



Medical and Veterinary Entomology

The ant fauna of hospitals: advancements in public health and research priorities in Brazil

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ABSTRACT

Ants inhabit several types of natural and urban habitats, where they successfully nest. In urban environments, the hospitals should be considered priority for studies, as ants pose risks to human health due to their pathogen carrying potential. We aimed at surveying the literature about studies on ants in hospital settings in Brazil in the past 20 years. We found 40 papers in 22 journals, the first one published in 1993. Among them, 26 papers assessed pathogenic microorganisms on ants. We recorded 59 ant species, being *Tapinoma melanocephalum* the most common. The Minas Gerais and São Paulo states had the largest number of published papers. Mato Grosso do Sul and Rio Grande do Sul showed the highest number of species. Exotic ant species were recorded in all states, except Goiás. Considering the potential to carry microorganisms and the importance of thorough studies on the ecology of ant species, our results can support and guide further research in Brazil.

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Introduction

The Family Formicidae is considered highly diverse and is among the most successful insect groups. Its members occur in almost all terrestrial environments (Wilson, 1987). Ants have varied diets, from predators to highly specialized species, and most build nests that vary from simple and small to complex and large (Hölldobler and Wilson, 1990; Longino and Hanson, 1995).

Ants raise the interest of scientists who study their ecological importance in ecosystems, because they play roles in nutrient cycling, soil aeration, pollination, seed dispersal, and food webs, as they make several trophic interactions (Del-Claro, 2012; Hölldobler and Wilson, 1990; Melo et al., 2012). In addition, some species have high economical importance, because of the damages they cause to crops, or because they harm humans (Della Lucia, 2003; Rust and Su, 2012). Ants of the genus *Solenopsis* Westwood, for example, can cause serious accidents with stings and bites, as their colonies are very populous (Drees et al., 2012) and easily found in Brazil (Zeringóta et al., 2014).

The ants known as tramp species live in close association with humans and are distributed all over the world, in particular in ur-

ban areas (Passera, 1994; Passera and Aron, 2005). Some species cause nuisance in several sites, such as households, schools, and gardens, and cause severe loss to food factories, restaurants, offices, and museums (Fowler and Bueno, 1998). Ant studies in hospitals have been raising great interest since the first reports made in England (Beatson, 1972) and Germany (Eicheler, 1990), due to the capacity of ants to carry pathogenic microorganisms (Bueno and Campos-Farinha, 1999), responsible for nosocomial infections. In Brazil, studies on ants in hospitals started recently in the 1990s (Fowler et al., 1993; Bueno and Fowler, 1994; Fowler et al., 1995b). Since then, the focus of these studies has been the ability of ants to explore hospital settings, and their association with bacteria and fungi.

Ant control in a hospital setting requires the use of specialized technologies, due to the particularities of ant foraging and nesting, as well as a need for constant monitoring. As a result, the conventional control form has temporary effects in most cases, because they eliminate only part of the colony. An efficient control method should be based on the complete elimination of the colony. Among current strategies, toxic baits stand out because the insecticide is incorporated in the feeding cycle of the colony (Bueno and Campos-Farinha, 1999; Bueno and Bueno, 2007). Therefore, studies on ant biology, behavior, and ecology in hospital settings are crucial to support efficient control methods.

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Hence, the objective of the present inventory was to survey the literature about ants in hospital settings in Brazil in the past 20 years. We aimed at advancing the knowledge of this issue through a discussion on research advancements and priorities.

Material and methods

We adapted the protocol proposed by Garcia and Lise (2013), who conducted a review on the association between ants and pathogenic microorganisms in hospitals in southern and southeastern Brazil. We carried out a systematic review, which allowed us to compile the current knowledge and tell apart information that is scientific from information that does not have solid support and requires further evidence.

The criteria for selection and inclusion of papers were: (i) papers that addressed the topic; (ii) papers indexed in the databases LILACS (Latin American Literature in Health Sciences), MEDLINE (Medical Literature Analysis and Retrieval System Online), and SciELO (Scientific Electronic Library Online), and (iii) papers published in journals within the defined time frame (from 1993 to 2014). The keywords used to search the databases were *ants* and *hospital*.

We recovered the following information from papers: focus of the study, site, duration, sampling methods, and number of ant species identified. Based on this information we made a map of the distribution of publications and properly identified ant species by state, and a table of ant species and collection methods used to sample them.

Results and discussion

We found 40 papers published in scientific journals, all resulting from empirical studies. The first paper on ants in a hospital setting in Brazil dates back to 1993 (Fowler et al., 1993), followed by another paper in 1995 (Fowler et al., 1995b). Then, there was a gap in publications until 2002, when a third paper was published. Since 2004, publication on the subject became more regular. The most productive years were 2009 and 2013, each with five papers published (Fig. 1; Table 1).

Most papers ($n = 22$; 55%) were published in the last six years (from 2009 to 2014) (Fig. 1). This concentration probably results from other research groups that recently started working on the topic in Brazil. We also observed that most publications ($n = 32$; 80%) identified the ant species collected, whereas only eight papers (20%) did not (Table 1).

The analysis of publication distribution in Brazil revealed an evident lack of papers on ants in hospital settings in the northern and northeastern regions, where for most states no papers in indexed journals have been published, or for which unpublished final course works, dissertations and theses have been produced. The states of São Paulo ($n = 10$) and Minas Gerais ($n = 8$) showed the highest number of papers (Fig. 2). These states belong to the core of science in Brazil, as they have most universities and research institutes, which played a vital role in starting the first studies and forming new research groups, which later spread the topic to other states.

We found papers in 22 journals, and the most frequent were: Neotropical Entomology ($n = 6$), Arquivos do Instituto Biológico ($n = 5$), and Revista da Sociedade Brasileira de Medicina Tropical ($n = 5$) (Table 1). The papers that investigated ant diversity were usually published in journals of Zoology and Entomology, such as Insect Science and its Application, Neotropical Entomology, and Sociobiology.

The articles that analyzed the association between ants and microorganisms were published in medical journals, such as Journal of Hospital Infection, Revista da Sociedade Brasileira de Medicina Tropical, and Revista de Patologia Tropical. However, we observed that some papers that focused on ant occurrences (Garcia et al., 2011; Gazeta et al., 2007; Fonseca et al., 2010) were also published in journals that traditionally publish studies in Human Health instead of Entomology, which shows the relevance of the topic for health. This phenomenon was reflected in the emphasis that the media (newspapers, magazines, and television programs) gave to this type of information (Bueno and Campos-Farinha, 1998; Fowler et al., 1995a; Garcia et al., 2011).

Most of the analyzed studies ($n = 26$) assessed the association between ants and pathogenic microorganisms, such as bacteria ($n = 16$; 61.5%), fungi ($n = 3$; 11.5%), and bacteria/fungi ($n = 7$; 27%) (Fig. 3). The pioneer study by Fowler et al. in 1993 already highlighted the concern about transmission of bacteria by ants in hospital settings, and since then most studies have assessed this topic. On the other hand, transmission of fungi by ants has been assessed only since 2005, with the publication of the study by Silva et al. (2005).

It is important to highlight that 14 studies (Bicho et al., 2007; Bragança and Lima, 2010; Carvalho et al., 2011; Cintra-Socowloski et al., 2014; Ferreira et al., 2008; Fonseca et al., 2010; Fowler et al., 1995b; Garcia et al., 2011; Gazeta et al., 2007; Pelli et al., 2013; Santos et al., 2002; Santos et al., 2009b; Zarzuela et al., 2002;) did not make microbiological assessments of ants in hospitals, but used an ecological-systematic approach to the species present in this kind

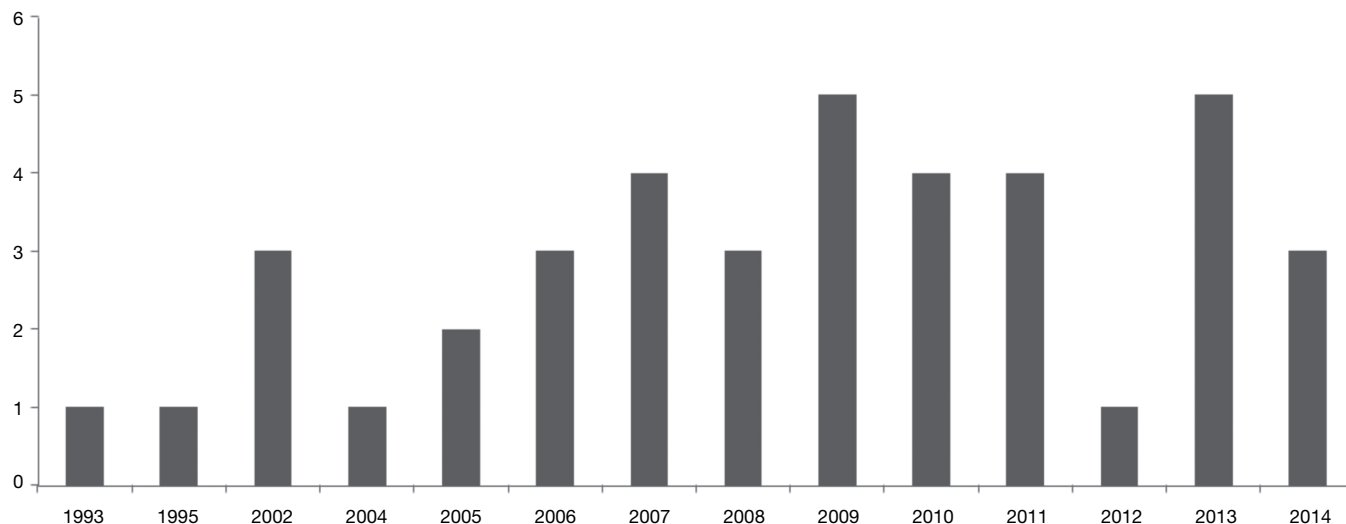


Figure 1. Number of papers on ants in hospital settings in Brazil published per year in national and international journals from 1993 to 2014.

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