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Research Article

Estimation of postmortem interval using the blowfly *Phaenicia (Lucilia) sericata* (Diptera: Calliphoridae) in Kaduna, Northern Nigeria

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ABSTRACT

Background: The period of insect activity (PIA) was experimentally estimated for a carcass of *Cavia porcellus* (guinea pig) using the blowfly *Phaenicia sericata* in Kaduna, northern Nigeria.
Methods: *Cavia porcellus* (guinea pig) was killed and the carcass placed inside in a wire cage measuring 81x53x45 cm to prevent larger animals and birds from scavenging and allowed to decompose under ambient conditions and an average of 12hour light and darkness.
Results: Six second-instar larvae of blowflies were collected from the decomposing carcass from which four adult flies emerged and identified (two each of *P. sericata and P. infernalis*). Using *P. sericata*, the period of insect activity (PIA) was estimated as the difference between the total development time of the species and the time it required to become adult in the laboratory. The estimated minimum post mortem interval was 13.8 days with the probable day of oviposition between 9th and 10th January, 2016, coinciding with the actual period the animal was killed
Conclusions: Estimated time between death and discovery of corpse (PMI) based on the period of insect activity (PIA) may be a better alternative in some situations because it eliminate taking multiple temperature measurements at the crime scene, at the carcass as well in the maggot masses on the cadaver.

Keywords: *Phaenicia sericata*, Period of insect activity, Post mortem interval, Kaduna, Nigeria

INTRODUCTION

Application of recognizable signs of death caused by chemical changes in the muscles after death leading to conditions of rigor mortis, livor mortis, algo mortis etc cannot be applied to situations when death has occurred for days, weeks, or longer to estimate time since death.[1] In such cases, insects may be more appropriate indicators of the postmortem interval (PMI).

The immature stages of the insects found on the dead body can provide evidence that can be used to estimate a minimum PMI ranging from one day up to a month or more depending on the insects species involved and the climatic conditions at the crime scene. Caution should be exercised as the calculated period may not always match the exact PMI.[2]

Studies on animal carcasses have demonstrated that species composition of insect visiting a cadaver vary between one geographical area and another and between seasons.[3-6] Therefore, the information obtained for a particular region or area may not necessarily be useful in determining PMI in another region. Even though insects of forensic significance are known to visit cadavers at timed and predictable succession, Tabor et al reported that not all of them are useful in forensic entomological studies as some are only opportunistic visitors and are only collected by chance, hence do not play a role in PMI estimation.[7] Most reports indicate that the greenbottle

blowflies are usually the first to colonize a cadaver, and are attracted by the odor produced during decomposition.[8,9]

The blowfly *P. sericata* is widely distributed in Nigeria commonly found visiting carrion, feces and garbage dumps.[10-13] *P. sericata* are considered as facultative ectoparasites that causes primary or secondary myiasis in humans and livestock making them of medical, veterinary, sanitary, and forensic important flies.[14-17] The objective of this study is to estimate the period of insect activity (PIA) as an indicator of when the insect colonized the carcass, equivalent to the age of the oldest larva collected on the carcass and correlating it with the experimental date of death. The result presented is a test of the reliability of PIA as an effective method for estimating PMI.

METHODS

Study area: The study was conducted in January 2016 corresponding to the mid dry season in the Zoological garden of Kaduna State University, (10°31`N, 007°26`E) in Kaduna State, northern Nigeria. The area is approximately 607 m above sea level and has average ambient temperatures of 25°C (range 20-31) and relative humidity of 36.7% (range 18-93) at the time of the study.

Experimental animal: *Cavia porcellus* (Guinea pig) was killed on 9th January, 2016 at about 12 noon by cutting its throat and severing the main blood vessels with a sharp knife and allowed to bleed. The carcass was placed inside a wire cage measuring 81x53x45 cm to prevent larger animals and birds from scavenging the remains but allowed insects access. The carcass was allowed to decompose under ambient conditions and an average of 12hour light and darkness.

RESULTS

Six second-instar larvae of blowflies were collected from the carcass on 14th January, 2016 and placed in a plastic rearing container with bovine meat provided as a substrate. The larvae were reared in the forensic laboratory facility of Kaduna State University maintained at a room temperature of 23-25°C (Figure 1).

From the six larvae, four adult flies emerged on 23rd January, 2016 and were identified as *Phaenicia (=L) sericata* and *Lucila infernalis*. Only the Period of Insect Activity of P. (L) sericata was subsequently estimated in this study because of the availability of information in the literature on the fly development. The Estimation of the PMI relies on published data of blowfly development to estimate the time since initial colonization of the carcass occurs.[18] According to Anderson average duration of the development time for *L. sericata* from egg through to adult at a temperature ranging between 23-25°C (condition under which larvae were reared in the laboratory) is 22.8 days (546.5 hours) (Table 1).[19]

Table 1: Development period in days (given in hours in parentheses) of *Lucilia sericata* calculated by Anderson (2000).

Source	Fly species	Temperature	Period from oviposition to adult emergence (days)
Anderson (2000)	*P. sericata*	23.3°C	22.8 (468.4 – 624.5 hours)

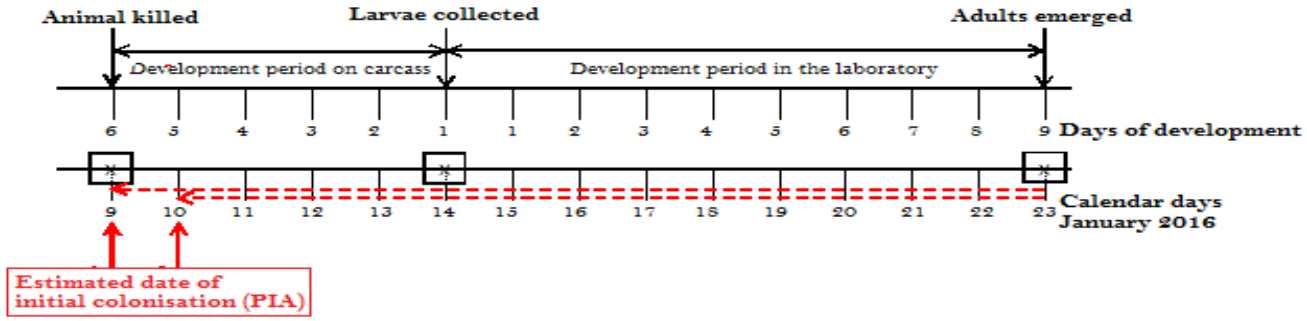

Figure 1: Time line summary of events showing date animal was killed (9 January), larvae collection (14 January), adults emergence (23 January), estimated mimimum post mortem interval (mPMI) (9th or 10th January).

Adopting the method of Amendt et al as used by Kosmann et al, the period of insect activity (PIA) was estimated as the difference between the total development time of the fly and the time required by the collected larvae to develop into adults in our laboratory (22.8 days).[19-21]

PIA = Total development time – Time required to develop into adults in the laboratory

PIA = 546.5h – 216h = 330.5h (13.8 days)

Counting 13 days backwards from the day of adult fly emergence in the laboratory (23rd/01/2016), the most

probable day of oviposition was between 9th and 10th January, 2016, coinciding with the actual period the animal was killed (Figure 1).

DISCUSSION

This study suggest that the necrophagous species of blowfly *P. sericata* can be used as a species of forensic interest in estimation of post mortem interval in Nigeria. The minimum PMI was inferred using the Period of Insect Activity (PIA) which suggested the time of colonization to be 9th January, 2016, coinciding with the day the guinea pig was killed.

Amendt et al cautioned that the period of insect activity (PIA) does not always correspond to PMI and could either be shorter than PMI, when there is a delay in accessing the body by insects or could be longer when there is myiasis (larvae initially feeding on living tissues, that continue feeding on necrotic tissues after death).[20] Being estimates, PIA values can deviate ±2 days.[22]

Several approaches are used in estimation of PMI, including the phenomenon of succession and use of accumulated degree-hours or degree-days ADH/ADD.[23] Each of the methods has its merits and demerits. For example, succession study is greatly affected by environmental factors that can affect the rate of decomposition, and thereby the insects attracted to the body.

For the calculated ADH/ADD values to be of use will depend on the thermal history of the immature stages of the insect of interest which must be evaluated together with the temperature at the crime scene before the body was discovered as well as temperature from the nearest weather station.[22,24]

Here, this paper has shown that estimation of time between death and discovery of corpse (PMI) based on the period of insect activity (PIA) may be the better alternative in some situations because it eliminate taking multiple temperature measurements at the crime scene, at the carcass as well in the maggot masses on the carcass. Availability of weather stations in most parts of rural Africa required to be used in extrapolating temperatures at the crime scene is another constraint eliminated by this approach.[23]

CONCLUSION

Estimated time between death and discovery of corpse (PMI) based on the period of insect activity (PIA) may be a better alternative in some situations because it eliminate taking multiple temperature measurements at the crime scene, at the carcass as well in the maggot masses on the cadaver.

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