# Clinical and epidemiological aspects of Bovine Cryptosporidiosis and contributions to health-disease process in population

DOI: 10.46981/sfjhv3n2-008

Received in: February 21st, 2022
Accepted in: March 31st, 2022

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**ABSTRACT**
Cryptosporidiosis is a zoonotic disease of worldwide distribution, caused by protozoa of the Cryptosporidium genus. In cattle, the main species involved is Cryptosporidium parvum, considered to be an important agent that causes diarrhea in naturally infected neonates, which can lead to death. This article sought to investigate and describe, based on a literature search, aspects related to the epidemiological chain, pathogenesis, clinical signs, diagnosis, treatment, control, and prophylaxis of bovine cryptosporidiosis (CB), in order to improve knowledge of the health-disease process in the population. The results showed that the disease is transmitted by the oro-fecal route, through the ingestion of food and water contaminated by sporulated oocysts of the agent. The asymptomatic picture is related to infection of the abomasum by Cryptosporidium andersoni in adult animals and by Cryptosporidium bovis or cervid genotype in weaned calves. Symptomatic symptoms usually appear in calves up to 30 days of age. The morbidity and mortality of the disease are high and low, respectively, affecting mainly lactating animals. It was concluded that investigations related to CB are fundamental to establish the clinical diagnosis and control and prevention measures of the disease.

**Keywords:** cryptosporidium spp., diarrhea, neonates, zoonosis.

## 1 INTRODUCTION

According to Bernardes (2019), the bovine sector presents constant growth in production, consumption, and exports, with increases of up to 22% per year, making it essential to monitor aspects that can influence the quality of the final product.

One of these aspects is the occurrence of diseases that can generate short and long term losses, which can lead the animals to death and compromise the income of the activity. It is possible to identify a series of diseases that can affect the animals (Galvão et al., 2012).

According to Oliveira, Silva and Monteiro (2007), enteroparasitoses are responsible for affecting the organic balance of animals, directly affecting the relationship of domestic animals with man. Among these diseases, Cryptosporidium parvum is an enteroparasite that can affect mainly calves (Galvão et al., 2012).

Despite its higher prevalence in calves, the infection can occur at any stage of the animal's development, as mentioned by Yap et al. (2016), generating losses linked to non-effective treatments, increased mortality after birth due to the association with other pathogens, which can cause losses linked to the indiscriminate use of antibiotics, which can cause resistance to treatment. Factors such as age, immunocompetence and the animal husbandry system have a direct impact on the disease's ability to infect the animal. Infection occurs mainly in environments conducive to the development of oocysts (Feitosa et al., 2008).

Although the other genera of the pathogen also affect animals, only Cryptosporidium parvum has a proven impact on the zootechnical performance of animals, causing watery diarrhea that can lead to high mortality rates in infected calves (Morse et al., 2007).

In agreement with Araújo et al. (2007), although the infection normally occurs in the intestine, it can occur outside the digestive tract, such as in the respiratory tract, especially in birds, requiring only one host for its cycle.

Another factor to be mentioned regarding the importance of this occurrence in herds is the fact that this is a zoonosis with wide geographic distribution, as mentioned by Thompson, Palmer and O'handley, R. (2008). Cases of diarrhea associated with Cryptosporidium parvum in immunocompetent children and adults are common, and spontaneous cure may occur.

According to Rossit et al. (2007), the infection in humans may also cause severe enteritis in immunocompromised individuals, especially in HIV-positive individuals, associated with dehydration and malnutrition, and most cases are fatal. In individuals with normal immunity, gastroenteritis occurs similar to that caused by giardiasis, and its main symptoms are diarrhea, anorexia, and vomiting. Its cure may occur spontaneously (Spósito Filha, 1994).

The permanence of cases in herds and in the general population is evidenced by the absence of vaccines and effective drugs in the treatment of affected cattle, so that prevention linked to management is the main ally of producers (Teixeira et al., 2019). In addition, Lima and Stamford (2003) point to the fact that the microorganism is very resistant and able to survive most disinfectants, such as alcohol, sodium hypochlorite, phenols etc., being indispensable adequate prophylaxis.

Spósito Filha (1994) mentions that some managements are essential for the prevention of the disease, such as sanitary education of the community in general, basic sanitation, adequate hygiene after the handling of animals, especially calves, adequate treatment of water and quarantine of affected animals. In addition, the author points out the importance of mitigating measures, such as avoiding transit in different places when one is infected.

In view of these aspects, it is essential that the professionals in the area have knowledge about the occurrence and characteristics of the disease so that the necessary precautions can be taken to reduce its occurrence. In addition, investigations related to cryptosporidiosis are fundamental, considering its zoonotic potential and pathogenicity in production animals and pets (Inácio et al., 2013). Thus, the present study aimed to review the main aspects related to the etiology, epidemiology, pathogenesis, clinical signs, diagnosis, treatment, control and prophylaxis of Bovine Cryptosporidiosis, in order to contribute to the knowledge of the health-disease process in the population.

## 2 METHODOLOGY

This study was based on an exploratory literature search in the scientific databases SciElo, PubMed, CAPES, LILACS, MEDLINE and Google Scholar. The search used the following keywords: Cryptosporidium spp., diarrhea, neonates, zoonoses, risk factors, veterinary medicine, and prevalence.

Scientific articles with panoramic approaches related to the subject of Bovine Cryptosporidiosis were selected, such as the prevalence and incidence of Cryptosporidium spp. in Brazil, forms of transmission, clinical signs, diagnosis and treatment; as well as the zoonotic aspects and prevention and control, totaling 15 articles selected. From the collected material, a qualitative analysis of the chosen articles was performed, seeking to highlight the factors linked to the health-disease process in the population, as well as the distribution of the parasite in different regions of the Brazilian territory.

## 3 RESULTS AND DISCUSSION

Cattle may be involved in the transmission of Cryptosporidium spp. infection and may have a relevant epidemiological role in this zoonotic disease (Ignatius et al, 2013). In these animals, the clinical signs are related to age, as well as the state of the host and the parasite responsible for the infection. The most common symptoms observed are yellowish watery diarrhea, weight loss and anorexia. Even with such importance of this pathology, its diagnosis is not routine in most farms in Brazil (Teixeira et al., 2019).

There are two clinical pictures observed in Cryptosporidiosis in bovines. The asymptomatic picture is related to infection of the abomasum by Cryptosporidium andersoni in adult animals and Cryptosporidium bovis or cervid genotype in weaned calves. Symptoms are seen in calves up to 30 days of age, generating acute enteritis, with severe diarrhea, dehydration and weight loss, colic, anorexia and depression. The diarrhea is abundant, watery, and yellow in color. Morbidity is high, mortality is small, affecting mainly lactating calves (Vargas Júnior et al., 2014).

Intestinal infection by this parasite leads to the excretion of oocysts measuring approximately 4.8 µm by 4.6 µm. In cattle, the cause of diarrhea is controversial, since such symptom can also be found in healthy animals. However, this protozoan is considered an important causative agent of diarrhea in naturally infected neonates. The protozoan usually acts with other enteropathogens, causing other intestinal problems and even the death of the animal (Oliveira, Wilmsen & Rosalinski-Moraes, 2012).

Santín, Trout and Fayer (2004) reported that 9% of calves positive for Cryptosporidium spp. all from the North American coast from 15 different farms were infected with Cryptosporidium bovis; 1% with Cryptosporidium andersoni and 5% with the cervid genotype. These same authors also found that 85% of the calves tested positive for Cryptosporidium parvum. However, no calves older than 60 days tested positive for this parasite.

In the states of Rio de Janeiro and São Paulo, there are several reports pointing to the existence of Cryptosporidium spp. oocysts found in the feces of cattle, which indicates the dissemination of the disease (Souza & Lopes, 1995; Ederli, Carvalho & Sales, 2004; Feitosa et al., 2004; Almeida, Oliveira & Teixeira, 2008; Cardoso et al., 2008). The economic impact caused by Cryptosporidiosis includes

expenses with several types of medication, besides zootechnical losses that impact animal growth and increased mortality (Olson et al., 2004; Santín, Trout & Fayer, 2008).

In Rio Grande do Sul, in November 2012, an outbreak of the disease occurred in a batch of 400 calves. Among them, 8.75% became ill and 4% died. The reports pointed out that the animals were mostly females, around 30-45 days old and without defined breed. Immediately after birth, the animals showed yellow diarrhea, gradual weight loss, depression, and weakness, as shown in Figure 1. As a result of the onset of clinical signs, the animals died. According to the veterinarian who attended the outbreak, the cattle were kept in native fields. In the year 2011, approximately 70 calves died with similar clinical signs, although numerous attempts at diagnosis using parasitological tests and fecal cultures were unsuccessfully performed (Vargas Júnior et al., 2014).

Figure 1. Calf with Cryptosporidiosis presenting with weakness and yellow diarrhea.

Figure 1. Taken from "Outbreak of Cryptosporidiosis in calves in southern Rio Grande do Sul" by S. F. Vargas Júnior, C. Marcolongo-Pereira, M. de L. Adrien, L. Fiss, K. R. Molarinho, M. P. Soares,. E. S. Sallis, 2014, Pesq. Vet. Bras, 34(8), p. 750.

The macroscopic lesions of Cryptosporidiosis in calves can be severe. Macroscopic diagnosis of Cryptosporidiosis is an important screening tool for endemic cases. A calf with later proven cryptosporidiosis died and was taken to the Regional Diagnostic Laboratory of the Veterinary School of the Federal University of Pelotas, where it was submitted to necropsy. Signs of congestion of intestinal and mesenteric blood vessels, distension of the small and large intestines due to the presence of gas, greenish intestinal contents, enlarged mesenteric lymph nodes and dilated lymphatic vessels were observed, as shown in Figure 2 (Vargas Júnior et al., 2014).

Figure 2. Macroscopic aspects of small intestine of calf with Cryptosporidiosis.

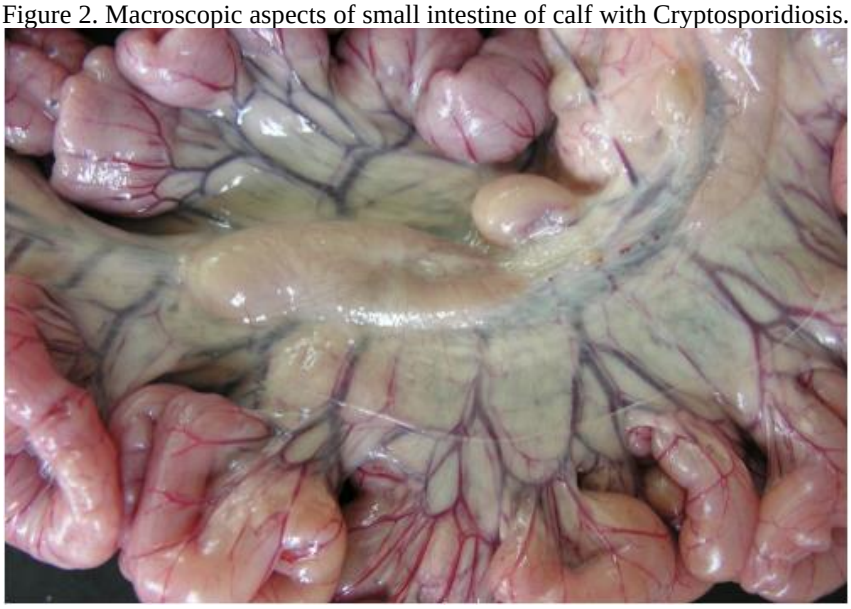

Figure 2. Taken from "Outbreak of Cryptosporidiosis in calves in the South of Rio Grande do Sul" by S. F. Vargas Júnior, C. Marcolongo-Pereira, M. de L. Adrien, L. Fiss, K. R. Molarinho, M. P. Soares,. E. S. Sallis, 2014, Pesq. Vet. Bras, 34(8), p. 750.

Bovine cryptosporidiosis is a widespread disease. In the United States and Canada, high prevalence of the disease in cattle has been demonstrated. In addition, in the United States, coinfection with Salmonellosis has been evidenced in animals (Sanford & Josephson, 1982; Wright et al., 1995; Cesaro et al., 2014).

Currently, among the measures to diagnose this parasitological and pathogenic disease, microscopic means made from fecal samples are most widely used. However, among the tests that tested positive in animals for Cryptosporidium oocysts, not all had clinical diarrhea, i.e., were asymptomatic (Ortolani, 1988). In addition, calves up to 2 months old, 38% evidenced diarrhea by Cryptosporidium spp. and 11.5% were asymptomatic carriers (Teixeira et al., 2019).

The Direct ELISA test is indicated to search for oocysts in the feces and serology is performed by means of the Indirect Immunofluorescence technique. The most significant problem in the diagnostic process is the high cost of testing the entire herd. In addition, some of these tests may give false negative results, since the samples may contain oocysts of different species of Cryptosporidiosis, such as C. andersoni, C. parvum and C. bovis (Vargas Junior et al., 2014).

Cryptosporidiosis also affects humans. Contagion has been identified in children who had connections with rural fairs and contracted the disease through contact with infected calves. Unlike rural animals, dogs and cats have a specific species of Cryptosporidiosis (Cryptosporidium canis and cats with Cryptosporidium felis). Unlike the disease in cattle, the contagion between dogs and cats with humans is very limited. Studies have shown that there are not many records of the disease in Brazil. The disease in humans has different transmission routes, and can occur directly or indirectly through human-to-

human, animal-to-animal, human-to-animal contact, and through the ingestion of unsanitary water. It can also be transmitted through the ingestion of food contaminated with oocysts of the parasite (Vargas Júnior et al., 2014).

The vast majority of animals are contaminated via oro-fecal route. Sick animals and carriers of Cryptosporidium spp. are a risk to healthy animals, as animal-to-animal contact through water, food, and suckling can transmit the infection to uninfected beings. The disease can then spread rapidly, especially among young animals and newborns. Such animals usually present symptoms and a clinical picture that can evolve in its severity. It is also important to take into consideration that a small number of oocysts is already enough for a vast contamination (Oliveira, Wilmsen & Rosalinski-Moraes, 2012).

Campbell et al. (1982) tested different disinfectants to eliminate oocysts, finding that only 10% formaldehyde and 5% and 10% ammonia were able to eliminate them. The defecated oocysts are resistant to a wide temperature range. They survive in temperatures between -10°C to 35°C. In addition, they can survive for up to 24 weeks in humid environments.

Various drugs, including antibiotics and anti-protozoals, have been tried with or without much success. In immunocompetent animals, Cryptosporidiosis is usually self-limiting. However, in immunocompromised animals, care needs to be based on trying to increase immunity by increasing hydration, electrolyte balance, and nutrition. The best alternative to save the affected animal is fluid therapy for fluid and electrolyte replacement. If no other infection occurs, diarrhea should be controlled for 7 to 10 days. The best strategy to control the pathogen is management, keeping the animals' facilities clean and dry. In addition, always fresh water will improve the health conditions of cattle (Teixeira et al., 2019).

Despite efforts, there is no curative and 100% effective treatment commercially available. However, some drugs, such as halofuginone lactate, paromomycin and decoquinate have been employed with relative success in some experiments, as can be seen in Table 1 made by De Graaf et al. (1999), cited by Oliveira, Wilmsen & Rosalinski-Moraes (2012).

Table 1. Efficacy of different drugs against Cryptosporidiosis in ruminants.

| Drug | Species | Dose/Kg body weight | Administration period | Better results | |
|---|---|---|---|---|---|
| | | | | Elimination of oocysts | Diarrhea |
| *Halofuginone* lactate | Sheep | 500 µg | 1-5 days | Prevented | Prevented |
| *Halofuginone* lactate | Cattle | 30-500 µg | 3-14 days | Prevented | Prevented |
| Paromomycin | Cattle | 25-100 mg | 11 days | Prevented | Reduced |
| Paromomycin | Goat | 100 mg | 12 days | Prevented | Improved |
| Decoquinate | Cattle | 2.5-10 mg | 8 weeks | Decreased | Improved |
| Decoquinate | Goat | 2.5 mg | 21 days | Decreased | Prevented |

Table 1. Taken from "A review of the importance of cryptosporidiosis in farm animals " by De Graaf et al. (1999), cited by Oliveira, S., Wilmsen, M. O., & Rosalinski-Moraes, F. (2012). Cryptosporidiosis in Ruminants: Review. PubVet, 6(8), 1-18.

For prevention, it is important that those who manage the animals adopt sanitary practices. Among the important practices, it is important to emphasize the sanitization of feeders and drinkers daily, the immediate removal and disinfection of feces, even in the beds, separation of healthy herds from those with clinical diarrhea, for example, frequent use of probiotics for the elimination or reduction of oocysts, and also to minimize Cryptosporidium infections (Oliveira, Wilmsen & Rosalinski-Moraes, 2012).

## 4 CONCLUSION

There is a high prevalence of infections by protozoa of the genus Cryptosporidium spp. in ruminants, indicating that the disease occurs endemically in herds. Most ruminants, especially calves, are directly affected in places that are already infected by the parasite. Therefore, the best form of management would be the direct prevention of this disease. For this, in addition to health care, medicated care is also included. In this way, the newborn animals can be born without clinical or subclinical disease and without risk of infection, which improves the quality of life of the calves and the herd.

## ACKNOWLEDGEMENTS

This work was developed during the course of Parasitology and Parasitic Diseases of Domestic Animals, taught by Professor Sérgio Eustáquio Lemos da Silva, PhD, from the Veterinary Medicine course at the Centro Universitário do Triângulo in Uberlândia-MG.

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