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SHORT COMMUNICATION

Diversity and prevalence of parasitic infestation with zoonotic potential in dromedary camel (*Camelus dromedarius*) and fat-tailed sheep (dhumba) in Bangladesh

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ABSTRACT

Objective: Parasitic infestation is a major cause of losses in livestock production in tropical regions. A cross-sectional study was conducted to determine the prevalence of Gastro-intestinal (GI) parasites of dromedary camel (*Camelus dromedarius*) and fat-tailed sheep (dhumba), and the prevalence of hemoparasites in camel from Dhaka, Bangladesh.

Materials and Methods: A total of 87 fecal samples (32 dhumba and 55 camel) and 55 camel blood samples were collected during September–October 2015. Fecal samples were examined by direct smear, sedimentation method, flotation technique, and McMaster technique for GI parasite. Giemsa stained blood smears were examined under microscope for hemoparasite detection.

Results: 62% camel (*n* = 34; 95% confidence interval (CI): 47.7–74.6) were infected with at least one genus of parasite. 15% camel were harboring more than one genus of parasite. The prevalence of GI parasite and hemoparasite in camel were recorded as *Trichuris* spp. (*n* = 16; 29%; 95% CI: 17.6–42.9), *Balantidium coli* (*n* = 12; 22%; 95% CI: 11.8–35.0), *Trichostrongylus* spp. (*n* = 7; 13%; 95% CI: 5.3–24.5), *Strongyloides* spp. (*n* = 5; 9%; 95% CI: 3.0–20.0), *Anaplasma* spp. (*n* = 5; 9%; 95% CI: 3.02–20.0), *Paragonimus* spp. (*n* = 1; 2%; 95% CI: 0.05–9.7), *Schistosoma* spp. (*n* = 1; 2%; 95% CI: 0.05–9.7), *Hymenolepis* spp. (*n* = 1; 2%; 95% CI: 0.05–9.7), *Moniezia* spp. (*n* = 1; 2%; 95% CI: 0.05–9.7), and *Babesia* spp. (*n* = 1; 2%; 95% CI: 0.05–9.7). Mean EPG feces of camel was 291.76 ± 42.03 with a range of 0–1,400. Total 59.4% dhumba (*n* = 19; 95% CI: 41–76) were positive for GI parasite, including *Trichostrongylus* spp. (*n* = 10; 31.3%; 95% CI: 16.1–50), *Strongyloides* spp. (*n* = 9; 28%; 95% CI: 13.8–46.8), *B. coli* (*n* = 5; 15.6%; 95% CI: 5.3–32.8), and *Trichuris* spp. (*n* = 4; 12.5%; 95% CI: 3.5–28.9).

Conclusions: High percentage of parasitic infestation in camel and dhumba in the present study refers to the necessity of use of anthelmintic for health and production improvement and to prevent zoonotic parasite transmission to animal handler and workers.

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Introduction

Single humped camel (*Camelus dromedarius*; Dromedary) and fat-tailed sheep (Dhumba) are well-known livestock species, reared mainly for meat or milk, skin, and wool. They are mostly reared in desert areas of Africa, the Middle East, and South Asia [1]. 94% of the world's camel populations are found in the Horn region of Africa. Dhumba comprises 25% of the world's sheep population; some well-known dhumba breeds are Afrikaner, Damara, Persian Black Head, Tswana, Pedi, Sabi, Karakul, Awassi, Balkhi, etc [2]. Camel and dhumba are not usual animals for Bangladesh. But these species are of high economic value during religious

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festival in our country. Only one established camel farm is found in Bangladesh, which excels in camel farming as well as dhumba farming [3]. The farm was established with six imported camel from India in 2006. Since then, the farmer was able to do successful breeding of camel and the number of animal is increasing.

Parasitic infestation is a major constraint for profitable livestock production in tropical and sub-tropical countries. Parasites directly or indirectly affect the production by reducing fertility and work capacity, decreasing food intake, and lowering weight gain and milk production, and lead to mortality in heavily parasitized animals. Public health is in danger because of zoonotic parasites. Fat-tailed sheep and camel are more resistant to disease than other domesticated livestock. But different types of parasites have been identified in dromedaries and sheep from various countries [4–8]. The only study on camel of Bangladesh reported gastro-intestinal (GI) parasite prevalence as 27.9%, 26.3%, and 26.2% in 2012, 2013, and 2014, respectively; zoonotic parasite *Fasciola hepatica* was detected in that study [9]. Previously, *F. hepatica* [4] had been identified in dromedary, responsible for hydatid disease and fascioliasis in human.

Knowledge about parasitic infestation in dromedary camel and dhumba and their zoonotic significance is very scarce in Bangladesh. Hence, the present study was conducted to provide preliminary information about prevalence and type of GI parasite of dromedary camel and fat-tailed sheep, and hemoparasites of camel. The study will provide information on common parasites of camel and dhumba and will help to create awareness among the farmers for regular use of anthelmintic and hygienic management. It will also be helpful to prevent zoonotic parasite transmission from these species to animal health workers.

Materials and Methods

Ethical approval

The study protocol was reviewed and approved by the Animal Ethical Experimentation Committee (AEEC) of Chittagong Veterinary and Animal Sciences University (CVASU), Bangladesh (CVASU/Dir-(R&E)-AEEC/2015/927) and the University of California, Davis (Institutional Animal Care and Use Committee #16048).

Sample collection and laboratory techniques

Samples were collected opportunistically as part of a larger study through the United States Agency for International Development (USAID) Emerging Pandemic Threats PREDICT project during September–October 2015 from a farm and a livestock market in Dhaka. The number of sample represented the total camel and dhumba population at the time of sampling. Because the farm was the only camel farm in Bangladesh at that time and the selected livestock market was the only place where camels and dhumba were kept for selling during the festival, all the camel and dhumba present at that time were included in the study for sampling.

Around 36 camel and 12 dhumba fecal samples from farm and 19 camel sample and 20 dhumba samples from market were collected. A total of 87 fecal samples (55 camels, 32 dhumba) were collected in leak-proof small glass bottles containing 10% formalin. Direct smear, sedimentation technique for trematode, and flotation technique for nematode and protozoa (McMaster technique to determine eggs per gram-EPG) were used (Fig. 1). Slides were initially examined under compound light microscope in wet mounts under low magnification (10×) to trace, followed by high magnification (100×) for identification of eggs or parasites [10,11]. Eggs of particular genera and adult parasites were identified based on morphological characters (shape and shell structure) and size [10]. Information was collected on the feeding system and source of water of the animals to trace back the source of parasites.

Blood samples were collected only from the camels. Ten mL of blood was collected from each camel via jugular venipuncture and kept in vacutainer containing Ethylene diamine tetraacetic acid (EDTA). Direct blood smear was prepared and stained with Giemsa solution for detecting hemoparasites.

Statistical analysis

Demographic data (location, age, sex, body condition, etc.) of each animal were collected and entered into Microsoft Excel-2007 (Microsoft Corporation, Redmond, WA 98052-6399 USA) along with the result of coproscopy. The data

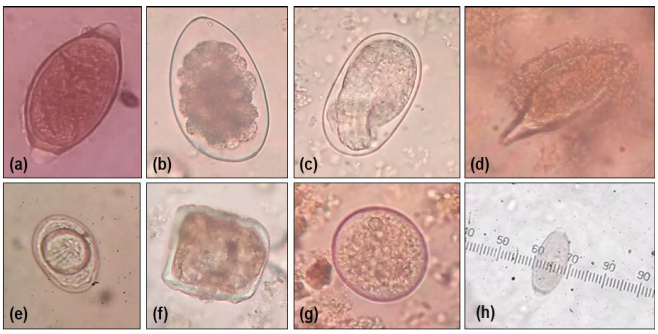

Figure 1. Egg of (a) *Trichuris* spp., (b) *Trichostrongylus* spp., (c) *Strongyloides* spp., (d) *Schistosoma* spp., (e) *Hymenolepis* spp., (f) *Moniezia* spp., and (g) *B. coli* found from camel samples, Dhaka, Bangladesh 2015. (h) Measurement of parasites' egg by McMaster technique.

Table 1. Prevalence of parasites in dromedary camel (*Camelus dromedarius*) and fat-tailed sheep (Dhumba) in Dhaka, Bangladesh, 2015.

Types of parasite	Name of parasites	Camel (*N* = 55)		Dhumba (*N* = 32)	
		Positive *n* (%)	95% CI	Positive *n* (%)	95% CI
Nematode	*Trichuris* spp.	16 (29.1)	17.6–42.9	4 (12.5)	3.5–28.9
	Trichostrongylus spp.	7 (12.7)	5.3–24.5	10 (31.3)	16.1–50.0
	Strongyloides spp.	5 (9.1)	3.0–20.0	9 (28.1)	13.8–46.8
Trematode	*Paragonimus* spp.	1 (1.8)	0.05–9.7	-	-
	Schistosoma spp.	1 (1.8)	0.05–9.7	-	-
Cestode	*Hymenolepis* spp.	1 (1.8)	0.05–9.7	-	-
	Moniezia spp.	1 (1.8)	0.05–9.7	-	-
Protozoa	*B. coli*	12 (21.8)	11.8–35.0	5 (15.6)	5.3–32.8
Hemoparasites	*Anaplasma* spp.	5 (9.1)	3.02–20.0	-	-
	Babesia spp.	1 (1.8)	0.05–9.7	-	-
Mixed infection		8 (14.6)	6.5–26.7	-	-

were imported to STATA 13 (StataCorp, 4905, Lakeway Drive, College Station, TX 77845) for analysis. Prevalence of GI parasite according to location (market versus farm), age (Camel > 3 years adult, < 3 years juvenile; Dhumba > 6 months-adult, < 6 months-juvenile), sex, and Body condition score (BCS; < 3-Poor, 3-Fair, > 3-Good) was estimated along with their 95% confidence interval (CI).

Results

The overall prevalence of GI parasite was 62% (*n* = 34; 95% CI: 47.73–74.59) in camel and 59.4% (*n* = 17; 95% CI: 40.65–76.30) in dhumba. Among 55 sampled camel, 34 (61.8%; 95% CI: 47.7–74.6) were infected with at least one type of parasite. We detected three nematodes (*Trichuris* spp., *Trichostrongylus* spp., and *Strongyloides* spp.), two trematodes (*Paragonimus* spp. and *Schistosoma* spp.), two cestodes (*Hymenolepis* spp. and *Moniezia* spp.), protozoan (*Balantidium*), and two hemoparasites (*Anaplasma* spp. and *Babesia* spp.) in camel (Fig. 1). *Trichuris* spp. was most prevalent nematode (29%) in camel than other nematodes identified. The only GI protozoa found in camel was *Balantidium coli* (22%). 15% camel (*n* = 8; 95% CI: 6.5–26.7) were infected with more than one type of parasites. Mean EPG feces was 291.76 ± 42.03 with a range of 0–1400. Two hemoparasites were detected, *Anaplasma* spp. (9%) and *Babesia* spp. (2%), after Giemsa staining (Table 1).

Out of 32 dhumba, 59.4% (*n* = 19; 95% CI: 41–76) were found to be positive for GI parasites. Four genera of parasites were identified in dhumba (Fig. 2). The highest prevalence was for *Trichostrongylus* spp. (*n* = 10; 31.3%; 95% CI: 16.1–50) followed by *Strongyloides* spp. (*n* = 9; 28%; 95% CI: 13.8–46.8), *B. coli* (*n* = 5; 15.6%; 95% CI: 5.3–32.8) and *Trichuris* spp. (*n* = 4; 12.5%; 95% CI: 3.5–28.9) (Table 1). Animals from market, female animals, adults, and animal with poor body condition, were found to be more parasitized (Table 2).

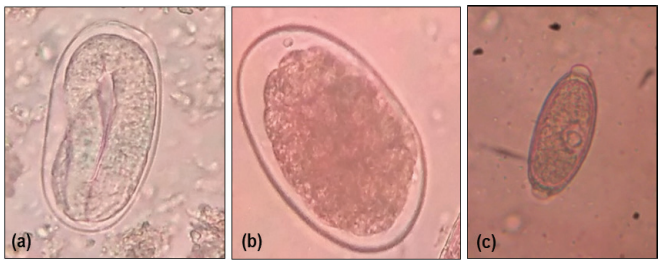

Figure 2. Egg of (a) *Strongyloides* spp., (b) *Trichostrongylus* spp., and (c) *Trichuris* spp. found in Dhumba fecal samples, Dhaka, Bangladesh 2015.

Discussion

The study estimated the prevalence of different GI parasites in dromedary camels and fat-tailed sheep and the prevalence of hemoparasites in camels of Bangladesh. To the best of the authors' knowledge, no previous study reported the prevalence of GI parasite in fat-tailed sheep and hemoparasites in camel in Bangladesh till date.

The overall prevalence of GI parasite was 62% in camel, similar to the findings of [12]. But previous studies reported both higher [13,14] and lower [15] percentage of GI parasite in camel than our study. One study from Bangladesh reported GI parasitic prevalence (26.2%–27.9%) much lower than our findings [9]. Trematode, cestode, nematode, and protozoa were identified in this study,

Table 2. Parasitic prevalence in dromedary (*Camelus dromedarius*) camel and fat-tailed sheep (Dhumba) in Dhaka, Bangladesh 2015, based on different variables.

Variables	Category	Camel (*N* = 55)			Dhumba (*N* = 32)		
		N	*n* (%)	95% CI	*N*	*n* (%)	95% CI
Location	Animal market	19	13 (68.4)	43.5–87.4	20	12 (60)	36–80.9
	Farm	36	21 (58.3)	40.8–74.5	12	07 (58)	27.7–84.8
Sex	Male	29	15 (51.7)	32.5–70.6	15	06 (40)	16.3–67.7
	Female	26	19 (73.1)	52.2–88.4	17	13 (76)	50.1–93.2
Age	Adult	44	30 (68.2)	52.4–81.4	25	17 (68)	46.5–85.1
	Juvenile	11	4 (36.4)	10.9–69.2	7	02 (29)	3.7–70.9
BCS	Good	30	18 (60.0)	40.6–77.3	6	0 (0)	0.00–45.9
	Fair	6	3 (50.0)	11.8–88.2	21	14 (66.7)	43–85.4
	Poor	19	13 (68.4)	43.4–87.4	5	5 (100)	47.8–100

which were also previously identified in camel [5,16,17]. Hence, the study indicates a frequent infection of camel with different parasitic species.

The study identified nematodes (*Trichuris* spp., *Trichostrongylus* spp. and *Strongyloides* spp.), trematodes (*Paragonimus* spp. and *Schistosoma* spp.), cestode (*Hymenolepis* spp. and *Moniezia* spp.), protozoa (*B. coli*), and hemoparasites (*Anaplasma* spp. and *Babesia* spp.) in dromedary. These genera of parasites were similar to the reports from Jordan, India, Pakistan, Somalia and Tanzania [12,13,16,17,18].

Nematode was the most commonly found parasites than other type of helminth in one-humped camel [5,14,19]. *Trichostrongylus* spp., *Trichuris* spp., and *Strongyloides* spp. were found in camel from different regions but percent prevalence varies with the present study [14,19]). Another study reported *Trichuris* sp. in Bactrian camels close to our estimated prevalence (32%) [15]. Moniezia (1.9%) in one-humped camel of Nigeria had similar infection level to our studied camel [20].

A total of 291.76 ± 42.03 eggs were detected per gram of camel feces with a range of 0–1,400. Average helminth eggs in Bactrian camel was found to be 0–191 eggs/gm and 51.96 ± 13.82 by [15], much lower than our findings. But in another study, mean EPG for nematode in dromedaries was 1,831 with a range of 100–21,200 [21], which is many times higher than our findings.

In case of fat-tailed sheep, prevalence of GI parasite was 59.4% in the present study. Previous study conducted in native sheep of Bangladesh reported comparatively higher prevalence (94.67%) of GI parasite [22]. Relatively high prevalence in domestic sheep had also been reported from other countries like Pakistan (72%) [23] and Ethiopia (75.8%) [24]. On the other hand, lower prevalence of GI parasites was estimated in India and Pakistan [25–27].

The helminths and protozoan recorded from fat-tailed sheep in this study were *Trichostrongylus* spp., *Strongyloides* spp., *Trichuris* spp., and *B. coli*. The most prevalent parasite was *Trichostrongylus* spp. (31%). Trichostrongylus is commonly found in small ruminants like sheep and goat, although the prevalence found to be much lower previously [7]. Similarly, *Strongyloides* spp. and *Trichuris* spp. were found in varied percentage in sheep throughout the world [7,8,28]. Previous studies from Bangladesh on domestic sheep (*Ovis aries*) reported prevalence of *Trichuris ovis* (3.67%–58.29%) [22], *Trichostrongylus* spp. (34.55%) [22], and *Strongyloides papillosus* (4%) [29].

The dissimilarity in the prevalence of parasites clearly indicates that infection rate varies from one geographical region to another and from species to species. Hot and humid condition is favorable for development and survival of parasite [28]. The study was conducted during the rainy season (September–October), most favorable for the accomplishment of parasites' life cycle [30]. Therefore, drinking water and animal feeds become contaminated and lead to higher prevalence of parasitic diseases in the rainy season.

The only protozoa identified in camel and dhumba was *B. coli*, which was previously been identified in domestic sheep of India (3.37%) [28]. *B. coli* was found in both one-humped and two-humped camels of Iran and in young camel of Bahrain [5,31]. The study also identified *Anaplasma* spp. (9.1%) and *Babesia* spp. (1.8%) in camel. Prevalence of *Anaplasma* spp. infection is nearly similar (7.2%) with the findings from China on Bactrian camels [32] and lower than a study conducted in one-humped camel of Tunisia (17.7%) [33]. *Babesia* spp. was found in both one-humped and two-humped camel of Iran [5] and in one-humped camel of Egypt with a high prevalence (11.8%) than the present study [34].

Different species of Trichuris, Trichostrongylus, Schistosoma, Hymenolepis, Balantidium, and Anaplasma infect human with a various degree of pathogenicity. Common route of infection for most of them is contaminated feed or water. Detection of so many zoonotic parasites in camel and dhumba in the study implies unhygienic condition of farm and market, contaminated water supply to the animals. These parasites can easily be transmitted to human handlers as they have frequent contact with these species. Moreover, the sampled farm followed cut-and-carry system of feeding. Same was applied for the market. So these could be an important source of the parasite in the sampled animals if the grasses were not supplied after proper washing.

Camel and dhumba from the market were more infected than that of farm. As the sample size was lower, the CI were overlapping and insignificant. Higher prevalence of GI parasites was found in female fat-tailed sheep (76%) and camel (73.1%) than that of male in the study. A previous study from Indore on slaughterhouse sheep reported higher prevalence in female [35]. Similarly, female camel was reported to be more infected than male in the study conducted by [21], although the prevalence was much higher than our study. The infection in female could be attributed to genetic predisposition and differential susceptibility due to hormonal control. During pregnancy and peri-parturient periods, female animals have a stressed and immune-suppressed condition that makes them susceptible to disease although they share similar husbandry practice with male [36]. Moreover, the discrepancy in prevalence may be influenced by the smaller sample size of the present study.

Adult fat-tailed sheep and camel were more parasitized than that of juvenile in this study which is in agreement with [15,19,37], because juveniles feed on milk while adult ones live on many different sources of feed, which predispose them to various source of infection. Similarly, camel and dhumba with poor body condition are harboring more parasites than others. The immunity of animals decreased with the advancement of age and due to poor management practices [37].

Conclusion

The study identified different GI parasites and hemoparasites in dhumba and camel, some of which have zoonotic importance. Furthermore, we studied the determinants which might be associated with a high prevalence of diverse GI parasites. This information will convey an important message to farmers and practitioners for parasite control strategies, especially the zoonotic ones. Regular use of anthelmintic and hygienic management should be implemented in farms in order to control the parasites and to prevent the transmission of zoonotic parasites from animal to farm personnel. Future studies should be implemented to identify the genus of the parasites for better control strategies.

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Conflict of Interest

The authors declare that there is no conflict of interest.

Authors' contribution

Ariful Islam and Shariful Islam conceived the study. Shariful Islam collected the samples. Md Kaisar Rahman, Md Helal Uddin, Sazeda Akter, and Md Hafizar Rahman carried out the laboratory examination. Ariful Islam, Jinnat Ferdous and Md Kaisar Rahman did the data analysis. Ariful Islam and Jinnat Ferdous prepared the manuscript. All authors reviewed, corrected and finally approved the manuscript.

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