

# Detection and Prevalence Rate of American Cockroaches (*Periplaneta americana*) Bacterial Infections in Human Dwellings

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**Background:** In hospitals, it has been clarified that *Periplaneta americana* can operate as possible vectors of nosocomial infections, chiefly for the transmission of drug-resistant bacteria. Also, these domestic insects have a role in transmitting food-borne diseases. The bacterial loads of these insects have been reported as seven million in each excretion dropping and up to 14 million on their cuticle. Their presence decreases human health and sanitary standards.

**Objectives:** This descriptive study was carried out to confirm that *Periplaneta americana* L. (Dictyoptera; Blattidae) carry pathogenic bacteria in residential areas, by bacteriological analysis of the cuticles of this insect.

**Materials and Methods:** In this research we caught 25 American cockroaches from human dwelling localities of Ahvaz province during 2008 and 2009. Cockroaches were collected using sticky traps, vacuum cleaners and direct collection. The collected cockroaches were brought to the laboratory and were identified as *P. americana*. They were examined for the presence of bacteria on their external surfaces using specific standard methods for bacterial infection.

**Results:** One hundred percent of cockroaches had bacterial infections. Culturing of the external parts wash homogenates resulted in the isolation of *Escherichia coli*, *Proteus*, *Serratia*, *Klebsiella*, *Enterobacter*, *Pseudomonas*, *Staphylococcus aureus*, *Streptococcus*, *Enterococcus*, *Citrobacter*, *Micrococcus*.

**Conclusions:** The results showed that *P. americana* is a possible reservoir and potential vector of some pathogenic agents.

**Keywords:** *Periplaneta americana*; Bacterial Infection; Iran

## 1. Background

Cockroaches have distributed all over the globe and about 4000 species have been identified. Domestic cockroaches such as *Periplaneta americana*, *Blattella germanica*, *Blatta orientalis*, *Periplaneta australis* and *Supella longipalpa* are frequently recorded in Iran. The American cockroach is a large insect and the adult body length is about 1-1/2 inches (38 mm). The adult is a shiny reddish brown to dark brown and has a yellow edge on the protergum. Adult *P. americana* have four wings and occasionally fly. This species is a synanthropic species, yet they can also propel indoor areas and live in human occupied environments (1-5). Members of this species generally live in warm and humid structures but may survive in drier regions if they have availability to water. American cockroaches are also known to transport pathogenic bacterial agents in their intestine and on their body surface. These germs may be transferred to food and other items that come in contact with the cockroaches. Various bacteria universally associated with these insects are recognized to inure diarrhea, dysentery and food intoxication in humans. Cockroaches have been associated with an outbreak of dysentery. *Shigella dysenteriae*, *Salmonella typhi*

and toxigenic strains of *Escherichia coli* can be retained in the gut of cockroaches for up to several days. Thus, these insects also play a role in transmitting food-borne diseases (6, 7). Based on previous investigations, bacteria species may stay alive on the cockroaches' cuticle for a few days (8). *Salmonella* is stable in cockroaches for more than 10 months (9). *Periplaneta americana* also produce allergens on their bodies and in their excrement. American cockroaches have been implicated as a possible reason for childhood asthma and allergic dermatitis (10-13). Multiple studies have demonstrated that cockroaches living near human environments were significant vectors of etiological agents and all groups of possible pathogens such as, protozoans, bacteria, helminthes and viruses (14). Different species of bacteria of public health significance have been isolated from *Periplaneta americana*, such as *Staphylococcus aureus*, *Streptococcus spp.*, *Enterobacteriaceae*, *Pseudomonas aeruginosa*, and so on. Cockroaches captured in hospitals and houses have been found to harbor multi-drug resistant bacteria (3).

## 2. Objectives

The aim of this investigation was therefore to assess

the role of American cockroaches as potential carriers of pathogenic bacteria and relative abundance of bacteria carried by this species in residential areas of Ahvaz province, Southwest Iran.

### 3. Materials and Methods

This descriptive study was conducted during 2008 and 2009 at the Ahvaz Jundishapur University of Medical Sciences, Ahvaz, Iran. A total of 25 cockroaches were collected using sticky traps, vacuum cleaners and hand catch methods from human dwellings, to determine the presence of pathogenic bacterial agents on their bodies. Sterile hand-gloves were used for sampling. The collected cockroaches were transferred by separate clean and sterile tubes. Next, samples were transported to the laboratory. The instruments were sterilized with alcohol and flame. Trapped cockroaches were frozen at 0°C for 10 minutes. Cockroaches were identified using reliable taxonomic keys. Each of the samples was washed in a sterile glass containing 2 mL of sterile saline and the resulting suspension was cultured. Bacteria were isolated and identified from American cockroach samples using standard techniques for bacterial infection. All specimens were cultured for growing bacteria on blood agar, MacConkey agar media and other selective bacterial media. The microorganisms were identified using necessary differential and biochemical tests.

### 4. Results

Twenty-five American cockroaches were randomly selected and detected by bacteriological examinations. Medically important bacteria were isolated from the external surface of 100% of cockroaches. This finding suggests that almost all the cockroaches in the residential environments carry medically important pathogenic bacteria. Eleven bacterial species were isolated from cockroaches. The most common detected bacteria were found to be *Escherichia coli*, *Staphylococcus aureus*, *Proteus spp.*, *Klebsiella spp.*, *Citrobacter spp.* and *Enterobacter spp.* where 100%, 72%, 60%, 60%, 56% and 52% of cockroaches were infected by these species, respectively. The minimum contamination was by *Serratia spp.* (20%), *Micrococcus spp.* (32%) and *Enterococcus spp.* (40%), respectively. The other extracted bacteria in this research were *Pseudomonas spp.* (44%) and *Streptococcus spp.* (48%). Most of the bacterial isolates from the external surface of cockroaches were gram-positive. All of American cockroaches examined in this research were infected with at least one bacterium.

### 5. Discussion

All cockroaches trapped in this research were identified as *Periplaneta americana*. American cockroaches are often found in close association with humans. They are numerous in cities and villages where unsanitary situations dominate. Due to their association with residents,

cockroaches can contact and obtain pathogenic agents. Pathogens can then be mechanically transmitted to human populations. The presence of cockroaches in human dwellings is never favorable, and should an issue of concern. They are also a risk factor for human sanitation and low level of health. The isolation of *Escherichia coli*, *Staphylococcus aureus*, *Proteus spp.*, *Klebsiella spp.*, *Citrobacter spp.*, *Enterobacter spp.*, *Serratia spp.*, *Micrococcus spp.*, *Enterococcus spp.*, *Pseudomonas spp.* and *Streptococcus spp.* from this cockroach species showed that household pests could be a health challenge to humans. Also, this finding indicated the potential role of cockroaches in distributing pathogens in human communities. Some of the bacterial isolates are known to be pathogenic while others are either opportunistic or play roles in food spoilage. The finding of *E. coli* among cockroaches means that these insects have been in contact with human feces or feces-contaminated material. The bacterial species most repeatedly isolated from cockroaches were gram-negative bacilli, particularly in the Family of *Enterobacteriaceae*. In fact, Blattaria are considered as an ecological niche of some *Enterobacteriaceae*. They can cause urinary tract infections, wound infections, gastroenteritis, sepsis, urinary, biliary and peritoneal infections and pneumonia (7, 15). Isolation of gram-negative bacilli such as *Pseudomonas spp.*, *Serratia spp.*, *E. coli*, *Klebsiella spp.*, *Proteus spp.*, *Citrobacter spp.* and *Enterobacter spp.* from the external surfaces in this study agrees with previous reports by Akinjogunla et al. (2), Feizhaddad et al. (15), Kassiri et al. (11), Nejati et al. (8) and Lamiaa et al. (6). Furthermore, in this study different species of gram-positive bacteria (*Micrococcus spp.*, *Enterococcus spp.*, *Staphylococcus aureus* and *Streptococcus spp.*) were isolated from cockroaches. Results of Chitsazi's studies showed that cockroaches were contaminated by four gram-positive bacteria species, including *Staphylococcus aureus*, *Enterococcus spp.*, *Enterococcus spp.* and *Streptococcus spp.* (16, 17). These results are consistent with the results of the present study. In conclusion, to reduce the risk of transmission of various pathogens, the application of appropriate control methods should be considered to manage populations of cockroaches in human dwellings. People should be aware of the potential pathogenic transmission by cockroaches and should keep kitchens, bathrooms and toilets clean and prevent infestation of cockroaches in their houses.

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### Authors' Contributions

Hamid Kassiri developed the original idea and the protocol, abstracted and analyzed the data. Hamid Kas-

siri and Ali Kasiri wrote the manuscript. Anvar Quaderi contributed to the development of the protocol and abstracted the data.

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