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A Baseline Study on Gastrointestinal Helminths Fauna of Crossbreed (CB) Karakul Sheep and Crossbreed (CB) Pashmina Goats of Some Selected Areas of Western Ladakh India

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ABSTRACT:
Gastrointestinal (GI) helminth worms are the major constraint to the health and production of sheep and goats worldwide. To ascertain the prevalence and the level of infections a cross-sectional study was conducted in crossbreed (CB)-Karakul sheep and crossbreed (CB)-Pashmina goats raised under the traditional husbandry system in Kargil, Ladakh India from March 2021 to February 2022. A total of 284 faecal samples consisting of 130 CB-Karakul and 154 CB-Pashmina were undergone through parasitological examination followed by standard floatation and sedimentation methods. The level/intensity of infection was determined by performing McMaster counting techniques. The positive samples were subjected to larval culture for identification of genera. The overall prevalence was found to be 66.9% in CB-Karakul sheep and 55.1% in CB-Pashmina goats with one or more GI-helminth parasites. The different genera/ order was found as *Nematodirus spp.* 34.6%, 27.2%; Strongyle nematodes/Strongylid nematodes *(*excluding *Nematodirus spp.)* 22.3%, 21.4%; *Strongyloid spp.* 18.4%, 15.5%; *Moniezia expensa* 17.6%, 13.6%, *Moniezia benedeni* 12.3%, 9.7%, and *Trichuris spp.* 8.4%, 9.7% in CB-Karakul sheep and CB-Pashmina goats respectively. The seasonal prevalence was found maximum infection in spring and minimum infection in winter in both the hosts. However, it was found statistically non-significant (P> 0.05). The average intensity of infection was recorded as very mild (< 500 EPG) in both hosts. The results of this study suggest that appropriate husbandry techniques, adequate veterinary knowledge, and quality nutrition can enhance the health and productivity of CB-Karakul sheep and CB-Pashmina goats in Kargil, a western region of Ladakh.

Keywords:
Gastrointestinal helminth parasites, Crossbreed, Karakul sheep, Pashmina goats, Kargil. Prevalence.

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INTRODUCTION

Production of small ruminants is a desirable attribute for the farmer and small herd rearers in the Kargil district of UT Ladakh owing to low capital input and belonging to a remote area people ultimately depend on rearing the livestock and are capable of thriving their livestock in the communal pasture. Small ruminants are a common sight in rural households, providing essential organic manure, milk, meat, wool, hides, and other everyday necessities. However, the growth and production of small ruminants are constrained by infection of gastrointestinal parasites (Khan et al, 2021) which ultimately cause production loss, weight loss, high mortality in young animals, and highly susceptible to various other health problems. Amongst the parasitic diseases, helminths are the major threat to the growth and production of these animals. Gastrointestinal helminths are the most significant disease-causing agents in veterinary science particularly in livestock which leads to substantial economic losses as a result of a decrease in meat, milk, and wool production (Roeber et al, 2013). Strongyle nematodes belong to the order Strongylida are a significant group of gastrointestinal nematodes that remarkably affect the health of ruminants, generally in tropical areas (Sato et al, 2014).

There are lots of previous studies on GI- parasites of sheep and goats have been reported from erstwhile Jammu & Kashmir such as (Allaie et al, 2018; Ashraf et al, 2022; Bhat et al, 2012; Lone et al, 2012; Shah et al, 2018; Tariq et al, 2008; Yadav et al, 2006). However, till date only a few studies have been reported from Ladakh region (Kuchai et al, 2011; Ashraf et al, 2022; Maqbool et al, 2016). By considering all the information in mind this study was conducted based on the available information on others region of the world with this reason the present study was conducted to ascertain the occurrence of GI-helminth parasites with special attention on CB-Karakul sheep and CB-Pashmina goats reared on pasture of Kargil district of UT Ladakh.

Kargil Ladakh harbour several breed of sheep and goats of which four breed are widely distributed in the region such as Purgi sheep, Purgi goats, CB-Karakul sheep and CB-Pashmina goats. This study was particular emphasized on CB-Karakul sheep and CB-Pashmina goats as these developed a major subsistence in the region. Pashmina goats (*Capra siberica)* is a native breed of Ladakh region particularly reared by changpas in changthang region of Ladakh India. This breed is highly adaptable to harsh cold climatic environment therefore it is raised all over the Ladakh region. This animals is generally reared for their fine wool and being used for the production of luxurious shawls which is a means of subsistence. Crossbreed of Pashmina goats possess both characteristic of Purgi goat and pashmina goats. Which is widely distributed throughout Kargil district.

Karakul is a fat tailed breed which originated in central Asia. This is a unique breed with a great adaptability in cold climatic regions. This breed plays a valuable role in economy globally and provide for many needs of mankind in various ways. The Karakul farm is located in Khumbuthang region of district Kargil Ladakh which is a unique identity having a Karakul farm of India. The department of sheep husbandry Kargil distributed 1 or 2 rams per household annually to the small herd rearers in the region. Rearing of Karakul sheep with other native breed is a traditional practice in the region for their livelihood. As Ladakh known to be tribal area where the maximum population inhabited in a rural areas howsoever the livestock sector is the main subsistence. This breed is well known for their coarse fibre and pelt while their fat tail is the main ingredient of some cuisine. The environmental condition favour's for their development and highly adaptable in cold weather condition. Crossbreed Karakul possess both characteristic of Purgi sheep and Karakul sheep which is reared in further extent in the region.

MATERIALS AND METHODS

Study area

The current study was performed in the Trans-Himalayan region of the cold, arid desert, Kargil Ladakh, India. Kargil is a district of UT Ladakh that covers around 14086 square km area with an altitude range between 8000 to 2300 masl, (meters

above sea level) and a geo-location is 34°34'12.00" N 76°05'60.00" E. The study area has great variation in weather with an extremely harsh cold winter with approximately -25 to -3° C and a moderate summer with 25 to 30° C. Winter is noticed with heavy snowfall due to such conditions the region failed to connect with rest of the state. The study map is depicted in **Figure 1.**

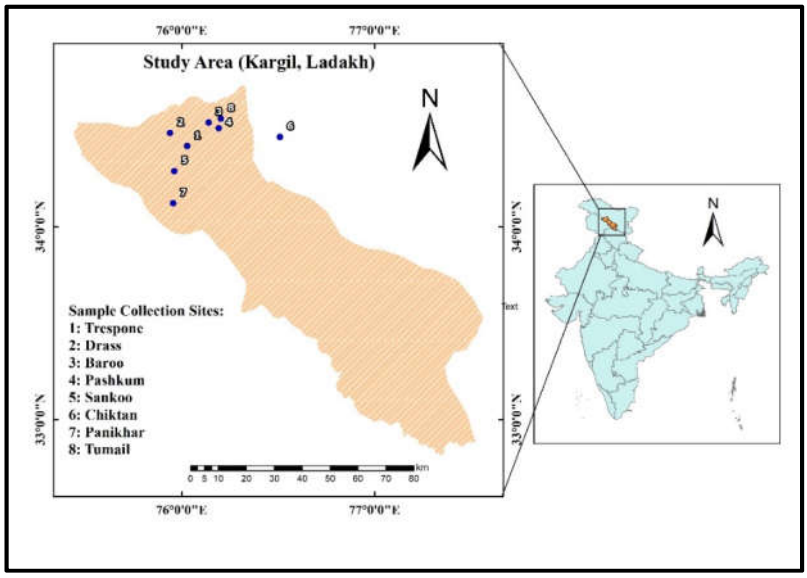

Figure 1: Location map of Kargil, Ladakh displaying study area.

Parasitological examination

A total of 284 faecal samples consisting of 130 from CB-Karakul sheep and 154 from CB-Pashmina goats were directly taken from the rectum using a gloved hand and placed in disposable polythene bags. The sample was brought to the Parasitology laboratory department of sheep husbandry Kargil, without any preservatives added. The samples were first thoroughly inspected to check for dead worms, mucus, blood, and color. Subsequently, they were analysed using conventional sedimentation and flotation methods (Soulsby, 1982). The faecal egg count was ascertained by a McMaster counting technique using the saturated salt solution as a floatation fluid to quantify the eggs (Hansen and Perry, 1994).

Faecal culture and extraction of third-stage larvae (L3)

The faecal culture was performed according to (Hansen and Perry, 1994) with little modification while the third-stage larvae (L3) were identified according to (Van Wyk et al, 2004). An approximately 15-20 grams of positive faecal samples were mixed with an equal amount of vermiculite. The culture took place in 90mm petri plate for 10-15 days. Extraction of larvae took place followed by the baermann funnel, method. The third-stage larvae were identified on the base of the head, no. of intestinal cells, caudal tips, presence or absence of sheath, and sheath tail extension (STE).

Data Analysis

Values were expressed as mean ± S.D. Data were analyzed in MS-Excel 2010, IBM SPSS Statistics-26, and ImageJ. The prevalence of gastrointestinal parasites was calculated as no. of the positive samples divided by the no. of the samples examined. The chi-square test was applied to determine the association of parasites with season. Egg per gram (EPG) was done to examine the level of infection and the values were expressed in mean ± S.D. All the values were analyzed at $P \leq 0.05$ for significance.

RESULTS

A total of 284 faecal samples consisting of CB-Karakul sheep (n=130) and CB-Pashmina goats (n=154) were examined in this study. Of these 172 (60.5%) were found positive for single or multiple GI- helminth parasites. According to preliminary parasitological examination followed by floatation and sedimentation methods three nematodes (*Nematodirus spp., Strongyloid spp., Trichuris spp.*) and two cestodes (*Moniezia expensa* and *Moniezia benedeni*) were reported. Moreover, the faecal culture examination revealed the presence and identification of *Strongyloid spp.* and *Nematodirus spp.* However, it was found difficult to differentiate the Strongyle based on both egg shape and structure as well as faecal culture examinations therefore it was regarded as Strongyle (Order Strongylida).

Overall prevalence and Parasite burden

The overall count of gastrointestinal helminth parasites was found as 66.9% in CB-Karakul sheep whereas 55.1% in CB-pashmina goats **(Table 1)**. The helminth parasites in decreasing order of prevalence (%) were *Nematodirus spp.* 34.6, 27.2; Strongyle (except *Nematodirus*); 22.3, 21.4; *Strongyloid spp.*18.4, 15.5; *Moniezia expensa* 17.6, 13.6; *Moniezia benedeni* 12.3, 9.7, and *Trichuris spp.* 8.4, 9.7 in CB-Karakul sheep and CB-Pashmina goats respectively **(Table 1)**. The *Moniezia expensa* showed the highest average intensity of infections (319.5 EPG in CB-Karakul and 314.2 EPG in CB-Pashmina) followed by Strongyle, *M. benedeni*, *Strongyloid spp., Nematodirus spp.,* and *Trichuris spp.* with least mean intensity of infections in both the hosts **(Table 1).**

Seasonal prevalence

The data revealed the clear seasonality of infection in both CB-Karakul and Pashmina goats with the highest infection in spring and the lowest in winter **(Table 2).** The helminth parasites were found higher with (78.3%, and 75.7%) in spring followed by summer, autumn, and winter with a low prevalence of infection in both CB-Karakul and Pashmina goats respectively. However, it was found statistically non-significant seasonal difference ($p > 0.05$) **(Table 2).**

Table 1: Prevalence of gastrointestinal helminths infections and the intensity of infections in CB-Karakul sheep and CB-Pashmina goats

Variables	CB-Karakul sheep (n=130)					CB-Pashmina goats (n=154)				
	Pos. (%)	EPG (Mean)	Inf.	Sup.	SD	Pos. (%)	EPG (Mean)	Inf.	Sup.	SD
Nematodirus spp.	45(34.6)	144.4	136.3	152.4	46.7	42(27.2)	126.1	118.8	133.3	45.8
Strongyle(excluding *Nematodirus spp.)*	29(22.3)	306.8	296.8	316.7	57.8	33(21.4)	262.5	252	272.9	66.3
Strongyloid spp.	24(18.4)	212.5	204.3	220.6	47.2	24(15.5)	169.6	163.7	175.4	37.3
Moniezia expensa	23(17.6)	358.6	345.9	371.2	73.3	21(13.6)	314.2	301.6	326.7	79.2
Moniezia benedeni	16(12.3)	309.3	284.1	334.4	146.3	15 (9.7)	250	233.1	266.8	106.9
Trichuris spp.	11(8.4)	---	---	---	---	15 (9.7)	---	---	-----	---
Overall count	87(66.9)	370.1	347.6	392.5	130.6	85(55.1)	320	302.1	337.8	112.9

Figure in parenthesis indicates percentage (%);n, examined samples; Pos., prevalence %; EPG, eggs per gram; Inf., lower limit; Sup., upper limit; SD, standard deviation; CB, Crossbred; Strongyle designate order Strongylida.

Table 2: Impact of season on gastrointestinal helminth parasites of CB-Karakul sheep and CB-Pashmina goats of Kargil, Ladakh.

Season	Host	Examined	Positive (%)	P-value	d.f	x^2
Spring	CB-KS CB-PG	37 33	29 (78.3) 25 (75.7)			
Summer	CB-KS CB-PG	29 37	21 (72.4) 22 (59.4)			
Autumn	CB-KS CB-PG	31 41	20 (64.5) 23 (56.0)			
Winter	CB-KS CB-PG	33 43	17 (51.5) 15 (34.8)			
Total	CB-KG CB-PG	130 154	87 (66.9) 85 (55.1)	0.10 0.14	3 3	6.20 5.41
Overall	CB-KS+CB-PG	284	172(60.5)	___	____	

Figures in parentheses indicates percentages; CB-KS: Crossbreed Karakul sheep; CB-PG: Crossbreed Pashmina goats; x^2: chi square value; d.f: degrees of freedom; p-value (significant value at ≤ 0.05).

DISCUSSION

In this study, four nematodes and two cestodes were reported. The overall count of gastrointestinal helminth parasites was found as 66.9% in CB-Karakul sheep whereas 55.1% in CB-pashmina goats. The prevalence of GI-helminth parasites recorded in the present study was found lower than that reported earlier with 83.64% in goats of Ganderbal Kashmir by Lone et al, (2012). However, Tariq et al (2008) reported that the prevalence of GI-nematodes to the tune of 67.34% in sheep of Kashmir Valley while Pandit et al (2003) reported 81.17%. Tariq et al (2010) reported 54.3% prevalence of GI-nematodes fauna in goats of Kashmir valley while Kuchai et al (2011) reported 71.26% GI-helminth parasites in goats of Ladakh region. The results of this study suggest the difference in the prevalence of GI- parasites could be due to several factors such as geographical condition, grazing behaviours, breeds of the animals, management practice, and sample size (Maqbool et al, 2016).

Amongst the GI- nematodes the prevalence of *Nematodirus spp.* was found high with 34.6%, 27.2% in CB-Karakul sheep and CB-Pashmina goats respectively. This result are in closely agreement with that the earlier observed by Maqbool et al (2016) in Pashmina goats of Ladakh. This could be possible that the region is known as cold desert where the temperature falls up to –30°C. Therefore *Nematodirus* infection requires a chilling temperature for hatching (Soulsby, 1982; Van Dijk and Morgan, 2019).

The Strongyle nematode reported in this study was 22.3%, 21.4% in CB-Karakul sheep and CB-Pashmina goats respectively. In contradiction to the present study the prevalence of Strongyle reported earlier with 68.30% and 72.85% by (Bihaqi et al, 2017; Allaie et al, 2018) in goats and small ruminants of Kashmir valley respectively. This could be attributed that the harsh cold and dry temperature is unfavourable for the development of *Strongyle* nematode. *Strongyloid spp.* was reported as 18.4 %, 15.5% in CB-Karakul and CB-Pashmina goats respectively. This findings are in closely coincides with earlier results with 20.1%, 11.11% by (Ibrahim et al, 2014; Hossain et al, 2015) in ovine of western Ethiopia and caprine of Bangladesh respectively. The low prevalence of this *Strongyloid spp.* could be due unfavourable environment for development of

eggs which required an ambient amount of moisture and suitable temperature.

In the present study two *Moniezia* species were recorded viz. *Moniezia expensa* and *Moniezia benedeni*. On the basis of PCR study this has been announced that the *Moniezia expensa* reported mostly in sheep and goats while the *Moniezia benedeni* more common in cattle (Nguyen et al, 2012). The observed prevalence of *Moniezia spp.* was found completely different from (Ashraf et al, 2022; Kuchai et al, 2012) and Maqbool et al (2016) who reported the prevalence of *Moniezia spp.* with 5.11%, 15.0% and 34.15% in Pashmina goats and small ruminants of Ladakh India. The possible outcomes could be the difference in sample size, duration of sample collection, low land/high land, and immunity status of host species. However, the occurrence of *Moniezia benedeni* in both hosts could be due to the sharing of the same shed with single or multiple cattle. A closely resemble result has also been reported from Senegal that the prevalence of *Moniezia expensa* was found 15.4%, and 6.2% in sheep and goats respectively (Ndom et al, 2016). Generally goats follows browsing behaviour which feeds on twigs and leaves this could explain the less interaction with intermediate oribatid mite; another fact is that goats prefer more ligneous food, rich in tannins, which are the known potential natural anthelmintic and probably limit the infection intensity (Achi et al, 2003).

The prevalence of *Trichuris spp.* is in accordance with the findings of (Wani et al 2011; Ibrahim et al 2014) who reported the prevalence of 7.0%, 7.9% in sheep of Kashmir and Ethiopia respectively. Ruhoollah et al (2021) observed that the goats were found more infected by *Trichuris spp.* than the sheep from Khyber Pakhtunkhwa Pakistan.

In this study the intensity of infections were reported lower than the earlier as the overall EPG count was found 454.35±27.85 in the ovine population in Kashmir valley by Tramboo et al (2015), while in Jammu an average EPG was found 1883.33 ± 117.6 in sheep and 1800±110.21 in goats during monsoon season by Khajuria et al (2013). Meanwhile, Saleem et al (2018) reported the mean EPG of gastrointestinal nematode (GIN) was found 2330.0±122.5 in small ruminants raised in private local farm-2 of Jammu province. The low egg per gram (EPG) in this study could be due to various reasons such as an unfavourable environment, rotational grazing, proper management practices, and good supplements.

According to the seasonal prevalence the GI-helminth parasites were found high in spring followed by summer, autumn, and winter in both the hosts. This could be due to the favourable temperature available for the development of L3 in pasture and lowland grazing. The pastoralists of Ladakh followed a seasonal migration system, a semi-intensive management system followed during spring and autumn mostly, an extensive management system followed during summer, and an intensive management system followed throughout winter. Therefore there could be the maximum possible outcomes of infection take place in spring. Generally, in spring the flock spends maximum time on low-land pasture where there could be a high chance of availability of infective stage larvae. Winter has seen high precipitation in the form of snow. The flock was completely penned throughout winter. Therefore, a low chance of infection is observed in winter. Katoch et al (1998) stated that the maximum humidity and moderate temperature promote bacterial growth which ultimately available a source of food for free-living larvae to survive.

Gastrointestinal helminth parasitism is a global problem, which is important to comprehend the depth of epidemiological aspects including prevalence, distribution, and seasonal pattern of transmission in various climatic zones. There is a great role of climatic factors which is convict that climate change may alter the geographical distribution of parasites and their impact on hosts, this situation is linked to the phenomenon of resistance (Charlier et al, 2014).

CONCLUSION

The study was carried out on traditional raised CB-Karakul sheep and CB-Pashmina goats of Kargil Ladakh. Examining 284 faecal samples consisting 130 CB-Karakul sheep, and 154 CB - Pashmina goats revealed the presence of several gastrointestinal parasites viz. *Nematodirus spp.*,

Strongyle nematodes, *Strongyloid spp., Trichuris spp., Moniezia expensa,* and *Moniezia benedeni*. The level of infection reported was very low at which the host exhibits no clinical symptoms, while it is still possible that it would increase in the upcoming years due to sharing of the same pasture/sheds with the exotic breeds. The current study may be seen as a step forward in determining the prevalence of parasites affecting CB-Karakul and CB-Pashmina raised in the region and developing a package of measures for their efficient control.

Abbreviations:
CB- Crossbreed; d.f- degrees of freedom;
EPG- eggs per gram; L3- third stage larvae;
x^2- chi-square

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