by measuring the amount of CO₂ produced during 13 hr of artificial incubation at four temperature treatments: 28⁰C, 31⁰C, 34⁰C, 36⁰C ($\pm 0.5^0$ C). The amounts of lipids and carbohydrates were also quantified in the eggs of queens and laying workers on day 1, 2 and 3 using high performance thin layer chromatography.

The mean respiration rate for fertilized and unfertilized eggs from queens was $0.1 \pm 0.0 \mu\text{L CO}_2/\text{hr}/\text{egg}$, the same as the mean respiration rate obtained for unfertilized eggs from laying workers. The results of carbohydrate analysis showed a total of $2.4 \pm 0.6 \mu\text{g}/\text{egg}$ total sugars in the fertilized eggs of queens, an equivalent of 8.3% on a dry weight basis, while unfertilized eggs contained a total of $1.4 \pm 0.4 \mu\text{g}/\text{egg}$ total sugars, equivalent of 6.3% on a dry weight basis. Total lipids, excluding fatty acids, were $10.7 \pm 6.1 \mu\text{g}/\text{egg}$ (37.4%) for fertilized eggs and $8.4 \pm 1.3 \mu\text{g}/\text{egg}$ (40.8%) for unfertilized eggs.

The respiration rate at 34⁰C was $0.17 \pm 0.01 \mu\text{L CO}_2/\text{hr}/\text{egg}$ on day 1, the same as day 1 at 36⁰C. Day 2 respiration rates were $0.13 \pm 0.04 \mu\text{L CO}_2/\text{hr}/\text{egg}$ and $0.15 \pm 0.01 \mu\text{L CO}_2/\text{hr}/\text{egg}$, respectively. On day three, $0.22 \pm 0.01 \mu\text{L CO}_2/\text{hr}/\text{egg}$ was recorded at 34⁰C and $0.24 \pm 0.01 \mu\text{L CO}_2/\text{hr}/\text{egg}$ at 36⁰C. At low temperatures of 28⁰C and 31⁰C, a respiration rate of $0.12 \pm 0.01 \mu\text{L CO}_2/\text{hr}/\text{egg}$ was recorded on day 1, for eggs held at both temperatures. Day 2 results were $0.07 \pm 0.01 \mu\text{L CO}_2/\text{hr}/\text{egg}$ at 28⁰C and $0.11 \pm 0.01 \mu\text{L CO}_2/\text{hr}/\text{egg}$ at 31⁰C, while 0.07 ± 0.01 and $0.12 \pm 0.01 \mu\text{L CO}_2/\text{hr}/\text{egg}$, respectively, were measured on day 3. Mortality results, as indicated by pre-emergence embryos, showed that 75% developed at 34⁰C compared to 37.5% at 36⁰C. Low temperatures of 28⁰C had 12.5% developing to pre-emergence stage while 50% developed at 31⁰C.

Respiratory results showed significant differences ($p=0.05$) between the different days of incubation and temperature treatments, respectively. No significant difference was observed between the fertilized eggs and unfertilized eggs from queens at the same temperature treatment. The comparison of unfertilized eggs from queens and those from laying workers also showed no significant difference. The regression ($R^2=0.65$) was significant ($P=0.05$) when CO_2 output on all the days and temperature treatments were compared.

The amount of nutrients in the eggs of queens and those of laying workers, were significantly different ($P=0.05$) depending on egg type and age. No significant difference was observed between the colonies headed by queens or those of laying workers. Although the queen-laid eggs showed a relatively higher mean value for carbohydrates than worker-laid eggs, the reverse was the case for lipids. On comparing the amount of nutrients per unit weight for queen-laid and worker-laid eggs, no significant differences were observed. From the results obtained, inferences were made about the natural differences between the eggs from queens, and those produced by laying workers.

This work is graciously dedicated to Henry, Carol and Matthew. They are our family martyrs. We miss them very much!

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