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Prevalence of gastrointestinal parasites in Tibetan sheep in alpine zone of North Sikkim, India

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ABSTRACT

Prevalence of gastrointestinal (GI) parasites in native Tibetan sheep (*Ovis aries*), a critically endangered small ruminant of North district of Sikkim, India was studied during July 2014 to June 2015. Of the 213 animals examined, 71 (33.33%) were found positive for different GI parasites. The overall prevalence of different parasites recorded was strongyles (67, 31.46%), coccidia (52, 24.41%), *Strongyloides* spp. (41, 19.24%), *Moniezia* spp. (37, 17.37%), *Nematodirus* spp. (25, 11.73%), amphistomes (12, 5.63%), *Dicrocoelium* spp. (9, 4.22%) and *Trichuris* spp. (8, 3.76%). The faecal egg counts (eggs per gram of faeces, epg) of nematodes ranged from 100 to 2700 with higher load during rainy and post rainy seasons. A higher infection rate was recorded in animals above 2 years of age (39.29%) followed by 1 to 2 year (24.14%) while those below 1 year of age showed only 13.33% prevalence and the parasites mostly recorded were *Haemonchus* spp., *Eimeria* spp. and *Moniezia* spp. The seasonal distribution of parasitism indicated a higher percentage of infestation in autumn (44.26%) and summer (37.74%) as compared to spring (31.92%) and winter (17.31%).

Keywords: Gastrointestinal parasites, Prevalence, Sikkim, Tibetan sheep

Parasites and infectious diseases of wildlife are a major threat to conservation of endangered species (Bogale *et al.* 2014). Thus, there is a great need for studying and documenting the prevalence of parasites among endangered species. Among the livestock, sheep rearing has gained an importance due to its short generation interval, higher prolificacy and the ease with which it can be reared, marketed and used as a resource to supplement the income of landless labourers and small marginal farmers (Molla and Bandyopadhyay 2016).

Tibetan sheep is considered as critically endangered species. The animal is important not only from conservation point of view but it has also enormous economic importance as most of the villagers of higher altitude are dependent on this animal for their livelihood. The gastrointestinal parasitic infections of goats and sheep have been investigated in different climatic environments of India (Swarnkar *et al.* 2014, Dabasa *et al.* 2017, Pal *et al.* 2017, Dappawar *et al.* 2018) and world (Gizachew *et al.* 2014, Raza *et al.* 2014, Eke *et al.* 2019, Kanal *et al.* 2019). However, the prevalence of gastrointestinal helminthes parasitizing the Tibetan sheep in alpine and dry climatic environment in Phalung-valley of North Sikkim, India, has not been investigated previously. Literature is available on the incidence of helminth infection in sheep and yaks in Sikkim (Pal *et al.* 2013, Pal *et al.* 2014, Pal *et al.* 2015). The aim of this investigation was to determine the prevalence of gastrointestinal parasitism in Tibetan sheep as monitored by faecal egg counts during 12-month period in the Tibetan sheep of a selected alpine zone of North Sikkim.

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MATERIALS AND METHODS

Faecal samples of 213 Tibetan sheep of both sexes and different ages were collected from Phalung valley of North Sikkim situated at an elevation of 5,250 to 6,000 m amsl of Sikkim between July 2014 to June 2015, and subjected to qualitative and quantitative examination of gastrointestinal parasites (Soulby 1982) and the parasites were identified by examining the eggs (Soulby 1982).

RESULTS AND DISCUSSION

The overall prevalence of the different gastrointestinal parasitic infections of the Tibetan sheep showed that *Haemonchus* spp. infection was most common in Tibetan sheep (24.49%) followed by *Moniezia* spp. (16.33%), *Strongyloides* spp.(12.24%), *Nematodirus* spp. (10.21%), *Dicrocoelium* spp. (8.16%) and amphistome spp. (4.08%) with a EPG range of 100–1800 (Table 1). Gastrointestinal parasitism involving only one species was found in 6.12%

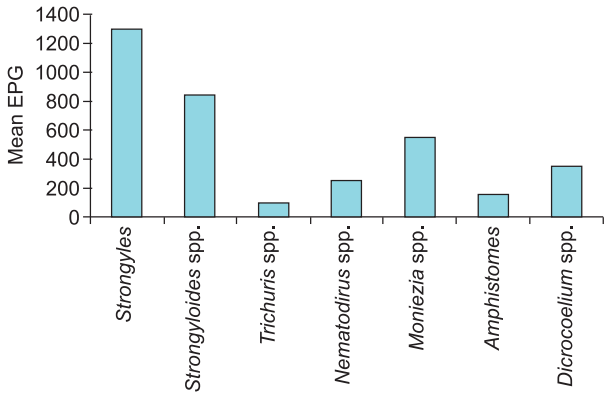


Fig. 1. Mean EPG of gastrointestinal helminth parasites in Tibetan sheep of Phalung valley in alpine zone of North Sikkim.

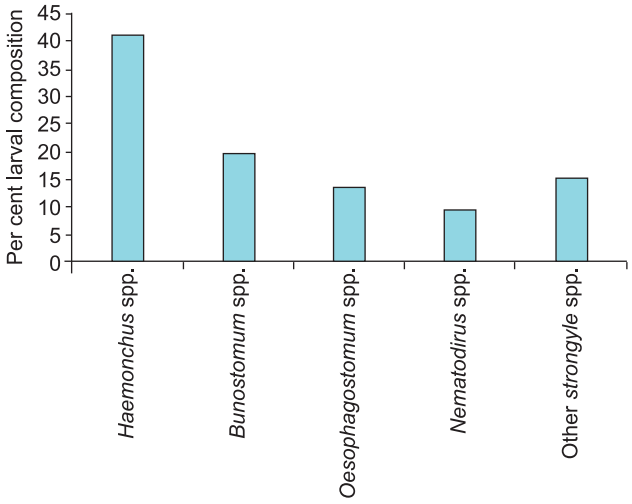


Fig. 2. Prevalence of different species of infective larvae of strongyle group of nematodes in Tibetan sheep of Phalung valley in alpine zone of North Sikkim.

of the samples and two or more species in 20.41%. The most frequent cases of multiple parasitism was formed among nematodes. Different gastrointestinal parasites and their effects were well studied and reported elsewhere in the country and world in sheep and goats (Bhat *et al.* 2012, Lone *et al.* 2012, Bogale *et al.* 2014) which are biologically related with Tibetan sheep. *Haemonchus contortus*, *Oesophagostomum columbianum*, *Bunostomum* spp., *Nematodirus* spp., *Ascaris* spp., *Trichostrongylus* spp. and *Trichuris* spp were most commonly mentioned as gastrointestinal parasites of yak (Pal *et al.* 2013, Pal *et al.* 2014). The only cestodes observed in the study area was *Moniezia* spp. The pathogenic significance of this parasite is not well understood. However, occurrence of this parasite in the alpine dry zones is associated with the ingestion of orbatid mites infected with cysts of *Moniezia* spp. A variety of factors like grazing habits, level of education and economic capacity of the farmers, standard of management and anthelmintic used can influence the prevalence of helminthes (Bhat *et al.* 2014).

There was a significant difference in prevalence of parasites with respect to season. The highest prevalence rate was observed during the autumn (44.26%) and the lowest during the winter (17.31%; Table 2). The seasonal

Table 1. Prevalence and degree of infection by gastrointestinal parasites recorded in Tibetan sheep in North Sikkim (N=213)

Parasite	Infected animals (%)*	Degree of infection (%)	Low	Moderate	Severe
Flukes	Amphistomes	12 (5.63)	7 (3.23)	4 (1.88)	1 (0.47)
	Dicrocoelium spp.	9 (4.22)	5 (2.35)	3 (1.41)	1 (0.47)
Cestodes	*Moniezia* spp.	37 (17.37)	23 (10.81)	11 (5.16)	3 (1.41)
Nematodes	Strongyles	67 (31.46)	17 (7.98)	22 (10.33)	28 (13.15)
	Strongyloides spp.	41 (19.24)	6 (2.82)	14 (6.57)	21 (9.86)
	Trichuris spp.	8 (3.76)	5 (2.35)	2 (0.94)	1 (0.47)
	Nematodirus spp.	25 (11.73)	15 (7.04)	7 (3.29)	3 (1.41)
Coccidia	*Eimeria* spp.	52 (24.41)	21 (9.86)	17 (7.98)	14 (6.57)
Total		71 (33.33)	33 (15.49)	27 (12.67)	11 (5.16)

*Total numbers and overall percentage of an animal exceeds expected values because of multiple gastrointestinal parasitism.

Table 2. Seasonal distribution of gastrointestinal parasite abundance, epg range and mean epg counts using coprological examination of examined Tibetan sheep and degree of EPG

Season	No. of examined Tibetan sheep	Percentage of egg positive sheep	EPG range	Mean epg count	EPG category (%)		
					Low	Moderate	Severe
Spring (March–May)	47	15 (31.92)	200–1100	617.58	3 (6.38)	7 (14.89)	5 (10.64)
Summer (June–August)	53	20 (37.74)	500–2700	1453.37	2 (3.77)	5 (9.43)	13 (24.53)
Autumn (September–November)	61	27 (44.26)	400–2100	1100.31	4 (6.56)	6 (9.84)	17 (27.87)
Winter (December–February)	52	9 (17.31)	100–500	323.12	5 (9.62)	3 (5.77)	1 (1.92)
Total	213	71 (33.33)	100–2700	873.595	14 (6.57)	21 (9.86)	36 (16.91)

Table 3. Parasite-wise seasonal prevalence in Tibetan sheep of Sikkim using coprological examination (n=213)

Parasite	No. of animals infected (n=47) (%)	Percentage (%)	No. of animals infected (n=53)	Percentage (%)	No. of animals infected (n=52)	Percentage (%)	No. of animals infected (%)	Percentage %	No. of animals infected (n=213)	Percentage %
Strongyles	14	6.57	19	8.92	25	11.73	9	4.22	67	31.46
Strongyloides spp.	7	3.29	14	6.57	17	7.98	3	1.41	41	19.24
Trichuris spp.	1	0.47	2	0.94	4	1.88	1	0.47	8	3.76
Nematodirus spp.	10	4.69	15	7.04	7	3.29	3	1.41	25	11.73
Amphistomes	2	0.94	5	2.35	4	1.88	1	0.47	12	5.63
Dicrocoelium spp.	1	0.46	4	1.88	3	1.41	1	7.69	9	4.22
Eimeria spp.	8	3.76	18	8.45	20	9.34	5	2.35	52	24.41
Moniezia spp.	6	2.82	10	4.71	17	7.98	4	1.88	37	37.37
Total	*15	31.92	20	37.74	27	44.26	9	17.31	71	33.33

*Total no. of animals affected is less than the summation of individual infection because same animal was infected with more than one type of gastro-intestinal parasite; n, total number.

pattern observed was that more eggs were found from June (end of pre-monsoon) to July/August. In the summer (rainy) and autumn (post-rainy) seasons, higher mean egg counts and animals found positive were recorded as compared to any other season with the highest epg counts of 2100.34 and 2000.33, respectively (Table 2). With the beginning of the winter from December onwards, the mean total egg count reduced to low level, steadily decreasing to a minimum of 450.50 epg in January; it then rose sharply with the increase in rainfall. The greater proportions of study animals (29.36%) were with moderate EPG while fewer (16.81%) showed low to severe infection rates (Table 1). The distribution of eggs was significantly different ($P<0.001$) among seasons. The rainy and post-rainy season had higher egg counts compared with both the winter and spring. The prevalence rates in the summer (75.29%) and autumn (74.54%) were significantly higher than the spring (64.23%) or winter (51.33%) (Table 2). During these periods, two peaks were identified in March/April and August/September. However, gastrointestinal parasitic infection was determined to occur throughout the year, which is in agreement with the reports of Kapoor (2013) in Kullu valley and Bhat *et al.* (2012, 2014) in Kashmir valley of India.

The high prevalence during the rainy and post-rainy seasons may be due to favourable conditions for the development of larvae in the host and environment, and also the availability of intermediate host (Lone *et al.* 2012). High rainfall in spring also helps in providing suitable molarity of salt present in soil, which is an important factor for ecdysis (Soulsby 1982). Thus, the presence of sufficient feed during rainy season could in turn increase the nutritional status, and these well-fed animals developed good immunity that suppressed the fecundity of the parasites. Relatively low infections recorded during winter could be associated with the absence of or harbouring of immature larvae and/or low level of infection because of little or no rain during the period and the faecal pellets rapidly dried out causing minimum chances for infection. The migration of infective larvae on grass blades was more in autum, where all the pre-parasitic activities were low in winter due to scanty rainfall (Molla and Bandyopadhyay 2016).

Further analysis of data revealed that the Tibetan sheep below 1 year of age are more susceptible to gastrointestinal parasite infection than above 1 year of age. These results are closely related to the findings of Bhat *et al.* (2014), Molla and Bandyopadhyay (2016). Thus, age is an important factor in the onset of infection because immunity played a greater significant role in the establishment of parasites in the host body. Raza *et al.* (2007) observed that the age of animal has a significant influence on the level of risk of gastrointestinal infections in sheep with higher prevalence in young animals than adults. Molla and Bandyopadhyay (2013) reported that the younger (80%) were more susceptible to nematode infection in comparison to older animals (62.5%). The cause of variation on the

Table 4. Influence of age, sex and body condition on the occurrence of gastrointestinal parasitism in Tibetan sheep using coprological examination

Variable	Category	No. of Tibetan sheep examined	No. of positive animals (%)*	EPG category (%)		
				Low	Moderate	Severe
Age	Group A (Below 1 years)	15	2 (13.33)	2 (13.33)	-	-
	Group B (1–2 years)	58	14 (24.14)	3 (5.17)	4 (6.91)	7 (12.07)
	Group C (above 2 years)	140	55 (39.29)	6 (4.29)	12 (8.57)	37 (26.43)
Sex	Female	152	47 (30.92)	4 (2.63)	16 (10.52)	27 (17.76)
	Male	61	24 (39.34)	5 (8.19)	5 (8.21)	14 (22.95)
Body condition	Poor	47	22 (46.81)	3 (6.37)	6 (12.77)	13 (27.66)
	Good	166	49 (29.52)	13 (7.83)	27 (16.27)	9 (5.42)

*Values in parenthesis indicate percentage prevalence.

basis of age is difficult to explain but it might be due to the fact that with the advancement of age, vigour of the animal become better and they develop resistance against the parasitic diseases through frequent challenge and expel the ingested parasites before they establish infection (Pal *et al.* 2017).

Sex-wise prevalence of gastrointestinal parasites was higher in male in comparison to female. The findings of the present study are in agreement with the study of other authors who reported that prevalence of gastrointestinal parasitic infection of sheep was higher in males than females (Gauly *et al.* 2006, Raza *et al.* 2007). Molla and Bandyopadhyay (2013) established that prevalence of gastrointestinal parasitic infection of Bonpala sheep was higher in male (76.67%) in comparison to female (63.33%). Although sex plays a significant role in the preponderance of gastrointestinal parasitic infection in the present study; management, environmental and climatic conditions have a greater role to play in the onset of gastrointestinal parasite in Tibetan sheep despite the gender difference as in the present study and by various observers in other parts of the world.

This is the first study about the gastrointestinal parasites affecting Tibetan sheep in Phalung valley in the alpine zone of North Sikkim, India. Therefore, lack of previous surveys create difficulty in comparing and contrasting of the results obtained in the current investigation. Hence, the present study may serve as baseline for future monitoring of gastrointestinal parasitism in this sheep and may contribute to the protection of these endangered animals which help in sustaining the production system and livelihood of highlanders. The present observations indicated the importance of gastrointestinal helminth parasites in Tibetan sheep in all seasons, age groups and both sexes and poly-parasitic nature of the diseases which underlines the need for further studies that may help to design appropriate strategies to control these parasites.

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