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Effect of Some Household Products (Kerosene, Insecticide and Perfume) on Arthropods Colonization on Rats' Cadavers

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Abstract The most common task of a forensic entomologist is to determine an accurate minimum post-mortem interval (PMI) using necrophagous fly larvae found on carrion. The presence of repellent substances on cadaver is not generally well informed and can be difficult to detect. This study aimed to evaluate the effect of some common household products (kerosene, insecticide, perfume) on arthropods colonization on rats' cadavers including their effect on the type of species, and first insect's arrival time. As well as relation of the stage of decomposition to both the type of species and first insect's arrival time. The experiment was performed during spring season. Twenty healthy rat carrions (200 ± 50 g) were randomly divided into four groups; each group was consisted of five rats. Group (1) served as a control, was kept without any substance poured on it. Group 2, *Kerosene poured rats,* where kerosene was splashed on each rat. Group 3, *Insecticide poured rats,* where flying insects killer was splashed on each rat. Lastly, 4th group, *Perfume poured rats,* where perfume was splashed on each one. The presence of arthropods was checked at regular intervals during the period of experiment. The use of these products didn't only affect the time of first insect's arrival but also type of insects and stage of decomposition. In control group, during the fresh stage of decomposition, the first insects appeared and the most abundant orders were Diptera of families *Sarcophagidae, Calliphoridae and Muscidae,* followed by Coleoptera (*Dermestidae*) during the bloat and wet decomposition stages. All presented species were collected from the control group, while *Musca domestica and Dermestes frischii* didn't appear in any of the poured cadavers (Groups 2, 3, 4) till the end of the experiment. Colonisation delay was for (96.5h ± 0.55) in rats of group (2), (3.5 h ±0.3) in rats of group (3) and (4.5 h ±S.D. 0.4) in rats of group (4). Distinct delay in decomposition stages was observed in kerosene poured rats (Group 2. These results together confirm the repellent effect of some household products on flies and the necessity for forensic entomologists to consider this hypothesis when estimating the PMI.

Keywords Forensic entomology; postmortem interval; flies

Introduction

Forensic or medicolegal entomology is the study of insects associated with a dead body, primarily to estimate minimum elapsed time since death or minimum postmortem interval (PMI) (VanLaerhoven, 2008).

Campobasso et al. (2001) stated that the entomological method statistically more reliable and superior in estimation of postmortem interval when compared to other prevalent procedures such as the medicolegal method based only on the classical postmortem changes in soft tissues (hypostasis, rigor mortis, body cooling, autolysis and decomposition).

Certain species of insects are often the first witnesses to a crime. They usually arrive within 24 hours of death if the season is suitable *i.e.* spring, summer and can arrive within minutes in the presence of blood or other body fluids (Anderson, 1998).

The usual classification of sarcosaprophagous fauna divides them into five distinct ecological groups: necrophagous, necrophilous, omnivorous, opportunists and accidentals. In general, necrophages, necrophils and omnivores are the most important for forensic purpose (Arnaldos et al., 2005).

Necrophages insects are the major vector in the degradation of the cadaver because of their elevated numbers and first colonizers of carrion. The necrophages insect category was made up of Diptera (flies) and Coleoptera (beetles). These two insect orders stand out among the others for their activity and frequency on human remains (Segura et al., 2009).

Insects feed on carrion in a successional manner dependent on the state of decomposition (Wolff et al., 2001). Arthropod succession analysis allows the association of each species or group to a well established decomposition stage [i.e. fresh, bloat, wet decomposition, dry decomposition or skeletal stage] (Campobasso et al., 2001; Abd El-bar and Sawaby, 2011).

The forensic entomologist is responsible for determining the period of insect activity according to all the variables affecting insect invasion of remains and their development. Also, the knowledge of factors inhibiting or favoring colonization and development of Diptera is a necessary pre-requisite for estimating the PMI using entomological data (Campobasso and Introna, 2001).

The attraction of large numbers of adult blowflies occurs as a result of decay, which are mainly due to bacterial action on dead tissues (Varatharajan and Sen, 2000). Their strategy on attraction is based on precise odour mediated location (Gibson and Torr, 1999).The presence of repellent substances on carrion is not generally well informed and can be difficult to detect. These substances could be used by murderers to conceal the smell of a cadaver or to prevent insect colonization. Such products can result both in a delayed colonization and/or the absence of the earliest necrophagous species. Thus, repellents can lead to an under-estimation of PMI by the wrong interpretation of the age or composition of species found on a corpse (Campobasso et al., 2001).

In Egypt, especially Assiut City, studies on carrion arthropods are very few, and the evaluation of entomological evidence in forensic cases is based on studies carried out in other biogeographical areas with different environmental conditions.

The present study, conducted under field conditions, aimed to evaluate the effect of some common household products (kerosene, insecticide and perfume) on necrophagous insects, including their effect on the type of species, and first insect's arrival time. The relation of stage of decomposition to both the type of species and first insect's arrival time is also studied.

Material and methods

Material

1- Kerosene was obtained from local gas distributor.
2- Insecticide (Trade name: New Pyrosol Flying Insects Killer). Contents : New-Pynamin forte 0.2%, Sumethrin 0.075%, Iso-propyl alcohol 0.26%, Perfume 0.52%, Kerosene 41.055%, Propane/Butane 57.89%). Produced by El-Nasr Co. for Intermediate Chemicals. Egypt.
3- Perfume (Trade name: Request. Eau de Cologne). Contents: Ethanol 70%and Essential oil 30%. Produced by Kesma Group. Egypt.

Site description

The study was carried out in Assiut City, Capital of Assiut Governorate, located 375 km South to Cairo. Assiut Governorate is known to present in the Great Desert region. Assiut City, geographical position ranges from longitude 30º 45' to 31º 27' east and from latitude 26 º45' to 27 º45' north. The study was located in Assiut University campus (31º 09' E, 27º 11' N) about 2 km north to city centre. Elevation of the study site was 39 meter above the sea level and 15 meter above the ground level. Coordinates and elevation of the study site were taken on the day of placement with handheld GPS unit (e-trex vista, Garmin corp., Olathe, KS) .The average maximum temperature for spring in Assiut is 31.3 ºC while the average relative humidity is 28% for spring (Moatamed, 2005). Daily weather data (mean of maximum and minimum temperature and relative humidity) were acquired from the Egyptian Meteorological Authority, Assiut station in the University campus.

Experiment

The experimental procedure was carried out according to the National Institute of Health Guidelines for Animal Care followed within the Faculty of Medicine, Assiut University. Experiment was carried out on the roof of the Faculty of Medicine, in an area with an all day length sun exposure and sheltered from wind. The experiment was started at 24th March 2010 and stopped at the end of 30th March. Twenty healthy rat carrions (Rattus norvegicus, 200 ± 50 g) were obtained from animal house of the Faculty of Medicine, and were randomly divided into four groups; each group was consisted of five rats. They were killed by cervical decapitation after ether inhalation anaethesia. As described by Charabidze et al. (2009), each rat was placed in a separate transparent covered plastic box (100cm x 80 cm x 15 cm). Both lateral sides of the box were replaced by plastic nets (1 cm x 1 cm) to allow access of insects. The bottom was covered with sand of 10cm height, in order to absorb putrid liquids. All boxes were separated from each other by a minimum of 20 meters in order to minimize interaction of the

odors. Common household products (kerosene, insecticide and perfume) were chosen regarding the type generally available in a house, taking into consideration the differences between the skin surface areas of rat and human cadavers. The experimental groups were dealt with as mentioned by Charabidze et al. (2009), in the following order: The 1st group of rats (n=5), Group 1, served as a control, and was kept without any substance was poured on it. The 2nd group of rats (n=5), Group 2, *Kerosene poured rats*, where 30 ml kerosene was splashed on each rat. The 3rd group of rats (n=5), Group 3, *Insecticide poured rats*, where 15 ml of flying insects killer was splashed on each rat. The 4th group of rats (n=5), Group 4, *Perfume poured rats*, where 3 ml of perfume extract was splashed on each one.

Observations of the species of insects, the first time of insect's arrival as well as decomposition stages were reported. Observations were reported, after placing the rats on the roof, every 15 min during the first hour; every hour for 8 hours and then daily every hour from 8 am to 5 pm till the end of the experiment. With each observation, any insect present in any box was collected. Flying insects were captured by an aerial net while crawling species were collected with a forceps. All collected insects were killed by ethyl acetate and placed in numbered and dated vials containing 70% alcohol until further identification (Centeno et al., 2002). All Collected flies were identified according to specific keys mentioned in Greenberg (1971); Mosallam (1980); Shaumar et al. (1989); Wells et al. (1999). Genus or species of adult beetles were identified according to Arnett et al. (1980); Yones et al. (2010).

Statistical analysis

The time of arrival was expressed as mean value ± standard deviation (SD). To assess statistical significance, Student's t-test was used to compare data between groups. A measured level of $p < 0.05$ was considered significant.

Results

Regarding the species; five genera of insects representing two orders and four families were found to be coexisted during the experiment. Family Sarcophagidae represented by *Sarcophaga haemorrhoidals* and *Wolhfahrtia sp.*, family Calliphoridae represented by *Chrysomya albiceps*, family Muscidae represented by *Musca domestica* and family Dermestidae represented by adult beetles of *Dermestes frischii* (Figure 1).

Figure (2) demonstrates the arrival time of the first necrophagous insects on all rats' cadavers. For control rats (Group 1), first arthropod appeared within half an hour (± S.D. = 0.10 h). When household products were placed on the rats' cadavers, they induced a significant ($p \leq 0.001$ in groups 2, 3,4) delay in the arrival time of arthropods on carrion i.e. the first insects appeared later compared to the controls. Colonisation delay was for 96.5 h (±S.D. = 0.55 h) in kerosene poured rats (Group 2), 3.5 h (±S.D. = 0.3 h) in insecticide poured rats (Group 3) and 4.5 h (±S.D. = 0.4 h) in perfume poured rats (Group 4).

All presented species were collected from the control group. *Sarcophaga haemorrhoidals* and *Wolhfahrtia sp* were collected from kerosene poured rats (Group 2), *Sarcophaga haemorrhoidal*s, *Chrysomya albiceps* and *Wolhfahrtia sp* were captured from insecticide poured rats (Group 3). While *Sarcophaga haemorrhoidals* and *Chrysomya albiceps* were collected from perfume poured rats (Group 4). *Musca domestica and Dermestes frischii* didn't appear in any of the poured cadavers (Groups 2,3,4) till the end of the experiment (Table 1, Figure 3).

Numbers and time of arrival of each insect species appeared in all groups are suumarized in (Tables 2-5) and (Figures 4-7).

As regarding the decomposition; three observable stages of decomposition were recognized in all rats' cadavers: fresh, bloat, and wet decomposition during the duration of experiment (Table 6). The insects attracted during various stages of decomposition in all experimental cadavers were reported (Table 7). The fresh decomposition stage (1st day), manifested by discoloration of skin and first appearance of *Sarcophaga haemorrhoidals* in control and groups 3,4. While *Chrysomya albiceps* appeared in rats control and group 3, and *Musca domestica* in control rats only. This stage delayed in appearance to 2nd day in kerosene poured rats (Group 2) without appearance of any insect. The bloat decomposition stage (2nd, 3rd days), characterized by body swelling and inflation, which was obvious in group 1 and gradual in groups 3, 4. This stage delayed in group 2 to the 5th day. Continuation of appearance of *Sarcophaga haemorrhoidals* in control rat, appearance of *Wolhfahrtia* in control group and groups 2, 3, *Chrysomya albiceps* appeared in control group and group 3, while *Musca domestica* and *Dermestes frischii* were found in control rats only. The wet decomposition stage (4th to 6th days), liquefaction was observed in rats of control and groups 3,4,with continuation the appearance of *Sarcophaga haemorrhoidals* ,*Musca domestica* and *Dermestes frischii* in control rats only and *Chrysomya albiceps* in rats of groups 3,4.This stage has not been observed in rats of group 2.

Table (1): First arrival time of each insect species in all groups during the experiment in Assiut (Egypt).

	Group (1) Control (n=5)	**Group (2) Rats poured with kerosene (n=5)**		**Group (3) Rats poured with insecticide (n=5)**		**Group (4) Rats poured with perfume (n=5)**	
	Mean± SD	Mean± SD	*P*	Mean± SD	*P*	Mean±SD	*P*
Sarcophaga	0.5±0.1	96.5±0.55	0.001*	3.5±0.30	0.001* 0.001#	4.5±0.40	0.001* 0.001# 0.005@
Chrysomya	3.5±0.45			5.5±0.55	0.001*	99.5±0.55	0.001* 0.001@
Musca domestica	6.4±0.37						
Wolhfahrtia	26.4±0.55	97.5±0.55	0.001*	26.2±0.45	0.546* 0.001#		
Dermestes	27.7±0.38						

**P. Probability of significance has been performed for each group referred to control.*
 # P. Probability of significance has been performed for each group referred to kerosene group.
@P. Probability of significance has been performed for each group referred to insecticide group.

Table (2): Numbers and time of arrival of each insect species appeared in control (Group 1).

Group (1)	**First day**		**Second day**		**Third day**		**Fourth day**		**Fifth day**		**Six day**	
	n	Mean± SD	n	Mean± SD	n	Mean± SD	n	Mean± SD	n	Mean± SD	n	Mean± SD
Sarcophaga	6	0.5±0.2	8	26.5±0.5	0	0	13	75.5±0.55	0	0	5	124±0.45
Chrysomya	13	3.5±0.42	34	26±0.3	10	54.5±0.55	0	0	0	0	0	0
Musca domestica	10	6.5±0.35	0	0	23	54.5±0.55	5	76.5±0.55	6	99.5+±0.55	6	123±0.45
Wolhfahrtia	0	0	5	26.5±0.55	0	0	0	0	0	0	0	0
Dermestes	0	0	5	28±0.27	0	0	5	78.5±0.55	0	0	0	0

n= Total numbers; Mean= mean of time of arrival.

Table (3): Numbers and time of arrival of each insect species appeared in kerosene poured rats (Group 2).

Group (2)	**First day**		**Second day**		**Third day**		**Fourth day**		**Fifth day**		**Six day**	
	n	Mean± SD	n	Mean± SD	n	Mean± SD	n	Mean± SD	n	Mean± SD	n	Mean± SD
Sarcophaga	0	0	0	0	0	0	0	0	6	96.5±0.55	0	0
Chrysomya	0	0	0	0	0	0	0	0	0		0	0
Musca domestica	0	0	0	0	0	0	0	0	0		0	0
Wolhfahrtia	0	0	0	0	0	0	0	0	6	97.5±0.55	0	0
Dermestes	0	0	0	0	0	0	0	0	0		0	0

n= Total numbers; Mean= mean of time of arrival.

Table (4): Numbers and time of arrival of each insect species appeared in insecticide poured rats (Group 3).

Group (3)	**First day**		**Second day**		**Third day**		**Fourth day**		**Fifth day**		**Six day**	
	n	Mean± SD	n	Mean± SD	n	Mean± SD	n	Mean± SD	n	Mean± SD	n	Mean± SD
Sarcophaga	10	3.5±0.3	0	0	0	0	0	0	0	0	0	0
Chrysomya	23	5.5±0.55	5	24.5±0.55	0	0	0	0	5	99.5±0.55	0	0
Musca domestica	0	0	0	0	0	0	0	0	0	0	0	0
Wolhfahrtia	0	0	8	26±0.45	0	0	0	0	0	0	0	0
Dermestes	0	0	0		0	0	0	0	0	0	0	0

n= Total numbers; Mean= mean of time of arrival.

Table (5): Numbers and time of arrival of each insect species appeared in perfumed poured rats (Group 4).

Group (4)	**First day**		**Second day**		**Third day**		**Fourth day**		**Fifth day**		**Six day**	
	n	Mean± SD	n	Mean± SD	n	Mean± SD	n	Mean± SD	n	Mean± SD	n	Mean± SD
Sarcophaga	6	4.5±0.40	6	26.5±0.5	0	0	0	0	0	0	0	0
Chrysomya	0	0	0	0	0	0	0	0	5	99.5±0.55	0	0
Musca domestica	0	0	0	0	0	0	0	0	0	0	0	0
Wolhfahrtia	0	0	0	0	0	0	0	0	0	0	0	0
Dermestes	0	0	0	0	0	0	0	0	0	0	0	0

n= Total numbers; Mean= mean of time of arrival.

Table (6): Decomposition (stages and duration) during the experiment.

Stage of decomposition (days post death)	**Group (1)** Control	**Group (2)** Rats poured with kerosene	**Group (3)** Rats poured with insecticide	**Group (4)** Rats poured with perfume
Fresh (0–1) Discoloration of skin		Late to 2nd day		
Bloat (>1–3) Body swelling and inflation	More obvious body swelling and inflation	Late manifested till the 5th day	Gradual inflation then deflation	Gradual inflation then deflation
Wet decomposition (>4-6)	Fluid leakage		Fluid leakage	Fluid leakage

Table (7): Entomofauna attracted during various stages of rat carcasses decomposition.

Order	**Family**	**Genus**	**Group (1)** Control (n=5)			**Group (2)** Rats poured with kerosene (n=5)			**Group (3)** Rats poured with insecticide (n=5)			**Group (4)** Rats poured with perfume (n=5)		
			F	B	W	F	B	W	F	B	W	F	B	W
			0-1 d	2-3 d	4-6 d	0-3 d	4-6 d		0-1 d	2-3 d	4-6 d	0-1 d	2-3 d	4-6 d
Diptera (flies)	Sarcophagidae	*Sarcophaga haemorroidals*	■	■	■		■		■			■	■	
		Wolhfahrtia sp.		■			■			■				
	Calliphoridae	*Chrysomya albiceps*	■	■					■	■	■			■
	Muscidae	*Musca domestica*	■	■	■									
Coleoptera (beetles)	Dermestidae	*Dermestis frischii*		■	■									

F, fresh; B, bloat; W, wet decomposition; d' day.

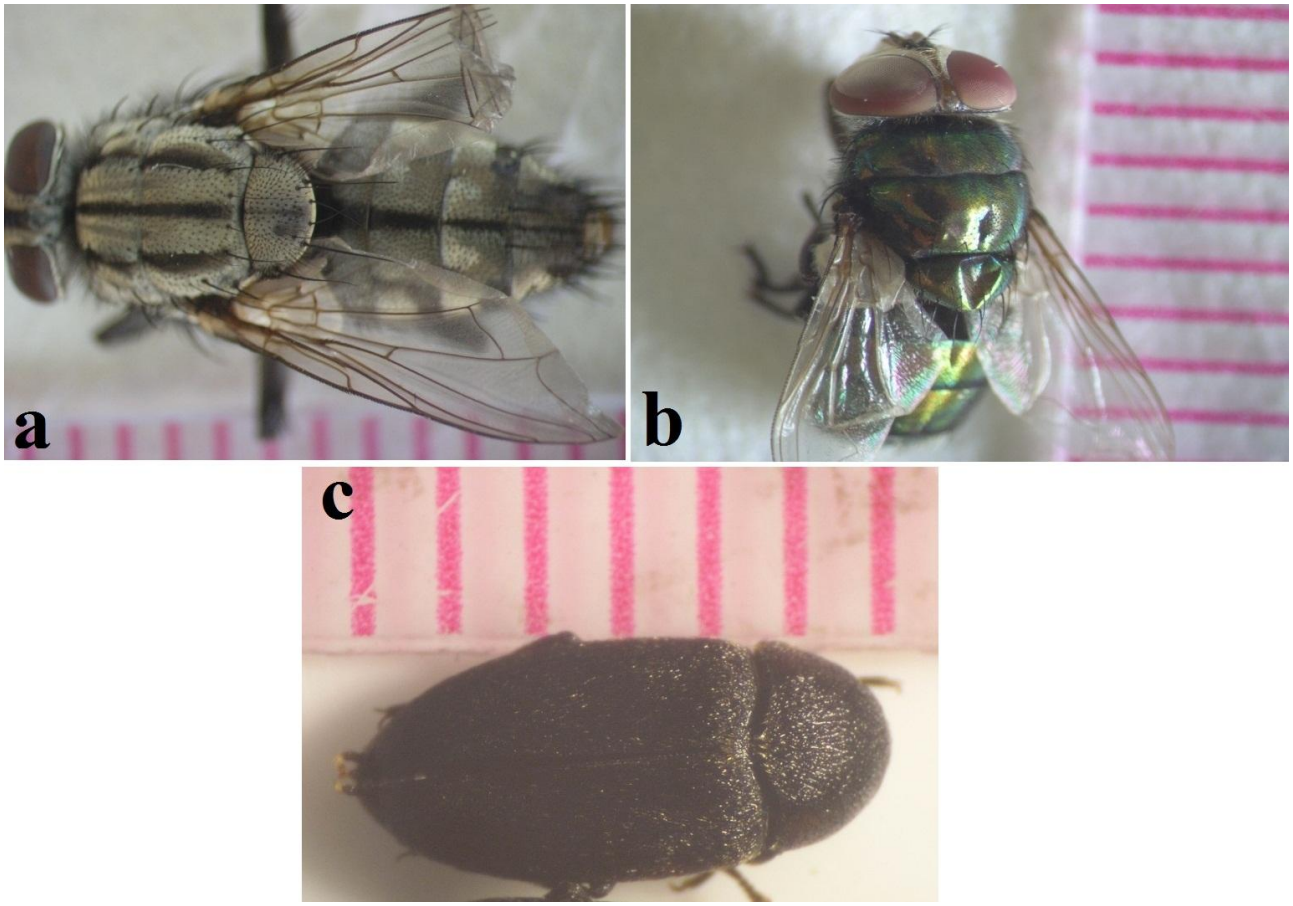

Figure (1): Photos of some species of arthropods appeared in rats' cadavers of the experiment in Assiut (Egypt); a, *Sarcophaga haemorrhoidals;* b, *Chrysomya albiceps;* c, *Dermestes frischii*.

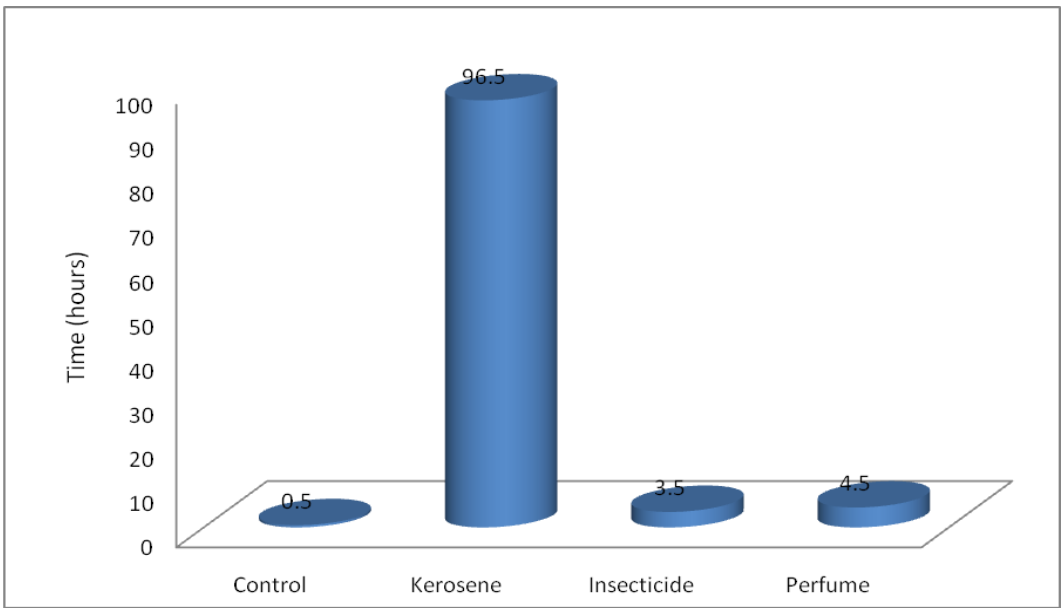

Figure (2): Arrival time of the first necrophagous insects in all rats' cadavers.

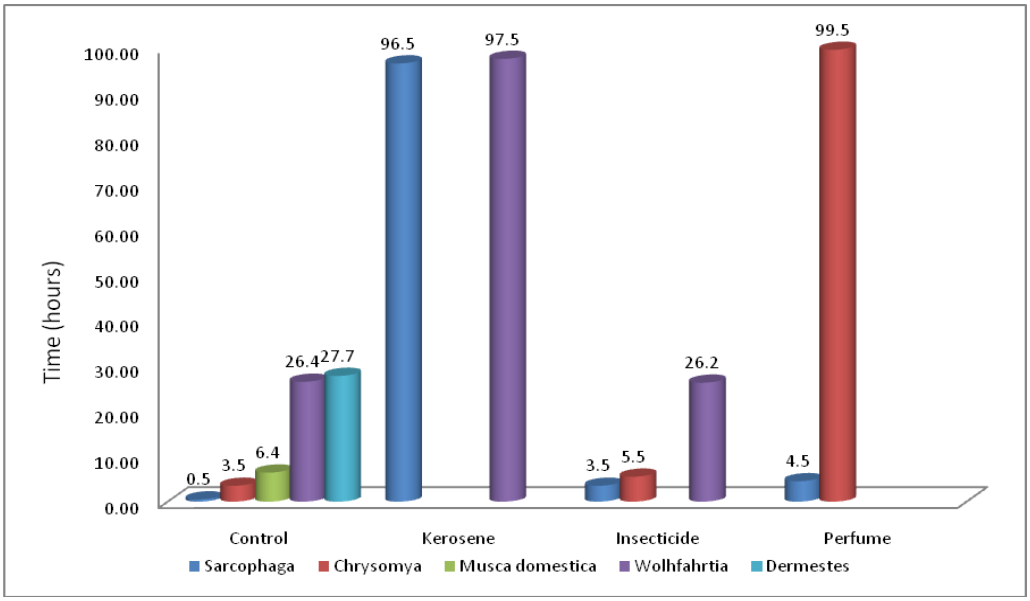

Figure (3): First arrival time of each insect species in all groups during the experiment in Assiut (Egypt).

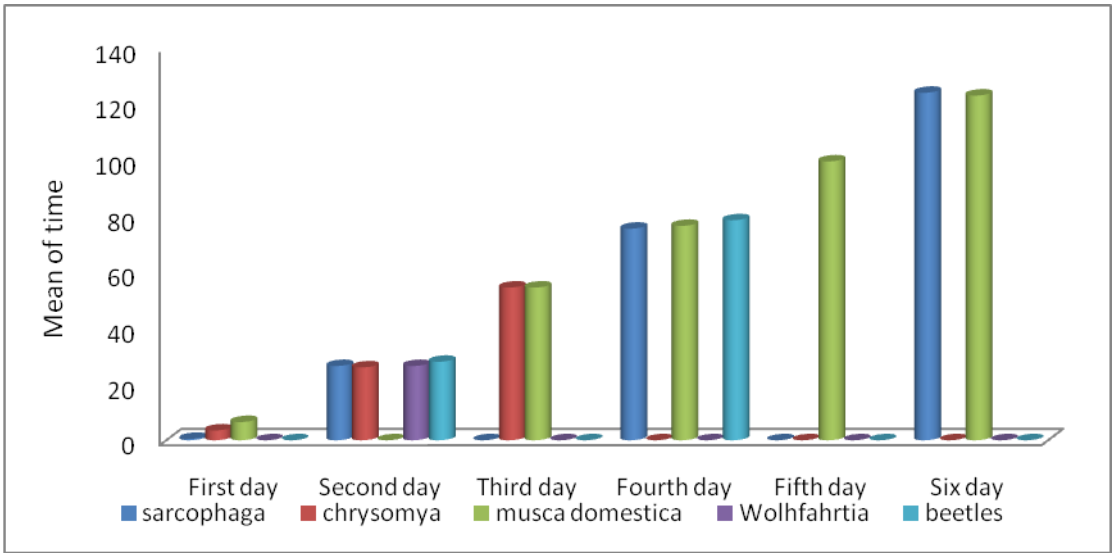

Figure (4): Time of arrival of each insect species appeared in control (Group 1).

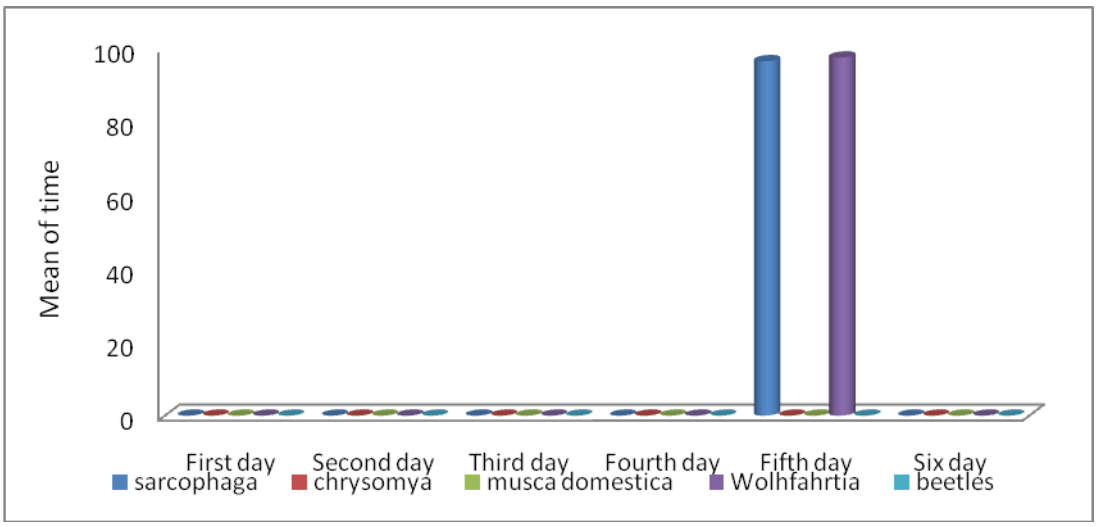

Figure (5): Time of arrival of each insect species appeared in kerosene poured rats (Group 2).

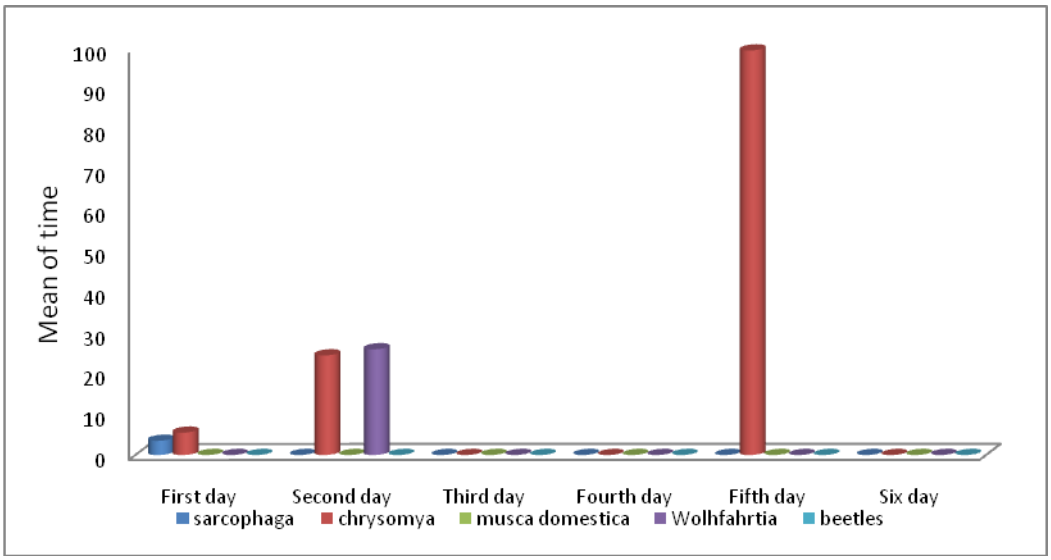

Figure (6): Time of arrival of each insect species appeared in insecticide poured rats (Group 3).

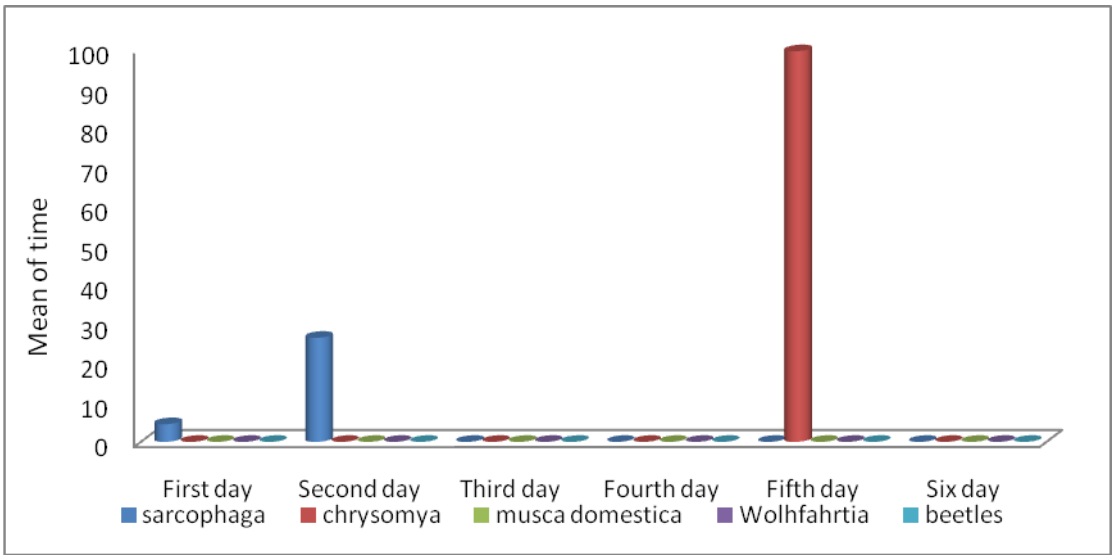

Figure (7): Time of arrival of each insect species appeared in perfumed poured rats (Group 4).

Discussion

Forensic entomology has been increasingly gaining international recognition in medicolegal discipline worldwide (Sukontason et al., 2007).

The present study provides a short field investigation on the response of necrophagous insects

to small carrion cadavers poured with different household products.

Five genera of insects representing two orders and four families were found to be coexisted on both control and treated carcasses. Family Sarcophagidae represented by *Sarcophaga haemorrhoidals* and *Wolhfahrtia sp.*, family Calliphoridae represented by *Chrysomya albiceps*, family Muscidae represented by *Musca domestica* and family Dermestidae represented by adult beetles of *Dermestes frischii*.

The succession of arthropod fauna observed on the carrion of the present study follows the same general pattern found in both tropical and temperate areas as stated by Galal et al. (2009): rapid invasion of specimens by adult Diptera (sarcophagidae and calliphoridae). It was followed by the appearance of Muscidae and adult coleopterans (beetles) during which the arthropod diversity reaches its maximum.

This agrees with that reported by Oliva (2001) in Argentina; who described families of Diptera as being the first to colonize cadavers and dominate in early stages of decomposition, whilst Coleoptera was the second. Varatharajan and Sen (2000) also stated that beetles colonize corpses later than the flies. As well as Wolff et al. (2001) observed that the first flies of Sarcophagidae and Muscidae arrived within 30 minutes and beetles after 2 days. Kyerematen et al. (2012) also reported that Diptera (flies) arrived within hours or few days at the most, followed by Coleoptera (beetles).

From the above mentioned data, the succession of arthropod fauna observed on the carrions can be explained by an adaptation to reduce competition or the fact that Dipterans are strong fliers and arrive at the site of the corpse earlier. Segura et al. (2009) also provided that different species usually appear and disappear one after the other, as a cadaver degrades, certain resources are used up and then become available to others whilst the changes occurring in the body favor one species first and then another.

Sarcophagidae in this study were represented by *Sarcophaga haemorrhoidals* and *Wolhfahrtia sp*. *Sarcophaga haemorrhoidals* was the only *Sarcophaga* species captured in this study. However *Sarcophaga carnaria* flies was recorded in Assiut by Attia (2002) and Galal et al. (2009) in spring and summer. Hegazi et al. (1991) and Tantawi et al. (1996) also found other *Sarcophaga sp* in the studied seasons for two years duration.

Wolhfahrtia sp. adults were also detected in this study (spring season) unlike Tantawi et al. (1996) where *Wolhfahrtia* adults were absent in spring and present in summer. This variation in season activity might be due to great climatic differences between Assiut and Alexandria in spring and summer seasons (Moatamed, 2005).

Chrysomya albiceps one of the calliphoridae detected in this study is a well-known hemisynanthropic fly and generally described as a tropical and subtropical species (Hall and Smith, 1993). *Chrysomya albiceps* had been mentioned to occur in Egypt as one of the most important carrion breeding fly by Adham et al. (2001) and Attia (2002). *Chrysomya albiceps* was the dominant dipteran fly in the current study as it was captured in all experimental rats except in kerosene poured rats (group 2). This agreed with the study of Abd El-bar and Sawaby (2011), in El-Qalyubiya, where they found that the blowfly Chrysomya albiceps constituted most of collected samples.

Beetles belonging to one genera were collected, namely, *Dermestes frischii.* Its adults had been observed at 2nd day on control only (group 1). This observation was in agreement with Tantawi et al. (1996). On the other hand, Rodriguez and Bass (1983); Early and Goff (1986); Grassberger and Frank (2004) studies, observed that *Dermestidae* were confined to later stages of decomposition and especially the dry stage.

This study aimed to evaluate the effect of some common household products (kerosene, insecticide and perfume) on first insect's arrival time. Charabidze et al. (2009) explained that the measurement of the repellent effect on a corpse by using the time to first arrival of flies is better than oviposition, as oviposition involved a more complex set of stimuli and responses.

In this study, three observable stages of decomposition were recognized in all rats' cadavers during the duration of experiment: fresh, bloat, wet decomposition. While in a study done by Galal et al. (2009) in Assuit city, four stages of decomposition were recognized (fresh, bloat, decay and dry). This may be explained by longer duration of study (20 days), higher temperature in summer (37 ºC) and different type of specimen (human remain weighting 2-2.5 kg). Kyerematen et al. (2012) also recorded four stages of decomposition in their study in Ghana, in a period of 28 days in February and March. While Wolff et al. (2001) recorded five stages of decomposition; fresh, bloating, active decay, advanced decay and dry remains, due to longer duration (207 days) in their study on Colombia.

The use of these common household products (kerosene, insecticide and perfume) didn't only affect the time of the first insect's arrival but also type of insects and stage of decomposition. The fresh decomposition stage (1st day), manifested by discoloration of skin and first appearance of *Sarcophaga haemorrhoidals* immediately (within half an hour ±S.D. = 0.1 hr) in control and delay of colonization for 3.5 h (±S.D. = 0.3 hr) in insecticide poured rats (group 3), 4.5 h (±S.D. = 0.4 hr) in perfume poured rats (group 4). *Chrysomya albiceps* appeared in rats of control and group 3, and *Musca domestica* in control rats only. This stage delayed in appearance to 2nd day in kerosene poured rats (Group 2) without appearance of any insect. The bloat decomposition stage (2nd, 3rd days), characterized by body swelling and inflation, which was obvious in group1 and gradual in groups 3, 4. This stage delayed in rats of group 2 to the 5th day. Continuation the appearance of *Sarcophaga haemorrhoidals* in control rats, appearance of *Wolhfahrtia* in control and groups 2, 3, *Chrysomya albiceps* appeared in control and rats of group 3, while

Musca domestica and *Dermestes frischii* were found in control rats only. The wet decomposition stage (4^{th} to 6^{th} days), liquefaction was observed in control and rats of groups 3, 4, with continuation of appearance of *Sarcophaga haemorrhoidals* ,*Musca domestica* and *Dermestes frischii* in control rats only , continuation the appearance of *Chrysomya albiceps* in rats of group 3, while 1^{st} appearance of *Chrysomya albiceps* in rats of group 4.This stage hasn't been observed in rats of group 2.

This agrees with Marchenko (1988), who clearly showed that compounds such as paint or gas dropped on clothing induce a delay in carrion colonization by a period twice as long as the control.

A study of Abd El-bar and Sawaby (2011) noticed insect species colonizing both control and test carcasses killed by organophosphorous injection were not different, indicating that organophosphorous were not masking the decomposition odors which were drawing the species to the bodies. They also found 48 h delay in blowfly colonization of test rabbit carcasses killed by organophosphorous injection. They observed distinct delay in decomposition stages, the decay of control carcasses was rapid while test carcasses did not decay completely, even 40 days post-killing.

As well as, Voss et al. (2008) observed a delay in appearance of Calliphoridae for 16-18 h, in carbon-monoxide-poisoned carcasses enclosed in vehicle, while the physical stages of decomposition was 3-4 days faster in the carcasses in enclosed vehicle due to higher temperatures there compared to external ambient temperature. El-Kady et al. (1994) found that neither arthropod invasion nor decomposition occurred on rabbits poisoned with arsenic oxide even after 11 months.

A study of the effect of chemical substances (petrol, patchouli, HCl, NaOH, insecticide, citronella and lime) , on the delay of colonization by necrophagous insects was carried out in 5 years duration (September 1999, July 2001, July 2002, July 2003 and August 2003) by Bourel and his coworkers. They stated that NaOH, citronella and lime had no or few effect on the delay of colonization and were similar to the controls. While Petrol, HCl and insecticide had an average retarding effect. Patchouli presented an important retarding effect (Bourel et al., 2004).

In contrast, in other experiment using HCl, patchouli perfume, insecticide and kerosene placed on the rat carcass, the strongest effect was noted with HCl and patchouli perfume, which induced a mean colonization delay of 73 h (S.D. = 46 h) and 101 h (S.D. = 95 h) respectively Charabidze et al., (2009).However the kerosene, very volatile in a very hot summer of the experiment, had no detectable repellent effect. It would seem that the effect of weather is an important factor in the degradation kinetic of tested products. Thus, high temperature and humidity could modify the kinetic of a substance's evaporation or fixation in animal tissues.

Conclusion

This study highlights the possibility to delay colonisation of a corpse by necrophagous insects simply by splashing substances on to the corpse. It seems that household products can be used to conceal or alter the odor associated with a cadaver and to induce a delay in the first arrival of necrophagous flies. Even if the precise estimation of the delay is difficult because it is also dependent on meteorological data, it is important to take it into account in forensic expertise. More studies are recommended to be carried out in different geographical situations and different habitats with the use of large scale different repellents to confirm the present study preliminary observations.

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الملخص العربى

تأثير بعض المواد المنزلية (كيروسين، مبيد حشري وعطر) على استعمار مفصليات الأرجل على جثث الفئران

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إن المهمة الأكثر شيوعا لعالم الحشرات الشرعي هو تحديد الفترة الزمنية التى مضت على الوفاه باستخدام يرقات الذباب آكل الجيف. دائما ما يكون استخدام بعض المواد الطارده للحشرات على الجثة غير معلن ويصعب اكتشافه. والهدف من هذه الدراسة هو تقييم تأثير بعض المنتجات الشائعة الإستخدام في المنزل على استعمار مفصليات الأرجل على جثث الفئران بما في ذلك تأثيرها على الأنواع وعلى وقت الوصول الأول لمفصليات الأرجل و تأثيرها على وقت حدوث التحلل. و قد أجريت التجربة فى فصل الربيع، على عشرين فأرا. تم تقسيمهم عشوائيا إلى 4 مجموعات. المجموعة الضابطة لم يتم إضافة أي مادة عليهم، المجموعة الثانية تم إضافة كيروسين، المجموعة الثالثة تم إضافة مبيد حشري. أما المجموعة الرابعة تم إضافة عطر. تم فحص وجود المفصليات على فترات منتظمة خلال فترة التجربة.و قد وجد أن إستعمال هذه المواد المنزلية لم يؤثر فقط على الظهور الأول للحشرات و لكن أيضا على نوعها و على مراحل التحلل. ففي المجموعة الضابطة الحشرات الأولى ظهرت بوفرة أكثر خلال المرحلة الأولى (الحديثة) من التحلل كانت تنتمى للحشرات ثنائيه الاجنحه (ذباب حقيقى) و يتضمن عائلات(الساركوفاجيدى؛ كاليفوريدى؛ ماسيدى) تليها الحشرات محميات الاجنحه (الخنافس) خلال مراحل التحلل الثانية (الإنتفاخ) والثالثة (الرطبة). بينما أظهرت النتائج أن ماسيدى والخنافس لم يظهروا في المجموعات الأخرى التي تم إضافة المواد المنزلية عليها. فقد تأخر معدل غزو المفصليات لأجسام الفئران المتحللة لمدة 96 ساعة و نصف (± 0.55 ساعة) في المجموعة الثانية، لمدة 3.5 ساعة (± 0.3 ساعة) في المجموعة الثالثة. أما المجموعة الرابعة فقد تأخر معدل غزو المفصليات لأجسام الفئران المتحللة لمدة 4.5ساعة (± 0.4 ساعة). كما لوحظ تأخر واضح في مراحل تحلل مجموعة الفئران المضاف عليها الكيروسين (المجموعة الثانية). أكدت هذه النتائج التأثير الطارد لهذه المواد المنزلية وضرورة أن يضع عالم الحشرات الشرعي هذا التأثير في الحسبان عندما يحدد الفترة الزمنية التي مضت على الوفاة.

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