ARTHROPOD FAUNA ASSOCIATED WITH DECOMPOSING GUINEA PIG (*CAVIA PORCELLUS*) CARRION AT THE COLLEGE OF EDUCATION WARRI, WARRI SOUTH LOCAL GOVERNMENT AREA, DELTA STATE, NIGERIA

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Accepted 21st May, 2020

A wet season survey of the arthropods collected on the decomposing Guinea pig carrions at the College of Education, Warri was carried out to create baseline arthropods information on the Guinea pigs' carrions. Six Guinea pigs (*Cavia porcellus*) were killed through cervical dislocation and monitored for 40 days, from April 2nd to May 11th 2019 with daily observation and collection of invading arthropods. Insects were collected with sweep nets, brushes, handpicking and pitfall traps, while the soil under the carrions were scanned for hidden insects' stages. The result obtained revealed five identifiable stages of decay: fresh, bloated, active decay, advance decay and dry decay respectively. Despite the fact that there was just a single decomposition process, 288 arthropods were recorded during the study; 168, Dipterans; 57, Hymenoptera; 60, Coleoptera and 3 belonged to orders. Thirty of these arthropods were recorded at fresh stage; 63, bloat; 67, active decay; and 76, advanced decay stage. Only 51 were recorded at the dry decay stage, belonging to nine families. Most of the arthropod groups from the orders of Diptera and Coleoptera were forensically significant. The fact that they used the decaying guinea pig carrions for either breeding and/or oviposition resulted in producing their young ones. This could be used in the predicting, estimating and calculation of the time of death (post mortem interval) of the organism Hymenoptera, especially the family of Formicidae may be of great forensic importance as their activities caused tear and wear; thus creating artificial openings on the carrions as observed during the study. This could be a source of great errors in the estimation of the Post mortem interval, while Lepidoptera and some other Hymenoptera were just incidental and used the carrion as safe resting venue. However, this suggests that more researches should be carried out at the College of Education and its environments during different seasons, using different animal models to create comprehensive insects of forensic important database at the oil rich city.

Key word: Forensic entomology, Carrions, decomposition, arthropods, species post-mortem interval.

INTRODUCTION

The period of courts' investigation subsequent to the finding of corpses and the determination of the time of demise is a very imperative subject for legal authorities (Catts and Goff, 1992). Such an approximation is more complex to ascertain when the carrion has reached the later stage of advanced decomposition. In this case, the entomological evidence can be one of the few sources of firmness. The systematic discipline forensic entomology is the use of the information obtained from the study of insect in criminal investigation. These insects have been around for more than four million years and it could be argued that they are the most flourishing and continuing life form that has ever arisen on planet earth. Diverse as well as abundant, insects comprise approximately half of the earth's one and half million known species (McGavin, 2007). There are many more species than those to which Taxonomists have given names and the past estimates have been as high as one hundred million. The majority view nowadays is that human beings share the planet

with between five and fifteen million species; of which insects has a sizeable proportion (McGavin, 2007).

For centuries, until in the recent times, in the developed world, worm-maggots either dead or crawling on the original orifices and wounds or dead bodies were considered a disgusting part of the decay as soon as corpses were placed on the table for autopsy. These maggots were washed most time without any form of relevant information deduced from them. The firearms examination ballistic, bite-marks, gun powder residue chemistry, blood splatter analysis and other elements of criminology were studied and refined; insects associated with the death scene were largely ignored (Catts et al., 1990).

It is not a new discipline as it was first recorded in China during the 13th century. It was until 1960s' that the discipline stated having recognition. Forensic entomology has been divided into three principle areas depending on those important issues most often litigated (Lord and Stevenson, 1986). The urban forensic entomology is concerned mainly with the controversies involving termites, cockroaches and other insects' related challenges emanating from human environment. Urban forensic entomology is somewhat a misnomer, in that private or public nuisance actions involving pest insects such as flies coming from livestock, or similar establishments are classified under this heading, urban forensic entomology. There are presently much litigation connected with insects' nuisance in reference to agricultural issues especially the cattle feedlots, poultry houses and corporate hog facilities. These several law suits that are concerned with termites' damages, termites' examinations, and the influence of termites and other related arthropods or structural pests in the value of the real estates are concerned with the urban forensic entomology. As a matter of fact, other several litigation suits under this urban forensic entomology rubric are not as easily foreseen. Uninformed patients in the hospitals and nursing homes occasionally suffer myiasis and this usually results in actions claiming neglect. Negligence legal actions levied against mortuaries could equally arise from the invasion of the human cadaver by the dipteran larvae (Bryd and Castner 2001). The area of the stored product entomology is concerned with disputes over arthropods and other arthropods body parts, frass and exuviae in food and other products; arthropods debris in breakfast cereal such as lepidopterous.

Larvae known as caterpillar in cans of vegetables and flies maggots in sandwiches from fast food restaurants are good examples of commonly litigated cases in the stored product. Sometimes, a consumer could attempt to defraud a restaurant or other companies of the same related services by putting insects or insects' parts in the food he bought. The judgment of this type of situations calls for the services of a forensic entomologist (Byrd and Castner 2001). This area of forensic entomology is concerned with all of those ingredients that are important to make up important legal matter. It involves important issues relating to human deaths of all ramifications, the system of human carrion decomposition stages and its related troubles. Also, the investigative duties that are important in bringing the criminals to courtroom for more investigation, the whole criminal justice processes with its legal related concepts, the unseals in homicides cases and the whole legal system involving human death or any related violence death or its attempts. The usage of impartial life science knowledge and it's never amazing now that medico legal forensic entomology has been accepted by different kinds of human beings. These are people like criminalists and detectives, prosecuting and defence counsels, judges and law enforcement agents, medical professionals, academic professionals, and the future forensic experts; the students in our institutions of learning such as in the universities, colleges and research institutes. This concept has also been applied to settle confusing issues about the death of animals other than human beings, such as in live stocks or protected species (Anderson, 1999). Medico legal forensic entomology equally may include deliberate homicide or assault, using insects cases of confusing and unexplained sudden deaths such as anaphylaxis from bee stings or causation of road related accidents such as the inattention to drive during frantic trials to escape a hymenopterous wasp inside a car or lorry, the typical issue confronting the medico legal

forensic entomologist includes the calculation or estimation of the particular time that the diseased died, this is referred to as the Post mortem interval (PMI) and sometimes, the place and cause of death (Hall, 1990; Abajue et al., 2017).

For the application of the concept of forensic entomology in the criminal and civil matters investigation in Warri and its environs, there is need for the creation of database for insects of forensic importance. This study will create a credible database on insects of forensic importance in Warri that will be available for law enforcement agents, other scholars, Judges and Lawyers for their further researches and investigation.

Information regarding forensic entomology in Nigeria is very scanty (Usua, 2007; Abajue et al., 2013; Ewuim and Abajue, 2016), though few researchers have carried out studies in this field of forensic entomology in Nigeria, information related to forensic entomology is very few and the practical application of forensic entomology in our legal processes are not realistic till now. Some of the few authors that have carried out studies associated with insects and their related arthropods on the decomposing carrions in Nigeria include Ekanem and Usua (2005), Ekanem (2008), Okiwelu et al. (2014), Ekanem and Dike (2010), Iloba and Odigie (2006), Iloba and Fawole (2006), Abajue et al. (2013, 2016, 2017), Arimoro (2013), Ekrakene and Iloba (2011; 2017), Ewuim and Abajue (2016), Odo (2016), Ekrakene and Odo (2017a), Odo et al. (2017), among others.

While many insects play significant roles in the processes of decomposition, Coleopterans and Dipterans are one of the insect Orders that are always associated with a decomposing body. The larvae of these insects are capable of secreting ammonia and digestive enzymes while feeding, dissolving soft tissues and exposing the muscles fibres for consumption; contributing organic liquids for other organisms (Braack, 1987). These insects arrive at the remains in a predictable successive pattern, as the remains progress through the decomposition stages, a corpse changes physically, chemically and biologically with each stage becoming attractive to a different group of insects (Okiwelu et al., 2013; Abajue et al., 2013; Ekrakene and Iloba, 2011; Ewuim et al., 2016).

Urbanisation affects the local climatic condition; more precipitation, lower wind speed and higher ambient temperature characterise urban area, the increase in temperature of an urban area is due to human activities and the radiation of natural surfaces is noticeable in densely populated areas and this is known as ‘’head island effect’’ (Hwang and Turner, 2009). Carrion flies partition resources in time and space; although some species are ubiquitous, certain species are narrowly indigenous. Different species of insects are found in different habitats with some in urban or rural areas, while others are in both areas (Anderson, 1995; Haskell et al., 1997; Grassberger andFran 2004; Horensten et al., 2007).

The aim of the study

The main aim of this study is to document arthropods of forensic importance in the College of Education, Warri, Delta State, Nigeria. Therefore, the objectives of the study are the determination of the arrival as well as the departure time of these arthropods’ groups and the determination of the periods of each stage of decomposition of the carrions

MATERIALS AND METHODS

Study area

This study took place in the Biological Science Departmental garden of the College of Education Warri, Delta State, Nigeria.

Location of the study area

Warri has a tropical climate characterised by two distinct seasons; the wet season, which occurs between April and October with a break in August, and the dry season which starts from November and ends in April, with a cold harmattan between December and January. Warri temperature ranges from 32° to 37° at an altitude of 21 m with mean annual rainfall of 2673.8 mm. The natural vegetation is rain forest; the forest is rich in timber trees and other flowering plants (Egborge, 1994). The biological Science garden of the College of Education, Warri is located at

05°32’34.95"N and 05°44’39.834"E. The site lies east of a botanical farm and southeast by other research crop plants. Grasses, wildflowers, herbs and weeds cover the field. The measurement of this study site approximate 300 × 200 m, this size will be to reduce overlapping olfactory cues between adjacent carrions.

Experimental animals

This study uses Guinea pig to mimic human cadaver.

Experimental set-up for the succession studies

Six Guinea pigs were used in this study, while 3 of them were used for collection of data, 3 were used to make descriptive observations without any possible disturbances due to sampling (Gill, 2005). Each guinea pig was stabbed in the thorax, above the foreleg with a sharp knife to simulate a typical homicide wound, each killing was around 6.00 pm a day before the commencement of this research work and the day of their death was counted as day 0 on each trial. The carrions were placed into heavy trash bags and carried from the killing place to the respective studying sites. The guinea pigs’ carrions were deposited on the ground, guarded against vertebrate scavengers with wire mesh that permits entrance of all the insects and other arthropods and protected the carrions against the other bigger animals. The wire meshes of 160 mm × 100 mm × 30 mm were used to form cages of height and width 30 and 20 cm respectively, the iron cages were removed on each sampling occasions. There were an inter carcass distances of at least 40m to minimise interruption of flies from adjacent carrions (Ekrakene and Iloba, 2011).

Insects sampling methods and data collection in the succession studies

The samples for the entomofauna were collected two times per day at 10 and 14.00 GMT for the initial week, while once daily for the remaining weeks. Insects were collected manually through the use of hand nets, sweep nets for flying insects; these flying insects were collected by making fifteen swings with the sweep net in each sampling occasion, while brushes were used to comb round the animal bodies to collect those insects that were found on the bodies and hand picking were also used manually. Pitfall traps were used for crawling insects, while the soil just under the decomposing carrions were always scanned to collect any stage of insect found hiding around as the age of the pupae was difficult to estimate. Second instars larvae were collected from the decaying carrions and the larvae from each carrion were bred in the transparent plastic containers with depth of 15 cm and width diameter of 11.5 cm at 25°C each (with muslin cloth covering and rubber bands that permitted ventilation and hindered the escape of the insects) containing saw-dust and part of the decaying carrion-remains to feed the immature insects, the second instars larvae were reared till adult stage (Ekrakene and Odo, 2017).

Insects rearing for the succession studies

Insects larvae found on the decomposing guinea pig carrions were collected in batches with the student art brush and blunt forceps, the first batch of the larvae were collected on the days that carrions were in the bloated stage. The second batches of the larvae were collected on the days that the carrions were in the active decay stage of decomposition. The third batch of the larvae were collected on days that the carrions were in the advance decay stages of decomposition, the fourth batch were collected when the carrions were in the dry decay/skeletalisation stage of decomposition. All the daily collection of each batch were at least 30 specimens (Tracqui et al., 2004). They were replicated thrice and reared in the transparent labelled plastic containers to adult stage in a simulated laboratory in their respective study areas.

Part of the decaying carrions were cut and used in the feeding of the larvae in the rearing containers, muslin cloth was as lids of the rearing containers, tightly held with rubber tube. When the adults emerged in the container, each of the containers was carefully introduced into a larger container, one quarter filled with soap solution. The rubber tube of the smaller containers was gently removed while the muslin cloth was still in place. The larger container was covered with another muslin cloth and held with rubber tube. Then the muslin cloth of the rearing container

was carefully removed with forceps. The flies then escaped into the larger container and got drowned in the soap solution. The drowned flies were collected with forceps and preserved in 80% ethanol. The adult beetles that emerged from the rearing containers simply collected with forceps immediately the rearing cloth was removed and preserved in 80% ethanol respectively. These emerged adult beetles and flies were sorted to their taxonomic groups for identification (Abajue et al., 2017)

Insects identification

Existing keys of identification of insects were applied in the identification of the insects that were collected in this research work.

Different Orders, family, species and Genus were identified using Arneth and Jacques (1981) and Byrd and Casttner (2001).

For Diptera: Shaumar and Mohammed (1983), Shaumar et al. (1998); Oldroyd, (1964), Zumpt (1965), Denno and Cothran (1975)

Coleoptera: Shaumar et al. (1990), Dillon and Dillon (1961), Lawrence and Newton (1982) and Almeida and Mise (2009).

For Hymenoptera: Brown (1955), Radchenko (1997), Bolton (1994) and Bolton et al. (2006).

Meteorological data collection

In all the studies, carrion internal temperature, ambient temperature, soil temperature, pig/soil interface temperature and relative humidity were recorded at 1400 h every day throughout the whole study period, with the aid of a mini TFH Global Water Xylem brand Ebro Hygro-thermometer (Model number 1340 – 5097). Internal, ambient, soil and pig/soil inter-phase temperature were recorded on every visit using a calibrated mercury thermometer after 5 min exposure time. Internal temperatures were taken through the anus. Maximum/minimum temperatures relative humidity was also recorded on each visit, using a thermo-hygrometer. Maggot mass temperatures were recorded during the Active and Advanced Decays of decomposition using a mercury thermometer.

Data analysis

Basic data analysis were done using Microsoft excel and the statistical package for social sciences (SPSS), graphs were used to demonstrate the relation between the orders of insects and their numbers collected on the decaying carrion and the stages of decomposition and their respective time taken for each of the period of decomposition.

RESULTS

Arthropods' succession and stages of decomposition of the Guinea pig carrions

Five different stages of decomposition was observed during this research work, the fresh, bloated, active decay, advanced decay and the dry decay stages of decomposition; despite the fact that the whole decomposition course was just an undistorted process. The stages of decomposition were explained below with their respective arthropod community according to the field observation.

The fresh stage of decomposition

This stage of decomposition started immediately the animals were killed (0 h) and stopped at 24hours, it takes only one day and only 2% of the entire period of decomposition. At this fresh stage of decomposition, there was no sign of physiological change in the decaying carrion. Only 30 arthropods species belonging to two Orders were recorded 21 Diptera and 9nine Hymenoptera and four Families of Calliphoridae, Muscidae, Sarcophagidae and Formicidae. The species of Diptera recorded were 5 *Lucilia sericata*, 9 *Chrysomya chloropyga*, *5 Musca domestica*, 2 *Sarcophaga inzi*, and 9 *Atta texane*. The first insect to visit the decaying guinea pig carrion was *L. sericata* at 5.0 ± 0.11, using advanced digital stopwatch for Android after exposition of the carrion. Eggs of the blow flies were seen on the natural orifices of the carrion; while *A. texane* were seen on the body of the carrion crawling.

The bloated stage of decomposition

This stage of decomposition started immediately the first sign of bloating was observed on the decaying carrions. It started on the 24th hour (2nd day) and lasted till the 3rd day, taking only 5% of the entire period of decomposition. At this stage of decomposition, there were few morphological

and biochemical changes on the decaying carrion, the bloating of the body was visible, the fluids have started coming out from the decaying body: 7, *Chrysomya albiceps*; 6, *Phormia regina*; 7, *M. domestica;* 5, *Drosophilis sp*; 4, *Sarcophaga inzi*. On the other hand, *S. haemorrhoidalis* were 6 and *Hermetia illucens* were only 2 but *Necrobia ruficolis* and *Necrobia rufipes* were 6 and 3 respectively. Also, *Atta texane* and *Myremacharis sp* were 7 and 4 respectively (Tables 1 and 2).

Table 1. Entomofauna encountered at the decomposing Guinea pig carrions Fresh stage of decomposition.

Order	Family	Genus/Species	Life stage	Numbers
Diptera	Calliphoridae	*L. sericata*	A	05
,,	,,	*C. chloropyga*	A	09
,,	Muscidae	*M. domestica*	A	05
,,	Sarcophagidae	*S. inzi*	A	02
Hymenopteras	Formicidae	*A. texane*	A	09

(Key: A= Adults, I = Immature).

Table 2. Bloated stage.

Order	Family	Genus/Species	Life stage	Numbers
Diptera	Calliphoridae	*L. sericata*	A, I	06
,,	,,	*C. albicephs*	A, I	07
,,	,,	*P. regina*	A	06
,,	Muscidae	*M. domestica*	A	07
,,	Drosophilidae	*Drosophilia sp*	A	05
,,	Sarcophagidae	*S. inzi*	A, I	04
,,	,,	*S. haemorrhoidalis*	A, I	06
,,	Stratiomyidae	*H. illucens*	A	02
Coleoptera	Cleridae	*N. rufipes*	A	03
,,	,,	*N. ruficolis*	A	06
Hymenoptera	Formicidae	*A. texane*	A	07
,,	,,	*Myremacharis sp*	A	04

(Key: A= Adults, I = Immature).

Active decay stage of decomposition

At this stage of decomposition there was strong odour of putrefaction, while the bloated abdomen deflated, intestines and the remaining tissues inside the abdomen were exuding out of the stomach and the whole carrion was fully wet and watery. Most of the Diptera flies at this stage of decomposition were at their maggot stage as the adults recorded at this stage of decomposition were fewer that the number recorded at the bloated stage. This stage started at about 2pm (Nigerian time) and lasted till the day 4th day, taking only 5% of the entire period of decomposition (Table 3). At this stage of decomposition, 68 arthropods were recorded, while 47 of them were Dipterans, 6were Hymenoptera and only 15 were Coleopterans. Ten families of arthropods were recorded at this stage of decomposition; they were Drosophilidae, Calliphoridae, Sarcophagidae, Muscidae, Stratiomyidae, Cleridae, Dermestidae, Silphidae, Histeridae and Formicidae respectively.

The advanced decay stage of decomposition

The advanced decay stage of decomposition started on the 4th at about 2 pm Nigerian time and lasted till the sixth day, taking only 7% of the entire period of decomposition. At this stage of decomposition, the odour has reduced drastically, while the moisture content of the carrion has also reduced and the activities of the arthropods

Table 3. Active decay stage.

Order	Family	Genus/Species	Life stage	Numbers
Diptera	Drosophilidae	*Drosophilia sp*	A	06
,,	Calliphoridae	*C. albicephs*	A, I	07
,,	,,	*L. sericata*	A, I	05
,,	,,	*P. regina*	A	06
,,	Sarcophagidae	*S. inzi*	A, I	07
,,	,,	*S. haemorrhoidalis*	A, I	06
,,	Muscidae	*M. domestica*	A	07
,,	Stratiomyidae	*H. illucens*	A	02
Coleoptera	Cleridae	*N. rufipes*	A	04
,,	,,	*N. ruficolis*	A	02
,,	Dermestidae	*D. maculatus*	A	02
,,	Silphilidae	*N. investigator*	A	04
,,	Histeridae	*H. monitor*	A	03
Hymenoptera	Formicidae	*M. minimum*	A	06

(Key: A= Adults, I = Immature).

reduced. Adults emerging from their pupa on the decaying carrions were recorded, more Coleoptera were seen at this stage of decomposition despite the fact that the bodies were not dried; they were no longer fresh, odorous nor watery.

At the dry decay stage of decomposition

At this stage of decomposition, this flesh and fluid were absent, the furs, bones and dry skin were left. The stage started on the 7th and lasted till the 40th day (Tables 4 and 5).

The insects' activities had reduced, especially

Table 4. Advance decay stage.

Order	Family	Genus/Species	Life stage	Numbers
Diptera	Sarcophagidae	*S. inzi*	A	03
,,	Calliphoridae	*L. sericata*	A, I	05
,,	,,	*C. megacephala*	A, I	06
,,	,,	*C. albicephs*	A, I	07
,,	Muscidae	*M. domestica*	A, I	06
,,	Drosophilidae	*Drosophilia sp*	A	08
,,	Stratiomyidae	*H. illucens*	A, I	10
Coleoptera	Cleridae	*N. ruficolis*	A	04
,,	,,	*N. rufipes*	A	06
,,	Dermestidae	*D. maculatus*	A	04
,,	,,	*D. ater*	A	03
Hymenoptera	Formicidae	*M. minimum*	A	07
,,	,,	*C. pennsylvanicus*	A	04
Lepidoptera		*Obania subvariegata*	A	03

(Key: A= Adults, I = Immature).

the Diptera that their frequencies had geometrically; while the Coleoptera and Hymenoptera numbers were still moderate and the odour was no more. There were pupa cases on and under the carrion; indicating the adults have emerged. While 51 arthropods were recorded 12 were of the Order Diptera, 20 were of Hymenoptera and 19 were Coleoptera.

The numbers of arthropods recorded at the decomposing Guinea pig carrions

There were 288 arthropods recorded on the decaying guinea pig carrions, while 168 of them were Dipterans, 57 were Hymenoptera and 60

Table 5. Dry decay stage.

Order	Family	Genus/Species	Life stage	Numbers
Diptera	Muscidae	*M. domestica*	A	02
,,	Calliphoridae	*C. albicephs*	A	04
,,	,,	*L. sericata*	A	04
,,	Sarcophagidae	*S. inzi*	A	02
Coleoptera	Histeridae	*H. monitor*	A	05
,,	Dermestidae	*D. maculatus*	A	02
,,	,,	*D. atar*	A	03
,,	Cleridae	*N. ruficolis*	A	02
,,	,,	*N.rufipes*	A	07
Hymenoptera	Formicidae	*M. minimum*	A	12
,,	,,	*Forelium pruino*	A	06
,,	,,	*W. arupunctata*	A	02

(Key: A= Adults, I = Immature).

were Coleoptera but only 3 of them belong to the other orders. Thirty of these arthropods were recorded at the fresh stage of decomposition. At the bloated stage of decomposition, 63 arthropods were observed but at active decay stage, there were 67 of them, while at the advanced decay stage of decomposition, 76 arthropods were recorded. At the dry decay/ skeletal stage of decomposition, 51 arthropods were recorded (Table 6).

Table 6. Number of insects from different order collected during the Guinea pig decomposition.

Stages of decomposition	Diptera	Hymenoptera	Coleoptera	Others	Total
Fresh stage	21	09	00	00	30
Bloated stage	43	11	09	00	63
Active decay	47	06	15	03	68
Advance decay	45	11	17	00	76
Dry decay	12	20	19	00	51
Total	168	57	60	03	288

The period of decomposition of the guinea pig

The fresh stage of decomposition took only 1 day from 0 h to 24 h, taking only 2% of the entire period of decomposition while the bloated stage of decomposition started on the day 2 and elapsed on the day 3 taking only 2 days and 5% of the entire period of decomposition. The active decay stage of decomposition started on day 3 and ended on day 4, taking only 2 days and 5% of the entire period of decomposition; while the advanced decay stage started on day 4 and elapsed on day 6, taking 3 days and 7% of the entire period of decomposition. However, the dry decay stage of decomposition started on day 7 and stopped on day 40, taking 33 days and 81% of the entire period of decomposition respectively (Figure 1).

DISCUSSION

The studying and documentation of forensically important insects' database in different countries, regions, geographical zones and seasons is very important for the application of insects and other related arthropods in the determination of the cause of death, time of death and place of death and in the investigation in criminal matters in our courts. It will be impossible to use the forensically importance insects and other related arthropods in the criminal and civil investigation when their biology and data base are not existing beforehand. Thus, this study will stand as an important ground breaking study in the documentation of entomofauna of forensically importance on the guinea pig carrions in the College of Education and the whole Warri City and its environs, where there is little or no information on the usage of Guinea pig in

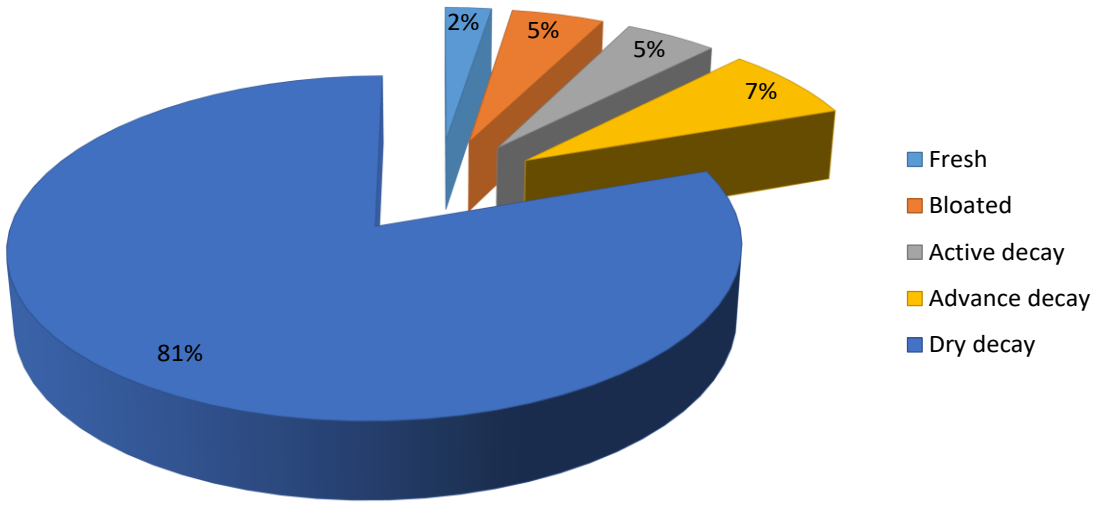

Figure 1. The period of decomposition of the guinea pig carrion at the College of Education. Warri (depending on when the initial sign of each stage of decomposition was noticed on the carrions).

forensic entomological studies and when even studies with other animal models were very scanty.

The most abundant insects Order here was Diptera followed by Coleoptera and Hymenoptera. The pattern of succession recorded in this study was similar to the result of other forensic entomological researchers (Odo et al., 2017; Ekrakene and iloba 2011) reported similar results with this study. The first set of insects that invaded the decaying carrion were the Diptera followed by the Hymenopterans respectively, while the Coleoptra and few others were found at the later days of decomposition respectively. This result was also in line with the work of Nyasha et al. (2014), except that they did not record the Hymenoptera Order right from the fresh stage of decomposition. The presence of Lepidoptera Order could be as a result of the rainy season, which made the environmental condition to be very wet; this was equally reported by Odo et al. (2017) who also carried out research works on insects of forensic importance in the similar environment though indifferent geographical region. Some of these insects were proactive on the carrions and were recorded almost at all decomposition stages; others were passive, hence they were recorded only a few stages such as the Lepidoptera.

The decomposition stages took dissimilar length of time notwithstanding the fact that it was just a continuous process without disconnected stages (Schoely and Reid, 1987). The fresh stage of decomposition took 2% of the entire period of decomposition; the bloated stage took 5% and the active decay stage took only 5% respectively. The advanced decay stage took 7% and the dry decay stage took 81% making the dry decay stage of decomposition the longest despite the fact that it was the most inactive stage; where fewer insects were recorded. Other scholars of carrion ecology have divided the process into four to six stages (Payne, 1965; Okiwelu et al., 2013; Abajue et al., 2016; Ekrakene and iloba 2011).

Insects are the fundamental organisms concerned with decomposing carrion and are assumed as the most significant in recycling these organic tissues back into the ecosystem. Insects in the Diptera Orders such as the Calliphoridae, Sarcophagidae and Muscidae families and Coleoptera such as the families of Dermestidae, Histeridae and Cleridae were the most cardinal and plenteous groups concerned with decomposing guinea pig carrions at the College of Education. Some species in these Orders such as *C. albiceps, L. sericata. S. inzi, M. domestica, D. maculatus. H. monitor, N.rufipes* and *N. ruficolis* were known as necrophagous organisms and were concerned with almost all of carrion breakdown. Predators and parasites of the necrophagous insects such as the *D.ater, E. aestuans, D. maculatus* represent another group of carrion arthropods. These groups did not always occur in succession, but followed the availability of their prey. Other groups found on

decomposing carrion could be adventitious or incidental species such as the Formicidae families. These groups were found on and around the carcass and used it only as an extension of their own natural environment. They were successive in availability, but some played the role of secondary predators of the first two early groups (Catts andGoff 1992; Keh 1985; Abajue et al., 2014,).

Conclusion

Most of the insects' species recorded in this study have been implicated by other researchers in the field of forensic entomology. The result of this study has shown that a comprehensive and proper collection of the insects found on the decaying carrions, whether adults or immature and their products or life stages, is very significant and indispensible for the maximum utilisation of arthropods in forensic entomological studies. This research work has therefore provided important documentation of information as long as the College of Education, Warri, Warri South Local Government Area in Delta State is concerned on the decomposing guinea pig carrion. The result has however created an information bank of forensically important insects connected with guinea pig carrions in the College and its environs.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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