Indian Journal of Animal Sciences **91** (6): 438–442, June 2021/Article
https://doi.org/10.56093/ijans.v91i6.115440

Prevalence of coccidiosis in Andaman local goat and its metaphylaxis in tropical island ecosystem

A K DE[1], P PERUMAL[1]✉, K MUNISWAMY[1], S K ZAMIR AHMED[1], A KUNDU[1], JAI SUNDER[1], R R ALYETHODI[1], S K RAVI[1] and D BHATTACHARYA[1]

ICAR-Central Island Agricultural Research Institute, Port Blair, Andaman and Nicobar Islands 744 101 India

Received: 10 January 2020; Accepted: 28 July 2021

ABSTRACT

This study reports the prevalence of coccidiosis in Andaman local goat, a native goat breed of Andaman and Nicobar Islands, India. The duration of study was one year. Maximum oocyst output was seen in kids of <6 months of age in month of March followed by in November, July, August, October, September, December, May and April. More oocyst count in kids of < 6 months of age compared to those of older goats may be attributed towards higher susceptibility towards this infection. Increase of oocyst output from the month of July was due to increase in relative humidity due to high rainfall. Onset of clinical cases of caprine coccidiosis with high oocyst count was due to fodder crisis in March which imposed stress in animals. Four species of *Eimeria* were detected and most prevalent species in pooled sample was *E. arloingi* (48%), followed by *E. faurei* (20%) and *E. pallida* and *E. parva* (16% each) and among them *E. arloingi* has been seen to be associated with clinical coccidiosis of goats. Amprolium, a potent thiamine antagonist, was used to treat the infected animals with high oocyst count and the compound was found effective @ 50 mg/kg body weight which was evaluated on the basis of oocyst count, improved body weight and clinical recovery. The report is the seminal information on prevalence of coccidiosis, species richness, metaphylaxis and its effect in Andaman local goat from Andaman and Nicobar islands, an isolated insular region of India.

Keywords: Amprolium, Andaman local goat, Coccidiosis, *Eimeria*, Prevalence

Success of goat rearing is mainly dependent on modest feeding requirements. Adaptability of the species in diversified climatic conditions and effective conversion of limited feed resources into meat, milk and hides has proved caprine as one of the important animal resources for sustainable livelihood development in rural economy (Balicka-Ramisz 1999). Andaman and Nicobar islands is home of 57,480 goats (Livestock Census 2012), of which 85% belong to native breed, locally known as Teressa and Andaman Local goat. Parasitic infection causes severe harmful effects through loss of production and mortality (Jalila *et al.* 1998). Coccidiosis, caused by *Eimeria* spp. is an important disease in goats (Pellérdy1974, Arslan *et al.* 1999). Parasitic infection is responsible for reduction of body weight gains up to 40–58% (Faizal *et al.* 1999). This pathogen causes anaemia, imbalance of electrolyte and poor absorption of nutrients. In general coccidiosis in small ruminants is associated with intensive breeding conditions, high animal density and high productivity (Foreyt 1990). Prevalence of gastrointestinal parasitic infection is dependent on changes in season (Malczewski *et al.* 1996). These groups of islands experience two seasons, monsoon and dry season. Further, gastrointestinal epidemics are common during hot and wet seasons compared to dry and cold seasons (Bankunzi *et al.* 2010). From mainland of India, coccidiosis in goats has been reported. To mention a few are 100% infection in kids and 84.61% infection in adult animals from North India (Singh *et al.* 2020), overall prevalence of 86.71% from semi-arid zone of India (Sharma *et al*. 2017) and as well as from hilly tracts of India (Sharma *et al*. 1997). But this information is lacking in Andaman and Nicobar islands. Therefore, prevalence data on coccidiosis in different seasons in these islands will be of great help in formulating control strategy against this disease along with its metaphylactic approach. Because metaphylaxis improves body weight (Foreyt 1990). Compounds like toltrazuril and diclazuril were effective to control coccidiosis in lambs (Gjerde and Helle 1991), calves (Mundt *et al.* 2005) and kids (Ruiz *et al.* 2012). Therefore, a study has been undertaken on prevalence of coccidiosis in Andaman and Nicobar islands in Andaman local goat and its metaphylaxis.

Present address: [1]ICAR-Central Island Agricultural Research Institute, Port Blair, Andaman and Nicobar Islands 744 101.✉Corresponding author e-mail: perumalponraj @gmail.com

MATERIALS AND METHODS

The study was undertaken in South Andaman district of Andaman and Nicobar Islands, situated at 11.623°N and

92.7265°E. Average annual rainfall of South Andaman district is 318 cm and temperature ranges from 24°C to 31°C throughout the year. The goats are reared in semi-intensive system. As a regular practice, animals are not provided with concentrate mixture, anthelmintics and anticoccidial medicines. Very few farmers (10–15%) supplement rice, wheat and wheat bran.

Samples were collected from Andaman local goats from April, 2017 to March, 2018, a total of 1,155 rectal faecal samples were collected from three different age groups, viz. less than 6 months, 6 months to one year and more than one year (Table 1). Samples after collection were transported to the laboratory maintaining cold chain.

Faecal samples were examined to determine oocysts per gram of faeces (OPG) by modified M'c Master technique as per the recommendation of Ministry of Agriculture, Fisheries and Food (MAFF1986).

The isolated oocysts were harvested into a shallow layer of 2.5% (w/v) aqueous potassium dichromate solution and were allowed to sporulate at 25°C. Species of *Eimeria* were identified on the basis of their characteristic morphological features described earlier (Pellérdy1974, Soulsby 1986, Wang *et al.* 2010). Differential oocyst count was performed out of 100 *Eimeria* oocysts identified from pooled faecal sample.

For this study, a total of 30 goats of less than 6 months of age, with history of diarrhoea, dehydration and decreased feed consumption and with more than 3 lakh OPG count were selected.

Amprolium soluble powder (20% w/w; Vetoquinol India Animal Health Pvt. Ltd., Maharashtra, India) was used for anti-coccidial therapy. The animals were divided into three equal groups. The animals were treated with two different doses of the medicine, i.e. 10 mg/kg body weight, 50 mg/kg body weight for 5 consecutive days and rest of the animals were left without treatment. OPG and body weights were monitored at regular interval up to 25 days post treatment.

Data are presented as mean±standard error of mean (SEM). Statistical significance was determined by analysis of variance (ANOVA) using GraphPad Prism 7 software (http://www.graphpad.com).

RESULTS AND DISCUSSION

During the period under report, no oocyst output was observed in February and June in kids of <6 months and 6 months to 1 year of age. Maximum oocyst output (n) was observed in goats of <6 months of age in March (300850±720.33) followed by in November (10354.21 ±123.35), July (5406.66±20.59), August (4000±72.73), October (3232.85±54.83), September (3000±50.00), December (2100±20.59), May (1500±24.55) and April (1470±30.86). This was further observed that, oocyst output was more in kids of <6 months of age as compared to those of other two age groups, viz. 6 months –1 year and >1 year (Table 1). Analysis of weather data at South Andaman district revealed that, the maximum and minimum temperature did not vary much throughout the year. Moreover, occurrence of rainfall was observed throughout the year but the maximum rainfall was recorded in June. The oocyst output in kids (<6 months) suddenly increased to 5406.66±96.47 in July and faecal score remained >2000 up to December. But interestingly, again there was sharp increase of oocyst count in March in kids of < 6 months of age (Table 1). A total of four species of *Eimeria* were detected based on their morphological features. *E. arloingi* was ellipsoidal in shape with distinct micropyle. Sporulation time of the species was 48–72 h. Length and breadth of *E. arloingi* oocysts were 27.9±0.002 µm (range: 27–29 µm) and 20.5±0.001 µm (range: 19–21 µm). The other species was indistinguishable from *E. parva* since the oocysts were sub-spherical in shape, sporulation time varied from 24–48 h and length and breadth of the oocysts were 16.4±0.001 µm (range: 15–17.3 µm) and 14.2±0.001 µm (range: 13.9–14.5 µm) (Fig. 1). The third species was *E. pallida* which could be identified on the basis of its typical ellipsoidal shape, sporulation time (which varied from 20–24 h) and as well as on its length and breadth. The length of *E. pallida* was 14.1±0.001 µm (range: 13.5 –14.2 µm) and breadth was 13.9±0.002 µm (range: 13.5–14.4 µm). The fourth

Table 1. Seasonal prevalence of coccidian infection of Andaman local goat

Month/Age	<6 months (n)	6 months (n)	>1 year (n)	Overall
January	885± 21.10^{a}(30)	248.57 ± 6.93^{b}(40)	28.12 ± 5.64^{c}(40)	240.32±16.84
February	0.00(35)	0.00(30)	0.00(35)	0.00
March	300850 ± 120.33^{a}(30)	270 ± 11.02^{b}(35)	15± 5.07^{b}(16)	75290±509.62
April	1470 ± 30.86^{a}(32)	275 ± 7.41^{b}(30)	42.63 ± 7.18^{c}(35)	247.74±22.00
May	1500±24.55^{a}(35)	350 ± 14.73^{b}(36)	30 ± 7.25^{c}(36)	220.58±18.86
June	0.00^{a}(30)	0.00^{a}(30)	21±6.45^{b}(30)	48.68±6.97
July	5406.66 ± 96.47^{a}(35)	760± 8.68^{b}(30)	70 ± 11.01^{c}(30)	3934±89.10
August	4000 ± 72.73^{a}(32)	760 ± 8.68^{b}(35)	70 ± 11.01^{c}(36)	2960.79±67.94
September	3000 ±50.00^{a}(30)	840 ± 0.00^{b}(31)	31.87 ± 7.64^{c}(31)	4478.57±106.10
October	3232.85 ± 54.83^{a}(32)	617.14 ± 14.68^{b}(35)	95.29 ± 10.16^{c}(31)	1577.50±49.46
November	10354.21 ± 123.35^{a}(27)	546± 13.59^{b}(29)	84.70 ± 10.03^{c}(35)	5358.68±108.44
December	2100 ± 20.59^{a}(30)	450.00 ± 0.00^{b}(30)	80.00 ± 10.15^{c}(31)	450.00±27.45

Data are presented as Mean±SEM; Means between columns not sharing a common superscript letter differ significantly (P≤0.05); Figures in the parentheses depicts the number of animals in each age group.

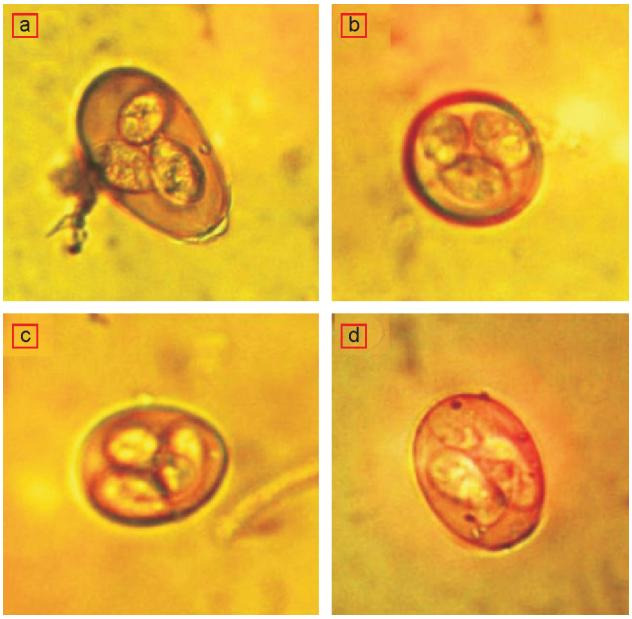

Fig.1. Oocysts of *Eimeria* (a) *E. arloingi,* (b) *E. parva*, (c) *E. pallida*, and (d) *E. faurei* (400×).

identified species was indistinguishable from *E. faurei*. The characteristic feature of the species included its oval shape. Sporulation time of the species varied from 24–48 h. Length and breadth of the oocysts was 28.0±0.001 µm (range: 27.1–28.0 µm) and 20.6±0.003 µm (range: 19.9–21.0 µm). Differential oocyst count revealed that, occurrence of *E. arloingi* was the maximum (48%) followed by *E. faurei* (20%) and *E. pallida* and *E. parva* (16% each).

The oocyst count in goats treated with amprolium @ 50 mg/kg body weight decreased significantly as compared to control from day 5 post-treatment onwards. On the other hand, the goats treated with 10 mg/kg body weight took little more time to respond (Table 2). Although, oocyst output decreased significantly in both the groups as compared to control group, amprolium dose @ 50 mg/kg body weight was found more effective in terms of oocyst output 25 days post treatment (Table 2). Further, it was also recorded that, goats received amprolium @ 50 mg /kg of body weight attained higher average body weight (7.179±0.02726 kg) as compared to the other two groups. After treatment with amprolium @ 50 mg/kg body weight, clinical improvement of the animals was observed from 15 days post treatment onwards and problem of diarrhoea was resolved. On the contrary, control goats and goats receiving amprolium @ 10 mg/kg body weight had abnormal discharge of manure till the end of experimental period.

Coccidiosis is a common infection of small ruminants. Literature suggests that, this infection is common throughout the world and has been reported time to time by different workers (Koudela and Bokova 1998, Balicka-Ramiz 1999, Gadahi *et al.* 2009, Sharma *et al.* 2017). Although there are reports of coccidiosis from mainland of India (Reshi *et al.* 2013, Sharma *et al.* 2017), there is no report on coccidiosis in Andaman local goat as well as from the island ecosystem. Therefore, systematic study on prevalence of caprine eimeriosis from this island has provided surely an insight on caprine coccidiosis in Andaman local goat, adopted in this island ecosystem.

It was observed that, intensity of infection was more in kids (<6 months) as compared to other two groups of animals. Previous studies also suggested that, young animals suffered more compared to older animals (Balicka-Ramiz *et al.* 1999, Arslan *et al.* 1999) which might happen due to lower resistance or less immunity to this infection in kids compared to older animals (Maigni and Munyua 1994). The present finding speaks about age-related decrease in *Eimeria* infection in goats and in accordance with the previous findings from France (Chartier *et al.* 1991), Spain (de la Fuente and Alunda 1992) and Netherland (Borgsteede and Dercken1996). Older goats in between 6–12 months and >1 year of age may serve as potential source of infection for kids <6 months of age (Woji *et al.* 1994).

Coccidia infection aggravates with increasing humidity. During the present study, increase in rainfall from the month of June to October was observed. The increase of oocyst

Table 2. Efficacy of amprolium soluble powder against caprine coccidiosis

Drug dosage	Parameter	Pre-treatment	Post-treatment				
		Day 0	Day 5	Day 10	Day 15	Day 20	Day 25
10 mg/kg B.Wt.	Oocyst count (n)	358707± 124.29^{A}	3253003± 139.58^{A}	16035± 1081^{A}	10138± 500.9^{A}	10836± 67.10^{A}	3470± 322.2^{A}
50 mg/kg B.Wt.	Oocyst count (n)	361103± 115.14^{A}	10520±741^{B}	8177±623.3^{B}	1588±180.5^{B}	1580 ±95.92^{B}	230±28.28^{B}
Control	Oocyst count (n)	358906± 167.002^{A}	359406± 178.69^{A}	365403± 148.54^{C}	361806± 110.04^{C}	365609± 143.08^{C}	367406± 52.11^{C}
10 mg/kg B.Wt.	Body weight (kg)	5.339± 0.06642^{a}	5.373± 0.1174^{a}	5.578± 0.08917^{a}	5.857± 0.1572^{a}	6.009± 0.1848^{a}	6.198± 0.03393^{a}
50 mg/kg B.Wt.	Body weight (kg)	5.358± 0.05761^{a}	5.342± 0.1713^{a}	5.766± 0.1075^{a}	6.155± 0.3609^{a}	6.870± 0.1337^{a}	7.179± 0.02726^{b}
Control	Body weight (kg)	5.297± 0.08775^{a}	5.245± 0.1064 ^{a}	5.499± 0.1626^{b}	5.783± 0.1325^{b}	5.858± 0.1940 ^{b}	6.076± 0.03062^{c}

Data are presented as Mean ± SEM; Means between columns not sharing a common superscript letter differ significantly (P≤0.05).

count from the month of July may be attributed towards increase in rainfall and break in sanitation favoured sporulation of the oocysts (Kumar *et al.* 2016). Oocyst count remained >2000 up to December due to continuous exposure to infective stage of the pathogen. Animals were prone to clinical coccidiosis when they were put under stressors like transportation, underfeeding, change of feed during weaning or exposure to other diseases (Mohamaden *et al.* 2018). Occurrence of high oocyst count and onset of clinical coccidiosis in March might be attributed towards induced stress due to feed and fodder crisis in South Andaman District during post monsoon season (Gangaiah and Kundu 2018) which might have resulted in lowered immunity (Gadahi *et al.* 2009).

Coccidiosis in goats happens due to complex interaction with parasites and hosts, involving several other factors, which influences the severity of the disease. The severity of the disease is dependent on involvement of species (Koudela and Bokova 1998). Clinical coccidiosis is most frequently caused by *E. ninakohlyakimovae* (Yvore *et al.* 1985), *E. arloingi* (Sayin *et al.* 1980), *E. caprina* (Norton 1986) and *E. christenseni* (Jagatheswaran 1957). During the present investigation, it was found that, frequency of *E. arloingi* oocysts were more (48%) as compared to the other three identified species. *E. arloingi* had been reported as a highly pathogenic species especially for kids (Prasad *et al.* 2017).

This has been well documented in the literature that, subclinical form of coccidiosis is responsible for production losses in domestic ruminants (Platzer *et al.* 2005). In kids, diarrhoea, dehydration, anorexia and damage of the colon result into poor development or slow growth in kids. Therefore, to evaluate the effect of coccidiosis in goats, the study was undertaken to see the efficacy of widely used amprolium in infected animals through faecal score and body weight gain. Proper medication against coccidiosis reduced oocyst shedding ameliorated intestinal lesions and increased the average growth rates of small and large ruminants (Platzer *et al.* 2005).

Young and others (2011) found that administration of amprolium @ 50 mg/kg body weight for five consecutive days was effective to reduce the infection. But, their data was not supported by regular monitoring of faecal oocyst count and body weight gain. Regular monitoring of post treatment faecal score evaluation and body weight gain was felt obligatory by the group of workers (Young *et al.* 2011) since they recorded significant number of eimerian oocysts even on 7th day post-treatment. In the present study, the points raised by Young *et al.* (2011) have been addressed.

Available literature suggests that, there is wide dose variation of amprolium, which starts from 10 mg/kg body weight to 100 mg/kg body weight (Yadav *et al.* 2007). To limit the chances of overdosing of amprolium, in the present experiment under field condition, the compound has been used in two different doses.

The present study is the first report on prevalence and speciation of *Eimeria* in goats in Andaman and Nicobar islands. The prevalence of *Eimeria* was found more in months of high rainfall and fodder crisis. The metaphylaxis study concludes that use of amprolium @ 50 mg/kg body weight is effective in controlling clinical cases of coccidiosis and may be recommended for treatment of coccidiosis in goats.

REFERENCES

Arslan M O, Umur S and Kara M. 1999. The prevalence of coccidian species in sheep in Kars province of Turkey. *Tropical Animal Health and Production* **31**: 161–65.

Bankunzi F R, Thwane S N, Motsei L E and Dzoma B M. 2010. Diversity and seasonal occurrence of Eimeria species in a mixed flock of communally reared sheep and goats in Mafikeng in the North West province, South Africa. *Journal of South African Veterinary Association* **81**: 148–50.

Balicka-Ramisz A. 1999. Studies on coccidiosis in goats in Poland. *Veterinary Parasitology* **81**: 347–49.

Borgsteede F H and Dercksen D P. 1996. Coccidial and helminth infections in goats kept indoors in the Netherlands. *Veterinary Parasitology* **61**: 321–26.

Chartier C, Pellet M P and Pors I. 1991. La coccidiose de la chevrette. Aspects e´pidemiolgique set zootechniques. *Recueil de Medecine Veterinaire* **167**: 113–19.

de la Fuente C and Alunda J M. 1992. A quantitative study of Eimeria infections of goats from central Spain. *Veterinary Parasitology* **41**: 7–15.

Faizal A C M, Rajapakse R P V J, Jayasinghe S R and Rupasinghe V. 1999. Prevalence of *Eimeria* spp. and gastrointestinal nematodes versus weight gains in treated goats raised in the dry areas of Sri Lanka. *Small Ruminant Research* **34**: 21–25.

Foreyt W J. 1990. Coccidiosis and cryptosporidiosis in sheep and goats. *Veterinary Clinics of North America: Food Animal Practice* **6**: 655–70.

Gadahi J A, Arshed M J, Ali Q, Javaid S B and Shah S I. 2009. Prevalence of gastrointestinal parasites of sheep and goat in and around Rawalpindi and Islamabad, Pakistan. *Veterinary World* **2**: 51–53.

Gangaiah B and Kundu M S 2018. Performance of fodder crops during post rainy season in Andaman and Nicobar Islands. *Forage Research* **44**: 205–08.

Gjerde B and Helle O. 1991. Chemoprophylaxix of coccidiosis in lambs with a single oral dose of toltrazuril. *Veterinary Parasitology* **38**: 97–107.

Iqbal A, Wazir V S, Singh R, Malik M A, Ahmad M and Chowhan R. 2012. Coccidiosis in goats of organized and unorganized farms of Jammu Region. *Indian Journal of Field Veterinarian* **7**: 32–34.

Jagatheswaran T. 1967. Occurrence of *Eimeria christenseni* (Hones 1942) in a kid in Ceylon. *Ceylon Veterinary Journal* **15**: 62–64.

Jalila A, Dorny P, Sani R, Salim N B and Vercruysse J. 1998. Coccidiosis infections of goats in Selangor, peninsular Malaysia. *Veterinary Parasitology* **74**: 165–72.

Koudela B and Boková A. 1998. Coccidiosis in goats in Czech Republic. *Veterinary Parasitology* **76**: 261–67.

Kumar B, Maharana B R, Prasad A, Joseph J P, Patel B and Patel J S. 2016. Seasonal incidence of parasitic diseases in bovines of south western Gujarat (Junagadh), India. *Journal of Parasitic Diseases* **40**: 1342–46.

Livestock Census (19th). 2012. Andaman and Nicobar Administration, Port Blair, Andaman and Nicobar Islands, India.

MAFF. 1986. *Manual of Veterinary Parasitological Laboratory Techniques*, pp. 78–90. Ministry of Agriculture, Fisheries and Food, HMSO, London.

Maingi N and Munyua W K. 1994. The prevalence and intensity of infection with *Eimeria* species in sheep in Nyandarua district of Kenya. *Veterinary Research Communication* **18**:19–25.

Malczewski A, Jolley W R and Woodard L F. 1996. Prevalence and epidemiology of trichostrongylids in Wyoming cattle with consideration of the inhibited development of *Ostertagia ostertagi*. *Veterinary Parasitology* **64**: 285–97.

Mohamaden W I, Sallam N H and Abouelhassan E M. 2018. Prevalence of *Eimeria* species among sheep and goats in Suez Governorate, Egypt. *International Journal of Veterinary Science and Medicine* **6**: 65–72.

Mundt H C, Bangoura B, Mengel H, Keidel J and Daugschies A. 2005. Control of clinical coccidiosis of calves due to *Eimeria bovis* and *Eimeria zuernii* with toltrazuril under field conditions. *Parasitology Research* **97**: S134–S142.

Norton C C. 1986. Coccidia of domestic goats, *Capra hircus*, with notes on *Eimeria oĺinoidalis* and *E. bakuenis*, *E. oĺina* from sheep Oĺisaries. *Parasitology* **92**: 279–89.

Pellérdy L P. 1974. *Coccidia and Coccidiosis*, 2nd edn. Paul Parey, Berlin, pp. 720–794, 959.

Platzer B, Prosl H, Cieslicki M and Joachim A. 2005. Epidemiology of *Eimeria* infections in an Austrian milking sheep flock and control with diclazuril. *Veterinary Parasitology* **129**: 1–9.

Prasad C K, Abraham J, Barman D, Sagar R S, Maruthi S T and Pavan M. 2017. Management of coccidiosis in an organized goat farm. *International Journal of Science, Environment and Technology* **6**: 1086–89.

Reshi A A and Tak H. 2013. Prevalence of coccidiosis in caprines and ovines in North Kashmir—A comparative account. *International Journal of Recent Scientific Research* **4**: 1041–43.

Ruiz A, Guedes A C, Muñoz M C, Molina J M, Hermosilla C, Martín S, Hernández Y I, Hernández A, Pérez D, Matos L, López A M and Taubert A. 2012. Control strategies using diclazuril against coccidiosis in goat kids. *Parasitology Research* **110**: 2131–36.

Sayin F, Dincer S and Milli U. 1980. The life cycle and pathogenicity of *Eimeria arloingi* (Marotel 1905, Martin 1909) in Angora kids and an attempt at its transmission to lambs. *Zentralb Veterinamed B* **27**: 382—97.

Sharma D K, Paul S, Rout P K, Mandal A, Bhusan S, Sharma N and Kushwah Y K. 2017. Caprine coccidiosis in semi-arid India: dynamics and factors affecting fecal oocysts count. *Journal of Advances in Veterinary and Animal Research* **4**: 52–57.

Sharma R L, Bhattacharya D, Laha R, Biswas J C, Rangarao G S C 1997. Preliminary observations on intestinal coccidiosis in Pashmina (Cashmere) goats in India. *Journal of Applied Animal Research* **12**: 107–12.

Singh A K, Shankar D, Rout P K, Kumar A and Kumar P 2020. Studies on *Eimeria* species in goats of Mathura region, Uttar Pradesh, India. *Haryana Veterinarian* **59**: 131–32.

Soulsby E J L. 1986. *Helminths, Arthropods and Protozoa of Domesticated Animals*, 7th ed. pp. 599–625. Balliere, London, UK.

Wang C R, Xiao J Y, Chen A H, Chen J, Wang Y, Gao J F and Zhu X Q. 2010. Prevalence of coccidial infection in sheep and goats in northeastern China. *Veterinary Parasitology* **174**: 213–17.

Woji A Y, Little D A and Ikwuegbu O A. 1994. Prevalence of coccidial infections in the West African Dwarf goat in the sub-humid zone of Nigeria. *Tropical Animal Health and Production* **26**: 1–6.

Yadav A, Khajuria J K, Sharma R K, Samanta A K and Mandal G P. 2007. Acute coccidiosis in kids and its treatment. *Journal of Veterinary Parasitology* **21**: 71–72.

Young G, Alley M L, Foster D M and Smith G W. 2011. Efficacy of amprolium for the treatment of pathogenic *Eimeria* species in Boer goat kids. *Veterinary Parasitology* **178**: 346–49.

Yvore P, Esnault A and Naciri M. 1985. La coccidiose caprine. Effect de contaminations mono oumultispe´ cifiques. *Recueil de MedecineVeterinaire* **161**: 347–51.