GASTROINTESTINAL PARASITES IN GIRAFFES KEPT IN ZOOLOGICAL GARDENS OF THE CZECH REPUBLIC*

I.A. Kyriánová, J. Drnek, I. Langrová, P. Peřinková, S. Nechybová

Czech University of Life Sciences Prague, Faculty of Agrobiology, Food and Natural Resources, Prague, Czech Republic

Parasite prevalence was investigated in giraffes (*Giraffa camelopardalis)* housed in six major Czech zoological gardens: Zoo Ostrava, Zoo Dvůr Králové nad Labem, Zoo Liberec, Zoo Olomouc, Zoo Praha, and Zoo Plzeň. In autumn 2012 and in spring 2013, 120 faecal samples from 21 animals were examined using the McMaster egg counting technique. Propagative stages of three parasite groups were discovered, namely eggs of the nematodes of the order Strongylida (prevalence 25.8%), whipworms *Trichuris* spp. (prevalence 25%), and oocysts of the unicellular coccidia of the genus *Eimeria* (prevalence 1.7%). The results indicate that captive giraffes in the Czech zoos are not substantially affected by parasitic infection.

Giraffa camelopardalis, endoparasites, Strongylida, *Trichuris*, *Eimeria*

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INTRODUCTION

In the past decade, zoos have played greater role in the promotion of animal biodiversity through the protection of endangered species (Kelly, English, 1997). Zoos are obligated to ensure the welfare and health of bred species. Accordingly, proper nutrition, effective husbandry procedures, and the treatment of disease-causing pathogens are extremely important (Malan et al., 1997). Indeed, parasitic diseases in zoo animals often represent major concern due to the maintenance of animals in confined areas (Geraghty et al., 1981; Citino, 2003) and stress brought on by captivity can also reduce their resistance to parasitic disease (Cordón et al., 2008).

There are relatively significant amounts of information regarding parasites of various cloven-hooved mammals – Artiodactyla, however, little is known about those concerning giraffes (Round, 1968; Pester, Laurence, 1974; Krecek et al., 1990; Fukumoto et al., 1996). One of the few known facts is that the wild giraffes are likely to die due to parasites that develop in water. Giraffes are known to consume large quantities of water, which is why they are so harshly affected by water-borne diseases. In captivity, animals are supplied with purified water which almost never causes illness or death of animals. Captive animals are also carefully monitored for any health issues.

Several studies found the following gastrointestinal parasites in captive giraffes throughout the world: unicellular parasites *Blastocystis* spp. (Parkar et al., 2010), *Cryptosporidium* spp. (Kodádková et al., 2010) and *Eimeria* spp. (Eid, Rawhia, 1996), nematodes *Camelostrongylus mentulatus* (Fukumoto

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Table 1. Overall prevalence of the most prevalent gastrointestinal parasites, extreme EPG/OPG values recorded during our survey

	Strongylida	*Trichuris* spp.	*Eimeria* spp.
Positive samples/total samples	31/120	30/120	2/120
Overall prevalence (%)	**25.8**	**25**	**1.7**
Minimum EPG/OPG	0	0	0
Maximum EPG/OPG	720	160	40

EPG/OPG = eggs/oocysts per g of faeces

et al., 1996), *Haemonchus* spp. (Wu et al., 2004), *Oesophagostomum columbianum* (Savin et al., 1991), *Trichuris barbetonensis* (Eid, Rawhia, 1996), *Trichuris giraffae, Trichostrongylus axei, Trichostrongylus vitrinus, Trichostrongylus colubriformis, Ostertagia ostertagi, Teladorsagia circumcincta, Teladorsagia trifurcata, Marshallagia marshalli,* and *Spiculopteragia asymmetrica* (Garijo et al., 2004).

Giraffes (*G. camelopardalis rothschildi*) belonging to the largest group outside Africa bred in a 25-acre grass enclosure in the Longleat Safari Park (Wiltshire, UK) were referred to be parasitized by a rather broad spectrum of parasitic organisms from various taxonomic groups (Melbourne, 1978). The giraffes lived together with camels and zebras and several species of nematode genera *Ostertagia*, *Cooperia*, *Haemonchus*, *Oesophagostomum,* and *Trichostrongylus* were diagnosed there.

Regarding wild giraffes in Africa, samples were collected from six animals (*Giraffa camelopardalis angolensis*) shot in three years in the Etosha National Park, Namibia; helminths recovered included nematodes *Parabronema skrjabini*, *Skrjabinema* spp., *Haemonchus mitchelli,* and the hydatic cysts of the tapeworm *Echinococcus* sp. which, however, do not represent parasites of gastrointestinal tract in the case of the intermediate host animals (Krecek et al., 1990). Protistans *Theileria* sp. and a *Babesia* sp. were diagnosed in a young giraffe (*Giraffa camelopardalis*) translocated from Namibia to South Africa (McCully et al., 1970). Another study from South Africa described originally three new sarcocyst species (Coccidiasina) in giraffes: *Sarcocystis giraffae, S. klaseriensis,* and *S. camelopardalis* (Bengis et al., 1998). Additional parasites referred in wild giraffes from various African regions were namely nematodes *Haemonchus mitchelli* (Sachs et al., 1973) and *Parabronema skrjabini* (Boomker et al., 1986), as well as the tapeworm *Moniezia expansa* (Pester, Laurence, 1974).

However, there is still little recent information available on parasites of giraffes, especially those bred in zoos. The aim of this study was to detect endoparasites occurring in captive giraffes at several zoos in the Czech Republic using coprological techniques.

MATERIAL AND METHODS

Zoological gardens in the Czech Republic breed two subspecies of giraffes, namely the Rothschild's giraffe (*Giraffa camelopardalis rothschildi*) and the Reticulated giraffe (*Giraffa camelopardalis reticulata*). Six Czech zoos were chosen for a parasitological study in giraffes: (1) Zoo Ostrava, (2) Zoo Dvůr Králové nad Labem, (3) Zoo Liberec, (4) Zoo Olomouc, (5) Zoo Praha, and (6) Zoo Plzeň. These zoological gardens implement similar antiparasitic measures. The majority of them (Zoos 1, 2, 3, 4, and 6) examine giraffe faecal samples twice a year. In the case that a parasitic infection is found, animals are treated with fenbendazole or macrocyclic lactones. Only in the Zoo Plzeň giraffes are treated preventively twice a year by using fenbendazole.

In autumn 2012 and spring 2013, 120 fresh faecal samples were collected from 21 giraffes; 55 samples in autumn 2012 and 65 samples in spring 2013. Out of them, 4 animals were young under one year of age, 11 giraffes were older females, and 6 were older males. Faeces were collected individually with the assistance of zoo keepers, stored in plastic bags, and refrigerated at 4°C until examination. The samples were divided into groups according to zoological gardens and gender of giraffes.

The samples were examined using the Concentrated McMaster method modified by Permin, Hansen (1998), which uses saturated sodium chloride and glucose as flotation solution and analytical sensitivity 20 eggs (oocysts) per g of faeces. The results of the coprology examination determine the overall prevalence of gastrointestinal (GI) parasites in captive giraffes and the prevalence of GI parasites according to gender of monitored captive giraffes. The prevalence was evaluated according to Bush et al. (1997).

RESULTS

The overall prevalence of parasites detected in 120 faecal samples from giraffes from six zoos in the Czech Republic was 1.7% of coccidian oocysts of the genus *Eimeria*, 25% of the nematodes *Trichuris* sp.,

Table 2. Prevalence of nematodes from the order Strongylida, nematodes *Trichuris* spp., and coccidia of the genus *Eimeria*, samples/positive samples numbers (*n*) in individual zoological gardens

ZOO	Prevalence (%)			Number of samples		Positive samples (autumn/spring)		
	Strongylida	*Trichuris* spp.	*Eimeria* spp.	*n*	autumn/spring	Strongylida	*Trichuris* spp.	*Eimeria* spp.
Ostrava (1)	27.2	9	0	11	6/5	2/1	1/0	0/0
Dvůr Králové nad Labem (2)	37.5	33.9	0	56	25/31	9/12	7/12	0/0
Liberec (3)	11.8	35.3	0	17	9/8	2/0	2/4	0/0
Olomouc (4)	41.7	16.7	8.3	12	6/6	3/2	1/1	1/0
Praha (5)	0	11.1	0	18	6/12	0/0	1/1	0/0
Plzeň (6)	0	0	16.7	6	3/3	0/0	0/0	1/0

Table 3. Prevalence of the nematodes from the order Strongylida, nematodes *Trichuris* spp., and coccidia of the genus *Eimeria* according to year season

	Prevalence (%)	
	autumn	spring
Strongylida	29	23
Trichuris spp.	21.8	27.7
Eimeria spp.	3.6	0

and 25.8% of nematodes from the order Strongylida (Table 1).

Giraffes from the Zoo Olomouc (4) had the highest Strongylida prevalence (41.7%) and no infection was detected in Praha (5) and Plzeň (6). The highest prevalence of *Trichuris* spp. (35.3%) was observed in Liberec (3) compared to Plzeň, where no infection was detected. The highest prevalence of *Eimeria* spp. was in Plzeň (6) (16.7%) (Table 2).

Table 2 presents the number of collected samples/positive samples in individual zoological gardens; Table 3 shows the prevalence of nematodes from the order Strongylida, nematodes *Trichuris* spp., and coccidia of the genus *Eimeria* in spring and autumn. Regarding year seasons, the prevalence of the order Strongylida was higher in autumn (29%) than in spring (23%). The parasite count of *Trichuris* spp. increased from 21.8% in autumn to 27.7% in spring. Prevalence of coccidia of the genus *Eimeria* was 3.6% in autumn while in spring no oocysts were found (Table 3).

According to the age and sex distribution, 52.6% of samples from young animals were tested positive for parasites; older females had higher percentages of infection than did males (56.9% and 44.4% positive samples respectively) (Table 4). The nematodes from the order Strongylida predominated in both males and females, while *Trichuris* spp. was the most prevalent in young animals. Coccidia of the genus *Eimeria* were found only in males.

DISCUSSION

Strongylids (Strongylida) were the most commonly occurring parasite being recorded from giraffe faeces in the Czech Republic, followed by eggs of the whipworms *Trichuris* spp., while exogenous stages – oocysts – of *Eimeria* spp. exhibited the lowest prevalence and low intensity, occurring solely in the Zoo Plzeň. Young giraffes served most often as hosts for *Trichuris* spp. This genus was observed also in adult animals, similarly as during an autopsy of two adult captive giraffes in Japan; four *Trichuris* species were found there, of which *T. giraffae* was the most abundant (N o d a , 1955). Regarding strongylid-type nematodes, G o o s s e n s et al. (2005) reported their 14.3% prevalence in Kordofan giraffes (*Giraffe camelopardalis antiquorum*) from the Antwerp Zoo and Animal Park Planckendael in Belgium. G a r i j o et al. (2004) detected as much as 2724 adult nematodes in one dead female giraffe from the Aitana Zoo in Spain, and the majority of these nematodes belonged to various strongyles (*C. mentulatus, T. axei, O. ostertagi, T. circumcincta, T. trifurcata, M. marshalli, T. vitrinus, T. colubriformis,* and *S. asymmetrica*, see also Introduction).

In the condition of the Czech Republic, giraffes from three zoological gardens (Ostrava, Dvůr Králové nad Labem, and Olomouc) had the highest Strongylida prevalence. No strongyles were observed in the Zoo Praha and in the Zoo Plzeň, where preventive anthelmintic treatment is carried out twice a year. Considering recent results, regular medication appears to be effective as it likely eradicated also trichurid nematodes. However, it is important to consider the risk of anthelmintic resistance. A case of resistance was recorded in Florida, where a rigorous and long-time deworming schedule had been in place. A larval development assay showed resistance to three classes of anthelmintics currently used to treat (G a r r e t s o n et al., 2009). Unlike our results, v a n W y k et al. (2006) recommended the use of anthelmintics exclusively in

Table 4. Samples/positive samples numbers (*n*) according to gender of giraffes and prevalence of nematodes from the order Strongylida, nematodes *Trichuris* spp., and coccidia of the genus *Eimeria*

		Young	Females	Males
Positive samples/samples *n*		10/19	37/65	16/36
Overall prevalence (%)		**52.6**	**56.9**	**44.4**
Prevalence (%)	Strongylida	10.5	32.3	22.2
	Trichuris spp.	42.1	24.6	16.7
	Eimeria spp.	0	0	5.5

individual animals requiring treatment as opposed to treating the entire herd.

A comparison of infections in the year seasons showed the prevalence of the order Strongylida and the genus *Eimeria* was higher in autumn (29% and 3.6%, respectively) than in spring (23% and 0%, respectively). With respect to *Trichuris* spp., the situation was reversed and the prevalence of trichurids increased from 21.8% in autumn to 27.7% in spring. In fact, seasonal differences are not very high and might be caused by a combination of weather and breeding conditions. Breeding management is apparently a very important factor for the occurrence of parasites in captive giraffes. For example, infection levels were significantly lower at the Antwerp Zoo than in the Planckendael Animal Park (Belgium); this was most likely due to the zero grazing and daily dung removal carried out at the Antwerp Zoo (Goosens et al., 2005). No parasites were found in giraffes at Italian zoological parks Zoosafari Fasanolandia and Giardino Zoologico (Pistoria). Indoor enclosures were cleaned on a daily basis at these zoos, and the animals were treated twice a year with an anthelmintic drug and routine faecal analyses were performed monthly by the zoo veterinarians (Fagiolini et al., 2010).

Another major factor is likely based on an opportunity of cross infections in common breads of giraffes and other ungulate animals in the same enclosures. According to Garijo et al. (2004), cross-infections of different species of wild ruminants with nematodes are common. The same context was referred by Melbourne (1978) in the Longleat Safari Park (UK). In the Czech Republic, giraffes in all the investigated zoos, apart from the Zoo Dvůr Králové nad Labem, are kept together with zebras or antelopes. Therefore, cross-infections between the ruminants seem likely and this topic will be the subject of our further study.

CONCLUSION

Gastrointestinal parasites of giraffes from six zoos in the Czech Republic were coprologically identified. The parasite prevalence detected in our study was not extremely high and the parasite compound did not significantly differ from that referred by other European studies. Nevertheless, zoo management in the Czech Republic might be improved.

Monitoring the health status of zoo animals is important because eventual deaths of giraffes associated with the parasite load have been reported (Wu et al., 2004). The possible transmission of parasites from other ruminant species kept in the same paddock as giraffes is worthy of attention. Therefore, it is essential to conduct further studies on parasites not only in giraffes, but also in the ruminants that are housed alongside.

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Corresponding Author:

Ing. Iveta Angela K y r i á n o v á, Czech University of Life Sciences Prague, Faculty of Agrobiology, Food and Natural Resources, Department of Zoology and Fisheries, Kamýcká 957, 165 00 Prague–Suchdol, Czech Republic, phone: +420 224 383 645, e-mail: kyrianovai@af.czu.cz