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Impact of two larval diets on some biological aspects of *Chrysomya albiceps* (Diptera: Calliphoridae)

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Abstract: Larval diet has a great effect on the post-embryonic development of the blowflies. The impact of meat type on some developmental parameters of *Chrysomya albiceps* (*Ch. albiceps*) was evaluated, regarding larval and pupal durations, and percentage of pupation and adult emergence. Newly hatched larvae of *Ch. albiceps* were reared under laboratory conditions of 26 ± 2 °C, 55 ± 10% RH, and 12L:12D photoperiod on beef and chicken meat. Larval duration was significantly different between the two meat types (*P* = 0.00068), while there was no significant difference in the pupal duration (*P* = 0.109), percentage of pupation (*P* = 0.184), and adult emergence (*P* = 0.347) with the shortest larval and pupal durations and the highest percentage of pupation and adult emergence went to the beef meat reared group. It was concluded that larval rearing medium affects the development rate and survival of larval and pupal stages of *Ch. albiceps*. Further investigation of the influence of diet on other developmental parameters of *Ch. albiceps* is suggested.

Keywords: ***Chrysomya albiceps,*** **Calliphoridae, Larval diet, Developmental parameters**

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I. Introduction

Chrysomya albiceps is one of the blowfly species that attract the attention of researchers because of its diverse medical importance. Due to its broad spectrum scavenger nutritional nature relating to decaying organic matters, *Ch. albiceps* is considered a considerable mechanical vector of some pathogens **(Ferraz *et al.*, 2012)**. Adult flies move between rubbish, rotten food remaining, natural body discharges and excreta, and exposed carcasses then rest on naked food in markets transferring pathogens through their appendages. They also cause myasis in animals and humans by laying eggs on open wounds and natural body openings.

Ch. albiceps plays an important role in forensic entomology as they found to be among the first arrivals to carcasses. So, it contributes to the estimation of post-mortem interval (PMI) through tracking the age and the developmental stage of the found insect specimens depending on the previously set standard development curves generated from studies on larval growth **(Clark *et al.*, 2006 and Salazar-Souza *et al.*, 2019)**.

Concerning maggot therapy (MT), *Lucilia sericata*, the related species of *Ch. albiceps*, is the main actor in MT. In maggot debridement therapy (MDT), sterilized alive maggots were applied to chronic wounds in a suitable dressing for a specific period depending on the predatory nature of maggots which attracted to necrotizing tissues causing wound debridement and disinfection **(Moya-López *et al.*, 2020)** . Because of the strict control requirements to produce laboratorial sterilized medicinal maggots , the fear of escape of maggots inside the wound, the rapid growth of maggots which requires intensive care and observation by professional physicians, and the disgust factor, maggot extracts may be prepared using certain techniques to reserve their active components which are involved in wound healing process **(Nigam *et al.*, 2010)**.

All of the above contributions of *Ch. albiceps* to medical field encouraged the researchers to take a curious look inside its life cycle and which factors affect it. As the development of *Ch. albiceps* is sensitive to any change in environmental conditions including larval diet **(Raise and Gemmellaro, 2024)**, many studies were carried out on the impact of different types of larval food on different developmental parameters **(Kaneshrajah and Turner, 2004; Flores *et al.*, 2014; Al-Shareef and Al-Qurashi, 2016; Mohamed *et al.*, 2021 and Selem *et al.*, 2023)** . Larval development rate varied even when larvae of *Ch. albiceps* reared on different tissues of the same animal **(Beuter and Mendes, 2013)**.

Application of species of Calliphoridae in medical or any other field must be carried out using inbred specimens from a previously defined and studied laboratory colony of the fly to avoid individual differences between species and strains **(Gallagher *et al.*, 2010 and Smith *et al.*, 2016)**.

The increasing need to maintain a continuous and stable laboratory colony induced the researchers to study alternative larval rearing diets which are efficient, available, and cost effective to expand the circle of choices **(Ferraz *et al.*, 2011 and Cardoso Da Silva *et al.*, 2015)**.

This study was carried out on beef and chicken meat as two larval diets to compare their effect on life cycle duration and completion which is a crucial factor in most medical applications of calliphorid larvae and evaluate the usefulness of chicken meat as a larval diet of *Ch. albiceps* as a species of Calliphoridae.

II.Materials and methods

Establishment of a laboratory colony

Adult flies and larvae were collected from an exposed rabbit carcass slaughtered for this purpose at the Entomology Laboratory, Zoology Department; Faculty of Science at Zagazig University. Adult flies were transferred to wooden cages with wire mesh sides and served with sugar crystals, cotton pieces soaked with water, and beef meat as an oviposition medium. Larvae were reared on beef meat kept in plastic containers covered with lace cloth. After completion of life cycle adult flies were taxonomically identified. *Ch. albiceps* adults were transferred to a rearing cage supplied with sugar crystals, water saturated piece of cotton, and beef meat to provide protein necessary for reproductive ability and an oviposition medium according to the method of **Byrd and Tomberlin (2019).**

Effect of larval diet on the larval duration and percentage of pupation

Two groups each of 100 newly emerged larvae were transferred to larval rearing containers, one group was provided with 200 gm fresh beef meat and the other one provided with 200 gm fresh chicken meat daily. When larvae entered the wandering phase, they were transferred to pupation containers with 5 cm deep sawdust as a pupation medium covered with mesh fabric. The duration between larval emergence and complete pupation and number of formed pupae were recorded.

Effect of larval diet on pupal duration and percentage of adult emergence

Each diet group was sifted carefully at hourly intervals to notice the formation of white pupae which were transferred to adult rearing cage. The duration between formation of pupae and adult eclosion and the number of emerged adults were recorded.

The experiment was conducted under laboratory conditions of 26 ± 2 °C, 55 ± 10% RH, and 12L:12D photoperiod.

Statistical analysis

The experiment was repeated three times. Data obtained were presented as mean ± SE and analyzed using student's *t*-test to compare means of the two study groups. Statistical significance was set at $P<0.05$ (GraphPad Prism, version 8.0.1; GraphPad Software, Inc., La Jolla, CA, USA).

III. Results

Effect of larval diet on the larval duration and percentage of pupation

Comparing the effect of beef and chicken meat larval diet on the larval duration revealed that larvae reared on beef meat had significantly shorter (P<0.05) larval duration than that reared on chicken meat. There was no significant difference (P>0.05) in percentage of formed pupae between both groups as presented in **Table 1)** and **Figure 1).**

Table 1: Impact of larval diet on larval duration, and percentage of pupation of *Ch. albiceps* under controlled laboratory conditions of 26 ± 2 °C, 55 ± 10% RH, and 12L:12D photoperiod

Biological aspects / Diet	Larval duration (Days)	Percentage of pupation (%)
	Mean ± SE	
Beef meat	3.45 ± 0.05[b]	98.7 ± 0.88[a]
Chicken meat	4.50 ± 0.09[a]	96.7 ± 0.88[a]
P-value	0.00068	0.184

SE: Standard error and **P:** Probability value.
Means with different letters in the same column are significantly different P<0.05.
Means with similar letters in the same column are not significantly different P>0.05.

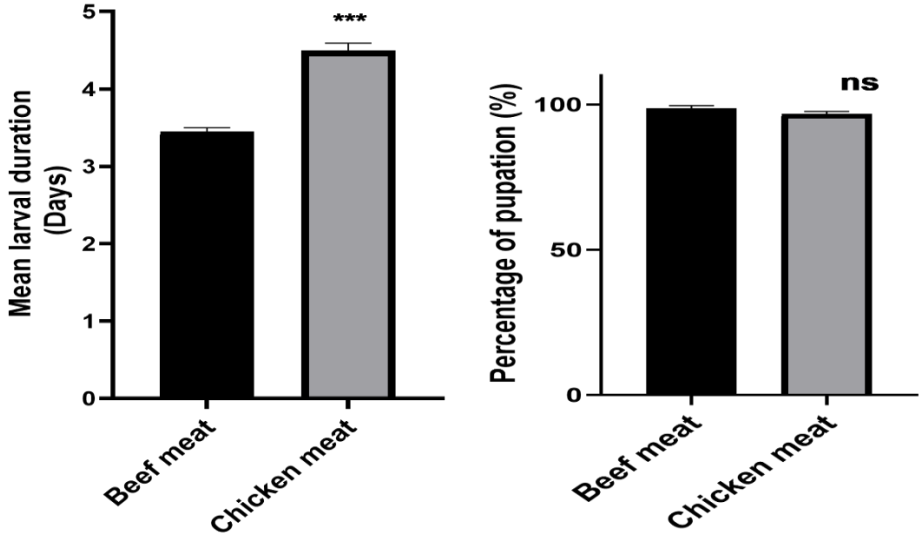

Figure 1: Effect of larval diet (beef meat and chicken meat) on larval duration and percentage of pupation of *Ch. albiceps* under controlled laboratory conditions of 26 ± 2 °C, 55 ± 10% RH, and 12L:12D photoperiod (***:P = 0.00068, ns: non-significant difference).

Effect of larval diet on pupal duration and percentage of adult emergence

Regarding the pupal duration and the percentage of adult emergence, both diets groups showed non-significant difference (P>0.05) when compared to each other as revealed in

Table 2) and **Figure 2)**.

Table 2: Impact of larval diet on pupal duration and percentage of adult emergence of *Ch. albiceps* under controlled laboratory conditions of 26 ± 2 °C, 55 ± 10% RH, and 12L:12D photoperiod

Biological aspects / Diet	Pupal duration (Days)	Percentage of adult emergence (%)
	Mean ± SE	
Beef meat	4.67 ± 0.042[a]	99.7 ± 0.33[a]
Chicken meat	5.04 ± 0.14[a]	98.9 ± 0.61[a]
P-value	0.109	0.347

SE: Standard error and **P:** Probability value.
Means with similar letters are not significantly different P>0.05.

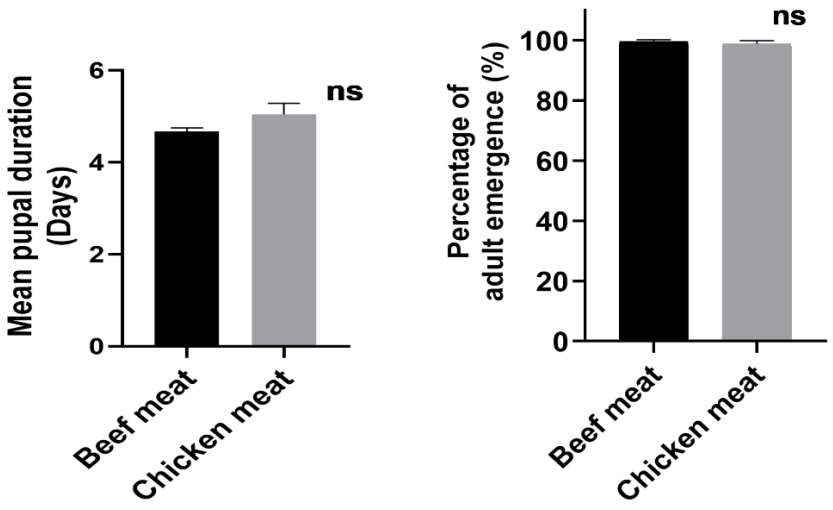

Figure 2: Effect of larval diet (beef meat and chicken meat) on pupal duration and percentage of adult emergence of *Ch. albiceps* under controlled laboratory conditions of 26 ± 2 °C, 55 ± 10% RH, and 12L:12D photoperiod (ns: non-significant difference).

IV. Discussion

In the present study, larval duration extends for significantly longer time on chicken meat than on beef meat. While pupal duration and completion of larval and pupal stages were not much affected that agreed to some extent with the results of **Thyssen *et al.* (2014)** who found that the nutritional composition of food affects the rate of development of calliphorids. **Day and Wallman, 2006 and Rabêlo *et al.* (2011)** suggested that the type of food especially affects the feeding stage of the fly; larvae fed on diet with high fat content direct more energy for metabolism and growth.

The delay in larval development rate of chicken meat group may be due to the fact that beef meat is higher than chicken meat in fat content as presented by **McCance and Widdowson (2014)**. **Li *et al.* (2014)** found that a high fat diet accelerates the rate of development of *Ch. megacephala* which was the same findings of **Noblesse *et al.* (2022)** who found that larval stage of *Lucilia sericata* reared on 20% fat diet was shorter than those reared on 10% fat diet. However, **Ujvari *et al.* (2009)** concluded that a high fat diet dramatically shortened the lifespan of the blowflies. Difference in the physical condition of the larval food substratum; texture, moisture, and flexibility; interferes with larval growth rate **(Byrd and Tomberlin, 2019)**. Variance in the rate of decomposition of larval diet may also has a role as documented by **Nespoli *et al.* (1998)**.

Our results align to a great extent with the findings of **Yanmanee *et al.* (2016)** in the same temperature range where they found that larval duration of *Ch. rufifacies* (Macquart, 1842) reared on beef meat ranged from 3.68 to 4.69 days and pupal duration from 4.9 to 5.78 days at 27 and 24 °C, respectively. Contrary to our findings, **Al-Shareef and Al-Qurashi (2016)** found that, on beef meat, larval stage of *Ch. albiceps* took longer duration (6 days) than pupal stage (5.5days) at 25 °C and 75% RH which is similar to **Salazar-Souza *et al.* (2019)** who found that the larval and pupal durations were 8.09 and 4.34 days, respectively. While **Claver and Yaqub (2015)** succeeded to laboratory colonize *Ch. megacephala* (Fabricius, 1794) on chicken meat and at a range of 24-28 °C/ 82-94% RH, larval and pupal durations were 2.04 and 2.29 days, respectively.

Regarding success of pupation and adult emergence, our results agreed with those of **Selem *et al.* (2023)** who found that there was no significant difference between larvae reared on chicken meat and beef meat in resulting percentage of pupation and adult emergence.

From the aforementioned studies and our study, the type of diet must be taken into consideration when the developmental parameters of a calliphorid fly are concerned. Further investigations on other types of larval rearing diet, even artificial diet, and the interaction of diet type with other developmental parameters must be conducted.

V. Conclusion

In conclusion, type of larval diet affects each single parameter of the calliphorid development. Chicken meat is an accepted alternative diet of beef meat for rearing larvae of Calliphoridae. Even if it has prolonged larval duration, it has no adverse effect on the continuity of the fly colony. But in case of mass rearing, beef meat is preferred due to the accelerated development rate of the larvae.

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