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DOMESTIC COCKROACHES AS CARRIERS OF HUMAN INTESTINAL PARASITES AND BACTERIAL PATHOGENS IN ILIE, SOUTHWEST, NIGERIA

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ABSTRACT
Cockroaches are insects of antiquity with great medical and public health importance and have been recognized as mechanical transmitter of pathogens to humans. This study was carried out to determine the prevalence of intestinal parasites and bacterial pathogens found in cockroaches in Ilie community, Nigeria. One hundred and seventy two cockroaches (172) were randomly collected by balloting from 37 selected houses in the study area. From this study, five intestinal parasites and six bacterial isolates were detected from the external surface and gut of the cockroaches. The parasites were *Ascarislumbricoides, Entamoebahistolytica, Strongyloidesstercoralis,* Hookworm and *Giardialamblia,* while the bacterial isolates were *Bacillus* spp., *Salmonella* spp., *Staphylococcus aureus*, *Pseudomonas aeruginosa* and *Klebsiellapneumoniae*. The overall prevalence for intestinal parasites was 69.2% while that of bacteria was 91.9%. For intestinal parasites, *Ascarislumbricoides* (43.0%) had the highest frequency, followed by *Entamoebahistolytica* (14.5%) and the least was *Giardialamblia* (1.2%), while the highest frequency for bacterial isolate was *Staphylococcus aureus* (40.1%) and the least was *Bacillus* spp. (5.8%). Bacterial Pathogens and intestinal parasites were more recorded on the external surface than in the gut of the cockroaches. This finding revealed that cockroaches are very important in transmission of some intestinal parasites and bacterial pathogens, therefore, personal hygiene, health education and effective control methods should put place in order to eliminate and minimize the menace of cockroaches in the community.

KEYWORDS: Cockroaches, intestinal, parasites, bacterial, pathogens.

INTRODUCTION
Cockroaches are arthropods with jointed appendages, exoskeleton, segmented bodies, central nervous system, open circulatory system and sensory receptors. They are oval, flat-bodied, dark in colour and dorso-ventrally flattened insects with chewing mouthparts and two pairs of wings. They have well developed compound eyes and long thread-like antennae.[1] There are about approximately 3500 species of cockroaches of the order Dictyoptera worldwide.[2] The vast majority of them have no significance to man.[2] Among these species, fifty are associated with human habitations.[2] *Periplanetaaustralasiae* and *Periplanetaamericana*are being common pests in the tropics while *Blattellagermanica*, and *Blattaorientalis*are the most common species in temperate regions.[3] The majority of these species lives in tropical and subtropical areas where they are not recognized as pests.[3] They are among the most common pests in many homes, buildings, food-handling establishments, hospitals and high moisture availability such as toilets, kitchens, sewages, and drainages.[4,5] They are pests because of their filthy habits and bad smell.[5] At night they search for food in kitchens, food storage places, rubbish bins, drains and sewers.

Cockroaches passively transport microbes on their body surfaces including pathogens that are potentially dangerous to humans.[2] They have been implicated in the spread of different kinds of bacteria including *Escherichia coli* and *Salmonella* species, intestinal parasites and other types of human pathogen.[2] Intestinal parasites are among the most common and widespread diseases of human globally responsible for considerable morbidity and mortality, especially among the most vulnerable population children.[6]

Cockroaches are carriers of many parasites of man and animal on their anatomical parts of the body and may cause allergic reactions, including dermatitis, itching, swelling of the eyelids and more serious respiratory conditions.[7] These parasites include,

Entamoebahistolytica, Entamoeba coli, Giardialamblia, Chilomastixmesnili, Ascarislumbricoides, hookworms, *Strongyloidesstercoralis, E. vermicularis, Gnathostomaspinigerum, Trichostorongluselongater, Fasciolabuski, Diphylobotriumlatum, Dipylidiumcaninum, H. diminuta, Taenia species* and *P. westermani.*[8] Several species of bacteria of public health significance are also carried by cockroaches and their digestive tract such as *Staphylococcus* spp, *Enterobacteriaceae, Pseudomonas aeruginosa Salmonella* spp., *Shigella* spp., *Campylobacter* spp. and *Klebsiellapneumoniae*.[5] Many studies have been carried out in several countries including Nigeria as well but to my knowledge no single one in the study area. Therefore, this study was designed to determine the prevalence of intestinal parasites and bacteria pathogens found in cockroaches in Ilie community in order to ascertain the public health importance of this insect as a mean of potential transmitting intestinal parasitic and bacterial infections in the community. This may be of immense benefit as this would provide effective methods for controlling and managing the menace of the cockroach infestation to the community.

MATERIALS AND METHODS

Study Area: The study area was Ilie, in Olorunda Local Government Area of Osun State, Nigeria. Ilie is about 20km from Igbona, the headquarter of the Local Government. It is located in the rain forest zone between latitude $4^{o}34^{l}$ and $4^{o}36^{l}$E and Longitude $7^{o}56^{l}$ and $7^{o}58^{l}$N with population of about 5,268 (National Population Commission, 2006). It is situated within the cocoa belt of Southwestern Nigeria. The area is rural and lack basic amenities such as good roads, standard hospitals and adequate facilities for refuse and sewage disposal. There is a big dam which serves as a source of water for bathing and other domestic activities. Members of the community are predominantly farmers though some engage in fishing and trading while some are civil servants. The community has one primary health center and three primary schools namely Community Primary School, Nawar-Ur-Deen Primary School and Saint James Primary School.

Sample Collection and Identification: Cockroaches was collected from different houses in Ilie community. One hundred and seventy two cockroaches were randomly collected by balloting from 37 selected houses in the study area. Sample collection was done by trapping then live through the use of sterile jars baited with pieces of bread soaked in a small amount of beer. The inside of the upper portions of the jars were coated with a thin film of Vaseline just to prevent cockroach from being escaped and were placed indoors for three consecutive days. The traps were left undisturbed between the hours of10:00 p.m in the night to 6.00 a.m in the morning. Cockroaches in the jars were then transported to the Medical Microbiology and Parasitology Laboratory, College of Health Sciences, Ladoke Akintola University of Technology, IsaleOsun, Osogbo where they wereanesthetized and killed by exposure to chloroform fume. The cockroaches were then identified morphologically using standard taxonomic keys.[9]

Parasites Isolation from Cockroach Body and Gut: After morphological identification, the cockroach was put inside the sterile universal bottle containing 5 ml of physiological saline and was shaken thoroughly for 2 minutes in order to dislodge the parasites from the body surfaces. The washing was decanted into centrifuge tube and centrifuged at 2,000 rpm for 5 minutes. The sediment was transferred to a clean glass slides, and a drop of 1% Lugols Iodine was added for proper identification of cyst or larval of any parasite and examined microscopically using x10 and x40 objective lenses.[10]

Parasites isolation from the gut of cockroaches were also performed by washingthe individual cockroach in a sterile universal bottle that contained 5ml physiological saline, then rinsed with 70% alcohol and allowed to air dried at room temperature. The cockroach was placed in a sterile petri dish and dissected under a dissecting microscope using sterile entomological needles. With the aid of fine pointed forceps, whole gut was removed carefully and homogenized in 5ml physiological saline. The homogenate was filtered using a tea sieve and centrifuged at 2000rpm for 5minutes. The sediment was transferred to a clean glass slides, and a drop of 1% Lugols Iodine was added for proper identification of cyst or larval of any parasite and examined microscopically using x10 and x40 objective lenses.[10]

Isolation of Bacterial from Cockroach: Bacterial pathogen was isolated from surface of the cockroach by transferring 2 ml of physiological saline into a sterile universal bottle containing cockroach and was thoroughly shaken for 2 minutes. One fixed volume 0.01 ml of saline washing was inoculated into blood agar, MacConkey agar, and Salmonella Shigella agar plates. The inoculated plates were incubated at 37^{0}C for 24 hours. After incubation, the colonies on the plates were identified according to bacteriological procedures.[11]

Statistical Analysis: Data obtained were analyzed using descriptive statistics while Chi-squared ($\chi 2$) analysis was used to determine association between variables using SPSS version 24 statistical package. $P < 0.05$ was considered statistically significant.

RESULTS

Distribution of Intestinal Parasites and Bacterial species from Cockroach specimens is shown in Table1. One hundred and seventy two cockroaches (172) were collected from 37 houses randomly selected by balloting. Five species of intestinal parasites and six bacterial isolates were found from the cockroaches. The parasites are *Ascarislumbricoides, Entamoebahistolytica, Strongyloidesstercoralis,* Hookworm and

*Giardialamblia*while bacterial are *Bacillus* spp., *Salmonella* spp., *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Klebsiellapneumoniae* and *Escherichia. coli*. For intestinal parasites, *Ascarislumbricoides* (43.0%) had the highest frequency, followed by *Entamoebahistolytica* (14.5%) and the least was *Giardialamblia* (1.2%), while the highest frequency for bacterial isolate was *Staphylococcus aureus* (40.1%) and the least was *Bacillus* spp. (5.8%).

Table 2 shows the prevalence of intestinal parasites by sites of infestation and sexes of Cockroaches in Ilie. All the five parasites species identified were more prevalent in the external surface as compared to gut. *Ascarislumbricoides* had the highest prevalence based on sites of infestation and sexes with (43.0%), (33.7%) respectively. Female cockroaches were more carriers of *Ascarislumbricoides* (18.0%) than male (15.7%). There is no statistically significant differences between prevalence on external surfaces and in gut of cockroaches (P= 0.572).

Prevalence of Bacterial isolates from External surface and Gut of Cockroaches in Ilie is shown in Table 3. *Staphylococcus aureus*(40.12%) was the highest prevalence from both external surfaces and in gut of cockroaches followed by*Klebsiellapneumoniae* (16.3%), then *Salmonella* spp.(11.1%) and the least was *Bacillus* species (5.8%).

Table 1: Distribution of Intestinal Parasites and Bacterial species from Cockroach specimens in Ilie community.

ORGANISMS	FREQUENCY N=172	%
Parasites		
Ascarislumbricoides	74	43.0
Entamoebahistolytica	25	14.5
Strongyloidesstercoralis	06	3.5
Hookworm	12	7.0
Giardialamblia	02	1.2
Bacterial isolate		
Bacillus spp.	10	5.8
Salmonella spp.	19	11.1
Staphylococcus aureus	69	40.1
Pseudomonas aeruginosa	17	9.9
Klebsiella. pneumoniae	28	16.3
Escherichia. coli	15	8.7

Table 2: Prevalence of Intestinal Parasites by sites of infestation and sexes of Cockroaches in Ilie.

PARASITE	***SITES OF INFESTATION***			***SEXES***		
	EXTERNAL SURFACE	***GUT***	***TOTAL***	***MALE***	***FEMALE***	***TOTAL***
	No.%	***No.%***	***No.%***	***No.%***	***No.%***	***No.%***
Ascarislumbricoides	**49(28.5)**	**25(14.5)**	**74(43.0)**	**27(15.7)**	**31(18.0)**	**58(33.7)**
Entamoebahistolytica	**16 (9.3)**	**09 (5.2)**	**25 (14.5)**	**12 (7.0)**	**05 (2.9)**	**17 (9.9)**
Strongyloidesstercoralis	**04 (2.3)**	**02 (1.2)**	**06 (3.5)**	**03 (1.7)**	**01 (0.6)**	**04 (2.3)**
Hookworm Giardialamblia	**09 (5.2)**	**03 (1.7)**	**12 (7.0)**	**03 (1.7)**	**08 (4.7)**	**11 (6.4)**
Total	**02 (1.2)**	**-**	**02 (1.2)**	**-**	**01 (0.6)**	**01 (0.6)**
	80 (46.5)	**39 (22.7)**	**119 (69.2)**	**45 (26.2)**	**46 (26.7)**	**91 (52.9)**

Table 3: Prevalence of Bacterial isolates from External surface and Gut of Cockroaches in Ilie.

BACTERIAL ISOLATE	EXTERNAL SURFACE	GUT	TOTAL
	No.%	No.%	No.%
Bacillus spp.	03(1.7)	07(4.1)	10(5.8)
Salmonella spp.	11 (6.4)	08 (4.7)	19 (11.1)
Staphylococcus aureus	42 (24.4)	27 (15.7)	69 (40.1)
Pseudomonas aeruginosa	12 (7.0)	05 (2.9)	17 (9.9)
Klebsiellapneumoniae	15 (8.7)	13 (7.6)	28 (16.3)
Escherichia. Coli	09 (5.2)	06 (3.5)	15 (8.7)
Total	92 (53.5)	66 (38.4)	158 (91.9)

DISCUSSION AND CONCLUSSION

Cockroaches are cosmopolitan normally found everywhere such as stored, hospital environments and in different houses within the communities and possess nocturnal and omnivorous features that make them to serve as carriers for transmission of pathogenic microorganisms including bacteria, protozoa, helminthes, fungus, and virus.[12] It has been documented that cockroaches are known to harbor pathogens, which can cause potentially devastating diseases, such as

gastroenteritis, typhoid, and diarrheal syndromes.[13] The importance of cockroaches as carriers of parasitic worms, eggs, cysts, or oocysts was based on some reports about the presence of parasitic forms on or in cockroaches.[12]

This study indicated that cockroaches are reservoirs and mechanical transmitters of microorganisms and is in agreement with previous studies carried out in Nigeria and some other countries by Bala and Sule[14]; Kassiri and Kazemi[15]; Etim *et al.*[16] and Nagham *et al.*[17] From this study, five intestinal parasites and six bacterial isolates are detected from the external surface and gut of the cockroaches. The parasites were *Ascarislumbricoides, Entamoebahistolytica, Strongyloidesstercoralis,* Hookworm and *GiardialamblıaI*, while the bacterial isolates were *Bacillus* spp., *Salmonella* spp., *Staphylococcus aureus*, *Pseudomonas aeruginosa* and *Klebsiellapneumoniae*. The overall prevalence for intestinal parasites was 69.2% while that of bacteria was 91.9%. The prevalence of intestinal parasites recorded in this study is almost similar to the work of Ajero*et al.*[18] in Owerri, Nigeria who reported 67% and lower than 94.2% reported in India by Fotedar*et al.*[19] and 98% reported in Egypt by El-Sherbini and El-Sherbini[20] and also higher than 18.41% reported in Nigeria by Ameh.[21] The high prevalence in this study may be attributed to the differences in the standard of household, environmental hygiene, overcrowding, poverty, poor hygiene standards and poor rural condition of the community.[20]

The high prevalence rate of *Ascarislumbricoides* in this study can be explained by the fact that *Ascaris*eggs have an inner shell layer of lipoprotein nature which makes them more resistant to harsh environmental conditions and air-borne compared to the eggs of other nematodes. Another reason is that *Ascaris*eggs can survive in adverse environmental conditions. It might also be due to the overdispersion of *Ascaris*eggs in the environment as a single female *Ascaris*lays relatively large number of eggs (200,000 eggs/day).[22] The higher rate of mechanical distribution of parasites on the external body surface, 46.5% compared to 22.7% in the gut content observed in this study agrees with 65.3% versus 34.6% prevalence in the anatomical site distribution recorded in Calabar by Etim*et al.*[16] The difference in prevalence between the external surface and the gut 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.[23] The parasites obtained from the external body surface of cockroach are non significant from those isolated from the gut.

Six bacterial isolates are detected both from the external surface and gut of the cockroaches. The bacterial were *Bacillus* spp., *Salmonella* spp., *Staphylococcus aureus*, *Pseudomonas aeruginosa* and *Klebsiellapneumoniae*. The most common bacterial from this study was *Staphylococcus aureus* (40.1%), followed by *Klebsiellapneumoniae* (16.3%) and the least was *Bacillus* spp.(5.8%). This is not in tandem with the work of Kassiri and Kazemi,[15] where *Klebsiella spp.* was the most common bacterium. This study indicates that cockroaches are important potential carrier of pathogenic microorganisms. Since cockroaches are the potential source of intestinal parasites and bacterial pathogens, effective prevention and control such as health education about cockroaches, personal household hygiene maintenance and always keep toilets clean are necessary to reduce cockroach associated infections. Sometimes pest controls methods can be also employed using insecticides.

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