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Full Length Research Paper

Parasites in synanthropic rodents in municipality of the Northwest region of the State of Paraná, Brazil

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The aim of this study was to identify the presence of different parasites in synanthropic rodents captured in the urban and peri-urban area in the city of Umuarama, Paraná (PR). The rodents were euthanized for measurement and collection of feces and ectoparasites. Specific identification keys were used for the ectoparasitological analysis and the technique by Hoffman et al. (1934) was used for the coproparasitological analysis. From the 162 rodents captured, 24.70% were found in the urban area and 75.30% in the periurban area in the city. The rodents belonged to the species *Rattus rattus* (96.91%) and *Rattus norvegicus* (3.09%), being 52.47% male and 47.53% female. 62.96% analyzed feces samples contained at least one parasite species. Identified parasites species were *Syphacia* sp., *Aspiculuris* sp., *Strongyloides* sp., *Hymenolepis diminuta* and *Entamoeba* sp. and protozoa eggs. Upon visual inspection, a total of three (1.85%) ectoparasites identified as *Xenopsylla cheopis* were collected. The importance of synanthropic rodents on the maintenance and possible transmission of different parasitic etiological agents with zoonotic potential was demonstrated, making both man and pets susceptible to possible parasitic infections.

Key words: Diagnosis, ectoparasites, enteroparasites, feces, rats.

INTRODUCTION

Rodents belong to the Rodentia order and there are approximately 2,000 rodent species in the world and they live in any terrestrial environment that can provide conditions for their survival (Brasil, 2002) and some species are considered synanthropic to man because they change their environments by their actions (Brasil, 2002; Guimarães et al., 2014).

Among the synanthropic species, the most important ones are the brown rat (*Rattus norvegicus*), the black rat (*Rattus rattus*) and the house mouse (*Mus musculus*)

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which can be found in the urban, peri-urban and rural areas of the cities. Factors such as urbanization and overcrowded cities and inadequate sanitation (water and sewer), have led to increasing numbers of these animals and consequently becoming increasingly common transmitted diseases (Brasil, 2002).

In addition to the diseases brought about by the transmission of different parasitosis, for which the rodents are reservoirs of different etiological agents (Jittapalapong et al., 2011; Ivanova et al., 2012; Sharma et al., 2013), these animals are also responsible for economic losses due to the treatment of different diseases (Guimarães et al., 2014).

Research on the presence of parasites in synanthropic rodents has been done in different countries like Korea, Iran, Spain, Switzerland, Mexico and Poland (Reperante et al., 2009; Yi et al., 2010; Kia et al., 2010; Foronda et al., 2011; Paziewska, 2011; Jiménez et al., 2012; Mowlavi et al., 2013). In Brazil, studies have been done in the states of Paraná (PR) and Sergipe (SE) (Araujo et al., 2010; Guimarães et al., 2014). These studies have shown the importance of synanthropic rodents in the transmission of different parasitic diseases of zoonotic potential chain. Considering the absence of regional data and the importance of rodents as transmitters of parasitic agents with zoonotic potential, the aim of this paper was to identify the presence of different parasite species in synanthropic rodents captured in the urban and peri-urban area in the city of Umuarama, Paraná, Brazil.

MATERIALS AND METHOD

Study setting

The locations chosen for capturing the rodents were selected based on the presence of residues or garbage associated with the proximity to men. The animals used in this work were captured in locations situated in urban and peri-urban areas in the city of Umuarama, located in the northwestern region of the Paraná (PR) State. The determination of the number of samples was based on the number of animals captured during the period of one year (October, 2012 to October, 2013).

Capture of rodents

The capture of rodents was performed using nine galvanized wire traps (Tomahawk), measuring 30 x 14 x 14 cm and 45 x 22 x 22 cm (previously cleaned before each capture), where the triggering mechanism was activated by the presence of the animal in its interior when seeking the bait. The used baits were: raw sweet corn, banana, sausage, cheese and feed developed by the members of the project, using sardines, peanut, corn flour and banana. The traps were assembled in the evening in places presenting traces of rodents (feces, trails and fat stains) and collected the following morning (Araujo et al., 2010). After the capture, the rodents were transported to the Laboratory of Preventive Veterinary Medicine and Public Health at UNIPAR for later conduction of parasitological tests and ectoparasitária identification.

In order to obtain the epidemiological data, a form was filled out for each rodent, containing data related to the species, gender, size, presence of ectoparasites, type of bait used and presence of communicating animals in the capture site. The age of the animals was not possible to identify.

The capture and handling of animals was done following the principles established by National Council for Control of Animal Experimentation (CONCEA) and approved by the Ethics Committee in Animal Experimentation (CEPEEA) in Universidade Paranaense (UNIPAR), under protocol 21822/2012.

Euthanasia, identification and collection of biological samples

The rodents captured were immediately placed in a saturated chamber with halothane vapor for euthanasia (Araújo et al., 2010). Right after they were identified (Brasil, 2002), the following procedures were followed: measurement using conventional measuring tape, visual inspection for the collection of ectoparasites and collection of feces.

After the euthanasia and necropsy of animals, the intestine was exposed for proper collection of feces, which were stored in individual plastic pots containing formalin at 10%, stored at room temperature until the coproparasitological examination.

Laboratory techniques used

In order to identify the ectoparasites, the specimens captured were stored in plastic pots kept in 70% alcohol until they were processed. For identification purposes, they were assembled between blade and coverglass and after, diaphanized with 10% KOH, dehydrated in alcoholic series (100, 90, 85, 80 and 70 for 10 min each stage), and later clarified with xylol. The specific identification was performed with the aid of identification keys proposed by Linardi and Guimarães (2000) using Nikon optical microscope (Eclipse E-200) with a 10x increase.

For the enteroparasitic identification (visualization of eggs, protozoa cysts and helminth larvae), the sedimentation technique described by Hoffman et al. (1934) was performed. The blades were analyzed using a Nikon optical microscope (Eclipse E-200), with an increase of 40x. The microscopic blades were assessed in duplicates for all examinations performed.

Statistical analysis

After the tabulation of epizootiological data, the program Prisma 5.0 for Windows (GraphPad Software, San Diego, CA, USA) was used. In order to verify the association between the variables (gender and animal species) with the presence of enteroparasites, Fisher's Exact Test was used, adopting a 5% significance level and Confidence Interval at 95% (CI).

RESULTS

From the 162 feces samples analyzed, 62.96% (102/162) presented at least one type of parasite. Monoparasitism was detected in 71.57% (73/102) of positive samples.

Different gastrointestinal parasites and parasitic structures were detected: *Syphacia* sp. (54.32%), *Aspiculuris* sp. (0.62%), *Strongyloides* sp. (14.20%), *Hymenolepis diminuta* (1.23%) and *Entamoeba* sp. (10.50%) and protozoa eggs (2.47%) (Table 1).

Table 1. Parasites and parasitic structures detected by the sedimentation method described by Hoffman et al. (1934) in 102 feces of synanthropic rodents captured in the urban and peri-urban area in the city of Umuarama, Paraná, Brazil, 2012-2013.

Phylum	Species	Total	%
	Aspiculuris sp.	01	0.62
Nematode	*Strongyloide* sp.	23	14.20
	Syphacia sp.	88	54.32
Platyhelminthes	*Hymenolepis diminuta*	02	1.23
Rhizopoda	*Entamoeba* sp.	17	10.50
Protozoa	Protozoa eggs	04	2.47

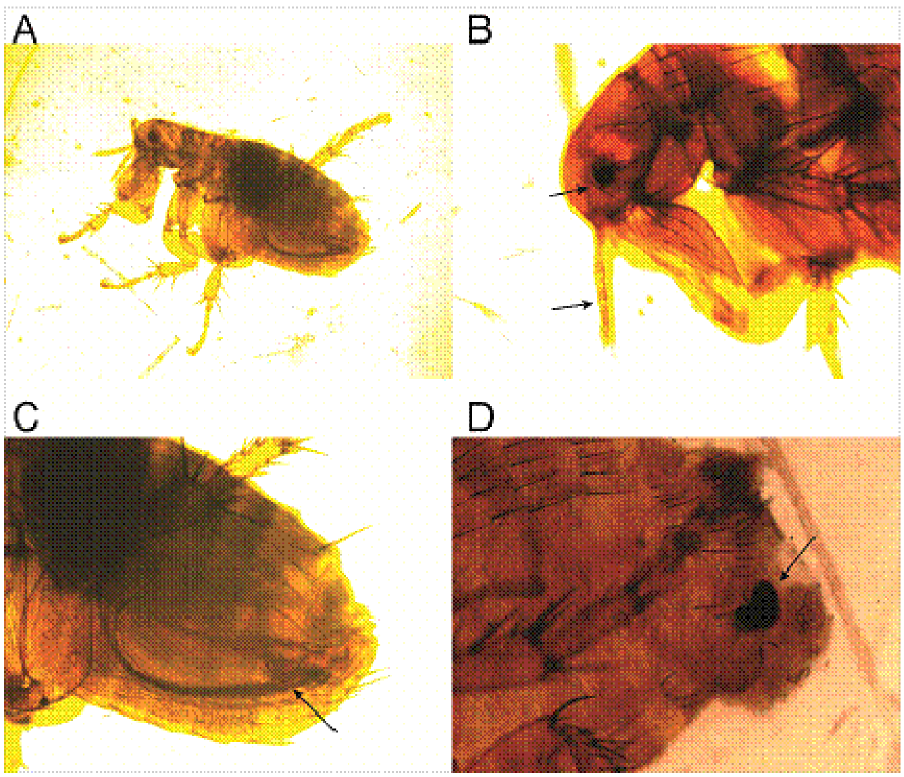

Figure 1. *Xenopsylla cheopis,* collected from *Rattus rattus* located in the peri-urban area in the city of Umuarama, Paraná, Brazil, 2012-2013. A) *Xenopsylla cheopis* - 10x increase; B) Presence of occiput with bristles forming a V shape and a pre-ocular bristle - 100x increase; C) Presence of genal bristle - 100x increase; D) Presence of spermatheca - 100x increase.

Upon visual inspection, we were able to collect only three (1.85% - 03/162) ectoparasites (two males, one female) that were identified as *Xenopsylla cheopis* species (Rothschild, 1903) (Figure 1).

Regarding the two variables analyzed, gender and animal species, there were no statistical difference when associated with the presence of enteroparasites (Table 2).

Regarding the presence of communicating animals in the place of capture of the rodents, in 9.26% there was the presence of birds *(Gallus gallus* and *Coturnix coturnix)* (15/162) and in 1.85% there was the presence of dogs (03/162).

The traps were set 89 times and there was a total of 32.58% (29/89) captures, with more than one animal captured per cage. The best bait used was the feed, with

Table 2. Variables associated with the presence of enteroparasites in 162 synanthropic rodents captured in the urban and peri-urban areas in the city of Umuarama, Paraná, Brazil, 2012-2013.

Variable	Positive sample (%)	p*	CI (95%)
Gender			
Male	59/162 (36.41)	0.2490	0.8-2.9
Female	46/162 (28.39)		
Species			
Rattus rattus	101/162 (62.34)	0.6575	0.04916-4.135
Rattus norvegicus	04/162 (2.46)		

p = Probability; *= Fisher's Exact Test; CI= confidence interval.

efficacy of 75.30% (122/162), followed by raw sweet corn, with 11.11% (18/162), cheese 7.41% (12/162), sausage 3.70% (09/162) and banana 0.62% (01/162).

Regarding the success of capture, traps were set 89 times and there was a total of 32.58% (29/89) captures, with more than one animal captured per cage.

DISCUSSION

The capture of 162 synanthropic rodents was performed throughout a year with possible catches in all months, which indicates that the locations where the traps were assembled provided favorable conditions (shelter, water and food) for the survival of this animal species.

Success in the capture of rodents shows an elevated infestation in the urban and peri-urban area in the city of Umuarama (PR), which can become an important public health problem, with possible transmission of different parasitic and infectious diseases with zoonotic potential (Jittapalapong et al., 2011; Ivanova et al., 2012; Sharma et al., 2013; Guimarães et al., 2014).

The most prevalent rodent species in the city of Umuarama (PR) is *Rattus rattus* and according to Brasil (2002), its action radius tends to be greater than the one for *Rattus norvegicus* (brown rat) due to its ability of scale vertical surfaces and the ease of walking on wires, cables and tree branches, which makes it a species that is more prone to capture. Also relating to public health, this action is of concern, since both direct exposure to the animal or indirect exposure to its waste (urine and feces) makes man and other animal species susceptible to different infectious-parasitic infections (Jittapalapong et al., 2011; Ivanova et al., 2012; Rohela et al., 2012; Sharma et al., 2013; Guimarães et al., 2014).

In the present paper, we observed polyparasitism, which was also documented by other studies (Seong et el., 1995; Franjola et el., 1995; Shintoku et al., 2005; Waugh et al., 2006; Sharma et al., 2013; Guimarães et al., 2014). This phenomenon is explained by the elevated physiological resistance of the animal in surviving a diverse parasitic load, which reflects on the capacity of these hosts in enduring the adversities of the invasion and developing a harmonious parasite-host relationship (Ribeiro et al., 2003; Claveria et al., 2005).

In this study, the conventional technique described by Hoffamm et al. (23) was used. This technique allows for the detection of eggs, protozoa cysts and helminth larvae; however, it is known that in rodents, the intestinal scraping technique (Kamiya, 2008) allows for the detection of other parasites such as protozoa, eggs, cysts, larva and adult helminths, with a better sensitivity (Hofer et al., 2000), which could possibly have influence on the results of this paper in the detection of other parasites.

Rodents present a growing importance in the transmission of different diseases to man (Guimarães et al., 2014), and can transmit parasitic diseases which have zoonotic potential, such as toxoplasmosis, hymenolepiasis, amoebiasis, strongyloidiasis, among others (Araujo, 2009; Araujo et al., 2010; Becker et al., 2011; Guimarães et al., 2014; Zanet et al., 2014); and in this paper, the presence of *Aspiculuris* sp., *Hymenolepis diminuta*, *Entamoeba* sp., *Strongyloide* sp., *Syphacia* sp. and protozoa eggs were detected in the feces samples analyzed. The different prevalences related to each parasite species detected in this work as compared to different research can reflect the environmental conditions, study location, time of the year, presence of hosts and animal reservoirs, and mainly the individual aspects of each parasite in each study region, enabling greater or smaller probabilities of a parasitic infection happening. Regarding the ectoparasites identified as *Xenopsylla cheopis* (Rothschild, 1903), it is possible to state that this is the first report of this Siphonaptera in rodents in the northwestern region in the state of Paraná (PR). This ectoparasite, common in rodents, has also been reported by Linardi et al. (1985) in Belo Horizonte (MG), where the authors identified 1,274 specimens collected from *Rattus norvegicus,* and in a more recent study by Ribeiro et al. (2003) in the city of Capão do Leão (RS), which identified 24 specimens, all collected from

Rattus rattus; results are similar to the one found in the city of Umuarama (PR). The importance of identifying this ectoparasite species is due to the possibility for transmitting *Yersinia pestis, Rickettsia typhi and Bartonella* spp. which are respectively the etiological agents for Bubonic Plague, Murine Typhus and Bartonellosis, which are zoonotic diseases of rodents (Ribeiro et al., 2003; Billeter et al., 2011). It must also be considered that *Xenopsylla cheopis,* which is adapted to the urban environment and to men, can parasite not only rodents but also other animal species, with its parasitism already described in foxes (*Cerdocyon thous)* (LINNAEUS, 1789) (Cerqueira et al., 2000; Ribeiro et al., 2003).

Considering further works with rodents, two epizootio-logical factors in this paper are worthy of emphasis. The first one is the type of bait used for the captures, since the feed developed by the members of this project was proven more efficient as compared to other foods (raw sweet corn, cheese, sausage and banana) used during the capture period. This shows how selective the rodents are, and in areas with plenty of food, the bait has to be very attractive in order to be successful. The second one is the presence of communicating animals, since both birds and dogs are considered important reservoirs for parasitic diseases when exposed to rodent waste and thus become trans-mitters of different parasitic diseases to men and other animals (Araújo et al., 2010; Jittapalapong et al., 2011; Rohela et al., 2012; Costa et al., 2010; Ferreira et al., 2013).

The results of this paper show the importance of synanthropic rodents on the maintenance and possible transmission of different parasitic etiological agents with zoonotic potential, making both man and pets susceptible to possible parasitic infections. Moreover, further copro-parasitological studies should be done on dwellers and students from the same locations as the capture of rodents would be essential to establish the relation of public health with the parasitosis detected in these rodents. Molecular studies on the ectoparasites collected would be critical for detecting possible etiological agents and consequently establish a possible zoonotic infection.

Conflict of Interests

The author(s) have not declared any conflict of interests.

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