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Isolation and Identification of Intestinal Parasites of Public Health implications from Cockroaches (*Periplanta americana*) from Kontagora Town, North-Central, Nigeria

***Olatayo Bamidele Oriolowo, Christiana Omolola Adeniran, Philip Jacob, Abdulkareem Aliyu**

Department of Biology
Federal University of Education,
PMB 39, Kontagora,
Niger State,
Nigeria.

Email: oriolowotayo@yahoo.ca

Abstract
We investigated the prevalence of human intestinal parasites in cockroaches and their public health implications in residential apartments in Kontagora, Niger State, North-Central Nigeria, in 2022. This work aims at determining the types and the prevalence of intestinal parasites harboured by cockroaches. About eighty (80) adult cockroaches (Periplaneta americana) were trapped from three residential areas and screened for human intestinal parasites. The results showed that 57.50% of the cockroaches caught were infected with parasites. There was a significant difference (P> 0.05) in the number of infected male and female cockroaches. Parasite species identified were as follows: Strongyloide stercoralis (19%), Entamoeba histolytica eggs (19%), Dipylidium caninum egg capsules (11%), Enterobius vermicularis eggs (20%), Ancyclostoma duodenale (15%), Ascaris lumbricoide (8%) and Hymenolapis nana (8%). Parasite prevalence and burdens varied with location; the prevalence was higher (P<0.05) in cockroaches from state low-cost residences than in Kwangara and Federal University of Education students' hostel. Parasite prevalence was significantly higher in the gut than on body surfaces and faecal material. Cockroaches carry infective stages of human intestinal parasites and may act as reservoirs and potential mechanical vectors for disease transmission in humans.

Keywords: Cockroaches, *Periplaneta americana*, *Vector,* Intestinal Parasites, Kontagora

INTRODUCTION
Cockroaches are one of the most hated non-biting insect pests in residential apartments, hospitals, restaurants, grocery stores and commercial facilities (Zahraei-Ramazani *et al.,* 2018). They are most active at night and commonly found in places of warmth, damps, darkness and where there are exposed food particles. Cockroaches visit dirty places like dumpsites, toilets, and sewage and are coprophagic, feeding on the faecal wastes of humans and animals. They often move between human living apartments and contaminated environments and this creates the risks of transmission of parasites and pathogens of public health importance (Atiokeng-Tatang *et al.,* 2017). They vomit part of their gut contents or defecate on exposed

**Author for Correspondence*

human food and have been implicated as an agent of food poisoning through their saliva droplets. In addition to acting as vectors of parasites and pathogens, cockroaches can trigger asthma because they carry certain proteins in their bodies which are allergens to some people (Rosenstreich *et al.*, 1997).

Cockroaches have remained a formidable part of our ecosystem for over 300 million years (Zurek & Schal, 2004). Less than 1% of over 3500 described species of cockroaches are associated with human-dwelling places. Among these, *Blatella germanica, Blatella orentalis* and *Periplaneta americana* are most common in homes and public places. In Nigeria, cockroaches are abundant in most homes (Etim *et al,* 2013), where their presence has become an embarrassment. Apart from their health risks at home, they release offensive secretions from their bodies which leave a long-lasting irritating smell in places or food they visit. Studies in Nigeria have shown the severity of health risks associated with cockroaches (Adenusi *et al.*, 2018). However, many are yet to come to terms with this reality especially dwellers in the rural and semi-urban areas of the country. In Kontagora, to the best of our knowledge, no epidemiological data on the risk factor associated with the presence of cockroaches in human dwellings are available.

The present study was therefore aimed at isolating and identifying parasites of public health concern from cockroaches collected from residential houses in Kontagora town. The findings will be of benefit to the residents and others within and outside the town as they will shed light on the potential risks they might face with the presence of cockroaches in their houses. It will also help in designing a more efficient control strategy against the insect.

MATERIALS AND METHODS

Study Area

The study was conducted in Kontagora town, Niger State, North-Central Nigeria, from April to September 2022. The town is located on the coordinate 10^{o}.24N Latitude and 5^{o}.28E Longitude and has an elevation of 335m above sea level (Iwalaye *et al.*, 2022). The town covers about 2,076 km^2 and with a population of 151,598 according to the recent population census (NPC, 2006). As a commercial town, Kontagora's sanitary conditions are below World Health Organization recommendations. Residences lack pipe-borne water and are therefore dependent on wells and commercial boreholes for their water supply. Many homes lack good toilet facilities, organized waste disposal systems, refuse dumpsites close to residential areas and poorly maintained drainage systems.

Sample collection

A total of eighty (80) adult cockroaches, *Periplaneta americana* were caught using a passive trap from three residential areas (Federal University of Education Kontagora students' hostels, Kwangara and State low-cost) in the town between 9 pm to 4 am. Each cockroach was kept separately in a labelled matchbox in the Biology laboratory, Federal University of Education Kontagora for 24 hours to get their faecal samples. Each cockroach was later preserved in a labelled vial containing cotton soaked in 10% chloroform. The cockroaches were sexed and identified using standard taxonomic keys (Ross, 1965)

Isolation of parasites from cockroach body surface

Parasites on the body surface were collected by adding 15 ml of physiological saline into the vial containing each cockroach and vortex slowly for 2 minutes. The cockroach was removed

from the vial using sterile forceps and air-dried at room temperature. The solution in the vial was centrifuged at 2000 rpm for 5 minutes. The supernatant was decanted and sediment placed on a slide, stained with Lugol's iodine and observed at x40 under the microscope for parasites.

Isolation of parasites from cockroach faecal

Faecal collected from each cockroach was put into a sterile test tube containing 15 ml of physiological saline solution for 30 minutes to dissolve. The mixture in the test tube was centrifuged at 2000 rpm for 5 minutes, allowed to stand for 2 minutes and the supernatant decanted. The sediment was placed on the slide, stained with Lugol's iodine and examined under a microscope at x40 for parasites.

Isolation of parasites from the cockroach intestine

The air-dried cockroach was placed in a petri dish, the head and legs removed and the abdomen dissected under a dissecting microscope. The gut was removed using fine needles. The gastrointestinal tracts were removed, opened, washed and homogenized in a test tube with 15 ml of saline solution. The homogenate was filtered with a tea sieve and centrifuged at 2000 rpm for 5 minutes. The supernatant was decanted and the sediment was placed on a slide, stained with Lugol's iodine and examined at x40 under microscope. Three microscopic examinations were carried out per sample per cockroach for all parasitic isolation, identification and count. Parasites isolated from the gut, faeces and body surfaces were identified according to Cheesbrough (2009).

Statistical Analysis

Descriptive statistics of percentage were used to present the number of cockroaches, sexes of cockroaches and number of infected cockroaches. Inferential statistics of t-test was used to compare the number of infected male and female cockroaches and Analysis of Variance (ANOVA) was used to compare the number of parasites isolated from the gut, faeces and body of the cockroaches at $P< 0.05$.

RESULTS

Table 1 shows the distribution of cockroaches used for the study. A total of eighty (80) cockroaches were collected for this study. Twenty 20 (25%) were collected from the Federal University of Education (FUE) Kontagora students' hostel, 27 (33.75%) from residential houses in Kwangara and 33 (41.25%) were collected from State low-cost residential houses. A total of 33 (41.24%) of the cockroaches were males and 47 (58.75%) were females.

Table 1: Distribution of Cockroaches collected by gender from the sample sites

Gender	FUE Hostel	Kwangara	State Low-cost	Total
Male	8	11	14	33
Female	12	16	19	47
Total	20	27	33	80

Table 2 shows the mean male cockroaches infected with at least a parasite to be 20.00 ± 2.45 (25%), the mean infected females was 26.00 ± 3.56 (32.5%) and the mean total number of infected cockroaches were 46.00 ± 4.08 (57.50%).

Table 2: Number of infected cockroaches

Gender	Body surface	Faecal	Intestine	Total
Male	17	20	23	20.00 ± 2.45^{a}
Female	29	21	28	26.00 ± 3.56^{b}
Total	46	41	51	46.00 ± 4.08

Values are the mean of triplicate counts

Values with superscripts of different letters in the same column are significantly different.
Table 3 shows the mean number of parasites isolated from the cockroaches' bodies, Faecal and intestines from the three sampled locations. More parasites were isolated from cockroaches from the state low-cost residence and the least parasites isolated were from the Federal University of Education students' residential hostels

Table 3: Average number of parasites isolated from cockroaches from each location

Location	Body surface	Faecal	Intestine
FCE Hostel	6.25 ± 1.09[a]	3.75 ± 0.43[a]	9.75 ± 1.41[a]
Kwangara	8.80 ± 2.92[b]	7.20 ± 2.04[b]	10.40 ± 1.85[b]
State Low-cost	9.67 ± 2.92[b]	9.67 ± 1.37[c]	13.17 ± 2.19[c]

Values are the mean of triplicate counts
Values with superscripts of different letters in the same column are significantly different.

Figure 1 shows the seven parasites isolated from cockroaches in this study; *Strongyloide stercoralis, Entamoeba histolytica* eggs, *Dipylidium caninum* egg capsules, *Enterobius vermicularis* eggs, *Ancyclostoma duodenale*, *Ascaris lumbricoide* and *Hymenolapis nana*. The most frequently occurring parasite was *E. vermicularis* and the least were *A. lumbricoide* and *H. nana* with 8% occurrence each.

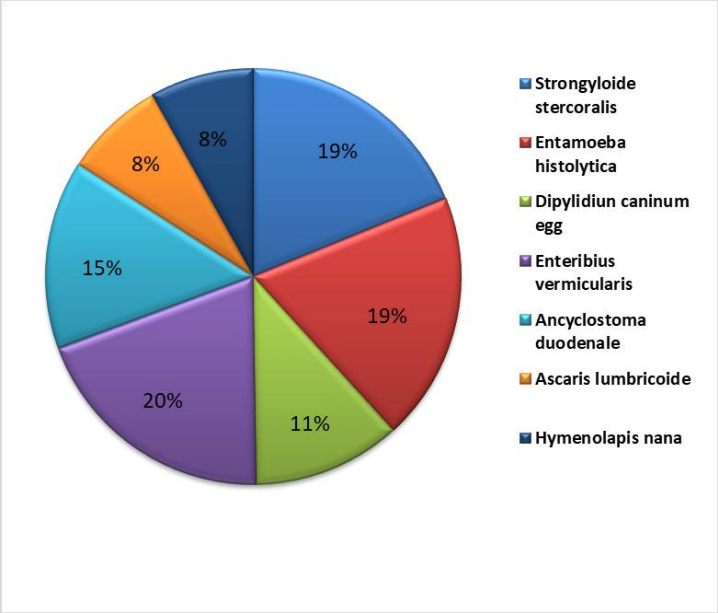

Fig. 1: Parasites isolated from the study locations

Figure 2 shows the ratio of parasites isolated from the cockroaches' body surfaces, faecal and intestine. There were more (42%) parasites recovered from the intestine, followed by the body surface (31%) and the least (27%) from the faecal material.

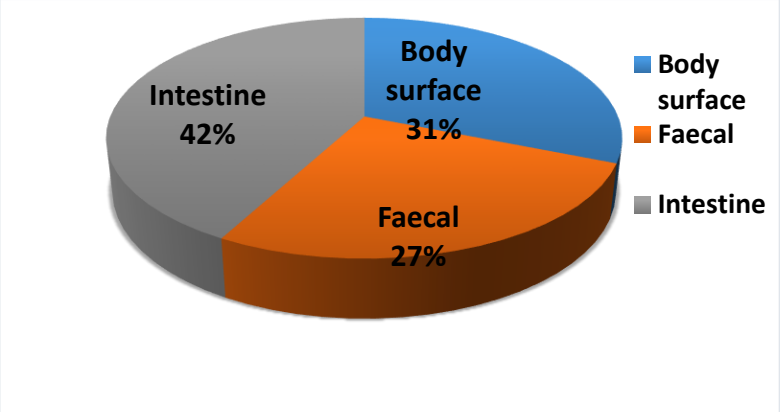

Fig. 2: Ratio of parasites isolated from cockroaches' body, faecal matter and intestine

DISCUSSION

Seven parasites of medical importance were isolated from the body surfaces, faecal material and gut contents of *Periplaneta americana*. The parasites identified were similar to those reported by Adenusi *et al*, (2018). This study shows that 57.25% of the cockroaches examined are infected with human parasites. This result is in contrast with 77.52% infected cockroaches reported by Bala & Sule (2012) and 32.2% reported by Oyeyemi *et al* (2016) who both assessed the vectoral capacity of cockroaches in the transmission of human intestinal parasites in Nigeria. Differences in the sanitary conditions of the environment might have accounted for the variation in the parasite loads of these cockroaches. The study also revealed female cockroaches harbour a higher number of parasites (56.52%) than males (45.48%). A similar result of higher female infection was reported by Atiokeng-Tatang *et al* (2017). Higher parasite loads on the females could be due to their habit of roaming more than males in search of food and sites for egg laying (Bala & Sule, 2012).

Six helminth worms *Strongyloide stercoralis, Dipylidium caninum, Enterobius vermicularis, Ancyclostoma duodenale, Ascaris lumbricoide, Hymenolapis nana* and one protozoan Entamoeba histolytica were isolated from the cockroaches. These are similar to the reports of the parasites isolated from cockroaches from other parts of Nigeria (Oyeyemi *et al*, 2016; Ikem *et al,* 2023). The three most encountered parasites in this study were *E. vermicularis*, *E. histolytica* and *S. stercolaris*. *E. vermicularis* is a nematode commonly called human pinworm. It usually infects children and its transmission is through the faecal-oral route. The infection is usually asymptomatic, however, at night the female worm migrates to the anal region where they cause severe perianal itching. *E. vermicularis* has been linked with the obstruction of the appendix vermiformis lumen leading to appendicitis (Eslahi *et al,* 2022). *E. histolytica* resides in the large intestine where its presence leads to severe ulceration, colon inflammation and diarrhoea associated with blood. The infiltration of their trophozoite into the blood causes hepatic abscess (Cassia *et al,* 2010). *E. histolytica* is the cause of amoebiasis, a leading cause of parasitic morbidity (Skappak *et al*, 2014).

S. stercolaris is a human parasitic threadworm which causes strongyloidiasis. The symptoms include abdominal pain, diarrhoea and rash. Severe symptom in immunosuppressed individuals leads to an imbalance in the gut microbiota (dysbiosis) and chronic kidney diseases (Nallu *et al,* 2017). *H. nana* commonly known as dwarf tapeworm is responsible for the most common cause of cestode infection in humans (Shahnazi *et al,* 2019). Clinical symptoms of the disease include headache, weakness, anorexia, abdominal pain and diarrhoea. A. lumbricoides is a human intestinal roundworm which causes ascariasis.

Ascariasis is a cosmopolitan intestinal parasitic disease estimated to affect approximately 1.4 billion people worldwide (Sarina & Chitkara, 1997). Heavy infestation of ascariasis causes blockage or perforation of the intestine and occasionally blockage of the bile and pancreatic ducts (Braid & Fatal, 1986). It also has a suppressing effect on the bone marrow of the patients, leading to an anaemia condition (Obeagu *et al*, 2017).

The helminth nematode, *A. duodenale* infection is acquired through direct contact with contaminated soil and faeca-oral route (Calvopina *et al,* 2017). The worm adheres to the inner wall of the small intestine, absorbing blood, causing erosions, ulcers and blood loss, resulting in anaemia. About 740 million people are infected by this parasite worldwide and the disease causes an average of 65,000 deaths per year (Djuikwo-Teukeng *et al,* 2019). *D. caninum*, also called dog tapeworm is the cause of dipilidiosis, however, human cases especially in children have been reported (Chong *et al*, 2020). The infection of humans by *D. caninum* can be asymptomatic with non-specific symptoms like abdominal pains, bloating, diarrhoea, and anal itching that may result in abrasions dermatitis, vomiting and fever (Chong *et al*, 2020).

CONCLUSION

The American cockroach, *Periplaneta americana* lives in human dwelling places and their health threats to human due to their habits and the parasites they harbor have been underrated. They thrive in filthy environments and good hygiene practices will keep them away. Periodic fumigation of homes is necessary to reduce their presence and the potential for nosocomial infections. It is very important to raise people's awareness of the need to keep themselves and their food safe from cockroach contamination as they could play a significant role in the mechanical transmission of parasite-related diseases

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