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Short Communication

Epidemiology of Gastrointestinal Parasitism in Blue Wildebeest (*Connochaetes taurinus*), Alpacas (*Vicugna pacos*), and Goats (*Capra aegagrus hircus*) with same Husbandry and Fence Site in Harbin Zoo, China

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Authors' Contributions
HZ designed the experiment. HC, LX and SH collected samples. WL executed the experimental work and wrote the article. SD, PZ and ZQ helped in the experimented work.

Key words
Zoo, Blue wildebeest, Alpacas, Parasites, Prevalence.

ABSTRACT

The objective of current study was to find out the prevalence of gastrointestinal parasites in blue wildebeest, alpacas, and goats with same husbandry and fence site in Harbin Zoo, China. From August 2015 to August 2016, 507 fecal samples of blue wildebeest (188), alpacas (195) and goats (124) were examined for gastrointestinal parasites by saturated sodium chloride floatation technique. The microscopic analysis, based on the morphology of oocysts, indicates that the present parasites are *Capillaria* sp. in blue wildebeest; *Eimeria christenseni*, *E. alijevi, Trichuris* sp. and one Strongy-type species in goats; *Trichuris* sp., *Nematodirus* sp., *Moniezia* sp., *E. macusaniensis*, another *Eimeria* sp. and another Strongy-type (different with goats) in alpacas. It was discovered that the infection rate was 45.74%, 38.97%, and 12.09% in blue wildebeest, alpacas and goats, respectively. The hosts have different dominant parasite and diverse prevalence in different season, temperature, and humidity groups. Host specificity is the main reason for the difference of host fauna among the three ruminants. The data of the study will provide an accumulating knowledge to help preventing and controlling the spread of infectious parasitic diseases in the zoo.

Habitat fragmentation and man-made destruction threaten the survival of some creations particularly wildlife animals. One of the best ways to protect these animals is domestication in form of zoo rearing different animals in same vicinity provoked some health issues, particularly spread of parasites. Parasites can cause enormous harm to animals (Haile *et al*., 2018) and hosts infected by the parasites always showed some clinical signs such as nutritional deficiency, cacoepy and even to die. Therefore, parasitic study is very important to protect animals.

The parasitic infestation is ordinary in blue wildebeest, alpacas and goats, but they have different parasite fauna (Horak *et al*., 1983; Ayako and Jun, 2016; Haile *et al*., 2018). It probably originates from spatial and temporal difference or host species specificity. Besides, there is a close relationship between host and parasite, which leads to co-evolution. In studies of host–parasite interactions, it has been suggested repeatedly that the environment alters the strength of selection; host genotypes suffer less or more from infection, depending on the environmental settings (Wolinska and King, 2009). Hence, monitoring parasites infecting the different hosts living the same environment is necessary. The primary object of the present study was i) investigating the prevalence of gastrointestinal parasites of blue wildebeest, alpacas, and goats who living together in Harbin zoo, China, and ii) decided either is the temporal and spatial difference or host specificity is the determining factor to the difference of three different ruminant animals.

Materials and methods

The study was carried out from August 2015 to August 2016 in Harbin Zoo, China (45°23′40.65″N, 127°06′39.06″E). A total of 507 fecal samples (188 blue wildebeest samples, 195 alpaca samples and 124 goat samples) were collected directly from ground immediately after they were discharged by hosts (Table I). Those animals were living in the same garden without barrier and were provided the same fodder. The fecal samples were processed and examined using saturated sodium chloride

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floatation technique (Srbek-Araujo *et al*., 2014; Owusu *et al*., 2016). The present parasites were identified with oocyst morphological characteristics. The eggs per gram of faces (EPG) were determined by modified McMaster technique (Nwosu *et al*., 2007) as an index for infection intensity.

The samples were divided into four groups based on the temperature when they were collected, namely, LNL (local natural lowest temperature) < t ≤ 0°C, 0 < t ≤ 10°C, 10 < t ≤ 20°C, and 20°C < t ≤ LNH (local natural highest temperature), or based on humidity, namely RH ≤ 60, 60 < RH ≤ 70, 70 < RH ≤ 80, and RH > 80.

The infection rate and intensity were counted by excel, and the Mann-Whitney U test was done with SPSS.

Results

The infection rate was 39.64% (201/507) for those ruminant hosts in whole year, the highest prevalence was observed in blue wildebeest (45.74%) followed by alpacas (38.97%) and goats (12.09%).

In blue wildebeest, the size of the *Capillaria* sp. oocyst is 77.27×43.91μm (Fig. 1A). The infection rate of *Capillaria* sp. is 45.74% (Tables I, II).

Table I.- The infection rate of three ruminants in this study.

English name	Host No.	Fecal sample No.	Positive samples	Infection rate
Blue wildebeest	8	188	86	45.74 %
Alpacas	20	195	76	38.97 %
Goats	20	124	39	12.09 %
Total	48	507	201	39.64%

All animals in the study are adults.

The types of parasites of alpacas are more abundant than that of the blue wildebeest and goats, there were six parasite species including two protozoa, one cestode, and three nematodes (Fig. 1, Table II). Most of their infection rate is less than 10% except the *E. macusaniensis* that is 10.64%.

There are four parasites were identified in goats, two protozoa and two nematodes. The maximum infection rate is *E. christenseni* (10.48%) followed by *E. alijevi* (8%), Strongy-type species (7.26%) and *Trichuris* sp. (4.03%).

The prevalence of different parasite, the same parasite in different season, temperature and humidity groups were not same completely (Tables III, IV, V).

Table II.- The oocyst size and their prevalence in different hosts.

Host animal / Parasites	Oocyst size (μm)	Infection rate	Infection intensity (EPG)
Wildebeest			
Capillaria sp.	43.91×77.27	45.74%	107.39
Alpacas			
Eimeria sp I	19×21	7.98%	22.31
Moniezia sp.	63×64	3.19%	12.46
Trichuris sp.	35.49×76.44	4.26%	8.62
Strongy-type species	47×93	9.04%	15.08
Nematodirus sp.	95×204	7.54%	7.23
E. macusaniensis	65×93	10.64%	0.92
Goats			
Eimeria alijevi	22×25	8%	16.49
Eimeria christenseni	23×30	10.48%	25.31
Strongy-type species	44×74	7.26%	5.65
Trichuris sp.	33.5×65.3	4.03%	1.57

Discussion

In current work, all the fecal samples collected from different hosts were examined by the microscope observation and most of them showed positive infection, but the species of parasites were much less than the record in other documents (Boomker *et al*., 2000; Booyse and Dehority, 2012; Hyuga and Matsumoto, 2016; Sorathiya *et al*., 2017; Chartier and Paraud, 2012). The reason maybe contributed to the Zoo garden has a short history with only twelve years and located in the forestry different from other zoos.

In the environment where the host lives, the favorable temperature and relative humidity have been recognized as the important abiotic factor related to the parasite prevalence. The ideal temperature range for larval development is between 22 and 26°C usually (Ashad *et al*., 2011), but the

Table III.- The *Capillaria sp.* prevalence of wildebeest in different season, temperature and humidity groups.

Season	Prevalence	Intensity	Temperature	Prevalence	Intensity	Humidity	Prevalence	Intensity
Spring	40.91%	113.98 a	LNL<t≤0°C	57.17%	99.38 a	RH ≤ 60	45%	119.25 a
Summer	50%	96.35 a	0 < t≤ 10°C	39.29%	64.29 a	60< RH ≤ 70	39.29%	77.14 a
Autumn	38.33%	107.34 a	10<t ≤ 20°C	47.92%	125 a	70< RH ≤ 80	50%	112.5 a
Winter	67.86%	118.93 a	20<t≤ LNH	40.63%	119.06 a	RH>80	47.37%	109.34 a

The infection intensity is significantly different (P<0.05) for each other are represented by different letters. LNL, the local natural lowest temperature; LNH, the local natural highest temperature.

Table IV.- The different kind parasites prevalence of alpacas in different season, temperature and humidity groups.

Parasite species	Season	Prevalence	Intensity	Temperature	Prevalence	Intensity	Humidity	Prevalence	Intensity
Eimeria sp. I	Spring	0%	0 a	LNL<t≤0°C	0%	0 a	RH ≤ 60	12.19%	40.97 a
	Summer	21.15%	57.69 b	0 < t≤ 10°C	0%	0 a	60<RH≤70	0%	0 b
	Autumn	5.63%	19.01a	10<t ≤ 20°C	4.08%	14.69 a	70<RH≤80	22.73%	60.68 a
	Winter	0%	0 a	20<t≤ LNH	18.84%	52.61b	RH>80	0%	0 b
Eimeria macusaniensis	Spring	0%	0 a	LNL<t≤0°C	2.08%	0.63 a	RH ≤ 60	0%	0 a
	Summer	0%	0 a	0 < t≤ 10°C	0%	0 a	60<RH≤70	0%	0 a
	Autumn	4.23%	2.54 a	10<t ≤ 20°C	0%	0 a	70<RH≤80	2.27%	0.68 a
	Winter	0%	0 a	20<t≤ LNH	2.89%	2.17 a	RH>80	2.47%	1.85 a
Moniezia sp.	Spring	0%	0 a	LNL<t≤0°C	0%	0 a	RH ≤ 60	2.44%	10.24 a
	Summer	0%	0 a	0 < t≤ 10°C	0%	0 a	60<RH≤70	3.45%	4.13 a
	Autumn	11.27%	34.23 b	10<t ≤ 20°C	0%	0 a	70<RH≤80	4.55%	5.45 a
	Winter	0%	0 a	20<t≤ LNH	11.59%	35.22 b	RH>80	4.94%	20.37 a
Strongy-type species	Spring	0%	0 c	LNL<t≤0°C	2.08%	0.63 a	RH ≤ 60	2.44%	0.73 b
	Summer	13.46%	7.5 ab	0 < t≤ 10°C	6.89%	6.21 ab	60<RH≤70	6.90%	6.21 ab
	Autumn	16.90%	35.49 a	10<t ≤ 20°C	8.16%	5.51 ab	70<RH≤80	18.18%	32.05 a
	Winter	3.57%	1.07 bc	20<t≤ LNH	18.84%	35.65 b	RH>80	11.11%	16.30 ab
Trichuris sp.	Spring	6.82%	2.72 a	LNL<t≤0°C	4.17%	1.25 b	RH ≤ 60	9.76%	3.66 ab
	Summer	5.77%	1.73 a	0 < t≤ 10°C	17.24%	40.34 a	60<RH≤70	17.24%	40.34 a
	Autumn	14.08%	20.28 a	10<t ≤ 20°C	12.24%	4.90 ab	70<RH≤80	2.27%	0.68 b
	Winter	3.57%	1.07 a	20<t≤ LNH	5.79%	3.04 ab	RH>80	8.46%	4.07 ab
Nematodirus sp.	Spring	0%	0 b	LNL<t≤0°C	0%	0 a	RH ≤ 60	7.32%	5.85 a
	Summer	11.54%	6.92 a	0 < t≤ 10°C	0%	0 a	60<RH≤70	3.45%	1.03 b
	Autumn	11.27%	14.79 a	10<t ≤ 20°C	4.08%	1.22 a	70<RH≤80	15.91%	17.73 a
	Winter	0%	0 b	20<t≤ LNH	17.39%	19.57 a	RH>80	3.7%	4.44 b

The infection intensity is significantly different (P<0.05) for each other are represented by different letters. LNL, the local natural lowest temperature; LNH, the local natural highest temperature.

Table V.- The prevalence of the parasites infecting the goats in different season and temperature groups.

Parasite species	Season	Prevalence	Intensity	Temperature	Prevalence	Intensity
Eimeria alijevi	Spring	0	0 a	LNL<t≤0°C	0	0 b
	Summer	23.80%	0.71 a	0 < t≤ 10°C	0.63%	1.88 ab
	Autumn	14.89%	25.85 a	10<t ≤ 20°C	17.39%	13.69 a
	Winter	16.67%	66.67 a	20<t≤ LNH	13.89%	47.22 a
Eimeria christenseni	Spring	0	0 a	LNL<t≤0°C	2.04%	2.45 a
	Summer	4.76%	3.57 a	0 < t≤ 10°C	0.63%	1.88 a
	Autumn	17.02%	33.79 a	10<t ≤ 20°C	17.39%	2.83 a
	Winter	25%	116.67 a	20<t≤ LNH	16.67%	81.19 a
Strongy-type species	Spring	0	0 a	LNL<t≤0°C	0	0 b
	Summer	2.38%	2.14 a	0 < t≤ 10°C	0.63%	5.63 ab
	Autumn	10.64%	7.87 a	10<t ≤ 20°C	0.44%	2.61 ab
	Winter	25%	20 a	20<t≤ LNH	16.67%	15.27 a
Trichuris sp.	Spring	0	0 a	LNL<t≤0°C	0%	0 a
	Summer	4.76%	0.71 a	0 < t≤ 10°C	12.50%	1.88 a
	Autumn	63.8%	2.23 a	10<t ≤ 20°C	8.70%	1.96 a
	Winter	16.67%	5 a	20<t≤ LNH	5.56%	3.33 a

The infection intensity is significantly different (P<0.05) for each other are represented by different letters. LNL, the local natural lowest temperature; LNH, the local natural highest temperature.

Trichuris sp. infecting the alpacas and goats is in higher prevalence in temperature group of 0 < T ≤ 10°C. This indicated that the favorable temperature for *Trichuris* sp. prevalence is lower than other nematodes. The same phenomenon was recognized in slender-horned gazelle who were kept at Animal Park Planckendael in Belgium, the *Trichuris* sp. prevalence is much higher in May-June and Sep-Oct than July-Aug, at the same time, another Stongyle-like parasite was continues increasing from July to November (Goossens *et al*., 2005).

It was found that 7.21% of samples collected from various animals (alpacas and goats) were positive with *Trichuris* sp. In the meantime, the prevalence rate of alpacas is higher than goats. The reason for which may be related to the animal evolution, it is reasonable speculated that goats have become resistant the infection of the *Trichuris* sp. with evolution because of they come in China are much earlier than alpacas.

Parasites are strongly influenced not only by environmental conditions but also rely on their hosts for completing of the life cycle (Studer *et al*., 2010). The host or genotype specific is an important factor mediated the parasite life cycle. In our study, the spices of parasites are different in different hosts though they live in the same fence site and husbandry, which further confirmed host specific is a critical element for parasite prevalence. This will be just one of the answers that the *Capillaria* sp. was only in blue wildebeest population, and the parasite abundance is much higher in alpacas that goats.

In general, Migration to a new habitat can simultaneously minimize exposure to common parasites in their original habitats and increase exposure to novel pathogens from new environments (Mijele *et al*., 2016). It is interesting that *Trichuris* sp. cannot be found in blue wildebeest in this study. It is possible that blue wildebeest developed resistance to this endemic *Trichuris* sp. naturedly due to host specificity.

The result of this study showed that parasites infections can impair animal health and increase the sensitivity to infectious diseases. Therefore, appropriate measures are necessary to promote parasitism prevention in animals. The findings here not only were significantly to add to existing knowledge of gastrointestinal parasites but also help in keeping the health of animals, although present study is at primary level.

Supplementary material

There is supplementary material associated with this article. Access the material online at: https://dx.doi.org/10.17582/journal.pjz/20190116080130

Statement of conflict of interest

The author declare no conflict of interest.

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