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Research Article

Forensic Evaluation of Abundance and Growth Indices of Carrion Insects from Rabbits Euthanized with Paraquat Dichloride Herbicide

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ABSTRACT
A study was carried out on the forensic entomotoxicological evaluation of carrion insects of rabbits euthanized with Paraquat dichloride herbicide between September and October 2020 at University of Ibadan. The rabbits were euthanized with 200ml of Paraquat while the control group were scarified by cervical dislocation. Adult carrion insects were collected from the carrions using a sweep net and stored in 70% alcohol. Calliphoridae and Muscidae were the initial pioneers of the decomposing carcass and were seen during the fresh stage, while Sarcophagidae arrived shortly after the fresh stage of decomposition. The control group had more abundance and species composition of carrion insects than the Paraquat-poisoned rabbits. The length and weight of the larvae as indices of growth were also observed to be comparatively higher in the control. The highest mean temperature value for the decomposing 20ml Paraquat-treated rabbits was 30.45°C while its lowest mean value was 24.4°C. The highest mean relative humidity value was 96.5% while the least recorded was 67% due to the rainy season. Paraquat was found to retard the growth of carrion larva as shown in *Musca domestica* when compared with the control. It can be deduced from this study that carrion insects are essential in providing the essential ecosystem service of decomposition and can be used in solving suicide puzzles through the extrication of post mortem intervals in conjunction with environmental variables. More studies are therefore needed to test the specific effects of other commonly used suicide poisons on carrion insects in Nigeria.

Keywords: Abundance; Carrion insects; Decomposition; Length; Paraquat; Weight

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INTRODUCTION

In many parts of the world, including developing countries like Nigeria and developed countries like the United States, drug-related mortality have increased over the years (Catts and Goff., 1992). These bodies can go unnoticed for days or weeks after they have died (Campobasso *et al.*, 2001). The bodies are usually in the skeletonized stage of decomposition or any other stage of decomposition when there isn't enough tissue on the body to allow proper post mortem evaluation. However, scientists and law enforcement authorities must study the reason from the incident in some way and the type of poison used so that they can determine whether the death was caused by homicide, suicide, or drug overdose (Catts and Goff, 1992). Traditionally, there are several reports of forensic entomotoxicology programs and experiments. This forensic entomotoxicology principle dates back to the thirteenth century at least. Nevertheless, forensic entomotoxicology has only been routinely investigated in criminal investigations in the last 30 years as a practicable source of evidence.

New research in the related field of entomotoxicology is currently studying the effects of drugs and suicide agents on the development of insects that have fed on the decomposing tissue of the deceased man or animal (Campobasso *et al.*, 2004). The effects of drugs and poisons on insect development are proving to be an important factor when determining the insect colonization time. It has been shown that cocaine use can accelerate the development of maggots (Byrd *et al.*, 2001).

Carrion insects are usually insects associated with decomposing remains (Nuorteva, 1977). Carrion insects perform vital ecosystem functions (Catts and Goff 1992) by promoting the breakdown and recycling of organic matter into the terrestrial ecosystems (Ratcliffe 1996).

Lot of corpses have been found long after the death of the victim and could be surrounded by various suspicious events which could give law enforcement officers a hard time cracking such cases and determining if the death was suicide, murder or natural (Byrd, 2001). However, the knowledge of local carrion insect assemblage and their growth rate including the population dynamics of these carrion insects are the reason for this study as it is a part of forensic entomotoxicology which could help the officers or whoever has the need of this knowledge in solving crime cases since carrion insects can provide information on the indication of time that has elapsed since death over longer time interval (Catts and Goff, 1992; Abajue *et al.*, 2013). This study was carried out to observe the effects of paraquat dichloride herbicide, a commonly used suicide agent in developing countries on the abundance and growth indices of carrion insects from euthanized decomposing rabbits.

MATERIALS AND METHODS

Study Site

The site to be used for the study is located at the back of the Stadium University of Ibadan. The site is suitable because it is at the almost extreme rear of the university and is not frequently visited by people, hence, the smell emanating from the decomposition of the carcass will pose little or no threat to humans. The latitude and longitude of the area as read on a digital compass were 7.434022 N, 3.890303 E respectively. The location of the area when imputed into internet maps showed Oyo, Akinyele, Ibadan and The Polytechnic Main Road, Nigeria because the Polytechnic Ibadan shares boundary with University of Ibadan around Awolowo Hall Stadium road.

Sample collection and processing

The rabbits used for the experiment were acquired from The Teaching and Research farm located in the University of Ibadan, Oyo State. The experiment is not a sex - specific experiment as the Paraquat poison will affect both male and female rabbits in the same way and the patterns of decomposition among male and female rabbits are likewise (Wahizatul and Lim, 2013). Both male and female rabbits were acquired for the experiment in no specific order and the rabbits acquired were inspected for injuries or disease to ensure they were apparently healthy.

Preparation of rabbits for Set-up

The rabbits were transported from the Teaching and Research farm to the study site. In the process of transporting the rabbits, a moderate spacious vehicle was used and the rabbits were placed in boxes so that they would be able to move freely and the stress on each rabbit would be reduced to the barest minimum. The windows of the vehicle were also opened to enhance cross ventilation. The rabbits were given 0.8ml of Dexmedetomidine intramuscularly to anaesthetize them. Following anaesthesia, a feeding tube was passed through the oesophagus into the stomach of the rabbits to be poisoned with paraquat after which 20ml of the poison was administered orally. These were done to ensure little or no pain during the administration to make the process as humane as possible. The control rabbit was just anaesthetized after which they were scarified by cervical dislocation (Byrd, 2001).

Mounting the rabbits

After death, the rabbits were placed on separate mounts. The mounts consisted of a board covered with sawdust and placed on a stool whose legs were dipped in a container half filled with spent engine oil. The sawdust is important because it mimics sand and it provides shelter for the developing larvae and pupae of the carrion insects. The stool is important as it provides a platform in which other animals that are not of entomotoxicological importance are not able to visit the carcass. Lastly, the container with the spent engine oil placed on each leg of the stool is able to trap other arthropods that are not of entomotoxicological importance that might also visit the carcass. 'Experiment in progress, please do not touch' signs were also placed on each carcass mount to better inform people who might encounter the field set-up (Byrd, 2001).

Sampling of carrion insect stages

Decomposition sampling is divided into three phases

I. Sampling for insects
II. Sampling for maggot/larvae
III. Sampling for pupa

Sampling for insects

Sampling for adult insect was done by using a sweep net and insecticide. The sweep net was swept clockwise and anticlockwise at an angle of almost 180° arc over the decomposing carcass after which the tip was quickly folded by using the second hand so as to prevent the trapped insects from escaping the sweep net. The insecticide was then sprayed over the sweep net to immobilize the insects after which the trapped insects were transferred into appropriately labeled, clean and clear sample bottles. The sampling procedure is

carried out twice a day (in the morning and in the evening) until the skeletonization of the carcass. The adult insects were then preserved and stored in 70% alcohol solution (Wahizatul and Lim, 2013).

Sampling for maggot

Maggot is the larva stage of carrion insects. Sampling for larvae involves using a sampling spoon to collect adequate amount of the maggots from the decomposing carcass into appropriately labeled, clean and clear sample bottles. The maggots were collected from crevices and other areas such as the eye, mouth, stomach and anus of each rabbit. The active maggots were then transferred into a small bowl. Hot water kept in a flask was then poured into the bowl containing the maggots. The hot water kills, renders the maggots inactive and prevent discoloration and shrinkage that will occur if living maggots are placed directly into common preservative solutions such as ethanol and formaldehyde (Wahizatul and Lim, 2013). The water was then sieved from the maggots by using a sieve and the maggots were put into appropriately labelled sample bottles containing 70% alcohol solution using a spatula.

Sampling for pupa

When the maggots on the decomposing carcass start reducing in number, the sawdust was checked for the presence or absence of pupa. If pupa were present, they were retrieved from the sawdust and transferred into a small bowl after which hot water kept in a flask was then poured into the bowl containing the pupa. The water was then sieved from the maggots by using a sieve and the maggots were put into appropriately labeled sample bottles containing 70% alcohol solution.(Wahizatul and Lim, 2013)

Measurement of larval body length and weight

Measurement of larvae body length and weight was carried out at regular intervals of 12hours, amounting to twice in a day. Five larvae were randomly sampled from each carrion group and demobilized in the boiled water according to the method of Adams and Hall (2003). The lengths and weights were measured and mean values recorded for each carrion group at different stages of decomposition. Mean values that were obtained from the lengths and weights were used for statistical analysis. Length of larvae from the second instar stage were obtained by using a pair of divider and read on a transparent meter.

Measurement of carcass temperature and humidity

The temperature of the carcass were read and recorded daily using an infrared thermometer that can accurately measure between -50°C to 330°C. The thermometer was used by pointing the infrared beam towards the rabbit carcass. Readings were then generated and shown on the thermometer screen. The readings were then recorded into the field experiment book. Measurement of relative humidity was done using a digital hygrometer. The hygrometer was placed as close as possible to the carcass, readings are generated on the screen of the hygrometer and the readings were then recorded into the field experiment book (Wahizatul and Lim, 2013).

RESULTS

Abundance and species composition of carrion insects on rabbit carcass

The result of the abundance of forensically important insects collected from rabbit carrion treated with 20ml of Paraquat is shown in Table 1. From the table, Calliphoridae Family was dominant in the fresh stage with 25 representatives, Silphidae, Cleridae, Dermestidae and Formicidae were the least dominant with no representative. During the bloat stage of decomposition, Muscidae dominated this stage also with about 43 individuals, Silphidae, Cleridae, Dermestidae and Formicidae were the least dominant with no representative. In the active stage of decomposition, Calliphoridae was observed to be the most dominant with about 58 individuals; Silphidae, Cleridae and Formicidae were the least dominant with no representative. In the advanced stage of decomposition, there was a drastic reduction in the occurrence and abundance of carrion insect that visited the decomposition set-up, Sarcophagidae was the most abundant, while Formicidae was the least abundant with no representative. At the dry stage of decomposition, Silphidae, Cleridae, Dermestidae were the most abundant, Muscidae and Calliphoridae were briefly seen to visit the rabbit carrion and Sarcophagidae was not seen at all.

Table 2 shows the abundance of forensically important insect collected from rabbit carrion in the control group. It can be seen that the species diversity in the control is more than that of the 200ml paraquat-poisoned rabbits. The Calliphoridae family was dominant in the fresh stage with 58 representatives, Sarcophagidae, Silphidae, Cleridae, Dermestidae and Formicidae were the least dominant with no representative. During the bloat stage of decomposition, Calliphoridae dominated with about 61 individuals, Silphidae, Cleridae, Dermestidae and Formicidae were the least dominant with no representative. In the active stage, Calliphoridae dominated with about 196 individuals, Silphidae, Cleridae and Formicidae were the least dominant with no

representative. In the advanced stage, Muscidae dominated with about 71 individuals, Cleridae was the least dominant with 3 individuals. In the dry stage, Family Calliphoridae dominated with about 20 individuals, Sacrophagidae was the least dominant with 3 individuals. In all the abundance of carrion insects in the control group was far more than that of the Paraquat group.

Table 1: Abundance of forensically important insects collected from rabbit carrion treated with 20ml of Paraquat

Family	Genus/species	Fresh	Bloat	Active	Advance	Dry
Calliphoridae	*Chrysomya albiceps*	18	7	36	5	1
	Chrysomya regalis	4	3	12	2	0
	Lucilia sericata	3	5	10	4	0
Sacrophagidae	*Sarcophaga spp*	1	3	24	26	0
Muscidae	*Musca domestica*	3	43	51	7	1
Silphidae	*Nicrophorus spp*	0	0	0	2	5
Cleridae	*Necrobia rufipes*	0	0	0	2	5
Dermestidae	*Dermestes masculatus*	0	0	2	3	5
Formicidae	*Pheidole spp*	0	0	0	0	4
	Total	29	61	133	51	21

Table 2: Abundance of forensically important insects collected from rabbit carrion from control rabbit (0ml Paraquat)

Family	Genus/species	Fresh	Bloat	Active	Advance	Dry
Calliphoridae	*Chrysomya albiceps*	10	13	58	11	5
	Chrysomya regalis	9	11	45	8	3
	Phormia regina	9	15	29	6	2
	Lucilia cuprina	18	13	31	8	4
	Lucilia sericata	12	9	33	10	6
Sacrophagidae	*Sarcophaga spp*	0	7	18	22	3
Muscidae	*Musca domestica*	9	16	48	44	12
	Hydrotaea spp	5	11	31	27	7
Silphidae	*Nicrophorus spp*	0	0	0	4	7
Cleridae	*Necrobia rufipes*	0	0	0	3	7
Dermestidae	*Dermestes masculatus*	0	0	3	7	9
Formicidae	*Pheidole spp*	0	0	0	4	7
	Total	69	95	296	155	72

From Table 3 which shows the occurrence matrix of carrion insect stage in 20ml of Paraquat treated rabbits, It can be observed that the adult and egg stages were present in the fresh stage of the calliphoridae and these life forms were also present in large quantities hence the deep shading. During the fresh stage, sacrophaghidae was not observed in the first day, however adult sacrophaghidae was observed at the late fresh stage. Muscidae was seen from the very first day of death although they weren't seen in large quantities. At the bloat stage, eggs and larva of most of the forensically important carrion insect were observed. During the stage of active decomposition, among the Calliphoridae, adult and larva were only seen in the early stages. However this was soon replaced by adult, larva and pupa life forms and finally only larva and pupa stages were observed at the end of the active decomposition stage. During the advanced decomposition stage, only larva and pupa life forms were observed for the Calliphoridae. The occurrence of the larva and pupa stages were not much hence the light shading on the table. Towards the end of the advanced stage, all Calliphoridae life forms disappeared from the decomposition set-up and this persisted till the end of the dry stage when an adult was spotted. The sarcophagidae were not observed in the early fresh stage of the experiment, however adult sarcophaghidae were seen at the late fresh stage. During the early bloat stage, egg and adult sarcophagidae were observed in large quantities on the decomposition set up however,

the egg and adult seen in the early bloat stage were later replaced by larva life forms at the late bloat stage of decomposition. During the active stage of decomposition, the larva life forms observed at the late bloat stage persisted for the early active stage of decomposition, however the larva stages were soon replaced by pupa stages and at the end of the advanced stage, no sarcophagidae life form was observed on the 20ml Paraquat poisoned rabbits. The trend continued throughout the dry stage of decomposition. The muscidae were observed from the fresh stage of decomposition as adult and eggs in early bloat stage, in the active stage, all stages were present but by the dry stage, only an adult was spotted. Silphidae, Cleridae, Dermestidae and Formicidae were all absent during the fresh, bloat stage and active stage except for Dermestidae that was slightly noticed in the active stage. In the advanced stage, the eggs, larvae and pupa of Silphidae, Cleridae and Dermestida were present. In the dry stage, Silphidae, Cleridae, Dermestida and Formicidae adults were observed.

Places with dark shading represent high abundance, while those with light shading represent low abundance.

From Table 4, It can be seen the occurrence matrix of carrion insect in the control group. *Sarcophaga* was not found in the fresh stage, it was found as adult, egg and larva in the bloat stage, adult, larva and pupa were found in the active decay stage, little adult were found in the advanced decay stage and dry decay stage of decomposition. Calliphondae is found in the fresh stage as adult forms Calliphoridae was found as adult, egg and larva in the bloat stage. In the early active stage, Calliphoridae was found as adult and larva, it was later found as larva forms only in the late active stage, and Calliphoridae was observed as adult and pupa in the late advanced stage of decomposition. Calliphoridae was found as few adult forms in the early dry decay stage. Muscidae was found as adult in the fresh stage, Muscidae was also found as adult, egg and larva in the bloat stage. Muscidae was also found as adult, larva and pupa in the active decay stage, in the early advanced decay stage Muscidae was found as larva and pupa form and it was also found as adults in the early dry decay stage. Silphidae, Cleridae, Dermestidae and Formicidae were all absent during the fresh, bloat stage and active stage except for Dermestidae that was slightly noticed in the late active stage. In the advanced stage, the eggs, larvae and pupa of Silphidae, Cleridae, Dermestida and Formicidae were present. In the dry stage, Silphidae, Cleridae, Dermestida and Formicidae adults were observed.

Table 3: Occurrence matrix of carrion insects stage in of Paraquat treated rabbits

Family	Genus/species	Fresh	Bloat	Active	Advance	Dry
	Days Post-mortem	0 1	2 3	4 5 6	7 8 9	101112
Calliphoridae	*Chrysomya albiceps*	AE AE	EL AL	AL ALP LP	LP LP O	A O O
	Chrysomya regalis	O AE	EL AL	AL ALP LP	LP O O	O O O
	Lucilia sericata	O AE	EL AL	AL ALP LP	LP LP O	O O O
Sacrophagidae	*Sarcophaga spp*	O A	EA L	L L P	P P PA	O O O
Muscidae	*Musca domestica*	A AE	AEL A	AL ALP LP	ALP P P	A O O
Silphidae	*Nicrophorus spp*	O O	O O	O O	O EL LP	A A A
Cleridae	*Necrobia rufipes*	O O	O O	O O	O EL LP	A A A
Dermestidae	*Dermestes masculatus*	O O	O O	O AE	LP A A	A A A
Formicidae	*Pheidole spp*	O O	O O	O O	O O	A A A

Key; A= Adults, E=Eggs P=Pupa L=Larva O=absent

Table 4: Occurrence Matrix of Carrion Insects Stages in Control Group

Family	Genus/species	Fresh		Bloat		Active			Advance			Dry		
	Days Post-mortem	0	1	2	3	4	5	6	7	8	9	10	11	12
Calliphoridae	*Chrysomya albiceps*	A	A	EL	AL	AL	L	L	AP	AP	P	A	O	O
	Chrysomya regalis	A	A	AL	AL	AL	L	L	AP	AP	P	A	O	O
	Phormia regina	A	A	AL	AL	AL	L	L	AP	AP	P	A	O	O
	Lucilia cuprina	A	A	AL	AL	AL	L	L	AP	AP	P	A	O	O
	Lucilia sericata	A	A	AL	AL	AL	L	L	AP	AP	P	A	O	O
Sacrophagidae	*Sarcophaga spp*	O	O	AE	AL	A	AL	L	A	AP	P	A	O	O
Muscidae	*Musca domestica*	A	A	AE	AL	AL	ALP	LP	LP	LP	P	A	O	O
	Hydrotaea spp	A	A	AE	AL	AL	ALP	LP	LP	LP	P	A	O	O
Silphidae	*Nicrophorus spp*	O	O	O	O	O	O	O	O	EL	LP	A	A	A
Cleridae	*Necrobia rufipes*	O	O	O	O	O	O	O	O	EL	LP	A	A	A
Dermestidae	*Dermestes masculatus*	O	O	O	O	O	O	AE	LP	A	A	A	A	A
Formicidae	*Pheidole spp*	O	O	O	O	O	O	O	O	EL	LP	A	A	A

Key; A= Adults, E=Eggs P=Pupa L=Larva O=absent

Places with dark shading represent high abundance, while those with light shading represent low abundance

Effects of paraquat on the length and weight of the control and 200ml larva

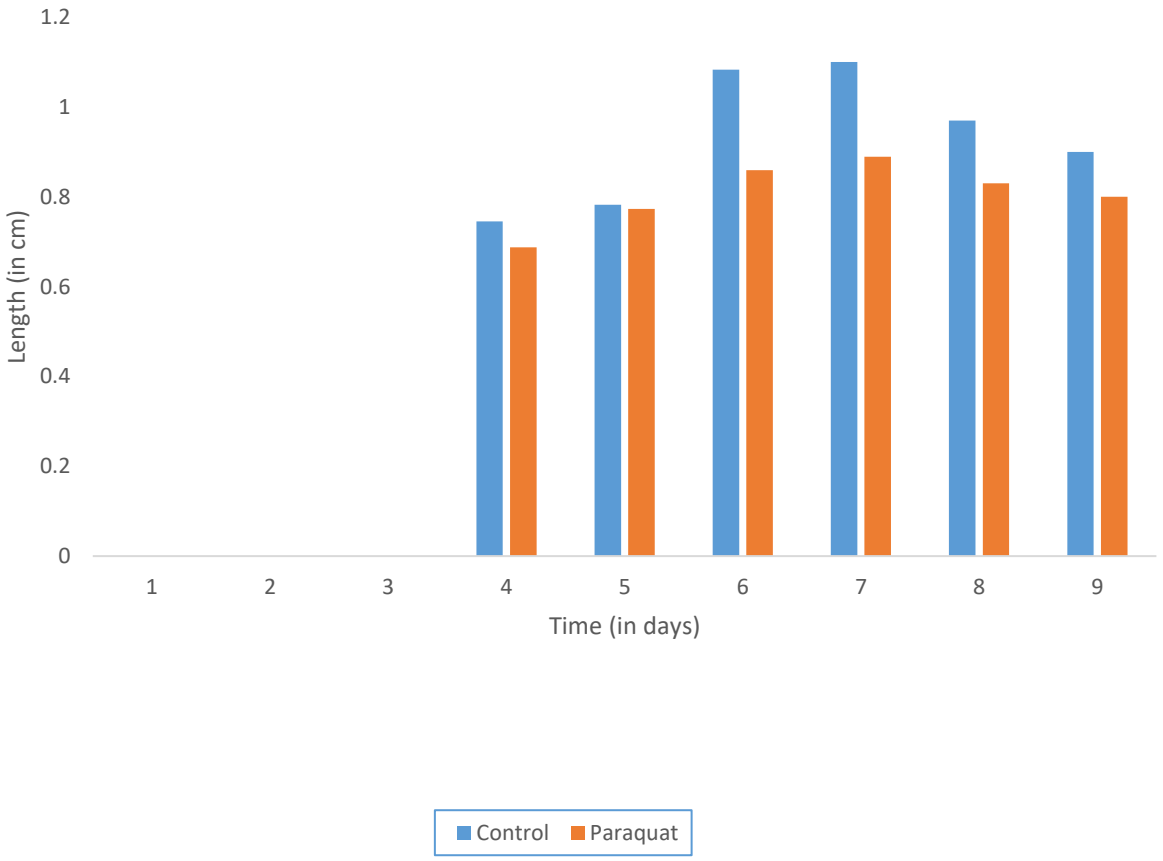

Fig 1: Histogram showing the mean body length of the larva of *Musca domestica* collected from the rabbit carcass

From the histogram in Fig 1, we can observe that the first 3 days after death of the rabbits was required for transformation of *Musca domestica* into the second instar stage. The second instar larva were collected from the decomposing rabbits on the fourth day (during active stage of decay) and the larva found on the Control rabbit were 0.0745 cm longer than the larvas of the 20ml paraquat which were 0.6875 cm in length.

On the fifth day (during active stage decay), the mean length of the control increased to 0.782 cm while that of the rabbits injected with 20ml Paraquat was 0.773. So the control group were 0.009 cm longer. On the sixth day (during active stage of decay), the mean length of the control

increased to 1.083 cm while that of the rabbits injected with 20ml Paraquat was 0.859. So the control group were 0.224 cm longer.On the seventh day (during advance stage of decay), the mean length of the control increased to 1.1 cm while that of the rabbits injected with 20ml Paraquat was 0.889. So the control group were 0.211 cm longer. On the eighth day (during advance stage of decay), the mean length of the control reduced to 0.97cm, while that of the rabbits injected with 20ml Paraquat was 0.83. So the control group were 0.14 cm longer. On the ninth day (during advance stage of decay), the mean length of the control further reduced to 0.90 cm while that of the rabbits injected with 20ml Paraquat also reduced to 0.80. So the control group were 0.1 cm longer.

The histogram in Fig 2 which shows the effect of Paraquat on the weight of larva of the decomposing rabbits is similar to that of fig. 1which shows the effect of Paraquat on the length of the larva of the decomposing rabbits. There were no values for the first three days as larva were still in the first instar stage, hence were too small to be analyzed. The larva weight in the control group was found to be higher than that of the Paraquat-poisoned groups on all days.

From the graph in Fig. 3 it was observed that the mean temperature of the control group ranges from 32.15°C, which was the highest value recorded to 23.5ºC which was the lowest value recorded. The highest mean temperature value for the decomposing rabbits treated with 20ml Paraquat was 30.45°C while its lowest mean value was 24.4°C. It should be noted that in both the control and the 20ml Paraquat injected rabbit, the temperature at the sixth day was higher than the temperature on other days. This might be because the sixth day and some days were part of the days of active decomposition in which insect activity particularly maggot, is high and the high insect activity have been observed to generate heat.

From the graph in Fig. 4, it is observed that the mean daily relative humidity value of the control group ranges from 98.5% which was the highest value recorded, to 67% which was the lowest value recorded. The highest mean relative humidity value for the decomposing 20ml paraquat rabbit was also 96.5%, while its lowest mean value was 67%. It should be noted that in both the control and the 20ml paraquat injected rabbit, the relative humidity value was high and this was because the decomposition experiment was carried out during the rainy season during which high values such as 90% and above were read, furthermore indicating a high probability that rain will fall soon after the readings were taken or that it had just finished falling when the reading was taken.

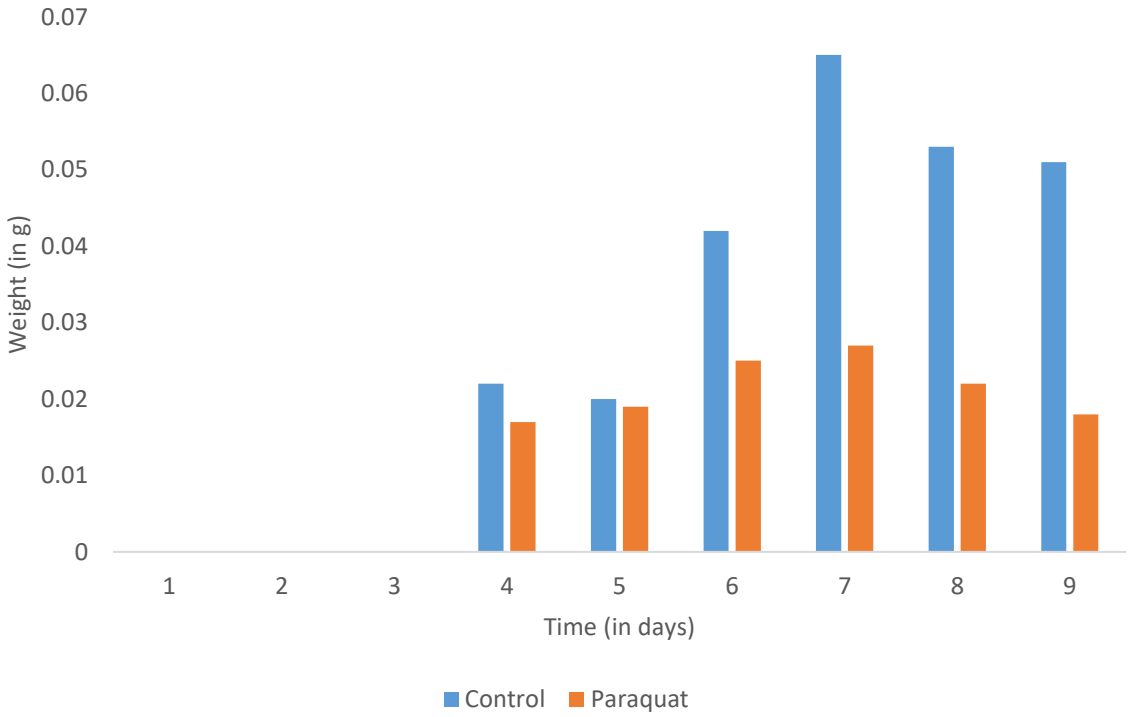

Fig 2: Histogram showing the mean body weight of the larvae of *Musca domestica* collected from the rabbit carcass

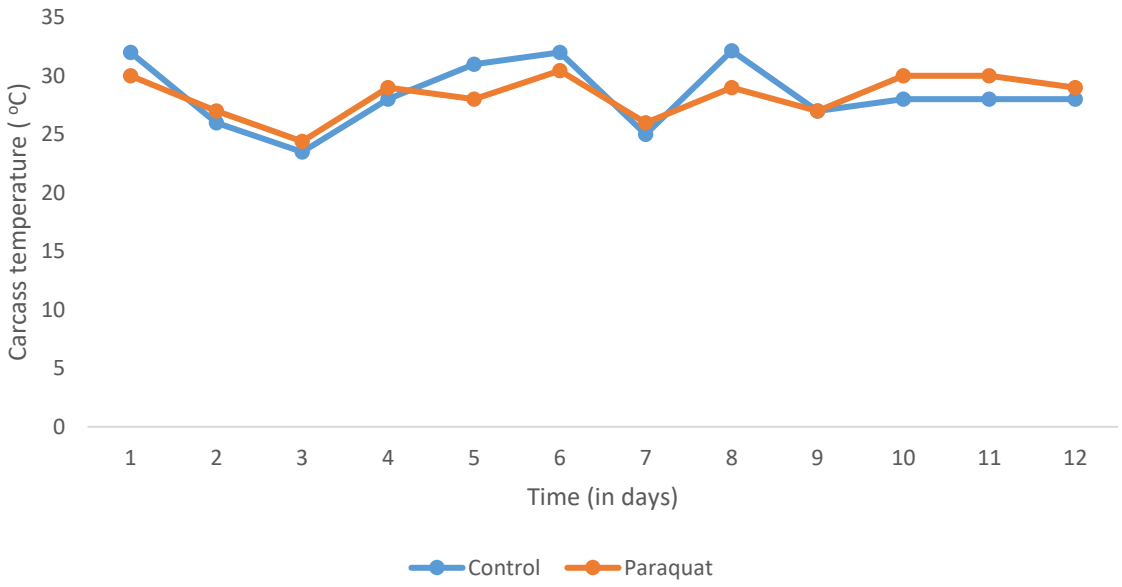

Fig 3: Comparison of Control and 20ml Paraquat-poisoned rabbit carcass temperature recorded

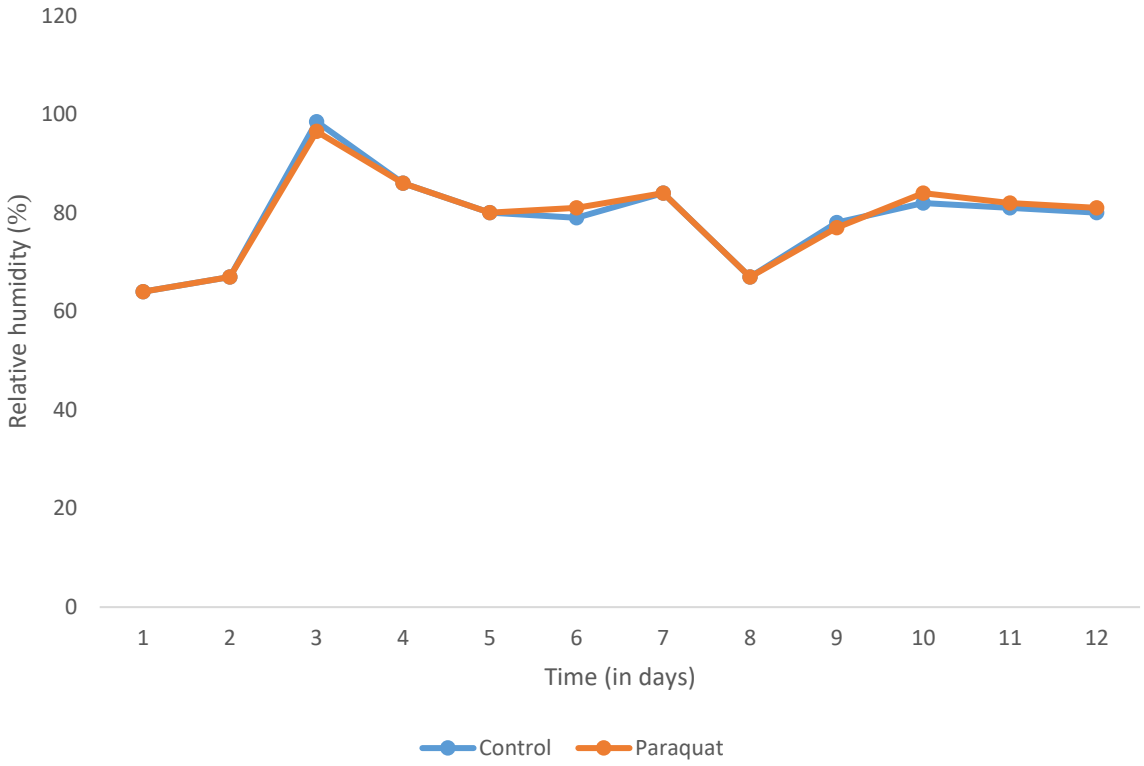

Fig 4: Comparison of Control and 200ml Paraquat-poisoned rabbit carcass relative humidity recorded in the field experiment

DISCUSSION

Abundance and species composition of carrion insects on rabbit carcass

At the end of the experiment, five stages of decomposition were observed and this confirmed earlier findings and experiments such as the one done by Wahizatul and Lim (2013) and Haddadi *et al* (2019) where they observed that the five important stages of decomposition are the fresh stage, bloated stage, active decay stage, advanced decay stage and the dry stage. The 3 major families of carrion insects that were predominant in the study were also reported in Wahizatul and Lim (2013) experiment, although this experiment recorded some families that Wahizatul and Lim (2013) didn't observe such as Silphidae, Cleridae, Dermestidae, Formicidae, that were seen in the

advanced decay and dry stages. This experiment also confirmed that the arthropods that arrived on a carcass from the beginning of the decomposition were the Calliphoridae, Sarcophagidae and Muscidae as it was stated by Wahizatul and Lim (2013) proving that they dominate among other carrion insects. In this particular study, the Calliphoridae dominated the control and 200ml Paraquat group.

Carrion insect succession on rabbit carcass

During the experiment, it was observed the Calliphoridae and Muscidae were the initial pioneers of the decomposing carcass and were seen during the fresh stage, while Sacrophagidae arrived during the late fresh stage of decomposition. Dermestidae was seen later in the late active stage and became very obvious in the advanced stage of decomposition and it was observed till the dry stage. The progression of events we noticed here was similar to those observed by Wahizatul and Lim (2013) that carried out a comparative study of some carrion species diversity on rabbit carrion at two mangrove areas, Mashaly (2016) who was observing the succession pattern on burnt and unburnt rabbit carrion from which he noticed that Calliphoridae, Muscidae and Sacrophagidae came first just as previous researches although he noticed a change in insect succession in the burnt rabbit carrion; and Haddadi *et al* (2019) that carried out his research in three different microhabitat (dry, semi-submerged and submerged) where he noticed that flies were most plenty at the dry area and least at the submerged area. Similar findings on succession has earlier been reported by Ekanem and Dike (2010).

Effects of Paraquat on the length and weight of larva

Mehani (1972) in publication discussed the effects of Paraquat on the stages of development of the larvae found in rabbits and rats in India which is a different ecological zone that is similar to findings in this study. Gunatilake and Goff (1989) were able to detect poisoning by organophosphate in a putrefying body by analyzing arthropod larvae growth. The effects of chemicals are numerous as the case is in Malathion poisoning has been found to delay larva development in contrast with cocaine and heroin in the carcass that can accelerate larval development. In this study, Paraquat was found to retard the growth of *Musca domestica* and when compared with the control this corroborates earlier findings by Ekrakene and Odo (2017) when they assessed effects of varying volumes of cypermethrin pesticide on the larval body length, weight, and developmental time of blowfly *Chrysomya albiceps* (Diptera: Calliphoridae) reared on rabbit carrions.

Variations in environmental variables at the field site

The experiment was conducted in Ibadan, Nigeria that is situated in a part of the world with a tropical climate and considerably high temperature and relative humidity values. Hence, the decomposition rates of the carrion rabbits was fast. The result of the fast decomposition agrees with Haddadi *et al* (2019) where it was established that higher temperature leads to faster decomposition rates and increase in the abundance of insects. The similarities in results could be due to habitat similarities, prevailing environmental conditions at that time they were observed.

CONCLUSION

In the last four decades, numerous research has been conducted on forensic entomotoxicology, and the purpose is to understand the correlation between the concentration of substances from the animal and the carrion Insects found on their carcass. Numerous researchers have experimented using various animals to establish a link between the substrate concentration and the effects on the insect so that toxicological interpretations can be obtained which is proving a bit tasking due to various factors affecting the process. In this experiment, we extensively studied the effects of paraquat poisoning in rabbits as well as the temperature and relative humidity. In addition, It was established that suicidal poisons will affect the diversity, abundance and composition of carrion insects found on decomposing rabbits as models for human cadaver. Furthermore, it was ascertained that an increase in the dosage of the Paraquat poisoning reduces the composition, abundance and diversity of carrion insects on the decomposing rabbit. It is recommended that more forensic entomotoxicological studies be carried out on more chemical suicide agents for ultimate extrapolation to human cases.

Conflict of Interest

The authors declare that there is no conflict of interest.

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