Available online at http://www.ajol.info/index.php/njbas/index
Nigerian Journal of Basic and Applied Science (June, 2012), 20(2): 111-115
ISSN 0794-5698

Vectorial Potential of Cockroaches in Transmitting Parasites of Medical Importance in Arkilla, Sokoto, Nigeria

***A.Y. Bala and H. Sule**
Department of Biological Sciences, Usmanu Danfodiyo University, Sokoto
[*Corresponding Author email: aminubala2001@yahoo.com]

ABSTRACT: A study was conducted to determine the role of cockroaches as potential carriers of parasites of medical importance in Arkilla Federal Low Cost, Sokoto, Nigeria from October 2011 to February 2012. A total of 218 cockroaches, comprising of two species were collected from different locations using sweep net and examined for human intestinal parasites using the concentration method. The dominant cockroach species was *Periplaneta americana* 145 (66.51%) followed by *Blatta orientalis* 73 (33.49%). Six medically important parasites were encountered in the following order *Entamoeba histolytica* (40.83%), *Ascaris lumbricoides* (28.40%), *Enterobius Vermicularis* (15.98%), *Schistosoma mansoni* (9.48%), *S. haematobium* (2.95%) and *Trichuris trichura* (2.36%). There was no statistically significant difference ($p > 0.05$) in the isolates between cockroach species and stage of development. However significant differences ($p < 0.05$) were observed between sexes and sites of cockroach collection. Therefore, as cockroaches continue to constitute important reservoir for infectious pathogens, control measures instituted in toilets, kitchens; and targeting especially the females and both stages of development of cockroach could substantially minimize the spread of infectious diseases in the study area.

Keywords: vectors, cockroaches, parasites, medical, Arkilla

INTRODUCTION

Cockroaches are the most abundant and obnoxious non-biting insect pests in residential buildings, hospitals, hostels, hotels and restaurants (Piper and Antonelli, 2012). They feed indiscriminately on human food and sewage. When cockroaches run over food, they contaminate the food by leaving an oily liquid that has offensive odour or bacteria that can cause food poisoning (Brenner *et al*., 1987). Some parasites have been found in the external and internal body parts of cockroaches. Findings have also shown that exposure to cockroach antigens may play an important role in Asthma related health problems (Montressor et al., 1998).

There is an unprecedented increase in cockroach population in public places all over the world. Particularly in Nigeria, the risk to human health arising from cockroach infestations have been reported (Allen, 1987). Cockroaches are abundant in most homes in Nigeria, where they are actually called "landlords" in homes.

Cockroaches are among the most notorious pests of premises, they frequently feed on human faeces, and therefore they can disseminate cysts of enteric protozoans in the environment if such faeces are contaminated. They can not only contaminate food by leaving droppings and bacteria that can cause food poisoning (Che Ghani *et al*., 1993) but they can also transmit bacteria, fungi, and other pathogenic microorganisms in infested areas (Kopanic, 1994; Czajka *et al*., 2003). Cockroaches feed on garbage and sewage and so have copious opportunities to disseminate human pathogens (Cotton *et al*., 2000; Pai *et al*., 2005). In addition, their nocturnal and filthy habits made them ideal carriers of various pathogenic microorganisms (Allen, 1987).

This work was therefore designed to isolate and identify parasites from external surface of cockroaches in Arkilla Federal Low cost, Sokoto. The findings may be of immense benefit to the residents of the area and residents of other areas within and outside Nigeria, as it will help to educate them on the dangers pose to them by the presence of cockroaches in their houses. The study will also inform them of the different parasites probably vectored by the cockroaches in the study area.

MATERIALS AND METHODS

Study area

The study area was Arkilla Federal Low Cost (latitude 13^0 1' 26'N and longitude 5^0 11'48'E) of Wamakko Local Government Area, Sokoto State. The study area has both hot and cold seasons. The hot season reaches its peak between March and April, while the cold season has its peak between November and February. The cold season is always accompanied by dust. The state experiences a short rainy season (June–September) and a long dry season (October–May). The rainfall (wet season) starts April and June and ends around October. The rainfall is usually

erratic and associated with periodic drought. The mean maximum temperature is about 40^{0}C and 15^{0}C mean minimum (Yakubu and Singh, 2001). Arkilla is mainly populated by Hausa–Fulani and a mixture of other languages like Yoruba, Igbo, Igala, Nupe, etc.

Sample collection

A total of 218 cockroaches were caught, using sweep net, from different locations (refuse dumps, toilets, kitchens, parlours and bedrooms) in the study area, May – December 2011. Each cockroach caught was placed in a sterile sample bottle separately, and transported to the Zoology Laboratory of the Usmanu Danfodiyo University, Sokoto. Each cockroach was euthanized alone in a killing jar using choloroform and then examined under the dissecting microscope. The sex, stage of development, and species of cockroaches were identified with the help of an entomologist using standard taxonomic keys.

Isolation and Identification of Parasites

After identification, each cockroach was placed in a test tube containing 2mls of normal saline. The test tube was shaken vigorously for two minutes to detach any parasite or their stages from the external body of the cockroach. Thereafter, the fluid was transferred to a centrifuge tube and centrifuged at 3000rpm for 5 minutes. After decanting the excess top fluid, the residual deposit was placed on a clean glass slide, covered with a cover slip and stained with Lugol's iodine and viewed under the x40 microscope objective lens. The parasites and/or their stages encountered were identified and counted using keys of Cheesbrough (1998).

Statistical Analysis

Descriptive statistics was used to analyze the prevalence while Chi square analysis was used to determine association and significant differences between the parameters tested at p≤ 0.05.

RESULTS

A total of 218 cockroaches were studied, all were identified as *Periplaneta american* (145) and *Blatta orientalis* (73), males (116) females (102); 182 were adults while 36 were at nymph stage. The results show that, out of the 218 cockroaches caught and examined for the presence of parasitic stages, 169 were found to be carrying different stages of parasites, representing 77.52%. Species specific prevalence shows that, out of the 169 cockroaches, 112 representing (77.24%) were the American cockroaches (*P. americana*), while the remaining 57 (78.08%) were oriental cockroaches (*B. orientalis*). There was no statistically significant difference ($p > 0.05$) in the occurrence of parasites in the two cockroach species (Table 1).

Medically important parasites encountered during the survey include cysts of *Entamoeba histolytica*, ova of *Ascaris lumbricoides*, *Trichuris trichura*, and eggs of *Schistosoma mansoni*, *S. haematobium* and *Enterobius vermicularis*. There was no significant difference ($p > 0.05$) in the occurrence of these parasites on the external parts of the cockroaches, although *E. histolytica* was the most encountered (40.83%), followed by *A. lumbricoides* (28.40%), then *E. Vermicularis* (15.98%), *S. mansoni* (9.48%), *S. haematobium* (2.95%) and finally *T. trichura* (2.36%) (Figure 1). Also it was found that the female roaches with 90.20% carrying parasites, was significantly ($p < 0.05$) more vectorial than males with 66.38% infection (Table 2).

Table 1: Number of Contaminated Cockroaches in the Study Area

Species	No. Examined	No. Positive
P. Americana	145	112 (77.24)
B. orientalis	73	57 (78.08)
Total	**218**	**169 (77.52)**

Values in parenthesis are Percentage of Contaminated cockroaches in the study area

Table 2: Distribution of Medically Important Parasites by Gender of Cockroach in the Study Area

Species	No. Examined	No. Positive
Males	116	77 (66.37)
Females	102	92 (90.19)

Values in parenthesis are Percentage of Contaminated cockroaches in the study area

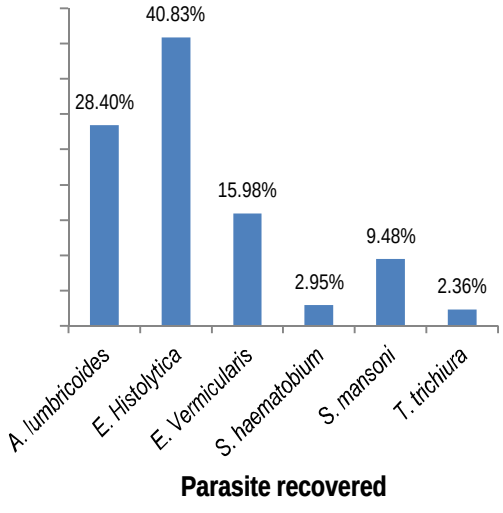

Figure 1: Recovery rate of parasites from the two cockroach species in the study area

The developmental stages of the cockroaches were equal in their vetorial potential ($p > 0.05$), although 157 (83.51%) adults were carrying parasites as against 17 nymphs (47.22%) (Table 3).

Based on the location, the results showed that 85.21% of the roaches caught in toilets carried parasites, followed by those caught in kitchens 79.41%, then refuse dumps 55.55%, bedrooms with 44.44% and the finally those caught in parlours having 37.50%. Vectorial potential was significantly associated with the locations where the cockroaches were caught ($p < 0.05$) (Figure 2).

Table 3: Occurrence of Medically Important Parasites in the Different Developmental Stages of the Cockroaches in the Study Area

Species	No. Examined	No. Positive
Adults	182	152 (83.52)
Nymphs	36	17 (47.22)

Values in parenthesis are Percentage of Contaminated cockroaches in the study area

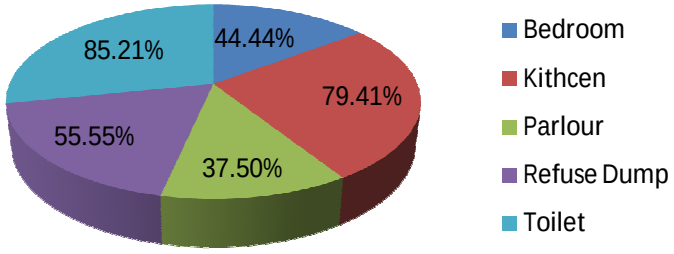

Figure 2: Parasite recovery rate from cockroaches in different locations of the study area

DISCUSSION

The importance of cockroaches, as carriers of parasitic worms, cysts, or eggs, was based on some reports about the presence of parasitic forms on or in cockroaches (Greenberg, 1973). The findings from this study revealed that cockroaches irrespective of the species do play a significant role in transmitting parasitic diseases, as more than 70% of the two cockroach species vectored parasites and are capable of transmitting them to humans or animals. As reported by Iwuala and Onyeka (1977), these two species of cockroaches are common in Nigeria. The overall prevalence of 77.52% recorded in this study seemed to be higher than 67% reported by Ajero *et al*. (2011) in Owerri, Nigeria, but is lower than 98% observed in Egypt by El-Sherbini and El-Shaebini (2011). The low prevalence in this study compared to that of Egypt, may be as reported by El-Sherbini and El-Sherbini (2011), that the area they conducted their research severely lacked hygiene services. According to them, the area they conducted their study had many piles of faecal matter in nearby mangrove swamp. This might have caused the high rate of contaminated cockroaches observed in their study.

The lack of significant difference in the occurrence of the different species of parasites in this study might possibly be an indication that all these parasites can equally be transmitted by the cockroaches irrespective of the species. Many reports in Nigeria have shown these parasites to be common in different localities, especially in those areas where personal hygiene is lacking. In addition, the presence of *E. vermicularis* infestation indicates that the cockroaches had contact with infected patients or contaminated clothes which emphasises their vectorial potential for parasitic diseases (Chan *et al*., 2004). The high occurrence of *E. histolytica* over other parasites, observed in this 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. Similarly, *A. lumbricoides*, *T. trichiura, S. mansoni and haematobium*, are causative agents of human helminthiasis while *E. histolytica* causes Amoebiasis. Since this report revealed the presence of these pathogens from the exoskeleton of roaches in a developing tropical environment like Arkilla Federal Low Cost, Sokoto, it becomes imperative to urgently institute control measures on these insects through massive public health/enlightenment education on improving the existing standard of environmental sanitary conditions.

The fact that the female roaches were significantly more vectorial than the males, may probably be attributed to the observation that they roam more than the males in search of both food and sites to lay their eggs. They come in contact with contaminated

materials as they roam, making them more vulnerable to be contaminated with pathogens.

Findings from this study also revealed that the different developmental stages of the cockroaches share equal potential in transmitting parasites of medical importance. This is observed by the lack of significant difference between such parameters. Therefore, control measures should target both stages.

Worthy of note is that vectorial potential significantly associated with the source of cockroaches in this study. The higher number of cockroaches vectoring parasites observed in the toilets is understandable because of the fact that cockroaches are more accessible to toilets where contamination with faecal matter is most likely. However, that toilets are followed by kitchens is quite insinuative and alarming. People have to be careful not to allow cockroaches' accessibility to kitchens, as they have the potential to vector and transmit parasites. They should also ensure they cover food and food utensils to reduce the rate of transmission of parasites by cockroaches.

From this investigation it can be concluded that over 70% of the cockroach population was contaminated. After resting and contaminating the environment with infective matter carried on the body surface, they can transmit the infection to the community, at the rate of 77.52%. The cysts of *E. histolytica*, ova of *A. lumbricoides*, *T. trichiura*, and eggs of *S. mansoni*, *S. haematobium* and *E. vermicularis* were observed in the external body parts of the cockroaches. The discovery of *A. lumbercoides, T. trichiura* on the insects supported the supposition that cockroaches play a significant role in the epidemiology of soil transmitted helminthes (STH), which could carry and spread pathogens to other places, since they are able to travel up to 3 miles an hour from and to unsanitary sites (Rivault *et al*., 1993). Cockroaches constitute important reservoir for infectious pathogens and also transmit parasites; therefore, the control of cockroaches could substantially minimize the spread of infectious diseases.

Acknowledgment

We are thankful to the residents of Arkilla Federal Low Cost for their understanding and support to conduct this research.

REFERENCES

Ajero, C.M.U., Ukaga, C.N. and Ebirim, C. (2011). The role of cockroaches in mechanical transmission of parasites in households in Owerri, South East Nigeria. *Nigerian Journal of Parasitology*, **32(2):** 153 – 156.

Allen, B.W. (1987). Excretion of viable Tubercle Bacilli by *Blatta orientalis* following ingestion of heat – fixed sputum smear: A laboratory investigation. *Medicine and Hygiene*, **81**: 98-99.

Brenner, R.J., Koehler, P.G. and Patterson, R.S. (1987). Health implications of cockroach infestation. Infections in Medicine: *Infectious Disease in Medical and Family Practice*, **4(8):** 349-355.

Bundy, D.A.P., Hall, A., Medley, G.F. and Savioli, L. (1992). Evaluation measures to control intestinal parasitic infections. *World Health Statistics Quarterly*, **45:** 168-79.

Chan, O.T., Lee, E.K., Hardman, J.M. and, Navin, J.J. (2004). The cockroach as a host for *Trichinella* and *Enterobius vermicularis*: implications for public health. *Hawaii. Medical Journal*, **63:** 74-77.

Chandler, A.C. and Read, C.P. (1962). *Introduction to parasitology with special references to the parasites of man*. 10th ed. New York: John Wiley & Sons.

Che Ghani, B.M., Oothuman, P., Hashim, B.B. and Rusli, B.I. (1993). Patterns of hookworm infections in traditional Malay villages with and without JOICFP Integrated Project in Peninsular Malaysia-1989. In: Yokogawa M, Editors. Collected papers on the control of soil transmitted helminthiases, Tokyo: APCO, **5:** 14-21.

Cheesbrough, M. (1998). *Medical Laboratory Manual, for Tropical Countries.* Vol. 1, ELBS, Cambridge. Pp. 323-431.

Cotton, M.F., Wasserman, E., Pieper, C.H., Van Tubbergh, D., Campbell, G., Fang, F.C. and Barnes, J. (2000). Invasive disease due to extended spec-trum beta-lactamase-producing *Klebsiella pneumoniae* in a neonatal unit: the possible role of cockroaches. *Journal of Hospital Infection*, **44:** 13-17.

Czajka, E., Pancer, K., Kochman, M., Gliniewicz, A., Sawicka, B., Rabczenko, D. and Stypulkowska-Misiurewicz, H. (2003). Characteristics of bacteria isolated from body surface of German cockroaches caught in hospitals. *Przeglad Epidemiologiczy*, **57:** 655-662.

El-Sherbini, G.T. and El-Sherbini, E.T. (2011). The role of cockroaches and flies in mechanical transmission of medical important parasites. *Journal of Entomology and Nematology*, **3(7):** 98-104.

Getachew, S., Gebre-Michael, T., Erko, B., Balkew, M. and Medhin, G. (2007). Non-biting

cyclorrhaphan flies (Diptera) as carriers of intestinal human parasites in slum areas of Addis Ababa, Ethiopia. *Acta Tropica*, **103:** 186-194.

Greenberg, B.I. (1973). *Ecology, classification and biotic association*. New Jersey: Princeton University Press, Vol. 1.

Iwuala, M.O.E. and Onyeka, J.W.A. (1997). Types and distribution pattern of domestic insects in Nsukka- Nigeria. *Environmental Entomology*, **6:** 49 – 60.

Kopanic, R.J. (1994). Cockroches as vectors of Salmonella: laboratory and field trials. *Journal of Food Protection*, **57:** 125-132.

Montresor, A., Crompton, D.W.T., Hall, A., Bundy, D.A.P. and Savioli, L. (1998). Guidelines for the evaluation of soil-transmitted helminthiasis and schistosomiasis at community level. WHO/CTD/SIP/98.1

Mott, K.E. (1989). The World Health Organization and the control of intestinal helminths. In: Yokogawa M, Editors. Collected papers on the control of soil-transmitted helminthiases, Tokyo: APCO, **4:** 189-200.

Pai, H.H., Chen, W.C. and Peng, C.F. (2005). Isolation of bacteria with antibiotic resistance from household cockroaches (*Periplaneta americana* and *Blattella germanica*). *Acta Tropica*, 93: 259-265.

Piper, G.L. and Antonelli, A.L. (2012). Cockroaches: Identification, Biology and Control. Agricultural Research Center, Washington State University. http://www.pnw0186.html. Retrieved on the 25th of May, 2012.

Rivault, C., Cloarec, A. and Guyader, A.L. (1993). Bacterial of cockroaches in relation to urban environment. *Epidemiology and Infection*, **110(2):** 317 – 325.

Sornmani, S., Vivatanasesth, P., Harinasuta, C., Potha, U. and Thirachantra, S. (1983). The control of Ascariasis in a slum community of Bangkok. In: Yokogawa M, Editors. Collected papers on the control of soil-transmitted helminthiases, Tokyo: APCO, **290(35):** 260-266.

Yakubu, M. and Singh, B.R. (2001). Erosional losses of soil and nutrients from dry land farm in Sokoto, Nigeria. *Journal Agriculture and Environment*, **1:** 147 – 155.