



Prevalence of various gastrointestinal parasites and effect of management practices on the parasitic load in Beetal and Bakarwal goats in Jammu

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ABSTRACT

The study was carried out to analyze the effect of management practices on prevalence of parasites in Beetal and Bakarwali goat breeds of Jammu district. A survey of 250 farmer households was conducted to gather the information on rearing, feeding and health management using a questionnaire. Faecal samples were collected to determine the parasitic load based on egg per gram (EPG) and oocyst per gram (OPG) of faeces. Blood samples were collected from animals having severe infection load and tissue samples were collected from animals having infestation of adult parasites. The prevalence rate of infections in goats based on EPG and OPG was moderate. Breed, location and seasons have significant effect on the parasitic load of goat. The management parameters like rearing and feeding systems showed a significant effect on egg per gram and oocyst per gram of faeces. A significant association of parasitic burden on hematological parameters like hemoglobin concentration, PCV, TLC, RBC, MCV, MCH, MCHC, platelets, lymphocytes and monocytes were observed. Histopathological changes were also significant in infected goats. The study concluded that management parameters like housing, deworming, rearing system, feeding systems and seasonal management can significantly affect prevalence of parasitic diseases in these goats.

Keywords: Goat, Hematology, Histopathology, Management practice, Parasitic load

Goat rearing is a reliable source of supplementary income and livelihood for poor people. They contribute to our food basket through meat and milk as well as fur and skin across the world. Goat rearing is adversely affected by many factors including diseases, nutritional deficiency, inadequate genetic potential and subpar management techniques, among which, parasitism negatively affects the economics of goat rearing by hampering animal health, growth rate, and production performance (Nor-Azlina *et al.* 2011). Various factors including genetic makeup of animals, geo-climatic conditions and management practices contribute to predisposing of parasitism in goats (Choubisa and Jaroli 2013). Previous studies have reported influence of season (Qadir *et al.* 2013, Singh *et al.* 2015, Pal *et al.* 2017) and goat breed (Bhattacharjee *et al.* 2021, Dappawar *et al.* 2018, Verma *et al.* 2018) on the prevalence rate of parasites. The effects of severe parasitic infections include anaemia, hypoproteinemia, diminished weight gain, and subpar output (Taylor *et al.* 2007). The gastrointestinal parasites (GIP) infections are generally known to cause serious impact on the major haematological parameters (Amulya *et al.* 2014, Ahmed *et al.* 2015) and have great

significance and indisputable role in assessing health of the animal (Dini *et al.* 2016). Detection of histopathological changes during certain parasitic invasions is particularly important for differential diagnosis and confirmation (Sołtysiak *et al.* 2014). Controlling parasitic diseases in goats, are imperative for economic production of goat. Integrative and sound management practices including housing and pasture management, deworming schedule, hygienic keeping of animals are key to control parasitic infections. In this backdrop, the study was undertaken to investigate the prevalence and impact of management practices adopted by farmers on parasitic load of Beetal and Bakarwali goat of Jammu.

MATERIALS AND METHODS

Sample collection and duration: Samples were collected from migrating and stationary goat flocks from different blocks of Jammu district viz. Jammu, Bhalwal, Bhatindi, R.S Pura and Akhnoor for a period of one year from May 2021 to April 2022. The study area is located about 332 m above sea level (ASL) and having a subtropical climate. The area is divided into four seasons; summer (March to June), monsoon (July to September), post-monsoon (October to November) and winter (December to February) (India Meteorological Department).

Survey of the management practices: Data on management practices adopted by owners were obtained

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from a survey based on a questionnaire randomly from 250 farmers belonging to different villages of Jammu district. The association between parasitic load on selected management practices of goats like rearing and feeding system, breed reared, housing, deworming and disinfection were evaluated.

Study of parasitic load: A total of 250 faecal pellets were collected per-rectally in disposable plastic bag from sedentary and migratory goat flocks and brought to the laboratory (refrigerated in ice-pack) where they were examined within 7 days after collection. Wet smear method was used to confirm the presence of parasitic eggs in the faecal samples followed by floatation and sedimentation techniques (Soulsby 1982) and those found positive were processed and further examined for faecal egg and oocyst counts using the Modified McMaster technique. The total number of eggs/oocyst was determined as follows:

$$\text{Total egg count} = \text{count in (chamber 1 + chamber 2)} \times 50 \text{ eggs per gram (EPG)}$$

The parasitic load of animals was graded based on EPG and OPG counts (Table 1)

Hematological examination: 4 mL blood was collected from infected animals in EDTA tubes. A total of 20 blood samples were analysed using an auto analyzer having model no (MYTHIC18 VET, made in Switzerland). The parameters analyzed were white blood cells (WBC) count, lymphocyte (%), monocyte (%), granulocyte (%), red blood cells (RBC) count, hematocrit, haemoglobin concentration, mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH), mean corpuscular haemoglobin concentration (MCHC) and platelet count.

Histopathological examination of parasite infected tissue samples: Faecal Samples were collected randomly from animals for EPG and OPG counts that were to undergo slaughtering. Further tissues suspected for parasitic infestation were also collected from the same animals after slaughtering. Tissue samples were collected in a jar with 10% formal saline and 30 samples from animals having high faecal egg counts were processed for histopathological examination post-slaughter. The tissue samples were fixed for 24 h which were then dehydrated in ascending grades of alcohol, hardened, cleared, embedded in paraffin, and sectioned at 5-micrometer thickness. The tissues were deparaffinized with xylene and hydrated by alcohol baths and water. Slides were stained with H&E and examined under bright field microscope.

Statistical analysis: SPSS software (Version13.0.,

IBM Corp, Armonk, NY) was used for descriptive analysis (Mean, SE, maximum, minimum, and frequency distribution) on management variables. The impact of management techniques on animal health metric was evaluated using a univariate model of analysis of variance. Fischer's LSD was used for pairwise comparison post-hoc analysis.

RESULTS AND DISCUSSION

Level of parasitic load in the goat population: Fig. 1a depicts the prevalence rate of parasitic infection in studied population. In terms of EPG counts, no infection was detected in 24.8% of animals, 35.2% animals were not infected whereas 21.6%, 34.4% and 8.8% had mild, moderate and severe infection, respectively. Overall, 34.51% infection with helminths was recorded. The highest infection was recorded for strongyle (15.19%), followed by amphistomes (7.49%), Strongyloides (4.81%), Trichuris (3.87%) and Moniezia (3.15%). As for OPG counts, 46.4%, 69.6%, 1.6% and 28.4% samples had no, mild, moderate and severe infection of *Eimeria* infection respectively. No ectoparasite infestation was reported in the animals under present the study.

Parasitism and endoparasitism, particularly in goats, have been reported worldwide from temperate to tropical zones (Choubisa and Jaroli 2013, Raza *et al.* 2014). High overall prevalence of 86.11 percent parasitic infections has been reported in goats of semi-arid region of India (Verma *et al.* 2018). Other studies have also reported moderate prevalence rate (range 50-70%) of endoparasitism in sheep and goats in different regions of India (Dappawar *et al.* 2018). A study by Sharma and Mandal (2013) reported low prevalence of coccidian (36.96-41.81%) and gastro-intestinal nematode infections (23.17-27.23%) in goats in semi-arid rural villages in India. Significant difference in infection intensity for all gastrointestinal parasites with agro-ecological zones (AEZ) have been noted which may be attributed to differences in AEZ's climatic factors, such as temperature, rainfall pattern, aridity index, and humidity, which are known to influence infection intensity and the development of nematode eggs (Zvinorova *et al.* 2016, Dabasa *et al.* 2017). The moderate prevalence rate reported in the present study was in concurrence to earlier studies in Kashmir valley (Bhat *et al.* 2012) and other parts of the country (Singh *et al.* 2013).

Parasitic load in goat breeds under study: The finding of the present study on prevalence of endoparasites in two different breeds (Fig.1b) showed a lower prevalence of

Table 1. Parasitic load of the animal based on EPG and OPG counts (Soulsby, 1982)

EPG (Eggs per gram of faeces)	Degree of infection	OPG (Oocyst per gram of faeces)	Level of infection
<200	Not infected	<1500	Mild
200 – 500	Mild	1500-2000	Moderate
>500 – 1000	Moderate	>2000	Severe
>1000	Severe	-	-

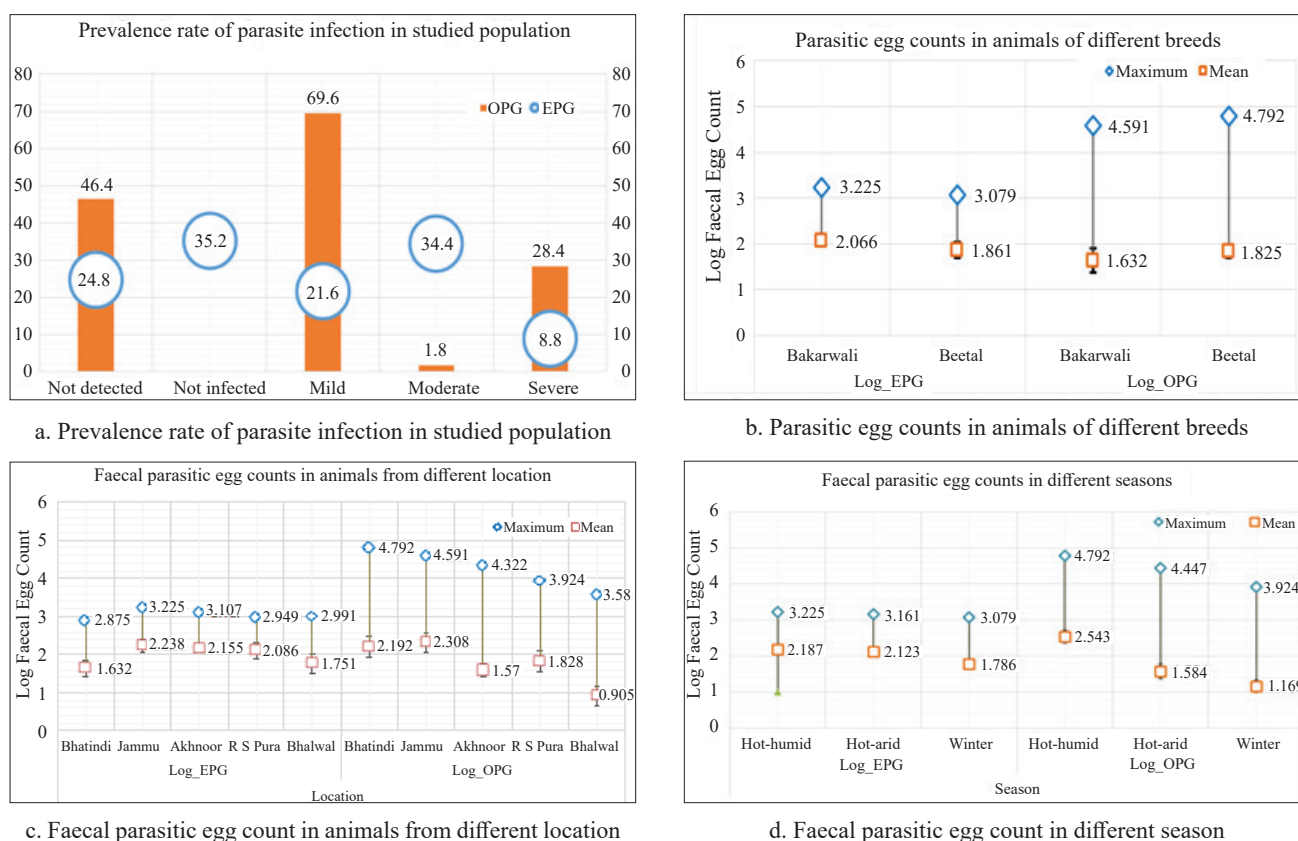


Fig. 1. Parasitic burden levels in goat population of Jammu district

endoparasitism and lower EPG count in Beetal compared to Bakarwal breed. However, the oocyst count was significantly lower in the Bakarwal when compared to Beetal. The results indicated that the Bakarwali breed had

Table 2. Management practices adopted by the farmers and their mean EPG and OPG

Management practice	EPG	OPG
<i>Rearing System</i>		
Intensive System	378.3 ^a ± 50.16	4179.6 ^b ± 1220.2
Semi Intensive	271.4 ^a ± 47.16	5545.7 ^b ± 2228.2
Extensive	508.1 ^b ± 30.694	1378.7 ^a ± 153.8
<i>Feeding system</i>		
Stall fed (No)	518.3 ^a ± 29.67	1558.5 ^c ± 200.84
Stall fed (Yes)	272.54 ^b ± 31.91	4991.3 ^d ± 1355.2
Grazing /Browsing (No)	255.8 ^a ± 31.439	5475.9 ^c ± 1513.4
Grazing/Browsing (Yes)	513.4 ^b ± 28.97	1542.1 ^d ± 195.9
<i>Deworming Statu</i>		
Deworming (No)	784.7 ^a ± 27.69	2814.4 ^a ± 566.51
Deworming (Yes)	216.7 ^b ± 20.11	2339.8 ^a ± 594.6
<i>Farm Disinfection</i>		
Farm Disinfection (No)	465.9 ^a ± 28.28	2351.5 ^a ± 322.4
Farm Disinfection (Yes)	422.8 ^a ± 42.71	2801.9 ^a ± 928.5

Means within each management practice with different superscripts differ at $p < 0.05$

low coccidian load while Beetal had low worm burden. Breed wise variations in prevalence have been reported earlier (Bhattacharjee *et al.* 2021, Dappawar *et al.* 2018, Verma *et al.* 2018). Variation in prevalence rate between Beetal and Bakarwal in this study may be attributed to genetic differences in susceptibility and resistance to GIPs between the breeds of goats. Stear and Wakelin (1998) reported that the ability of animals to resist infections with parasites is genetically determined and therefore varies between individuals or breeds of a given host species. Low FEC is a good indicator of low worm burden and has been recommended as a tool to select for improved resistance to nematodes in goats (Behnke *et al.* 2006, Mandonnet *et al.* 2006).

Parasitic load at different locations under study: The maximum and mean values of EPG and OPG in the animals reared on different locations of Jammu district are depicted in Fig. 1c. The Bhalwal area showed lower OPG and EPG counts in animals. Animals from Bhatindi had lowest EPG but higher OPG counts while animals from Akhnoor showed a reverse trend. Similar result has been reported by Radostits *et al.* (2000), Sutar *et al.* (2010), Mpofu *et al.* (2020). The prevalence and intensity of various GIPs vary from one geographical location to another (Bhowmik *et al.* 2020, Mpofu *et al.* 2020). In this study the variation in prevalence rate at different locations can be attributed to differences in ecological condition such as temperature, rainfall and humidity which influence the bionomics,

distribution and intensity of infection with GIPs or on the basis of difference in management systems of the study areas under which the animals are raised.

Parasitic load at different season: The result showed that season had a significant ($p < 0.05$) effect on faecal egg count (Fig. 1d). Various authors have also linked season to the prevalence or intensity of various GIPs (Sissay *et al.* 2007, Jatau *et al.* 2011, Verma *et al.* 2018, Mpofu *et al.* 2020). The mean values of EPG were highest in hot humid season (July to September) followed by hot arid (April to June) and lowest in winter (October to March). The average temperature, rainfall and humidity in Jammu district during the hot humid season was reported as 27.1°C, 9.16 mm (in) and 77% (IMD 2021). A similar trend of prevalence of parasitic burden in different seasons have been reported in earlier studies (Jitendra *et al.* 2013, Fadunsin *et al.* 2017). Raman *et al.* (2010) also found high prevalence of gastrointestinal parasites in rainy season followed by winter and summer seasons with moderate and low level of infections. It has been argued that climatic conditions during rainy season are generally favourable for transfer, development and survival of parasitic nematodes (Nwosu *et al.* 2007) and the likelihood of animals being exposed constantly to the larval stage of parasites on the ground for grazing leading to a higher rate of parasitic infection in the animals (Debbarma *et al.* 2022). On the contrary, OPG count followed a reverse trend with highest value in winter and lowest value in hot humid summer which is in concurrent to the finding of Mpofu *et al.* (2020) and Dixit *et al.* (2017) and can be attributed to the favourable environment for oocyst sporulation (Bakunzi *et al.* 2010).

Impact of managerial factors on the parasitic load of the animals

Rearing systems: Rearing system had a significant effect ($p < 0.05$) on EPG and OPG counts of animals (Table 2). The mean EPG count was highest under extensive and lowest in semi-intensive rearing system while OPG count was highest in animals reared under semi-intensive and lowest in intensive system of rearing. Similar trends of association of production system and parasitic burden have been reported by earlier studies (Rahmann and Seip 2007, Dey *et al.* 2020). The prevalence of high egg count in extensive system of rearing could be attributed to contamination of grass by L₃ from infected faecal material in flock (Challaton *et al.* 2022). The degree of oocyst infection depends on animal production intensity and dams acting as a carrier of coccidian infection to their kids (Kong *et al.* 1997). It is apparent that rearing of animal unhygienically and in higher numbers in semi-intensive system could lead to higher incidence of coccidia infections.

Feeding systems: The system of feeding management had significant effect ($p < 0.05$) on EPG and OPG counts in animals (Table 2). The mean EPG values were higher in the flocks in which grazing is practiced as compared to stall fed which can be attributed due to contact of animals with the intermediate hosts or larval stages of endoparasites during grazing. This finding is in accordance to Prasanna *et al.*

(2020). In contrast to this, higher OPG values were reported in stall fed animals. The degree of oocyst infection depends on animal production intensity and dams acting as a carrier of coccidian infection to their kids as opined by Kong *et al.* (1997). The higher OPG in stall-fed animals may be attributed to unhygienic housing leading to contamination of feed and water troughs with infected faeces.

Deworming: The study showed that the mean values for EPG and OPG counts were higher in non-dewormed than dewormed animals (Table 2). Deworming has no significant effect on OPG counts but significantly ($p < 0.05$) affected EPG counts in goats. The higher egg counts in dewormed animals suggest ineffectiveness of deworming program like faulty drenching or improper concentration of dewormers (Novobilsky and Hoglund 2015). Use of dewormers in livestock is a routine process by most of the farmers in Jammu district. The animals are recommended to be dewormed twice a year (onset and offset of monsoon) in accordance with the prevailing climatic conditions. The higher OPG counts may occur due to the injudicious use of anticoccidial drugs that can create drug resistance (Stear *et al.* 2007).

Disinfection: Disinfection of animal house (Table 2) helps to reduce the parasitic load, thus improving the production potential of the animals, at the same time acting as a barrier for the transmission of various parasitic diseases too. In contrary, the present study, revealed no significant effect of disinfection on the maximum and mean EPG and OPG counts.

Hematological parameters of parasitic infected animals: Significant variation were observed in hematological parameters of parasitic infected animals compared to healthy animals (Fig. 2). A decrease ($p < 0.05$) in hemoglobin concentration, PCV percent, leucocyte count and RBC count was observed in infected animals' blood compared to normal healthy animals. This may be due to blood sucking activity of the parasites (Amulya *et al.* 2014, Ahmed *et al.* 2015). The reduction in leucocyte count can be credited to the immunosuppression caused by the parasite located inside any organ of the body towards which there can be increased sequestration of these cells. The same results have been reported by Alam *et al.* (2020). Differential leucocytic count showed an increase ($p < 0.05$) in platelet count, lymphocyte%, monocyte%. and increase ($p > 0.05$) in granulocyte%. Increase in the number of lymphocytes and platelets can be attributed towards the increased concentration of histamines secreted because of inflammation and immune responses to fight the parasites inside the body (Feldman *et al.* 2000). An increase in the monocyte and lymphocyte count is evident suggesting of phagocytic activity leading to digestion of parasitic debris. These results are in concurrence with the studies conducted by Ahmed *et al.* (2015).

Histopathological changes in tissues infected with parasitic diseases: Goats are infected by a coccidian protozoan parasite that forms tissue cysts and affects both wild and domesticated animals causing sarcocystosis (Abu-

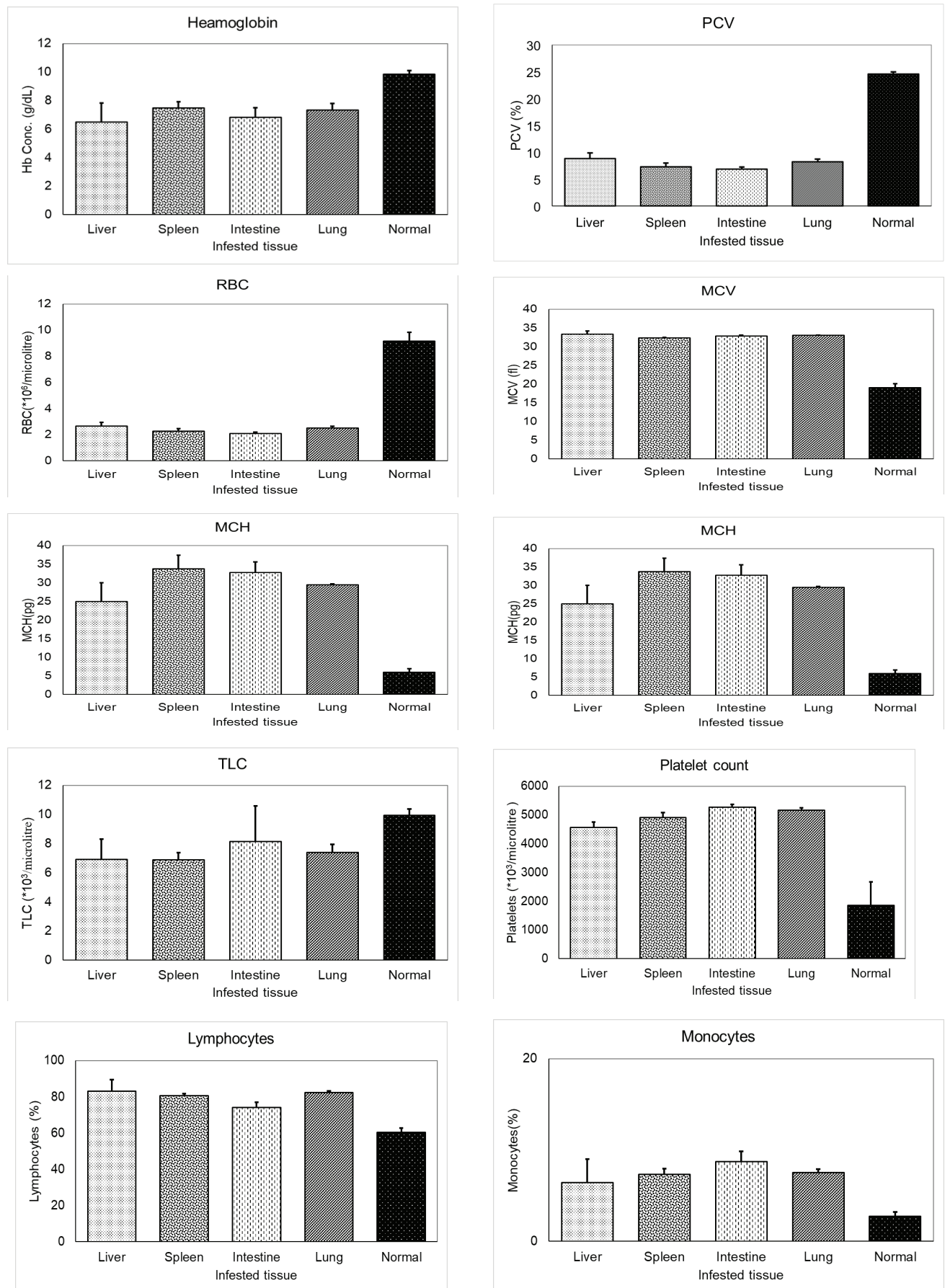


Fig. 2. Hematological parameters in parasite infested animals as compared to normal animals

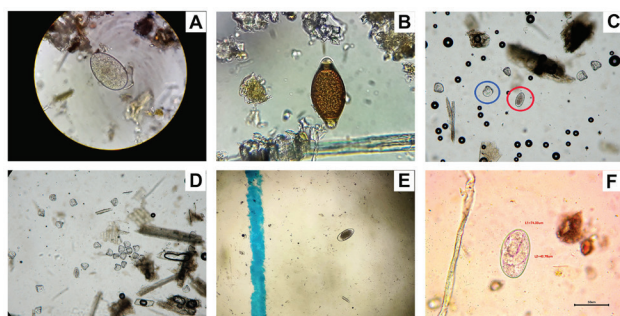


Fig. 3. Microphotographs of parasitic eggs showing (A) trematode egg, (B) nematode egg, (C) mixed cestode and trematode egg, (D) cestode egg, (E) oocyst and (F) nematode egg

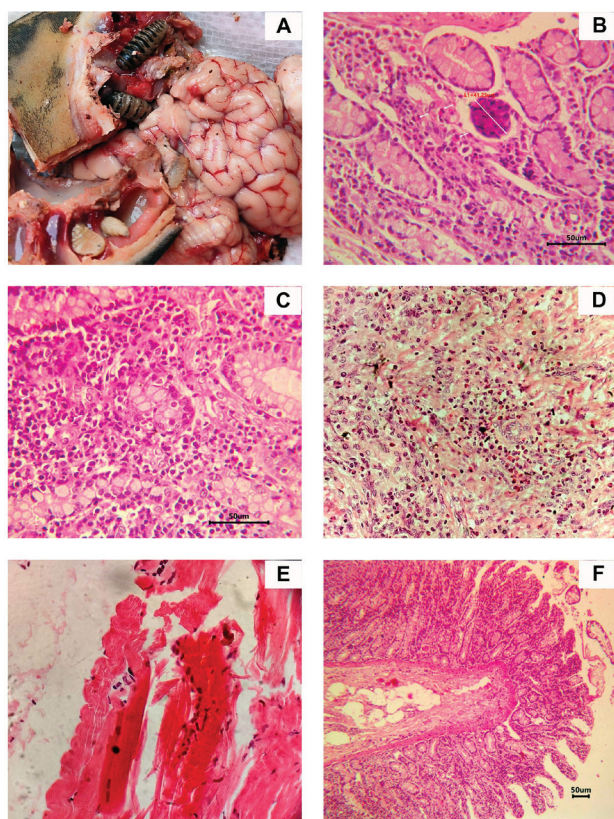


Fig. 4. Histopathological changes in parasite infested tissues showing (A) adult parasite in goat brain, (B and C) oocyst with inflammatory cells including eosinophils in enterocytes, (D) eosinophilic infiltration in hepatic parenchyma, (E) inflammatory changes in muscle tissues and (F) atrophy and epithelial desquamation of enterocytes

Elwafa *et al.* 2015). Histopathological analyses revealed the presence of a sarcocyst with various bradyzoite nuclei in skeletal muscles of infected goats, length 203.3 μ m and width 110.56 μ m, H&E bar 50 μ m (Fig. 3). Muscle atrophy and inflammatory cell infiltration were seen in sarcocystosis. Satish *et al.* (2018) reported similar type of histopathological changes in parasite infected tissues. Presence of an oocyst measuring 41.23 μ m with numerous inflammatory cells including eosinophils were observed

in the enterocytes of infected animals. Infiltration of eosinophils and other inflammatory cells were observed in the hepatic parenchyma in infected hepatocytes. The skeletal muscle tissue of infected animals showed infiltration of inflammatory cells (Fig. 4). Various inflammatory cells such as lymphocytes, plasma cells, macrophage, and eosinophils were observed in the enterocytes of infected animals. Similar changes were seen by Jyothisree *et al.* (2017). Around the oocyst, neutrophils, lymphocytes, and macrophages were the most common cell types.

The present study revealed a moderate prevalence of parasitic infections in the studied population of goats from various areas of Jammu district. The parasitic load in animals of different breeds of goat (Beetal and Bakarwali) varied significantly. A profound effect of seasonal variation was observed on the parasitic load and infection rate in animals. Hot humid season was most favorable for parasitic infections in animals. Management parameters such as housing, deworming, rearing and feeding systems could also significantly affect the prevalence of parasitic diseases in goats. Infection with endoparasites also significantly alter the hematological and histological parameters of animals.

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