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Epidemiology, prevalence and therapeutic evaluation of caprine coccidiosis in goat kids in and around Mumbai, India

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Abstract

An epidemiological investigation was undertaken to assess the prevalence of gastrointestinal parasites with special reference to *Eimeria* spp., along with evaluation of therapeutic efficacy of selected anticoccidial drugs in goat kids reared under field conditions in the Mumbai region of India. A total of 520 faecal samples were collected from goat kids of different age groups, sexes and management systems during the period from March 2025 to January 2026. The overall prevalence of gastrointestinal parasites was recorded as 54.43%, indicating a considerable burden of infection in the study area. Among the different parasites identified, *Eimeria* spp. showed the highest prevalence (27.12%), followed by *Strongyle* spp. (8.85%), mixed infections (9.62%), *Trichuris* spp. (5.38%), *Strongyloides* spp. (1.92%) and *Moniezia* spp. (1.54%). Significant variation in prevalence was observed with respect to age, sex and season. Goat kids aged 0–6 months showed the highest prevalence (40.87%), followed by 6–12 months and 12–18 months age groups. Female animals exhibited higher prevalence (31.48%) compared to males (22.40%). Seasonal analysis revealed that the highest prevalence occurred during the monsoon season (39.71%), followed by winter and summer. Therapeutic evaluation of anticoccidial drugs revealed that toltrazuril showed the highest efficacy with a mean reduction of 97.37% in oocyst count, followed by amprolium (96.66%) and sulfadimidine (94.60%). The study concludes that coccidiosis is a major constraint in goat kids and highlights the importance of integrated control strategies combining chemotherapy with improved management practices for effective and sustainable disease control.

Keywords: Goat kids, coccidiosis, *Eimeria*, epidemiology, prevalence, anticoccidial

Introduction

Goat farming constitutes a vital component of the livestock sector in India and plays a significant role in the socio-economic development of rural communities. Goats are often referred to as the “poor man’s cow” due to their ability to survive and produce under minimal input conditions, making them highly suitable for small and marginal farmers^{1,2}. Their adaptability to diverse climatic conditions, efficient feed utilization and multipurpose utility further enhance their importance in the livestock economy. Despite these advantages, goat production is severely affected by various health-related problems, among which gastrointestinal parasites is one of the most important constraints. Parasite infections not only reduce growth rate and feed efficiency but also predispose animals to secondary infections, resulting in significant economic losses^{3,4,5}.

Among gastrointestinal parasites, coccidiosis caused by protozoan parasites of the genus *Eimeria* is of particular importance in young goat kids. The disease is characterized by enteritis, diarrhoea, dehydration, reduced weight gain and, in severe cases, mortality^{6,7}. Young animals are highly susceptible due to their immature immune system and increased exposure to contaminated environments, especially under intensive and semi-intensive management systems. Environmental factors such as temperature, humidity and rainfall play a crucial role in the epidemiology of coccidiosis. The warm and humid climatic conditions of the Mumbai favours sporulation and survival of *Eimeria* oocysts, thereby enhancing transmission of infection. Although several studies have reported the prevalence of gastrointestinal parasites in goats in different parts of the world^{8,12}, region-specific epidemiological data are essential

for designing effective control strategies. In addition to prevalence studies, evaluation of commonly used anticoccidial drugs under field conditions is equally important to determine their efficacy and to guide appropriate therapeutic interventions. Therefore, the present study was undertaken to investigate the prevalence of gastrointestinal parasites with special reference to *Eimeria* spp. and to evaluate the therapeutic efficacy of selected anticoccidial drugs in goat kids of the Mumbai.

Research Methodology

The present study was conducted in and around the Mumbai region during the period from March 2025 to January 2026. A cross-sectional study design was employed to determine the prevalence of gastrointestinal parasitism under field conditions. A total of 520 faecal samples were collected randomly from goat kids of different age groups and sexes maintained under various management systems. Samples were collected either directly from the rectum or immediately after defecation using clean and sterile containers to avoid contamination. The collected samples were transported to the laboratory and processed using standard qualitative coprological techniques, including sedimentation and flotation methods. Microscopic examination was carried out for the identification of parasitic eggs and oocysts based on their morphological characteristics. For therapeutic evaluation, twenty-four naturally infected goat kids were selected and randomly divided into three treatment groups (n = 8 per group). Group I animals were treated with amprolium, administered orally at 100 mg/kg body weight for 5 days, Group II with

toltrazuril administered orally at 20 mg/kg body weight single dose and Group III with sulfadimidine administered orally at 100 mg/kg body weight for 5 days. Oocyst per gram (OPG) counts were recorded on day 0 (pre-treatment) and subsequently on days 7, 14, 21 and 28 post-treatment to assess the efficacy of the drugs. Data were analyzed using one-way ANOVA followed by post hoc test and Chi-square test using WASP software (version 2.0). Differences were considered statistically significant at $P < 0.05$ and highly significant at $P < 0.01$.

Results and Discussion

The analysis of faecal samples revealed that gastrointestinal parasitism is widely prevalent among goat kids in the Mumbai region. Out of 520 samples examined, 283 were found positive, resulting in an overall prevalence of 54.43%. This high prevalence indicates a substantial level of infection pressure under field conditions and reflects the influence of favourable environmental conditions and prevailing management practices. Similar levels of infection have been reported in goats from tropical and subtropical regions by various researchers [8-12]. Among the different parasites detected, *Eimeria* spp. were found to be the most predominant, accounting for 27.12% of the total infections. This clearly indicates that coccidiosis is the major parasitic problem affecting goat kids in the study area. The predominance of *Eimeria* spp. observed in the present study is in agreement with earlier reports¹³⁻¹⁶, which also identified coccidiosis as a leading cause of morbidity in young goats.

Table 1: Prevalence of different gastrointestinal parasites in goat kids of Mumbai

Sr. No.	Type of Parasitic Infection	Total No. Faecal Samples Examined	No. of samples found positive	Prevalence (%)	Chi-Square (X ²)	S/NS
1	<i>Eimeria</i> spp.	520	141	27.12	256.54	S
2	<i>Strongyle</i> spp.	520	46	8.85		
3	<i>Trichuris</i> spp.	520	28	5.38		
4	<i>Strongyloides</i> spp.	520	10	1.92		
5	<i>Moniezia</i> spp.	520	8	1.54		
6	Mixed infections	520	50	9.62		
7	Overall	520	283	54.43		

A significant difference in prevalence was observed among different parasites groups (Chi-square = 256.54, $P < 0.05$).

Strongyle spp. (8.85%) constituted the next important group, followed by mixed infections (9.62%), *Trichuris* spp. (5.38%), *Strongyloides* spp. (1.92%) and *Moniezia* spp. (1.54%). The occurrence of mixed infections suggests simultaneous exposure of animals to multiple parasitic species, which may enhance disease severity and negatively affect growth performance.

Age-wise prevalence

A clear age-related variation in prevalence was observed. Goat kids aged 0–6 months exhibited the highest prevalence (40.87%), followed by 6–12 months (19.64%) and 12–18 months (15.97%).

Table 2: Age-wise prevalence of *Eimeria* spp. infection in goat kids of Mumbai region

Age (Months)	Total	Positive	Percent prevalence	Chi-Square test (X ²)	S/NS
0–6	208	85	40.87	33.69	S
6–12	168	33	19.64		
12–18	144	23	15.97		
Overall	520	141	27.12		

A statistically significant difference was observed among age groups ($P < 0.05$). Goat kids aged 0–6 months showed a significantly higher prevalence compared to 6–12 and 12–18 months age groups ($P < 0.05$).

The higher susceptibility of younger animals may be attributed to their immature immune system, increased exposure to contaminated surroundings and lack of prior immunity. As age advances, repeated exposure to parasitic infection leads to the development of partial resistance, resulting in reduced prevalence in older animals. Similar

trends have been reported by Ruiz *et al.*, Ayana *et al.* and Bakunzi *et al.* [10-12].

Sex-wise prevalence

Sex-wise analysis indicated that female goat kids showed higher prevalence (31.48%) compared to males (22.40%).

Table 3: Sex-wise prevalence of *Eimeria* spp. infection in goat kids of Mumbai region

Sex	Total Samples examined	Positive	Percent prevalence	Chi-Square test (X ²)	S/NS
Male	250	56	22.40	4.87	S
Female	270	85	31.48		
Overall	520	141	27.12		

A statistically significant difference was observed between sexes ($P < 0.05$).

This difference may be attributed to management practices, as female animals are generally retained longer in the herd for breeding purposes, leading to prolonged exposure to infective stages. Hormonal and physiological stress factors may also contribute to increased susceptibility. Comparable findings have been reported by Sharma *et al.* and Dixit *et al.*

[17-19].

Season-wise prevalence

Seasonal variation revealed that the highest prevalence was recorded during the monsoon season (39.71%), followed by winter (19.34%) and summer (18.52%).

Table 4: Season-wise prevalence of *Eimeria* spp. infection in goat kids of Mumbai region

Season	Total Samples examined	Positive	Percent prevalence	Chi-Square test (X ²)	S/NS
Summer (Mar–May)	135	25	18.52	26.95	S
Monsoon (Jun–Sept)	204	81	39.71		
Winter (Oct–Jan)	181	35	19.34		
Overall	520	141	27.12		

A highly significant difference was observed among seasons ($P < 0.01$), with highest prevalence during the monsoon.

The increased prevalence during the monsoon may be attributed to favourable environmental conditions such as high humidity and moderate temperature, which promote sporulation and survival of *Eimeria* oocysts. In contrast, the relatively dry conditions during summer are less favourable for parasite development, resulting in reduced transmission. Similar seasonal patterns have been reported by earlier workers [17, 18].

Species identification

Identification was based on morphological keys such as size, shape, micropyle and sporulation characteristics as described by Soulsby (1982). Micrometric and morphological examination confirmed the presence of four *Eimeria* species, namely *E. arloingi*, *E. ninakohlyakimovae*, *E. christenseni* and *E. hirci*. Among these, *E. arloingi* was found to be the most predominant species.

The predominance of *E. arloingi* is of particular significance, as it is considered one of the most pathogenic species affecting goat kids and is commonly associated with severe clinical coccidiosis. Similar findings have been reported in earlier studies conducted in different regions.

Therapeutic efficacy of anticoccidials

A marked reduction in oocyst count was observed in all treatment groups following administration of anticoccidial drugs.

Among the drugs evaluated, toltrazuril showed the highest efficacy with a mean reduction of 97.37% in OPG counts, followed by amprolium (96.66%) and sulfadimidine (94.60%). The differences among treatment groups were statistically significant ($P < 0.01$), indicating the effectiveness of these drugs in controlling coccidial infection.

Table 5: Comparative efficacy of anticoccidials on oocyst per gram (OPG) count in goat kids

Treatment	Day 0	Day 7	Day 14	Day 21	Day 28
T ₁ – Amprolium	1925.00 ^{bmu} ± 59.01	825.00 ^{dmv} ± 25.00	250.00 ^{fmw} ± 37.79	100.00 ^{gmx} ± 26.72	62.50 ^{gmx} ± 18.29
T ₂ – Toltrazuril	1862.50 ^{bnu} ± 59.57	437.50 ^{env} ± 37.50	225.00 ^{fmw} ± 25.00	50.00 ^{gmx} ± 18.89	37.50 ^{gmx} ± 18.29
T ₃ – Sulfadimidine	2300.00 ^{ou} ± 110.19	937.50 ^{cov} ± 32.39	575.00 ^{fmw} ± 36.59	387.50 ^{gmx} ± 29.50	137.50 ^{gmx} ± 37.50

Differences among treatment groups were analyzed using one-way ANOVA and were found to be statistically significant ($P < 0.01$).

Values are expressed as Mean ± SE. Means bearing different superscripts differ significantly ($P < 0.01$). Superscripts b, c, d, e, f, g indicates significant differences within columns (between treatments), whereas superscripts m, n, o, u, v, w, x indicate significant differences within rows (between days).

Toltrazuril demonstrated rapid action and resulted in early

reduction of oocyst shedding, suggesting its superior therapeutic potential. Amprolium also showed high efficacy but with a comparatively slower response, while sulfadimidine produced moderate yet satisfactory results. These findings are in agreement with previous studies¹⁹, which reported higher efficacy of toltrazuril in the treatment of caprine coccidiosis.

Effect on growth performance

In addition to reduction in oocyst count, improvement in body weight gain was observed in treated animals. Goat kids treated with toltrazuril showed the highest mean weight gain, followed by those treated with amprolium and sulfadimidine.

Table 6: Comparative efficacy of three anticoccidials on body weight gain after three months of treatment

Treatment	Body weight gain Mean $\pm$ SE in kg
Sulfadimidine	4.18 ^c $\pm$ 0.02
Amprolium	4.71 ^b $\pm$ 0.03
Toltrazuril	5.62 ^a $\pm$ 0.04

Means bearing different superscripts differ significantly at 5% and 1% levels of significance. CD (5%) = 0.13, CD (1%) = 0.17

The improved growth performance can be attributed to reduction in intestinal damage and better nutrient absorption following effective control of infection. This highlights the economic importance of timely therapeutic intervention in infected animals.

Conclusion

The present study clearly demonstrates that gastrointestinal parasites is highly prevalent among goat kids in the Mumbai region, with an overall prevalence of 54.43%. Among the various parasites identified, *Eimeria* spp. were found to be the most predominant. The higher prevalence observed in younger animals (0–6 months), in females and during the monsoon season indicates the significant influence of host-related and environmental factors on the occurrence and transmission of infection.

Therapeutic evaluation revealed that all the anticoccidial drugs tested were effective in reducing oocyst counts; however, toltrazuril showed superior efficacy (97.37%), followed by amprolium and sulfadimidine. In addition to reducing infection, treatment also resulted in improved growth performance, highlighting the economic importance of timely intervention.

The findings further emphasize that reliance on chemotherapy alone may not be sufficient for long-term control of coccidiosis. Adoption of an integrated management approach involving improved hygiene, sanitation, proper housing, balanced nutrition and strategic use of anticoccidial drugs is essential for sustainable control of the disease.

Overall, the study provides valuable baseline data on the epidemiology and therapeutic management of caprine coccidiosis in the Mumbai region and can be useful for developing effective control strategies in goat farming systems.

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