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Ants (Hymenoptera: Formicidae) in five hospitals of Porto Alegre, Rio Grande do Sul State, Brazil

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ABSTRACT. The presence of ants in hospitals is health risk for the hospital community, since presents a strong capability to carry pathogenic organisms throughout this environment. This study was carried out from May 2007 to April 2008, aiming the identification of ant species that infest the hospitals in Porto Alegre, Rio Grande do Sul State, Brazil. A total of 989 ants from 19 species were sampled: *Acromyrmex niger* (Fr. Smith, 1858), *Brachymyrmex* sp., *Camponotus rufipes* (Fabricius, 1775), *Camponotus sericeiventris* (Guerin-Meneville, 1838), *Camponotus* sp_1, *Camponotus* sp_2, *Gnamptogenys* sp., *Hypoponera* sp., *Labidus coecus* (Latreille, 1802), *Monomorium pharaonis* (Linnaeus, 1758), *Pachycondyla* sp., *Paratrechina fulva* (Mayr, 1862), *Paratrechina longicornis* Latreille, 1802, *Pheidole* sp_1, *Pheidole* sp_2, *Pheidole* sp_3, *Pheidole* sp_4, *Pheidole* sp_5, and *Tapinoma melanocephalum* Fabricius, 1793. Among them, *Brachymyrmex* sp. was the most frequent one (47.0%) followed by *Monomorium pharaonis* (18.7%) and *Labidus coecus* (17.2%).

Keywords: ants, vectors, public health care, environment, hospital infection.

RESUMO. Formigas (Hymenoptera: Formicidae) em cinco hospitais de Porto Alegre, Rio Grande do Sul, Brasil. A presença de formigas em hospitais constitui risco à saúde da comunidade hospitalar, uma vez que elas possuem o poder de carrear microrganismos patogênicos por este ambiente. Este estudo foi realizado no período de maio 2007 a abril de 2008, com o objetivo de identificar as espécies de formigas que infestam hospitais em Porto Alegre, Brasil. Foi coletado um total de 989 formigas pertencentes a 19 espécies, sendo: *Acromyrmex niger* (Fr. Smith, 1858), *Brachymyrmex* sp., *Camponotus rufipes* (Fabricius, 1775*), Camponotus sericeiventris* (Guerin-Meneville, 1838), *Camponotus* sp., *Camponotus* sp.2, *Gnamptogenys* sp., *Hypoponera* sp., *Labidus coecus* (Latreille, 1802), *Monomorium pharaonis* (Linnaeus, 1758), *Pachycondyla* sp., *Paratrechina fulva* (Mayr, 1862), *Paratrechina longicornis* Latreille, 1802, *Pheidole* sp., *Pheidole* sp.2, *Pheidole* sp.4, *Pheidole* sp.5, *Pheidole* sp.7 e *Tapinoma melanocephalum* Fabricius, 1793. Destas, *Brachymyrmex* sp. foi a mais frequente com 47,0%, seguida por *Monomorium pharaonis* com 18,7% e *Labidus coecus* com 17,2%.

Palavras-chave: formigas, vetor mecânico, saúde pública, ambiente, infecção hospitalar.

Introduction

The occurrence of ants in hospitals became focus of study due to exposure of patients and health care professionals to risks associated with such insects. Studies point that they can act as mechanic vectors of microorganism, contaminating the environment and collaborating with hospital infections. The hospital infections are, currently, a serious problem for the public health care, being directly proportional to the development of invasive technology (probes and catheters). However, the awareness regarding the information of practices against infections among the health care professionals is not proportional to its development (FOWLER et al., 1993, MOREIRA et al., 2005).

The ants are responsible for causing problems in hospitals worldwide. This fact was initially identified in England (EDWARDS; BACKER, 1981), in Chile (IPINZA-REGLA et al., 1981), in Germany (EICHLER, 1990), in Trinidad (CHADEE; MAITRE, 1990), in Colombia (OLAYA-MASMELA et al., 2005), in Spain (ESPALDER; ESPEJO, 2002), in The United States (KLOTZ et al., 1995; NELDER et al., 2006), in Malaysia (NA; LEE, 2001), and in Korea (KIM et al., 2005). In Brazil, they are probably carriers of bacteria (LISE et al., 2006, FERRABOLI et al., 2007; BICHO et al.,

2007; MAIA et al., 2009; SANTOS et al., 2009; TEIXEIRA et al., 2009), fungi (PEREIRA; UENO, 2008; PANTOJA et al., 2009), endosymbiont bacteria, eggs of *Ascaris*, and cysts of protists (VILLANI et al., 2008).

In Brazil, researches concerning the urban ants started in 1980 (CAMPOS-FARINHA et al., 2002). Surveys in hospitals of São Paulo state allowed concluding that: (a) all hospitals visited presented ant infestations; (b) the presence of several species with the predominance of one was always observed; (c) the infestation rate varied from 16 to 61% in the sampled points, reaching 73% at the population explosion of one of the species; (d) the presence of pathogenic bacteria was found in 15-20% of the ant samples in a large hospital in the Southeastern region of the country; (e) the sectors presenting the highest rates of infestation were the baby nurseries and the intensive care units; (f) the most common species were *T. melanocephalum* and *P. longicornis* – which are introduced species (BUENO; CAMPOS-FARINHA, 1998, 1999).

Anthropoliphic ants are different from the others since they share some characteristics regarding the adaptation ability to changes established by humans; they migrate easily, changing the nest to occupy new areas; the species are unicolonial, characterized by the absence of aggressiveness against other nests and individuals in the same area, which allows the transit of individuals of the same species from one nest to the other; they present strong interspecific aggressiveness; present a polygenic behaviour, allowing more than 200 queens in the same nest; the size of the workers are tiny, the smallest are between 1.3 and 2.2 mm in length, being generally monomorphic, presenting reproduction through colony fragmentation, i.e., the workers and the fecundated queens leave the nest to new places to comprise a new colony (SILVA; LOECK, 1999). The nuptial flight does not occur in some species and the coupling happens inside the nest (BUENO, 2003; CAMPOS-FARINHA; BUENO, 2004). Such skills characterize these ants as tramp species (ULLOA, 2003).

Despite the efforts to know the urban myrmecofauna in Brazil, only few studies were published in this area encompassing Southern Brazil, three in Santa Catarina State in the municipalities of Chapecó (LISE et al., 2006), Pinhalzinho (FARNEDA et al., 2007), and Xanxerê (IOP et al., 2009); two in Rio Grande do Sul State in the municipalities of Bagé (BICHO et al., 2007) and Pelotas (SILVA; LOECK, 1999); and only one in Paraná State in the municipality of Maringá (OLIVEIRA; CAMPOS-FARINHA, 2005). Among them, only two were carried in hospitals (LISE et al., 2006, BICHO et al., 2007).

Thus, this study aimed the identification of ant species that infest the hospitals of Southern Brazil, since such insects may act as vectors of several pathogens. Currently, the literature present few works regarding this subject in Rio Grande do Sul State.

Material and methods

This study was carried out in five hospitals in the municipality of Porto Alegre, Rio Grande do Sul State, Brazil, from May 2007 to April 2008. The ant samplings were performed through the inspections in the visited sites, discarding the use of attractive baits, since the objective was identifying the species occurring naturally in the environment, without any attractive component in the moment of the data sampling (OLIVEIRA; CAMPOS-FARINHA, 2005), using a swab, depositing the specimens into a flask containing 70% alcohol, identified with date, sampling place and collector.

The hospitals were numbered from 1 to 5. Their bed numbers are the following: hospital 1 – 749 beds; hospital 2 – 200 beds; hospital 3 – 170 beds; hospital 4 – 165 beds; and hospital 5 – 140 beds. This method prevented the segregation of the institutions by the results from this study. The sites where the samplings were accomplished are the intensive care units for adults (aICU), neonatal ICU, nutrition sectors, pantries and nursing stations.

The specimens were identified at the species level using the identification keys of Fernández (2003) and Bueno and Campos-Farinha (1999). To identify the sites of occurrence, a spreadsheet was generated to distribute the ant species in the sampled sectors per hospital, containing in the columns the sampled sites and in the rows the ant species found, marking the occurrence of a certain species in the sampled site assessed. In this assessment, the number of individuals was not taken into account, but only their presence in the sampled site (ZARZUELA et al., 2002). A distribution spreadsheet of the species was created, the visited hospitals in the columns, and the species found in the rows, facilitating comparison between different hospitals.

The index of relative frequency was used to identify the most frequent species that infest the hospital (LISE et al., 2006).

Results and discussion

The samplings revealed a total of 989 ants from 19 species, which were the following: *Acromyrmex niger* (Fr. Smith, 1858), *Brachymyrmex* sp., *Camponotus rufipes* (Fabricius, 1775), *Camponotus sericeiventris* (Guerin-Meneville, 1838), *Camponotus* sp.1, *Camponotus* sp.2, *Gnamptogenys* sp., *Hypoponera* sp., *Labidus coecus* (Latreille, 1802), *Monomorium pharaonis* (Linnaeus, 1758), *Pachycondyla* sp., *Paratrechina fulva* (Mayr, 1862), *Paratrechina longicornis* (Latreille, 1802), *Pheidole* sp.1, *Pheidole* sp.2, *Pheidole* sp.3, *Pheidole* sp.4, *Pheidole* sp.5, and *Tapinoma melanocephalum* (Fabricius, 1793). Among them, *Brachymyrmex* sp. was the most frequent species (47.0%), followed by *Monomorium pharaonis* (18.7%), and *Labidus coecus* (17.2%) listed in the Table 1.

Table 1. Absolute and relative frequency of ants sampled in five hospitals of Porto Alegre, Rio Grande do Sul State, Brazil, between May 2007 and April 2008.

Species	Absolute frequency	Relative frequency
Acromyrmex niger	14	1.4
Brachymyrmex sp.	465	47.0
Camponotus sp.	1	0.1
Camponotus sp.2	1	0.1
Camponotus rufipes	1	0.1
Camponotus sericeiventris	5	0.5
Gnamptogenys sp.	2	0.2
Hypoponera sp.	14	1.4
Labidus coecus	170	17.2
Monomorium pharaonis	185	18.7
Pachycondyla sp.	1	0.1
Paratrechina longicornis	1	0.1
Paratrechina fulva	71	7.2
Pheidole sp.1	2	0.2
Pheidole sp.2	11	1.1
Pheidole sp.3	25	2.5
Pheidole sp.4	10	1.0
Pheidole sp.5	5	0.5
Tapinoma melanocephalum	5	0.5

The number of ant species obtained in this study is superior to obtained in hospitals by Lise et al. (2006) in Chapecó (Santa Catarina State); by Bicho et al. (2007) in Bagé (Rio Grande do Sul State); by Zarzuela et al. (2002) in Sorocaba (São Paulo State); by Moreira et al. (2005) in Campos dos Goytacazes (Rio de Janeiro State); Gazeta et al. (2007) in Rio de Janeiro (Rio de Janeiro State); Tanaka et al. (2007) in Marília (São Paulo State); by Pesquero et al. (2008) in Morrinhos (Goiás State); Santos et al. (2009) in Divinópolis (Minas Gerais State); Fonseca et al. (2010) in Luz (Minas Gerais State); Costa et al. (2006) in Uberaba (Minas Gerais State); Pantoja et al. (2009) in Fortaleza (Ceará State); and by Ferreira et al. (2008) in Ponta Porã (Mato Grosso do Sul State).

The most frequent species in this study was *Brachymyrmex* sp. (47%), corroborating the results found in the hospitals of the following municipalities: Maringá (Paraná State) (OLIVEIRA; CAMPOS-FARINHA, 2005); Chapecó, with two species of bacteria (LISE et al., 2006); Bagé (BICHO et al., 2007); Morrinhos (PESQUERO et al., 2008), Luz (FONSECA et al., 2010) and Palmas (BRAGANÇA; LIMA, 2010) and inside the residences in the municipality of Pelotas (Rio Grande do Sul State) (SILVA; LOECK, 1999). This species was not sampled in Sorocaba (ZARZUELA et al., 2002). According to Silva and Loeck (2006), this species nidifies inside holes among tiles, sockets, and cracks on the floor and walls.

The species *M. pharaonis* (pharaoh ant) was the second most frequent species found in the sampled hospitals (18.7%), and had been dispersed worldwide by humans (Americas, Europe, Oceania, and Southeastern Asia) (OLAYA-MASMELA et al., 2005; NA; LEE, 2001). The results obtained diverge from those presented by Bueno and Campos-Farinha (1999), Peçanha et al. (1999), and Zarzuela et al. (2002) in several municipalities of São Paulo State; Silva and Loeck (1999) in Pelotas, Rio Grande do Sul State; and Delabie et al. (1995) in Bahia State. However, it was considered as dominant by Fowler et al. (1993) in 15 hospitals of São Paulo State. *M. pharaonis* nests exclusively in holes and in home environment, and its importance as pathogenic microorganisms vector was proved by Eichler (1990) and Zarzuela et al. (2002), evidencing, therefore, a potential risk for the public health care, specially in hospitals. The main problems caused by *M. pharaonis*, according to Eichler (1990), are irritation, skin lesions that could evolve to infections due to the following microorganisms identified in this species: *Micrococcus pyogenes*, *Proteus vulgaris*, *E. coli*, *Alcaligenes fecalis*, *Salmonella*, *Pseudomonas aeruginosas*, *Clostridium*, and *Bordetella bronchi* (LISE et al., 2006). Its high frequency in the hospital studied may be attributed to the high dominance upon other species, and the rapid colony growth (BUENO; CAMPOS-FARINHA, 1999; CAMPOS-FARINHA et al., 2002) – being more difficult its control (CAMPOS-FARINHA et al., 1995).

Labidus coecus has shown a frequency around 17% in this study, being detected in residences and commercial establishments in Pinhalzinho, Santa Catarina State (FARNEDA et al., 2007), without the presence o pathogens; however, it can sting painfully (MALASPINA, 2002).

The genus *Paratrechina* (Motschulsky 1863) presents 177 species of ants, whose origin is still uncertain (Asia or Africa). This group has spread throughout the continents, and infested homes and hospitals. The species *P. fulva* and *P. longicornis* occur in the Americas, and are considered important pests

in urban environments (FOWLER et al., 1993; ZARZUELA et al., 2002) in the United States (KLOTZ et al., 1995), and in Malaysia (NA; LEE, 2001). They are considered in Brazil as native; meantime, information about its biology is still scarce (CAMPOS-FARINHA et al., 2002). Furthermore, this two species have ability to adapt to artificial environments created by human, and ability to migrate whenever necessary (SOLIS et al., 2007). *P. longicornis* is a very common species in hospitals (CAMPOS-FARINHA et al., 1995), detected in Brazil at hospitals of Minas Gerais State, carrying pathogenic microorganisms (COSTA et al., 2006). *P. fulva* presented frequency of 7% in this study, and the importance as pest is restricted to Southern Brazil (SILVA; LOECK, 2006).

T. melanocephalum presented low frequency in the hospital of Porto Alegre; however, studies carried out in Minas Gerais State evidenced that this species carries microorganisms (TEIXEIRA et al., 2009; COSTA et al., 2006), and is considered as pest of international importance in Colombia (OLAYA-MASMELA et al., 2005), in Spain (ESPALDER; ESPEJO, 2002), in the United States (KLOTZ et al., 1995), and in Malaysia (NA; LEE, 2001). Its biological characteristics contribute to the success in the occupation of hospitals and residences due to relatively small size (between 1.3 and 1.5 mm), difficult perception due to its colour, the colonies that present several queens, and due to a large number of workers, followed by its little organized nests that can be created in small places, such as behind tiles, underneath vases, just needing humidity to survive.

A. niger may act as mechanical vectors of eggs of *Ascaris lumbricoides* (VILLANI et al., 2008). Species of this genus were also sampled in Divinópolis, Minas Gerais State (SANTOS et al., 2009) and Palmas, Tocantins State (BRAGANÇA; LIMA, 2010).

Despite the low frequency in the hospitals of Porto Alegre, some species of *Camponotus* infest linings, frames of window and door and even electronic devices (CAMPOS-FARINHA et al., 2002). For Bueno and Fowler (1998), the occurrence in the inner areas indicates structural deficiencies of the hospital, which favour the nidification of this species. The surveys carried out in Brazil point the low occurrence of ants of this genus, more in hospitals as carriers of pathogenic bacteria, acting as a mechanical vector (ZARZUELA et al., 2002, LISE et al., 2006; BICHO et al., 2007; SANTOS et al., 2009). Furthermore, the presence of endosymbionts – cysts of *Escherichia coli* – was evidenced in the species *C. rufipes* (VILLANI et al., 2008).

The occurrence of *Pheidole* is quite low; however, it was present at neonatal care units. It is distributed in 35 countries of the New World, but the number of species as well as the relative percentage of the species varies considerably. The Brazilian fauna of *Pheidole* represents 24.3% (152 species) of its total diversity, followed by Mexico presenting 18.6% (116 species), Costa Rica presenting 18.1% (113 species), Colombia with 15.2% (95 species), Peru showing 12.5% (78 species), and the United States presenting 12.2% (76 species) (ZARA; FOWLER, 2005). The species of this genus nidify in walls and tiles, taking advantage on the structural failures of the buildings (SILVA; LOECK, 2006). The *Pheidole* species have been sampled in hospitals from several Brazilian states, as Rio de Janeiro (GAZETA et al., 2007), Goiás (PESQUERO et al., 2008), Minas Gerais (SANTOS et al., 2009, FONSECA et al., 2010; COSTA et al., 2006), Santa Catarina (LISE et al., 2006), and Rio Grande do Sul (BICHO et al., 2007), Mato Grosso do Sul (FERREIRA et al., 2008), and Ceará (PANTOJA et al., 2009).

Some species presented substantially low frequency. The species of *Gnamptogenys* was also found in residences in the urban area of Xanxerê, Santa Catarina State (IOP et al., 2009). This genus comprises 102 species distributed in the Neotropical Region, Southern Nearctic, from India until Fiji (BROWN JR., 2000), but no report was found regarding its presence in hospitals – considered the sampling of only two specimens as accidental. Species of *Pachycondyla* occurred in neonatal ICU and represents a great concern for the public health care of the United States (NELDER et al., 2006); it is comprised of 150 species distributed in tropical regions and some temperate and hot regions. As regard to *Hypoponera*, it was detected at the hospital surroundings in Goiás State (PESQUERO et al., 2008).

The general index of occurrence ranged from 20.0 to 100.0%; the hospital 2 (H2) presented the highest level, and the H1, the lowest. In all hospitals, the nutrition sector presented ants. Only in the H2 we verified the occurrence of ants in the neonatal ICU; furthermore, this hospital presented 11 of the 19 species sampled (Table 2).

Ants sampled at the nutrition sector of the five hospitals of Porto Alegre reveal a worrying scenario, since the possibility of food contamination are considerably high, emphasizing that the nutrition sector is responsible for the diets of all patients. Their presence reinforces the idea that they could be in contact with human material (faeces, urine and sputum) and could take the microorganism until the

food, or deposit them on the surface of utensils, contributing to put the patients under risk of contamination (LESER et al., 2000). The Brazilian legislation has been improved to guarantee the food safety and consider the mechanical vector as animals that convey infectious agents from reservoirs until the potential hosts, acting as carriers of such agents, which take contaminants to the foods, worsening the human health (ANVISA 2010).

Table 2. Distribution of ant species in five sectors from five hospitals of Porto Alegre, Rio Grande do Sul State, Brazil, from May 2007 to April 2008. Where: P = pantry; H 1-5 = Hospitals; N= Nutrition sector; NS = Nursing stations; aICU = Adult Intensive Care Unit; and nICU = Neonatal Intensive Care Unit.

	H1		H2				H3			H4	H5	
Species	N	P	N	NS	aICU	nICU	P	N	NS	P	N	N	aICU
Acromyrmex niger		X	X					X					
Brachymyrmex sp.								X	X		X		
amponotus sp.1					X								
Camponotus sp.2					X								
Camponotus rufipes			X										
Camponotus sericeirenthis												X	
Gnamptogenys sp.												X	
Hypoponera sp.				X									
Labidus coecus		X	X										
Monomorium pharaonis								X	X		X		
Pachycondyla sp.			X			X							
Paratrechina longicornis	X												
Paratrechina fulva		X	X										
Pheidole sp.1			X			X						X	
Pheidole sp.2		X											
Pheidole sp.3								X				X	
Pheidole sp.4			X										
Pheidole sp.5											X		
Tapinoma melanocephalum													X
General Index of Occurrence (%)	20		100				40			20	40		

The hospitals 3 and 5 presented an occurrence index of 40%, being the hospital 5 the only one with ants at the adult intensive care unit. The study pointed that the pathogens carried by ants found at the ICU presented resistance to several antimicrobials (BELLEI et al., 2006).

With regard to the hospitals 1 and 4, they presented an occurrence index of 20%; the hospital 4 housed two species of ants at the nutrition sector; the hospital 1, despite showing the highest occurrence index, presented only one species, *P. longicornis*, at the nutrition sector, evidencing that even a hospital with extra capacity can maintain under control the ant population densities.

Concerning the control of hospital infections, all measures to ensure its safety must be questioned, and the Committee of Hospital Infection Control (CHIC) must warn the professionals about the care required when preparing the medication in counters and when using glucosed serum that presents strong attractiveness, which requires special care avoiding residuals on the floor and in the garbage. Such insects may occupy clean sites; however, the presence of garbage and residuals facilitate its proliferation (TANAKA et al., 2007).

Studies also demonstrate that the pathogenic bacteria are present in hospital environments and on the body surface of ants, which carries several bacterial species – Gram-positive, Gram-negative – whose strains can be multiresistant to antimicrobials (CINTRA-SOCOLOWSKI, 2007; TANAKA et al., 2007; LISE et al., 2006).

Among the factors that influence the presence of ants in hospitals, the architectonic structure, the proximity to the residences, the packaging of some medicines that could bring some nests into the hospital, the circulation of a large number of people with clothes and belongings that can shelter ant nests, besides foods that act as extra attraction, promoting the occurrence of ants in the hospitals (ZARZUELA et al., 2002; MOREIRA et al., 2005).

Based on the results found in the examined hospitals, is evident the relevance of the problem in the public health care, in special, in the Hospital Infection Control. We believe that the knowledge about the biological aspects, ecology and habits of ants can contribute for decreasing the problem caused by the ants in the hospitals. The presence of ants in this environment must be considered as an alert to the CHIC and the entire multiprofessional team of the hospital, in order to optimize the control against hospital infections and to develop basic preventive measures, such as washing hands and clearance of the work environments, and ant control. However, before all these improvements, the awareness regarding this subject must be on the first plan.

Conclusion

The ant control can be done by prohibiting the entrance of food and flowers in the hospitals, covering little gaps on the wall, removing branches that are near the windows and walls of the hospital, removing the rubbish around the outer areas, since several factors contribute to the occurrence of ants in the hospitals, as the poor structure of the buildings, the large amount of people that circulates in the building everyday (patients, families, relatives, employees and suppliers) favouring the entrance of insects, and the medications that acts as attractive to these insects.

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