

# Evaluation of the role of cockroaches as a vector of medical important parasites carried in Lokoja, Kogi State, Nigeria

JS Ngwamah<sup>1\*</sup>, A. Mathias<sup>2</sup>, YB Dakum<sup>1</sup>

<sup>1</sup> Department of Biological Sciences, Federal University, Lokoja, Kogi State, Nigeria

<sup>2</sup> Department of Zoology, Modibbo Adama University of Technology, Yola, Adamawa State, Nigeria

Correspondence Author: JS Ngwamah

Received 9 Mar 2021; Accepted 28 Apr 2021; Published 13 May 2021

## Abstract

The study was carried out in Lokoja, Kogi State, Nigeria. It involved the trapping and examination of cockroaches from different locations (Jakura, Lokongoma, Adankolo, Felele and Zango) to isolate and identify parasites on adult and nymph and also to assess the possible role of cockroaches in the dissemination of infectious parasites. A total of 150 cockroaches were collected from the different site where 99 (66%) were identified as *Periplaneta americana* and 51 (34%) as *Blattella germanica*. The result showed significant difference ( $P < 0.05$ ) among the species of cockroaches in the study area with *Periplaneta americana* proved to be the most common cockroaches found in the study. Out of 150 cockroaches 102 (68%) are infected with one or more parasites of medical importance. Parasites that were isolated and identified during the course of this study include *Entamoeba coli*, *Ascaris lumbricoides*, *Strongyloides stercoralis*, *Enterobius vermicularis*, *Moniliformes dubius*, *Trichuris trichura*. The *Strongyloides stercoralis* 37(24.67%) proved to be the most prevalent specie that is associated with cockroaches in the study area, followed by *Ascaris lumbricoides* 33(22%) and *Moniliformes dubius*. This study has shown that cockroaches represent an important reservoir of important parasites of public health concern. It also highlighted cockroaches as the potential mechanical vectors of ova and cysts which they pick up from dustbin, toilet and any other form of unhygienic place. For this reason control of cockroaches is eminent.

**Keywords:** cockroaches, *Blattella germanica*, medical importance, parasites, *Periplaneta americana*

## Introduction

Cockroach is one of the most important insect vectors found in urban communities. They have been in existence on earth for over 360 million years without significant evolution (Cochran, 2013). They are regarded as one of the most effective groups of animals because of their ability to adapt to different kinds of environmental conditions. There are about 3,500 species of cockroaches identified worldwide (Kopanic R.J., 1994) [10]. Among these species, thirty are associated with human residence and are considered as mechanical vectors (Kinfu *et al.*, 2008). Three most domiciliary species are *Periplaneta americana* Linnaeus, 1758, *Blattella germanica* Linnaeus, 1767 and *Blatta orientalis* are the most common species (Goddard, 2003 and Al-Mayali *et al.*, 2010) [5]. Most of these species live in tropical and subtropical areas where they are not known as pests (Vazirianzadeh *et al.*, 2009) [20]. In these areas, they are abundantly found in areas with occurring standing water bodies or with frequent and high water availability such as toilets, kitchens, sewages and drainages where water provides movement routes from place to place (Siachua *et al.*, 2008) [16]. They are also found in unsanitary communities where garbage, dead animal carcasses, and piles of human and animal faeces are scattered and unattended. In addition to their disgusting and annoying characteristics, they eat and pollute food and leave an indefinite continuous odour in invaded places. Cockroaches often feed on human faeces, garbage and sewage (Uckay *et al.*, 2009) [19]. Therefore they have many opportunities to transfer pathogenic substances on food materials. They are primarily active during the night and have dirty habits coupled with their feeding mechanisms make them successful vectors of

pathogens like bacteria (*Klebsiella pneumoniae*, *Enterobacter cloacae*, *Enterobacter aerogenes*, *Salmonella sp.*, *Shigella sonnei*, *Vibrio cholerae*, *Citrobacter freundii* (Iboh *et al.*, 2014) [9]. Viruses (Poliomyelitis) (Mourier *et al.*, 2014) [12]. Protozoan (oocysts of *Isospora belli*, *Cryptosporidium parvum*, *Cyclospora cayentanensis*, cysts of *Entamoeba histolytica*, *Balantidium coli*, and *Giardia lamblia*) (Salehzadeh *et al.*, 2007) [15], fungi (*Candida sp.*, *Rhizopus sp.*, *Aspergillus sp.*, *Mucor sp.* (Tatfeng *et al.*, 2005) [17] and eggs of some pathogenic intestinal worms (*Ascaris lumbricoides*, *Trichuris trichiura*, Hookworm, *Enterobius vermicularis*, *Hymenolepis nana*, *Toxocara canis*, and *Strongyloides stercoralis* larvae (Nagham Y.A., Bala A. *et al.*, 2011) [13]. Cockroaches not only contaminate food with their droppings or by pathogens but they also cause food poisoning (Pai H.H. *et al.*, 2005). According to (Tatfeng *et al.*, 2005) [17] some people are allergic to the pathogens and faeces of cockroaches which may result in asthmatic related health problems (Salehzadeh *et al.*, 2007) [15]. Studies have been carried out in several states (Adamawa, Calabar and Osun), within the country where parasitic diseases were found related to the presence of cockroaches in households (Etim *et al.*, 2013; Wahedi *et al.*, 2020 and Adeleke *et al.*, 2012) [2, 21, 3]. In Lokoja, there is no epidemiological data on this risk factors associated with the presence of cockroaches in the households within the study area. This study was therefore designed to identify cockroaches' species while examining the occurrence of medically important parasites they carried in Lokoja Metropolis, Kogi State, Nigeria. This study may be of great benefits to the local residents and others within and outside the state as it will serve as an important tool for

the potential dangers they might face with the presence of cockroaches in their houses.

## Materials and Methods

### Study Area

Lokoja is an urban settlement, located in the middle-belt of Nigeria. It is the capital of Kogi State. It lies at the Confluence of the Niger and Benue rivers and covers an area of 3180 km<sup>2</sup>. The town is about 201 km southwest of Abuja. Lokoja is situated in the savannah region of Nigeria and temperature remains hot all year round. The town has a population of about 195,261 (NPC 2006 Census). The study area covers Lokoja Metropolis. People of Lokoja are predominantly farmers and some fishermen. Their sanitary conditions are below standard. Due to lack of pipe borne water supply, they depend sufficiently on River water and well water for most of their occupational and domestic activities. With no toilet facilities, majority use pit latrine toilets while others defecate on road sides and bushes and refuse dumps. These facilities largely contribute to the proliferation of cockroaches which are reported to be serious vectors of pathogens.

### Sample Collection

Sample were collected from different parts of Lokoja Metropolis (Adankolo, Lokogonma, Jakura, Felele and Zango area). Samples were collected daily between the hours of 9:00pm and 12:00am. During the period, cockroaches were collected from different places from the sample area above. Each cockroach was collected using gloved hands and placed in a petri dish and then the samples were transported to the laboratory. The cockroaches were identified morphologically using standard taxonomic keys as reported by Tawasin *et al.*, 2001.

Only cockroaches captured whole and live was used for this study.

### Isolation and identification of parasites cyst and ova/larvae from external surfaces

After identification, the cockroaches were killed by exposure to chlorofoam for few minutes in their respective containers and then each cockroach was transferred into 75ml of conical flask and 5ml of normal saline was added and then cockroaches were shaken vigorously for 2 minutes. The washings were decanted into a centrifuge tubes and centrifuged at 2000 rpm for 5 minutes. The sediments were transferred to a clean glass slides and a drop of Lugol's Iodine was added for clarity. The slide was then covered with cover slip and examined under a light microscope at x10 and x40. The cyst, ova and larvae of parasites were identified and counted.

### Parasite identification

Cysts, oocysts, eggs and/or larvae of human intestinal parasites

were identified microscopically using bench aids and their numbers recorded. A cockroach was considered a carrier if any parasite stage was detected.

### Data Analysis

Descriptive statistic was used to analyze the prevalence and Chi Square was used to show level of significance between the species of cockroaches, stages of development and the locations across the study area.

## Results

### Prevalence of cockroaches' species in the study area

A total of 150 cockroaches were collected. They were made up of 99 (66%) *Periplaneta americana* and 51 (34%) *Blattella germanica*. The result showed significant difference ( $P < 0.05$ ) among the species of cockroaches in the study area with *Periplaneta americana* proved to be the most common cockroaches found in the study (Table 1).

### Prevalence of parasites based on their location in the study area

Table 2 shows the parasites that are associated with cockroaches in the study that comprise of *Entamoeba coli*, *Ascaris lumbricoides*, *Strongyloides stercoralis*, *Enterobius vermicularis*, *Moniliformes dubius*, *Trichuris trichura*. Out of the total number (150), 102 were infected with one or more parasite species. The result also showed that significant difference ( $P < 0.05$ ) within the parasites associated with cockroaches in the study area. The *Strongyloides stercoralis* 37(24.67%) proved to be the most prevalent specie that is associated with cockroaches in the study area, followed by *Ascaris lumbricoides* 33(22%) and *Moniliformes dubius*. Felele proved to have higher species [*Moniliformes dubius* 10 (33.33%); *Ascaris lumbricoides* 5(16.66%); *Strongyloides stercoralis* 9(30%);] than any other sample collection sites.

### Distribution of medically important parasites based on species of cockroaches

The distribution of parasites according to the species of cockroaches in different locations in Lokoja metropolis shows that prevalence of *Periplaneta americana* was highest in Lokogonma with 18 (27.3%) followed by the ones collected from Felele with 13 (19.7%), followed by the ones collected from Jakura 12 (18.2%) and Adankolo 12 (18.2%) and the least was gotten from Zango 11 (16.7%). The result shows that there was significant difference ( $P < 0.05$ ) between the species of cockroaches from the study area. The highest species of *Blattella germanica* was gotten from Jakura with 9 (23.7%) followed by the ones gotten from Felele, Zango and Adankolo each with 7 (18.4%) and the least was recovered from Lokongoma with 6 (15.8%).

**Table 1:** Prevalence of cockroaches' species in the study area

Location	Total capture	<i>Periplaneta Americana</i>		Total no	<i>Blatella germanica</i>		Total no
		No of Nymph	No of adult		No of adult	No of Nymph	
Jakura	30	7 (18.4%)	10(16.4%)	17	7 (22.6%)	6 (30%)	13
Lokogonma	30	5 (13.4%)	18(29.5%)	23	5 (16.1%)	2 (10%)	7
Adankolo	30	9 (23.7%)	12(19.6%)	21	6 (19.4%)	3 (15%)	9
Felele	30	10(26.3%)	9 (14.8%)	19	7 (22.6%)	4 (20%)	11
Zango	30	7 (18.4%)	12(19.6%)	19	6(19.4%)	5(25%)	11

Total No	150	38	61	99	31	20	51
----------	-----	----	----	----	----	----	----

**Table 2:** Prevalence of parasites based on their location in the study area

Sampling Area	No Sampled	Parasites						
		EV (%)	EH (%)	MD (%)	SM (%)	AS (%)	SS (%)	TT (%)
Jakura	30	1(3.33)	1(3.33)	0(0)	3(10)	9(30)	7(23.33)	1(3.33)
Lokogoma	30	0(0)	0(0)	4(13.33)	0(0)	3(10)	15(50)	2(6.67)
Adankolo	30	0(0)	1(3.33)	2(6.67)	0(0)	5(16.66)	6(20)	5(16.66)
Felele	30	0(0)	0(0)	10(33.33)	0(0)	5(16.66)	9(30)	0(0)
Zango	30	0(0)	0(0)	0(0)	0(0)	11(36.66)	7(23.33)	2(6.67)
Total	150	1(0.66)	2(1.33)	16(10.66)	3(2)	33(22)	37(24.67)	10(6.66)
Grand Total (%)		102(68)						

**Table 3:** Distribution of medically important parasites based on species of cockroaches

		<i>Periplaneta Americana</i>	<i>Blatella germanica</i>
Location	Total captured	No positive	No positive
Jakura	30	12 (18.2%)	9 (23.7%)
Felele	30	13 (19.7%)	7 (18.4%)
Zango	30	11 (16.7%)	7 (18.4%)
Lokongonma	30	18 (27.3%)	6 (15.8%)
Adankolo	30	12 (18.2%)	7(18.4%)
Total	150	66 (44%)	38 (25.3)

Based on the stages of development of cockroaches in the study area, out 17 adult cockroaches captured in Jakura 15 (18.8%) was positive to parasite and out of 13 nymphs captured 7 (21.9%) was positive to parasite. In Lokongonma out of 23 captured, 20 (25%) was positive to parasite and then out of 7 nymphs captured 4 (12.5%) was positive to parasite. Then coming to Adankolo, out of 18 adult of cockroaches captured, 16 (20%) was positive to parasite while out of the 12 nymphs captured, 8 (25%) was positive to parasite. There was no statistically significant difference ( $P > 0.05$ ) in the distribution between adult and the nymph of cockroaches. In Felele, out of 16 adults captured 13 (16.3%) was positive to parasite while out of 14 nymphs captured, 8 (25%) was positive to parasite. Then in Zango, out of 19 adults captured, 16 (20.0%) was positive to parasite while out of 11 nymphs collected 7 (21.9%) was positive to parasite (Table 4).

**Table 4:** Distribution of medically important parasites based on the stage of development

Location	Adult		Nymph	
	Total captured	No positive	Total captured	No positive
Jakura	17	13 (18.6%)	13	7 (21.9%)
Lokongonma	23	18 (25.7%)	7	4 (12.5%)
Adankolo	18	14 (20%)	12	6 (18.8%)
Felele	16	13 (18.6%)	14	8 (25%)
Zango	19	12 (17.1%)	11	7 (21.9%)
Total	93	70 (86.0%)	57	32 (56.1%)

## Discussion

Cockroaches are considered pests whose activities cause negative effect on human's health. Their efficacy as potential mechanical vectors of parasites are of great concern to human and public health. It is widely assumed that cockroaches important in the transmission of parasitic worm, cysts, egg or ova, was based on some reports about the presence of parasitic forms on or in cockroaches (Wahedi, *et al.*, 2020, Etim, *et al.*, 2013<sup>[21, 8]</sup> and Atiokeng Tatang *et al.*, 2017)<sup>[6]</sup>. The way we

take care of our home and environment i.e our sanitary behavior will significantly reduce the prevalence of parasitic or pathogenic infestation in our communities but other factors that contribute greatly to transmission of such disease are neglected.

This study revealed that cockroaches may serve as important vector for the transmission of infectious parasites more especially those isolated and identified on them. The medically important parasites that have been isolated during this study are *Ascaris lumbricoides*, *Moniliformes dubius*, *Strongyloides stercoralis* and *Trichuris trichiura* majorly while *Entamoeba coli*, *Hymenolepis nana* are few.

The overall occurrence of 68% of parasite recorded in this study is higher than 58.6% reported by Etim *et al.*, 2013<sup>[8]</sup> in Calabar but is in agreement with 62.2% by Ojianwuna C.C (2014) in Abraka, Delta State and 67% reported by Ajero *et al.*, (2011) in Owerri. The prevalence of the study is far lower than 98% observed in Egypt by El-sherbini and El-shaebini (2011). The differences in sanitary conditions, temperature and humidity in the various locations may be reason for the differences in parasite density rate among the different settings. This study also disclose that cockroaches regardless of their species play a vital role in transmitting parasitic infections as more than 23% of the two cockroaches species (*P. americana* and *B. germanica*) are carriers of parasites and are able to transmit them to humans or animals and this is in agreement with the report (Tilahun, *et al.*, 2012)<sup>[18]</sup>. Significant difference ( $P < 0.05$ ) observed between the species as more parasites are transmitted by *P. americana* (44%) which is similar to other studies carried out by Taiwatsin *et al* (2011), Saichua *et al.*, (2008)<sup>[16]</sup>. The reason of high significant difference may attributed to large area of the body of *P. americana* than *B. germanica*; due to their adaptation in different environmental conditions and their trend of being more active in search of food and sites to lay egg compared to that of *B. germanica*. Findings from this study also showed that the different developmental stages of the cockroaches showed significant difference ( $P < 0.05$ ) in their ability to harbor parasites of medical importance. There were more parasites encountered on the body surface of adult (86.0%) than those of the nymphal stages (56.1%) of cockroaches examined. The difference may be due to the fact that adult cockroaches have wings, more active and mobile than the nymph hence more opportunity in contaminating itself with parasitic organisms (Tilahun, *et al.*, 2012)<sup>[18]</sup>.

*Strongyloides spp* (24.67%) and *Ascaris spp* (22%) are the most prevalent helminthes parasite encountered in the study area. These worms respectively are responsible for the cause

strongyliasis and ascariasis in human. They are the most prevalent in the study area irrespective of the location, age and the species of the cockroaches encountered. The highest transmission of these helminthes can be explained by the fact that both of them have an inner shell layer of lipoprotein nature which makes them more resistant to harsh environmental conditions and are air-borne as reported by Atiokeng *et al.* (2017) [6]. In general high occurrence of *helminthes* in most of the locations is also associated with poor hygienic conditions of these locations (Wahedi *et al* 2020) [21].

### Summary

Results gotten from this study revealed the parasites that are carried by cockroaches. The study showed that *Ascaris lumbricoides*, *Strongyloides stercularis*, and *Moniliformes dubius* and *Trichuris trichuria* are the major parasites of these locations.

It was observed that there was no significant difference ( $P > 0.05$ ) between the adult and nymph. Significant difference was observed between the species of cockroaches; *Periplaneta americana* and *Blattella germanica* at ( $P < 0.05$ ) and between the different locations across the study ( $P > 0.05$ ).

### Conclusion

Cockroaches create an important reservoir for pathogens. There close contact with cockroaches should be avoided. Due to low sanitation in Lokoja especially in areas like Felele and Lokogonma, there is need to educate and enlighten people on the health risk associated with cockroaches and how to control them. There is also need to improve on the way we keep our environment clean in order to reduce or avoid contact with cockroaches in our surrounding. To control parasitic diseases, cockroaches in the human and animal dwellings must be controlled by making the environment less advantageous to them by the use of insecticides, gum traps, ensuring proper food storage facilities, and proper disposal of household refuse.

### Recommendations

In view of the presence of parasites carried by cockroaches, it is recommended that further control of infectious agents such *Ascaris lumbricoides*, *Strongyloides stercularis*, *Entamoeba coli*, *Moniliformes dubius* can be achieved with the following:

1. Reducing contact to water, food items and utensils: cockroaches are attracted to areas where food and water are easily gotten. People should reduce substances that attract cockroach such as pet food dishes, drains, dishwaters etc. food and water source should be limited by storing them in a well-sealed containers and avoid keeping dirty plates overnight by cleaning storing them properly.
2. The use of insecticides: sporadic use of insecticides to reduce cockroach population is recommended. This is done by finding their hiding places and treating the locations. The house should be cleaned thoroughly and an approved insecticide should be use. Insecticides are used when the infestation is small, but when severe, several managements is required achieving the desired result.
3. Health education of people: this is training and enlightening people on proper disposal of waste and making them to understand that how it creates breeding sites for cockroaches. People should avoid littering places with refuse dumps, faeces and waste and could be done by

observing good personal hygiene by subjects, household and locations members as well as construction of proper drainage system to allow appropriate flow of water from toilets and bathrooms.

### References

1. Gholam HS, Saadat P, Alireza RSN. Cockroach Infestation and Factors affecting the Estimation of Cockroach Population in Urban Communities. International Journal of Zoology, 2013, 1-6.
2. Etim SE, Okon ON, Akpan PA, Ukpong GI, Oku EE. Prevalence of Cockroaches (*Periplaneta Americana*) in house hold in Calabar: Public Health Implications. Journal of Public and Epidemeology, 2013; 5(3):149-152.
3. Adeleke MA, Akatah HA, Hassan AO, Sam-Wobo SO, Famodimu TM, Olatunde GO, *et al.* Implication of Cockroaches as vectors of gastrointestinal parasites in parts of Osogbo, South western Nigeria. Munis Entomology and Parasitology, 2012; 7(2):1106-1110.
4. Ajero CMU, Ukaga CN, Ebirim C. The role of cockroaches in the transmission of parasites of medical importance in Arkilla, Sokoto, Nigeria. Nigeria Journal of Basic and Applied Science, 2001; 20(2):111-115.
5. Al-Mayali HM, Al-Yaqoobi MSM. "Parasites of cockroach *Periplaneta americana* (L) in Al-Diwaniya provinve," Irag Journal of Thi-Qar Science, 2010; 2(3):128-132.
6. Atiokeng Tatang RH, Stila HG, Wobo Pone' J. Medically Important parasites Carried by Cockroaches in Melong Subdivision, Littoral, Cameroon. Journal of Parasitology Research, 2017, 1-8.
7. Bala A, Sule H. "Vectorial potential of cockroaches in transmitting the parasites of medical importance in Arkilla, Sokoto Nigeria," Nigerian Journal of Basic and Applied Science, 2012; 20(2):111-115.
8. Etim SE, Okon OE, Akpan PA, Ukpong GI, Oku EE. "Prevalence of cockroaches (*Periplaneta americana*) in households in Calabar: public health implications. journal of public health and epidemiology," Journal of Public Health and Epidemiology, 2013; 5(3):149-152.
9. Iboh CI, Etim LB, Abraham JT, Ajang RO. "Bacterial and parasites infestation of cockroaches in a developing community, South Eastern, Nigeria," International Journal of Bacteriology Research, 2014; 2(5):045-048.
10. Kopanic RJ. "Cockroaches as vectors of salmonella: laboratory and field trials," Journal of Food Protection, 1994; 57(2):125-135.
11. Kinfu A, Erko. "Cockroaches as carriers of human intestinal parasites in two localities in Ethiopia," Transactions of the Royal Society of Tropical Medicine and Hygiene, 2004; 102(11):1143-1147.
12. Mourier A. Lutte integree contre deux insects synanthropes: *Blattella germanica* et *Cimex lectularius*. Apports de l'ecologie scientifique pour le conseil a l'officine. Pharmaceutical sciences. Dumas, 2014, 103p.
13. Nagham YA, Anfal SAA, Israa KA. Risks associated with cockroach *Periplaneta americana* as a transmitter of pathogen agents," Diyala Journal of Medicine, 2011; 1(1):91-97.

14. Pai HH, Chen WC, Peng CF. "Cockroaches as potential vectors of nosocomial infections," *Infections Control and Hospital Epidemiology*, 2004; 25(11):979-984.
15. Salehzadeh A, Travacol P, Mahjub H. Bacterial, fungal and parasitic Contamination of cockroaches in public hospitals of Hamadan, Iran. *Journal of Vector Borne Diseases*, 2007; 44:105-110.
16. Siachua P, Pinmai KH, Somrithipol S, Tor-Udom S. "Isolation of medically important fungi from cockroaches at Thamasat Chalermprakait hospital," *Thamasat, Medical Journal*, 2008; 8(3):345-349.
17. Tafeng YM, Usuanlele MU, Orukpe A, *et al.* "Mechanical transmission of pathogenic organisms: the role of cockroaches," *Journal of Vector Borne Diseases*, 2005; 42:129-134.
18. Tilahun B, Worku B, Tachbele E, Terefe S, Kloos H, Legesse W. High load of multi drug resistant nosocomial neonata pathogens carried by cockroaches in a neonatal intensive care unit at tikur Anbessa specialized Hospital, Addis Ababa, Ethiopia," *Antimicrobial Resistance and infection Control*, 2012; 1:12.
19. Uckay I, Sax H, Pietro LD, *et al.* "Cockroaches (*Ectobius vittiventris*) in an intensive care unit, Switzerland," *Emerging Infectious Diseases*, 2009; 15(3):496-497.
20. Vazirianzadeh B, Mehdinejad M, Dehghani R. "Identification of bacteria which possibly transmitted by *Polyphaga aegyptica* (Blattetea; Blattidea) in the region of Ahvaz," *SW. Iran. J. undishapur Journal of Microbiology*, 2009; 2(1):36-40.
21. Wahedi JA, Pukuma MS, Gambu JW, Elkana OS. Prevalence of parasites in Cockroaches and Perception on their Influence in Disease transmission in Mubi-South, Adamawa State, Nigeria, *Animal research international*, 2020; 17(2):3790-3798.