Short Communication

Braz. J. Vet. Parasitol., Jaboticabal, v. 26, n. 4, p. 521-524, oct.-dec. 2017
ISSN 0103-846X (Print) / ISSN 1984-2961 (Electronic)
Doi: http://dx.doi.org/10.1590/S1984-29612017066

Gastrointestinal parasites in feral cats and rodents from the Fernando de Noronha Archipelago, Brazil

Parasitos gastrointestinais em gatos ferais e roedores do Arquipélago de Fernando de Noronha, Brasil

Victor Fernando Santana Lima[1]*; Rafael Antonio Nascimento Ramos[2]; Raphael Lepold[1]; João Carlos Gomes Borges[3]; Carlos Diógenes Ferreira[4]; Laura Rinaldi[5]; Giuseppe Cringoli[5]; Leucio Câmara Alves[1]

[1] Departamento de Medicina Veterinária, Universidade Federal Rural de Pernambuco – UFRPE, Recife, PE, Brasil

[2] Unidade Acadêmica de Garanhuns, Universidade Federal Rural de Pernambuco – UFRPE, Garanhuns, PE, Brasil

[3] Fundação Mamíferos Aquáticos, Recife, PE, Brasil

[4] Coordenadoria de Meio Ambiente, Administração do Arquipélago de Fernando de Noronha, PE, Brasil

[5] Dipartimento di Medicina Veterinaria e Produzioni Animali, Università degli Studi di Napoli Federico II, Napoli, Italia

Received August 7, 2017
Accepted October 19, 2017

Abstract

Gastrointestinal parasites are important pathogens affecting animals, some of them are of medical and veterinary concern. Although the dynamic of parasitic infections is a complex phenomenon that has been studied under experimental conditions, it shows several gaps in knowledge, especially in insular regions where a confined population of animals and parasites co-exists. In this study was assessed the parasitism by endoparasite gastrointestinal in feral cats (n = 37) and rodents (n = 30) from the Fernando de Noronha Archipelago; in addition, the risk of human infection and ecological implications of these findings were discussed. Out of all samples analysed, 100% scored positive for the presence of gastrointestinal parasites in both feral cats and rodents. A total 17 genera and/or species of endoparasite gastrointestinal were identified, *Ancylostoma* sp., *Strongyloides* sp., *Trichuris campanula* and *Toxocara cati* were the parasites more frequently in feral cats. In rodents *Eimeria* sp., *Strongyloides* sp. and *Trichuris muris* were parasites more frequently herein detected. Human population living in this area are at risk of parasite infections due to the population of rodents and feral cats in the archipelago.

Keywords: Helminths, protozoal disease, zoonosis, synanthropic animals.

Resumo

Parasitas gastrointestinais são importantes agentes patogênicos que afetam os animais, sendo alguns destes de interesse médico e veterinário. Embora a dinâmica das infecções parasitárias seja um fenômeno complexo que tem sido estudado sob condições experimentais, existem várias lacunas no conhecimento, especificamente em regiões insulares onde existem populações confinadas de animais e parasitas. Neste estudo foi avaliado o parasitismo por endoparasitas gastrointestinais em gatos ferais (n = 37) e roedores (n = 30) do Arquipélago de Fernando de Noronha. Além disso, discutiu-se o risco de infecção humana e implicações ecológicas desses achados. De todas as amostras analisadas, 100% obtiveram resultados positivos para a presença de parasitos gastrointestinais tanto em gatos ferais quanto em roedores. Um total de 17 gêneros e/ou espécies de endoparasitos gastrointestinais foram identificados, *Ancylostoma* sp., *Strongyloides* sp., *Trichuris campanula* e *Toxocara cati* foram os parasitos mais frequentes em gatos ferais. Em roedores *Eimeria* sp., *Strongyloides* sp. e *Trichuris muris* foram os mais detectados. A população humana que vive nesta área corre o risco de infecções parasitárias, devido à população de roedores e gatos ferais no arquipélago.

Palavras-chave: Helmintos, doenças protozoárias, zoonoses, animais sinantrópicos.

***Corresponding author:** Victor Fernando Santana Lima. Departamento de Medicina Veterinária, Universidade Federal Rural de Pernambuco – UFRPE, Rua Dom Manoel de Medeiros, s/n, Dois Irmãos, CEP 52171-900, Recife, PE, Brasil. e-mail: victor.fslima@gmail.com

Introduction

Gastrointestinal parasites are important pathogens affecting animals and humans throughout the world (BLAGBURN et al., 1996; DEPLAZES et al., 2016). According to the World Health Organization (WHO), approximately 3.5 billion of people are affected by these parasites every year, being 450 million children who present clinical manifestations (OKYAY et al., 2004). Among animals, cats and rodents are considered important reservoirs for a wide range of zoonotic parasites. For example, cats may harbour several species of gastrointestinal parasites (e.g., *Ancylostoma tubaeforme, A. brasiliensis, Toxocara cati* and *Toxoplasma gondii*), and shed their immature stages through the faeces, contaminating the environment (BALASSIANO et al., 2009; COSTA et al., 2012; BEUGNET et al., 2014; MONTEIRO et al., 2016; SARAVANAN et al., 2016).

Similarly, rodents may represent an important risk for human beings as involved in the transmission of different pathogenic agents, including gastrointestinal parasites (e.g., *Giardia duodenalis* and *Hymenolepis diminuta*) (BACKHANS et al., 2013; LÖHMUS & ALBIHN, 2013; DEPLAZES et al., 2016). Amongst the most relevant are *A. tubaeforme, A. brasiliensis* and *T. cati*, causative agents of *Cutaneous* and *Visceral Larva Migrans* in humans, especially in children (DESPOMMIER, 2003; COELHO et al., 2004).

The transmission cycle of gastrointestinal parasites is influenced by several abiotic and biotic factors, which impact on their abundance into a given environment (MONTEIRO et al., 2016). Accordingly, the availability of infective stages in a highly contaminated habitat enhances the chance for paratenic (e.g., rodents) and accidental (e.g., humans) hosts to be exposed to the pathogens (THOMPSON & CONLAN, 2011).

In these circumstances, understanding the dynamic of the infection is essential to plan control strategies. Besides experimental activities in controlled-laboratory conditions, the dynamic of the infection by parasites has been poorly studied in select areas, such insular regions, where confined animal population animals and pathogens may show a different behaviour. For instance, studies on gastrointestinal parasites in cats and rodents at the Fernando de Noronha Archipelago are scarce, although this archipelago has suffered over the last years from anthropic modification, which took to the introduction of exotic animal species, including cats and rodents (COSTA et al., 2012). Recently, few studies have been conducted in this area with *T. gondii* (SILVA et al., 2017), however lack information to others gastrointestinal parasites.

Therefore, because the scarce of data about gastrointestinal parasites and their implications on animals living in Fernando de Noronha Archipelago, the aim of this study was to assess the parasitism by gastrointestinal parasites in feral cats and rodents.

Material and Methods

Ethical aspects

This study approved by the *Instituto Chico Mendes de Conservação da Biodiversidade - ICMBio* (licence number 48994-3) and performed following the current legislation of the Brazilian College of Animal Experimentation.

Study area

The study was performed on August 2016 in the middle of winter of the Fernando de Noronha Archipelago (3°50'24" S and 32°24'48" W). The area is formed by the main island and other 21 secondary islands comprising a total area of 26 km^2. The main island has about 3000 inhabitants, but every year may host until 50.000 tourists (IBGE, 2010). The local ecosystem is comprised by several native and exotic species of birds, reptiles, mammals, marine animals and several non-native species of arthropods.

Sampling and laboratorial procedures

Rodents were trapped using Tomahawk Live Traps (Gabisa Ltda., São Paulo, Brazil) that were placed at 17:00 pm and recovered at 06:00 am. All rodents were anesthetized with i.m. ketamine (Vetanarcol®, Konig, Santana de Panaíba, SP, Brazil; 30 mg/kg) and xylazine (Xilazin®, Syntec, Santana do Parnaíba, SP, Brazil; 2 mg/kg), then, fecal samples were obtained.

Conversely, samples of cats were obtained after spontaneous defecation. A total of 67 faecal samples were collected, 37 from feral cats (*Felis catus*) and 30 from rodents (*Rattus rattus*, n = 25; *Kerodon rupestris*, n = 05). All samples were conserved into plastic tubes containing 10% formalin solution until laboratory evaluation. Each sample was individually analysed through the FLOTAC technique (CRINGOLI et al., 2010). All cysts, eggs, oocysts and larvae were identified based on morphological features provided in Bowman et al. (2006) and Taylor et al. (2010).

Data analysis

Data were analysed by using the software InStat (GraphPad Software), with a significance level of $p<0.05$.

Results

All samples analysed, scored positive for at least one gastrointestinal parasite species, and up to 17 parasite genera were identified. In particular, infections by trematodes, cestodes, nematodes and protozoa and were observed in 5.8% (1/17), 17.8% (3/17), 53% (9/17) and 23.5% (4/17), respectively (Table 1). Eggs and larvae of *Ancylostoma* sp., *Strongyloides* sp., *Trichuris campanula* and *Toxocara cati* were the parasites more frequently detected in feral cats. In rodents eggs, larvae and/or oocysts of *Eimeria* sp., *Strongyloides* sp. and *Trichuris muris* were parasites more frequently.

Co-infections were detected in 83.6% (56/67) fecal samples, in particular, 60.7% (34/56) and 39.2% (22/56) in the feral cats and rodents, respectively (Table 1).

Discussion

This study investigated, for the first time, the presence of gastrointestinal parasites in rodents and feral cats living at the Fernando de Noronha Archipelago, Brazil.

Table 1. Gastrointestinal parasites in the fecal samples of feral cats and rodents from Fernando de Noronha archipelago, Brazil.

Order / Family	Species	Parasite	Positivity	
			AF (n/N)	RF (%)
Carnivora/ Felidae	*Felis catus*	*Ancylostoma* sp.	35/37	94.59
		Ascarididae	02/37	5.40
		Dipylidium caninum	01/37	2.70
		Cystoisospora felis	13/37	35.00
		Giardia sp.	01/37	2.70
		Platynosomum factosum	10/37	27.00
		Strongyloides sp.	20/37	54.00
		Toxocara cati	07/37	19.00
		Trichuris campanula	18/37	48.6
Rodentia/ Muridae	*Rattus rattus*	Ancylostomatidae	25/25	100.00
		Ascarididae	02/25	8.00
		Capillaria sp.	07/25	28.00
		Eimeria sp.	09/25	36.00
		Dipylidium sp.	01/25	4.00
		Entamoeba sp.	01/25	4.00
		Enterobius sp.	02/25	8.00
		Giardia sp.	03/25	12.00
		Hyminolepis nana	06/25	24.00
		Nematospiroides dubius	05/25	20.00
		Nippostrongylus brasiliensis	03/25	12.00
		Strongyloides sp.	10/25	40.00
		Taenia sp.	07/25	28.00
		Toxocara sp.	04/25	16.00
		Trichuris muris	08/25	32.00
Rodentia/ Caviidae	*Kerodon rupestris*	Ancylostomatidae	03/05	60.00
		Capillaria sp.	01/05	20.00
		Eimeria sp.	04/05	80.00
		Strongyloides ratti	03/05	60.00

AF- Absolute frequency; RF - Relative Frequency.

Data indicate that the level of parasitism in these "exotic" animals is higher than that observed in other studies performed in other insular areas (THOMPSON & CONLAN, 2011). For instance, a prevalence of 53.5% (15/28) and 76% (76/100) were documented in feral cats from Christmas (Australia) and Baleares (Spain) islands (ADAMS et al., 2008; RAAB et al., 2016), whereas a positivity of 46.2% (30/65) was reported in rodents from the Santa Catarina island (Brazil) (KUHNEN et al., 2012). This suggests that animals living in the study areas are exposed to a high infective pressure.

Worthy of note, the majority of the parasite detected in this study are of medical concern (e.g., *Ancylostoma* sp. and *T. cati*), representing a threat for the public health. For example, *Ancylostoma* sp. were recorded in cats from Brazil (THOMPSON & CONLAN, 2011), causing cutaneous *Larva migrans* syndrome in humans (BOWMAN et al., 2010). Another important parasite that deserves attention due the risk for humans are those of the *Toxocara cati* observed in this study in feral cats, and considered the responsible for visceral *larva migrans* (VLM), ocular *Larva migrans* (OLM) and cerebral *Toxocariasis* in humans (DESPOMMIER, 2003; FAN et al., 2015).

In addition, it is important to highlight the detection of *Hymenolepis nana* and *Taenia* sp. parasitizing rodents and humans, all of them of medical and veterinary concern (MOLINARO et al., 2009; GALAN-PUCHADES, 2015), were helminths that parasitize humans, which may cause diarrhea, abdominal pain, irritability and weight loss (MUEHLENBACHS et al., 2015).

On the other hand, *G. duodenale* causes serious problems to host health, due to the appearance of enteritis, which trigger enzymatic and morphological changes in intestinal loops (SMITH et al., 2007). It is interesting to note that based on molecular and phylogenetic evidence, *G. duodenale* is part of a complex genetic group, with genotypes A and B accounting for more than 80% of human infections (RYAN & CACCIÒ, 2013).

In the present study, the sharing of parasites among different hosts suggests this phenomenon and may have important implications on the risk for human infections. For instance, data herein reported demonstrated the sharing of some parasite species, particularly, Entamoebidae among rodents, and humans, since data of the Surveillance Service of the island recorded frequently the parasitism by *Endolimax nana* in human native residents.

The presence of parasites on these hosts from the island may be a result of ecological events and their early introduction in this environment by conquestors. However, their perpetuation is favoured by several determinants factors such as inadequate facilities and inappropriate basic sanitation. Therefore, people living

in this area are at risk of parasite infections due to the population of feral cats and rodents in the archipelago.

References

Adams PJ, Elliot AD, Algar D, Brazell RI. Gastrointestinal parasites of feral cats from Christmas Island. *Aust Vet J* 2008; 86(1-2): 60-63. PMid:18271830. http://dx.doi.org/10.1111/j.1751-0813.2007.00246.x.

Backhans A, Jacobson M, Hansson I, Lebbad M, Lambertz ST, Gammelgård E, et al. Occurrence of pathogens in wild rodents caught on Swedish pig and chicken farms. *Epidemiol Infect* 2013; 141(9): 1885-1891. PMid:23174339. http://dx.doi.org/10.1017/S0950268812002609.

Balassiano BCC, Campos MR, Menezes RCAA, Pereira MJS. Factors associated with gastrointestinal parasite infection in dogs in Rio de Janeiro, Brazil. *Prev Vet Med* 2009; 91(2-4): 234-240. PMid:19577316. http://dx.doi.org/10.1016/j.prevetmed.2009.05.030.

Beugnet F, Bourdeau P, Chalvet-Monfray K, Cozma V, Farkas R, Guillot J, et al. Parasites of domestic owned cats in Europe: co-infestations and risk factors. *Parasit Vectors* 2014; 7(1): 291. PMid:24965063. http://dx.doi.org/10.1186/1756-3305-7-291.

Blagburn BL, Lindsay DS, Vaughan JL, Rippey NS, Wright JC, Lynn RC, et al. Prevalence of canine parasites based on fecal flotation. *Comp Cont Educ Pract* 1996; 18: 483-509.

Bowman DD, Lynn RC, Eberhard ML, Alcaraz A. *Parasitologia veterinária de Georgis*. 8. ed. São Paulo: Elsevier; 2006.

Bowman DD, Montgomery SP, Zajac AM, Eberhard ML, Kazacos KR. Hookworms of dogs and cats as agents of cutaneous larva migrans. *Trends Parasitol* 2010; 26(4): 162-167. PMid:20189454. http://dx.doi.org/10.1016/j.pt.2010.01.005.

Coelho LM, Silva MV, Dini CY, Giacon AA No, Novo NF, Silveira EP. Human toxocariasis: a seroepidemiological survey in schoolchildren of Sorocaba, Brazil. *Mem Inst Oswaldo Cruz* 2004; 99(6): 553-557. PMid:15558160. http://dx.doi.org/10.1590/S0074-02762004000600002.

Costa DGC, Marvulo MFV, Silva JSA, Santana SC, Magalhães FJR, Lima CD Fo, et al. Seroprovelence of *Toxoplasma gondii* in domestic and wild animals from the Fernando de Noronha, Brazil. *J Parasitol* 2012; 98(3): 679-680. PMid:22150091. http://dx.doi.org/10.1645/GE-2910.1.

Cringoli G, Rinaldi L, Maurelli MP, Utzinger J. FLOTAC: new multivalent techniques for qualitative and quantitative copromicroscopic diagnosis of parasites in animals and humans. *Nat Protoc* 2010; 5(3): 503-515. PMid:20203667. http://dx.doi.org/10.1038/nprot.2009.235.

Deplazes P, Eckert J, Mathis A, Samson-Himmelstjerna G, Zahner H. *Parasitology in veterinary medicine.* The Netherlands: Wageningen Academic Publishers; 2016.

Despommier D. Toxocariasis: clinical aspects, epidemiology, medical ecology, and molecular aspects. *Clin Microbiol Rev* 2003; 16(2): 265-272. PMid:12692098. http://dx.doi.org/10.1128/CMR.16.2.265-272.2003.

Fan CK, Holland CV, Loxton K, Barghouth U. Cerebral toxocariasis: silent progression to neurodegenerative disorders? *Clin Microbiol Rev* 2015; 28(3): 663-686. PMid:26062575. http://dx.doi.org/10.1128/CMR.00106-14.

Galan-Puchades MT. *Hymenolepis nana* vs. *Taenia solium* life cycle. *Parasite Immunol* 2015; 37(8): 429. PMid:26216023. http://dx.doi.org/10.1111/pim.12204.

Instituto Brasileiro de Geografia e Estatística – IBGE. *Censo Demográfico*. Rio de Janeiro: IBGE; 2010. 270 p.

Kuhnen VV, Graipel ME, Pinto CJC. Differences in richness and composition of gastrointestinal parasites of small rodents (Cricetidae, Rodentia) in a continental and insular area of the Atlantic Forest in Santa Catarina state, Brazil. *Braz J Biol* 2012; 72(3): 563-567. PMid:22990827. http://dx.doi.org/10.1590/S1519-69842012000300019.

Lõhmus M, Albihn A. Gastrointestinal pathogens in rodents overwintering in human facilities around Uppsala, Sweden. *J Wildl Dis* 2013; 49(3): 747-749. PMid:23778637. http://dx.doi.org/10.7589/2013-02-028.

Molinaro EM, Caputo LFG, Amendoeira MRR. *Conceitos e métodos para formação de profissionais em laboratórios de saúde*. vol. 4. Rio de Janeiro: Escola Politécnica de Saúde Joaquim Venâcio, Instituto Oswaldo Cruz; 2009. 290 p.

Monteiro MFM, Ramos RAN, Calado AMC, Lima VFS, Ramos ICN, Tenório RFL, et al. Gastrointestinal parasites of cats in Brazil: frequency and zoonotic risk. *Rev Bras Parasitol Vet* 2016; 25(2): 254-257. PMid:27096530. http://dx.doi.org/10.1590/S1984-29612016019.

Muehlenbachs A, Bhatnagar J, Agudelo CA, Hidron A, Eberhard ML, Mathison BA, et al. Malignant Transformation of *Hymenolepis nana* in a Human Host. *N Engl J Med* 2015; 373(19): 1845-1852. PMid:26535513. http://dx.doi.org/10.1056/NEJMoa1505892.

Okyay P, Ertug S, Gultekin B, Onen O, Beser E. Intestinal parasites prevalence and related factors in school children, a western city sample-Turkey. *BMC Public Health* 2004; 4(2): 64. PMid:15615592. http://dx.doi.org/10.1186/1471-2458-4-64.

Raab O, Greenwood S, Vanderstichel R, Gelens H. A cross-sectional study of *Tritrichomonas foetus* infection in feral and shelter cats in Prince Edward Island, Canada. *Can Vet J* 2016; 57(3): 265-270. PMid:26933262.

Ryan U, Cacciò SM. Zoonotic potential of *Giardia. Int J Parasitol* 2013; 43(12-13): 943-956. PMid:23856595. http://dx.doi.org/10.1016/j.ijpara.2013.06.001.

Saravanan M, Sarma K, Mondal DB, Ranjith Kumar M, Vijayakumar H. Concomitant infestation of *Toxocara cati* and *Ancylostoma tubaeforme* in a mongrel cat. *J Parasit Dis* 2016; 40(1): 205-207. PMid:27065627. http://dx.doi.org/10.1007/s12639-014-0451-5.

Silva JCR, Ferreira F, Dias RA, Ajzenberg D, Marvulo MFV, Magalhães FJR, et al. Cat-rodent *Toxoplasma gondii* Type II-variant circulation and limited genetic diversity on the Island of Fernando de Noronha, Brazil. *Parasit Vectors* 2017; 10(1): 220. PMid:28468666. http://dx.doi.org/10.1186/s13071-017-2150-4.

Smith HV, Cacciò SM, Cook N, Nichols RAB, Tait A. *Cryptosporidium* and *Giardia* as foodborne zoonoses. *Vet Parasitol* 2007; 149(1-2): 29-40. PMid:17728067. http://dx.doi.org/10.1016/j.vetpar.2007.07.015.

Taylor MA, Coop RL, Wall RL. *Parasitologia veterinária*. 3. ed. Rio de Janeiro: Guanabara Koogan; 2010.

Thompson RC, Conlan JV. Emerging issues and parasite zoonoses in the SE Asian and Australasian region. *Vet Parasitol* 2011; 181(1): 69-73. PMid:21570190. http://dx.doi.org/10.1016/j.vetpar.2011.04.025.