Egyptian Journal of Forensic Sciences (2016) 6, 11–16

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Contents lists available at ScienceDirect

Egyptian Journal of Forensic Sciences

journal homepage: http://www.journals.elsevier.com/egyptian-journal-of-forensic-sciences

ORIGINAL ARTICLE

Study of some biological aspects of the blowfly *Chrysomya albiceps* (Wiedemann 1819) (Diptera: Calliphoridae) in Jeddah, Saudi Arabia

Layla A.H. Al-Shareef *, **Shaza I.D. Al-Qurashi**

Faculty of Science Al Faisaliah Branch, King Abdulaziz University, Ministry of Education, Kingdom of Saudi Arabia

Received 10 March 2015; revised 22 June 2015; accepted 25 June 2015
Available online 14 August 2015

KEYWORDS

Blowflies;
Chrysomya albiceps;
Postmortem interval;
Forensic entomology

Abstract: We reared *Chrysomya albiceps* (Wiedemann 1819) unadult stages (first larval instar, second larval instar, third larval instar and pupal stage) under four constant temperatures. Results proved that increasing temperature from 20 to 25, 30 and 35 °C reduced total larval stage duration (9–6, 4.83 and 4.75 days, respectively) and pupal duration (7, 5.5, 4 and 1.5 days, respectively). *C. albiceps* larvae at first instar reached adult stage in the longest time at 20 °C (16 days), and in the shortest time at 35 °C (6.25 days). The accumulation degree-day (ADD) at 20, 25, 30, 35 °C for first larval instar were 8.86, 13.86, 18.86, 23.86 DD, for second larval instar were 10.5, 12, 17, 22 DD and for third larval instar were 35.88, 42.08, 43.97, 56.43 DD. Heat requirements for larval stage at different temperatures; 20, 25, 30 and 35 °C (49.68, 63.12, 75.01 and 97.47 DD) were more than the pupal requirements at the same temperatures (39.78, 58.76, 62.73 and 31.02 DD). Total heat requirements for *C. albiceps* to develop from the first larval instar to adult eclosion were the lowest at 20 °C (89.46 DD) and the highest at 30 °C (129.138 DD). Decreasing of temperature increased larval body length at the same age. The development curves for *C. albiceps* were established at four constant temperatures using larval length and the time since egg hatching.

1. Introduction

Chrysomya albiceps (Wiedemann 1819) (Diptera: Calliphoridae) originated from the Old World tropics and it is widely distributed in different regions of the world: Africa, South America, many parts of Europe, Southwest Asia, East and Northwest India.[1,2] This blowfly was recorded in Saudi Arabia especially in slaughterhouses, markets and garbage.[3,4] It has major medical and veterinary importance because it feeds on cadaver and feces and can be a vector of viruses, bacteria, helminthes. It can also cause myiasis in human and livestock.[1,5] *C. albiceps* was recognized among the first wave of the faunal succession on human cadavers[6–8] and was therefore valuable in providing data for the estimation of minimum postmortem interval (PMI_{min}).[9–11] There were two ways to estimate the PMI using entomological data; by predicting the sequences of arrival and colonization of different species of insects on a

* Corresponding author. Tel.: +966 564469922.
E-mail address: Layladr@hotmail.com (L.A.H. Al-Shareef).
Peer review under responsibility of The International Association of Law and Forensic Sciences (IALFS).

http://dx.doi.org/10.1016/j.ejfs.2015.06.003

dead body (long PMI), or by determining the age of immature blowflies (short PMI) which can be assessed by calculating the duration of larval development or body length (or weight).[12–18] Since the development of immature insects highly depends on its body temperature which is affected by ambient temperature and heat generated by maggot aggregations,[8,19] PMI is normally calculated by the accumulated degree day/hour (ADD/ADH) model (means measuring of thermal time taken to reach each development event K) which is associated with basal temperature or development zero, Dz, (temperature below which development ceases).[20–22] In addition, the duration of larval growth varies according to the species on genetic bases,[23,24] and to the differentiation in geographical area.[17,25] A thermal summation model relating larval growth rate to temperature has been published for only few species.[26–29,17]

In this study we examined the growth parameters (duration of unadult stages and larval body length) of forensic important blowfly, *C. albiceps* (Wiedemann 1819) at single constant temperatures and calculated the ADD/K required for sex development events including first larval instar, second larval instar, third larval instar, total larval stage, pupal stage and the duration from first larvae to adult eclosion.

2. Materials and methods

2.1. Preparing insect colony

C. albiceps fly was used for this study. It was collected from decomposed carcasses of domestic rabbit located in a garden at the northern side of Jeddah. Jeddah city is located on the west coast of the Kingdom of Saudi Arabia (latitude 29.21 north and longitude 39.7 east), in the middle of the eastern shore of the Red Sea south of the Tropic of Cancer. The flies were caught by entomological nets and immediately transferred into glass jars, then brought back to laboratory of Entomological Research Unit at Science College for Girls, King Abdulaziz University in Jeddah. Flies were reared in a metal cage ($30 \times 30 \times 30$ cm^3); upper, frontal and back side made of transparent plastic, lateral sides covered with a fine metal net. The front side of the cage was provided with a cotton cloth sleeve for access to exchange of food dishes. The cage was supplied with food for adult fly consisted of skimmed powder milk and $10 \times$ gm sugar in 100 ml water, and was put in a Petri dish. Approximately 25 gm of fresh beef meat was provided in the cage every 24 h as an oviposition medium and larval food. The rearing cage was kept in laboratory conditions at 25 °C, 75% RH and a photoperiod of 12 h light:12 h dark.

2.2. Larval rearing cage

Eggs were collected within 30 min of oviposition and were put in a small rearing cage ($15 \times 12 \times 11$ cm^3), this cage was made of transparent plastic in lower and lateral side, but the upper face was covered with fine metal net for ventilation and to prevent larvae from crawling out. A thin layer (2.5 cm) of sterilized soil was put in a cage bottom. A piece of 25 gm of beef meat was put on the soil for larval feeding, and each cage housed only 30–40 larvae. The cage was kept in an incubator at single constant temperatures (20, 25, 30, 35 °C), 75% RH and photoperiod of 12 h light:12 h dark.

2.3. Estimation of development duration and ADD for unadult stages of *C. albiceps*

Newly hatched larvae (approximately 1 h old) from insect colony cage were placed individually in a plastic cup (4 cm in diameter) containing 10 gm of minced beef meat covered with muslin secured with a rubber band. About 30 replicates were kept in an incubator at single constant temperatures (20, 25, 30, 35 °C), 75%RH and a lighting cycle of 12:12 h (light:dark). The replicates were observed every 24 h for noticing and calculating the duration of all unadult stages, first larval instar, second larval instar, third larval instar (feeding and post-feeding phase), total larval stage, pupal stage and the duration from first larvae to adult eclosion. Basal temperature or lower development threshold temperature (Dz) was obtained from previous studies. It was 9.72 °C for first larval instar,[5] 11.14 °C for second larval instar.[24] Since the Dz value for third larval instar was not available in previous studies, we used Dz for larval period, they were 15.04 °C by Queiroz[30] and 13.92 °C by Richards et al.[24] the average was 14.48 °C. For pupal stage, Dz values were 17.39 °C,[30] 11.65 °C[5] and 13.65 °C,[24] the average was 14.317 °C. Dz value for first larvae-adult eclosion period was 15.38 °C according to Queiroz.[30]

The ADD for each developmental stage was calculated using the formula; ADD = D (Tm − Dz), where; D = duration of development (days), Tm = experimental temperature (°C), Dz = basal temperature (°C), according to Higley and Haskell.[8]

2.4. Measuring of larval body length

About 10 newly hatched larvae were randomly collected from larval rearing cage every 24 h. For measuring the length of the larvae, they were put in hot water (70–80 °C) for 3–5 min. This prevents larval shrinkage when preserved in 75% alcohol. Body length of the larvae was measured to the nearest 0.01 mm under binocular stereoscope (Meiji binocular microscope from Lica company).

2.5. Data analysis

The duration of first, second, third larval instar, total larval period, pupal period and the period from first larval instar to adult eclosion, length of the larvae every 24 h until pupae onset were calculated using the mean (average ± standard deviation), according to Arkin and Colton.[31]

3. Results

3.1. Development of *C. albiceps* at single constant temperatures

During this study *C. albiceps* was reared under four constant temperatures (20, 25, 30 and 35 °C), 75% relative humidity and 12 h photoperiod, in an incubator at Jeddah city, Kingdom of Saudi Arabia. In all cases, development time for each first larval instar, second larval instar, third larval instar (feeding and post-feeding phase), pupal stage and the duration from first larvae to adult eclosion are represented in Table 1.

Results showed that the development duration of the first larval instar was similar (1 day) under different temperatures