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Parasitological survey of domestic cockroaches in some residential houses in Calabar, Nigeria

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ABSTRACT

Objective: Cockroaches have been implicated in the carriage and transmission of a wide range of microorganisms of public health importance, but their role in the transmission of intestinal parasitic diseases in this locality has not been well investigated. Domestic cockroaches (*Periplaneta americana*) caught in Calabar were examined for intestinal parasites of medical importance to ascertain their vectoral role in the transmission of parasitic diseases.

Materials and Methods: External surface (wash fluid) and gut contents of 240 cockroaches in 80 pools of three insects each, collected from sanitary and insanitary areas of the study households, were examined for parasites using direct microscopy and formal-ether concentration technique.

Results: In all, 27.5% tested positive for parasites with more protozoa (22.5%) than helminthes (5.0%) ($P < 0.05$). External surface wash samples recorded a significantly higher parasite prevalence than the gut content samples (45% vs. 10%, $P < 0.05$). Cockroaches from insanitary areas of households were observed to carry more parasites than those from sanitary areas (40% vs. 15%, $P < 0.05$). The parasites detected in this study were *Isospora belli* (50.8%), *Enterobius vermicularis* (43.1%), *Ascaris lumbricoides* (3.1%), and *Entamoeba histolytica* (3.1%).

Conclusion: The presence of these pathogenic parasites in and on the studied cockroaches suggests their role as potential mechanical vectors of these parasitic diseases in Calabar. Appropriate control measures should be taken to make residential areas cockroach free as they represent a public health risk.

Keywords: Cockroaches, Intestinal parasites, *Periplaneta americana*, Transmission, Calabar

INTRODUCTION

Cockroaches (roaches) are insects of the order *Dictyoptera* that abound mostly in tropical and subtropical regions with more than 3500 known species living in a wide range of environments, especially around warm and humid regions of the world.[1-4] Some species, including the American (*Periplaneta americana*), German (*Blattella germanica*), Asian (*Blattella asahinai*), and oriental cockroaches (*Blatta orientalis*), have adapted to human habitation[5] and have become pests in many homes and other buildings associated with adequate food storage.[6] The American cockroach (*P. americana*) followed by the German cockroach (*B. germanica*) is the type most often identified with domestic infestations in Nigeria.[7]

As a pest, these insects infiltrate every area in homes and they breed very fast, contaminating every food storage site with their droppings and bad smell. They have been reported to bite humans and feed on food residues on the faces of sleeping humans.[3] Their nocturnal foraging

on household refuse makes them ideal carriers of various microorganisms[6] including agents of such diseases as diarrhea, dysentery, typhoid fever, cholera, leprosy, plague, and poliomyelitis.[8] Other reports have associated them with carriage of eggs of parasitic worms and causation of allergic reactions, including dermatitis, itching, swelling of the eyelids, and asthma.[9,10]

However, cockroaches have previously been implicated in the direct and indirect mechanical transmission of a number of human and animal diseases.[11] They have been reported to harbor more than 100 causative pathogens of over 65 diseases of humans and animals.[12]

The makeup of the microbial composition of the cockroach gut content has been shown to include a variety of microorganisms, bacteria, protozoa, and nematodes.[4] Recent studies have shown that cockroaches harbor eggs of seven species of helminths (hookworm, giant human roundworm, pinworm, tapeworm, and whipworm) and three protozoa species (*Entamoeba histolytica, Naegleria fowleri,* and *Giardia intestinalis)*.[13] Millions of people have died from diseases carried by cockroaches. For example, an outbreak of food poisoning in a Brussels hospital[14] and outbreaks of *Klebsiella pneumoniae* in neonatal units of Ethiopian and South African hospitals, respectively, have been tied to cockroach infestations.[8,15] Humans have struggled over the years to overcome these diseases, but it is a long, expensive, and hard fight, especially in areas of extreme poverty.[16]

This study, therefore, aimed to investigate the common cockroaches that are found in some human habitations in Calabar, Nigeria, for the range of intestinal parasites of public health importance that is potentially transmissible by this insect. The awareness can provide the effective methods of cockroach infestation management and the suggestions toward effective control of the associated parasitic diseases they transmit in our communities.

MATERIALS AND METHODS

Study area

This study was carried out at Goldie Street in Calabar South Local Government Area, Cross River State in South Nigeria between August and December 2012. Goldie is the longest street in Calabar. Goldie Market, situated at the eastern origin of the street, is the only commercial center in the locality. The market has a single refuse bin that is always filled with market litter. The nearest community dump site is located about 0.5 km from the market center. Tenement blocks account for most of the housing units and are characterized by serious overcrowding. About 40% of the housing units have water system toilet facilities. These units provide accommodation mostly for low-to-medium-level income families.

Sampling technique and sample collection

Two hundred and forty cockroaches (12 each) were collected from different wards of 20 randomly selected (odd number) household units for the study. Sample collection was done mostly in the night and early in the morning through the use of sticky traps (adhesive-based traps) with baits. The traps were left overnight, undisturbed until the morning. One hundred and twenty cockroaches were caught from unsanitary (bathrooms and toilets) and 120 from sanitary (living room, bedroom, and kitchen) areas of the enrolled households. Three cockroaches were gently detached from each trap and pooled into one clean, dry widemouthed, and leak-proof container using forceps. One or two drops of cooking oil were applied around any insect that was firmly stuck to the glue for ease of extraction.[17] The containers with the samples were then taken to the laboratory immediately for processing.

Identification of parasites from external surface

The collected insects were killed slowly using chloroform-soaked cotton wool and identified using standard taxonomical keys.[18] They were washed by manual shaking for 1 min using formal-detergent technique. Each pool of three insects was washed with 5 ml of formalin-detergent solution (1 ml of detergent + 1 ml of formaldehyde + 48 ml of distilled water), properly mixed and dispensed into a centrifuge tube, and spun for 5 min at 3000 rpm. The residue was mixed, poured on a dry clean slide, coverslip applied, and the slide microscopically examined using ×10 and ×40 objective lenses.[18]

Identification of parasites from gut contents

After external washing, cockroaches were placed in a clean sterile container and air-dried. Each cockroach was dissected and the gut content poured into a clean universal container and processed using formal-ether concentration technique.[19]

Data analysis

Data obtained in the study were analyzed using descriptive statistics while for inferential statistics, Chi-square (χ^2) test was used to test the association between variables using SPSS version 20 statistical package. $P < 0.05$ was considered statistically significant.

RESULTS

The results of this study are shown in Figure 1 and Tables 1-3.

Table 1 shows the distribution of parasites in pooled washed and dissected cockroach specimens. Of the 80 pooled cockroaches examined, 22 (27.5%) carried intestinal parasites with protozoa cysts being more 18 (22.5%) than helminthes

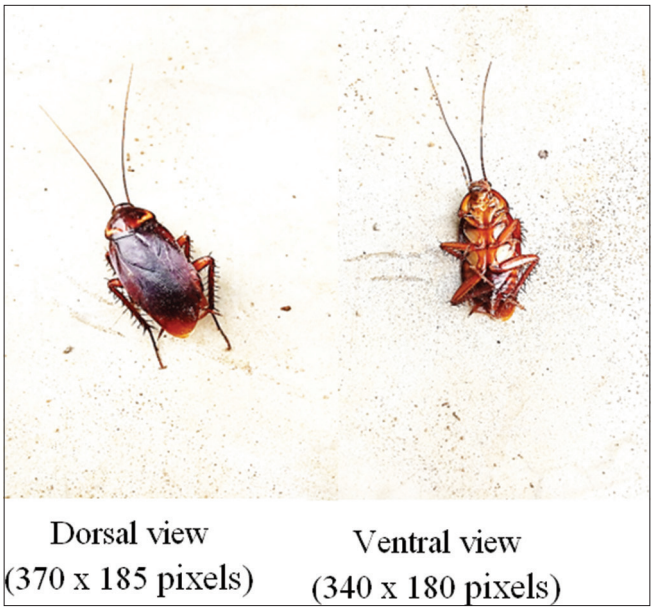

Figure 1: Photograph of adult *Periplaneta americana* caught during the study.

Table 1: Distribution of parasites in pooled washed (external) and dissected (internal) cockroach specimens.

Sample	Number of examined	Number of % with parasites		
		Ho	Pc	Total
Washed	40	3 (7.5)	15 (37.5)	18 (45.0)
Dissected	40	1 (2.5)	3 (7.5)	4 (10.0)
Total	80	4 (5.0)	18 (22.5)	22 (27.5)

Ho: Helminthes ova, Pc: Protozoa cyst

ova 4 (5.0%) (χ^2 = 12.29, P < 0.001). Washed (external surface) samples were more contaminated, 18 (45.0%) than the dissected (gut) samples, 4 (10.0%) (χ^2 = 12.29, P < 0.001).

Table 2 displays the prevalence of parasites in pooled insect samples from sanitary and insanitary areas. Sixteen (40.0%) insects from insanitary household sites were observed to carry intestinal parasites compared to 6 (15.0%) from sanitary areas. There was a statistically significant difference in the prevalence of intestinal parasites between cockroaches caught from sanitary and insanitary areas (χ^2 = 6.2696, P = 0.012).

Table 3 shows the frequency of the occurrence of stages of parasites species in pooled cockroach specimens. The most frequently detected parasite in this study was *Isospora belli* (50.8%) followed by *Enterobius vermicularis* (43.1%). Others were *Ascaris lumbricoides* and *E. histolytica/dispar* (3.1% each).

DISCUSSION

About 27.5% overall carriage rate of human intestinal parasites by cockroaches as recorded in this study is low

Table 2: Prevalence of parasites in pooled insect specimens from sanitary and insanitary household areas.

Location	Number of examined	Number of % with parasites		
		Ho	Pc	Total
[1]Sanitary	40	-	6 (15.0)	6 (15.0)
[2]Insanitary	40	4 (10.0)	12 (30.0)	16 (40.0)
Total	80	4 (5.0)	18 (22.5)	22 (27.5)

Ho: Helminthes ova, Pc: Protozoa cyst. Key: [1]Sanitary areas include hygienic areas such as kitchen, living room, bedroom, and passage. [2]Insanitary areas include filthy areas such as toilet, bathroom, septic tank, and trash can. -: Denotes absence of parasites

Table 3: Frequency of occurrence of stages of parasites species in pooled cockroach specimens.

Parasites species	No detected	Frequency (%)
Isospora belli oocysts	66	50.8
Ascaris lumbricoides ova	4	3.1
Entamoeba histolytica cysts	4	3.1
Enterobius vermicularis ova	56	43.1
Total	130	100.0

compared to earlier reports elsewhere: 67% in Owerri[20] and 77.52% in Sokoto,[21] Nigeria, and 98% in Egypt.[22] The low prevalence in our study compared to these reports of high prevalence may be attributed to the differences in the standard of household environmental hygiene as some of the study areas, as reported, severely lacked food sanitation and household hygiene practices.[22]

The higher rate of mechanical distribution of parasites on the external body surface, 45% compared to 10% in the gut content observed in this study agrees with 65.3% versus 34.6% prevalence in the anatomical site distribution recorded by Etim *et al.*[7] in their work in Anantigha area of Calabar, with a higher prevalence of 58.6% of vectoral transfer through fecal route. The difference in prevalence between the external surface and the internal contents of this insect may be associated with its body features, roaming, clustering, and habitual visitation of filth. They have been documented elsewhere to carry and transport organisms mechanically on their body parts (feet, body hairs, spines, and mouthparts) as they roam about feeding on filth.[12]

The higher prevalence of parasites in insanitary than sanitary locations of the studied residences (40% vs. 15%) may as well be linked to the difference in their degree of contact with the more contaminated materials in the insanitary areas with higher contamination with parasites than in the sanitary areas. A common observation in the study area is the prevalent absence of good toilet facilities in some houses as well as improper disposal of

household refuse. In such conditions, the abundance of cockroaches and their menace to public health cannot be overemphasized.

The intestinal parasites detected in this study included *I. belli* oocysts, ova of *E. vermicularis* and *A. lumbricoides,* and cysts of *E. histolytica/dispar*. This observation is similar to the reports of Tatfeng *et al.*[23] and Bala and Sule,[21] who also detected similar stages of parasitic organisms in their work in Edo and Sokoto States, Nigeria, respectively. In some other reports, parasites and other microbial agents have been found in external surfaces or internal body parts of cockroaches.[8,24] The previous reports[25] have associated these parasites with both human and animal diseases with significant morbidity and mortality, especially in circumstances of overcrowding, poverty, and poor hygiene standards.

The presence of these parasites of medical importance in the body parts of cockroaches is an indication that they could mechanically transmit same to their victims directly from their bodies or feces to the food for human and animal consumption[26,27] and/or indirectly through contact with inanimate objects.

CONCLUSION

This study has recorded a moderate prevalence of medically important parasites in cockroaches. It has also related the parasites prevalence with anatomical sites of the cockroach and the household environmental hygiene. This suggests a possible role of this insect as a potential agent of mechanical transmission of parasitic disease in this area.

To control these diseases, cockroaches in the human and animal habitations must be controlled by making the environment less favorable to them by the use of insecticides, gum traps, ensuring proper food storage facilities, and effective disposal of household refuse.

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Declaration of patient consent

Patient's consent not required as patients identity is not disclosed or compromised.

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Conflicts of interest

There are no conflicts of interest.

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