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Synanthropic Ants as Vectors of Pathogens in Hospitals of Iran

Mehran Shahi, Ph.D.¹, Parivash Davoodian, M.D.², Maryam Ansari, B.Sc.³, Fereydoon Ghazi, B.Sc.⁴,
Kamran Akbarzadeh, Ph.D.⁵

1- Assistant Professor, Department of Medical Entomology & Vector Control, School of Public Health, Infectious and Tropical Diseases Research Center, Hormozgan Health Institute, Hormozgan University of Medical Sciences, Bandar Abbas, Iran

2- Associate Professor, Infectious and Tropical Diseases Research Center, Hormozgan Health Institute, Hormozgan University of Medical Sciences, Bandar Abbas, Iran

3- Infectious and Tropical Diseases Research Center, Hormozgan University of Medical Sciences, Bandar Abbas, Iran

4- Reference Laboratory, Hormozgan, Bandar Abbas, Iran

5- Assistant professor, Department of Medical Entomology and Vector Control, School of Public Health, Tehran University of Medical Sciences, Tehran, Iran (Corresponding author; kakbarzadeh@tums.ac.ir)

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Abstract

Background: Synanthropic ants can transmit pathogens especially in hospital environments, but this fact had not been confirmed in Palaearctic region. This is the first study on confirming this ability of ants in this region.

Methods: Three hospitals of Bandar Abbas, Iran have been selected for monthly sampling of ants in their various wards. The main processes on collected samples were washing out and culturing on various culture media.

Results: As many as 250 individuals from 3 sub-families and 7 species of ants have been collected. Most of the collected species were from Formicinae sub-family. *Paratrechina longicornis* and *Camponotus* sp. were the most common species. At least 12 species of pathogens were found on ant species in the study.

Conclusion: Environmental sanitation with emphasis on renewal of the hospital structures and informing the personnel about the ability of ants on transmission of pathogens are recommended for preventing the harmful impacts of ants.

Introduction

Currently, the number of ant species has increased to more than 14,000 around the world. It has been estimated that the true number of the ants in the world are about 30000 species. Due to huge variations in climatic, geological and altitudinal conditions in Iran, fauna of the country would be richer and more diverse. There are 148 ant species from 32 genera of ants in various parts of Iran (1, 2).

Ants (Hymenoptera: Formicidae) are eusocial and comprise an important part of animal biomass (3). Ants with their diverse functions in ecosystems have various ecological

roles which are almost useful (4). Some ant species can have impact on human health through their painful sting and allergic and anaphylaxis reactions (5) as well as their role in transmission of pathogenic micro-organisms (6). This issue may be more dangerous in hospital environments. A study on ability of ants to transmit pathogenic micro-organisms has been done in nine hospitals around the world (7). A similar research has been carried out to emphasize the medical importance of synanthropic ants in hospital environments in Brasil (8).

Despite the numerous faunistic studies conducted on Iranian ants (9), the medical importance of ants in Iran became more attractive for researchers after the description of the occurrence (10) and medical importance of Iranian biting ants (11). Some of the ant species present in hospital environments can be health-threatening agents and may cause nosocomial infections (12). Hot climate in some parts of Iran such as Hormozgan province produce suitable conditions for the activities of ants all year round. This issue may increase the risk of pathogen transmission by ants. This study has been conducted to find the potential of carrying pathogens by the ant in hospital environments of Bandar Abbas, Hormozgan province, south of Iran.

Materials and Methods

Bandar Abbas city, 27°12'N, 56°22'E, capital of Hormozgan province, is located on flat ground north of Persian Gulf and its elevation is about 9m above the sea level. This city has a hot and humid climate. Maximum temperature in summers can reach up to 49 °C while in winters the minimum temperature may drop to 5 °C. The annual rainfall is around 170 millimeters (6.7 in) and the relative humidity is 65%.

The sampling sites were Shahid Mohammadi, Shariatee and Koodakan hospitals of Bandar Abbas city during one entire year. Due to the faunistic structure of this study, all ant

species in the various wards of the hospitals such as infectious diseases, operating rooms, obstetrics, surgery and internal diseases wards have been carefully surveyed to find ant colonies. The sampling process has been done based on a monthly schedule. Ant specimens were collected by means of small forceps. The collected ants were transferred to 15 ml volume tubes with distilled water. The tubes were transferred to the laboratory after labeling. The samples were cultured in Blood Agar and EMB media in 35°C and surveyed after 24 hours for finding the colonies of pathogens. The cultured pathogens were transferred to Shahid Mohamadi Central lab for identification.

After the washing out process, ant samples were placed in tubes with 70% EtOH and sent to the School of Public Health of Tehran University of Medical Sciences for identification. Species identification of collected ants has been done by the use of relevant keys (13, 14).

Results

As much as 250 ant samples from 3 sub-families and 7 species were collected. Most of the collected species were from the Formicinae sub-family. The species *Paratrechina longicornis* and *Camponotus* sp. were the most common in the studied ant community of Bandar Abbas city, south of Iran (table 1).

Table 1. Number of individual ants and their systematic information, Bandar Abbas, Iran.

Number of vials	Sub-family	cast	Species
4	Dolichoderinae	worker	<i>Technomyrmex vexatus</i>
4	Dolichoderinae	worker	<i>Tapinoma</i> sp.
11	Formicinae	worker	<i>Paratrechina longicornis</i>
16	Formicinae	workers	<i>Camponotus</i> sp.
2	Pomerinae	-	Worker
		-	Reproductive
		workers	<i>Brachyponera semmaarensis</i>
2	Myrmicinae	Worker	<i>Cardiocondyla</i> sp.

Various ant species showed that Koodakan hospital which is a special center for pediatric diseases was more inoculated with ant colonies (table 2). Colonies of two species

Camponotus sp. and *Cardiocondyla* sp. we're not found in Koodakan hospital, while the rest of the five ant species were all present in this hospital.

Table 2. Hospitals' status in regard to the presence of ants, Bandar Abbas, Iran.

Hospital name	Ant species						
	<i>Camponotus</i> sp.	<i>Tapinoma</i> sp.	<i>Paratrechina longicornis</i>	<i>Cardiocondyla</i> sp.	<i>Brachyponera sennaarensis</i>	<i>Technomyrmex vexatus</i>	<i>Technomyrmex setosus</i>
Shahid Mohammadi	+	-	-	+	+	-	-
Koodakan	-	+	+	-	+	+	+
Shariati	+	-	-	-	-	-	-

At least 12 species of pathogens were found on ant species in the study sites. Despite the low number of colonies in Shahid Mohammadi hospital as compared to that in Koodakan hospital (table 3), the inoculation of pathogens on

ants was higher (more than 83%) in this hospital (table 3). With the exception of *Diphthroid* (*Corynebacterium*) and *Micrococcus*, the rest ten bacteria species have been separated from ants in Shahid Mohammadi hospital.

Table 3. Identified Pathogens in surveyed hospitals, Bandar Abbas, Iran.

Bacteria	Hospital		
	Shahid Mohammadi	Kodakan	Shariati
<i>Bacillus</i>	+	+	-
<i>Staphylococcus epidermis</i>	+	+	-
<i>Klebsiella</i>	+	+	-
<i>Citrobacter diversus</i>	+	+	-
<i>Morganella</i>	+	-	-
<i>Diphthroid</i> (<i>Corynebacterium</i>)	-	-	+
<i>Acineobacter</i>	+	+	-
<i>Micrococcus</i>	-	+	-
<i>Pseudomonas</i>	+	+	-
<i>Citrobater freundii</i>	+	-	-
<i>Flavobacter</i>	+	-	-
<i>E. cloi</i>	+	-	-

With the combination of tables 1 and 2, the inoculation of any ant taxa with various kinds of pathogens (table 4) showed

that *Camponotus* sp. and *Cardiocondyla* sp. were inoculated more than the other ant species.

Table 4. Pathogens isolated from various ant taxa collected from three hospitals of Bandar Abbas Iran

Pathogens	Ant species						
	<i>Camponotus</i> sp.	<i>Tapinoma</i> sp.	<i>Paratrechina</i> <i>longicornis</i>	<i>Cardiocondyla</i> sp.	<i>Brachyponera</i> <i>sennaarensis</i>	<i>Technomyrmex</i> <i>vexatus</i>	<i>Technomyrmex</i> <i>setosus</i>
<i>Bacillus</i>	+	+	+	+	+	+	+
<i>Staphylococcus epidermidis</i>	+	+	+	+	+	+	+
<i>Klebsiella</i>	+	+	+	+	+	+	+
<i>Citrobacter diversus</i>	+	+	+	+	+	+	+
<i>Morganella</i>	+	-	-	+	+	-	-
<i>Diphthroid (Corynebacterium)</i>	+	-	-	-	-	-	-
<i>Acineobacter</i>	+	+	+	+	+	+	+
<i>Micrococus</i>	-	+	+	+	-	+	+
<i>Pseudomonas</i>	+	+	+	+	+	+	+
<i>Citrobater freundi</i>	+	-	-	+	+	-	-
<i>Flavobacter</i>	+	-	-	+	+	-	-
<i>E. cloi</i>	+	-	-	+	+	-	-
<i>Total pathogens on any ant species</i>	11	7	7	11	10	7	7

Discussion

The genus *Camponotus* was dominant in this study but in a study conducted in Brazil, it accounted for about 14% of the samples (15). The presence of the genus *Camponotus* is an indication of some weaknesses in the structure of hospitals. However, they can go out of the buildings for foraging (16). Due to limited budget and some other reasons, renewal of hospital structures in Iran lasts a very long time. These situations are conducive for the establishment of ant colonies.

The species *P. longicornis* was also more common in collected samples in hospitals of Bandar Abbas. Its presence is worldwide and it is present in the Palearctic region (13). We found two genus of this Dolichoderinae in south of Iran: *Technomyrmex* MAYR, 1872 and *Tapinoma* FOERSTER, 1850. Recent investigations on ant fauna of south of Iran did not show the presence of these genera (17); therefore, this report can be regarded as the first record of them from south of the country.

The genus *Technomyrmex* is very similar to the genus *Tapinoma* in morphology (18). They are active in tropical and

sub-tropical areas of the world (19). It seems that their ecology and behaviors are similar in the southern part of Iran.

Presence of the Iranian Samsun Ant, *Brachyponera (Pachycondyla) sennaarensis* (Hymenoptera: Ponerine) in Bandar Abbas region is not surprising due their identified distribution in Iran. Bandar Abbas is in its distribution area covering southern parts of Iran from Sistan and Baluchestan province in the east to southern parts of Fars province (10, 20-22). This species is a venomous insect which can annoy and cause problems such as allergies, irritations and small blisters on victims (11, 23). Thus, the presence of this species, despite its role in transmission of pathogens, causes more annoyance for hospitalized people who need more rest. On the other hand, their biting can make painful blisters in the most of victims (11).

A few species of the genus *Cardiocondyla* have been reported in Iran (17, 24). Many species of the world fauna were typically found in anthropogenic habitats and sometimes they show preference for habitats with a high degree of urbanization (24). The presence of this genus in hospital

environments has been reported from Brazil (8). In this study, we found members of the genus *Cardiocondyla* in low density.

Various ant species including *Camponotus* sp. (12, 25, 26), *Tapinoma* sp. (12, 15, 26-32), *P. longicornis* (15, 25-28) and *Cardiocondyla* sp. (32, 33) which were found in this study, have been reported from hospital environments of other parts of the world (4). Three other taxa included *B. sennaarensis*, *Technomyrmex vexatus* and *Technomyrmex setosus*.

The potential of mechanical transmission of various pathogens with synanthropic ants is being reported for the first time in Iran. There are some reports about this ability of Pharaoh's ant in some hospitals around the world (7). There are some reports regarding this issue in Brazil (8, 12, 15, 16) which is placed in Neotropical region. Therefore, this study can be the first report of this issue in southern part of Palaearctic region.

Various pathogens including *Bacillus* sp. (27, 34), *Staphylococcus epidermis* (27, 32), *Klebsiella* sp. (8, 30, 33 - 35), *Diphtheroid (Corynebacterium)* (15, 29), *Pseudomonas* sp. (8, 12, 15, 30-32), *E. coli* (8, 12, 29, 30, 33), which were found in this study, have been reported from ant's body surfaces mostly from Brazil. The famous Gram-negative bacteria, *Pseudomonas* sp. and *E. coli* have been reported frequently in the literature. However, we are reporting six other taxa which can be added to the checklist of pathogens on body surface of

ants in hospital environments and they include: *Citrobacter diversus*, *Citrobater freundi*, *Morganella* sp., *Acineobacter* sp., *Micrococcus* sp. and *Flavobacters* sp.

House flies *Musca domestica* (Diptera: Muscidae) are regarded as the main source of mechanical transmission of pathogens in hospital environments in Iran. Kassiri et al in 2012 found seven pathogens on house flies collected from some hospitals in Ahwaz, southwest of Iran (36) which were *Pseudomonas* sp., *Klebsiella* sp., *Staphylococcus* sp., *Bacillus* sp., *Diphtheroid* sp., *Citrobacter* sp. and *Pseudomonas* sp. All the identified genera of pathogens on house flies were similar to the identified pathogens from the body surface of the ants in this study. It seems that pathogens which can be transmitted mechanically in the hospital environment have the same origins.

Environmental sanitation with emphasis on renewal of hospital structures, educating the personnel about the ability of ants to transmit pathogens are recommended for the prevention of their harmful impact on human health in hospital environments.

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References

1. Radchenko A, Paknia O. Two New Species of the Genus *Cataglyphis* Foerster, 1850 (Hymenoptera: Formicidae) from Iran. *Annales Zoologici* 2010; 60(1):69-76.
2. Firouzi FP, Raad S, Hossein Nezhad S, Agosti D. Four new records of ants from Iran (Hymenoptera: Formicidae). *Zoology in the Middle East* 2011; 52(1): 71-8.

3. Chavhan A, Pawar S. Distribution and diversity of ant species (Hymenoptera: Formicidae) in and around Amravati City of Maharashtra, India. *World Journal of Zoology* 2011;6(4):395-400.
4. Thongphak D, Kulsa C. Diversity and community composition of ants in the mixed deciduous forest, the pine forest and the Para rubber plantation at Chulaborn Dam, Chaiyaphum Province, the Northeastern Thailand. *Int J Env Rural Dev* 2014;5:72-6.
5. Golden DB. Insect sting anaphylaxis. *Immunol Allergy Clin North Am* 2007;27(2):261-72.
6. Oliveira BRM, de Sousa LF, Soares RC, Nascimento TC, Madureira MS, Fortuna JL. Ants as Vectors of Bacteria in Hospital Environments. *Journal of Microbiology Research* 2017;7(1):1-7.
7. Beatson S. Pharaoh's ants as pathogen vectors in hospitals. *The Lancet* 1972;299(7747):425-7.
8. Garcia FR, Lise F. Ants associated with pathogenic microorganisms in brazilian hospitals: attention to a silent vector. *Acta Scientiarum Health Sciences* 2013;35(1): 9-14.
9. Nezhad SH, Rad SP, Firouzi F, Agosti D. New and additional records for the ant fauna from Iran: (Hymenoptera: Formicidae). *Zoology in the Middle East* 2012;55(1):65-74.
10. Akbarzadeh K, Tirgari S, Nateghpour M, Abaie M. The first occurrence of Fire Ant *Pachycondyla Sennaarensis* (Hym: Formicidae), southeastern Iran. *Pakistan Journal of Biological Sciences* 2006;9(4):606-9.
11. Akbarzadeh K, Nateghpour M, Tirgari S, Abaei M. Medical importance of fire ant *Pachycondyla sennaarensis* (Hymenoptera: Formicidae) in Iranshahr and Sarbaz Counties, southeastern of Iran. *J Med Sci (Faisalabad, Pakistan)* 2006;6(5):866-9.
12. Santos PF, Fonseca AR, Sanches NM. Ants (Hymenoptera: Formicidae) as vectors for bacteria in two hospitals in the municipality of Divinópolis, State of Minas Gerais. *Rev Soc Bras Med Trop* 2009;42(5):565-9.
13. Bolton B. Identification guide to the ant genera of the world. Cambridge: Harvard University Press; 1994.
14. Sharaf MR, Collingwood CA, Aldawood AS. *Technomyrmex montaseri* sp. n., a new ant species of the *T. gibbosus*-group from Oman (Hymenoptera, Formicidae) with a key to the *Technomyrmex* species of the Arabian Peninsula. *ZooKeys* 2011(108):11-9.
15. Lise F, Garcia FR, Lutinski JA. Association of ants (Hymenoptera: Formicidae) with bacteria in hospitals in the State of Santa Catarina. *Revista da Sociedade Brasileira de Medicina Tropical* 2006;39(6):523-6.
16. Williams DF. Exotic ants: biology, impact, and control of introduced species. *Environmental Entomology* 1996; 25(6):1463-4.
17. Ghahari H, Collingwood CA. A study on the ants (Hymenoptera: Formicidae) of southern Iran. *Calodema* 2011;176:1-5.
18. Holldobler B, Wilson EO. *The Ants*. USA: Harvard University Press; 1990.
19. Guillem R, Bensusan K. *Technomyrmex vexatus* (Santschi, 1919) from Gibraltar (Hymenoptera: Formicidae): a new ant species for Europe and genus for Iberia. *Myrmecological News* 2008;11:21-3.
20. Nikbakhtzadeh MR, Movahhedi N, Akbarzadeh K, Shaeghi M. Volatile compounds from dufour "gland" of the fire ant, *pachycondyla; sennaarensis* (Hymenoptera: formicidae). *Biochemical and Cellular Archives* 2009;9(1):37-41.
21. Zarei A, Rafinejad J, Shemshad K, Khaghani R. Faunistic study and biodiversity of scorpions in

- Qeshm Island (Persian Gulf). Iran J Arthropod Borne Dis 2009; 3(1): 46-52.
22. Khoobdel M, Akbarzadeh K, Jafari H, Mehrabi Tavana A, Mousavi Jazayari A, Rafienejad J, et al. Ant sting in military forces on three Persian islands of Abu-Musa, Great Tonb and Lesser Tonb. Journal Mil Med 2012;14(2):155-62.
23. Nikbakhtzadeh M, Akbarzadeh K, Tirgari S. Bioecology and chemical diversity of abdominal glands in the iranian samsun ant *Pachycondyla sennaarensis* (Formicidae: Ponerinae). Journal of Venomous Animals and Toxins including Tropical Diseases 2009;15(3):509-26.
24. Seifert B. The ant genus *Cardiocondyla* (Insecta: Hymenoptera: Formicidae)-a taxonomic revision of the *C. elegans*, *C. bulgarica*, *C. batesii*, *C. nuda*, *C. shuckardi*, *C. stambuloffii*, *C. wroughtonii*, *C. emeryi*, and *C. minutior* species groups. Annalen des Naturhistorischen Museums in Wien Serie B für Botanik und Zoologie 2002:203-338.
25. Barros R, Campos-Farinha A, Prezoto F. Ocorrência, comportamento e vetoração de fungos por formigas no Hospital. Revista Brasileira de Zoociências 2006;8(2):217-20.
26. Pantoja L, Moreira Filho R, Brito E, Aragão T, Brillhante R, Cordeiro R, et al. Ants (Hymenoptera: Formicidae) as carriers of fungi in hospital environments: an emphasis on the genera *Tapinoma* and *Pheidole*. Journal of Medical Entomology 2009;46(4):895-9.
27. Moreira D, Morais VD, Vieira-da-Motta O, Campos-Farinha AEdC, Tonhasca A. Ants as carriers of antibiotic-resistant bacteria in hospitals. Neotrop. Entomol 2005;34(6):999-1006.
28. Costa SB, Pelli A, Carvalho GP, Oliviera AG, Silva PR, Texiera MM, et al. Formigas como vetores mecânicos de microorganismos no hospital escolar da universidade federal do triângulo mineiro. Rev Soc Bras Med Trop 2006; 39(6): 527-29.
29. Tanaka II, Viggiani AMF, Person OC. Bactérias veiculadas por formigas em ambiente hospitalar. Arq Med ABC 2007; 32(2): 60-3.
30. Rando JS, Matsumoto LS, Silva GV, Quirino AF, Haddad RE. Caracterização da mirmecofauna em estabelecimentos ligados a área da Saúde no Município de Bandeirantes, PR. Arq Inst Biol 2009; 76(4): 665-71.
31. Teixeira MM, Pelli A, dos Santos VM, Reis MdG. Microbiota associated with tramp ants in a Brazilian University Hospital. Neotrop Entomol 2009;38(4):537-41.
32. de Gonçalves M, Loeck A, da Silva W, Rosado J, Bastos C, Bassani M. Associação entre formigas (Hymenoptera: Formicidae) e bactérias patogênicas em cinco hospitais do município de Pelotas, RS. Arquivos do Instituto Biológico 2011;78(2):287-95.
33. Pereira RS, Ueno M. Formigas como veiculadoras de microrganismos em ambiente hospitalar. Rev Soc Bras Med Trop 2008; 41(5): 492-5.
34. Pesquero MA, Carneiro LC, Pires DDJ. Insect/Bacteria association and nosocomial infection. Salmonella-A Diversified Superbug: InTech; 2012.
35. Pesquero MA, Filho JE, Carneiro LC, Feitosa SB, Oliveira MAC, Quintana RC. Formigas em ambiente hospitalar e seu potencial como transmissoras de bactérias. Neotrop Entomol 2008; 37 (4): 472-7.
36. Kassiri H, Akbarzadeh K, Ghaderi A. Isolation of pathogenic bacteria on the house fly, *Musca domestica* L. (Diptera: Muscidae), body surface in Ahwaz hospitals, Southwestern Iran. Asian Pacific Journal of Tropical Biomedicine 2012;2(2): S1116-S9.