

A Systematic Review on Bovine Coccidiosis and its Economic Impact

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Abstract

Protozoan diseases pose a significant threat to human and animal health throughout the world. Bovine coccidiosis is a significant disease in the cattle industry that can cause considerable annual economic losses. It has a worldwide distribution and is seen most commonly in animals housed or confined in small areas contaminated with oocysts. The disease is caused by highly host-specific Eimeria species. It is primarily the disease of young calves in which clinical coccidiosis is more common than adult cattle in which it is mostly subclinical. Economically, the disease results in an estimated worldwide loss of US\$ 400 million annually. In Ethiopia, bovine coccidiosis is a significant disease in the cattle industry, with severe calf morbidity and mortality. Anticoccidial drugs and continuous management procedures are used to prevent the disease. It is crucial to create awareness at all levels about the economic loss of coccidiosis in the cattle industry. Therefore, this communication primarily focuses on the economic importance of bovine coccidiosis.

Keywords: Cattle, Economic Loss, Eimeria Species, Management, Occurrence.

Introduction

Livestock farming faces numerous challenges like disease, feed, climate, management, and market conditions. Among the various diseases that constrain the livestock industry, coccidiosis is considered one of the most important. Coccidiosis is an important disease of animals including poultry (Pal *et al.*, 2024). The disease entails rapid invasion and intestinal mucosal damage by the genera *Eimeria* or *Isospora*. This disease is economically significant in the global cattle industry (Bangoura and Bardsley, 2020). These coccidia species reside in intestinal cells, multiplying and causing mucosal damage, leading to symptoms like malnutrition, anemia, diarrhea, and bloody feces (Yu, 2011). The disease reduces feed consumption, body weight, feed efficiency, and neurological signs, including hyperactivity and epileptiform seizures, with up to 50% mortality in North American beef calves (Bangoura and Bardsley, 2020).

Epidemiologically, coccidiosis is widespread, particularly in young animals kept in small, contaminated areas with oocysts. It is frequently observed with a seasonal incidence that may be associated with the time of year young calves and lambs are brought together for weaning, moved into feedlots, or fed in small areas for the winter months (Radostits *et al.*, 2007). Infection rates and disease incidence are also age and management-related. The number of oocysts swallowed, the species of *Eimeria* present, the animal's age and management-related stressors are some of the variables that determine the severity of the disease (Kahn, 2005).

Economic losses from coccidiosis may clinically include weight loss, a dull appearance, morbidity, mortality, the expense of treatment, and control measures. Although sub-clinically infected animals may appear normal, they may have reduced feed consumption, feed conversion, and growth retardation (Vorster and Mapham, 2012). Coccidiosis costs cattle feeders up to \$400 million annually in lost profits due to clinical causes (Jolley and Bardsley, 2006). Therefore, this paper presents an over review on the economic importance of coccidiosis, particularly within the cattle industry.

Etiology

Bovine coccidiosis is caused by unicellular protozoan parasites of the genus *Eimeria*, with over 20 species reported in cattle worldwide (Lopez-Osorio *et al.*, 2020). Of these species, *E. zuernii*, *E. bovis*, and *E. auburnensis* are typically associated with clinical disease globally (Tomczuk *et al.*, 2015; Cruvinel *et al.*, 2018). Nine species have been identified in Ethiopian cattle (Tamrat *et al.*, 2020). Although coccidia are host-specific, mixed infections with more than one species are more common than single-species diseases (Bangoura and Bardsley, 2020).

Epidemiology

Prevalence of Infection

Coccidiosis occurs universally, most commonly in animals housed or confined in small areas contaminated with oocysts. It mostly affects young animals (most animals acquire *Eimeria* infections of varying severity when between 1 month and 1 year old). Older animals are usually resistant to clinical disease but may have sporadic, inapparent infections. However, clinically healthy, mature animals can be carriers of the disease and still be sources of infection for young and susceptible animals (Kahn, 2005; Bangoura and Bardsley, 2020). The morbidity rate in the country due to disease is relatively high, although mortality is estimated at between 7% and 20% but can go as high as 80% during outbreak cases. *Eimeria* infection prevalence in cattle varies globally, including in Ethiopia (as shown in Table 1). Age and Animals housed in close proximity affect the occurrence and frequency of the disease. Therefore, feedlots and dairy cattle are most susceptible (Kahn, 2005). In housed dairy cattle, the prevalence of infection is 46% in calves, 43% in yearlings, and 16% in adult cows (Radostits *et al.*, 2007). Coccidiosis epidemics are prevalent in feedlot cattle during cold weather, making them susceptible to the disease year-round (Kahn, 2005).

Risk Factors

Factors that predispose to an outbreak of coccidiosis in cattle include the age of the host, which is usually common in calves or weaners (which have no immunity), stress due to weaning, cold weather or inappropriate weaning diets, weaning light-weight calves, confinement in small areas such as yards or small paddocks and feeding on the ground or in troughs, which can contaminate feces (also applies to water troughs) (Fitzpatrick, 2006). Alcalá-Canto *et al.*

(2020) mentioned that macroenvironmental variables such as temperature and rainfall influence the presence of *Eimeria* species in cattle. However, in Ethiopia, as studied by different authors, ages, housing conditions, season of year, and management factors significantly impact the occurrence of coccidiosis.

Table 1: Prevalence of coccidiosis in cattle across different countries

Countries	Prevalence (%)	Source
Pakistan (Lahore)	57.2	(Jahanzaib <i>et al.</i> , 2017)
Bangladesh	55.6	(Chandra Deb <i>et al.</i> , 2022)
Mexico	39.7	(Olivares-Muñoz <i>et al.</i> , 2022)
Indonesia	72.07	(Hamid <i>et al.</i> , 2019)
India	11.05	(Kumar <i>et al.</i> , 2021)
Ethiopia	20.1	(Tamrat <i>et al.</i> , 2020)
Colombia	75.5	(Lopez-Osorio <i>et al.</i> , 2020)
Saudi Arabia	31.27	(Ibrahim <i>et al.</i> , 2015)
Korea	25.9	(Kim <i>et al.</i> , 2018)

Pathogenesis and Clinical Signs

Coccidian infection in cattle occurs when they ingest infective (sporulated) oocysts. These oocysts are released into the environment through the feces of an infected host. Bovine coccidiosis can manifest as a sub-clinical, chronic, or acute disease. Subclinical coccidiosis is more economically significant than clinical coccidiosis, accounting for over 95% of all losses associated with coccidiosis (Toaleb *et al.*, 2011). Some common signs of coccidiosis are the sudden onset of severe diarrhea with foul-smelling fluid faeces containing mucus and blood straining (tenesmus), loss of appetite, a slight fever, weakness, and potentially death (Maas, 2007; Malek *et al.*, 2018; Olmos *et al.*, 2022). In Ethiopia, *Eimeria* is a prevalent cause of diarrhea in calves, leading to significant morbidity and mortality (Tamrat *et al.*, 2020).



Figure 1: Clinical observation of general poor condition and the dirty perineal area with fecal matter due to diarrhea. **Source:** (Olmos *et al.*, 2022).

Another clinical syndrome linked to coccidia infection is nervous coccidiosis, marked by symptoms like muscle incoordination, twitching, and seizures. This syndrome, involving hyperactivity and epileptiform seizures with a 50% mortality rate reported in North American beef calves (Bangoura and Bardsley, 2020).

Economic Importance

Coccidiosis is a disease that affects calves and can have significant economic impacts. The costs associated with coccidiosis can be divided into production costs, treatment costs, and mortality costs (Daugshies and Najdrowski, 2005). While the costs of acute disease may be more visible to farmers and clinicians, the costs of chronic disease

are likely to be more significant, even though they are more challenging to quantify. These costs can include reduced feed conversion efficiency and daily live weight gain in young calves, which are most efficient at converting food into weight. Cattle that survive after a severe illness may experience significant weight loss that is difficult to regain or can remain permanently stunted (Daugschies and Najdrowski, 2005).

It is estimated that 95% of all losses due to coccidiosis are due to subclinical disease, meaning that many cattle experience reduced feed consumption, malnutrition, weight loss, or decreased weight gain without showing obvious signs of illness, resulting in the majority of economic losses (Maas, 2007). Some authors estimate economic loss due to coccidiosis infection (Table 2) with an impact of up to US\$400 million in coccidiosis costs due to clinical cases, which include animal mortality, veterinary expenses, and disease treatment (Jolley and Bardsley, 2006), with 3% recorded in Estonia due to cattle calf mortality (Lassen and Østergaard, 2012). In the UK, losses due to the effects of subclinical coccidiosis in dairy cattle vary between £24 and £59 per animal (Taylor, 2016).

Table 2: Economic loss due to *Eimeria* infection in cattle

Country	Overall farm loss /year (US\$)	Source
23.78 million	Mexico	(Rodríguez-Vivas <i>et al.</i> , 2017)
3.8 million	Canada	(Rehman <i>et al.</i> , 2011)
62 million	USA	(Williams, 1984)

Diagnosis

Cattle producers and veterinarians have problems diagnosing coccidiosis because clinical signs are associated with the late portion of the early sexual phase. Passage of oocysts follows signs of coccidiosis; therefore, if there are large numbers of oocysts in the feces, coccidians have probably already completed their life cycle (Makau, 2014). Veterinarians can diagnose coccidiosis based on clinical signs, fecal oocyst examinations, and postmortem examinations of dead animals (Maas, 2007; Olmos *et al.*, 2022).

Treatment

Coccidiosis is a self-limiting disease, and spontaneous recovery without specific treatment occurs commonly when the multiplication stage has passed (Radostits *et al.*, 2007). Commonly used drugs for treatment include sulpha drugs and others, like amprolium (Table 3).

Table 3: Anticoccidial drug used for treatment and prevention in cattle

Disease reduction methods	Drug	Dosage
Treatment	Amprolium	10 mg/kg daily for 5 days
	Sulfaquinoxaline	2.7 mg/kg daily for 3-5 days
	Sulfamethazine	110 mg/kg daily for 5 days
Prevention	Bovatec	1 mg/kg) per day, max.360 mg/day
	Deccox	22.7 mg/100 lb. daily for 28 days
	Rumensin	100 to 360 mg/head per day

Source: (Maas, 2007; Richards *et al.*, 2015).

Prevention and Control

Preventing coccidiosis is more crucial than curing it as it can reduce subclinical production losses and the risk of environmental pollution (Keeton and Navarre, 2018). Preventive measures include keeping drinking water and feed from getting contaminated with manure, maintaining dry pens, and providing adequate dry bedding. Additionally, well-drained pastures should be used, watering troughs should be raised above ground level, grazing should be minimized on grasses along the edges of ponds and streams, overgrazing should be avoided, and heavily parasitized animals should be isolated and treated separately from the rest of the herd. Prevention of bovine coccidiosis involves the use of various anticoccidial drugs (Table 3) since no vaccines are available (Richards *et al.*, 2015; Noack *et al.*, 2019).

Conclusions and Recommendations

Coccidiosis is widely distributed causing considerable economic losses in the cattle industry primarily of young cattle, in intensive animal husbandry conditions, or free-ranging on pastures. It causes severe illness with the death of clinically infected calves as well as additional expenses for medication and nutrition of sub-clinically infected cattle in a herd. The global coccidiosis cost of cattle is estimated at hundreds of millions annually. Preventing the ingestion of sporulated oocysts is crucial to minimize the chances of infection. This can be achieved by ensuring that drinking water and feed are not contaminated with manure, using well-drained pastures, keeping pens dry and supplied with ample dry bedding, and implementing thorough hygiene standards to reduce the incidence of diseases. Overall, cattle producers need to have a sound understanding of disease epidemiology and implement effective disease management strategies to prevent the spread of coccidiosis. Based on the above conclusion, the following points will be forwarded:

- Calves should get colostrum within 24 hours of birth to prevent coccidiosis and ensure a robust immune system.
- Avoid overcrowding and transportation to prevent the onset of disease.
- Keep feed and water troughs high enough to avoid fecal contamination.
- Create awareness within the community at all levels about the economic loss of coccidiosis in the cattle industry.
- Further research should be carried out to investigate the economic consequences of coccidiosis in dairy cattle.

Contribution by Authors

Equal contribution. All authors declared that ‘written informed’ consent was obtained from the approved parties for the publication of this article and accompanying images.

Conflict of Interests

There is no conflict of interest.

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