Research Note

Occurrence of gastrointestinal helminths in commensal rodents from Tabasco, Mexico

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Article info

Summary

The aim of this study was to determine the prevalence and species composition of helminths in commensal rodents captured inside private residences in the city of Villahermosa in Tabasco, Mexico. Trapping was performed at each house for three consecutive nights from October to December 2015. Fifty commensal rodents were captured: 23 *Rattus norvegicus*, 16 *Mus musculus* and 11 *Rattus rattus*. Rodents were transported alive to the laboratory and held in cages until they defecated. Feces were analyzed for helminth eggs using the Sheather's flotation technique. The overall prevalence of helminths in rodents was 60 %: *R. norvegicus* was more likely to be parasitized (87.0 %) than *R. rattus* (63.6 %) and *M. musculus* (18.8 %). Eggs from at least 13 species of helminths were identified: *Hymenolepis diminuta*, *Rodentolepis nana, Moniliformis moniliformis, Heligmosomoides polygyrus*, *Heterakis spumosa*, *Mastophorus muris*, *Nippostrongylus brasiliensis*, *Strongyloides ratti*, *Syphacia obvelata*, *Syphacia muris*, *Toxocara* sp., *Trichosomoides crassicauda*, and *Trichuris muris*. This is the first study to report the presence of *H. polygyrus*, *S. ratti* and *T. crassicauda* in commensal rodents in Mexico. In conclusion, our results suggest that helminths commonly infect commensal rodents in Villahermosa and therefore rodents present a health risk to inhabitants in this region.
Keywords: Helminths; *Mus musculus*; *Rattus rattus; Rattus norvegicus*; Tabasco; Mexico

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Introduction

Commensal rodent species that are most commonly found in close proximity to humans are *Rattus norvegicus*, *Rattus rattus*, and *Mus musculus* (Battersby *et al.*, 2008). These species are a nuisance on poultry farms and in urban and rural households in Mexico (Villa *et al.*, 1997; Panti-May *et al.*, 2015), and often cause economic damage to stored food (Pimentel *et al.*, 2005). In relation to public health, commensal rodents represent an important public health risk because they harbour many zoonotic pathogens such as viruses, bacteria, protozoa, and helminths (Meerburg *et al.*, 2009). Several studies have investigated the prevalence and species composition of intestinal parasites in rodents in different parts of the world, revealing the occurrence a diverse range of helminths and other parasites (de León, 1964; Waugh *et al.*, 2006; Hancke *et al.*, 2011; De Sotomayor *et al.*, 2015; Panti-May *et al.*, 2015). Zoonotic helminths often associated with commensal rodents include *Hymenolepis diminuta*, *Rodentolepis* (= *Hymenolepis*) *nana*, and *Moniliformis moniliformis* (de León, 1964; Waugh *et al.*, 2006; Hancke *et al.*, 2011). In Jamaica, Waugh *et al.* (2006) found nine species of helminths in commensal rats, including *M. moniliformis* and *H. diminuta*. In Puerto Rico, de León (1964) reported ten species of helminths, which included the zoonotic species *Callodium hepaticum*, *H. diminuta*, and *M. moniliformis*. Zoonotic helminths can cause many symptoms in humans, including weakness, pruritus, headaches, anorexia, abdominal pain, and diarrhea (Sale-

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habadi *et al.*, 2008,). It is therefore important that commensal rodents are monitored for the presence of gastrointestinal helminths so that effective control and prevention strategies for the mitigation of the parasitic diseases can be implemented.

Despite the medical importance of some species of helminths, few surveys have examined the intestinal helminths carried by commensal rodents in Mexico. In a study performed in a rural locality in Yucatan State, southeastern Mexico, four species of helminths (*Nipponstrongylus brasiliensis*, *Syphacia muris*, *Trichuris muris*, and *Taenia taeniaeformis*) were identified in *R. rattus* and *M. musculus* (Panti-May *et al.*, 2015). In a human investigation performed in Tabasco State, six species of intestinal helminths were identified in children: *Necator americanus*, *Ascaris lumbricoides*, *Trichuris trichiura*, *Strongyloides stercoralis*, *R. nana* and *H. diminuta* (Dewey, 1983). However, no studies have been performed to identify the helminths carried by commensal rodents in Tabasco State. The aim of this study was to identify the helminth species associated with commensal rodent species trapped inside houses in the city of Villahermosa in Tabasco State, Mexico.

Materials and Methods

Study area and rodent sampling

The study was carried out in the city of Villahermosa (17° 99' N and 92° 95' W) in Tabasco State, Mexico. Villahermosa is the largest city in the state of Tabasco; it is 92 km^2 in area and has a population of approximately 650,000. The average annual temperature is 26 °C and rain falls year-round (based on data from Instituto Nacional de Estadistica y Geografia. Available from: http://www.inegi.org.mx, last accessed July 2016). Villahermosa has an average elevation of 10 m, is surrounded by the Grijalva and Usumacinta rivers and contains five large lagoons within the city. Flooding occurs frequently and many inhabitants that live in poor conditions are located on the margins of the rivers and lagoons.

Trapping was performed from October to December 2015 inside 20 houses following the methodology described by (Panti-May *et al.*, 2015). The houses were located near public areas such as meat and fruit markets. Sampling was performed at each site for three consecutive nights. Rodents were trapped using Sherman traps (8 x 9x 23 cm, H. B. Sherman Traps Inc., Tallahassee, Florida, USA) and Tomahawk traps (Tomahawk Live Trap 66 x 23 x 23 cm, Hazelhurst, Wisconsin, USA) baited with sunflower seeds and/or a mixture of oats and vanilla. Two Tomahawk traps and four Sherman traps were used at each house and were located in bedrooms, kitchens, and food stores. The majority of houses are small with solid floors, ceilings and walls. Most houses have a small backyard, potable water and electricity, and windows protected by mosquito screen.

Collection and examination of feces

Trapped rodents were transported alive to the Tropical and Vector-borne Diseases Laboratory at Autonomous University Juarez

of Tabasco. Rodents were housed inside metal cages and provided with water and seeds *ad libitum* until defecation. Feces were collected, and rodents were euthanized by CO_2 inhalation. Helminth eggs were identified using the Sheather's sugar flotation technique, as previously described by Dryden *et al.* (2005). Briefly, droppings were macerated using a mortar and pestle, then 2 to 5 g of each sample was mixed with 10 ml of Sheather's sucrose solution (specific gravity of 1.27 to 1.33). Samples were mixed thoroughly to disrupt aggregates and centrifuged at 1,000 *g* for 5 minutes allowing eggs to float. A drop (~10 μl) of each preparation was placed on a glass slide and eggs were visualized by light microscopy and identified according to morphological characteristics (Sirois, 2014). Fecal samples were evaluated in triplicate and stained with lugol solution for microscopy analysis. A sample was considered positive if at least one helminth egg was observed.

Statistical analysis

The prevalence and confidence intervals of infection were calculated according to Bush *et al.* (1997) using Quantitative Parasitology 3.0 (Rózsa *et al.*, 2000). The association between prevalence of infection and commensal rodent species was compared using a Chi-square test of independence and using IBM SPSS statistics version 22 software for windows (IBM Corporation, Armonk, NY). When more than 25 % of cells had expected counts fewer than five, Fisher's exact test was used. Results were considered significant when $P < 0.05$.

Results and Discussion

Fifty commensal rodents were captured: 23 *Rattus norvegicus* (46 %), 16 *Mus musculus* (32 %) and 11 *Rattus rattus* (22 %). Helminth eggs were detected in the feces of 30 (60%) rodents (95 % confidence interval (CI): 45.2 – 73.6 %). The prevalence of helminth infection varied between rodent species and was 87.0 % (95 % CI: 66.4 – 97.2 %) for *R. norvegicus*, 63.6% (95 % CI: 30.8 – 89.1%) for *R. rattus*, and 18.8 % (95 % CI: 4.0 – 45.6 %) for *M. musculus*. *Mus musculus* had a significantly lower prevalence of helminth infection compared to *R. rattus* (Fisher's exact test P= 0.04) and *R. norvegicus* (χ^2= 18.14, d. f. = 1 P= 0. 00). Helminth eggs of 12 genera and at least 13 species were identified: *Heligmosomoides polygyrus*, *Heterakis spumosa*, *Hymenolepis diminuta*, *Mastophorus muris*, *Moniliformis monoliformis, Nippostrongylus brasiliensis*, *Rodentolepis nana*, *Strongyloides ratti*, *Syphacia muris*, *Syphacia obvelata*, *Toxocara* sp., *Trichosomoides crassicauda*, and *Trichuris muris*. The prevalence of helminths in each rodent species is shown in Table 1. Of 30 infected rodents, 24 (80.0 %) contained more than one species of helminth.

As already noted, *R. norvegicus* was the most common rodent species collected in this study. *Rattus norvegicus* also displayed the highest infection rate (87 %) and harbored more helminth species (12) than the other rodent species. *Rattus norvegicus* is typically more aggressive species than *R. rattus;* the latter species

Table 1. Prevalence (P) of helminth eggs recovered from *Rattus norvegicus* (n = 23), *Mus musculus* (n = 16) and *Rattus rattus* (n = 11) from Villahermosa, Tabasco, Mexico.

Helminth species	*Rattus norvegicus*		*Mus musculus*		*Rattus rattus*	
	P%	95 % CI	P%	95 % CI	P%	95 % CI
Cestoda						
[b]*Hymenolepis diminuta*	13.0	2.8 – 33.6	–	–	–	–
[b]*Rodentolepis nana*	30.4	13.2 – 52.9	–	–	9.1	0.2–41.3
Nematoda						
[a]*Heligmosomoides polygyrus*	56.5	34.5 – 76.8	–	–	36.4	10.9–69.2
Heterakis spumosa	13.0	2.8 – 33.6	–	–	–	–
Mastophorus muris	17.4	4.9 – 38.8	–	–	–	–
Nippostrongylus brasiliensis	34.8	16.4 – 57.3	6.3	0.1 – 30.2	18.2	2.3 – 51.8
[a]*Strongyloides ratti*	65.2	42.7 – 83.6	12.5	1.5 – 38.3	45.5	16.7 – 76.6
Syphacia obvelata	4.4	0.1 – 21.9	6.3	0.1 – 30.2	–	–
Syphacia muris	–	–	–	–	27.3	6.0 – 60.9
Toxocara sp.	4.4	0.1 – 21.9	–	–	–	–
[a]*Trichosomoides crassicauda*	8.7	1.1 – 28.0	–	–	–	–
Trichuris muris	13.0	2.8 – 33.6	6.3	0.1 – 30.2	–	–
Acanthocephala						
[b]*Moniliformis moniliformis*	8.7	1.1 – 28-0	–	–	–	–

[a]New records in rodents in Mexico.
[b]Species of helminths with zoonotic potential
CI, confidence interval

is arboreal and prefers areas with trees (Battersby *et al.*, 2008). The high prevalence of infection of *R. norvegicus* could influence the spread and distribution of parasites, as the number of hosts available for infective parasite stages (usually present in the soil) is known to determine the helminth infection rate (Krasnov *et al.*, 2006).

To the best of our knowledge, 10 of the 13 helminths species identified in our study have not been previously reported in Villahermosa, and are as follows: *T. muris, N. brasiliensis, H. polygyrus, S. ratti, S. muris, S. obvelata, H. spumosa, M. moniliformis, T. crassicauda* and *M. muris.* Furthermore, three of the aforementioned species (*H. polygyrus, S. ratti* and *T. crassicauda*) have never before been reported in Mexico. *Heligmosomoides polygyrus* and *S. ratti* are two of the most commonly used parasites in laboratory experiments (Paterson & Barber, 2007; Reynolds *et al.*, 2012). *Trichosomoides crassicauda* is specific for the urinary bladder of rats and its occurrence indicates that the feces were contaminated with urine.

The high number of gastrointestinal helminth species found in this study is consistent with that reported in the State of Hidalgo, Mexico where 13 species were also identified (Pulido-Flores *et al.*, 2005). A lower species diversity was reported in the States of Yucatan and Michoacan where four and five species, respectively were identified (Tay Zavala *et al.*, 1999; Panti-May et al., 2015). We detected 12 helminth species in the feces of *R. norvegicus* which is considerably greater than that found in *R. rattus* (5) and *M. musculus* (4). However, these findings could likely be because a higher number of *R. norvegicus* were trapped compared to the two other species. The number of helminth species detected in

R. rattus and *M. musculus* in our study was similar to that reported in other studies performed in Mexico. For instance, in Hidalgo State, *M. musculus* and *R. rattus* harbored five and three helminth species, respectively (Pulido-Flores *et al.,* 2005). In Yucatan State three helminth species were identified in each rodent species (Panti-May *et al.,* 2015). In a study performed in Michoacan, western Mexico, *R. norvegicu*s were shown to be infected with *Trichinella spiralis*, *H. diminuta*, *Sarcocystis lindemani* and *M. dubius* (Tay-Zavala *et al*., 1999).

In the present study, we identified eggs of three zoonotic helminths: *H. diminuta*, *R. nana,* and *M. moniliformis*. Although in Mexico there are no records of human infection with *M. moniliformis*, this helminth has been associated with human infections in Florida, USA (Neafie & Marty, 1993). The detection of *R. nana* and *H. diminuta* in *R. norvegicus*, in Villahermosa is significant because both pathogens were previously identified in stools of children in Mexico (Quihui *et al.*, 2006; Martínez-Barbabosa *et al*., 2010, 2012). Although those studies do not identify the source of infections in children, exposure is likely to occur as a result of accidental ingestion of infected intermediate hosts (e.g. beetles) or by direct ingestion of *R. nana* eggs (Baker, 2007).

We recognize several limitations of this study, most notably the small sample size and the inability to estimate the intensity of infection with the flotation technique. However, our preliminary results increase our understanding of gastrointestinal parasite carried by rodents in Mexico. Furthermore, our work highlights the public health risk posed by rodent populations to humans in Villahermosa. Nevertheless, it is advisable that further parasitological studies are performed in Villahermosa. Future studies should include the

collection of adult helminths and involve a larger number of study sites, a larger rodent sample population and year-round trapping.

Acknowledgments

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