



Full Length Research Paper

Public health implications of cockroaches within households in Calabar municipality, Cross River State, Nigeria

Cletus I. Iboh^{1*}, Raymond O. Ajang², Hannah E. Etta¹ and Johashaphat T. Abraham¹

¹Department of Biological Sciences, Cross River State University of Technology, P. M. B. 1123, Calabar, Nigeria.

²Department of Zoology and Environmental Biology, University of Calabar, P. M. B. 1115, Nigeria.

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This study was carried out between May 2013 and April 2014 to investigate the different parasites harbored and transmitted by cockroaches within households in Calabar Municipality, Nigeria, in order to initiate integrated eradication programme. Four hundred and thirty (430) cockroaches from toilets, kitchens, bedrooms and living rooms were trapped using sterile hand gloves from different households within Calabar municipality between 7p.m. and 9p.m. Live cockroaches were placed in perforated sterile plastic vials and transported to the Biology Laboratory of Cross River University of Technology, Calabar for parasitological studies. Each identified cockroach was placed in a test tube containing 5ml of normal saline solution and shaken thoroughly for 5 minutes to detach any parasite or its stages of development from the body surface of the cockroach. The fluid was centrifuged at 3000 rpm for 10 minutes, and the deposit examined under a binocular microscope in search of parasites. Three hundred and forty-eight (348) parasites were recovered and identified as *Ancylostoma duodenales* larvae, *Ascaris lumbricoides* ova, *Enterobius vermicularis* ova and larvae, *Strongyloides stercoralis* ova and larvae, *Entamoeba histolytica* cysts and *Fusarium* species. This study revealed that cockroaches are reservoirs and mechanical transmitters of human intestinal parasites, and therefore require integrated control. We also advocate for investigation into the bacteriological profile of Cockroaches within houses in the study area

Key words: Cockroaches, households, implications, parasites, reservoir, transmitters.

INTRODUCTION

Cockroaches have existed more than 300 million years ago on this planet earth (Chamavit *et al.*, 2011). About 4500 species of cockroaches have been identified and are found all over the world (Nagham *et al.*, 2011). Cockroaches are nocturnal insects and only appear in the daytime when disturbed from their hiding places or when excessively large infestations erupt (Piper and Antonelli,

2012). Most of these species are found in the tropics and subtropical regions, living in dark places such as cesspits, septic tanks, sewers, rubbish dumps, refuse tips, dustbins and cupboards, drawers, underneath chairs, tables, sinks, baths and beds, behind refrigerators, cooking stoves, among stacked dishes in fact in almost any dark place (Service, 1980).

*Corresponding authors: E-mail: clenaboh@yahoo.com , Tel +2348035825249

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It has been disclosed that cockroaches are the most abundant and obnoxious non-biting insect pest in residential buildings, hospitals, hostels, hotels and restaurants (Bala and Sule, 2012). Cockroaches are among the most disagreeable insects that must be dealt with by occupants of homes, apartments or commercial establishments (Piper and Antonelli, 2012). Al-Mayadi and Al-yaqoobi (2010), observed that Cockroaches are aesthetically displeasing because they can soil items with their excrement and regurgitations.

In addition to their repulsive and annoying characteristics, they eat or contaminate human food and leave a persistent, objectionable odour in infected areas (Ajero *et al.*, 2011; Piper and Antonelli, 2012). Cockroaches habitually disgorge partially digested food and deposit their excreta on almost anything, including food (Herms, 1961). Some investigators revealed that cockroaches are the most notorious pest of premises that feed on human faeces, garbage and sewage and therefore have copious opportunities to disseminate cysts of enteric protozoan's and human pathogens (Monzon *et al.*, 1991; Cotton *et al.*, 2000; Thaddeus *et al.*, 2005; Pai *et al.*, 2005).

Several studies have documented the presence of parasites, bacteria and fungi on the external and internal body parts of cockroaches (Kinfu and Erko, 2008; El-Sherbini and El-Sherbini, 2011; Salehzadeh *et al.*, 2007; Fotedar *et al.*, 1991; Kapanic, 1994; Kassiri and Kazemi, 2012; Al-Mayadi and Al-yaqoobi, 2010). Furthermore, it has been established that cockroaches are intermediate hosts of pathogenic helminthes and carriers of viruses, fungi, protozoa and helminthes eggs (Salehzadeh *et al.*, 2007; Fotedar *et al.*, 1991; Kassiri and Kazemi, 2012).

The main objective of this study was to investigate parasites harboured and transmitted by cockroaches, with a view to eradicating these pests prior to the launch of a free environmental health day in the lower Cross River State by the National Ministry of Health.

MATERIALS AND METHODS

Study Area

The study on cockroaches as carriers and mechanical transmitters of parasites was conducted among households in Calabar municipality, Cross River State, Nigeria. This area is located between longitude 4° 57'0" and latitude 8° 19' 0" (Collins Map, 2014) and its sanitary condition posed a serious threat to public health. Shortage of houses in the study area occasioned by student population had resulted in crowded living conditions with poor toilet facilities. Pit toilets are kept inside thatched and semi-permanent buildings, and where water closets exist are in poor sanitary conditions due to broken soak-away pits and incessant shortage of pipe borne water supply. Inhabitants resorted to defecating around premises and along roads. Despite the

cleaning of roads by Calabar Urban Development Authority (CUDA), the filth in houses, streets and premises have favoured the proliferation of cockroaches in the area.

Sample Collection

Four hundred and thirty (430) cockroaches from toilets, kitchens, bedrooms and living rooms were trapped with sterile hand gloves from different households within Calabar municipality between 7p.m. and 9p.m. Each live cockroach was placed in a perforated sterile plastic vial and transported to the Biology Laboratory of Cross River University of Technology, Calabar, for parasitological studies. Each cockroach with complete body parts in the sterile vial was anesthetized by freezing at 0°C for 10 minutes. These were identified by their morphology and compared with standard taxonomic keys (Piper and Antonelli, 2012; Service, 1980).

Isolation and Identification of Parasites.

Each identified cockroach was placed in a test tube containing 5ml of normal saline solution. The test tube was thoroughly shaken for 5 minutes to detach any parasite or its stages of development from the body surface of the cockroach. The fluid was centrifuged at 3000 rpm for 10 minutes. The supernatant was poured into test tubes and 1ml deposit placed on a sterile microscope glass slide. This was stained with 1% Lugol's iodine solution, covered with cover slip and examined with x4, x10, and x40 microscope objective lens. The parasites and their stages of development were identified, counted and snapped. The identification was done using standard keys (Salehzadeh *et al.*, 2007; WHO, 2004).

Statistical Analysis

Chi square analysis was used to determine the association and significant difference between male and female cockroach infection and prevalence of helminthes and protozoa in cockroaches.

RESULTS

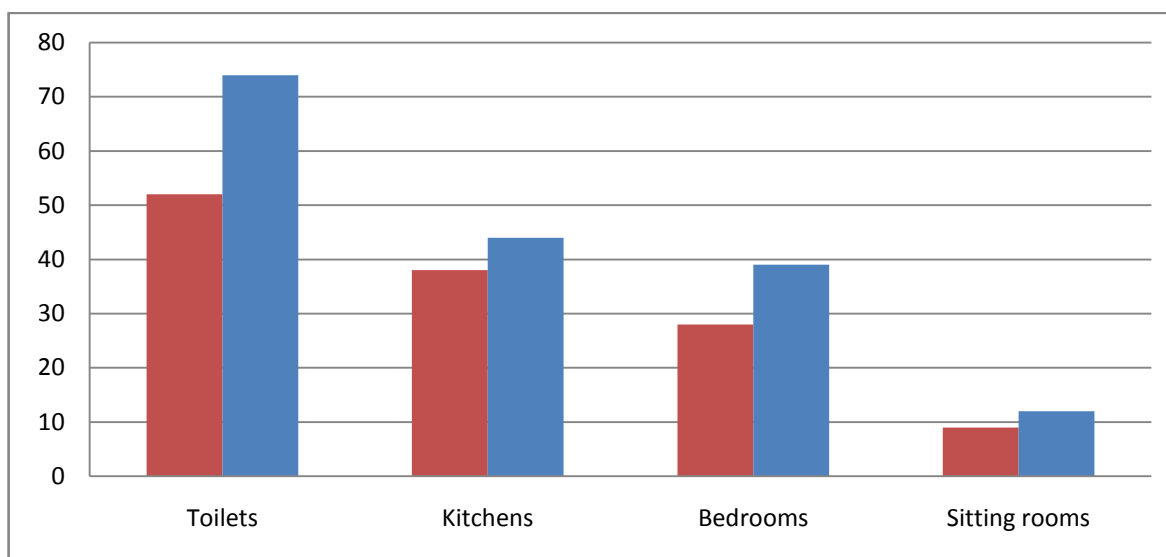
This study revealed that 68.8% of the 430 roaches trapped from various locations within households in Calabar municipality, harboured parasites of medical importance. The abundance and distribution of parasites in cockroaches based on location are illustrated in [Table 1](#). This table showed that cockroaches collected from toilets had the highest infection rate of 78.8% and parasite load of 3-52 parasites/ml, while those from kitchens had 70.8% and parasite load of 2-25 parasites/ml. An infection rate of 60.9% and parasite load of 1-15 parasites/ml were recorded in those roaches

Table 1: Percentage Infestation of cockroaches trapped in four locations within households in Calabar Municipality Nigeria.

Location	Cockroaches Examined	Cockroaches Infected	Percentage Infected(%)	Range of Parasite/ml
Toilets	160	126	78.8	3-52
Kitchens	120	85	70.8	2-25
Bedrooms	110	67	60.9	1-15
Living rooms	40	18	45.0	1-6
Total	430	296	68.8	

Table 2: Percentage Infestation of male and female cockroaches collected within households in Calabar Municipality, Nigeria.

Sex	No. of Cockroaches examined	No. of Cockroaches Infected	Percentage Infection (%)
Males	235	124	41.9
Females	195	172	58.1
Total	430	296	100

**Figure 1:** No. of Cockroaches Infected According to Sex and Location
Male ■
Female ■

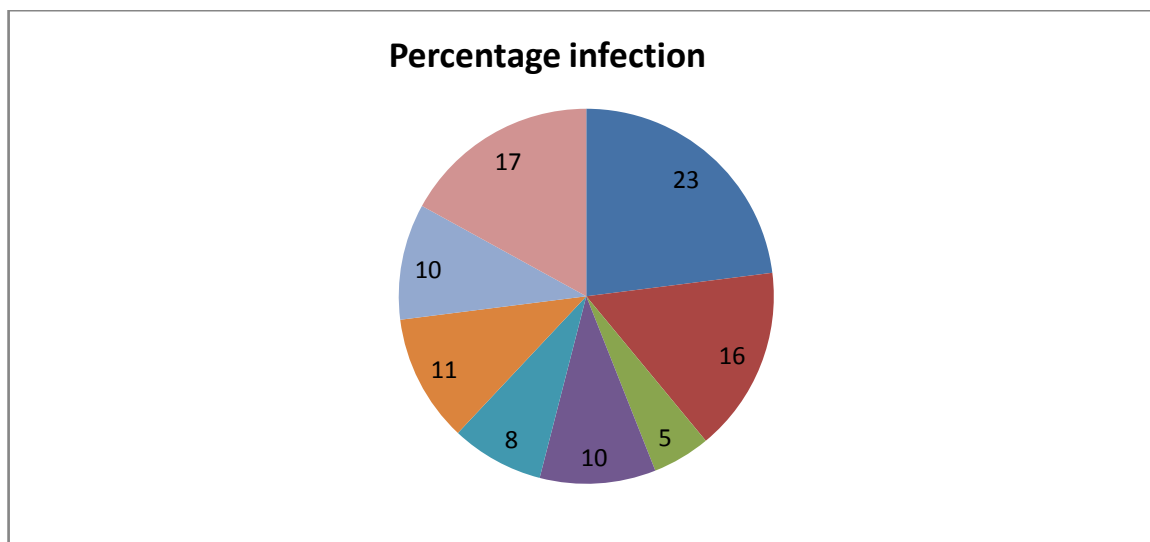
trapped from bedrooms. However, cockroaches collected from sitting rooms had an infection rate of 45.0% and parasite load of 1-6 parasites/ml. Mixed infections were observed in over 31% cockroaches trapped in the study area because 36.9% cockroaches had one parasite each, 17.4% recorded two parasites each and 14.5% showed 3 parasites each. It was found that the parasite capacity of 58.1% in female roaches was statistically higher (χ^2 -test, $P < 0.05$) than males with 41.9% parasite capacity (Table 2). This result indicated that though more male roaches were encountered in the study area than females, there was a higher parasite capacity in female roaches. Figure 1 showed parasite distribution in cockroaches according to sex and location. Female cockroaches collected from

toilets were the most infected, while those from the sitting rooms were the least infected.

In this study, 348 parasites were recovered and identified from the external body surface of 296 roaches. These comprised of 78.0% helminthes, 17.0% protozoa and 5.0% fungi (Table 3). The helminthes identified were *Ancylostoma duodenales* larvae (23.0%), *Acaris lumbricoides* ova (16.0%), *Enterobius vermicularis* larvae (10.0%), *Enterobius vermicularis* ova (8.0%), *Strongyloides stercoralis* larvae (11.0%) and *Strongyloides stercoralis* eggs (10.0%). The protozoa encountered were *Entamoeba histolytica* cysts (17.0%). The fungi isolated were mega conidia of *Fusarium* species (5.0%). There was no significant difference (χ^2 -

Table 3: Type and Percentage of Parasitic Infestation in Cockroaches within households in Calabar Municipality, Nigeria.

Type of Infection	No. of Cockroaches Infected	No. of Parasites isolated	Percentage Infection (%)
Helminthes	208	236	67.8
Protozoa	78	94	27.0
Fungi	10	18	5.2
Total	296	348	100

**Figure 2:** Percentage abundance of parasites recovered in the study area.

- *Ancylostoma duodenale* larvae
- *Ascaris lumbricoides* ova
- Fusarium spp. Conidia
- *Enterobius vermicularis* larvae
- *Enterobius vermicularis* ova
- *Strongyloides stercoralis* larve
- *Strongyloides stercoralis* egg
- *Entamoeba histolytica* cysts

test, $P > 0.05$) in the prevalence between helminthes and protozoa in cockroaches. **Figure 2** illustrated the percentage abundance of the species of parasites recovered from roaches in the study area. The most abundant parasite encountered in the study area was *Ancylostoma duodenales* larvae (23.0%). **Figure 3** showed the pictorial representation of some of the parasites recovered from the external body surface of cockroaches.

DISCUSSION

The possible involvement of cockroaches as transmitters of parasitic infections to humans has always been the opinion of people in many communities. The findings from this study revealed that more than 60% of cockroaches from the study area harboured parasites of medical importance and are capable of transmitting them mechanically to humans. The overall infection rate of 68.8% in cockroaches reported in this study is lower than

83.33% recorded by Al-Mayali and Al-yaqoobi (2010) in Al-Diwaniya; 98.0% recorded by El-Sherbini and El-Sherbini (2011) in Egypt and 77.25% observed by Bala and Sule (2012) in Sokoto. However, the infection rate observed in this study is higher than 54.1% shown by Chamavit *et al.*, (2011] in Thailand, 67.0% recorded by Ajero *et al.*, (2011) in Owerri and 58.6% observed by Etim *et al.*, (2012) in Anantigha, Calabar South.

In the study area, the inhabitants defecated around houses and along road paths, apart from keeping pit toilets right inside thatched and semi-permanent buildings. This environment favoured the proliferation of cockroaches and their contamination with parasites of medical importance. This findings correlated with that of Tاتفeng *et al.*, 2005; Etim *et al.*, 2012; El-Sherbini and El-Sherbini, 2011, who conducted their studies in areas littered with fecal matter.

Throughout the sampling period only one species of cockroach was found and identified as *Periplaneta americana*. *Blatta orientalis* were not encountered at all. The highest infection rate of 78.8% and parasitic load of

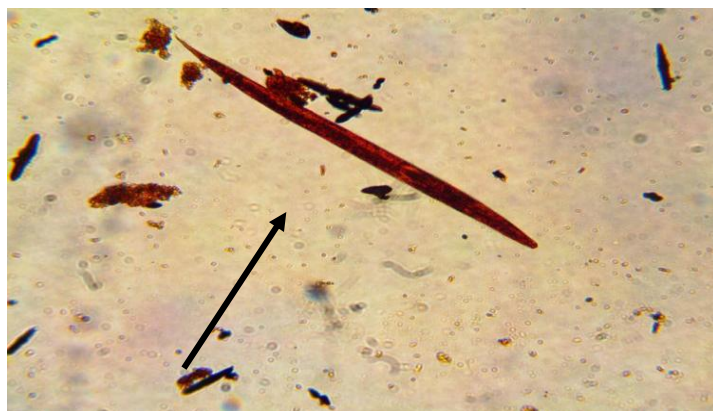
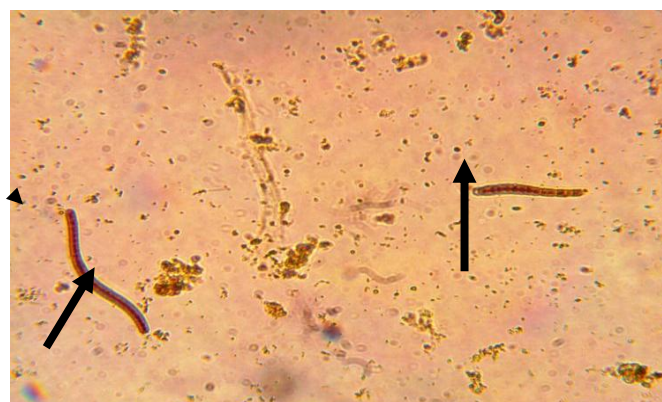
Larva of *Ancylostoma duodenale* (x40) Mega conidium of *Fusarium* spp.An ovum of *Ascaris lumbricoides* (x40)Ovum and larva of *Enterobius vermicularis* (x40) Filariformlarvae of *Strongyloides stercoralis* (x40)

Figure 3: Pictorial representation of some of the parasites recovered from the external body surfaces of cockroaches.

3-52 parasites/ml recorded by cockroaches from toilets with decreasing rates in kitchens, bedrooms and living rooms connotes their habitat, feeding and mobile behavior. This finding is in line with that of previous researcher like Tatfeng *et al.*, 2005; El-Shebani and El-Shebani, 2011).

This variation could be explained on the basis of their favorable hideouts in toilets during the daytime and frequently feeding on human feces, from which they acquired and have copious opportunity to disseminate pathogenic helminthes, fungi, and protozoa. In the evening time, they migrate into kitchens, bedrooms and living rooms where they deposit pathogens present on their body surface on kitchen utensils, clothing in bedrooms and on chairs in the living rooms. This observation corroborates several previous reports (Monzon *et al.*, 1991; Fotedar *et al.*, 1991; Cotton *et al.*, 2000; Thaddeus *et al.*, 2005).

Result from this study revealed that the parasite capacity in female cockroaches was higher than that in males. Although more male roaches were encountered in this study, the female parasite load was higher due to the

frequent roaming activity of females in search of food and egg – laying sites. Bala and Sule (2012), reported a similar view while working in Sokoto, Nigeria.

The American cockroach has been incriminated as the mechanical transmitter of parasitic and fungi infections in the study area. Unfortunately, cockroaches are common site in our homes but never taken seriously as reservoirs and transmitters of organisms causing dysentery, diarrhoea, typhoid and food poisoning. This report is similar to earlier reported findings of Banjo *et al.*, 2012; Bala and Sule, 2012). Information from different parts of the world revealed that parasitic infections abound in localities where environmental and personal hygiene is very low (Chamavit *et al.*, 2011; Piper and Antonelli, 2012). The present study recorded *A. duodenales*, *A. lumbricoides*, *E. vermicularis* and *S. stercoralis* which have been incriminated as the causative agents of helminthiasis. The presence of *E. vermicularis* infestation showed that *Periplaneta americana* had opportunity to contact infested patients directly or contaminated clothing's which symbolized their transmission potentials for parasitic diseases (Chan *et al.*, 2004) Also, *E.*

histolytica and *Ballantidium coli* cysts infestation of cockroaches, suggests strongly that cockroaches are transmitters of amoebiasis.

Worthy of mention in this study is the contamination of cockroaches with mega conidia of *Fusarium* species. Talaro and Talaro (1996), revealed that *Fusarium* occasionally infects the eyes, toenails and skins of humans. Mechanical introduction of the fungus into the eyes, by contaminated lenses can induce a severe mycotic ulcer. It can also cause a patchy infection of the nail bed like *Tinea unguium*. *Fusarium* colonization of patients with widespread burns has occasionally led to mortalities (Talaro and Talaro., 1996).

CONCLUSIONS

These findings revealed that cockroaches constituted a serious health risk for humans in the study area, although most of the inhabitants are not aware of the role of cockroaches in disease transmission. The Government should intervene by providing Health Education programmes aimed at inculcating environmental sanitation amongst inhabitants of this area. Suitable chemical spray of insecticides should be encouraged by Government within houses in the study area. We also advocate for investigation into the bacteriological profile of Cockroaches within houses in the study area.

Competing Interests

There was no competing interest in this research work.

Authors' Contribution

CII initiated the concept of this investigation and was the leader of this research work. CII, ROA, JTA, and HEE, were involved in the collection of data and writing the manuscript. CII, JTA and HEE provided the parasitological procedure, typed the manuscript, and carried out the statistical analysis. The approval of the final manuscript was the responsibility of all the authors.

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