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Original Research Article

Non-biting Flies: Occurrence, Constance and Substrate Preferences in Ile-Ife, Nigeria

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Non-biting flies are of ecological, preventive medicines and sanitary importance because, in most cases, they serve as purveyors of human and animal pathogenic agents, inducers of myiasis and degrader of organic matters. This study was conducted to ascertain the fauna of house flies, blow flies, flesh flies and their allies in Ile-Ife. Using an insect sweep net, flies were caught from abattoirs, fresh food markets, garbage piles and public latrines between December 2014 and May 2015. The caught flies were identified in the laboratories in the department of Medical Microbiology and Parasitology and the Museum of Natural History of Obafemi Awolowo University. One thousand and eight-three (1083) flies were caught. These belong to four dipteran families of Calliphoridae, Muscidae, Sarcophagidae and Stratiomyidae. Garbage piles had the highest number of flies. *M. domestica* is reported as accessory species, *F. scalaris* and *C. vicina* as accidental species. The number of flies caught from each collection site though statistically insignificant, points to the fact that the sites always had substrates supporting the lives of these species.

Keywords: flies, pathogen, substrate, contamination, constance, filth

INTRODUCTION

From time immemorial, non-biting flies have been constant companions of humans, albeit, with both positive and negative impacts. They are notorious nuisance, vectors of human and animal pathogens (Bruce-Chwatt, 1988, Harrison, 1978) and causers of myiasis. Non-biting flies such as house fly, blow fly and flesh fly, in various cultures have undesirable sights over guise of behavioural and biological links with filthiness. There are strong associations between human, filth flies and several diseases such as yaws, eye diseases, polio, tuberculosis and various parasitic illnesses. According to Stedman (1966), the close association between man and these flies shows problems related to human and veterinary health, demonstrating its presence in the rural and urban areas (Madeira *et al*., 1989)

Several studies across the globe, including those of Suliaman *et al*. (1988) showed that non-biting flies carry different developmental stages of helminths and protozoan parasites. Incidentally, Doiz *et al* (2000) implicated houseflies as proficient vectors of eggs and cysts of human enteric parasites. Oocysts of *Cryptosporidium parvum* have been isolated from wild filth flies of Muscidae, Sarcophagidae and Calliphoridae families collected from diarrheic faeces (Graczyk *et al.*, 2000). Among the isolated pathogenic bacteria from flies are diarrhoeagenic *Escherichia coli* strains, *Campylobacter spp* and *Staphylococcus aureus* (Förster *et al*., 2007, Fotedar *et al*., 1992). These flies have been found contributively in the spread of typhoid fever (Pierce, 2007). Flesh flies can carry leprosy bacilli and can transmit intestinal pseudomyiasis to people who ingest their larvae (Pape, 1998). House flies are vectors of many enteroviruses, poliomyelitis, viral hepatitis A and E among others (Malik *et al*., 2007, Graczyk *et al*., 2005).

Synanthropic flies, as non-biting flies are often called, have been reported as major epidemiological factors responsible for the spread of acute gastroenteritis and trachoma amongst infants and young children predominantly in developing countries (Förster *et al*., 2009). Finally, the strong association of fungi and flies has been confirmed from various works (Salehzadeha *et al*., 2007, Zarrin *et al*., 2007). It is of interest to investigate the different types of pathogens that will be associated with non-biting flies in this relatively large town in southwest Nigeria. However, before embarking on such a

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study, it sounds expedient to first ascertain the existing non-biting flies, hence this study.

MATERIALS AND METHODS

Ile-Ife is located within Osun State, in the centre of the western part of Nigeria. From the points of longitude and latitude, Ile-Ife is about 4°30′ to 4°34′ east of the prime meridian and 7°28′ to 7°45′ north of the equator. Adult non-biting flies were caught from different collection sites between the hours of 10:00 am and 12:00 noon from December 2014 to May 2015 with a fine insect sweep net. These collection sites include abattoirs, fresh-food markets, garbage piles and public latrines. Flies were collected from across the length of Ile-Ife. Flies caught in the sweep net were transferred into a killing glass jar containing a wad of cotton soaked with ethyl acetate and overlaid by a piece of cardboard paper. The caught flies were immediately transported to the laboratory at the department of Medical Microbiology and Parasitology, Obafemi Awolowo University, Ile-Ife, Nigeria.

An illuminated Loupe (led light of a little magnifying lens) 20×/21 MM was used to view the arrangement of the eyes, antennae and body pattern. The flies were identified into various families and species, based on gross morphological features, (Service, 1980, Turmrasvin *et al*., 1979). The identified flies were preserved by pinning them with entomological pin and oven-dried. The occurrence level and relative attractiveness of non-biting flies to the collection sites were determined using the following relationship: $C= S_n.100/N$. Where C= Constance coefficient, S_n=specimen according to species and *N*=total of collects. Species were identified as constant if found at least 50%, accessories, if found between 20% and 50%, and accidental, if found up to 25% of the collects (Bodenheimer cited Silveira-Neto, 1976). The identified species from each collection sites were compared by using IBM SPSS 2013 to evaluate univariate analysis of variance (ANOVA) at $p<0.05$.

RESULT

1083 non-biting dipteran flies belonging to four families, seven genera and nine species were caught. The identified species include *Calliphora vicina*, *Calliphora stygia*, *Lucilia illustris* of family Calliphoridae. *Fannia scalaris*, *Musca domestica*, *Musca vetustissima of the family Muscidae. Sarcophaga haemorrhoidalis* and *Tricholioprocta hardyi* belonging to the family Sarcophagidae and *Hermetia illuscens* of family Stratiomyidae (Table 1). Seven species of fly crisscrossing the four identified families were caught from fresh food markets and this gave the highest number of variety of flies caught from the various sites.

Three species were caught from public latrines while each of the abattoir and garbage piles had six and four species caught from it respectively. Members of Muscidae family had the highest number (642) followed by Calliphoridae (258), then Sarcophagidae (176) and Stratiomyidae (7). The highest number of non-biting fly species were caught from garbage piles and the least were caught from public latrines. *M. domestica* was most abundant of the total collect. This is followed by *F. scalaris* while the least abundant non-biting flies were *H. illuscens*. Similarly, *M. domestica* and *F. scalaris* were caught from all the collection sites. *M. vetustissima*, *T. hardyi and H. illuscens* were only caught from fresh food markets and *L. illustris* were caught from the abattoir. *C. vicina, C. stygia, S. sarcophaga* were caught from at least two of the collection sites (Table 2).

The structural features of the identified non-biting flies are shown in Table 3. Of the seven species identified from fresh food markets, *M. domestica* occurred most frequently followed by *C. vicina*, *M. vetustissima, T. hardyi*, *C. stygia* and *H.* illuscens. From abattoirs, *S. haemorrhoidalis* was the most prevalent of six non-biting flies caught. *C. vicina*, *L. illustris*, *T. hardyi* and *F. scalaris* followed in order of abundance. From garbage piles sampled, *M. domestica* appeared most frequently while *C. stygia* was the least in number of the four species recorded. *M. domestica* and *F. scalaris* were the most numerous of the three species caught from latrines as well as the non-biting flies collected from all the sites (Table 4).

Using the Bodenheimer's classification as a basis premised on the relative attractiveness to the different sites, *M. domestica* is registered as constant species in refuse dumps *S. haemorrhoidalis* as accessory species in abatoirs. *C. vicina*, *L. illustris*, *F. scalaris* were recorded as accidental species. In Ile-Ife, *C. vicina, F. scalaris* and *S. haemorrhoidalis* were listed as accidental species and *M. domestica* with highest occurrence level (36%) as accessory species within the months of December, 2014 to May 2015 (Table 4). The number of non-biting flies caught from the four collection sites was statistically not significant (Sig. = 0.166, df = 1, 3: $p< 0.05$). However, when it was analysed in relation to species, *L. illustris, H. hermetia, M. vetustissima* and *C. stygia* showed differences. The preference for substrate is thus evident.

DISCUSSION

The mere presence of non-biting flies from all the collection sites indicated some levels of unhygienic environment enough to interest workers of public health. Though flies abundance and predominance are determined by several climatic factors such as humidity and temperature (Axtell, 1986, West, 1951). These are not sufficient to attract non-biting flies in a sanitized environment. The variety of species sampled from the fresh food markets are in conformity with previous reports by various works (Sukontason *et al.,* 2000, Greenberg, 1973) as the site may contain all kinds of fresh and decaying organic matters. Species of *C. vicina*, *H. illuscens*, *M. domestica* may feed on food sources, including nectar, animal carcasses, garbage, and other filthy materials, or even human food.

Barrack (1986) and Putman (1977) ascertained these species as the principal consumers of deteriorating organic materials, rubbish, some plants and shrubs products and romantic flowers (Sulaiman *et al.,* 1988). The variety of substrates in fresh food markets premised the variety of species caught. Predominance of *S. harmorrhoidalis* in abattoirs significantly demonstrated the inclination of this species to fresh and decaying animal tissues. *F. scalaris* and *M. domestica,* with fluctuating frequency, also show partiality for certain substrates (Table 2). However, they were more dominant in public latrines which means their substrate preference tilts more towards excreta. *H. illucens* was only recorded from fresh food markets and is consistent with Barry's (2004) and Laclercy's (1997) claims that this species subsist well on food wastes.

Five species of all the collects have been recorded as potential vectors of human enteric pathogens. These are *F. scalaris, M. domestica, M. vetustissima, S. haemorrhoidalis* and *H. illuscens*. The first two species were identified as most numerous from our findings. High occurrence of *F. scalaris* (latrine flies) (20.31%) is suggestive of an environment being

littered with excreta (Sychevskaya, 1970). *F. scalaris* prefer to breed in excrement or deep semi-fluid latrine material and cesspool, decaying animal and plant matter. In like manner, the appearance of *M. vetustissima* is an indicator of the excreta littered environment as these flies have a strong attraction towards animal and human dung (Kettle, 1984). Flies from such environments are sure sources of pathogens for diseases such as diarrhoea, dysentery and many other food and water borne diseases. The underlining fact has it that all these fly species are carriers of pathogens whose spread are enhanced by unhygienic food handling and human carriers presenting a health problem to preventive medicines.

Flies of the genus *Sarcophaga* are known to cause myiasis in necrotic wounds and in anatomical cavities where fluids like pus, sputum urine etc. have collected. *S. heamorrhoidalis* is one of the 20 species known to cause gastrointestinal myiasis and infestation of living tissues (Mullen and Durdan 2002) and it was one of the isolates in this study. *S. haemorrhoidalis* has been implicated severally with cutaneous myiasis. Larvae of *H. illuscens,* caught from the market from where human food are sold and bought has been delineated as causer of severe gastrointestinal disturbance. The implication is an increase of the parasitic relevance of the genus. *L. illustris*, a facultative myiasis agent, primarily feed on necrotic tissues of living hosts which may be ingested with meat, especially when eaten raw or tasted uncooked. *C. stygia,* in low occurrence (2.96%) has severally been implicated in fly strike in sheep. The insignificant univariate ANOVA test resulting from the sampling sites suggested an assumed equal unsanitary situation of the sites, as many flies with greater pal with human enteropathogens criss-crossed the sites. This is particularly a health risk in abattoir and greater risk in fresh food markets where most food bought may be consumed raw or insufficiently boiled.

CONCLUSION

From all indications, it is suggested that more work be done on molecular and biochemical characterization of these non-biting flies and collection should be extended to remote villages and from within houses. Elimination of suitable substrates by bagging trash, animal carcases and other decaying materials will do much more in the reduction of flies' abundance. Covering garbage containers will surely limit infestation and annoyance of these flies just as usage of mesh screen and residual sprays. Finally, adequate awareness of the involvement of flies in human disease epidemics and proper disposal of excreta should be reinforced in the environment.

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TABLES

Table1: Families and species of Non-biting flies caught from collection sites

Family	species name	Common names
Calliphoridae	*Calliphora vicina* (Robineau-Desvoidy 1830)	blue bottle fly
	Calliphora stygia (Fabricius 1781)	brown blow fly/rango tumaro
	Lucilia illustris (Meigan 1826	green bottle
Muscidae	*Fannia scalaris* (Fabricius 1794)	latrine fly
	Musca domestica (Linnaeus)	house fly
	Musca vetustissima (Walker)	bush fly
Sarcophagidae	*Sarcophaga haemorhoidalis* (Fallen)	red tailed flesh fly
	Tricholioprocta hardyi	
Stratiomyidae	*Hemertia illuscens* (Linnaeus 1758)	black soldier fly

Table 2: Nonbiting flies caught from various collection sites

	COLLECTION SITES				
Nonbiting flies spp	ABT	FFM	GBP	PLT	TOTAL
Calliphora stygia	-	13	14	-	27
calliphora vicina	63	61	51	-	175
F. scalaris	2	39	72	107	220
Lucilia illustris	56	-	-	-	56
Musca domestica	16	89	187	108	400
Musca vetustissima	-	22	-	-	22
Sarcophaga haemorrhoidalis	90	-	-	33	123
Tricholioprocta hardyi	31	22	-	-	53
Hermetia illuscens	-	7	-	-	7
TOTAL	258	253	324	248	1083

KEY: ABT – Abattoirs, FFM – Fresh Food Markets, GBP – Garbage Piles, PLT – Public Latrines

Table 3: Features of the identified species of Non-biting flies

S?N	Species	Identified features	Length
1	*Calliphora vicina*	Eyes red; side of face orange; thorax blue gray; abdomen metallic blue; sclerite at base of yellow costa	10-11mm
2	*Calliphora stygia*	Grey thorax and yellow-brown abdomen	
3	*Fania scalaria*	Thorax and abdomen dark gray to bluish black; 4 darker longitudinal stripes on thorax; middorsal abdominal stripe forms triangular markings; middle tibia with tubercle.	4-6mm
4	*Lucilia ilustris*	Shiny metallic green, sometimes range to dark blue; palpi yellow; sclerite at the base of costa with setae	6-9mm
5	*Musca domestica*	Proboscis with fleshy apical lobe; outer thoracic stripes complete; R_5 cell nearly closed at wing tip; abdomen with lighter patch on each side near base.	5-9mm
6	*Musca vetustissima*	*Lower calypter very broad with almost straight transverse posterior margin, M1 strongly bent forward from near middle of distal section*	
7	*Sarcophaga haemorrhoidalis*	Gray thorax with 3 to 5 distinct black stripes, tip of abdomen reddish.	10-14mm
8	*Tricholioprocta, hardyi*	Arista plumose, thorax with three	

		broad, longitudinal very faint dark stripes, abdomen with black patches with steno-pleura bristles	
9	*Hermetia illucens*	Dark-coloured, abdomen is very broad and flat and the elongated, third antennal segment is ringed. It has 2 light elongated patches at the base of abdomen.	15-20mm

Table 4: Constance Coefficient of Non-biting flies species caught from Ile-Ife metropolis

S/N	Species Name	Number Caught	Constance Coefficient
1	*Calliphora vicina*	175	16.16%
2	*Calliphora stygia*	27	2.96%
3	*Fania scalaria*	220	20.31%
4	*Lucilia ilustris*	56	5.16%
5	*Musca domestica*	400	36.93%
6	*Musca vetustissima*	22	2.03%
7	*Sarcophaga haemorrhoidalis*	123	11.35%
8	*Tricholioprocta hardyi*	53	4.89%
9	*Hermatia illuscens*	7	1%
	Total	1083	100%

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