4-18-2012

Effects of Dietary Regimen on Lifespan and Fecundity of Blow Fly, Lucilia sericata (Diptera: Calliphoridae)

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Introduction

The green bottle fly, *Lucilia sericata*, is a forensically important organism that is used to determine post-mortem interval (PMI) in deceased individuals due to its necrophagous lifestyle. Insect colonization and species succession on decaying organic material are well-characterized events, with *Lucilia sericata* being one of the first species to colonize. Forensic methods for determination of PMI using insect developmental stages have been developed based on laboratory methods for culture of insect species but there is no standard method for laboratory culture of *Lucilia* with respect to diet.

In order to determine the PMI, one must rely on life cycle data obtained in artificial laboratory settings. There are no standard procedures or protocols for rearing these flies in a laboratory setting which can set the precedence for life cycle and PMI calculation. Differences in development can arise when different tissues or food sources are used in the culturing of fly populations (Kanehsrahq and Turner, 2004).

In a laboratory setting blowflies are typically reared on a carbohydrate based diet however, in order for females to reach sexual maturity, dietary protein is required (Barton Brown, 1993). During ovarian development, females exhibit food-seeking behaviors specific for the protein needed for vitellogenesis (Barton Brown, 1986; Barton Brown, 1992). Preference of female blowflies for a protein-rich diet is correlated with the organism's stage of ovarian development (Dethier, 1961; Roberts and Kitching, 1974; Bale, 1978; Rachman, 1980). Although the females need the protein for larval production, raw meat is highly susceptible to contamination and putrescence (Daniels, Smith, 1993).

It has been noted that dietary protein is essential for sexual development in female blowflies, yet it has not been documented as to whether or not protein is essential for male sexual development. Most sexual behavior occurs as a response to sex pheromones released by females as a type of calling behavior (Barton Brown, 1993).

Materials and Methods

Pupa were separated and transferred into single holding containers. The pupa was incubated and upon emergence, the flies were grouped according to sex. Three groups of 15 males and 15 females were placed into Bug Dorms. Cages were selected at random to represent one diet. The three dietary treatments: 1:1 honey/water mixture ad libitum, dry sucrose ad libitum, and 5g liver. Fresh dietary substrate was given to each cage every other day throughout the course of the experiment. The flies given ad libitum water, administered by a capillary action driven watering mechanism in each cage. All treatment groups were observed under controlled conditions of temperature (21-23°C), light (12:12 light:dark cycle), and humidity (25-25%).

Measurements were taken every other day upon feeding. The dead flies in each treatment were counted and classified according to sex.

The data was analyzed using the Kaplan-Meier estimate to estimate survivorship proportions.

Acknowledgements

We would like to thank Marie McCracken for her contribution to this project. This work has been supported in part by the University of Dayton Office of Graduate, Predoctoral & Continuing Education through the Graduate Student Summer Fellowship Program.

Results

After completing Kaplan-Meier survivorship analysis, the data was found to support the Honey Water treatment order as the most favorable dietary regimen. Figure 1 reveals a similar survivorship curve between the males and females for the Honey Water treatment. Figure 2 compares the survivorship between males and females fed only Liver which showed marginally significantly higher survivorship in days than females. Also, overall days lived by either sex compared to Figure 1 was six days less. Figure 3 shows that males had a four day less survivorship than the females when fed only Sucrose. Figure 4 is most revealing with the comparison of all three treatments Honey Water, Liver, and Sucrose. This figure shows that the Honey Water treatment had the highest survivorship over the longest time, in days, over the other two treatments.

Discussion and Conclusions

Interestingly, comparison of Figure 2 and Figure 3 both exhibit males and females subjected to treatments of Liver only and Sucrose only having a much shorter lifespan than Honey Water, but they also depict a substantial difference in lifespan of males versus females in both cases. In Figure 2 the males outlived the females by eight days, which when compared to overall lifespan, is roughly 25% of the total days. Figure 3 shows that the females lived four days longer than their counterpart males. This is a much lower percentage of total lifespan, but is still significant. Figure 1 reveals that the males and females had an individual number of days survived. This is quite revealing in the sense that the diet appears to have an equal nutritional impact on survival for both sexes.

In the honey water study, there were substantial differences in survivorship and overall days lived by the population compared to the other experiments. (Figure 4). This suggests that the Honey Water food source is the most suitable for both males and females in the Blow Fly species *Lucilia sericata*. Figure 1 shows the extreme similarity between the survivorship of males and females fed only Honey Water. This further supports the diet as most beneficial for both sexes. This diet proves sufficient for females due to its coalescence of nutrients including, amino acids and sugar. The need for protein in a female Blow Fly's diet is known to be directly correlated to larval production, along with oviposition (Barton Brown 1986, Barton Brown, 1992). It is suspected that when females begin laying eggs that the pheromones secreted are detected by the males, but the necessity for protein in a male's diet remains unknown. This topic is of significant importance for future research alongside research to determine how males and females alike can detect the presence of flesh and protein sources.

Based on dietary findings, it is postulated that Blow Fly species *L. sericata* can be sufficiently reared and will develop properly if given a regimen of Honey Water. These findings have forensic significance and provide a plausible protocol for rearing and perpetuating a population of Blow Flies which can detect decomposing material leading to a positive identification of Post Mortem Interval.

References

Barton Brown, K., "Influence of sex and prior protein feeding on preferences by the housefly. Musca domestica", between source solutions and solutions of L-leucine or sodium phosphate buffer". Entomology (1989) 41, 135-139.


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