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Assessment of the Role of Cockroaches (*Periplaneta americana*) as Carriers of Medically Important Parasites and Microorganisms in College of Agriculture, Lafia, Students Hostels, Nasarawa State, Nigeria

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Authors' contributions

This study was carried out in collaboration between all the authors and all the authors read and approved the final manuscript

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ABSTRACT

Cockroaches are found in human dwellings. They are distributed worldwide. They play an important role in transmitting diseases either mechanically and occasionally biologically. Numerous bacteria and parasites of medical importance have been isolated from cockroaches. This research was therefore designed to identify parasites and to isolate microorganisms of medical importance from external surfaces and gastrointestinal tract of cockroaches collected from different parts of student hostels of College of Agriculture, Lafia, Nasarawa State, Nigeria. A total of 170 cockroaches were trapped and collected from different location of the male and female hostels in the College and were examined using standard parasitological and microbial techniques. Normal saline was used in the

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washing and examination of external surfaces, dissection and examination of gastrointestinal tract; culturing the external surfaces, wash and intestine homogenates of the cockroaches in groups. Ova and cysts of some human parasites were found from the gut of cockroaches *Trichuris trichiura* (21.17%), *Ascaris lumbricoides* (23.52%), *Entamoeba histolytica* (24.70%), Hookworm (12.94%), and *Enterobius vermicularis* (15.29%) and also some species of bacteria and fungi were also recovered; *Staphylococcus aureus* (25.88%), *Staphylococcus epidermidis* (21.17%), *Bacillus cereus* (20.58%) *Escherichia coli* (32.35%). The result from this study indicates that cockroaches as a domestic pests could pose a health problem to human. Therefore, we must control cockroaches particularly in indoors, sewage and solid wastes.

Keywords: Assessment; role; cockroaches; parasites; microorganisms; Nigeria.

1. INTRODUCTION

Cockroaches are household pest and are about 10-50 mm in length and have an oval, flattened shape, long antennae, and are nocturnal in habit. These species inhabit human dwellings; the most common of these are the American cockroach (*Periplaneta americana*) and the German cockroach (*Blattella germanica*) (Robinson [1]; Uneke [2]). Cockroaches are omnivore; they eat anything organics but prefer food sources such as sweets, sheet, meat products, starches, and grease. They also feed on plants, vegetables, and fruits. Cockroaches generally like warm and moist environment with abundant food. Sewers and wet, decaying areas are their natural habitat (Jirage, R. 2011). They have the ability to survive without food for weeks and breed throughout the year in suitable environmental conditions (Kumie et al. [3]). When they descend on food, they contaminate the food by introducing an oil liquid that have offensive smell or contain bacteria that can cause food poisoning (Pai et al. [4]; Mlso et al. [5]; Ghosh and Gayen, 2006). Cockroaches are also the major sources of indoor allergens through exposure and sanitization is associated with asthma-related health problems (Hamu et al. [6]).

Cockroaches being nocturnal, their feeding habits make them perfect carriers of a variety of pathogenic microorganism, such as oocyst of *Cystoisospora belli*, *Cryptosporidium parvum*, *Cyclospora cayetanensis*, cyst of *Entamoeba histolytica*, *Balantidium coli* and *Giardia lamblia* (Graczy et al.; Salehzadeh et al. [7] and Uckcy et al., 2009).

Gastrointestinal infection can reach epidemic proportions. The protozoan pathogen *Cryptosporidium parvum* has been known to cause severe water borne epidemic in first-world countries such as the United States and the United Kingdom. Other infections such as the

amoebiasis or *enterobiasis* can be more localized infecting households or institutions Ajero et al. [8].

Many studies have shown that egg of *Ascaris lumbricoides*, *Trichuris trichiura*, *Hookworm*, *Enterobius vermicularis*, *Hymenolepis nana*, *Toxacora canis* and *Strongyloides stercoralis* larvae are carried by many species of cockroaches (Haridy et al. [9]; Ismail and et al. [10]).

The hostel environments provide cockroaches with suitable conditions and ready source of food. This work was therefore designed to identify parasites and to isolate microorganisms of medical importance from external surfaces and digestive tract of cockroaches collected from different parts of students' hostel of College of Agriculture, Lafia, Nasarawa State, Nigeria.

2. MATERIALS AND METHODS

2.1 Study Area

The study was carried out in College of Agriculture, Lafia main hostels, Shabu. The main hostels are located in the school. Lafia North is located in the South Western part of the State on latitude 8° 31'N and longitude 7° 31'E. Its location on the regional road confers on its good linkage with Makurdi capital of Benue State, Nigeria. The mean monthly temperature in this area ranges between 30°C in March and 25°C in December. The mean annual rainfall is about 1270 – 1540 mm received over seven to eight months (April to October) of rainy season with four months of dry season. The main socio-economic activities of the people are farming, trading and some are in public services.

The College of Agriculture, Lafia students hostels are mostly populated by students from various

parts of the State and the entire country Nigeria. Each room was originally designed for 8 students, but because of increase in students' enrolments without corresponding increase in hostel accommodation, a room now accommodates up to 16 students. As a result, the research area experienced an increase of garbage accumulation with no strategies for disposal. The water closet system in the hostel is usually in rather poor sanitary conditions. Cockroaches feed indiscriminately on garbage and sewages. This, therefore favour the proliferation of cockroaches in the students hostel.

2.2 Sample Collection

Cockroaches were collected by trapping using baits, empty jars coated with thin film of Vaseline bated with assorted food items such as piece of bread soaked in water, crayfish, ripe plantain and sugar. A total of 170 cockroaches were trapped and collected, 85 from male hostel and 85 from female hostel. Each of these cockroaches were collected in a specimen bottle and taken to the laboratory for examination. Cockroaches identified were the *Periplaneta americana* specie. The identification was performed in accordance with standard taxonomic key (Lane and Crosskey, 1993).

2.3 Parasitological Analysis

2.3.1 Isolation and identification from external surface

Each cockroach was placed in a test tube containing 2ml of normal saline. The test tube was shaken vigorously for two minutes to detach any parasite or their larval stages from the external body of the cockroach. Thereafter, the fluid was centrifuged at 3000 rpm for 5 minutes decanting the excess fluid. The residual deposit was placed on a clean glass slide with a cover slip and stained with lugol's iodine and view under an x40 microscope objective lens. The parasite seen were identified and counted using standard keys (Bala and Sule, [11]).

2.3.2 Isolation and identification from digestive tract

Cockroaches after external washing were placed in flasks and rinsed with 70° alcohol for 5 minutes to remove contamination from external surfaces, then transferred to sterilized conical flask and allow to dry at room temperature. The cockroaches were then washed with normal

saline to remove the traces of alcohol. The gastro intestinal tracts were remove by dissection 1ml of macerate was centrifuged at 2000 rmp for 4-5 minutes. The supernatant decanted and 1-2 drops of the sediment was placed on microscope slide, stained with 10% lugol iodine and examined under the microscope and cyst and ova identified (Cheesbrough, 2003).

The resulting macerate was also cultured on nutrient, blood and mac conkey agar plates separated and incubated at 37°C for one night. Isolates colonies were further subjected to bacteriological test, bio chemical test and microscopic morphological test for identification of bacteria (Alcamo, 1991).

The washing was cultured in saturated dextrose agar for fugal isolation. The growth identified by visual comparison, Gram stain and microscopy (Fotedar, 1991).

2.4 Data Analysis

Simple percentage was used in the analysis.

3. RESULTS

All 170 cockroaches sampled were contaminated. Parasites of medical importance discovered include *Entamoeba histolytica* (24.70%), Hookworm (12.94%), *Enterobius vermicularis* (17.64%), *Ascaris lumbricoides* (23.52%) and *Trichuris trichuira* (21.17%). This finding is reported in Table 1.

Table 2 captured bacteria isolates separated from the external surface. This includes; *Escherichia coli* with 55 (32.35%), being the highest prevalence, followed by *Staphylococcus aureus* 44 (25.88%), *Staplylococcus epideermidis* 36 (21.17%) and *Bacillus cereus* with the least prevalence of 35 (20.58).

Table 3 captured fungal isolates recovered from the gastrointestinal tract after wash up and these includes; *Aspergillus spp* 75(44.11) and *Penicillum spp* 95 (55.88%).

The research further identified the parasites found from the gastrointestinal tract of the cockroaches to include; *Trichuri strichiura* had the highest prevalence of 40 (23.52%). Followed by *Ascaris lumbricoides* 37(21.76%), *Enterobius vermicularis* 35(20.53%), *Entamoeba histolytica* 33 (19.41%) and 26 (15.29%) Hookworm as shown in Table 4.

Table 1. Parasite isolated from external surfaces of cockroaches from male and female hostels

Parasites isolated	Hostels		
	Male	Female	
	No. % infected	No. % infected	No. % infected
<i>Entamoeba histolytica</i>	19(22.35)	23(27.05)	42(24.70)
Hookworm	10(11.76)	12(14.11)	22(12.94)
<i>Enterobius vermicularis</i>	16(18.82)	14(16.47)	30(17.64)
<i>Ascaris lumbricoides</i>	23(27.05)	17(20)	40(23.52)
<i>Trichuris trichura</i>	17(20)	19(22.35)	36(21.17)
Total	85	85	170

Table 2. Bacterial isolated from external surfaces of cockroaches from male and female's hostels

Bacteria isolate	Hostels		
	Male	Female	
	No. % infected	No. % infected	No. % infected
<i>Staphylococcus aureus</i>	23 (27.05%)	21(27.05%)	44(25.88)
<i>Staphylococcus epidermidis</i>	17 (20%)	19(20%)	36(21.17)
<i>Escherichia coli</i>	26(30.58)	29(34.11)	55(32.35)
<i>Bacillus cereus</i>	19(21.17)	16(18.82)	35(20.58)
Total	85	85	170

Table 3. Fungal isolated from external surface of cockroaches from male and female hostels

Fungal isolates	Hostels		
	Male	Female	
	No. % infected	No. % infected	No. % infected
<i>Aspergillus spp</i>	38 (44.70)	37 (43.52)	75 (44.11)
<i>Penicillium spp</i>	47(55.29)	48 (56.47)	95 (55.88)
Total	85	85	170

Table 4. Parasite isolated from digestive tract of cockroaches from male and female hostels

Parasites found	Hostels		
	Male	Female	
	No. % infected	No. % infected	No. % infected
<i>Ascaris lumbricoides</i>	21(24.70)	16(18.82)	37(21.76)
<i>Trichuris trichura</i>	18(21.17)	21(24.70)	40(23.52)
<i>Enterobius vermicularis</i>	17(20)	18(21.17)	35(20.58)
Hookworm	13(15.29)	13(15.29)	26(15.29)
<i>Entamoeba histolytica</i>	16(18.82)	17(20)	33(19.41)
Total	85	85	170

The type of bacteria found from the gastrointestinal tract of the sample cockroaches as reported in Table 5 are *Escherichia coli* 62(36.47) which accounted for the highest prevalence, followed by *Staphylococcus aureus* *Bacillus aureus* 37 (21.76) while *Staphylococcus epidermidis* has 33(19.41) respectively.

Fungal isolates discovered from the gastrointestinal tract after wash-up are *Aspergillus spp* 87(51.17%) and 83 (48.82%) for *Penicillium spp* as presented in Table 6.

4. DISCUSSION

The result of this study showed that cockroaches constitute serious public health problems in College of Agriculture, Lafia in addition to their destructive habits. They are known for transmission of parasites particularly those isolated and identified. Personal hygiene has drastically minimized the spread of parasitic infections in the area of study, but other factors that immensely contributed to transmission of such infection are neglected. There were

speculations that cockroaches are possible sources for transmission of infections in our communities, but no documented records available in that regard. The species of cockroaches *Periplaneta americana* found in the research area are common and wide spread and have been reported in other parts of Nigeria (Omodu and Akosa, 2013). Cockroaches (*Periplaneta americana*) are species that survived in a habitats with availability of an abundance and different food materials and conducive refuge. The result from the research revealed moderate parasitic, bacterial and fungal contamination. *Salmonella spp*, *Shigella flexneri*, *Escherichia coli*, *Staphylococcus aureus* and *Bacillus cereus* were isolated from cockroaches collected from restaurants and hospitals in Adisa Ababa, Ethiopia (Ajaro, et al., 2012) studied bacterial contamination of cockroaches and identified *Enterobacter*, *Enterococcus*, *Staphylococcus*, *Pseudomonas*, *Shiggella*, *Serrata*, *Proteus*, *Escherichia coli* and *Bacillus*.

Adeleke et al. [12] isolated 23 microorganisms from cockroaches in Oshogbo, South Western, Nigeria, which again provide the reality of microbial presence in cockroaches. *Ascaris lumbricoides*, *Trichuris trichiura*, *Entamoeba histolytica*, *Staphylococcus spp*, *Escherichia coli*, *Bacillus cereus*, *Aspergillus spp*, *Penicillium spp* and *Hookworm* are known to produce diseases (Tatfeg, et al. [13]). It was also observed that the female cockroach came in contact in this work

had more parasites than the male cockroach. This may be due to the fact that the female roam more than the males in search of both food and locations to lay their eggs, as a result come in contact with contaminated materials subjecting them to the pathogens. This findings corroborated with the work of (Bala and Sule, [11]) who found that females cockroach harbour parasites more than the male cockroaches with parasite infection rate (32.35%). Cockroaches reported in this study is less than the 54.1% of cockroaches as recorded by (Al-mayali and Al-yakoobi, [14]), (Chamavit et al. [15]) reported infection rates of 67% and 83.33% respectively as recovered from the body of cockroaches are of medical importance and have been implicated in many digestive tract disorders. *Entamoeba species*, *B. coli*, *E. vermicularies*, *Hookworm* and *A. lumbricoides* have been reported to cause chronic diarrhea, liver disorder and reduced growth in the affected children (Mbanugo and Abazie, [16], WHO, [17]).

This work confirms that *Ascaris*, *Hookworm* and *Trichuris trichiura* contamination are usually common in many communities in Nigeria. *Geohelminths* also known as soil-transmitted parasites; the disease is spread by poor sanitary habits such as indiscriminate disposal or dumping of human and animals' feces. These parasites promote great health problems in many tropical and subtropical countries (Chamavit, et al. [15]).

Table 5. Bacteria recovered from the digestive tract of cockroach as from male and female hostels

Bacteria found	Hostels		
	Male	Female	
	No. % infected	No. % infected	No. % infected
<i>Staphylococcus aureus</i>	26(30.58)	22(25.88)	48(28.23)
<i>Escherichia coli</i>	23(27.05)	39(45.88)	62(36.47)
<i>Bacillus aureus</i>	19(22.35)	18(21.17)	37(21.76)
<i>Staphylococcus epidermidis</i>	17(20.0)	16(18.82)	33(19.41)
Total	85	85	170

Table 6. Fungal isolated from the digestive tract of cockroaches from male and female hostels

Fungal isolates	Hostels		
	Male	Female	
	No. % infected	No. % infected	No. % infected
<i>Aspergillus spp</i>	44(51.76)	43(50.58)	87(51.17)
<i>Penicillium spp</i>	41(48.23)	42(49.41)	83(48.82)
Total	85	85	170

The control and eradication of cockroaches should be an attempt, to stop intestinal parasite transmission in the community in addition to drug administration. The result of the present work showed contamination of almost all cockroaches collected from hostels with different parasites. The important of cockroaches as carrier of parasitic worms, cysts or eggs is because there are some reports about presence of parasitic forms on or in cockroaches (WHO, [17]).

5. CONCLUSION AND RECOMMENDATIONS

The findings of the present study showed the parasitic contamination in both the external surfaces and gastrointestinal tract of cockroaches and is potential mechanical vectors of pathogen and parasites. Therefore, control of cockroaches will substantially reduce the spread of infectious diseases in our communities.

Since cockroaches as domestic pests which pose health challenge to human, efforts should be geared towards proper sanitation of the environment both residential and industrial, proper storage of food stuff, vegetables and fruits for human consumption, government should invest and pay more attention on health education of citizenry to control the vectors of pathogen and parasites and the use of pesticides and insecticide should be encouraged to control the vectors.

ETHICAL APPROVAL

As per international standard or university standard written ethical approval has been collected and preserved by the authors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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