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Forensic Entomology: Decomposing Pig Carrion and Its Associating Insect Fauna in Okija, Anambra State, Nigeria

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Abstract

Studies were conducted to ascertain the insects composition associated with decomposing pig carrions *Susscrofa* Linn., as models. The experiments were carried out in a fallow plot of land in Okija town of Anambra State, Nigeria. Both the adult insects and their larvae were collected at various decomposition stages of the carrions. Samples of the collected larvae were reared to adult stage in the laboratory. The adult insects were identified to species level. The species that are useful inforensic science include the *Chrysomya albiceps* Weid (Diptera: Calliphoridae), *C. chloropyga* Weid (Diptera; Calliphoridae), *C. regalis* Rob-Desv (Diptera: Calliphoridae), *Isomyia dubiosa* Villen (Diptera: Calliphoridae), *Isomyia* sp., *Sarcophaga inzi* Curran (Diptera: Sarcophagidae), *Chrysomyza africana* Hendel (Diptera: Ulidiidae), *Musca domestica* Linn. (Diptera: Muscidae), *Hermatiaillucens* Linn. (Diptera: Stratiomyiidae), *Dermestes frischii* Kug (Coleoptera: Dermestidae), *Necrobia rufipes* Deg (Coleoptera: Cleridae) and *Necrobia ruficolis* Fab. (Coleoptera: Cleridae). The Usefulness of the insects in estimating minimum postmortem interval (mPMI) of carrions in relation to forensic science was discussed.

Keywords

Forensic Entomology, Insects, Carrions, Decomposition Stages, Okija

1. Introduction

The study of insects have gained global acceptance in many research studies relating to agriculture, ecology, genetics, medicine, veterinary and forensic science. The application of insects in the later study is known as "*forensic entomology*".

Forensic entomology is the study that utilizes the knowledge of insect biology, in the investigation of crimes relating to homicide or mysterious death. Okiwelu *et al*. (2008) defines it as the application of the study of insects and other arthropods to legal issues, especially in a court of law.

Crime scene investigation in the developed world has found some insect species useful in determining when a victim died, the possible cause of the death and other clues. Many studies of insects associated with decomposing carcasses, have pinned down some species as insects of forensic importance (Gennard, 2007) and the history of insects in relation to forensic science (Mcknight, 1981; Benecke, 2001; Greenberg and Kunich, 2002).

Amendt *et al*. (2004) stated that when human body or other animals are found days, weeks, or months after death, it may be difficult for medical coroners to estimate the time of death using parameters such the body temperature, as well as the rigor and livor mortis of the body. In such cases, insects may provide valuable indications of the postmortem interval (PMI). PMI is the shortest amount of time the victim has been dead. If forensic entomologist finds larvae that take at least three days to develop, he can infer that the victim has been dead for three days. Hence, the ages of insects immature stages on the decomposing body can provide evidence for the estimation of a minimum PMI of the body (Amendt *et al*., 2004; Gennard, 2007). Thus, the immature stages of insects

especially the fly larvae which were earlier seen as disgusting elements of decay during autopsy do not only provide valuable PMI, but can also be useful in toxicological assessment. The larvae while feeding on a decomposing corpse may sequester drugs and toxicants which may have been ingested by the victim. Thus bodies in a state of advanced decomposition or dried remains may be difficult to examine for toxicologically relevant substances due to lack of blood and urine. So, the analysis of the insects, especially the immature stages encountered may enable toxicological assessment of the cause of death (Goff and Lord, 2001; Introna *et al*., 2001; Amendt *et al*., 2004; Campobasso *et al.*, 2004).

In Nigeria, forensic science in general has not been fully in application in the legal system especially criminal cases relating to homicides and questionable deaths. This had however negatively affected other branches of forensic science, including forensic entomology. Hence, the report of (Usua, 2007) that forensic entomology in Nigeria is still in its infancy stage, was a clarion call which has stimulated interests in forensic entomology. Few entomologists have responded to the call thus, studies are gradually spreading from the Southern Nigeria to the Eastern Nigeria, in the last few years. Thesestudies were at least to provide entomological base line information on the dearth knowledge of our legal system, that insects can provide useful answers to questionable deaths.

To add to the baseline information for our legal system, efforts were made to study the insect fauna associated with the decomposing pig carrions as models, to enhance unbiased delivery of justice in the case of homicides and questionable deaths in Nigeria. The study critically observed different stages of decomposition of the pig carrions and marking the stages of the decomposition with time that had elapsed cum insects that are distinctively unique on each decomposition stage.

2. Materials and Methods

The experimental study was carried out between the months of January and May, 2012 in a fallow plot of land at Ubahueze-Okija (05°53.240N and 006°46.510E). Okija is a town in Anambra State, Nigeria. The town is located in the tropical rainforest with patches of forests, dominated by oil palm trees. The topography is a combination of hills and low land areas. The daily temperatures range from 26°C to 30°C with wet and dry seasons in a yearly cycle (Okija in-Home, 2010).

Six white pigs (*Susscrofa* Linn.) serve as the experimental animals, each weighing about 24.8 ± 0.9kg as models for human beings. The pigs were purchased from a piggery at Umuogu-Okija. They were slaughtered by 18.30 hours local time and transferred immediately to the study site. The carcasses were deposited each on a polyester mat, three metres apart. The carrions were protected from vertebrate scavengers with metal wire mesh and held in position with concrete blocks.

Insects associated with the decomposing pig carrions were collected with either blunt forceps or fine arts' brush and sweep net. Samples of the insect larvae were reared in the laboratory to adult stage for identification and for calculating the time taken for each species to hatch, for the purpose of estimating minimum postmortem interval (mPMI) of corpse in the region, when such service is legally required. The daily ambient temperature and relative humidity of the study area were recorded using general purpose 'glass rod' mercury thermometer and portable digital thermo hygrometer respectively.

3. Results

Figure 1 shows that the pig carrions passed through four distinctive decomposition stages; fresh, bloated, active decay and dry decay. Each of the decomposition stageis distinctively unique with observed physical characteristics and peculiar insects.

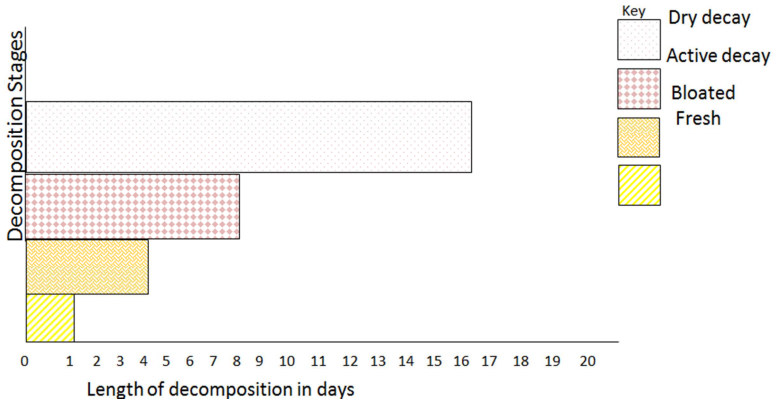


Figure 1. *Average Length of Time in Days Taken by the Pig Carrions to Decompose in the Fallow Plot in Okija. Anambra State, Nigeria.*

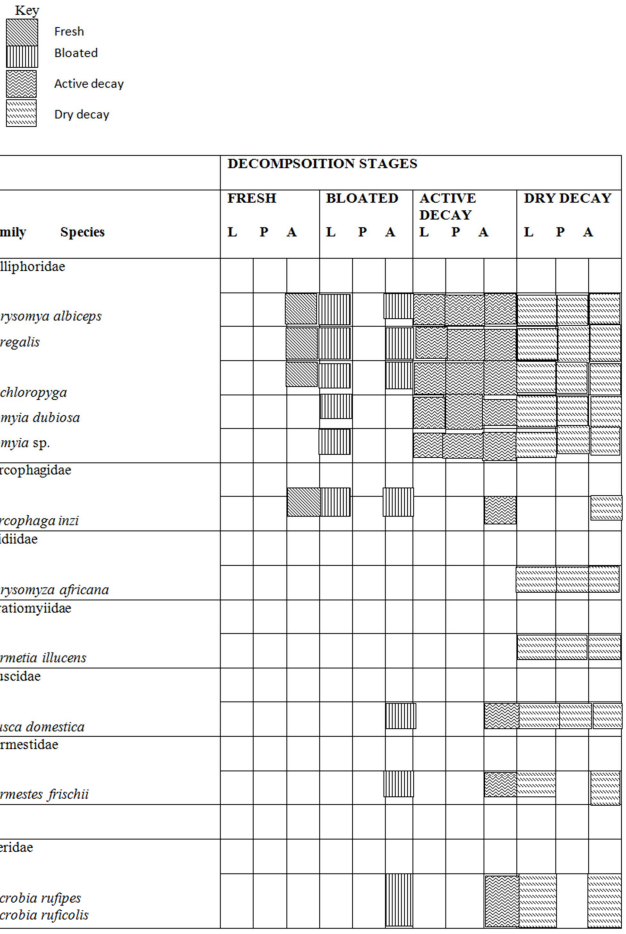
The fresh stage of the carrions was observed as a fresh cadaver immediately after death occurred, between 0 to 12 hours. The body may appear physically fresh but internal physiological changes such autolysis and putrefaction is taking place. Insects found at this stage are mainly few adults of blowflies (Calliphoridae) and flesh flies (Sarcophagidae)

either on the carrions or around the scene.

The bloated stage was observed as inflated body noticeably from the abdomen and turgid feet between the early hours of day 2 through day 4. This was caused by formation of gases trapped within the body as a result of autolysis and putrefaction of the fresh stage. Insects found at this stage include eggs of blowflies and first instars of flesh flies larvae on the orifices of the pig carrions during the onset of the bloating stage on day 2. First instars of blowflies are also observed during the late hours of day 2 through day 3 and total dispersal of the larvae to the entire body of the carrions on day 4. Adult houseflies (Muscidae), hide beetles (Dermestidae) and bone beetles (Cleridae), are also spotted on the carrions, in addition to preponderance of blowflies and conspicuous number of flesh flies.

The active decay stage was observed as gases leak from the carrions, noticeably from the foul odour emanating from the scene between day 5 and day 8. Fluid was also found to leak fromthe bodies on day 6 through day 8. The remaining soft tissues begin to show signs of desiccation to various degrees. The insects of this stage include, the post feeding larval and pupal stages as well as few newly emerged adult blowflies. Adult flesh flies and house flies are also spotted while hide and bone beetles are conspicuously found.

The dry decay stage was observed as absence of fluid from the bodies and was marked by secretion of oil from the topmost skin, with evidence of the tissues drying. Insects found at this stage were few posts feeding larval, pupal and clusters of newly emerged adult blowflies on the scene and not on the carrions, during the onset of the drying stage on day 9 through day 10. Other larval and pupal stages found at this stage include the false fruit flies (Ulidiidae), soldier flies (Stratiomyiidae) and houseflies as well as the larval stages of the hide and bone beetles on the carrions during the peak of the drying stage on day 12 to day 16 through the completely dried remains i. e. skeletonization of the carrions. Few adults of flesh flies and houseflies were still occasionally found while the conspicuous number of hide and bones beetles were still observed. The immature stages of the last group of insects were seen beyond the dry decay stage and emerged during the skeletonization of the carrions. Figure 2 shows the successional pattern of the insects that can be useful to estimate the postmortem interval (PMI) of corpses collected, according to the decomposition stages of the pig carrions.



L = larvae, P = Pupae, A = Adult
(Source: Abajue, 2012)

Figure 2. *Pattern of Succession of Insects that can estimate PMI of corpse, collected on the Pig Carrions from Jan to May, 2012 in the fallow plot in Okija, Anambra State, Nigeria.*

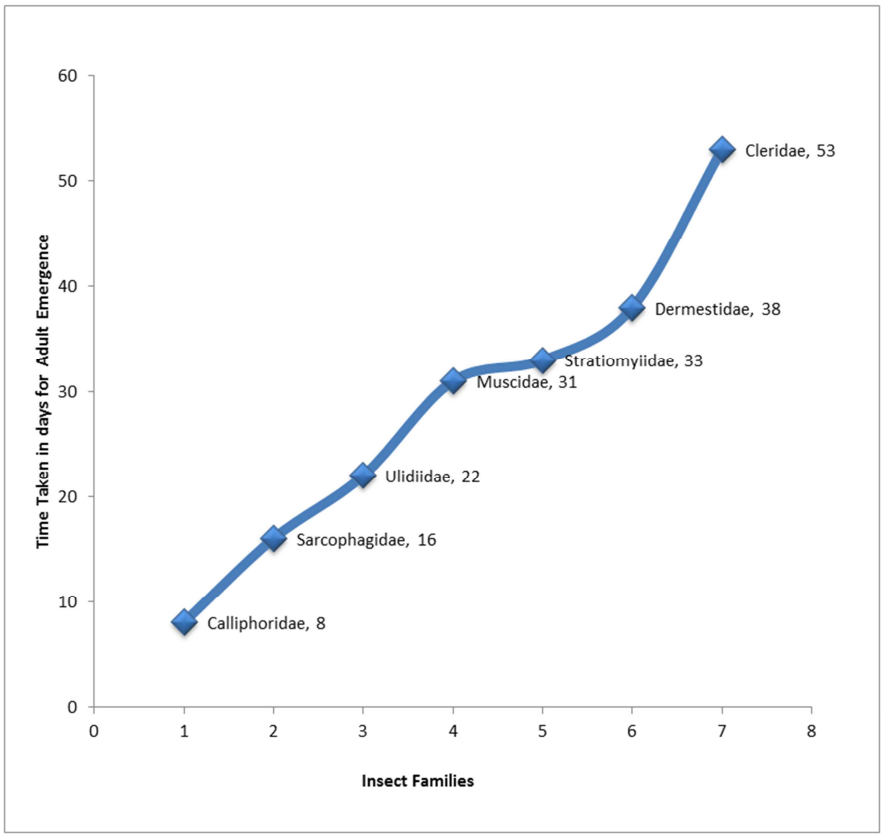


Figure 3. *Time Taken for each insect species to first emerge into adult in the Laboratory (Source: Abajue, 2012).*

Table 1. *Checklist of Insects Collected from the Pig Carrions from Jan to May, 2012 in the fallow plot in Okija, Anambra State, Nigeria.*

Insect Order	Family	Species
		Chrysomya albiceps (Wied.),
		Chrysomya regalis (Rob-Desv.)
Diptera	Calliphoridae	*Chrysomya chloropyga* (Wied.)
		Isomyia dubiosa (Villen.)
		Isomyia sp.
Sarcophagidae		*Sarcophaga inzi* (Curran)
Ulidiidae		*Chrysomyza africana* (Hendel)
Tephritidae		*Trirhithum* sp.
Stratiomyiidae		*Hermetia illucens* (Linn.)
Muscidae		*Musca domestica* (Linn.)
	Chrysomelidae	*Buphonella* sp.
	Dermestidae	*Dermestes frischii (*Kug.)
	Staphylinidae	*Ocypus raffrayi* (Fauvel)
	Cleridae	*Necrobia rufipes (*Deg.)
Coleoptera		*Necrobiaruficolis (*Fab.)
	Carabidae	*Angionychus lividus* (Klug.) (Klug). *Zophosis* sp.
		Gymnopleurus sp.
	Scarabaeidae	*Hypocacculus* sp.
	Histeridae	*Hister*sp.
	Formicidae	*Pheidole* sp.
		Oecophylla longinoda (Latr.)
Hymenoptera		*Camponotus perrisi* (For.)
		Paratrechina sp.
	Tiphiidae	*Tiphia* sp.
	Coreidae	*Hydara tenuicorris* (Westwood)
Hemiptera	Plastaspidae	*Ceratocoris bucephalus* (White)
	Alydidae	*Riptortus dentipes* (Fab.)
Orthoptera	Gryllidae	*Gryllusbi maculates* (Deg.)
	Prygomorphidae	*Poekiloerushiere glyphicus* (Kug.)
Dictyoptera	Mantidae	*Spodromantis* sp.

(Source: Abajue, 2012)

The time taken for each species to emerge into adults under laboratory condition was recorded when the first insect species emerged while subsequent emergents of the same species were noted (fig. 3) while table 1 shows the checklist of the insects associated with the decomposing pig carrions in Okija, Anambra State, Nigeria.

4. Discussion

Dead animals including humans begin to deteriorate minutes after death. This results from the physiological changes which have stopped abruptly, leading to putrefaction of tissues. This physically unnoticed deterioration attracts insects that first perceive the changes (Abajue *et al*., 2013).

The arrival of the insects is known to occur in a predictable succession according to the decomposition stages of the carrions.

The decomposition stages of the pig carrions passed through four distinctive stages; fresh, bloated, active decay and dry decay. Each of this stage presents unique life cycle of insect species.

During the fresh stage, postmortem interval (PMI) of the carrions can be estimated by complete absence of eggs of blowflies and first instars of flesh flies respectively, if the carcasses are exposed. This observation is obvious, even when there is presence of the adult flies.

During the bloating stage, PMI of the carrions can be estimated using the eggs of blowflies and the first instars of flesh flies respectively on the orifices of the carrions. Few spots of adult houseflies hide and bone beetles in addition to the preponderance of blowflies and conspicuous number of flesh flies was also found during the peak of the bloating stage.

During the decaying stage, PMI of the carrions can be estimated using the post feeding larval and pupal stage of blowflies, spots of adult blowflies, flesh flies, house flies and conspicuous number of hide and bone beetles.

During the drying stage, PMI of the carrions can be estimated using the few post feeding larval and pupal stages of blowflies. Other larval and pupal stages, useful at this stage include the false fruit flies, solider flies, house flies, hide and bone beetles. However, the presence of these adult insect groups may not be useful in estimating the PMI of the carrions at this stage, probably because of the mixture of the newly emerged adults and few colonized adults still found on the carrions.

The insects collected in this study play vital roles in the ecology of carrions. They utilize the carrions as food source as well as substrates to propagate at least one generation of their progeny (Abajue *et al*., 2014). The understanding of these insects in relation to carrions decomposition makes them reliable tools in forensic entomology for estimating the minimum postmortem interval (PMI) of corpses which can be applied in forensic science. Hence, the findings of the study, is in line with the reports of other forensic researchers in Nigeria (Ekanem, 2008; Okiwelu *et al.*, 2008; Ekanem and Dike, 2010; Ekrakene and Iloba, 2011; Abajue *et al.*, 2013; Abajue *et al.*, 2014) and comparable with the reports of other researchers in other countries (Catts and Goff, 1992; Lord *et al.*, 1993 and Gill, 2005) as the insect genera are surrogates of their reported insects.

Hence, the insects have been established as insects of forensic importance for various reasons. Their arrival to carrions are predictable, complete at least one generation of their progeny on the carrions, which are valuable tools in estimating (mPMI) of the carrions and may sequester drugs while feeding on the carrions which can aid toxicological assessment of the carcass when the soft tissues, urine and blood have dried out.

5. Conclusion

The carrion feeding insects (flies and beetles) provide important ecological services on dead animals. In case of suspicious death, forensic entomologist can use insect evidence to help forensic investigators determine what had happened to the victim and use documented information about the life cycles and guild structures and community dynamics of these insects to determine facts like the time of death. Hence, the insects can be useful in criminal investigation relating to homicides and questionable deaths in the court of law.

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