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Occurrence of *Acanthocephalan, Moniliformis dubius* in Cockroach, *Periplaneta americana* and *Blattella germanica* in Zaria, Nigeria

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ABSTRACT

A study was conducted to determine the role of cockroaches as carriers of *Moniliformis dubius* in Ahmadu Bello University Main Campus, Zaria, Kaduna State. A total of 378 cockroaches, comprising of two species were collected from six halls of residence using hand gloved hand and examined for *M. dubius* using the sedimentation method. The overall prevalence of *M. dubius* in this study is 24.58%. Suleiman Hall had the highest prevalence followed by Danfodiyo hall with a prevalence of 35.0% while the Akenzua Hall had the least prevalence of 12.50%. *Periplaneta americana* only harboured the parasite, *Blattella germanica* was observed to harbour no *M. dubius*. *M. dubius* isolated from male and female *P. americana* revealed no significant difference ($P > 0.05$) with the female and male having a prevalence of 12.50% and 12.08% respectively. Adults of *P. americana* (20.83%) was highly significant ($P \leq 0.01$) from the nymphs (3.75%). *M. dubius* obtained from the body surfaces of *P. americana* showed that the parasite dominate more in the internal body surface (10.58%) than the external body surface (7.14%), with no significant differences ($P > 0.05$).

Mean load of *M. dubius* was highest in Suleiman Hall, 2.03 (128 *M. dubius* parasite) and least in Akenzua Hall, 0.13 (8 *M. dubius*). Cockroach continue to constitute important reservoir for infectious pathogens, control measures should be instituted in toilets, bathrooms and kitchens, targeting both sexes and stages of development of cockroaches could substantially minimize the spread of acanthocephaliasis infections in the study area.

Keywords: *Moniliformis dubius*, *Blattella germanica* *Periplaneta Americana*, Parasite and Prevalence.

INTRODUCTION

Cockroaches are the world's most common insects and have been on earth for about 300 million years. They are considered one of the most successful groups of animals because of their adaptability (Salehzadeh *et al.*, 2007). Thirty species of cockroaches are associated with human habitations and about 4,500 species can be found in every part of the world with *Periplaneta americana* (Linnaeus, 1758) and *Blattella germanica* (Linnaeus, 1767) being the most common species (Robinson, 2005; Uneke, 2007). Cockroaches have been recognized as mechanical vectors of human pathogens (Cochran, 1982). They contaminate food by their droppings containing parasites and also transmit bacteria, fungi, and other pathogenic microorganisms in infested areas (Che Ghani *et al.*, 1993). They serve as carriers of bacterial diarrhea and nosocomial infections in hospitals (Fotedar *et al.*, 1991).

Acanthocephalan worms are endoparasites of animals. They form a unique phylum by virtue of their unique structure and extreme parasitic habits (Makki *et al.*, 2006). Acanthocephalans are not primarily human parasites. The parasite must have at least two hosts in order to complete its life cycle. Intermediate hosts are either beetles or cockroaches, which must be eaten by a definitive host (human inclusive). Several species of Acanthocephalans have been reported to cause human infection including *Moniliformis moniliformis*, *Macroacanthorhyncus hirudinaceus*, *Macracanthorhynchus ingens*, *Acantocephalus bufonis*, *Corynosoma strumosum*, and *Acanthocephalus rauschi* (Beever *et al.*, 1984; Makki *et al.*, 2006). *Moniliformis dubius* and *Macroacanthorhyncus hirudinaceus* have been reported to have cosmopolitan distribution as reviewed by Schmidt (1971).

Moniliformis dubius is an acanthocephalans that is a normal parasite of the rat, the hamster, the white mouse in most parts of the world (Meysers *et al.*, 2000). It develops in the haemocoel of the cockroach, *Periplaneta americana* and sexual maturity is achieved in the small intestine of rats. *Moniliformis dubius* has been reported in Iraq, Italy, Sudan, Honduras, and Palestine (Al-Rawas *et al.*, 1977) in association with cockroaches. *Moniliformis* species has been reported in rodents in Khuzestan, Iran (Sadjadi and Massoud, 1999). The first report of *Macracanthorhyncus hirudinaceus* in man was reported by LAMBL in 1859 in a child in Prague. The first case of human infection with *Moniliformis* species in Iran was reported in 1970 in an 18 month-old child from a village in the southeast of the country, near Zabol. The child suffered from anorexia and vomiting accompanied by foamy diarrhoea (Sahba *et al.*, 1970). The second case was a 4 month old Iranian boy, who exhibited characteristics of irritability, cough, diarrhoea, sweating, and pallor. A total of 9 worms were detected in the patient during 5 months of follow up (Moayedi *et al.*, 1971). Data on the pathogenesis of *Moniliformis dubius* are limited, and records in humans tend to be scarce (Gibson, 1998).

The aim of this study is to isolate and determine the prevalence of this parasite in sexes, stage of development and on the body surfaces of cockroaches captured from Ahmadu Bello University, Main Campus, Zaria, Kaduna State.

MATERIALS AND METHODS

Study Area: Ahmadu Bello University, Samaru lies on latitude 11°10'N and 7°38'E. It is located in Sabon Gari Local Government Area of Kaduna State after Kaduna town north ward along Kaduna-Kano highway.

Sample Collection: Cockroaches were captured from six halls in Ahmadu Bello University Main Campus, Zaria, Kaduna State. The following are the sampling halls for collection of cockroaches; Akenzua, Suleiman, Danfodiyo, Yar'adua, Amina and Ribadu.

Samples were collected daily between the hours of 10:00 pm and 4:00 am. During the period, cockroaches were captured from kitchens, bathrooms, and toilets. Each cockroach was collected using gloved hands and placed in a sterile test-tube containing 5 ml of sterile normal saline (0.9%) (Adeleke *et al.*, 2012); samples were transported to the laboratory and immobilized by freezing at 0°C for 5 minutes. The cockroaches were identified morphologically using standard taxonomic keys (Tawatsin *et al.*, 2001). Only cockroaches captured whole and live was utilized for the study.

Cockroaches were thoroughly shaken for 2 minutes after identification and the washings was decanted into centrifuge tubes and centrifuged at 2000 rate per minute (rpm) for 5 minutes. Sediments obtained were transferred to a clean glass slides, and a drop of 1% Lugols Iodine solution was added. The slide was then covered with a cover slip and examined under a light microscope at x40 and x100 magnifications. The cystacanth of parasites seen was identified and counted (Chandler and Read, 1962).

After external washings, cockroaches were placed in flasks rinsed with 70% alcohol for 5 minutes and transferred to sterilized flasks, and allowed to dry at room temperature under sterile conditions. Cockroaches were then washed with sterile normal saline for 2 to 3 minutes to remove traces of alcohol. The head was first severed out, and next are the legs, with the help of fine pointed forceps and scissors. The body was then pinned to a small dissection tray with thin entomological pins. The ligaments were cut on the right hand side of the abdominal sternites using a scissor and releasing the ventral plate, clearing its adhesions to the internal organs with sharp needles or with a microscalpel. The alimentary canal was isolated and was then set free from its ties, it was then separated more or less completely, the gizzard was moved with the tweezers until the esophagus was seen and then it was cut distally. The rest of the digestive tract was then liberated with the needles, and cut at the other end, at the level of the anus (or cloaca). The intestinal caecae was identified. With the help of the forceps and the scissors, two cuts were made in the intestine: one below the caecae, and another one at the level of the cloaca. The separated intestine was then transferred to a capsule with clean physiological solution. With the two rigid teasing needles, fine and sharpened, the intestine was open alongside, releasing its content. After dissection, the cockroach intestines were macerated aseptically in a sterile pestle and mortar in 5 ml of sterile normal saline. The resulting macerate was then processed in a similar way as described previously and the results recorded (Garcia and Bruckner, 1997).

STATISTICAL ANALYSES

Descriptive statistics was used to analyze the prevalence. Paired T-test was used to compare the prevalence of *Moniliformis dubius* between the locations, species, sex and stage of development. Statistical Package for Social Sciences (SPSS) version 21.0 was used for the Analyses.

RESULTS

The overall prevalence of *Moniliformis dubius* in this study is 24.58% (59 cockroaches). According to the halls, Suleiman Hall had the highest prevalence according to location followed by Danfodiyo hall with a prevalence of 35.0% (14 cockroaches) and 32.50% (13 cockroaches) respectively while the Akenzua Hall had the least prevalence of 12.50% (5 cockroaches). A *Blattella germanica* cockroach was observed to have no *M. dubius* (Table 1). Comparative prevalence of *M. dubius* between the male and female *Periplaneta americana* revealed no significant difference ($P>0.05$) with the female having the highest prevalence of 12.50% (30 cockroaches) while the males had a prevalence of 12.08% (29 cockroaches) (Table 2). Based on developmental stages, adults of *P. americana* had the highest prevalence of 20.83% (50 cockroaches) which was significant from the nymphs with a prevalence 3.75% (9 cockroaches). Highly significant difference ($P\leq 0.01$) was noted between the adult and nymph. Also, *M. dubius* obtained from the body surfaces of *P. americana* showed that the parasite dominate more in the internal body surface with a prevalence of 10.58% (40 cockroaches) than the external body surface with a prevalence of 7.14% (27 cockroaches). Comparison of *M. dubius* based on body surface revealed no significant differences ($P>0.05$).

Mean load of *M. dubius* was determined and result showed that Suleiman Hall had the highest mean load of 2.03 (128 *M. dubius* parasite) followed by Ribadu Hall with a mean load of 1.37

Table 1. Occurrence of *Moniliformis dubius* Based on Sex of Cockroaches Species from Sampling Halls.

Sampling Halls	<i>Periplaneta americana</i>				<i>Blattella germanica</i>			
	Number Examined	Male (%)	Female (%)	Total (%)	Number Examined	Male (%)	Female (%)	Total (%)
Akenzua Hall	40	0 (0.00)	5 (12.50)	5 (12.50)	23	0 (0.00)	0 (0.00)	0 (0.00)
Suleiman Hall	40	6 (15.00)	8 (20.00)	14 (35.00)	23	0 (0.00)	0 (0.00)	0 (0.00)
Yar'adua Hall	40	3 (7.50)	3 (7.50)	6 (15.00)	23	0 (0.00)	0 (0.00)	0 (0.00)
Danfodiyo Hall	40	4 (10.00)	9 (22.50)	13 (32.50)	23	0 (0.00)	0 (0.00)	0 (0.00)
Queen Amina Hall	40	9 (22.50)	3 (7.50)	12 (30.00)	23	0 (0.00)	0 (0.00)	0 (0.00)
Ribadu Hall	40	7 (17.50)	2 (5.00)	9 (22.50)	23	0 (0.00)	0 (0.00)	0 (0.00)
	240	29 (12.08)	30 (12.50)	59 (24.58)	138	0 (0.00)	0 (0.00)	0 (0.00)

T – test -0.085

Df 5

P value 0.935ns

Standard Error of the difference is 0

Table 2. Occurrence of *Moniliformis dubius* Based on Developmental Stage of Cockroaches Species from Sampling Halls

Sampling Halls	<i>Periplaneta americana</i>				<i>Blattella germanica</i>			
	Number Examined	Adult (%)	Nymph (%)	Total (%)	Number Examined	Adult (%)	Nymph (%)	Total (%)
Akenzua Hall	40	5 (12.50)	0 (0.0)	5 (12.50)	23	0 (0.00)	0 (0.00)	0 (0.00)
Suleiman Hall	40	12 (30.00)	2 (5.00)	14 (35.00)	23	0 (0.00)	0 (0.00)	0 (0.00)
Yar'adua Hall	40	5 (12.50)	1 (2.50)	6 (15.00)	23	0 (0.00)	0 (0.00)	0 (0.00)
Danfodiyo Hall	40	11 (27.50)	2 (5.00)	13 (32.50)	23	0 (0.00)	0 (0.00)	0 (0.00)
Queen Amina Hall	40	8 (20.00)	4 (10.00)	12 (30.00)	23	0 (0.00)	0 (0.00)	0 (0.00)
Ribadu Hall	40	9 (22.50)	0 (0.00)	9 (22.50)	23	0 (0.00)	0 (0.00)	0 (0.00)
	240	50 (20.83)	9 (3.75)	59 (24.58)	138	0 (0.00)	0 (0.00)	0 (0.00)

T – test 6.006

Df 5

P value 0.002**

Standard Error of the difference is 0

Table 3. Occurrence of *Moniliformis dubius* from External and Internal Body Surfaces of Cockroach from the Sampling Halls.

Sampling Halls	Total Captured	External	Internal	Total Number Positive (%)
		Number Positive (%)	Number Positive (%)	
Akenzua Hall	63	4 (6.35)	2 (3.17)	5 (7.94)
Suleiman Hall	63	9 (14.29)	6 (9.52)	14 (22.22)
Yar'adua Hall	63	4 (6.35)	2 (3.17)	6 (9.52)
Danfodiyo Hall	63	0 (0.00)	13 (20.64)	13 (20.64)
Queen Amina Hall	63	5 (7.94)	8 (12.70)	12 (19.05)
Ribadu Hall	63	5 (7.94)	9 (14.29)	9 (14.29)
Total	378	27 (7.14)	40 (10.58)	59 (15.61)

T – test -0.878

Df 5

P value 0.420ns

Table 4. Mean Load of *Moniliformis dubius* from Sampling Halls in Ahmadu Bello University, Zaria.

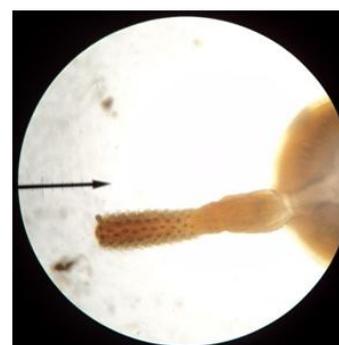
Sampling Areas	Total Captured	Number of Parasites (Mean)
Akenzua Hall	63	8 (0.13)
Suleiman Hall	63	128 (2.03)
Yar'adua Hall	63	15 (0.24)
Danfodiyo Hall	63	60 (0.95)
Queen Amina Hall	63	56 (0.89)
Ribadu Hall	63	86 (1.37)
Total	378	353 (0.93)



(a)



(b)



(c)

Plate I. *Moniliformis dubius* (a) cystacanths within cyst (Magnification = X10) (b) cystacanth freed from cyst and proboscis evaginated (Magnification = X10) (c) proboscis showing rows of hooks use in attaching to host intestines (Magnification =X40).

(86 *M. dubius* parasite) while Akenzua Hall had the least mean load of 0.13 (8 *M. dubius* parasite).

DISCUSSION

From the present study, it was apparent that the cockroaches captured from Ahmadu Bello University Main Campus, Zaria, Kaduna, Nigeria harboured an acanthocephalan parasite, *Moniliformis dubius* on both internal and external body surfaces. This findings from this study also revealed that *Blatella germanica* do not harbour *Moniliformis dubius*.

Significant difference was observed in the prevalence between the adult and nymph with the adult harbouring more of the parasite. This was observed due to the time frame with which the adult cockroaches ingest the faeces of the definitive host in comparison to the nymph with a short time frame.

Lack of significant difference in prevalence between the sexes showed that the cockroaches have equal opportunities of harbouring the parasite as both move in search of food, mate and reproduction. Also, no significant difference in prevalence between the external and internal body surfaces.

The high prevalence of this parasite is an indication of the presence of large number of rodents found in the study area which serve as the definitive host of this parasite. These rodents are subjected to little disturbance within the campus, thereby serving as a reservoir for this parasite.

CONCLUSIONS

Since children in this young age group may be prone to various types of accidents such as ingestion of foreign bodies, family members in areas with reduced hygiene should be advised about the need to constantly care for children to help them avoid hazards and foods that may be infested with arthropods. Meanwhile, it must be considered that individuals with acute abdominal pain, especially children from rural areas with history of eating raw or undercooked insects, may be suffering from acanthocephaliasis (Leng *et al.*, 1983).

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