ISSN 1996-3351

Asian Journal of Biological Sciences

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OPEN ACCESS Asian Journal of Biological Sciences

ISSN 1996-3351
DOI: 10.3923/ajbs.2019.313.319

Research Article
Spatial Distribution and Prevalence of Parasites Vectored by *Periplaneta americana* in Southern, Nigeria: Implication for Intervention

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Abstract

Background and Objective: Cockroaches pose significant public health problem due to their ability to mechanically transmit human intestinal parasites and other disease-causing micro-organisms. Hence this investigation was carried out to assess the prevalence and distribution of parasites associated with *Periplaneta americana* in Otefe-Oghara, Delta state, Nigeria. **Materials and Methods:** About 984 *P. americana* were collected from 4 sampling locations using jars baited with bread soaked in beer. The specimens were subjected to standard parasitological techniques for isolation of ecto and endo-parasites in each *P. americana*. **Results:** Of the 984 *P. americana* examined, 899 were infected with 13 parasites with an overall general prevalence of 79.89%. Of the 13 parasites encountered in this study, *Ascaris lumbricoides* had the highest prevalence (39.63%), closely followed by hookworm (35.77%). The prevalence of other parasites were in the following trend: *Trichuris trichiura* (32.72%), *Strogyloides sterocalis* (29.57), *Giardia intestinalis* (23.07), *Entmoeba histolytica* (19.00), *Hymenolepsis nana* (15.85), *E. coli* (13.11), *Balantidium coli* (12.91), *Enterobius vermicularis* (13.00), *I. belli* (8.13), *Cryptosporidium parvum* (2.95) and *Taenia* species (2.02). Two Factor ANOVA showed significant difference ($p<0.05$; $F = 12.44$; $p = 1.9\times10^{-09}$) in the prevalence of parasites and the studied locations ($p<0.05$; $F = 24.80$; $p = 7.05\times10^{-09}$). The exoskeletons of *P. americana* had more parasitic species that the alimentary tracts which was statistically significant ($p<0.05$; $F = 4.61$, $p = 0.006$). However, Pearson (r) correlation analysis showed a strong and positively significant value of 0.9378 between prevalence of parasites in the exoskeleton and alimentary canal. **Conclusion:** It is imperative to urgently institute control measures against *P. americana* through massive public enlightenment, education, improved sanitary conditions associated with proper waste management of landfills and fumigation of cockroach susceptible sites in Otefe-Oghara and its environ.

Key words: *Periplaneta americana*, helminths prevalence, protozoan parasites, Oghara, Delta state

Received: December 20, 2018 Accepted: February 04, 2019 Published: March 15, 2019

Citation: Ito Edore Edwin, 2019. Spatial distribution and prevalence of parasites vectored by *Periplaneta americana* in southern, Nigeria: Implication for intervention. Asian J. Biol. Sci., 12: 313-319.

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Competing Interest: The author has declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Cockroaches (Hexapoda: Blattaria) are dorso-ventrally flattened, domestic, ubiquitous insects with an oval shape and a characteristic long moniliform antennae[1]. About 30 out of over 3,500 known cockroach species are associated with human habitation since antiquity[1,2]. Of these number, only 4 species (*Periplaneta americana* (Blattaria: Blattidae; Linnaeus, 1758), *Blattella germanica*, (Blattaria: Blattellidae; Linnaeus, 1767) and *B. orientalis* and *Supella longipalpa*) are considered as the most common notorious pest associated with households, supermarkets, public places and refuse dumps[3,4]. The *P. americana* commonly called American cockroach is a tropical and subtropical household pest particularly in Nigeria where they live in clusters. This species is of public health importance due to its association with human waste as well as its ability to traffic from sewers into homes and commercial establishments like restaurants. *P. americana* are attracted to dark and moist-warmth environment such as toilets, bathrooms, kitchens and basements.

Generally, cockroaches are known to be vectors of several diseases like dysentery, typhoid and polio as well as gastroenteritis. *P. americana* is a coprophagous vector, contaminating large quantity of consumable by leaving behind human faecal matter and parasitic cyst/eggs of helminths and protozoa. The *P. americana* does not only contaminate food with their faecal pellets, their filthy, breeding, habits, feeding mechanisms and indiscriminate travel between filth and food can also cause food poisoning[5]. The prevalence and morbidity of human parasitic infections in Nigeria, especially, in rural communities like Oghara are continuously high partly due to the vectorial role of *P. americana*[6,7]. Parasites of public health importance have been isolated from external surfaces and internal body parts of *P. americana*. Poor personal hygiene are epidemiological factors believed to encourage the spread of *P. americana* and sustenance of parasitic infections. Tropical parasitic infections like ascariasis, trichuriasis, amoebiasis, giardiasis, balantidiasis, taeniosis and *Enterobius vermicularis* are acquired either by ingestion of the eggs/cyst[6] or by dermal penetration of skin by larva of *Strongyloides stercoralis*, hookworms, *Schistosoma mansoni* and *S. haematobium*[8]. Transmission is closely related to personal and environmental hygiene[9]. Epidemiological studies have documented these parasites to be vectored by *P. americana*[3,4,10-12]. The presence of *P. americana* in households is of epidemiological significance due to their nocturnal and filthy habits[13], a characteristics feature that makes them an ideal carriers of pathogens.

Human population expansion has caused over 60% of cockroach populations to be isolated from urban areas, partly due to insufficient dumpsites, domestic waste accumulation, poor housing standards, over-crowding, inadequate water supplies and ignorance. The *P. americana* is the most abundant and obnoxious non-biting insect pests in Oghara metropolis, inhabiting residential buildings, hospitals, hostels, hotels, waste dumpsites and restaurants. Despite the abundance of *P. americana* in Oghara community, there is no documented data on their epidemiological and vectorial role in this study area. This research was carried out to: (1) Investigate the prevalence of parasites of public health importance in *P. americana*, (2) Establish the distribution and abundance of *P. americana* in four ecological niches and geographic locations and (3) Study the vectorial role of *P. americana* in the transmission of parasites eggs in Otefe-Oghara community, Delta state, Nigeria.

MATERIAL AND METHODS

Description of study area: This research was carried out between July and September, 2018, in Otefe-Oghara, a tropical academic community in Ethiope West Local Government Area, Delta state, Nigeria. The study area is located within the tropical rainforest belt in Nigeria on a geographical coordinate of Longitude 5°45'17'' N and Latitude 5°58'52'' E of the Greenwich meridian. The study area is an agglomeration of several communities aligned linearly along the River Jameson, Delta state. Physiographically, the area is a typical coastal plain terrain, monotonously lowland and flat with a gentle slope towards the Jameson River. Scarcity of good housing facilities elicited by the teeming population of Delta state Polytechnic students had resulted in overcrowded living conditions. The community lacks good environmental and personal hygiene services, with many piles of faecal matter in nearby residential areas. The proliferation of *P. americana* infestation can be attributed to pit latrine, multiple refuse dumpsite including the use of deformed, rusty, overflowed uncovered punctured bins and the untimely collection of refuse. The heavy flooding during the rainy season frequently increases sanitation problem. Inhabitants of the community are mainly farmers, few artisan, sand miners, students and civil servants. The study area was partitioned into 4 regions based on roads accessibility. A total of 80 houses (including hostels) were sampled from staff quarters (location 1: Latitude: 5°57'43'' N; Longitude: 5°45'17'' E), Mondele (location 2: Latitude: 5°58'52'' N; Longitude: 5°45'36'' E), Genesis (location 3: Latitude: 5°59'59'' N; Longitude: 5°45'44'' E) and Ibori quarters (location 4: Latitude: 5°59'1'' N; Longitude: 5°45'47'' E).

Cockroach collection and identification: Jars baited with bread soaked in beer were placed in kitchen, toilets/bathrooms, living and bedrooms in accordance with standard methods[4,14]. The inside portion of these jars were smeared with a thin film of petroleum jelly to prevent cockroach escape. The collection bottles were set at 18:00 h and collected by 07:00 h the next morning for 2 consecutive months. Collections of 1 cockroach per bottle were transported to Tropical Disease Research unit, Delta state University where they were anaesthetized and killed by chloroform fume for possible identification using standard entomological keys[15,16]. A total of 984 adult, whole *P. americana*, sorted by capture location were included in this study while those showing missing body parts were excluded.

Parasitological investigation

Please make the spacing visible in this highlighted text: Methods of Bala and Sule[17] were employed in the isolation of ecto-parasites of cockroaches. Briefly, 2 mL of normal saline was added to the universal container with the cockroach and shaken vigorously for 2 min to detach the parasites on the surface of the cockroach and then filtered with a Cheese cloth. About 1 mL of the washing fluid was transferred to a centrifuge tube and centrifuged at 2000 rpm for 5 min. The supernatant was discarded and the deposits was placed on a clean glass slide, covered with a cover slip. Cysts and oocysts were identified by adding 1 drop of 1% Lugol's iodine at the border of the cover slides and the preparation was observed at 40x microscope objective lens for the identification of parasites.

isolation of parasites from gastrointestinal tract of cockroaches: Washed *P. americana* were individually placed and rinsed in a flask containing 70% ethanol for 5 min. They were transferred to another sterile flask to air dry at room temperature (25°C) and then washed with normal saline for 3 min to remove the alcohol. After washing, each *P. americana* were fixed on a dissecting petri dish where the head and appendages were severed and the abdomen was opened using fine pointed forceps with small scissors. The gut and other abdominal organs were lifted with a teasing needle and a small forceps and washed in a vial containing 5 mL of saline solution. The gastrointestinal tract were finely macerated into tiny bits by means of sterile scalpel blade then filtered with a Cheese cloth. About 2 mL of the filtrate was centrifuged at 2000 rpm for 5 min and the deposits placed on a clean glass slide, stained with 1% Lugol's iodine. Each slides was stained with modified acid fast stain and Ziehl-Neelsen staining method for *Isospora belli*, *Endolimax nana* and *Cryptosporidium* oocysts, respectively[18]. The slides were examined microscopically for ova, oocyst, larva and cysts of parasites present at X10 and X40 objective lens and identified using standard taxonomical keys[19,20]. Specimens which could not be processed immediately were kept in the refrigerator[2,17] at -4°C.

Data analysis: Data were analyzed using descriptive statistics, percentage and frequencies; cross tabulation of the outcome was performed. One-way analysis of variance (ANOVA) test was used to determine the association and significant difference between the distribution of cockroaches and the parasites identified. Subsequently, t-test analysis was used to determine association and significant differences between the parameters tested. All results were considered significant at the 95% confidence interval and significance level was set at $p<0.05$.

RESULTS

Prevalence of parasites based on gender and ecological niche: Of the 984 *P. americana* examined, 899 were infected with 13 parasites with an overall general prevalence of 91.36%. About 587 males (59.65%) were infected, while the females had 31.71% prevalence of the 363 *P. americana* examined. The prevalence of parasites in *P. americana* captured from toilet was higher (99.19%) than kitchen, bedroom and living room with respective values of 95.39, 83.15 and 56.79% in the study area (Table 1).

Based on the general *P. americana* population, Fig. 1 indicated the eco-niche prevalence of parasites. Irrespective of eco-niche, 8.64% of *P. americana* were uninfected with parasites. The least eco-niche prevalence was recorded in *P. americana* obtained from living rooms (Fig. 1).

Table 1: Prevalence of *P. americana* parasites within households in the study area

Eco-niche	No. of examined	N.I (infected %)
Toilets	372	369 (99.19)
Kitchens	347	331 (95.39)
Bedrooms	184	153 (83.15)
Living rooms	81	46 (56.79)

N.I: No. infected

Table 2: Prevalence of parasites associated with *P. americana* in four selected locations in Otefe-oghara, community

	N.I (%)					
Parasites	Location 1	Location 2	Location 3	Location 4	Total No. of infected (%)	Mean (%) prevalence ±SE
Hookworm	33(15.42)	63(26.36)	163(57.39)	93(37.65)	352(35.77)	34.21±8.96
A. lumbricoides	38(17.76)	93(38.91)	169(59.51)	90(36.44)	390(39.63)	38.16±8.54
T. trichiura	27(12.62)	70(29.29)	135(47.53)	90(36.44)	322(32.72)	31.47±7.32
S. stercoralis	27(12.62)	75(31.38)	121(42.61)	68(27.53)	291(29.57)	28.54±6.19
E. vermicularis	12(5.61)	26(10.88)	61(21.48)	29(11.74)	128(13.00)	12.43±3.31
G. intestinalis	17(7.94)	51(21.34)	116(40.85)	43(17.41)	227(23.07)	21.89±6.92
E. histolytica	17(7.94)	25(8.79)	78(27.46)	67(27.13)	187(19.00)	17.83±5.47
E. coli	3(1.41)	25(10.46)	73(25.70)	28(11.34)	129(13.11)	12.23±5.02
I. belli	9(4.21)	18(7.53)	32(11.27)	21(8.50)	80(8.13)	7.88±1.46
C. parvum	0(0.00)	11(4.60)	17(5.99)	1(0.40)	29(2.95)	2.75±1.50
B. coli	10(4.67)	20(8.37)	60(21.26)	27(10.93)	127(12.91)	13.81±2.80
H. nana	7(3.27)	31(12.97)	91(32.04)	27(10.93)	156(15.85)	14.80±6.11
Taenia spp.	4(1.87)	3(1.26)	6(2.11)	7(2.83)	20(2.03)	2.02±0.32
Total No. of infected	137(64.02)	197(82.43)	219(77.11)	233(94.33)		
No. of examined	214	239	284	247		

Data presented in parenthesis are prevalence values of each parasite isolated, S.E: Standard Error

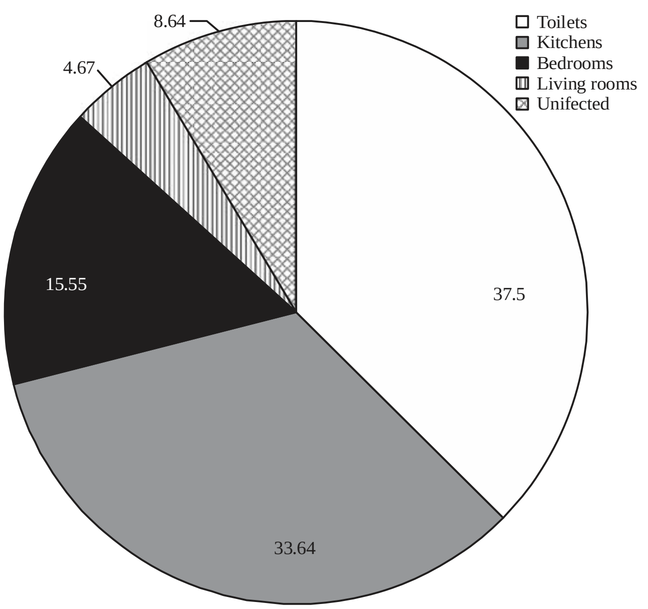

Fig. 1: Eco-niche prevalence of parasites vectored by *P. americaca*

Prevalence of specific parasites and geographical location: Out of the 13 parasites encountered in this study, *A. lumbricoides* had the highest prevalence (39.63%), closely followed by hookworm (35.77%). The prevalence of other parasite in this study were in the following trend: *T. trichiura* (32.72%), *S. sterocalis* (29.57), *G. intestinalis* (23.07), *E. histolytica* (19.00), *H. nana* (15.85), *E. coli* (13.11), *B. coli* (12.91), *E. vermicularis* (13.00), *I. belli* (8.13), *C. parvum* (2.95) and *Taenia* species (2.02) (Table 2). Further evaluation revealed that *A. lumbricoides* had 59.51% as the prevalence value. All parasites encountered in this study were present in location 2, 3 and 4 except for location 1 which had no prevalence for *C. parvum* (Table 2). *Taenia* species had the least prevalence of parasitic infection in all locations. Results shown in Table 2 indicated that, *P. americana* in location 1 were least infected. In this investigation, location 4 (Ibori quarters) had the highest prevalence (94.33%) of parasitic infection (Table 2). This was followed by location 2 (Mondele) with a prevalence of 82.43%. Next on the prevalence scale was location 3 (Genesis quarters) with a value of 77.11%. While the least prevalence was recorded in location 1 (staff quarters) with a value of 64.02%. Statistically, two factor analysis of variance (ANOVA) showed significant difference ($p<0.05$; $F = 12.44$; $df = 12$; $p = 1.9\times10^{-09}$) in the prevalence of parasites encountered and the studied locations ($p<0.05$; $F = 24.80$; $df = 3$; $p = 7.05\times10^{-09}$). However, t-test indicated that there was no significant difference ($p>0.05$) in the prevalence between location 1 vs. 2; 1 vs. 3; 1 vs. 4; 2 vs. 3; 2 vs. 4 since $t_{Statistics}$ (-3.6742, -5.6581, -4.1985, -5.9003, -1.1344, respectively) $<t_{critical\ two\ tail}$ (2.1788) except location 3 vs. 4 (t_{stat} = 5.1556) which was statistically significant at 0.05 level of significance.

Prevalence of parasites eggs/cysts in exoskeleton and digestive tracts based on location: This study further indicate that high number parasitic eggs/cyst were encountered in the external surface (exoskeleton) of *P. americana* than was found in the alimentary tract (Table 3, 4). Statistically, there was significant difference ($p<0.05$) in the mean prevalence of parasitic species isolated from the exoskeleton and alimentary canal (internal organs) of *P. americana* (Parasitic species: $F = 4.61$, $p = 0.006$, $df = 12$ and site of isolation (external/internal): $F = 54.47$, $p = 8.5\times10^{-06}$, $df = 12$).

Table 3: Mean prevalence of parasites from exoskeleton and alimentary tract of *Periplaneta americana* in the study area

	Exoskeleton		Alimentary canal	
Parasitic species	Total No. of infected (Prevalence %)	Mean (%) Prevalence±Standard error	Total No. of infected (Prevalence)	Mean Prevalence±Standard error
Hookworm	283(28.76)	27.20±8.67	69(7.01)	6.90±1.36
A. lumbricoides	288(29.26)	27.80±8.55	102(10.37)	10.35±3.58
T. trichiura	251(25.51)	24.32±7.40	71(7.22)	7.15±2.45
S. stercoralis	227(23.07)	21.93±6.46	64(6.50)	7.86±2.35
E. vermicularis	112(11.38)	10.83±3.19	16(1.63)	2.04±0.81
G. intestinalis	189(19.21)	17.92±7.31	38(3.86)	3.95±0.83
E. histolytica	162(16.46)	15.80±4.58	25(2.54)	2.45±0.71
E. coli	115(11.69)	10.73±5.42	14(1.42)	1.49±0.69
I. belli	75(7.62)	7.37±1.52	5(0.51)	0.51±0.20
C. parvum	28(2.85)	2.61±1.46	1(0.10)	0.11±0.11
B. coli	120(12.20)	11.56±3.68	7(0.71)	0.76±0.29
H. nana	135(13.72)	12.72±5.81	21(2.13)	2.08±1.24
Taenia spp.	20(2.03)	2.01±0.32	0(0.00)	0.00±0.00

Table 4: Prevalence of parasites associated with *P. americana* in four selected locations in Otefe-oghara, community

	Exoskeleton N.I (%)				Alimentary canal N.I (%)			
Parasitic species	Location 1	Location 2	Location 3	Location 4	Location 1	Location 2	Location 3	Location 4
Hookworm	22(10.28)	40(16.34)	138(48.59)	83(33.60)	11(5.14)	23(9.62)	25(8.80)	10(4.05)
A. lumbricoides	23(10.74)	44(18.41)	141(49.65)	80(32.39)	15(7.00)	49(20.50)	28(9.86)	10(4.05)
T. trichiura	18(8.41)	37(15.48)	113(39.79)	83(33.60)	9(4.21)	33(13.81)	22(7.75)	7(2.83)
S. stercoralis	18(8.41)	41(17.15)	111(39.08)	57(23.08)	9(4.21)	34(14.23)	10(8.55)	11(4.45)
E. vermicularis	11(5.14)	18(7.53)	56(19.71)	27(10.93)	1(0.46)	8(3.35)	5(3.52)	2(0.81)
G. intestinalis	5(2.34)	39(16.32)	107(37.67)	38(15.38)	12(5.61)	12(5.02)	9(3.16)	5(2.02)
E. histolytica	15(7.01)	21(8.79)	69(24.30)	57(23.08)	2(0.93)	4(1.67)	9(3.16)	10(4.05)
E. coli	0(0.00)	17(7.11)	73(25.70)	25(10.12)	3(1.40)	8(3.35)	0(0.00)	3(1.21)
I. belli	7(3.27)	18(7.53)	30(10.56)	20(8.10)	2(0.93)	0(0.00)	2(0.70)	1(0.40)
C. parvum	0(0.00)	10(4.18)	17(5.99)	1(0.40)	0(0.00)	1(0.42)	0(0.00)	0(0.00)
B. coli	7(3.27)	28(11.72)	60(21.13)	25(10.12)	3(1.40)	2(0.84)	0(0.00)	2(0.81)
H. nana	7(3.27)	18(7.53)	84(29.58)	26(10.53)	0(0.00)	13(5.44)	7(2.46)	1(0.40)
Taenia spp.	4(1.87)	3(1.26)	6(2.11)	7(2.83)	0(0.00)	0(0.00)	0(0.00)	0(0.00)

N.I: Number of infected, Data presented in parentheses are prevalence values of each parasite isolated

However, Pearson (r) correlation analysis showed a strong and positively high value of 0.9378 (93.78%) between prevalence of parasites in the exoskeleton and alimentary canal of *P. americana*. Furthermore, t-test analysis revealed significant difference (p>0.05) in the prevalence between parasites associated with external surfaces and alimentary tract since $t_{statistics}$ (7.3802) >$t_{critical\ two\ tail}$ (2.1788) at 0.05 level of significance.

DISCUSSION

There is a dearth of epidemiological reports on the vectorial role of *P. americana* in the transmission of human parasitic diseases in Delta State, Nigeria. This present study had incriminated *P. americana* as a mechanical vectors of intestinal parasitic infections in Oghara community. Preliminary reports in Africa[3,13,21] particularly in Nigeria[2,4,10,12,22] had documented *P. americana* as a paratenic vector of several human intestinal parasites. The current study showed that all the parasites isolated from *P. americana* are of medical importance and have been implicated in many gastrointestinal disorder. This study further indicated that the prevalence of parasites in the external surfaces of *P. americana* is higher compared to the internal tracts. This was substantiated by Etim *et al.*[2] who documented 65.3% for external surfaces and 34.6% for internal organs. Similarly, high (72.5 and 88.5%) parasitic infection were observed on the external surfaces of cockroaches caught from the hospital environment and residential areas, respectively[21].

It is evident in this present study that the overall parasites recovered from the external surface were more than those recovered from gut of *P. americana*. This marginal disparity could be explained in 2 ways, it could be that the *P. americana* only have body contacts with the parasites without ingesting them or the parasites were unable to survive in the cockroaches studied. Both reasons are valid given the fact that some of the ova/cysts of the parasites encountered in this study are sensitive to changes in environmental factors[23,24].

A wide range of parasitic composition were isolated from the *P. americana* sampled, a rare observation by other studies[10,11,25]. This study recovered 13 parasites belonging to 2 taxonomic groups: Helminths (hookworm, *A. lumbricoides*, *T trichiuria*, *Taenia* spp., *E. vermicularis*, *S. stercoralis*) and Protozoan (*E. histolytica*, *E. coli*, *H. nana*, *G. intestinalis*, *B. coli*, *C. parvum*, *I. belli*) parasites of medical importance similar to earlier reports[26]. The number of protozoan parasites were more in number but not in occurrence compared to the helminths group. The prevalence (39.63%) of *A. lumbricoides* obtained in this study is higher than 27.40, 13.20 and 33.60%, respectively recorded by other researchers[2,10,25]. Contrarily, Oyeyemi *et al.*[22] recorded a higher prevalence of 52.30%.

The most prevalent parasites encountered in this study were hookworm and *A. lumbricides* and *T. triciura* corroborated by earlier reports[14]. Findings from Osogbo, Oyo state, Nigeria[27] and Ghana[28] also reported hookworm (49%) as the most frequently common parasite of *P. americana*. The high occurrence of *A. lumbricoides* and hookworm, not only on the cockroaches but in the environment and faecal sample over other gastrointestinal parasites has also been documented in human populations in Africa, West Africa, Nigeria[6,29]. The risk of transmissions has been associated with poor sanitary condition[30]. Other species of the helminths order also formed a larger part of the overall total of parasites identified and isolated in this result. The *T. tirchiuria*, *S. stercorahs* and *E. vermicalaris* were identified from previous report in Ethopia[26]. The occurrence of *E. histolytica* observed in their study, might probably be because of the resistance conferred by the cyst wall, which makes the cysts to survive days to weeks in the external environment and probably be vectored by cockroaches and other synanthropic insects.

The vectorial potential of cockroaches have also been reported[17]. They documented *E. vermicularis* which indicates that the cockroaches had contact with infected patients or contaminated clothes which emphasizes their vectorial potential for parasitic diseases. The occurrence of *E. histolytica* might be because of resistance conferred by the cysts wall, which make the cysts to survive days to weeks in the external environment and probably be vectored by cockroaches and other synanthropic insects.

CONCLUSION AND RECOMMENDATIONS

The findings of this study shows that *P. americana* in the study area are potential vectors of parasitic disease. The parasites eggs, cyst, oocyte encountered in this study are of medical importance. It is imperative to urgently institute control measures on these insects through massive public health/enlightenment education on improving the existing standard of environmental sanitary conditions such as general cleanliness, proper discarding of leftover food, timely washing of dishes and rinsing of cans or bottles before disposal and the use of cockroach-proof garbage bins should be instituted at home. Periodic fumigation and proper management of landfills are also recommended in the control of this insect pest (cockroach).

SIGNIFICANCE STATEMENT

This study revealed that *P. americana* is an important epidemiological factor in the transmission of several tropical parasites. This study identified 13 parasites isolated in *P. americana* from four ecological niches. *P. americana* captured from toilets had the highest (99.19%) prevalence of parasites, followed by kitchen, bedroom and living room with respective values of 95.39, 83.15 and 56.79%. This study further indicate that high number parasitic eggs/cyst were encountered in the external surface of *P. americana* than the alimentary tract. The parasites isolated from *P. americana* causes human diseases of public health importance. The prevalence of these parasites are detrimental to human capital development, because they affect work efficiency and outputs. This study will help parasitologist, entomologist, the general public, governmental and non-governmental organisations in proper management of vectors and diseases associated with *P. americna*.

ACKNOWLEDGMENT

Research assistance received from Center for Research in Environmental Resource Management (CREMA) and Tropical Disease Research (TDR) Unit, Delta State University, Nigeria is highly appreciated.

REFERENCES

1. Ito, E.E. and E.J. Ighere, 2017. Basic Entomology and Pest Control. University Printing Press, Delta State University, Abraka, ISBN: 978-33772-08-12, Pages: 361.
2. Etim, S.E., O.E. Okon, P.A. Akpan, G.I. Ukpong and E.E. Oku, 2013. Prevalence of cockroaches (*Periplanata Americana*) in households in Calabar: Public health implications. J. Public Health Epidemiol., 5: 149-152.

3. Haile, T., A.T. Mariam, S. Kiros and Z. Teffera, 2018. Cockroaches as carriers of human gastrointestinal parasites in Wolkite Town, southwestern Ethiopia. J. Parasitol. Vector Biol., 10: 33-38.
4. Adenusi, A.A., M.I. Akinyemi and D. Akinsanya, 2018. Domiciliary cockroaches as carriers of human intestinal parasites in Lagos Metropolis, Southwest Nigeria: Implications for public health. J. Arthropod-Borne Dis., 12: 141-151.
5. Graczyk, T.K., R. Knight and L. Tamang, 2005. Mechanical transmission of human protozoan parasites by insects. Clin. Microbiol. Rev., 18: 128-132.
6. Ito, E.E. and A.O. Egwunyenga, 2017. Soil-transmitted helminthiasis in Aviara community: An observation from primary school children in Nigeria. Int. Med. J., 24: 205-208.
7. Okafor-Elenwo, E.J. and A.C. Elenwo, 2014. Human infecting parasitic worms, in cockroaches from Odau in the Niger delta region of Nigeria. Int. J. Nat. Sci. Res., 2: 176-184.
8. Ito, E.E. and A.O. Egwunyenga, 2015. Schistosomiasis: The Aftermath of 2012 floods in Delta state, Southern Nigeria. Int. Med. J., 22: 218-223.
9. Awolaju, B.A. and O.A. Mornikeji, 2009. Prevalence and intensity of intestinal parasites in five communities in South-West Nigeria. Afr. J. Biotech., 8: 4542-4546.
10. Isaac, C., P.O. Orue, M.I. Iyamu, J.I. Ehiaghe and O. Isaac, 2014. Comparative analysis of pathogenic organisms in cockroaches from different community settings in Edo State, Nigeria. Korean J. Parasitol., 52: 177-181.
11. Iboh, C.I., R.O. Ajang, H.E. Etta and J.T. Abraham, 2015. Public health implications of cockroaches within households in Calabar municipality, Cross River State, Nigeria. Global J. Public Health Epidemiol., 2: 114-119.
12. Morenikeji, O.A., A. Adebiyi and O.A. Oluwayiose, 2016. Parasites in cockroaches recovered from residential houses around Awotan dumpsite in Ido local government area of Oyo state, Nigeria. Annu. Res. Rev. Biol., 9: 1-10.
13. Tatang, R.J.A., H.G. Tsila and J.W. Pone, 2017. Medically important parasites carried by cockroaches in Melong Subdivision, Littoral, Cameroon. J. Parasitol. Res., Vol. 2017. 10.1155/2017/7967325.
14. El-Sherbini, G.T. and E.T. El-Sherbini, 2011. The role of cockroaches and flies in mechanical transmission of medical important parasites. J. Entomol. Nematol., 3: 98-104.
15. Choate, P.M., 2000. A dichotomous key for the identification of the cockroach fauna (Insect: Blattodea) of Florida. Species Identification Insects of Florida, Insect Classification Exercise. https://entnemdept.ifas.ufl.edu/choate/blattaria_new.pdf
16. Roth, L.M., 1999. New cockroach species, redescriptions and records, mostly from Australia and a description of *Metanocticola christmasensis* Gen. nov., sp. nov., from Christmas Island (Blattaria). Records-Western Aust. Museum, 19: 327-364.
17. Bala, A.Y. and H. Sule, 2012. Vectorial Potential of Cockroaches in Transmitting Parasites of Medical Importance in Arkilla, Sokoto, Nigeria. Niger. J. Basic Appied Sci., 20: 111-115.
18. Adegbola, R.A., E. Demba, G. de Veer and J. Todd, 1994. *Cryptosporidium* infection in Gambian children less than 5 years of age. J. Trop. Med. Hyg., 97: 103-107.
19. Cheesebrough, M., 2009. District Laboratory Practice in Tropical Countries. Cambridge University Press, Cambridge, UK., pp: 202.
20. Salehzadeh, A., P. Tavacol and H. Mahjub, 2007. Bacterial, fungal and parasitic contamination of cockroaches in public hospitals of Hamadan, Iran. J. Vector Borne Dis., 44: 105-110.
21. Al-Bayati, N.Y., A.S. Al-Ubaidi and I.K. Al-Ubaidi, 2011. Risks associated with cockroach *Periplaneta americana* as a transmitter of pathogen agents. Diyala J. Med., 1: 91-97.
22. Oyeyemi, O.T., M.O. Agbaje and U.B. Okelue, 2016. Food-borne human parasitic pathogens associated with household cockroaches and houseflies in Nigeria. Parasite Epidemiol. Control, 1: 10-13.
23. Alzain, B., 2013. Cockroaches: Transmission of medically important parasites. ARPN J. Sci. Technol., 3: 18-22.
24. Sam-Wobo, S.O. and C.F. Mafiana, 2005. The effects of surface soil physico-chemical properties on the prevalence of helmiths in Ogun State, Nigeria. J. Sci. Technol. (Zambia), 9: 13-20.
25. Ojianwuna, C.C., 2014. Potentials of cockroach vectors in transmitting parasites of medical importance in Abraka, Delta State, Nigeria. Int. J. Applied Biol. Res., 6: 9-20.
26. Hamu, H., S. Debalke, E. Zemene, B. Birlie, Z. Mekonnen and D. Yewhalaw, 2014. Isolation of intestinal parasites of public health importance from cockroaches (*Blattella germanica*) in Jimma Town, Southwestern Ethiopia. J. Parasitol. Res., Vol. 2014. 10.1155/2014/186240
27. Adeleke, M.A., H.A. Akatah, A.O. Hassan, S.O. Sam-Wobo, T.M. Famodimu, G.O. Olatunde and C.F. Mafiana, 2012. Implication of cockroaches as vectors of gastrointestinal parasites in parts of Osogbo, Southwestern Nigeria. Munis Entomol. Zool., 7: 1106-1110.
28. Tetteh-Quarcoo, P.B., E.S. Donkor, S.K. Attah, K.O. Duedu and E. Afutu *et al*., 2013. Microbial carriage of cockroaches at a tertiary care hospital in Ghana. Environ. Health Insights, 7: 59-66.
29. Egwunyenga, O.A. and D.P. Ataikiru, 2005. Soil-transmitted helminthiasis among school age children in Ethiope East Local Government Area, Delta State, Nigeria. Afr. J. Biotechnol., 4: 938-941.
30. Sam-Wabo, S.O., O.A. Oyeyemi, O.A. Idowu and A. Afolarin, 2007. Assessment of health knowledge and risk factors associated with intestinal helminths in tertiary schools in Abeokuta, Nigeria. Niger. J. Parasitol., 27: 76-80.