NOTE *Parasitology*

A survey of gastrointestinal parasites of alpacas (*Vicugna pacos*) raised in Japan

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ABSTRACT. This study aimed to determine the prevalence of gastrointestinal parasites in alpacas raised in Japan. From December 2010 to October 2011, 53 alpacas (*Vicugna pacos*) raised at a farm in the Kanto region, Japan, were examined for gastrointestinal parasites by 3 fecal tests: direct smear, centrifuged flotation and formalin-ether sedimentation. Eggs of *Nematodirus* sp. were found in 13.2%, *Trichuris* sp. in 11.3%, *Capillaria* spp. in 5.7%, strongyle-type in 50.9% and *Moniezia* sp. in 1.9%. Oocysts of *Eimeria punoensis* and/or *E. alpacae* were found in 69.8%, *E. lamae* in 1.9% and *E. macusaniensis* in 7.5%. We found that alpacas raised in Japan have gastrointestinal parasitic fauna similar to those in other countries.

KEY WORDS: alpaca, gastrointestinal parasite, Japan, *Vicugna pacos*

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Alpacas (*Vicugna pacos*), together with llamas, are South American camelids (SAC). They are native to the high Andes region of South America and are presently distributed nearly worldwide, including in North America, Australia, New Zealand, Europe and South Africa. In 1999, 200 alpacas were introduced into Japan from Chile for farming [8]. During the last decade, they have become popular in Japan, and an estimated number of alpacas kept in the country has reached approximately 500. They are exhibited at farms and zoos, where people can make close contact with them.

Parasitic infection of alpacas can be a health concern by causing poor utilization of nutritional resources and can reduce the quality and quantity of alpaca fur [7]. Actually, deworming of alpacas using ivermectin resulted in an increased amount of fur production compared with untreated controls [11]. Moreover, infection of alpacas with zoonotic parasites, such as *Cryptosporidium* and *Giardia*, could be a public health concern [6, 10]. However, information on the prevalence of gastrointestinal parasites, especially helminths, in alpacas is limited. The aim of this study was to estimate the prevalence of gastrointestinal parasites in alpacas raised in Japan.

Alpacas kept in a farm located in Kanto region, Japan, were the subjects of the present survey that was performed between December 2010 and October 2011. The farm was located in a dairy area and surrounded by several ruminant farms within a radius of 3 km from there. The farm kept about 390 alpacas, corresponding to nearly 80% of alpaca population held in Japan. They consisted of the animals introduced in 1999 from Chile and their Japan-born descendants. All of the animals were treated with the standard dose (approximately 0.5 mg/kg) of ivermectin, topically applied once every 3 months. All of the alpacas were clinically healthy at the time of sample collection. In the present study, 53 animals were examined for gastrointestinal parasite infection. They were chosen randomly from each of the following 8 groups: 3 male adult groups, 2 female adult groups, 1 old-aged group (>10 years), 1 young group (1–3 years), and 1 group of infants (<1 year) and their dams. The 53 animals consisted of 17 male adults, 22 female adults, 7 male youngs/infants and 7 female youngs/infants.

Fecal samples were collected from the animals immediately after defecation. All of the collected samples were examined by 3 standard tests including the direct smear technique, a double-centrifuged flotation technique with sugar solution (specific gravity=1.28) and formalin-ether sedimentation. One gram of fecal sample was used for each test except for the direct smear technique in which about 0.1 g of sample was examined. The double centrifugation-sucrose flotation was performed as described previously [4], using half amount (1 g) of fecal samples compared with the original procedure. Eggs per gram (EPG) and oocysts per gram (OPG) were determined following Cebra and Stang [4] by examining 1 or 2 cover slips in this flotation technique. Some of the samples with eimeriid oocysts were suspended in 2% (w/v) dipotassium dichromate in water and then incubated at 25°C for several days to observe morphological characteristics of sporulated oocysts, as necessary. Samples with parasite eggs/oocysts detected in any of the 3 tests were determined to be positive.

Of the 53 alpacas examined, 48 (90.6%) had at least 1 parasite species. Among these positive cases, 30 were co-infected with 2 or more parasites (here, *Eimeria punoensis* and/or *E. alpacae* are counted as 1 species). The prevalence of each gastrointestinal parasite is summarized in Table 1. The typical appearance of the eggs/oocysts of each parasite is shown in Figs. 1 and 2. Of the helminths, *Nematodirus* sp.

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Table 1. Prevalence of gastrointestinal parasites in alpacas raised in Japan (n=53)

Parasite species	# Positives in each technique			# Positives[b)]	Prevalence (%)	Range in EPG/OPG[c)] (median)	
	Direct smear	Flotation	Sedimentation[a)]				
Nematodirus sp.	0	7	0	7	13.2	5–60	(5.0)
Trichuris sp.	3	4	4	6	11.3	0–5	(5.0)
Capillaria spp.	0	3	0	3	5.7	5–10	(5.0)
Moniezia sp.	0	1	0	1	1.9	1,565	
Eimeria punoensis and/or *E. alpacae*	19	35	24	37	69.8	0–705	(30)
E. macusaniensis	2	3	2	4	7.5	0–250	(18)
E. lamae	1	1	1	1	1.9	85	

a) One drop (about 25 μl) of sediment was examined for each sample. b) Samples with parasite eggs/oocysts detected in any of the 3 tests were determined positive. c) EPG/OPG was determined based on the result of flotation technique, thus can be 0 when no parasite was detected in this technique.

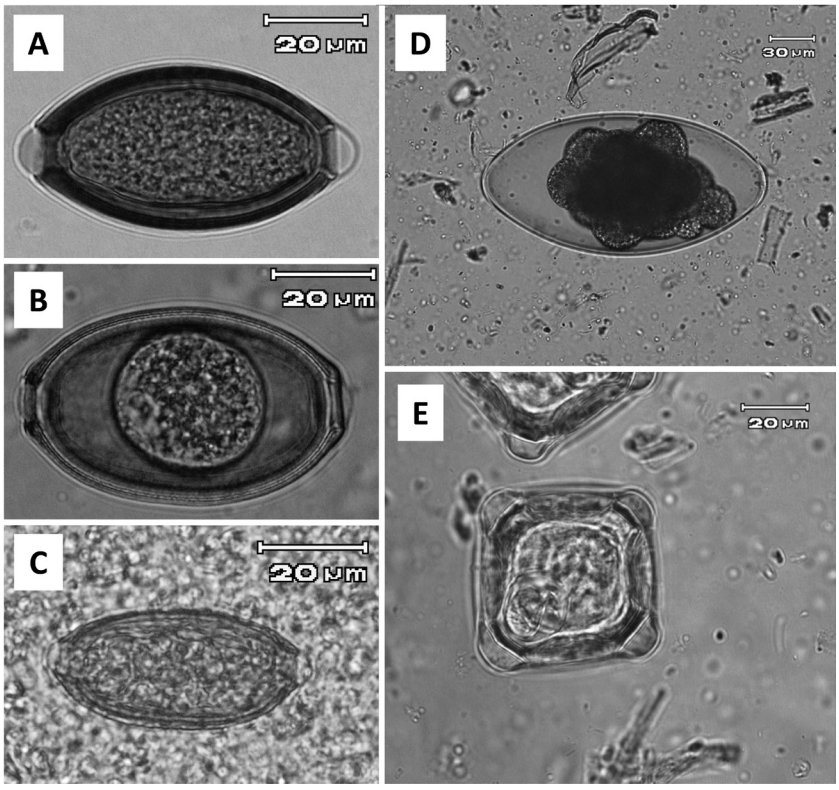

Fig. 1. Parasite eggs found in feces of alpacas raised in Japan. A) *Trichuris* sp., B) *Capillaria* sp., C) *Capillaria* sp., D) *Nematodirus* sp., E) *Moniezia* sp.

was most prevalent, followed by *Trichuris* sp. and *Capillaria* spp. We detected 2 types of *Capillaria* eggs that differed in shape and size. The size of the larger ranged from 74.7–84.7 × 44.0–46.0 μm with barrel-shape, whereas that of the smaller was 54.0 × 23.3 μm with elongated-shape. Eggs of *Moniezia* sp., morphologically similar to those of *Moniezia benedeni*, were detected in 1 animal. In addition, unidentified strongyle-type eggs were observed in 27 animals.

Of the protozoan parasites, oocysts of *E. punoensis* and/or *E. alpacae* were most prevalent. The presence of these 2 *Eimeria* species was confirmed by morphological observation of sporulated oocysts found in representative samples. However, oocysts of the 2 species were not differentiated for all fecal samples, because of their close resemblance in morphology. The EPG/OPG for each parasite is shown in Table 1.

The results of this study revealed for the first time that alpacas raised in Japan have gastrointestinal parasitic fauna basically similar to that described in previous reports [1, 5]. SAC including alpacas have at least 5 species of *Eimeria*: *E. punoensis*, *E. alpacae*, *E. lamae*, *E. macusaniensis* and *E. ivitaensis* [1, 5]. These 5 species are considered common in alpacas and llamas [3]. Of these, the first 4 species were detected in this study for the first time in Japan, whereas *E.*

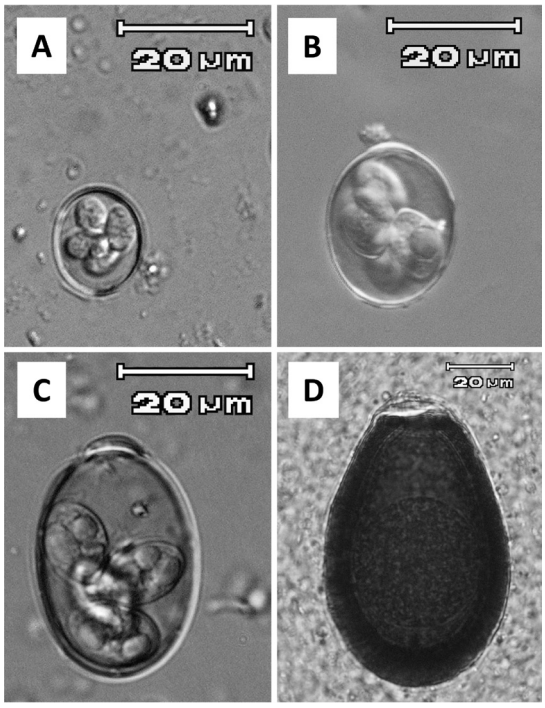

Fig. 2. Eimeriid oocysts found in feces of alpacas raised in Japan. A) *Eimeria punoensis*, B) *E. alpacae*, C) *E. lamae*, D) *E. macusaniensis*. A–C are sporulated, whereas D is unsporulated.

ivitaensis was not found in this survey. These 4 *Eimeria* species were most likely introduced into Japan by host animals from foreign countries, because these eimeriids show high host specificity. Co-infection with *E. ivitaensis* and *E. macusaniensis* is highly pathogenic to animals [9]; therefore, newly introduced alpacas should be carefully examined for infection with these parasites.

On the other hand, some of the parasites found in this study may have been transmitted from domestic ruminants to alpacas after they were imported to Japan. SAC share many parasites with domestic sheep, goats and cattle [1]. Some of the helminths detected, such as *Moniezia* sp., are relatively common among ruminants in Japan. Since the farm was located in a dairy area, we suspect that parasite transmission occurred between domestic ruminants and alpacas.

In the present study, zoonotic parasites were not found. However, *Cryptosporidium parvum* has been transmitted from infected alpacas to humans [10], and even healthy alpacas can shed *Cryptosporidium* oocysts [2]. Because alpacas are popular in petting zoos in Japan, we should take care to minimize the risk of transmitting infection from alpacas to humans.

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REFERENCES

1. Ballweber, L. R. 2009. Ecto- and endoparasites of new world camelids. *Vet. Clin. North Am. Food Anim. Pract.* **25**: 295–310. [Medline] [CrossRef]
2. Burton, A. J., Nydam, D. V., Mitchell, K. J. and Bowman, D. D. 2012. Fecal shedding of *Cryptosporidium* oocysts in healthy alpaca crias and their dams. *J. Am. Vet. Med. Assoc.* **241**: 496–498. [Medline] [CrossRef]
3. Cafrune, M. M., Marín, R. E., Rigalt, F. A., Romero, S. R. and Aguirre, D. H. 2009. Prevalence of *Eimeria macusaniensis* and *Eimeria ivitaensis* in South American camelids of Northwest Argentina. *Vet. Parasitol.* **162**: 338–341. [Medline] [CrossRef]
4. Cebra, C. K. and Stang, B. V. 2008. Comparison of methods to detect gastrointestinal parasites in llamas and alpacas. *J. Am. Vet. Med. Assoc.* **232**: 733–741. [Medline] [CrossRef]
5. Fowler, M. E. 2010. Parasites. pp. 231–270. *In*: Medicine and Surgery of Camelids, 3rd ed., Wiley-Blackwell, Ames.
6. Gomez-Puerta, L. A., Lopez-Urbina, M. T., Alarcon, V., Cama, V., Gonzalez, A. E. and Xiao, L. 2014. Occurrence of *Giardia duodenalis* assemblages in alpacas in the Andean region. *Parasitol. Int.* **63**: 31–34. [Medline] [CrossRef]
7. Leguía, G. 1991. The epidemiology and economic impact of llama parasites. *Parasitol. Today (Regul. Ed.)* **7**: 54–56. [Medline] [CrossRef]
8. Nasu Alpaca Farm. 2009. Smile Alpaca. Kenchiku Shiryo Kenkyusha, Tokyo (in Japanese).
9. Palacios, C. A., Perales, R. A., Chavera, A. E., Lopez, M. T., Braga, W. U. and Moro, M. 2006. *Eimeria macusaniensis* and *Eimeria ivitaensis* co-infection in fatal cases of diarrhoea in young alpacas (*Lama pacos*) in Peru. *Vet. Rec.* **158**: 344–345. [Medline] [CrossRef]
10. Starkey, S. R., Johnson, A. L., Ziegler, P. E. and Mohammed, H. O. 2007. An outbreak of cryptosporidiosis among alpaca crias and their human caregivers. *J. Am. Vet. Med. Assoc.* **231**: 1562–1567. [Medline] [CrossRef]
11. Windsor, R. H. S., Teran, M. and Windsor, R. S. 1992. Effects of parasitic infestation on the productivity of alpacas (*Lama pacos*). *Trop. Anim. Health Prod.* **24**: 57–62. [Medline] [CrossRef]