A Review of Coccidiosis in Goats

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ABSTRACT

Coccidiosis is a highly prevalent and economically important parasitic disease of goats caused by protozoa of the genus *Eimeria*, which invade and multiply within the intestinal epithelium. The disease predominantly affects young kids and results in substantial production losses due to impaired growth, reduced feed efficiency, increased susceptibility to secondary infections, and mortality in severe cases. Among the caprine coccidia, *Eimeria arloingi* and *Eimeria ninakohlyakimovae* are regarded as the most pathogenic species. Although clinical disease is frequently reported, subclinical infections remain a major hidden constraint in goat production systems, particularly under intensive and semi-intensive management. This review synthesizes classical and recent literature on caprine coccidiosis, covering the taxonomy, life cycle, epidemiology, pathogenic mechanisms, clinical manifestations, diagnostic approaches, and current strategies for treatment and prevention. Emphasis is placed on emerging challenges such as anticoccidial resistance, climate-driven changes in disease epidemiology, and the need for integrated control strategies in sustainable goat farming systems.

Keywords: *Eimeria,* Coccidiosis, Goats, Epidemiology, Control strategies

INTRODUCTION

Eimeria is a genus of apicomplexan parasites that includes several species that can cause coccidiosis in animals such as cattle, poultry, dogs, cats and small ruminants, including sheep and goats, and particularly affects young animals(López-Osorio et al., 2020; T. Sontakke et al., 2023; Sontakke & Nalage, 2021). *Eimeria* species are considered monoxenous and stenoxenous because they tend to be host specific (Chapman et al., 2013; Duszynski & Couch, 2013; Price, 2012).

Coccidiosis is a common disease associated with high mortality rates in goat farming(Ghimire & Bhattarai, 2019; Mohamed et al., 2023; Silva et al., 2020). This potentially fatal disease has economically devastating consequences for goat breeders(Ali et al., 2025). The severity of coccidiosis is determined by the *Eimeria* species and the infectious dose level of the oocysts.

Coccidiosis in goats is caused by a complex interaction between parasites and hosts, as well as other factors that determine the severity of the disease. The severity of the disease depends on the species involved(Pilarczyk et al., 2021; T. Sontakke et al., 2025). Coccidia can damage intestinal cells of the host, causing anaemia and electrolyte loss, and even death of the animal is observed in severe cases(Lu et al., 2021; “Systemic Diseases,” 2016).

There are 16 types of coccidial sp. found in goats, and most pathogenic species are as *E .arloingi, E. christenseni, E. caprina* and *E.ninakohlyakimovae*(Ali et al., 2025; Barba et al., 2025; Bawm & Lat Htun, 2023). Traditionally, Eimeria species identification relied on the morphology of sporulated oocysts and host specificity. Microscopic examination identified 17 Eimeria species in goats globally(Bawm et al., 2020; Liu et al., 2024).

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Despite extensive documentation of *Eimeria* infections in goats, coccidiosis remains underdiagnosed and inadequately controlled in many developing countries, where small ruminants represent a vital source of livelihood. Increasing intensification of goat farming, coupled with climate variability, poor hygiene, and limited access to diagnostics, has contributed to the persistence and re-emergence of the disease. Moreover, reliance on chemoprophylaxis has raised concerns regarding drug resistance and residue issues, highlighting the necessity for updated reviews that integrate classical parasitology with recent molecular and epidemiological insights.

Historical Background

Eimeria species are among the most widely distributed intestinal parasites of domestic animals. The first description of coccidian oocysts dates back to *1674*, when *Antony van Leeuwenhoek* observed oocysts of *E. stiedai* in rabbits. In 1902, Moussu and Marotel described *E. faurei* as the first *Eimeria* species in sheep. In 1910, H. B. Fantham elucidated the life cycle of a coccidian parasite in birds, providing an early conceptual framework for understanding coccidial development(Chatterjee et al., 2023).

In the late 1940s, Kotlán, Skrjabin, and Yakimoff delineated several caprine *Eimeria* species, including *E. arloingi, E. ninakohlyakimovae*, and *E. hirci*, distinguishing them primarily based on oocyst morphology (size and shape), sporulation characteristics, and the nature and distribution of lesions in the goat intestine(Ali et al., 2025). By the 1970s, more than 10 *Eimeria* species infecting goats had been recognised and described in detail. The life cycle of *Eimeria* includes three main phases: schizogony (asexual multiplication), gametogony (sexual reproduction), and sporogony (development of sporulated oocysts in the environment).

Site of Infection

Coccidiosis in goats is primarily an infection of the gastrointestinal tract(Faizal & Rajapakse, 2001). The parasites undergo endogenous development in the intestinal epithelium, leading to destruction of enterocytes and subsequent impairment of digestive and absorptive functions(Bąska & Norbury, 2022).

Different *Eimeria* species show a predilection for specific segments of the intestine. Species that predominantly invade the small intestine include *E. arloingi, E. christenseni, E. ahsata, E. intricata, E. alijevi,* and *E. jolchijevi*. In contrast*, E. ninakohlyakimovae, E. hirci, E. caprina, E. parva,* and *E. faurei* preferentially parasitise the large intestine. Damage to the intestinal mucosa can result in villous atrophy, haemorrhage, and inflammatory cell infiltration, which collectively contribute to diarrhoea, dehydration, and weight loss.

The prevalence and intensity of gastrointestinal parasitism, including coccidiosis, are strongly influenced by seasonal and climatic conditions. Variations in temperature and humidity affect oocyst survival and sporulation in the environment, thereby modulating infection pressure on grazing animals.

Taxonomical Classification:

Domain - Eukaryota

Infra- Kingdom - Animalia

Kingdom - Protista (Protozoa)

Sub-kingdom - Biciliata

Phylum - Myzozoa

Sub-Phylum – Apicomplexa

Class - Conoidasida

Sub-class - Coccidia or Coccidiasina

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Order - Eucoccidiorida

Sub-order- Eimeriina

Family – Eimeriidae

Genus - *Eimeria*

Taxonomic classification of coccidia

Epidemiology of parasites

Several factors play an important role in the spread of the coccidiosis, which causes economic losses in animal herds they are:

- Age is considered a major factor in the severity of the infection. Kids (1-6 months of age) are more susceptible to infection than adults
- The state of pregnancy in the animal is one of the important factors in the incidence of disease epidemiology, leading to the weakness of immunity in pregnant ewes, thus increasing the number of oocysts in the stool
- Environmental factors such as temperature, humidity, and climate play an important role in infection. Infection rates are higher during the rainy season and humid months because warm temperatures and moisture promote sporulation
- (27-32ºc) is considered the ideal degree of sporulation of the parasite

Recent studies indicate that the epidemiology of caprine coccidiosis is being reshaped by climate change, intensification of farming systems, and animal movement. Rising ambient temperatures and increased humidity enhance oocyst sporulation and environmental persistence, leading to higher infection pressure. Molecular epidemiological studies have also revealed mixed-species infections as the norm rather than the exception, complicating diagnosis and control strategies(McCallum et al., 2022; Sharma et al., 2017; Singh et al., 2023).

Clinical Signs and Symptoms

Goats are most vulnerable to clinical coccidiosis between 1 and 6 months of age, with many clinical cases reported, particularly in kids between 4 and 8 weeks. Both clinical and subclinical infections occur, and the predominant *Eimeria* species often determines the pattern and severity of disease (Sontakke 2021; Norton, 1986).

Clinical coccidiosis in goats is most frequently associated with *E. ninakohlyakimovae*, *E. arloingi*, *E. caprina*, and *E. christenseni*. Affected animals typically present with diarrhoea, which may be watery, mucoid, or frankly bloody, accompanied by dehydration, anorexia, abdominal discomfort, and progressive weight loss. In heavy infections, especially in young animals, severe haemorrhagic enteritis may develop, leading to marked wasting and, in some cases, sudden death(Ali et al., 2025; Sontakke 2015; Norton, 1986).

1. Subclinical coccidiosis is common and is a major cause of production losses in domestic ruminants. Even in the absence of overt diarrhoea, subclinical infections can reduce feed intake, impair feed efficiency, and depress growth rates, resulting in poor weight gain and delayed market readiness. Over time, this translates into heterogeneous growth within groups, uneven body condition, and extended time to reach sexual maturity.
2. The appearance of clinical signs depends on the type of *coccidia* and its location in the intestine, Genetic susceptibility, and stress factors. Diarrhoea is the most prevalent clinical symptom and can be

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bloody or mucoid. Heavy infections in young goats cause severe bloody diarrhoea, and wasting of animals is common.

3. The incidence of *Eimeria* parasites is either acute or chronic, in acute case the signs are diarrhoea (last for 3-4 days), as well as weakness, loss of appetite, abdominal pain, and weight loss, anorexia, depression are seen.

4. While in chronic infection, coccidiosis increases the consumption index, damage to the colon results in poor development or slow growth in kids, generates heterogeneous groups, causes weight loss, lowers feed conversion rate, weakness delays sexual maturity.

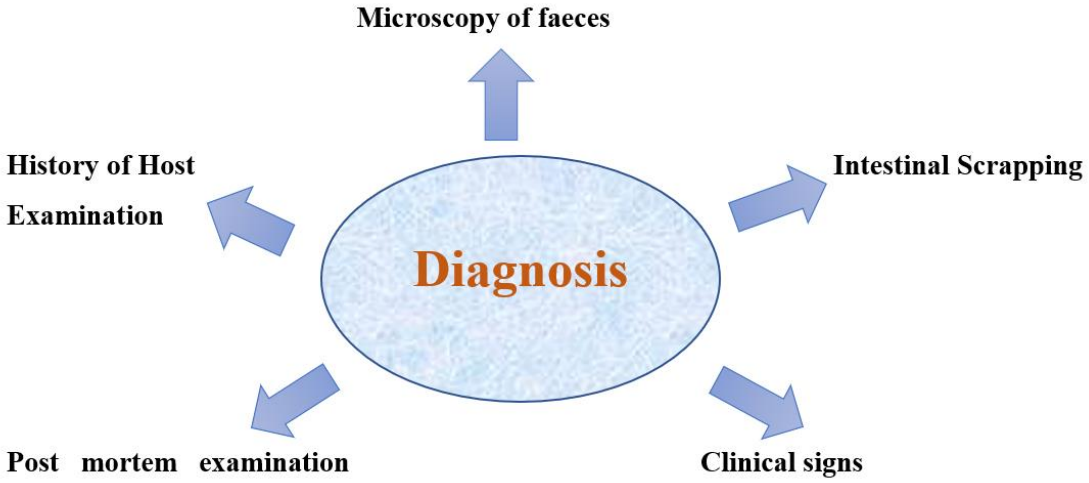
5. This pathogen causes anaemia, imbalance of electrolytes and poor absorption of nutrients. The disease in goats is chiefly confined to females and young animals up to 6 months of age.

Diagnosis

Many laboratory tests can be performed to confirm the diagnosis of coccidiosis:

1. Microscopy of faeces
2. Post mortem examination
3. History (age of affected animals, environment and management)
4. Clinical signs (diarrhoea, hair loss, lower milk production in several young animals are indicative)
5. Intestinal scraping examination - The histopathological examination of the intestine showed loss of microvilli, areas of sloughing, coccidian oocysts, along with inflammatory cells involving the entire intestine

In recent years, molecular diagnostic tools such as polymerase chain reaction (PCR) and sequencing of ribosomal ITS regions have enhanced the accuracy of *Eimeria* species identification, overcoming limitations associated with morphological overlap of oocysts(Nalage, Kudnar, et al., 2024; Nalage, Sontakke, et al., 2024). Quantitative PCR assays further enable assessment of infection intensity and mixed infections, offering valuable insights for epidemiological surveillance and control planning. However, the high cost and technical requirements limit routine use in field conditions, particularly in low-resource settings.



Treatment and preventive measures

This treatment was completely successful without any complaints. Effective drugs against coccidiosis include

1. Amprolium (100 mg/kg BW for21 days)

2. Sulfonamides
3. Decoquinate (0.5 mg/kg B.W),
4. Monensin, clopidol- methyl benzoate, sulpha drugs and lasalocid
5. Diclozuril at a dose of 1 mg/kg mixed with sulfonamide and chlorlet racycline gives protection in lambs
6. Injection Dextrose 10% @-20-50ml/ kg body weight by I/V route would be given 2-3 days.
7. Injection Biotrim (Sulphadiazine 400 mg + Trimethoprim 80 mg) I/M: 1 ml/20kg b.w once daily for 3-5 days.
8. Injection Flunimeg (Flunixin 50 mg) IM or IV 1-2 ml/45kg b.wt. Once daily for 3-5 days.
9. Injection Vitakey 1ml per 30 kg of body weight S/C or I/M for 3 to 5 days.

Chemotherapeutic control remains the cornerstone of coccidiosis management in goats, with commonly used drugs including amprolium, sulfonamides, decoquinate, diclazuril, and ionophores. While these agents are effective in reducing clinical disease, indiscriminate and prolonged use has raised concerns regarding anticoccidial resistance and drug residues in animal products(Ahmed et al., 2025; Mesfin et al., 2024). Supportive therapy, including fluid replacement and correction of electrolyte imbalance, is critical in severely affected animals.

Integrated Control Strategies

Effective control of caprine coccidiosis requires an integrated approach combining strategic drug use, improved hygiene, optimal stocking density, nutritional management, and stress reduction during critical periods such as weaning. Recent studies suggest that nutritional supplementation, probiotics, and plant-based anticoccidial agents may offer adjunct or alternative control options, although further validation under field conditions is required (Ahmad et al., 2024; Ciszewski et al., 2022).

Preventive measures

The lambing and kidding grounds must be kept clean and dry in case of outbreaks in the herds; the infected animals should be isolated and given the anticoccidial drugs(Delano et al., 2002; Keeton & Navarre, 2018).

1. Improve hygiene of facilities, pastures, pens, and feeding and water sources. Avoid moist areas without direct sunlight, such as under feed bunks and near water troughs.
2. Avoid crowded pens and pastures.
3. Quarantine before introducing new animals to theexisting herd.
4. Minimise weaning stress. If needed, creep feed to adjust the kids to a new diet before weaning.

Future Perspectives and Research Gaps

Despite extensive research, several gaps remain in the understanding and management of caprine coccidiosis. Limited data are available on the molecular diversity of *Eimeria* species in goats, particularly in tropical regions. The emergence of anticoccidial resistance necessitates systematic surveillance and evaluation of alternative control measures. Additionally, the role of host genetics(Sontakke et al., 2023) and gut microbiota(Nalage et al., 2023; Nalage, Kale, et al., 2024; Patil et al., 2023; T. Sontakke et al., 2022) in modulating disease susceptibility warrants further investigation. Addressing these gaps will be essential for developing sustainable and cost-effective control strategies.

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