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

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Thesis submitted to the Faculty of the Virginia Polytechnic Institute and State University
in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

in

Entomology

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October 12, 1998
Blacksburg, Virginia

Keywords: Respiration rates, Levels, Carbohydrates, Lipids, Eggs, *Apis mellifera*.

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 CO_2 produced during 13 hr of artificial incubation at four temperature treatments: 28^0C, 31^0C, 34^0C, 36^0C ($\pm$ 0.5^0C). 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 ± 0.0 µL CO_2/hr/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 ± 0.6 µg/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 ± 0.4 µg/egg total sugars, equivalent of 6.3% on a dry weight basis. Total lipids, excluding fatty acids, were 10.7 ± 6.1 µg/egg (37.4%) for fertilized eggs and 8.4 ± 1.3 µg/egg (40.8%) for unfertilized eggs.

The respiration rate at 34^0C was 0.17 ± 0.01 µL CO_2/hr/egg on day 1, the same as day 1 at 36^0C. Day 2 respiration rates were 0.13 ± 0.04 µL CO_2/hr/egg and 0.15 ± 0.01 µL CO_2/hr/egg, respectively. On day three, 0.22 ± 0.01 µL CO_2/hr/egg was recorded at 34^0C and 0.24 ± 0.01 µL CO_2/hr/egg at 36^0C. At low temperatures of 28^0C and 31^0C, a respiration rate of 0.12 ± 0.01 µL CO_2/hr/egg was recorded on day 1, for eggs held at both temperatures. Day 2 results were 0.07± 0.01 µL CO_2/hr/egg at 28^0C and 0.11 ± 0.01 µL CO_2/hr/egg at 31^0C, while 0.07 ± 0.01 and 0.12 ± 0.01 µL CO_2/hr/egg, respectively, were measured on day 3. Mortality results, as indicated by pre-emergence embryos, showed that 75% developed at 34^0C compared to 37.5% at 36^0C. Low temperatures of 28^0C had 12.5% developing to pre-emergence stage while 50% developed at 31^0C.

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!

ACKNOWLEDGMENTS

I express my heartfelt gratitude to Dr. Richard D. Fell for his assistance, patience, kindness, tolerance and invaluable guidance in the study. My graduate committee members Drs. Donald E. Mullins and Douglas G. Pfeiffer for their suggestions. Many thanks to Drs. Donald E. Mullins, Sally Paulson and Scott Salom for allowing me to use facilities in their laboratories. I appreciate and will always remember Keith Tignor for laboratory assistance and technical problems relating to setup at Price's Fork. I also thank the entire faculty, staff and fellow graduate students in the Department of Entomology for their encouragement when things never seemed to be moving at all; Yew-Haur Lee and Seth Clark of the Statistical Consulting Center (VPI&SU).

The money used for this degree program was made available by I.D.A. / I.B.D.R. (World Bank) through the Government of the Republic of Kenya. I thank the World Bank and my Government for the assistance. The Townsends have always assisted me since I knew them during an internship (Summer 1990). I therefore thank Richard, Georgia, Chris, (Kelly and Kent) for generous help during the pre-study settlement in Virginia (Blacksburg). Glenn and Velma Horst for their constant prayers. Last but not least I thank my wife Orpah, our children Benjamin, Katherine and George for putting up with all this hard and grueling years of waiting at the time when many changes have been taking place in the family. My parents did miss me too! For this, thanks Mom and Dad.

God bless you ALL.

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