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ORIGINAL PAPER

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INVESTIGATION OF BACTERIOLOGICAL INFECTIONS OF THE AMERICAN COCKROACHES IN PAVEH CITY, KERMANSHAH PROVINCE

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ABSTRACT

Introduction: American cockroaches, *Periplaneta americana*, are the most important pests in hospitals and dwelling environments. They are mechanical vectors of some bacterial pathogens. **Goal:** The present investigation was carried out in Ghods hospital and 5 dwelling localities of Paveh city to evaluate bacterial infestations of American cockroaches in this region of Iran.

Methods: The samples were randomly collected from hospital environments and toilets and kitchens of the dwelling localities from December-March 2012 and July-September 2013. The samples were captured using sterile test tubes and sterile hand gloves. **Results:** Totally, 98 cockroaches were collected from hospital (45.9%) and dwelling (54.1%) environments. Eight groups of bacteria including: *Pseudomonas* spp., *Proteus* spp., *Klebsiella* spp., *Staphylococcus* spp., *Bacillus* spp., *Serratia* spp., *Enterobacter* spp. and *Escherichia coli* were extracted. **Conclusions:** The findings of the present study revealed that the American cockroaches are very important in transmission of some bacterial pathogens, so health education and using the effective control methods to elimination and reduction of cockroaches are necessary.

Key words: American cockroaches, *Periplaneta Americana*, Bacteria, Hospital, Dwelling, Iran.

1. INTRODUCTION

Cockroaches are belonging to animal kingdom and insect order. About 80% of all recognized animals are insects (1). Cockroaches are one of the most common pests in many homes and other buildings. They are very successful with the highest history of life. These insects have been existed since Pennsylvanian period (2).

They transmit bacteria, Viruses, fungi and other pathogenic microorganisms in infested areas. They are also intermediate hosts for some pathogenic intestinal worms (3, 4). About 3500-4000 species of cockroaches are living around the world (5, 6). *Periplaneta americana* (L.), the American cockroaches are the largest cockroaches. They are reddish-brown with light colored edges to body (6).

They are the most common household cockroaches in cities that found around the world. This cockroach may breed to enormous numbers of materials. They often move from sewers into dwellings where they contaminate foods

with their saliva and feces (7, 8). American cockroaches are frequently encountered cockroaches in homes and they are one of the major sources of indoor allergens; exposure and sensitization to this insect is associated with the development of acute asthma morbidity (9). American cockroaches are mechanical vectors of bacteria.

Many species of bacteria have been isolated from this cockroach. In a study in Morocco, *Escherichia coli*, *Klebsiella* spp., *Providencia* spp., *Staphylococcus* spp. and *Enterococcus* spp. were isolated from American cockroaches (10).

In another study in Sanandaj hospitals, 9 species of bacteria were isolated from American cockroaches. Many studies in Iran and some countries revealed that this insect is one of the major sources of bacterial infections (2-4, 6, 11-15). The present study was conducted to evaluate bacteriological infections of American cockroaches in Paveh city.

Places of collection	External surfaces		Internal surfaces		Non-infected cockroaches		Total	
	No.	%	No.	%	No.	%	No.	%
Hospital	28	49.1	10	62.5	7	28	45	45.9
Dwellings	29	50.9	6	37.5	18	72	53	54.1
Total	57	100	16	100	25	100	98	100

Table 1. Occurrence of different bacterial spp. identified from the external and internal surfaces of the American cockroaches in Ghods hospital and dwelling localities, Paveh city

2. MATERIAL AND METHODS

2.1. Study area

Paveh city is located in 46°21' longitude and 35°03' latitude. This city is located 1540 meters above sea level with a cold winter and mild summer. The maximum temperature in summer is 39°C and the minimum temperature in winter is -9°C. The annual rainfall is 749 mm. The annual relative humidity of the area ranges from 26% to 72%. Paveh city had an estimated total population of 57813 in 2011. The highest mount in Paveh city, Shaho, is located in 3390 m above the sea level (16).

2.2. Samples collection

Cockroaches were collected randomly from Ghods hospital and five houses of the city from December-March 2012 and July-September 2013. Cockroaches were collected using sterile test tubes and sterile hand gloves from different parts of the hospital like kitchen, basements, cloth cabinets, shelves and corridors. In the houses, cockroaches were captured from kitchens and toilets. The captured cockroaches were transported to the laboratory and anesthetized by freezing at 0°C for five minutes. Two cc of sterile normal saline 0.9% was added to each test tube and the samples were thoroughly shaken for two minutes. One fixed volume 0.01 ml of saline washing was inoculated into blood agar (Hi Media, India), MacConkey agar (Merck, Germany) and deoxycholate citrate agar (Merck, Germany) plates. All of plates incubated during the night at 37°C. In the morning of the next day, all of the colonies evaluated and identified using standard bacteriological procedures (17). After that, 0.5 ml aliquots of saline washings inoculated into thioglycollate and selenite broth (Merck, Germany), incubated for a full day at 37°C and subcultured on the same media. After 24 hours at 37°C, the media examined and colonies identified.

3. RESULTS

During the period of the study, 98 American cockroaches were collected from Ghods hospital (45 cockroaches) and 5 houses (53 cockroaches) of Paveh city. All of them were examined for bacteriological infections. Totally, 73 samples (74.5%) were infected to 8 types of bacteria. 78.1% of all infestations were observed in external surfaces of the examined cockroaches and 21.9% of the total contaminations were reported from the internal surfaces of the examined samples. 25 samples (25.5%) of the examined cockroaches from hospital and dwelling places did not have any contamination to bacteria that 72% of it was reported from the collected cockroaches from dwellings and 28% of contaminations were reported from the collected cockroaches from Ghods hospital (Table 1). Among 45 samples of the collected cockroaches in the hospital, 38 specimens (84.4%) were infested to the bacteria. The most common diagnostic bacterium was observed to be *Escherichia coli* at which 92.6%

of cockroaches were infested in external surfaces while in the internal surfaces of the cockroaches did not observe any infection related to this bacterium in collected samples from the hospital environments. The second common diagnostic bacterium in hospital cockroaches was *Proteus spp.* at which 71.4% of external and 70% of internal infections by this bacterium were reported. The least infection was observed in *Serratia spp.* at which 25% of external contamination was reported by this bacterium (Table 2).

Bacteria spp.	External surfaces		Internal surfaces		Total	
	NO.	%	NO.	%	NO.	%
<i>Pseudomonas</i>	15	53.6	7	70	22	57.9
<i>Proteus</i>	20	71.4	7	70	27	71.1
<i>Klebsiella</i>	18	64.3	4	40	22	57.9
<i>Escherichia coli</i>	26	92.6	-	-	26	68.4
<i>Staphylococcus</i>	14	50	-	-	14	36.8
<i>Bacillus</i>	19	67.9	2	20	21	55.3
<i>Serratia</i>	7	25	-	-	7	18.4
<i>Enterobacter</i>	9	32.1	-	-	9	23.7
Total	28	73.7	10	26.3	38	100

Table 2. Occurrence of different bacterial spp. identified from the external and internal surfaces of the American cockroaches in Ghods hospital, Paveh city

Among 53 collected cockroaches from dwelling localities, 35 samples (66%) of them were reported as infested cockroaches and the others were not infested to any bacterium. The most common diagnostic bacterium (82.8%) in external surfaces of collected cockroaches from dwelling localities was observed in *Escherichia coli* while in the internal surfaces of the examined cockroaches were not reported any infection related to this bacterium. After *Escherichia coli*, *Proteus spp.* was the infested bacterium in collected cockroaches from dwellings. The least infection was reported in *Serratia spp.* at which 20.7% of external contamination was reported by this bacterium (Table 3). All of collected cockroaches (15 samples) from toilets and bathroom of the hospital were infected to all types of bacteria. 12 collected cockroaches from kitchen and restaurant of the hospital were infested

Bacteria spp.	External surfaces		Internal surfaces		Total	
	NO.	%	NO.	%	NO.	%
<i>Pseudomonas</i>	17	58.6	3	50	20	57.1
<i>Proteus</i>	20	69	5	83.3	25	71.4
<i>Klebsiella</i>	19	65.5	2	33.3	21	60
<i>Escherichia coli</i>	24	82.8	-	-	24	68.6
<i>Staphylococcus</i>	18	62.1	-	-	18	51.4
<i>Enterobacter</i>	14	48.3	-	-	14	40
<i>Serratia</i>	6	20.7	-	-	6	17.1
Total	29	82.9	6	17.1	35	100

Table 3. Occurrence of different bacterial spp. identified from the external and internal surfaces of the American cockroaches in dwelling localities, Paveh city

to 6 types of the bacteria. *Serratia spp.* and *Enterobacter spp.* were not reported in the collected cockroaches from the kitchen or restaurant of the hospital. All of the collected cockroaches (14 samples) from the toilets of the dwelling localities were infested to 6 types of the bacteria and the collected samples in the kitchens of dwellings were infected to 4 types of bacteria including *Proteus*, *Klebsiella*, *Staphylococcus* and *Escherichia coli*.

4. DISCUSSION

The present study showed that there were 8 types of the bacteria in American cockroaches in Paveh city. This cockroach is the main active cockroach in hospital and dwelling localities in Paveh city, which is similar to the results of the researches in Zanjan (18), Tehran (19), Sanandaj (2, 20), Mashhad (21), Sari (22), Kashan (23) and Ahvaz (6).

In another study in Khorramshahr county, 9 groups of the bacteria were reported from American cockroaches. In that research, the most common bacterium was *Klebsiella spp.* (15) but in our study the most common bacterium was *E.coli*. In this investigation *E.coli* was the most common isolated bacterium from the collected cockroaches of both localities; hospital and dwellings. The presence of this pathogenic bacterium can be dangerous for dwellers in the dwelling localities and the patients in the hospital and for the drug resistance to antibiotics (24, 25). American cockroaches are one of the most important groups of insects as transmitters and spreaders of pathogenic bacteria in hospitals and dwelling localities (26). Cockroaches are known to carry some pathogenic microorganisms such as bacteria, fungi, helminthes and viruses so they have a real sanitary hazard. They also have capacity for disseminating bacteria (25). The collected cockroaches from the hospital had a high contamination to many bacteria in the present study. This finding revealed that hospital environments are infected to many microorganisms such as bacteria because in these environments some patients have infectious diseases. This finding is similar to the results of Kassiri and Kazemi (15), Chaichanawongsaroj et al. (27), Nejati et al. (28). In a study in Hamedan city, west of Iran 12 species of bacteria were reported from American cockroaches that *E.coli* was the dominant species of them (28).

This finding is similar to our investigation that *E.coli* was the dominant species of the isolated bacteria. In another investigation which was carried out in dwelling localities of Morocco (10), 11 species of bacteria were extracted from American cockroaches that 6 species of them were extracted from the collected cockroaches of our investigation. Only 2 bacteria including *Pseudomonas spp.* and *Bacillus spp.* were reported in our study that did not reported in Morocco. This study revealed that American cockroaches represent a store of infectious pathogens, different organisms have been identified from their body surfaces. This finding is similar to the studies that were conducted by Tatfeng et al. (29), Salehzadeh et al. (3) and Zacharia et al. (30).

5. CONCLUSION

The results of the present study and other studies in Iran and foreign countries revealed that American cockroaches are important as a potential carrier of pathogenic microor-

ganisms. Although it is difficult to prove direct involvement of cockroaches in transmission of bacterial diseases, the role of cockroaches in the spread of the pathogens such as bacteria is strongly suspected.

Hospital authorities should to remove possible sources of bacteria and control the pests in hospital environments. Staffs, patients and visitors should follow this and they can help in controlling of the cockroaches in hospitals. Being aware of the potential of cockroaches in the carrying pathogens can help people at the household level to keep their kitchens and toilets clean and prevent them of cockroach infestations. Health education about cockroaches and their role in transmission of bacterial diseases in hospitals and health centers for the people and dwellers of Paveh city is suggested. Being cockroaches especially in hospital environments is dangerous for the patients, so elimination of them is necessary.

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