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Food-borne human parasitic pathogens associated with household cockroaches and houseflies in Nigeria

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ABSTRACT

Cockroaches and houseflies pose significant public health threat owning to their ability to mechanically transmit human intestinal parasites and other disease-causing microorganisms. This study aims at assessing the vectoral capacity of cockroaches and houseflies in the transmission of human intestinal parasites. Intestinal parasite external surface contamination of 130 cockroaches and 150 houseflies caught within dwelling places in Ilishan-Remo town, Ogun State, Nigeria was determined. Cockroaches (six parasite species) were more contaminated than houseflies (four parasite species). The most prevalent parasites were *Trichuris trichiura* (74.0%) and hookworm (63.0%) in houseflies and cockroaches respectively. There were significant differences in the prevalence of hookworm, *T. trichiura* and *Taenia* spp. isolated from cockroaches and houseflies ($P < 0.05$). There is high contamination of human intestinal parasites in cockroaches and houseflies in human dwelling places in the study area, thus they have the ability to transmit these parasites to unkempt food materials.

1. Introduction

Soil transmitted parasites are important pathogens of public health concerns in most rural areas of many endemic countries (Hoorfar, 2011). Poverty, poor environmental hygiene, and impoverished health services have been noted as the predisposing factors (El-Sherbini and Gneidy, 2012). The most notable source of transmission of these parasites is through the indiscriminate disposal of human faecal waste. While these pathogens are often transmitted through consumption of contaminated water, convalescent carrier, and unhygienic food handlers, the importance of mechanical carriers like cockroaches and flies cannot be over-emphasised (Breitschwerdt et al., 2010).

Approximately 99% of the 4000 species of cockroaches described are wild and do not represent a risk to human health while the remaining 1% which are domestic have become a considerable nuisance and pose public health threat (Ramirez, 1989). Cockroaches are indiscriminate feeders and often times subsist on human faeces thus can serve as potential carrier of parasites, fungi and bacteria (Fotedar and Banerjee, 1992; Rivault et al., 1993a; Doiz et al., 2000; Pai et al., 2003). The role of cockroaches in the transmission of parasites such as *Entamoeba histolytica*, *Toxoplasma gondii*, *Sarcocystis*, *Giardia lamblia* and other protozoan parasites had been emphasised (Graczyk et al., 2005).

Associated with unsanitary conditions and human pathogens transmission are over 50 species of synanthropic flies (Getachew et al., 2007; Shoukry and Morsy, 2011). Flies are often attracted to unsanitary communities with garbage, carcasses and faeces and when scattered around dwelling places, they could facilitate the flies' migration indoors. Although our study area has factors that

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could potentiate easy contamination of cockroaches and flies with human intestinal parasites, little is known about the role of these insects in parasite transmission. So, the study assessed the public health impact of cockroaches and flies in relation to parasite contamination in a peri-urban community of Nigeria.

1.1. Materials and methods

1.1.1. Study area

Cockroaches (*Periplaneta americana* and *Blatta orientalis*) and houseflies (*Musca domestica*) were sampled from dwelling places within Ilishan-Remo community, Ogun State. The community is peri-urban with inadequate infrastructural facilities. Due to a lack of good toilet facilities in some dwelling places and organised community waste disposal systems, the people often resort to making use of nearby bushes for these purposes. There are small and large public waste and refuse dump sites around the community of which most are close to dwelling places, thus serving as suitable breeding sites for flies and cockroaches and their eventual migration into nearby houses.

1.1.2. Insects' collection and parasite isolation

A total of 130 cockroaches and 150 houseflies were caught through sweeping combined with trapping from different locations indoor including toilets, kitchens, parlours and bedrooms in the study area, January–February 2014. Cockroaches trapped in crevices, boxes, cooking utensils, cupboards and other household materials were used while houseflies' collection was through sweeping using clean brooms designated for the purpose in the different locations. Each intact insect caught was placed in a sterilised sample bottle and then transported to the Microbiology Laboratory, Department Biosciences and Biotechnology, Babcock University, Ilishan-Remo, Ogun State, Nigeria. The cockroaches and houseflies were identified using standard taxonomic keys. After identification, each insect was placed in a centrifuge tube containing 5 mL of normal saline (Tatfeng et al., 2005). The tube was shaken vigorously in order to detach any insect's external body surface adhering parasites. After removal of insects, the fluid was centrifuged at 3000 rpm for 3 min. The supernatant was decanted while the sediment was place on a clean glass slide, and stained with Lugol's iodine and viewed under the ×40 microscope objective lens for parasite identification eggs and cysts (Cheesbrough, 1998).

1.1.3. Statistical analysis

Analysis of data was performed by GraphPad Prism 5 (GraphPad Software, Inc., La Jolla, CA 92037, USA). Descriptive statistics was used to analyze the proportion of insects infested by parasites while Chi square analysis was used to determine significant differences in proportion of cockroaches and houseflies infested with parasites. P value less than 0.05 was significantly different.

1.2. Results

Cockroaches which were more contaminated were infested with six parasite species (*Ascaris lumbricoides*, *Enterobius vermicularis*, hookworm, *Trichuris trichiura*, *E. histolytica* and *Taenia* spp.). Houseflies however, were infested with four parasite species (*A. lumbricoides*, hookworm, *T. trichiura*, and *Taenia* spp.). *E. vermicularis* (15.3%) and *E. histolytica* (0.8%) in cockroaches were absent in houseflies. The most prevalent parasites were *T. trichiura* (74.0%) and hookworm (63.0%) in houseflies and cockroaches respectively. There were significant differences in the prevalence of hookworm, *T. trichiura* and *Taenia* spp. isolated from cockroaches and houseflies ($P < 0.05$) (Table 1). The female cockroaches were more contaminated 78/83 (94.0%) than their male counterparts 38/47 (80.9%) (Fig. 1).

1.3. Discussion

Although no study on epidemiology of human parasitic diseases has been carried out in the study area, the present study suggests cockroaches and houseflies as important agents of pathogen transmission to man. The most convenient route of transmission could be through contamination of food since the insects were collected within human dwelling places. While the two insects are waste scavengers, the larger size of cockroach could have enabled it to trap more parasites than the housefly, thus increasing its vectoral capacity. Cockroaches especially inhabit dark places of which latrines are examples of those places, thus also increasing their parasite carrying capacity. Houseflies and other non-blood sucking insects are common indoors and outdoors

Table 1
Human intestinal parasites isolated from cockroaches and houseflies.

Parasite spp.	Cockroach (n = 130)			Housefly (n = 150)			
	No. positive	No. negative	Prevalence (%)	No. positive	No. negative	Prevalence (%)	P-value
A. lumbricoides	68	62	52.3	71	79	47.3	0.41
E. vermicularis	20	110	15.4	0	0	0.0	–
Hookworm	82	48	63.1	44	106	29.3	<0.0001
T. trichiuria	27	103	20.8	111	39	74.0	<0.0001
E. histolytica	1	129	0.8	0	0	0.0	–
Taenia spp.	53	77	40.8	41	109	27.3	0.02

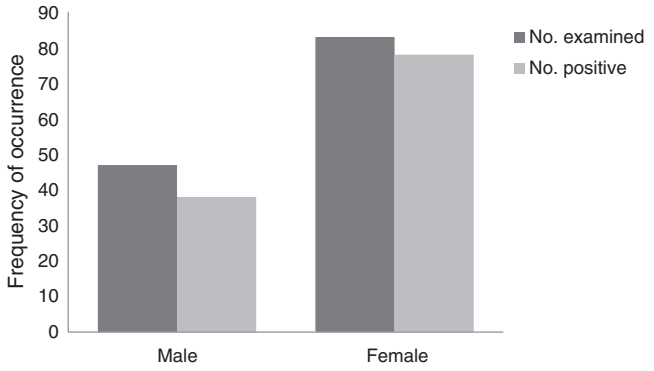

Fig. 1. Parasite occurrence on male and female roaches.

(Mikhail et al., 2011). The housefly being a long distance migrating insect has the ability to transport parasites from positive infested faeces from an open defecation area to indoors. This is supported by the isolation of three different soil transmitted helminths on the external surface of the insect. Studies elsewhere had reported similar observations (El-Sherbini and Gneidy, 2012; Mikhail et al., 2011).

Similar parasites including *E. histolytica*, *T. trichiura*, *A. lumbricoides* and *E. vermicularis* have been isolated from roaches collected from the kitchen, toilet, parlour and bedroom in Ekpoma, Edo State, Nigeria (Tatfeng et al., 2005). In addition to these, *Taenia* spp. and *Entamoeba coli* have been reported as parasites associated with household insects in Ethiopia (Kinfu and Erko, 2008). The high occurrence of *A. lumbricoides* and *Taenia* spp. in this study might have been due to possession of thick egg wall thus conferring resistance on them and enhancing their prolonged survival. Although *E. histolytica* cyst shares similar feature, its low occurrence might be related to its lesser endemicity in the study area. The persistence of hookworms and *T. trichiura* in the insects similar to a study previously reported in Nigeria (Etim et al., 2013) could have been due to the dampen nature of the locations they were sampled from (especially the toilets). The isolation of these parasites from the insects agreed with the supposition that they are important agents in parasite transmission owning to their ability to travel a long distance from and to unsanitary sites (Rivault et al., 1993b). The higher parasite contamination level in female cockroaches than in male roaches could be due to their greater roaming behaviour especially while searching for food and sites to lay their eggs (Bala and Sule, 2012).

One limitation of this study is the sole usage of microscopy to identify the isolated parasites. A more reliable method such as polymerase chain reaction which can accurately differentiate between ambiguous parasite species is recommended.

2. Conclusion

Houseflies and cockroaches can pose significant public health threat in that they may contribute to the spread of food-borne parasitic diseases in developing countries. Efforts should be made to prevent these insects gaining entrance into dwelling places. Improvement in environmental health condition through the use of an appropriate waste disposal system will help to avert risk posed by these insects.

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