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Full Length Research Paper

Ecto and endo parasitic helminths of cockroaches (*Periplaneta americana*) from Diobu, Port Harcourt, Nigeria

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Abstract

Cockroaches have established a synanthropic relationship with humans and are vectors and reservoirs of helminth parasites of public health importance. This study assessed the role of the American cockroach (*Periplaneta americana*) in the transmission of intestinal helminth parasites in the Diobu axis of Port Harcourt, Rivers State-Nigeria. A total of seventy-eight cockroaches comprising thirty-five males and forty-three females were collected, euthanized with chloroform individually in a jar and examined for helminths using conventional methods. Parasites recovered were *Ascaris lumbricoides*, hookworm, *Strongyloides stercoralis, Enterobius vermicularis* and some unknown ova. These were recovered from fifty-two (66.6%) cockroaches: twenty-three (29.4%) males and twenty-nine (37.2%) females. There was no significant difference in prevalence considering gender (p≥0.05) though Chi-square proved prevalence to be sex associated (p≤0.016). A total of 1,236 helminth parasites were recovered with the external body surface having a higher abundance (n=701) in comparison with the gut (n=535). *Ascaris lumbricoides* followed by hookworm was the most abundant species. Conclusively, *P. americana* was found to host intestinal helminth parasites of public health importance. Therefore, it becomes imperative to intimate residents on the potential role of cockroaches in the transmission of human helminthiasis and encourage sanitation and appropriate use of insecticides.

Keywords: Public health, cockroaches, helminthiasis, environmental sanitation.

INTRODUCTION

Cockroaches are ubiquitous and have survived the earth for over 300 million years without any change (Zurek and Schal, 2004). They are regarded as one of the most successful extant groups of the kingdom Animalia because of their ability to adapt and thrive in prevailing environmental conditions. There are about 3000 species of cockroaches worldwide (Kopanic, 1994) amongst which only 30 species are associated with human habitations and environs (Kinfu and Erko, 2008). The most common species of cockroaches seen within human dwellings are *Periplaneta americana* and *Blattella germanica* (Tilahun *et al.,* 2012). Majority of these cock-

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roaches are found abundantly in the tropics and subtropics where no serious economic importance is attached to their increasing number (Vazirianzadeh *et al.,* 2009).

Cockroaches are found in areas with constant and high moisture availability such as drainages, kitchens, toilets, sewage tanks (Tatfeng *et al*., 2005). These insects are nocturnal in nature and possess a repulsive smell which is characteristic of the corners they inhabit. They fly over, consume and contaminate food leaving this constantly repulsive smell on surfaces (Zurek and Schal, 2004). Cockroaches make a meal of man's faeces, sewage and garbage (Siachua *et al.,* 2008). This obnoxious characteristic puts them in a pivotal role in the transmission of pathogens in the environment such as bacteria (*Vibrio cholerae, Salmonella spp., Klebsiella pneumoniae* and *Enterobacter aerogenes*) (Iboh *et al.,* 2014), viruses, protozoa and helminths (Tatfeng *et al*., 2005).

There is insufficient literature on the role of cockroaches as paratenic hosts of helminth parasites in Rivers State, Nigeria. This research was therefore, designed to identify the parasitic helminths associated with the external parts and gut of cockroaches from the Diobu axis of Port Harcourt, Rivers State, Nigeria. The results obtained from this study would be of public health importance and also bridge the gap on the paucity of information on cockroaches as paratenic hosts in the study location.

MATERIALS AND METHODS

Study area: This study was carried out in Diobu, a densely populated neighborhood of Port Harcourt, Rivers State, Nigeria, between September and October, 2020. It is located within Port Harcourt metropolis and has three extensions: Mile 1, 2 and 3. It is bordered by New GRA to the north, Rivers State University to the northwest, D-line to the northeast, Old GRA to the east, Eagle Island to the southwest and Kidney Island to the southeast. The GPS coordinates of Diobu are: latitudes 4°47'24"N and Longitude 6°59'36"E. Diobu is a semi-cosmopolitan town with a lot of commercial activities due to the large markets it harbors, and is characterized by prevailing poor sanitary conditions.

Sample collection/size: A total of seventy-eight (78) adult cockroaches were trapped in the environs of Diobu between the hours of 8pm and 10pm using sterile hand gloves. They were transported in vials stored in ice packs to the Entomology and Parasitology Laboratory, Department of Animal and Environmental Biology, Rivers State University, Port Harcourt, for proper identification and parasitological analyses.

Identification of Cockroaches and Parasitological Analyses: The roaches were identified to species level using their morphological and morphometric characteristics. The gender of the specimens was determined by examining their morphological characteristics.

Isolation of Parasites from the External Body Parts: Parasitic helminth eggs and/or larvae were dislodged from the external body surfaces by submerging each individual in 2ml sterile physiological saline in a test tube which was shaken vigorously. Cockroaches were removed from wash solutions using sterile forceps, fixed in 70% alcohol for 5minutes and allowed to air dry at room temperature. Wash solutions were centrifuged at 2000rpm for 5mins with the supernatant decanted and the sediment properly mixed. A drop of the sediment was mixed with a drop of Lugol's iodine stain on a clean grease free glass slide, covered with coverslip and examined under the light microscope using x40 objective (Nwangwu *et al.* 2013; Al-Aredhi 2015). Helminth parasite species recovered were identified following Cheesbrough (2009).

Isolation of parasites from the gut: After washing, cockroaches were pinned on a dissecting dish. Head, legs and the wings were first severed with the help of fine pointed forceps and scissors. The body was pinned to another small dissection dish with a dark background by thin but strong pins facing the ventral surface upwards. Using scissors, the ligaments on the edges of both sides of the abdominal sternites, beginning at the posterior end of the ventral plate were cut and one side was lifted from the rear towards the anterior. The petri dish was filled with physiological saline to allow the fatty bodies around the gut float, carefully removing them with the aid of a fine brush. The gut was cut out of the body, teased in a vial containing 2ml of physiological saline. The solution was centrifuged at 2000rpm for 5mins with the supernatant decanted and the sediment mixed properly. A drop of Lugol's iodine was added to a drop of the sediment on a clean grease free glass slide, covered with coverslip and examined under the light microscope using x40 objective (Nwangwu *et al.* 2013; Al-Aredhi, 2015). Helminth parasites recovered were identified following Cheesbrough (2009).

Statistical Analyses: Prevalence of infection was computed as percentage of infected hosts after Bush *et al*. (1997). Descriptive statistics were used to determine prevalence of infection while Chi-square (χ^2) analysis was used to determine association and significant differences between the gender tested at $p<0.05$.

RESULTS

Five parasitic helminth species were encountered in this study and they included: *Ascaris lumbricoides* (Plate 1), hook worm, *Strongyloides stercoralis* (Plate 2), *Enterobius vermicularis* and some unknown ova.

Seventy-eight (78) adults were examined; fifty-two (52) were infected with parasitic helminths accounting for a

Plate 1: Photomicrograph of *A. lumbricoides.*

Plate 2: Photomicrograph of larvae of *S. stercoralis.*

Table 1: Prevalence of Infection Based on Gender.

Organism	**Infected n(%)**		**Uninfected n(%)**	
Periplanata americana	Male	Female	Male	Female
	23 (29.4)	29 (37.2)	12 (15.38)	14 (17.95)
Total prevalence	52 (66.6)		26 (33.4)	

total prevalence of 66.6%. Infected males and females accounted for a prevalence of 29.4% and 37.2%, respectively (Table 1).

Ascaris lumbricoides was the most prevalent helminth parasite with a total prevalence of 65.4% followed by hook worm (34.6%), while the unknown ova had the lowest (2.6%) (Fig.1). Prevalence of infection was observed to be higher in females than in males but there was no statistical difference between prevalence in gender ($p \geq 0.05$) (Fig. 2). However, Chi-square proved the prevalence to be sex dependent ($p \leq 0.016$).

Predilection of Helminth Parasites in Infected *P. americana*

A total of 1,236 helminth parasites were recovered from this survey with the external body surface having 701 and the gut, 535. Prevalence of parasites did not differ significantly between the external surface and gut, except for *Strongyloides stercoralis* and hook worm ($p \geq 0.05$) which were more prevalent on the external than in the gut.

DISCUSSION

The significance of cockroaches as carriers of most forms of parasitic helminths such as eggs or larvae was based on previous studies reporting the presence of such parasitic forms in and on these organisms (Robert *et al*., 2016; Villagrán-Herrera *et al*., 2019). Cockroaches play significant roles as potential vectors of parasitic helminthiasis in various communities (Bala and Sule, 2012; Etim *et al*., 2013). Observations from this study has revealed cockroaches to be reservoirs, mechanical transporters and transmitters of parasitic helminths. This is in agreement with previous reports from studies in Nigeria (Tatfeng *et al*., 2005 in Edo State; Bala and Sule, 2012 in Sokoto; Etim *et al*., 2013 in Calabar; Ojianwuna,

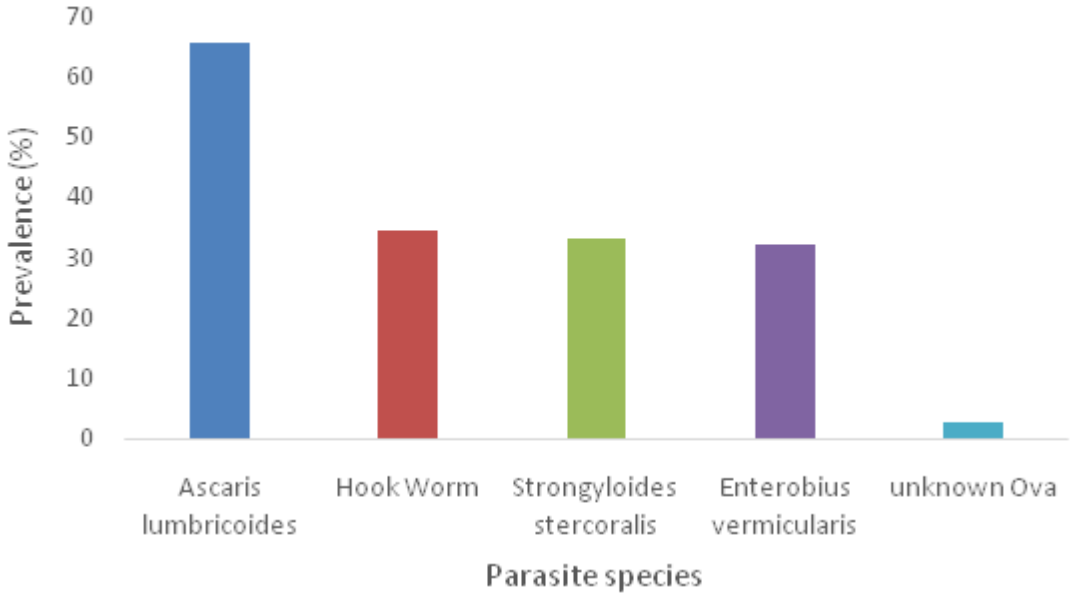

Fig. 1. Total Prevalence of Helminths in Infected *P. americana*, Diobu, Port Harcourt, Nigeria.

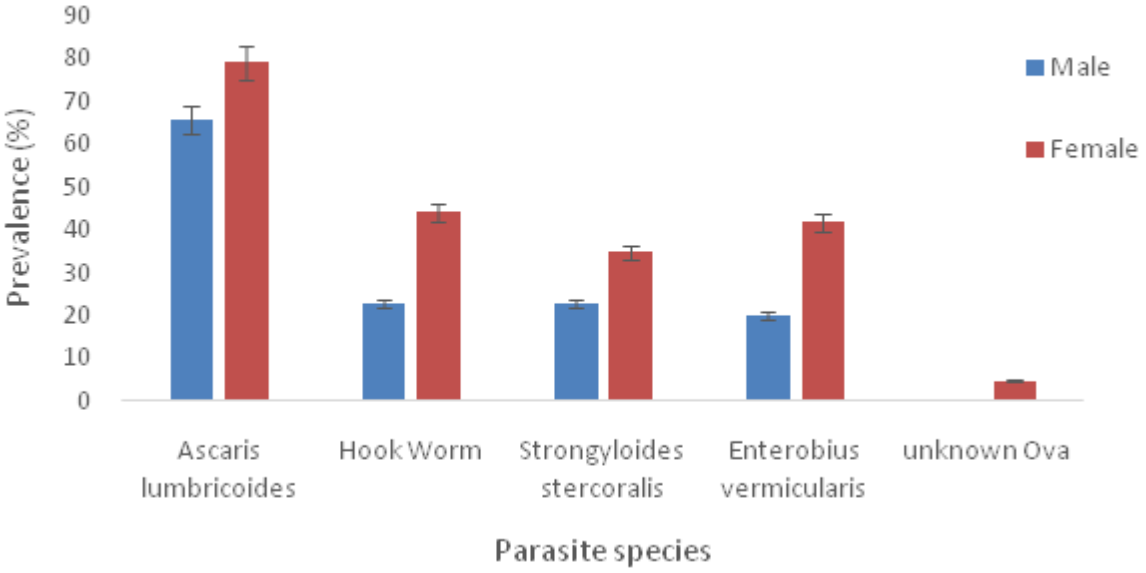

Fig. 2. Prevalence of Helminths Based on Gender, in Infected *P. americana*, Diobu, Port Harcourt, Nigeria.

2014 in Delta State and Otu-Bassey *et al*., 2019 in Calabar) and Haile *et al*. (2018) in Ethiopia.

Periplanata americana was the only species of cockroach encountered in this study from Diobu axis of Port Harcourt. Reasons could be due to their cosmopolitan nature and wide distribution in addition to their reproductive ability and survivability in the tropics (Tatfeng *et al*., 2005). Some authors previously reported two species *Periplanata americana* and *Blattella germanica* (Ajero *et al*., 2011; Ameh, 2015). However, the monospecificity observed in this research could be due to the effects of the global lockdown (which was a precautionary measure against the Covid-19 pandemic) which provided opportunity for frequent use of insecticides to eliminate the other sedentary species (Tatang *et al*., 2017).

In the present study, the species of helminth parasites recovered from the cockroaches were *Ascaris lumbricoides,*

hookworm, *Enterobius vermicularis, Strongyloides stercoralis* and an unknown spp. Four of these species have also reported in previous studies (Ajero *et al*., 2011; El-Sherbini and El-Sherbini, 2011; Okafor and Elenwo, 2014; Ameh, 2015; Tatang *et al*., 2017; Otu-Bassey *et al*., 2019). These species have been noted to cause some pathological conditions in humans which could lead to serious health issues (Adenusi *et al*., 2018).

The overall prevalence of 66.6% recorded in this study is higher than the 58.6% reported from Calabar by Tatang *et al*. (2017) but lower that 79.1% reported by Okafor and Elenwo (2014) in Abua Odua in Rivers State, Nigeria. The observed prevalence is also lower than 98% reported in Egypt by El-Sherbini and El-Sherbini (2011). The low prevalence of these helminths in our study when compared to Okafor and Elenwo (2014) in Abua Odua could be as a result of an improved sanitary condition in our study area over the latter which is a rural area. In comparison with report from Egypt, however, the lower prevalence computed in the recent research could be due to differences in sampling sites: we sampled houses while they sampled areas littered with piles of fecal matter.

Female roaches had more helminth parasites than the males irrespective of predilection site but there was no significant difference in their prevalence ($p > 0.05$). This is in variance with previous reports (Tatfeng *et al*., 2005; Okafor and Elenwo, 2014; Tatang *et al*., 2017). This suggests that both genders could have equal chances of vectoring these helminths. These disparities could also be due to differences in sample size. Previous authors had large sample sizes but this study had a handful due to the lack of compliance of residents in allowing personnel into their homes for the fear of contracting the widespread Covid-19. The differences in abundance of helminth parasites between the predilection sites does not change the fact that both sites could have an equal chance of vectoring the parasites.

Ascaris lumbricoides and hookworms, which cause Ascariasis and hookworm infections, respectively, in humans were the most encountered species irrespective of predilection site. This is in consonance with the findings of Micheal *et al*., (2017) who reported *Ascaris lumbricoides* to be of the highest prevalence in their study to determine prevalence of gastro-intestinal parasitic helminths among school children in Port Harcourt city. Also Goodhead *et al*., (2018) recorded 45.16% prevalence for *Ascaris lumricoides* in Port Harcourt. These reports of high prevalence of Ascariasis in roaches and man could be linked to the observed crude sewage disposal method. In the areas sampled, sewage is disposed directly into the drainages thereby allowing roaches feed directly on the fecal matter. This paves way for the spread of the eggs of parasitic helminths.

The high vectoring of *Ascaris lumricoides* eggs observed in this study can also be explained by the fact that ova of *Ascaris* species are adapted to be resistant and survive harsh environmental conditions due to the possession of an innermost shell layer with a lipoprotein nature that enables them to be airborne (Smyth, 1996). These make them unique amongst other nematodes eggs. Furthermore, high fecundity in the females is another reason for higher abundance as a single female could lay relatively about 200,000 eggs in a day (Soulsby, 1982). The unknown species which was scarcely recovered has not been properly identified but its occurrence suggests it could also be of potential risk to man.

CONCLUSION

This study has shown rich diversity of parasitic helminths in the cockroaches examined in Diobu, Port Harcourt, and has revealed them to be reservoirs and vectors. As such, parasitic infections could spread easily from the cockroaches to humans in the community even as they share a synanthropic relationship. Keeping close proximity with cockroaches, most importantly around human residence, should therefore be discouraged. Constant sensitization and orientation of residents on the public health dangers associated with cockroaches and the best fit control measures are encouraged. There should also be constant monitoring of the sewage disposal practices in this location in addition to efficient environmental sanitation. Studies on the helminth infection status of Diobu residents and mass deworming programs are also recommended.

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