

Risks Associated with Cockroach *Periplaneta Americana* as a Transmitter of Pathogen Agents

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Abstract

Objective: To determine the possible role of cockroaches as a transmitter of medically important microorganisms, pathogenic organisms were isolated and identified from external and guts of cockroaches trapped at hospitals and houses.

Methods: One hundred and fifty two cockroaches were collected from different parts of hospital and houses around it. They were collected for isolation and identification of bacteria and parasites from external surface and internal digestive tract of cockroaches. Statistical analysis was done by using t- test.

Results: This study show that high rates of cockroaches show contamination of medically important bacteria and parasites. The species of the pathogenic agents was determinate and the number and percentages of infected cockroaches was recorded.

Conclusion : And for this, cockroaches act as a potential transmitter of medically important pathogenic and may cause of nosocomial infection in both hospitals and houses. Therefore, control of cockroaches will substantially minimize the spread of infectious diseases in our environment.

Key words: cockroaches, Bacteria, Parasites.

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Introduction

Cockroaches have survived on the earth for more than 300 million years virtually without change [1]. There are approximately 3500 species of cockroaches worldwide [2], 50 species of them have been reported living in or around human structures [3]. The majority of these species live in tropical and subtropical area but are not pests [4], so they found in abundance near areas where there is frequently standing water or areas where continued moist is usually available such as

toilets, kitchen and drainages water frequently serve as a migration routes from place to place [5].

Cockroaches frequently feed on human feces, carbage and sewage, therefore they have copious opportunity to disseminate pathogenic agents [6]. They are known as one of the most important agents in transmission and distribution of many different bacteria, viruses, protozoa and fungi to human life, and they are intermediate host for some pathogenic intestinal worm [7]. In

addition to the presence of some bacteria, parasites and fungi in external surfaces of cockroaches they have been found in internal parts of their body [8,9], therefore these insects are considered important disease vectors transmitted by both mechanical and biological routes.

So, the present study was conducted to isolate and identify bacteria and parasites from external and internal (digestive tract) surface of the cockroaches *Periplaneta americana* which were collected from hospital and some houses around the hospital in Diyala.

Materials and Methods

Samples collection:- One hundred and fifty two adult cockroaches were collected between October 2008 and February 2009 for both parasitological and bacterial studies. Eighty cockroaches were trapped from different parts of hospitals and seventy two from houses around those hospitals. Seventy six cockroaches designed for bacterial studies (40 from hospitals and 36 from houses) were collected in a sterile containers while those for parasitological studies (40 from hospitals and 36 from houses) were collected in a sterile containers containing 5 ml of normal saline. The insects were transported to the laboratory for analysis.

Isolation and identification of parasites and bacteria from external surface of cockroaches: Each container containing cockroaches in normal saline (0.9%) was shaken vigorously to detach the parasites from surface of the insect body. The fluid was transferred to a conical test tube and centrifuge at 2000 rpm for 5 min. The deposit was transferred to a clean glass slides, covered with a cover slip and examined with 40x microscope objective lens after staining with 1% Lugols Iodine. The parasites were identified and counted.

For bacterial isolation, 2ml of sterile normal saline (0.9%) was added to the test tube cockroaches which were vigorously shaken for 2 min. A loopful of each suspension was cultured on MacConkey agar, blood agar, deoxycholate citrate (DCA) and Sabour and dextrose agar plates. The plates were incubated at 37°C for 24h. The results were read and colonies identified.

Isolation and identification of parasites and bacteria from internal digestive tract of cockroaches: After external washing, cockroaches were placed in flask, rinsed with 70% alcohol for 5 min (to decontaminate external surface), then transferred to sterilized flask, and allowed to dry at room temperature under sterile conditions. Cockroaches were then washed with normal saline for 2-3 min. to remove traces of alcohol. Only cockroaches captured whole and live were utilized for study. The gut of each cockroaches was dissected out and macerated aseptically in a sterile pestle and mortar in 2ml of sterile normal saline. One ml of resulting macerate was centrifuged at 2000 rpm for 5 min. and the deposit examined for parasitic ova/cysts, after staining with 1% Lugols Iodine under light microscope and identified.

For bacteria isolation the rest of resulting macerate was used. A similar way as described previously was done and culture were examined and results were read and colonies identified. Statistical analysis was done by using t- test.

Results

One species of cockroach was caught in the course of the present study, namely *Periplaneta americana*. A total of 152 cockroaches were trapped at houses and hospital (72 from houses and 80 from hospitals). All cockroaches caught at hospitals (40) were found to carry one or

more species of medically important bacteria on external surface and 38(95%) of these cockroaches were found to carry one or more bacteria in their guts and the differences were statically significant ($p < 0.05$) as shown in table 1. While 30 (83.3%) of cockroaches caught at houses around the hospitals were found to carry one or more bacteria on their external surface and 26(72.7 %) of them were found to harbor bacteria in their guts and these statically significant ($p < 0.05$) in the same table. Bacteria isolated from cockroaches included: *Escherichia coli*, *Streptococcus faecalis*, *Enterobacter cloacae*, *Klebsiella pneumoniae*, *Proteus mirabilis*, *Proteus vulgaris*, *Staphylococcus epidermidis*, *Pseudomonas aeruginosa*, *Staphylococcus aureus*, *Salmonella sp.*, *Shigella sp.*. The results show that the cockroaches trapped from both site shared the same bacteria except *Shigella sp.* and *Salmonella sp.* which were found only on external surfaces of cockroaches trapped from hospitals. Table 1 shows the numbers and rates of cockroaches that contaminated with these bacteria. These were significant differences between numbers of cockroaches contaminated with bacteria according to the site of isolation (external and guts) within each groups of cockroaches trapped at hospitals or houses. Table 1, also shows that there was significant difference between cockroaches contaminated with bacteria in both groups trapped at hospitals and houses. There was no correlation between bacteria carried in the guts of cockroaches but there was strong correlation between these cockroaches carried bacteria on external surface at hospital and houses. There was strong correlation between bacteria on external surface and internal gut of cockroaches that captured in hospitals and houses.

In this study the vast majority of isolated bacteria attributed to the genera *E. coli* (100%, 95%) in hospitals and (83.8%, 72.7%) in houses followed by *Streptococcus faecalis* (95%, 62.5%) in hospitals and (83.3%, 66.6%) in houses while the lowest bacteria isolated from cockroaches were *Salmonella sp.* (7.5%) and *Shigella sp.* (5%) which were isolated from only external surface of cockroaches trapped at hospital as show in table 1. Different species of parasites were also isolated from test groups of cockroaches (table 2). In the hospitals the predominated parasites were cysts of *Entameoba coli*, (57.5%, 27.5%) and *Entameoba histolytica* (20%, 15%), other isolated parasites were cyst of *Giardia lamblia* (17.5%, 2.5%), ovum and adult of *Enterobius vermicularis*, ovum of *Hymenolepis nana* and ovum of *Ascaris lumbricoides*, on the external and internal surfaces, respectively. Moreover the same parasite species which were mentioned above were also isolated from houses cockroaches but *E. histolytica*, *E. coli* and *H. nana* were isolated from only external surface. Numbers and rates of infection were presents in isolated from only external surface. Numbers and rates of infection were presents in table 2. The results demonstrated that there was a significant difference between the numbers and rates of cockroaches trapped at hospitals while the differences were not significant among other groups (external surfaces and internal guts at houses groups and between houses and hospitals). *E. coli* was the highest infection followed by *Enterobius vermicularis* (ovum) while *Ascaris lumbricoides* was the lowest infection. There were strong correlation among all groups.

Table 1: Number and rates of parasitic infections of hospital and houses cockroaches in term of type of infection.

Bacterial species	Hospitals				Houses			
	External		Internal		External		Internal No(%)	
	No	%	No	%	No	%	No	%
<i>Escherichia coli</i>	40	100	38	95	30	83.3	26	72.7
<i>Streptococcus faecalis</i>	38	95	25	62	30	83.3	24	66.6
<i>Enterobacter cloacae</i>	35	87.5	18	45	26	72.2	19	52.7
<i>Klebsiella pneumoniae</i>	35	87.5	20	50	20	55.5	11	30.5
<i>Proteus mirabilis</i>	32	80	28	70	25	69.4	15	41.6
<i>Proteus vulgaris</i>	30	75	22	55	23	63.8	5	13.8
<i>Staphylococcus epidermidis</i>	30	75	8	20	28	77.7	24	66.6
<i>Pseudomonas aeruginosa</i>	25	62.5	3	7.5	17	47.2	0	
<i>Staphylococcus aureus</i>	25	62.5	9	22.5	17	47.2	8	22.2
<i>Salmonella sp.</i>	3	7.5						
<i>Shigella sp.</i>	2	5						
t-test	t=18.28**		5.18**		14.12**		4.74**	
	External & Internal=5.49 **				External & Internal= 5.50**			
	(External): Hospital & Houses= 7.291**							
	(Internal): Hospital & Houses= 1.315 n.s.							

**= significant at 0.01

n.s.= non significant at 0.05

Correlation: (Hospital): External & Internal= 0.831**

(Houses): External & Internal=0.909**

(External): Hospital & Houses= 0.788**

(Internal): Hospital & Houses= 0.535 n.s.

Table 2: Number and rates of parasitic infections of hospital and houses cockroaches in term of type of infection.

Parasites species	Hospital				Houses			
	External		Internal		External		Internal	
	No.	%	No.	%	No.	%	No.	%
<i>Entamoeba coli</i> (cyst)	23	57.5	11	27.5	13	36.1	9	25
<i>Entamoeba histolytica</i> (cyst)	8	20	6	15	7	19.4	3	8.3
<i>Giardia lamblia</i> (cyst)	7	17.5	1	2.5	3	8.3	0	
<i>Enterobius vermicularis</i> (ova)	10	25	4	10	7	19.4	0	
<i>Enterobius vermicularis</i> (adult)	2	5	0		1	2.7	0	
<i>Hymenolips nana</i> (ova)	5	12.5	0		4	11.1	1	2.7
<i>Ascaris limricoides</i> (ova)	3	7.5	0		2	5.5	0	
T-test	t= 2.91*		t= 1.28n.s.		t= 3.40*		t= 1.47n.s.	
	External & Internal=3.59 *				External & Internal=4.79**			
	(External): Hospital & Houses= 1.99n.s.							
	(Internal): Hospital & Houses= 1.89 n.s							

*= significant at 0.05

**= significant at 0.01

n.s.= non significant at 0.05

Correlation: (Hospital): External & Internal= 0.945

** (Houses): External & Internal=0.890**

(External): Hospital & Houses= 0.950**

(Internal): Hospital & Houses= 0.909**

Discussion

The American cockroaches are the potential vectors of bacteria (over 100 species of bacteria have been isolated from or passed through cockroaches), fungi, and parasites [10]. Because the cockroaches feed on filth and feces they may disseminate infection with the fecal-oral route [11]. These cockroaches are very common. They are sometimes not taken very seriously but they are definitely carriers of organisms causing dysentery, diarrhea, typhoid and food poisoning [12].

The results of the present study revealed contamination of almost all cockroaches collected from hospitals with different microorganisms which are significantly higher in comparison to those collected from houses. Many studies show that a large number of microorganisms have been isolated from cockroaches captured either from houses or building [13], from food-handling establishments [6], or from hospital as shown by [5] who they demonstrated that the cockroaches were found to carry the 13 genera of medically important fungi. Microorganism also were isolated from cockroaches trapped from toilets and kitchens [13].

In this study, the microorganisms which were isolated from external surface of cockroaches were higher from that isolated from guts. This demonstrated that bacteria and parasites may be disseminated by contact more than their food habits. Ingestion, intestinal transit of these organisms and their subsequent diffusion by feces are not an absolute necessity before cockroaches can disseminate organism and become involved in spreading diseases.

Among common bacterial pathogens *Escherichia coli* and *Streptococcus faecalis* were isolated from highest numbers of cockroaches trapped from both hospital and

houses (on external surface) followed by *Enterobacter cloacae* and *Klebsiella pneumoniae* (at hospital) and *taphylococcus epidermidis* (at houses).

roteus sp., *Pseudomonas aeruginosa*, *Staphylococcus aureus*, *Salmonella sp.*, *Shigella sp.* also were isolated. These species can cause urinary tract infection, sepsis, gastroenteritis, biliary and peritoneal infection, pneumonia, or wound infections. [14], the presence of cockroaches in a bacteria –rich environment (hospital), especially with pathogenic and potentially pathogenic bacteria, is more serious than in a bacteria – poor environment [6]. The increase in cockroaches contaminated with bacteria in hospital compared with those in houses reflect this fact. Areas where people have low level immunity (patients) should be aware of bacteria contamination from cockroaches.

In this study *Shigella sp.* and *Salmonella sp.* were isolated from only external surface of cockroaches trapped in hospital. A study was carried by [15] shows that *Salmonella sp.* can be carried by cockroaches and have been found to cause a gastro-enteritis out break. [16] demonstrate that cockroaches was associated with out break of dysentery in Northern Ireland and causative agent was *Shigella dysenteria*. [17] show isolated *Salmonella* from seven species of cockroaches trapped from hospitals. The same study experimentally shows that cockroaches may play a role in transmitted bacteria from contaminated food to uncontaminated cockroaches. The results of the present study confirm that cockroaches are much more than a nuisance and show that they pose potentially serious health risks as mechanical vectors of these bacteria especially that they were isolated from only external surface of cockroaches.

[10] have compared the transmitted bacteria between housefly and American ockroaches.

They have isolated *Staphylococcus* spp., *Streptococcus* spp., *Salmonella* spp., *Shigella* spp., *Proteus* spp., *Serratia* spp., *Klebsiella* spp., and *Escherichia coli* from external surface of both insects trapped from different sites. This agrees with the present study. All these bacteria were considered to be as pathogenic agents. In addition, isolation of *E. coli* (a key-stone in environment surveillance) on cockroaches which had detection in all groups means that they have been contacted with human feces or feces contamination objects.

In addition to bacteria, many species of parasites were isolated from external surface and guts of cockroaches included cysts of *Entamoeba coli*, *Entamoeba histolytica* and *Giardia lamblia* and adult and ova of *Enterobius vermicularis* and ova of *Hymenolepis nana* and *Ascaris lumbricoides*. This finding correlation with that of [19] who proved experimentally that cockroaches may play an important role in the transmission of helminthes. Also, this study agrees with [18,20] who reported that cockroaches act as important epidemiological role in transmission of amoebiasis and giardiasis and agrees with [3] who confirmed that cockroaches serve as carriers of human intestinal parasites.

Infection acquired by patients as a direct result of their confinement in hospitals are called nosocomial infections [20]. In hospital and similar institution and cockroaches may mechanically transmit pathogens to patients. These insects may be attracted to secretions and excretions from patients including vomits, blood, pus, sweat, tears, urine, mucosal secretion, serum seepage, sputum and feces [11]. In addition, the fecal disposal facilities, found in this study revealed that bacterial and parasites isolated from cockroaches trapped from hospital and houses with simple water system and with pit latrine or manhole still have access to fecal

disposal facilities such as conduct pipes and soak ways. These fecal disposal facilities are more accessible to insects going by the behavioral pattern of cockroaches. Manholes represent a favorable hideout during the hours of the day, at evening time they all move into other places in hospital and houses where they might be posited pathogens presented on their body surface on kitchen utensils or other houses and hospital equipment they move on.

So that the cockroaches trapped from hospitals had more than one source of infection (secretion and excretion of patients and from fecal disposal facilities) compared with those trapped from houses. Thus the potential of cockroaches to transmit diseases should not be ignored or simply rejected but afforded further investigations.

Conclusion

And for this, cockroaches act as a potential transmitter of medically important pathogenic and may cause of nosocomial infection in both hospitals and houses. Therefore, control of cockroaches will substantially minimize the spread of infectious diseases in our environment.

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