Journal of Animal Research: v.8 n.1, p. 39-45. February 2018

DOI: 10.30954/2277-940X.2018.00150.07

Epidemiology of Common Gastrointestinal Parasitic Infections in Goats reared in Semi-Arid Region of India

Rupesh Verma[1], Dinesh Kumar Sharma[2*], Souvik Paul[2], Kumaresan Gururaj[2], Mahesh Dige[2], Vishesh Kumar Saxena[3], Pramod Kumar Rout[2], Saket Bhusan[2] and P.S. Banerjee[4]

[1]Department of Parasitology, Veterinary College, NDVS University, M.P., INDIA
[2]ICAR- Central Institute for Research On Goats, Makhdoom Farah Dist. Mathura (UP), INDIA
[3]ICAR: Central Avian Research Institute, Izatnagar, Bareilly Uttar Pradesh, INDIA
[4]ICAR- IVRI Izatnagar, Bareilly Uttar Pradesh, INDIA

**Corresponding author: DK Sharma; Email: lkofwb@yahoo.co.in*

Received: 04 Sept., 2017 **Revised:** 16 Dec., 2017 **Accepted:** 19 Dec., 2017

ABSTRACT

A total of 1419 faecal samples of goats collected and examined for gastrointestinal parasitic infestations for a period of 9 months (August 2015 to April 2016) revealed overall prevalence of 86.11 percent. The common parasitic infections prevalent were coccidian (71.45%), strongyle (28.40%), *Moniezia* spp. (18.74%) and *Strongyloides* spp. (0.70%). Highest prevalence of coccidia (81.07%) was observed in Jamunapari goats, while highest strongyle prevalence (30.64%) was observed in Barbari goats. Jakhrana goats showed highest prevalence rate of *Moniezia* spp. infection. Age-wise, prevalence of coccidian oocysts was highest in >6-12M age group while higher prevalence of strongyles was observed in > 6M age. *Moniezia* spp. infection, however, was more prevalent in goats of 2-6M age group. Month-wise, prevalence was higher in during September and October. The intensity of coccidian infection in terms of overall least squares means of coccidian oocysts count per gram of faeces (LFOC) was 4.673±.007, while the corresponding least squares means (Transformed value) of eggs per gram of faeces (LFEC) of strongyles and *Moniezia* spp. were 4.628±.002, 4.625±.003, respectively. Factors like breed, age of animal and collection month significantly influenced (P<0.01) the total coccidian and strongyle intensity (faecal oocysts/ eggs count). *Eimeria* infection involved was of mixed nature, while nematode infections showed preponderance of *Haemonchus* spp. The most common *Eimeria* spp. recorded were *E. arloingi* and *E. ninakohlyakimovae.*

Keywords: Goat, epidemiology, gastrointestinal parasites

Goats are reared for milk and meat purpose. They are more adapted to harsh environmental conditions and have ability to efficiently convert low-quality fodder into energy efficient fat, muscle and milk. Goats' demand in food is growing rapidly as they provide the wonderful source of animal proteins. However, gastrointestinal parasite infections, mixed or single species, are major problems affecting goats in tropical and temperate climates (Rahman, 1994; Borgsteede and Dercksen, 1996). The problems like anorexia, general weakness, gastritis, enteritis, diarrhoea, anaemia caused by GI parasites lower the production in goats. Stress factors such as weaning, dietary changes, inclement weather, travel and regrouping are common predisposing factors (Urquhart *et al.*, 1987). The study here deals with epidemiology of common gastrointestinal (GI) parasitic infections affecting goats in the light of various determinant factors like breed, age, sex and various climate conditions.

MATERIALS AND METHODS

Location of work and Animals

The study was conducted at Central Institute for Research on Goats, Makhdoom, Mathura, India, The institute is located at 10°N longitude and 78.02°E latitude and 169m MSL in the ravine of Yamuna river in North India.

The climate of the place is semi-arid with temperature ranging 29-48 °C in summer and 1-10 °C in winters. The vegetation is scarce in sandy soil with salinity of drinking water as high as > 2000 tdn. The goat flocks are maintained here in semi intensive system of goat rearing, characterized with 4-6 hrs grazing in different seasons and daily supplementation of concentrate mix depending on physiological need of the animals and availability of feed fodder in grazing ground. The animals are dewormed routinely with application of anthelmintics viz. Valbazine, twice annually i.e. pre and post monsoon, as scheduled in health care management.

Sample collection and parasitological procedures

A total 1419 faecal samples of goats were collected and examined at CIRG, Makhdoom, Mathura, UP over a period 8 months (August 2015 to March 2016). At the time of sample collection, the breed, age and sex of goats was also recorded. The faecal samples were collected directly from the rectum and examined qualitatively using floatation for evaluating the incidence of infections. For quantification of infections, the oocysts per gram of faeces for *Eimeria* spp. (FOC) and eggs per gram of faeces for strongyles (FEC) in each positive sample were determined by modified McMaster technique (Sloss *et al*., 1994). Identification of the oocysts in the samples was made on the basis of morphological and sporulation characteristics in case of *Eimeria* species and morphology of eggs and hatched out larvae in case of strongyles (Soulsby, 1982; Hansen and Perry, 1994).

Statistical Analysis

Four factor factorial analysis of variance techniques was used to adjudge the influences of sex (male/female), breed, month and age (2-6, >6-12 and above 12 month) along with their possible interactions. Main effects were further compared by Duncan's multiple range tests at 5% level of significance. Data of faecal oocysts/eggs count for kids and adults were subjected to log transformation as it might be skewed. The log transformation was done by adding 100 (FOC/FEC+100) as this transformation was found suitable and appropriate for this data set. The transformed data was used for statistical analysis by SPSS V-16.0 including all main interactions. The results were back transformed by taking antilogarithms of least squares means, subtracting 100 and the final result were presented as Geometric means (GFOC/GFEC).

RESULTS AND DISCUSSION

A total 1419 faecal samples of goats were collected and examined for presence of eggs/ oocysts of gastrointestinal parasites by routine parasitological procedures. Results of analysed data have been described in Table 1-3.

Prevalence of infection

Out of the 1419 animals examined, 1222 (86.05 %) were found positive with one or more parasites. The prevalence of coccidia, strongyles and *Moniezia* spp. was 71.45 (1014), 28.40 (403) and 18.74 (266) percent, respectively (Table 1). Nematode infections showed preponderance of *Haemonchus contortus* while *Strongyloides papillosus infection* was sporadic. *Moniezia* infection involved two common species *Moniezia expansa* and *M. benedeni.* Depending on oocyst shape, size, presence or absence of micropyle, oocyst wall and sporulation time, nine species of *Eimeria* viz. *Eimeria alijevi* (17.65%), *E. apsheronica* (0.14%), *E. arloingi* (36.90%), *E. caprina* (1.01%), *E. christenseni* (18.08%), *E. hirci* (1.15%), *E. jolchijevi* (0.14%), *E. ninakohlyakimovae* (22.28%) and *E. caprovina* (2.60%) were identified (Table 2). *Eimeria arloingi* predominated the eimerian infections and was followed by *E. ninakohlyakimovae.* Age wise analysis of data showed that goats in >6-12M group had higher prevalence of coccidian infections compared to 2-6M and >12M old goats (Table 1).

Sex wise data analysis showed that prevalence of various infections like coccidia, strongyles and *Moniezia* spp. in male goats was 71.55, 30.64 and 14.67 percent, respectively, while corresponding values in females were 71.39, 27.00 and 21.28 percent, respectively (Table 1). Among breeds, Jamunapari showed highest prevalence rate (81.07%) of coccidian infection while highest strongyle (32.43%) and *Moniezia* spp. (32.29 %) prevalence was recorded in Barbari and Jakhrana, respectively (Table 1). During eight months study, the hot and humid months of September and October showed highest prevalence of infection (Fig. 1).

Study revealed that coccidia, strongyles and *Moniezia* species were common gastro-intestinal parasitic infections in goats. Other sporadic infection seen in goats during

Table 1: Prevalence of parasitic infections in goats CIRG Makhdoom

	Total Sample	*Coccidia* (%)	*Strongyles* (%)	*Moniezia* (%)	*Strongyloides* (%)
Overall	1419	71.45 (1014)	28.40 (403)	18.74 (266)	0.70(10)
Age					
2-6 Month	765	70.19 (537)	25.22 (193)	20.00 (153)	0.78(6)
>6-12 Month	343	79.88 (274)	32.06 (110)	26.23 (90)	0.29(1)
>12 Month	311	65.27 (203)	32.15 (100)	7.39 (23)	0.64 (2)
Sex					
Male	545	71.55 (390)	30.64 (167)	14.67 (80)	1.28 (7)
Female	874	71.39 (624)	27.00 (236)	21.28 (186)	0.22(2)
Breeds					
Barbari	632	65.98 (417)	32.43 (205)	16.61 (105)	0.94 (6)
Jamunapari	465	81.07 (377)	25.59 (119)	12.25 (57)	—
Jakhrana	322	68.32 (220)	24.84 (80)	32.29 (104)	0.62(2)
Months					
August	137	72.99 (100)	43.06 (59)	37.22 (51)	0.72 (1)
September	70	80.00(56)	71.42 (50)	44.28 (31)	—
October	350	80.28 (281)	46.85 (164)	22.57 (79)	1.14 (4)
November	145	64.13 (93)	11.03 (16)	20.68 (30)	—
January	412	78.39 (323)	21.11 (87)	15.53 (64)	0.72 (3)
February	96	55.20 (53)	6.25 (6)	—	1.04 (1)
March	83	51.80 (43)	6.02 (5)	7.22 (6)	—
April	126	51.58 (65)	12.69 (16)	3.96 (5)	—

Table 2: Morphological characteristics of different *Eimeria* species in goats

Species	Oocysts	Length × Width (µm)		Average Sporulation time (days)	
		**Reference (Min-Max.)*	*Observed (Min-max)*	*Reference*	*Observed*
Eimeria alijevi	No/inconspicuous micropyle	15-23 × 12-22	14- 22 × 11-22	1-5	1-5
E. apsheronica	Micropyle present	24-37 × 18-26	25-36 × 18-25	1-2	1-6
E. arloingi	Micropyle present with prominent cap	24-33 × 18-25	20-34 × 16-28	1-4	1-6
E. caprina	Micropyle present with cap	30-42 × 20-28	28-39 × 20-29	2-3	1-6
E. christenseni	Micropyle present with prominent cap	32-46 × 20-29	32-48 × 20-30	2-6	1-5
E. hirci	Micropyle present with polar cap	17-19 × 14-22	19-20 × 14-24	2-3	1-6
E. jolchijevi	Micropyle present with polar cap	26-37 × 18-26	26-38 × 19-25	2-4	1-6
E. ninakohlyakimovae	Micropyle present but may be indistinct	19-28 × 14-23	19-28 × 15-23	1-4	1-5
E. caprovina	Micropyle present with polar cap	22-26 × 21-28	22-28 × 21-30	1-4	1-6

Min –minimum, Max- maximum; *Taylor *et al.* 2007.

study was of *Strongyloides* spp. Studies from different parts of India (Singh *et al.*, 2013; Choubisa and Jaroli, 2013; Singh *et al.*, 2015) also revealed high prevalence rates of gastrointestinal parasites up to 94.48 percent. Variations in prevalence of infections can be explained on the basis of genetic variations among breeds and due to variability in management practices like feeding, watering, housing, rearing, stocking rate, health control measures along with varied climatic conditions of geographical area.

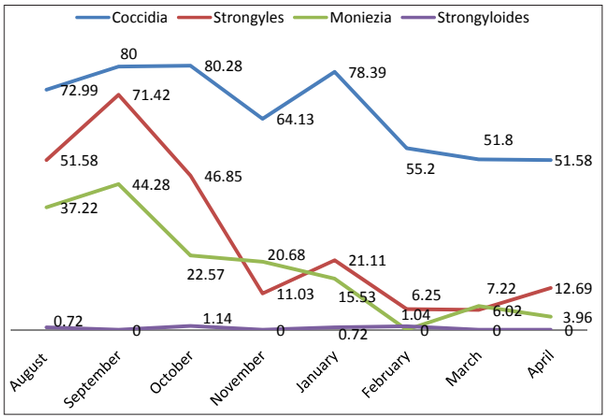

Fig. 1: Month wise percent prevalence of gastrointestinal parasitic infections

Prevalence of coccidian infection (71.45 %) was highest among gastrointestinal parasitic infections in present study. Observations were similar to some other studies conducted in India and abroad (Obijiaku and Agbede 2007; Jatau *et al.,* 2011; Singh *et al.,* 2015) describing coccidiosis as major parasitic problem in small ruminants. Sharma *et al.* (2009) reported coccidian prevalence of 42.86 percent in Jakhrana goats from CIRG, Makhodoom. Nine *Eimeria* species identified in the present study were similar to some previous reports (Sharma *et al.*, 2009; Chartier and Paraud 2012; Balicka-Ramisz *et al.,* 2012). Most frequent and predominant species, *Eimeria arloingi* and *E. ninakohlyakimovae* were also reported earlier (Kumar *et al.,* 2005; Balicka-Ramisz, *et al.*, 2012). The difference in prevalence might be due to geographical and agro-climatic variability, seasons and number of animals included in various studies along with management practices adopted locally.

Strongyle prevalence of 28.40 percent was comparable to previous reports from India (Sharma *et al.* 2009; Singh *et al*., 2013). However, our finding was in contrast to Brahma *et al*. (2015) from West Bengal, India who reported much higher GI helminth prevalence rate of 71 percent. Lower prevalence rate in our study can be attributed to preventive health control measures adopted at the farm at CIRG, Makhdoom. Predominance of *Haemonchus contortus* infection encountered in the present study was similar as reported by some other workers (Faizal and Rajapakse, 2001; Almalaik *et al*., 2008; Ikem *et al*., 2013; Raza *et al*., 2014). The finding can be attributed to the fact that this nematode has a relatively short generation interval and ability to take advantage of favourable environmental conditions. *Strongyloides* spp. infection in the study was similar as described by various workers from India and abroad (Singh *et al.,* 2010; Rabbi *et al.,* 2011; Raza *et al.,* 2014; Khajuria *et al*., 2014) in goats.

The prevalence of *Moniezia* spp. infection (18.74 %) in goats in the study was quite high. Finding was similar to that of Hailelul (2002) from Ethiopia and Hossain *et al.* (2015) from Bangladesh who reported moniezial prevalence of 16.13, 23.81 and 35.56 percent, respectively. High prevalence rate of *Moniezia* spp. infection suggests the availability of intermediate host, the oribated mites.

Faecal oocysts/eggs count (FOC/FEC)

Faecal oocysts/egg counts (FOC/FEC) for coccidia and strongyle infections recorded in goats during the present study have been described as least squares means in Table 3. While overall mean LFOC was 4.673±.007(1403), the overall means LFEC for strongyle worms and *Moniezia* spp. were 4.628±0.002 (461), 4.625±0.002 (401) respectively. Breed-wise Jamunapari had significantly higher LFOC (2229) than Jakhrana (1967) and Barbari (1425) goats.

Age wise analysis of data revealed that there was significant difference ($p<0.01$) in mean LFOC/LFEC in three age groups. The mean LFOC in 6-12 M age group was significantly higher than the corresponding values in 2-6M and> 12 M age group. In contrast, mean LFEC value for strongyles was significantly higher in >12 M age group. Mean LFEC for *Moniezia*, however was significantly higher in 6-12M age group. The age of animal was found to be a determinant factor influencing the FOC/FEC in G.I. parasites affected animals. Month wise mean LFOC/ LFEC in G.I. parasite infected animals were found

Table 3: Factor-wise Least Squares and Geometric Means of FOC/FEC of different parasites

Source of variation	Obs.	Coccidia		Strongyles		*Moniezia*	
		LFOC	GFOC	LFEC	GFEC	LFEC	GFEC
Overall	1285	4.673±.007	1403	4.628±.002	461	4.625±.003	401
Breed							
Barbari	545	4.674 [a]±.009	1425	4.634 [a] ±.003	584	4.620[a]±.004	299
Jamunapari	465	4.714[b] ±.009	2229	4.620 [b] ±.003	298	4.609 [b]±.003	77
Jakhrana	275	4.699 [b] ±.012	1967	4.618[b]±.004	258	4.640 [c] ±.005	708
Age							
1-6 Month	719	4.703 [a] ±.008	2055	4.615 [a] ±.002	197	4.625[a] ±.003	400
>6-12 Month	343	4.699 [ab] ±.012	1967	4.634 [b] ±.004	585	4.618 [a] ±.005	258
>12 month	223	4.655 [b] ±.014	1021	4.647[c] ±.004	854	4.609[b]±.005	77
Sex							
Male	534	4.677±.010	1489	4.624 [a] ±.003	380	4.626±.004	421
Female	751	4.668±.007	1296	4.632[b] ±.002	543	4.624±.003	380
Months							
Aug.	129	4.728 [c] ±.015	2613	4.634 [b] ±.005	585	4.648 [a] ±.006	875
Sept.	70	4.731 [c] ±.019	2681	4.641 [bc] ±.006	729	4.643[a] ±.008	771
Oct.	350	4.680[a] ±.009	1554	4.651 [c] ±.003	938	4.618[b] ±.003	258
Nov.	145	4.658[ab] ±.014	1085	4.609 [a] ±.004	76	4.612 [b] ±.006	137
Jan.	412	4.721 [c] ±.010	2456	4.613 [a] ±.003	157	4.620 [b] ±.004	299
Feb.	96	4.659[ab] ±.017	1106	4.606 [a] ±.005	16	4.605 [b] ±.007	0
Mar.	83	4.633[a] ±.019	564	4.508 [a] ±.006	0	4.606 [b] ±.007	17

*****Means in each main effect bearing same superscript do not differ significantly (P<0.05); * LFOC/LFEC - Least Squares means of transformed faecal oocyst/egg count data; *GFOC/ GFEC- Geometric means of faecal oocyst/egg count data.

significantly different. As such, the LFOC/LFEC in hot-humid months i.e. August, September and October was significant higher. Statistical analysis of data showed that both sexes were equally affected with coccidiosis as mean LFOC/ LFEC in males and female goats were statistically similar.

Age wise data analysis revealed variation in parasites prevalence in different ages of goats. High prevalence rate of gastrointestinal parasites in young animals recorded in the present study is similar to that reported by Sharma *et al.* (2009); Emiru *et al.* (2013) and can be supported by the fact that kids are more vulnerable as compared to adults and worm burdens decrease with increasing age due to immunological maturity acquired after repeated exposure.

Higher coccidian prevalence and mean LFOC in Jamunapari goats compared to Barbari and Jakhrana seems to be more due to variations in management practices than the genetic difference as coccidiosis is a management problem and improved management and veterinary practices can reduce the prevalence of coccidian. Higher strongyle prevalence and mean LFEC in Barbari can be attributed to local goat management at farm or due to physiological status of animals involved in study as Jamumapari has been considered a susceptible breed to *Haemonchus* infection (Nimisha *et al.,* 2012; Nimisha *et al.*, 2015). Higher moniezial prevalence in Jakhrana and Barbari goats can be attributed to probable availability of intermediate host of parasite in the vicinity. The prevalence of GI helminths is governed both by genetics of the host as well as the local management and environmental factors. However, proportional contribution of any factor in particular case is difficult to ascertain.

Effect of sex of animals was not significant except in strongyle infection where mean LFEC was significantly higher in female. Higher mean LFEC of strongyle eggs in females has also been reported by Nimisha *et al.* (2015),

who attributed this variation to physiological status like pregnancy/ lactation which causes dip in natural body resistance in goats against parasites. Maqsood *et al.* (1996) and Sharma *et al.* (2009) also reported higher prevalence of gastrointestinal parasites in females than in males. However, Fikru *et al*. (2006) and Tefera *et al*. (2009) showed that sex of animals did not affect prevalence of gastrointestinal parasites in small ruminants. Contrary to the current results, Ayaz *et al.* (2013) reported that prevalence and intensity of infection were higher in males than females. Higher prevalence of gastrointestinal parasite infection in wet months compared to winter months has been reported by various workers (Nwosu *et al.*, 2007; Sharma *et al*., 2009; Singh *et al*., 2015).

The present study corroborates the previous findings (Table 1). The mean LFOC and LFEC in coccidial and helminthic infections (both strongyle and *Moniezia*), for wet and humid months were significantly higher (Table 3). High humidity and temperature during the post monsoon period are favourable for the development, optimum sporulation/ hatching, survival and translocation of pre-parasitic stages, which might be the precipitating factors for higher prevalence and intensity of infection (LFOC/ LFEC) in wet months. In winter, reduced grazing hours also reduce the chances of contact between the host and parasites leading to lower prevalence in winter months. Further, inclement environmental conditions in winter force the strongyles to go under hypobiosis, resulting reduced egg production.

CONCLUSION

The results of study will help in better understanding of parasitic problem in goats in local farm conditions and emphasize the need based planning of control measures to control GI parasites for ensuring better production.

ACKNOWLEDGEMENTS

Authors duly acknowledge the financial and technical help of Director, Central Institute For Research on Goats, Makhdoom and Director, IVRI, Izatnagar for co-ordinating the research assistance.

REFERENCES

Agrawal N., Sharma, D.K., Mandal, A., Rout, P.K., Kushwah, Y.K. 2015. Dynamics of faecal egg count in natural infection of *Haemonchus* Spp. in Indian goats. *Vet. World*, **8**: 38-41

Agrawal Nimisha, Sharma, D.K. and Mandal, Ajoy 2012. Susceptibility pattern of Jamunapari and Sirohi goats to natural infection with *Haemonchus contortus* in semi- arid region of India. *Indian J. Anim. Sci.*, **82**: 581–585

Almalaik, A.H.A., Bashar, A.E. and Abakar, A.D. 2008. Prevalence and dynamics of some gastrointestinal parasites of sheep and goats in Tulus area based on post-mortem examination. *Asian J. Anim. Vet. Adv.,* **3**: 390-399.

Ayaz, M.M., Raza, M.A., Murtaza, S. and Akhtar, S. 2013. Epidemiological survey of helminths of goats in southern Punjab, Pakistan. *Trop. Biomed.*, **30:** 62-71.

Balicka-Ramisz, A., Ramisz, A., Vovk, S. and Snitynskyj, V. 2012. Prevalence of coccidia infection in goats in Western Pomerania (Poland) and West Ukraine region. *Ann. Parasitol.*, **58**: 167-171.

Borgsteede, F.H.M. and Derckseen, D.P. 1996. Coccidial and helminths infections in goat kept in the Netherlands. *Vet. Parasitol.*, **61**: 321-326.

Chartier, C. and Paraud, C. 2012. Coccidiosis due to Eimeria in sheep and goats, a review. *Small Ruminant Res.*, **103**: 84-92.

Choubisa, S.L. and Jaroli, V.J. 2013. Gastrointestinal parasitic infection in diverse species of domestic ruminants inhabiting tribal rural areas of southern Rajasthan, India. *J. Parasit. Dis.*, **37**: 271-275.

Emiru, B., Amede, Y., Tigre, W., Feyera, T. and Deressa, B. 2013. Epidemiology of gastrointestinal parasites of small ruminants in Gechi District, Southwest Ethiopia. *Adv. Biol. Res.*, **7**: 169-174.

Faizal, A.C.M. and Rajapakse, R.P.V.J. 2001. Prevalence of coccidia and gastrointestinal nematode infections in crossbred goats in the dry areas of Sri Lanka. *Small Ruminant Res.*, **40**: 233-238.

Fikru, R., Teshale, S., Reta, D. and Yosef, K. 2006. Epidemiology of gastrointestinal parasites of ruminants in Western Oromia, Ethiopia. *Int. J. Appl. Res. Vet. M.*, **4**: 51-57.

Hailelul, N. 2002. Study on prevalence of GIT helminths of small ruminants in and around Wolayta Soddo, Southern Ethiopia. DVM Thesis, Faculty of veterinary medicine, Addis Ababa University, Debre-Zeit. Ethiopia, pp. 353.

Hansen, J. and Perry, B. 1994. The epidemiology, diagnosis and control of helminth parasites of ruminants. A handbook. ILCA, Addis Ababa, pp. 40-76.

Ikem, C.O., Rose, N.O., Doris, N.O. and Micheal Awi. 2013. High prevalence of gastro-intestinal parasite in indigenous goats of Nigeria. *Paripex Indian J. Res.*, **2**: 17-19.

Jatau, I.D., Abdulganiyu, A., Lawal, A.I., Okubanjo, O.O. and Yusuf, K.H. 2011. Gastrointestinal and haemoparasitism

of sheep and goats at slaughter in Kano, Northern-Nigeria. *Sokoto J. Vet. Sci*. **9**:7-11.

Kumar L, Sinha, S.R.P., Sinha, S., Sharma, S.K., Mandal, K.G. and Verma, S.B. 2005. Studies on *Eimeria* spp. in goats in and around Patna. *Journal of Veterinary Parasitology*, **19**: 139-141.

Maqsood, M., Iqbal, Z. and Chaudhry, A.H. 1996. Prevalence and intensity of haemonchosis with reference to breed, sex and age of sheep and goats. *Pak Vet. J.,* **16** (1): 41–43.

Nwosu, C.O., Madu, P.P. and Richards, W.S. 2007. Prevalence and seasonal changes in thepopulation of gastrointestinal nematodes of small ruminants in the semi-arid zone of north-eastern Nigeria. *Vet. Parasitol.,* **144**: 118 –124.

Obijiaku, I.N. and Agbede, R.I.S. 2007. Prevalence of coccidiosis and associated pathology in lambs and kids from three contrasting management systems. In: Proceedings of the 44th Annual Congress of the Nigerian Veterinary Medical Association (NVMA), Delta, pp. 229–23.

Rabbi, A.K.M.A., Islam, A., Anisuzzaman, M., Majumdar, S. and Rahman, M.H. 2011. Does feeding system influence parasitism in Black Bengal Goats in Bangladesh. *Progress. Agric.*, **22**: 85-95.

Rahman, W.A. 1994. Effect of subclinical *Eimeria* species infections in tropical goats subsequently challenged with caprine *Haemonchus contortus*. *Vet. Rec.*, **134** (10): 236-237.

Raza, M.A., Younas, M., Schlecht, E. 2013. Prevalence of Gastrointestinal Helminths in Pastoral sheep and goat flocks in the Cholistan desert of Pakistan. *J.* Anim. *Plant Sci.*, **24**: 127-134.

Sani, R.A., Awang, I.P.R. and Sheikh-Omar, A.R. 1985.Incidence and factors effecting endoparasitism in Serdang,West Malaysia. *Kajian Veterinar.*, **17**: 127-131.

Sharma, D.K., Agrawal, N., Mandal, A., Nigam, P. and Bhushan, S. 2009. Coccidia and gastrointestinal nematode infections in semi-intensively managed Jakhrana goats of semi-arid region of India. *Tropical and Subtropical Agroecosystems*, **11**: 135-139.

Singh, A., Hazarika, G.C., Phukan, A. and Hussain, P. 2010. Seasonal incidence of caprine gastrointestinal nematodosis. *Vet. World*, **3**: 321-322.

Singh, A.K., Das, G., Roy, B., Nath, S., Naresh, R. and Kumar, S. 2015. Prevalence of gastro-intestinal parasitic infections in goat of Madhya Pradesh, India. *J. Parasit. Dis.*, **39**:716-719.

Singh, V., Varshney, P., Dash, S.K. and Lal, H.P. 2013. Prevalence of gastrointestinal parasites in sheep and goats in and around Mathura India. *Vet. World*, **6**: 260-262.

Sloss, M.W., Kemp, R.L. and Zajac, A.M. 1994. Veterinary Clinical Parasitology (Ed. 6). Iowa State University Press.

Soulsby, E.J.L. 1982. Helminths, Arthropods and Protozoa of Domesticated Animals. (7th Ed.) ELBS and Bailliere Tindall, London, pp. 809.

Taylor, M.A., Coop, R.L. and Wall R.L. 2007. Veterinary Parasitology. Blackwell Publishing Ltd. Oxford OX4 2DQ, UK.

Tefera, M., Batu, G. and Bitew, M. 2009. Prevalence of gastrointestinal parasites of sheep and goats in and around Bedelle, South-western Ethiopia. *Int. J. Vet. Med.*, **8**(2): 1-6.

Urquhart, G.M., Armour, J., Duncan, J.L., Dunn, A.M. and Jennings, F.W. 1987. Longman Scientific and Technical,(3rd Ed.) Burnt Mill, Harlow, UK, pp. 217-224.