Uttar Pradesh Journal of Zoology

Volume 44, Issue 20, Page 6-11, 2023; Article no.UPJOZ.2780
ISSN: 0256-971X (P)

Forensic Entomological Importance of "Hairy Maggot Blowfly": A Study in Reference to Kerala, India

Madona Mathew [a++*] and Jaseel Abdul Kader V. [b#]

[a] Department of Forensic Science, Usha Martin University, Jharkhand, India.
[b] Department of Forensic Science, Jharkhand Raksha Shakti University, Jharkhand, India.

Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

Article Information

DOI: 10.56557/UPJOZ/2023/v44i203640

Editor(s):
(1) Dr. Angelo Mark P. Walag, University of Science and Technology of Southern Philippines, Philippines.
Reviewers:
(1) M. Baranitharan, Government Arts and Science College, Vandavasi, India.
(2) Ali Sher, Infectious Diseases Hospital, Kuwait.

Original Research Article

Received: 21/06/2023
Accepted: 29/08/2023
Published: 07/09/2023

ABSTRACT

In order to highlight the scopes in entomology, this study aims to determine the usefulness and applicability of forensic entomology from an Indian perspective, to develop an understanding of insect lifecycle, awareness of beneficial insects, understanding of forensic entomology, and increase critical thinking application. In situations where the body has been dead for a while, forensic entomology is quite helpful. After a few days, bug evidence is frequently the most reliable and, in some cases, the only way to determine how long has passed after death. The life cycle of Chrysomya rufifacies was examined in the afore mentioned study at Kerala, India, under a room temperature (dry) 24-280C.

[++] *Assistant Professor;*
[#] *PG Student;*
**Corresponding author: Email: madona2908mj@gmail.com;*

Keywords: Insect succession; post mortem interval; entomology; cadaver; forensics.

1. INTRODUCTION

In courts all across the world, forensic entomology - the study of insects connected to a dead body has been utilized and approved. It is mostly employed to establish the time of death [1]. Insects that consume corpses may serve as a trustworthy sample for toxicological tests (Entomotoxicology) in addition to measuring the post-mortem interval (PMI) [2-3]. In a death investigation, knowing the time of death is crucial since it helps to focus the investigation on the appropriate time period. The majority of forensic entomological research have focused on mortality caused by drugs and PMI. Nevertheless, after a few days, insect evidence is frequently the most reliable and, in some cases, the only way to determine the time since death [4-5]. The specifics of each instance dictate the approach to be taken [6–8].

When determining the length of time since death or the post-mortem interval, FLY LARVAE OR MAGGOTS are significant as entomological evidence in many situations of human mortality.

In accordance with Lord 1990, Goff 2000, Byrd and Castner 2001, (2002) Greenberg and Kunich. The blow flies are a group of insects usually discovered at the scene of a death. It is possible to identify by maggots. The second and third instars of the blow fly are based on their presence on the body, categorized into two groups based on the existence and lack of tubercles on the body's surface, with the former dubbed a "hairy maggot." Within this specific group, only there have been reports of two blow fly species from a body, Chrysomya albiceps (Wiedemann) and Chrysomya rufifacies (Macquart).

C. rufifacies has significant effects on the forensic and medical fields, ecology of invasions and science. The blow fly with hairy maggots is regarded as a second stage carrion fly on dead animals [5] and therefore, when collected alone, not significant in defining maximum postmortem intervals (PMIs). The additional It is helpful in forecasting since C.rufifacies colonizes carrion. the minimum postmortem period determined by the length of the insect conduct (PIA). The PIA will be, excluding premortem myiasis, as this measure solely accounts for time elapsed, it is shorter than the PMI. between the initial settlement of the remains and the gathering of the Evidence based on entomology [6]. We shall refer to this kind of analysis as PIA. estimate.

Additionally widely distributed around the globe is the blowfly species *Chrysomya rufifacies*. It is more suited to tropical climates and is present all year long [9]. Many scientists have employed this species as a forensic indication [10–12]. We can determine the time since the egg was laid if we are aware of how long it takes an insect to reach each stage of its life cycle. This estimation of the insects' ages can be used to determine the minimum time until death. However, even if the estimated bug age is accurate, the victim's passing happened before the eggs were laid.

Although entomological information can indicate how or where a person died, it is most frequently utilized to determine when someone died. There may be two time-dependent mechanisms at play here. The development of insect larvae that feed on the victim is the first. The age of a larva offers a minimum amount of time since death because the majority of the carrion insects start succession on the corpse right after the death. The body's succession of carrion-arthropod species, which may be able to provide both a minimum and a maximum approximate post-mortem interval [13], is the second factor.

2. METHODOLOGY

The beef meat was collected from random beef market in Pathanamthitta District, Kerala, India. A total of 3kg of beef liver from buffalo was used to catch and raise flies. In Pathanamthitta, the beef liver was maintained in an open atmosphere and subjected to fly collecting. The time period of the study was 2 months (January 2023- March 2023). *Chrysomya rufifacies* flies were employed in this study. Every observation was recorded daily.

Chrysomya rufifacies were put in jars. Jars were placed in the raising chamber at 24-28^{0}C room temperature. From the point of the larva's first appearance, closely Periodically, counts of larva and pupa were made. until every larva had developed into a pupa.

3. RESULTS

On January 30th, the jar containing mature blow flies was left at room temperature. By the 31th of Januay, it was seen that the eggs had been laid. The first in star stage was noticed on the third day following incubation, where the counting started after 6 hours. By the 78th hour, a mixture of a larva and pupa were included in the counting, and the final reading taken at 90 hours was of the pupa.

Table 1. Day Wise observation of the Flies

Date of observation	Observation
30th January	4 adult flies placed in jars
31st January	No activity
1st February	1 adult fly dead
2nd February	Eggs laid, 2 adult fly dead,
3rd February	1 adult fly dead,1st instar, (2mm)
4th February	2nd instar (9mm)
5th February	3rd instar (16mm)
6th February	Pupae

Table 2. Shows count of larvae taken every 6 hours after first appearance larvae

Hours	No. of larvae/pupae
6	21
12	37
18	53
24	66
30	78
36	79
42	79
48	82
54	88
60	88
66	89
72	89
78	91 (larvae/pupae)
84	91 (larvae/pupae)
90	91 (pupae)

4. DISCUSSION

The impact of temperature on the life cycle of insects has been the subject of numerous research. Thirteen species of flies from nine genera in the family Calliphoridae were studied for their life histories and rates of development by Mearns [14], Singh et al. [11], Anderson [15], and Kamal [16]. Singh et al. [17] from India have stressed the need to produce the crucial basic data so that this research can be properly applied in India as well. The author's decision to pursue the current suggestion was motivated by the entire circumstance.

Insects are significant forensic indicators, according to Singh et al.'s study of forensic entomology from an Indian perspective. They investigated the connection between insects and the decay of corpses. Singh and Bharti classified the blowfly species that can be significant from a forensic perspective, including the Order Diptera, Family Calliphoridae, Species Chrysomya megacephala, Chrysomya rufifacies, Calliphora vicina, Lucilia Sericata, and Lucilia illustris that are present in the state of Punjab. [18].

According to facies and C. albiceps, the "hairy" look began to take shape in the second instar and largely manifested itself in the third instar [19].

The results of this investigation unmistakably demonstrated that the spine along the tubercles was a characteristic that could distinguish between the hairy maggots' third instar. While the spines of C. rufifacies are rounded knobs that spiral three times around the base of each tubercle, those of C. villeneuvi appear to be powerful with their sharp ends encircling the entire tubercle. Only C. rufifacies' biology and pace of development have been described for these two species of hairy maggots [20]. As a result, PMI could be determined at this time if a C. rufifacies specimen was present.

The two Calliphorids that could be found throughout the year were Chrysomya megacephala and Chrysomya rufifacies. The length of the degradation process was influenced by climatic factors and reflected seasonal temperature variations. When it rained, corpses decomposed far more quickly than they did in the winter and spring. Summer temperatures that were warmer accelerated succession, but winter temperatures that were colder slowed it down by delaying the growth of dipterous larvae [21-23].

Blowing flies do lay eggs at night, as Singh and Bharti's study of this activity revealed [24]. This fact should be taken into account while drawing

conclusions from entomological data based on blowfly nocturnal oviposition behavior. Calculating the post mortem interval requires careful consideration of the effects of temperature. The temperature of the environment affects insect development, with higher temperatures causing faster rates of growth [25–26]. When the temperature range is acceptable and the constant temperatures equal the mean of the fluctuating temperatures, it has been demonstrated that developmental rates in many species are the same at natural, varying temperatures as they are at constant temperatures [15–16].

5. CONCLUSION

This study intends to enhance the use entomology in solving forensic cases, and explain the further scopes in the field of forensic entomology, by awareness of beneficial insects, understanding of forensic entomology, and understanding of beneficial insects. The rate of insect development is impacted by a range of factors, including temperature. As noted by Bayer [27] and later Levine [28], it was discovered that when the temperature was raised, blow fly larvae matured more quickly and produced more offspring.

Additionally highlighted by Nabity et al. [24], it was clearly discovered that humidity had an impact on the colonization cycle and that blow flies thrived best in environments with high temperatures and high levels of humidity. The temperature of the environment affects insect development, with higher temperatures causing faster rates of growth [29,14]. To help with crime investigation by determining the post-mortem interval if it cannot be determined using conventional methods. In India, forensic entomology is a seldom-used instrument and a subject that receives minimal attention. Insects are used by forensic entomologists to help identify the cause, location, and time of death in cases involving decomposing remains [17]. When other techniques are ineffective, they might be employed to precisely pinpoint the time of death. They can also demonstrate whether a body has been moved after passing away [15]. Insects that consume corpses may serve as a trustworthy specimen for toxicological investigations in addition to estimating the post-mortem interval (PMI).

We advise against using C. rufifacies as the main species in PIA estimates, especially in regions where this fly is imported and would have evolved under certain conditions. Lower temperatures weren't taken into account in the published development data [11]. Our research highlights the necessity for further improvement data collections on the species, particularly in cold climates. Future research on this and other technologies' development [30-34].

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Baumgartner DL. The hairy maggot blow fly *Chrysomya rufifacies* (*Macquart*) confirmed in Arizona. Journal of Entomological Science. 1986;21:130-132.
2. Baumgartner DL. Review of *Chrysomya rufifacies* (Diptera: *Calliphoridae*). J Med Entomol. 1993;30:338**-**352.
3. Monthei DR. Entomotoxicological and thermal factors affecting the development of forensically important flies. Faculty of Virginia Polytechnic Institute, Blacksburg. 2009;1–112.
4. Commack JA, Nelder MP. Cool-weather activity of the forensically important hairy maggot blow fly *Chrysomya rufifacies* (*Macquart*) (Diptera: *Calliphoridae*) on carrion in Upstate South Carolina, United States. Forensic Sci Int. 2010;195:139**-**142.
5. Figarola JLM, Skoda SR. *Chrysomya rufifacies* (Macquart) (Diptera: Calliphoridae) in Nebraska. J Entomol Sci. 1998;33:319-321.
6. Tabor K, Fell RD, Brewster CC, Pelzer K, Behonick GS. Effects of ante mortem ingestion of ethanol on insect successional patterns and development of *Phormia Regina* (Diptera: *Calliphoridae*). J Med Entomol. 2005;42:481-489.
7. Verma K, Paul MPR. Assessment of Post Mortem Interval, (PMI) from Forensic Entomotoxicological Studies of Larvae and Flies. Entomol Ornithol Herpetol. 2013;2: 104-107.
8. Greenberg B, Povolny D. Bionomics of Flies. Flies and Disease, Greenberg, B.

(Ed.), Vol. 1, Princeton University Press, Princeton.1971;57-83.
9. Goff ML, Early M, Odom CB, Tullis K. A preliminary checklist of arthropods associated with exposed carrion in the Hawaiian Islands. Proceedings of the Hawaii Entomological Society. 1986;26:53-57.
10. Goff ML, Odom CB. Forensic entomology in the Hawaiian Islands: three case studies. The American Journal of Forensic Medicine and Pathology. 1987;8:45-50.
11. Singh D, Bharti M. Forensically important blow flies (Diptera: *Calliphoridae*) of Punjab (India). Uttar Pradesh J Zool 2000; 20:249-251.
12. Greenberg B, Kunich JC. Entomology and the Law: Flies as Forensic Indicators. Ed 1st, Cambridge University Press, Cambridge. 2002;1-306.
13. Goff ML, Lord WD. Entomotoxicology: A new area for forensic investigation. Am J Forensic Med Pathol. 1994;15:51**-**57.
14. Mearns AG. Larval infestation and putrefaction. Recent advances in forensic medicine. Smith KGV and Glaister J, Eds. Churchill, P. Blakiston's Co, Philadelphia. Ed 1st. 1939, 250-256.
15. Anderson GS, Laerhoven SLV. Initial studies on insect succession on carrion in southwestern British Columbia. Journal of Forensic Sciences. 1996;41(4):617-625.
16. Kamal AS. Comparative study of thirteen species of *Sarcosaprophagous, Calliphoridae* and *Sarcophagidae* (Diptera) I. Bionomics. Annals of the Entomological Society of America. 1958; 51:261- 270.
17. Singh D, Bharti M, Singh T. Forensic Entomology in the Indian Perspective. Journal of Punjab Academy of Sciences. 1999;1:217-220.
18. Verma K. Forensic Entomology world: A new study on *Chrysomya rufifacies* from India. J. Entomol. Zool. Stud. 2013;1:125-41.
19. Wells JD, Introduced Chrysomya, (Diptera: *Calliphoridae*) in north central Alabama, Journal of Entomological Science. 2000; 35:91–92.
20. Baumgartner DL, The hairy maggot blow flfly Chrysomya rufififacies (Macquart) confifirmed in Arizona, Journal of Entomological Science. 1986;21:130–132.
21. Singh D, Bharti M. Further observations on the nocturnal oviposition behavior of blow flies (Diptera: *Calliphoridae*). Forensic Science International. 2001;120:124-126.
22. Greenberg B, *Chrysomya megacephala* (F.) (Diptera: Calliphoridae) collected in North America and notes on *Chrysomya* species present in the new world. Journal of Medical Entomology. 1988;25:199–200.
23. DeJong GC, Chadwick JW. Additional county records and a correction to the checklist of the *Calliphoridae* (Diptera) of Colorado, with a new state record for *Chrysoma rufififacies*. Journal of the Kansas Entomological Society. 1997;70: 47–51.
24. Greenberg B. Flies as Forensic Indicators. Journal of Medical Entomology 1991; 28(5):565-577.
25. Goodbrod JR, Goff ML. Effects of larval population density on rates of development and interactions between two species of *Chrysomya* (Diptera: Calliphoridae) in laboratory culture. J Med Entomol. 1990; 27:338-343.
26. Byrd JH, Butler JF. Effects of temperature on *Chrysomya rufifacies* (Diptera: Calliphoridae) development. J Med Entomol. 1997;34:353-358.
27. Norton LE, Garriott JC, Di Maio VJM. Drug detection at autopsy: a prospective study of 247 cases. Journal of Forensic Sciences. 1982;27:66-71.
28. Garriott JC, Di Maio VJM, Petty CS. Death by poisoning: a ten-year survey of Dallas County. Journal of Forensic Sciences. 1982;27:868-879.
29. Clarkson CA, Hobischak NR, Anderson GS. A comparison of the development rate of *Protophormia terraenovae* (Robineau-Desvoidy) under constant and fluctuating temperature regimes. Canadian Society of Forensic Science Journal. 2004;37:95-101.
30. Meek CL, Puskarich-May C, Carlton CE. New state record for the hairy maggot blow flfly Chrysomya rufififacies (Macquart), Southwestern Entomologist. 1998;23:373–375.
31. Meek CL, Puskarich-May C, Carlton CE. New state records for the hairy maggot blow fly *Chrysomya rufifacies* (*Macquart*). Southwest Entomol. 1998;23: 373**-**375.
32. Roy DN, Siddons LB. The life history and bionomics of *Chrysomya rufifacies*

Macq. (Order Diptera, Family *Calliphoridae*). Parasitology. 1939;31:442-447.

33. Subramanian H, Mohan KR. Biology of the blow flies *Chrysomya megacephala*, *Chrysomya rufifacies* and *Lucilia cuprina*. Kerala Journal of Veterinary Science. 1980;11:252-261.

34. Byrd JH, Allen JC. The development of the black blow fly, *Phormia Regina* (Meigen). Forensic Science International 2001;120: 79-88.