Research Articles

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Mechanical transmission of pathogenic organisms: the role of cockroaches

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Background & objectives: Cockroaches (*Diploptera punctata*) are basically tropical insects and will do their best to find a home that is both warm and moist. Their involvement in the transmission of tropical diseases is poorly investigated in Africa.

Methods: A study on the bacterial, fungal and parasitic profile of cockroaches trapped in and around houses in Ekpoma was carried out using standard microbiological techniques.

Results: Of a total of 234 cockroaches trapped from different sites (toilets, parlours, kitchens and bedrooms) in houses with pit latrines and water system, the bacterial, fungal and parasitic isolates were identical irrespective of the site, these included: *E. coli, Klebsiella pneumoniae, Proteus vulgaris, Proteus mirabilis, Citrobacter freundii, Enterobacter cloacae, Salmonella* sp, *Pseudomonas aeruginosa, Serretia marcescens, S. aureus, S. feacalis, S. epidermidis, Aeromonas* sp, *Candida* sp, *Rhizopus* sp, *Aspergillus* sp, *Mucor* sp, cysts of *E. hystolitica*, oocysts of *C. parvum, C. cayetenensis* and *Isospora belli*, cysts of *Balantidium coli*, ova of *Ascaris lumbricoides, Anchylostoma deodunalae, Enterobius vermicularis*, ova *Trichuris trichura*, larva of *Strongyloides stercoralis.* Cockroaches trapped in the toilets of houses with pit latrines had a mean bacterial and parasites count of 12.3×10^{10} org/ml and 98 parasites/ml respectively, while those trapped in the houses with water system had a mean bacterial and parasitic count of 89.5×10^{7} org/ml and 31 parasites/ml respectively. A bacterial count of 78.9×10^{7} org/ml was recorded from cockroaches trapped from the kitchens of houses with pit latrines. On the other hand a mean bacterial and parasitic count of 23.7×10^{6} org/ml and 19 parasites/ml were recorded from kitchens of houses with water system.

Interpretation & conclusion: Cockroaches represent an important reservoir for infectious pathogens, therefore, control of cockroaches will substantially minimise the spread of infectious diseases in our environment.

Key words Cockroaches – infestation – Nigeria – parasite count – pathogens

A great variety of insects are carrier of pathogens[1,2]. Cockroaches (*Diploptera punctata*) are known to carry a diverse pathogenic bacteria flora, different protozoans, pathogenic worms, fungus and viruses[3,4], but their role in the direct transmission of infection has seldom been established[5].

Cockroaches have survived on the earth for more than 300 million years virtually without change. They are survivors, and will likely be with us for a few more million years. Cockroaches are basically tropical insects and will do their best to find a home that is both warm and moist. They are especially attracted to wet

areas and will be found in abundance near leaking faucets or pipes, wet sponges, persistently damp corners, areas where there is frequently standing water, or areas where continual moisture is usually available, such as drains, kitchens, bathrooms and maintenance rooms with sink traps. Water and steam pipes frequently serve as migration routes from room-to- room[6].

The filthy breeding habits, feeding mechanisms and indiscriminate travel between filth and food make some groups of synanthropic insects such as nonbiting flies and cockroaches efficient vectors of human enteric protozoan parasites. Twenty-one species of filth flies have been listed by regulatory agencies concerned with sanitation and public health as causative agents of gastrointestinal diseases based on synanthropy, endophily, communicative behaviour and strong attraction to filth and human food. Outbreaks and cases of foodborne diarrhoeal diseases in urban and rural areas are closely related to the seasonal increase in abundance of filth flies, and enforced fly control is closely related to reductions in the occurrence of such diseases[6].

Material & Methods

Study area: This study was carried out in Ekpoma between January and June 2005. Ekpoma is a rural settlement hosting a tertiary institution growing to be a semi-cosmopolitan town. It is mostly populated by the Esan people of Edo State and students from various parts of Nigeria. Sanitary conditions in this village are almost underdeveloped. Faecal disposal and water supply are very elementary, the majority of the population relies on pit toilets for faecal disposal and hand-dug wells for water storage. These facilities could contribute immensely to the proliferation of insects such as mosquitoes, cockroaches, etc. which are reported to be serious vectors of parasitic, bacterial, viral and fungal diseases.

Sample collection/size: Two hundred and fifty-two (252) adult cockroaches were trapped from different parts of the houses in Ekpoma for both parasitological and bacteriological studies. The cockroaches destined for bacterial and fungal studies were collected into sterile universal containers, while those for parasitic studies were collected into universal containers containing 5 ml of formol saline. The insects were transported to the laboratory immediately for analysis.

Parasitological studies: Each universal containing a cockroach in formol saline was shaken vigourously to detach the parasites from the insect body. The fluid was transferred to a conical test tube and spun at 3000 rpm for 5 min. The deposit was transferred onto a clean glass slide, covered with a cover slip and viewed with × 40 microscope objective lens. The parasites were identified and counted.

Kinyoun stain: The deposits of the spun fluid were stained using modified Ziehl Nelseen stained as indicated by Cheesbrough[7] for characteristic features of *Cryptosporidium parvum* and *Cyclospora cayetenensis*.

Bacteriological and fungal studies: To each sterile universal container with a cockroach, 5 ml of sterile normal saline was added and shaken vigourously, a loopful of each suspension was cultured on Mac Conkey agar, blood agar, deoxycholate citrate (DCA) and Sabouraud dextrose agar plates. The plates were incubated at 37°C for 24 h.

The organisms were identified using standard bacteriological techniques as described by Mackie and Mc Cartney[8].

Total viable count: A ten-fold dilution was carried out on each suspension to determine the total viable count of each cockroach using the pour plate method; counts were made on plates showing discrete and evenly distributed colonies.

Results

This study revealed that cockroaches trapped from different sites (toilets, parlours, kitchens and bedrooms) in the houses with pit latrines and water sys-

tem shared the same parasites. The parasites included: cysts of *Entomoeba hystolitica*, oocysts of *C. parvum*, *C. cayetenensis* and *Isospora belli*, cysts of *Balantidium coli*, ova of *Ascaris lumbricoides, Anchylostoma deodunale, Enterobius vermicularis*, ovae *Trichuris trichura* and larvae of *Strongyloides stercoralis* (Table 1). Plate 1 shows the pictorial representations of some of the ova and larva of parasites identified.

Bacterial isolates also remained unchanged from one site to other, these included *E. coli, Klebsiella pneumoniae, Proteus vulgaris, Proteus mirabilis, Citrobacter freundii, Enterobacter cloacae, Salmonella* sp, *Pseudomonas aeruginosa, Serretia marcescens, S. aureus, S. feacalis, S. epidermidis, Aeromonas* sp, *Candida* sp, *Rhizopus* sp, *Aspergillus* sp and *Mucor* sp (Table 2).

Cockroaches trapped in the toilets of houses with pit latrines had a mean bacterial and parasites count of 12.3×10^{10} organisms/ml and 98 parasites/ml respectively, while those trapped in the houses with water system had a mean bacterial and parasitic count of 89.5×10^{7} org/ml and 31 parasites/ml respectively. A mean bacterial count of 78.9×10^{7} org/ml was recorded from cockroaches trapped from the kitchens of houses with pit latrines. On the other hand a mean bacterial and parasitic count of 23.7×10^{6} org/ml and 19 parasites/ml were recorded from kitchens of houses with water system (Table 3).

Table 1. Distribution of medical important parasites by sites and toilet facilities

Source	No. of cockroaches studied	
	Houses with pit toilets	Houses with water system
Toilets	35	23
Kitchens	27	22
Parlours	17	11
Bedrooms	15	9

Parasites identified—Cysts of *E. hystolitica*, oocysts of *C. parvum, C. cayetenensis, Isospora belli*, cysts of *Balantidium coli*, ova of *Ascaris lumbricoides, Anchylostoma deodunalae, Enterobius vermicularis*, ova of *Trichuris trichura* and larva of *Strongyloides stercoralis*

Table 2. Distribution of bacterial isolated by sites and toilet facilities

Source	No. of cockroaches studied	
	Houses with pit toilets	Houses with water system
Toilets	17	13
Kitchens	15	11
Parlours	11	9
Bedrooms	10	7

Bacteria isolated—*E. coli, Klebsiella pneumoniae, Proteus vulgaris, Proteus mirabilis, Citrobacter freundii, Enterobacter cloacae, Salmonella* sp, *Pseudomonas aeruginosa, Serretia marcescens, S. aureus, S. feacalis, S. epidermidis, Aeromonas* sp, *Candida* sp, *Rhizopus* sp, *Aspergillus* sp and *Mucor* sp

Table 3. Mean bacterial and parasitic count of cockroaches by sites and toilet facilities

Source	Houses with pit toilets		Houses with water system	
	Mean bacterial count	Mean parasitic count	Mean bacterial count	Mean parasitic count
Toilets	12.3×10^{10} org/ml	98 parasites/ml	89.5×10^{7} org/ml	31 parasites/ml
Kitchens	78.9×10^{7} org/ml	50 parasites/ml	23.7×10^{6} org/ml	19 parasites/ml
Parlours	45.8×10^{7} org/ml	47 parasites/ml	8.9×10^{5} org/ml	11 parasites/ml
Bedrooms	10.3×10^{6} org/ml	38 parasites/ml	5.9×10^{5} org/ml	11 parasites/ml

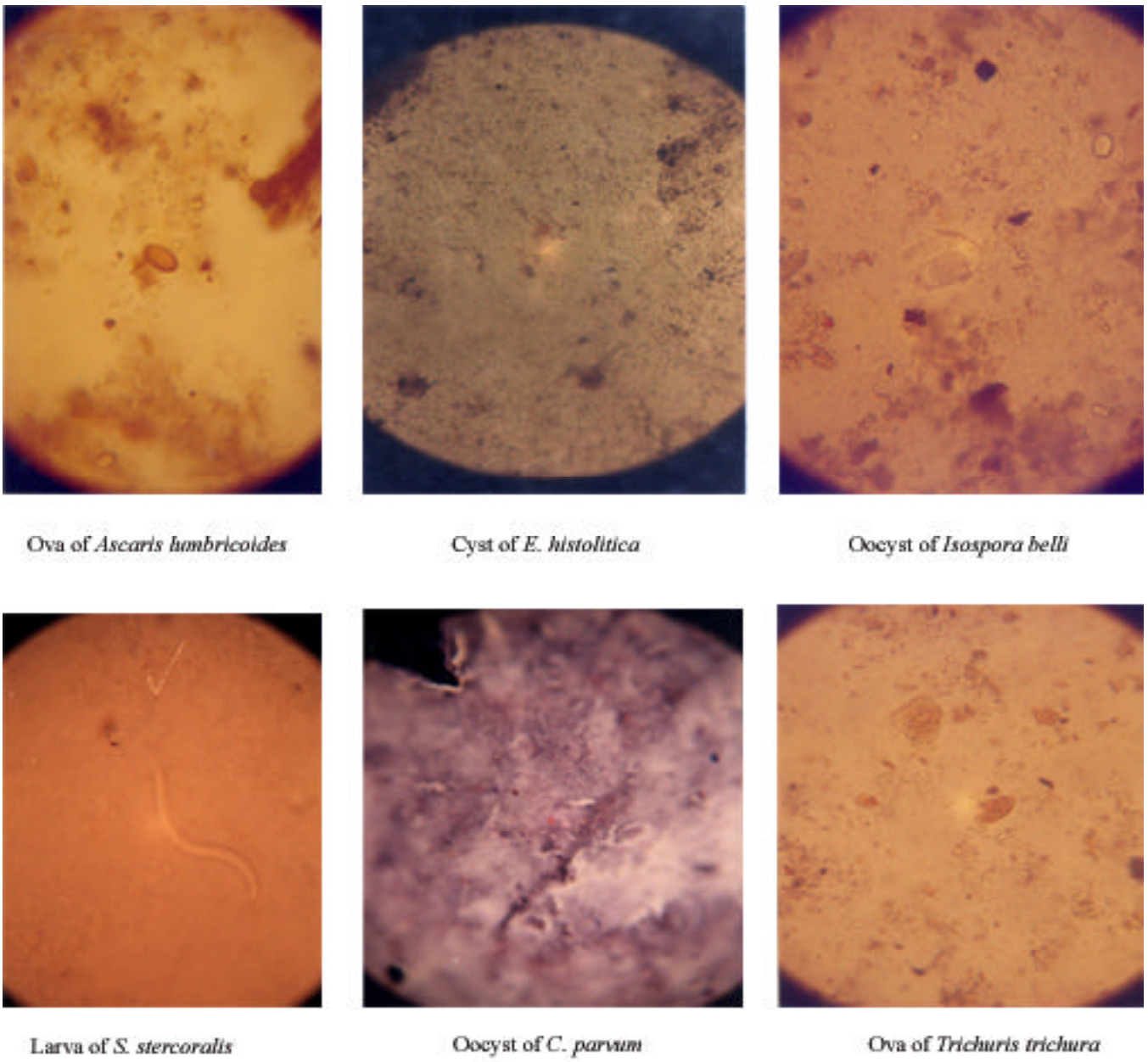

Plate 1. Pictorial representation of some of the ova and larvae of parasites identified

Discussion

Personal hygiene has drastically reduced the prevalence of parasitic and bacterial infections in our communities, but other factors that contribute immensely to transmission of such infections are neglected. Speculations have always been made on the involvement of cockroaches as possible vectors of transmission of infections in our communities, but no documented studies are available in that regard.

This study revealed that cockroaches represent a store of infectious pathogens, different organisms have been identified or isolated from their body surfaces, as mentioned earlier. This finding correlates with that of Hossein *et al*[9], in their investigations on cockroaches trapped in houses, poultry and in hospital environment identified similar organisms. They also established that those within the hospital premises carried multi-drug resistant organisms such as *Salmonella* sp. In a similar study carried out by Gliniewicz *et al*[10] the commonest

bacterial isolates identified were identical to those obtained in this study; but the parasitic profile of the cockroaches was not studied. The similarities in the bacterial isolates, isolated from the above mentioned studies could be due to the similarity in the behavioural pattern of cockroaches irrespective of their species and location.

Based on the faecal disposal facilities, findings from this study revealed that bacterial, fungal isolates and parasitic bugs from cockroaches trapped from houses with pit latrines and houses with water system were identical. This strongly suggests that cockroaches from houses with water system still have access to faecal disposal facilities such as conduct pipes and soak ways. Even though there was similarity in the microbial profile of these cockroaches, the load varied. Cockroaches from different parts of houses with pit latrines recorded a higher mean bacterial/parasitic count compared to those trapped from houses with water system. Cockroaches trapped in the toilets of houses with pit latrines had a mean bacterial and parasites count of 12.3×10^{10} org/ml and 98 parasites/ml respectively, while those trapped in the houses with water system had a mean bacterial and parasitic count of 89.5×10^{7} org/ml and 31 parasites/ml respectively. A mean bacterial count of 78.9×10^{7} org/ml was recorded from cockroaches trapped from the kitchens of houses with pit latrines. On the other hand a mean bacterial and parasitic count of 23.7×10^{6} org/ml and 19 parasites/ml were recorded from kitchens of houses with water system (Table 3). This variation could be explained from the fact that pit latrines are more accessible to these insects; going by the behavioural pattern of cockroaches, pit latrines represent a favourable hideout during the hours of the day, at the evening time, they all migrate into houses where they might deposit pathogens present on their body surface on kitchen utensils or other house equipment they move on.

The viability and infectivity of the ova and oocysts of parasites identified are still questionable, one would expect that high temperature in latrines and soak ways might denature these ova and oocysts of these parasites, but some of these are heat resistant, therefore, their viability and infectivity could have still been maintained.

Cockroaches constitute an important reservoir for infectious pathogens, therefore, control of cockroaches will substantially minimise the spread of infectious diseases in our environment.

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