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Research Article

Bovine Cryptosporidiosis and Impacts on Public, Occupational and Environmental Health

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Abstract

Bovine Cryptosporidiosis is a worldwide disease caused by protozoa of the genus *Cryptosporidium*, which are parasites of the gastrointestinal epithelium. Cattle are considered the main hosts responsible for zoonotic Cryptosporidiosis, disseminating the infective form of the protozoan in the ecosystem. Contact with infected calves is the main cause of outbreaks of Cryptosporidiosis in humans, and the appearance of clinical signs in infected cattle is directly related to the age, immune status of the host, and the species of parasite responsible for the infection. This study was carried out through an exploratory survey using various scientific data. Through these studies, a comparison was made, thus verifying the structural and functional changes in cells, tissues, and organs that are or may be subject to diseases in the animal's organism. The results show the need for proper sanitary management on farms and for technicians and livestock farmers to work together to implement sanitary vaccination schedules to prevent infection by the protozoan and reduce the number of oocysts released in feces, since there are no reported drugs capable of combating the disease. Care must be taken not only with animals that show clinical signs, but also with proper hygiene for food and water consumption. It was concluded that proper management, in partnership with good herd breeding practices, significantly reduces the number of sick animals. This shows the need to reduce the number of animals per facility in order to minimize infection rates, both environmentally and among animals, and consequently limit economic losses caused by mortality and the cost of medicines.

Keywords: Diarrhea; Zoonosis; *Cryptosporidium* spp; Neonates

Introduction

Bovine Cryptosporidiosis (BC) is a worldwide disease caused by protozoa of the genus *Cryptosporidium*, which are parasites of the gastrointestinal epithelium of a wide variety of vertebrates, such as birds, fish, reptiles, mammals, and even humans [12]. The first reported case of the disease in cattle occurred in 1971, and since then this parasitosis has been affecting herds worldwide, impacting both dairy and beef cattle farming [13].

CB is a cosmopolitan disease that affects, in addition to cattle, a wide variety of vertebrates, including humans. The parasite primarily affects the gastrointestinal tract of young animals, causing watery and yellow diarrhea, weight loss, and dehydration. The disease poses a challenge to livestock farming, resulting in significant economic losses due to growth retardation and high morbidity and mortality rates in herds [2].

Cryptosporidiosis in cattle also represents a concern for public health authorities due to the risk of transmission to humans. Diagnosis is still a challenge and is not present in the daily routine of Brazilian farms, for example, due to the small size of the parasite's oocysts, making it difficult to visualize these structures in coproparasitological tests [1].

In Brazil, the first case of Cryptosporidiosis was reported in goats in the year 1997. However, being considered a general concern, Cryptosporidiosis is also seen as a public health issue, as it is a zoonosis affecting not only animals but also humans, with increasing episodes of diarrhea in children and also in immunocompetent adults, in which most cases evolve to spontaneous recovery [19]. The episodes of *Cryptosporidium parvum* and *Cryptosporidium hominis* in humans vary according to the region, geographical conditions, and socioeconomic factors. In European countries and New Zealand, *Cryptosporidium* hominis and *Cryptosporidium parvum* are commonly detected, severely impacting public health [18].

In livestock farming, CB represents a challenge, resulting in significant economic losses, such as growth retardation, mortality, and medication expenses, especially when *Cryptosporidium* spp. is accompanied by other concomitant and opportunistic agents. The occurrence of these protozoan species in humans varies according to geographical areas and socioeconomic conditions *Cryptosporidium* [16].

Cryptosporidiosis is a parasitic infection, in which the etiological agent is a protozoan from the Apicomplexa phylum of the *Cryptosporidium* genus, often associated with diarrhea in young animals and severe and prolonged gastroenteritis in immunocompromised individuals [1]. The enteric lesions caused by *Cryptosporidium* spp. are a result of its life cycle, which is closely related to considerable economic losses in cattle farming. For example, if calves are affected on a large scale in agricultural production and die, the producer's income declines, thus losing a significant portion of their profit [11,17].

The species most frequently isolated in cattle is *Cryptosporidium parvum*, which is one of the main sources of infection for animals and humans. The species *Cryptosporidium bovis*, *Cryptosporidium andersoni*, and *Cryptosporidium rynae* cause infections, whose transmissions occur via the oral-fecal route through the ingestion of food and water contaminated with pathogenic sporulated oocysts [5].

Cattle, especially young animals, are considered the main hosts responsible for the transmission of human or zoonotic Cryptosporidiosis, in addition to having a considerable role in the epidemiological chain of the disease, as they are capable of eliminating large quantities of oocysts during the patent period, disseminating the infective form of the protozoan in the ecosystem, thus contaminating the environment and consequently increasing the likelihood of human contamination [10].

In Brazil, the diagnosis of CB is still a challenge and is not part of the daily sanitary practices on Brazilian farms. One of the biggest obstacles to this diagnosis is the size of the oocysts, which, being very small and measuring about 4 to 6 micrometers in diameter, are difficult to visualize in coproparasitological exams [1]. The most commonly used method for diagnosis is microscopy, and for better visualization of the oocysts, some staining methods, such as methylene blue, are suggested [2]. Nevertheless, for immunological diagnostic techniques, tests such as ELISA and Direct Immunofluorescence kits can be used, whose usage limitations are linked to financial issues, as they have exorbitant costs and their use often becomes unfeasible [3].

The treatment for humans and animals is symptomatic, and there is no known effective treatment for Cryptosporidiosis, which makes the intake of fluids imperative, along with drugs responsible for maintaining the body's homeostasis in immunocompromised individuals. The use of anti-inflammatory medications can be advantageous to minimize the clinical signs of the disease. Some tested drugs have caused positive effects in studies conducted with cattle [1].

The present work aimed to identify important links in the epidemiological chain of Bovine Cryptosporidiosis, such as the routes of transmission and elimination of the protozoan, in order to highlight the impacts of this disease on the environment, public health, and the people who directly handle the animals, with a focus on occupational health.

Methodology

The present study was conducted through an exploratory bibliographic survey in scientific databases such as Google

Scholar, PUBVET, SciElo, ResearchGate, Lilacs, Pubmed, CAPES, and MEDLINE, employing the following keywords: calves, diarrhea, zoonosis, public health, *Cryptosporidium*, Bovine Cryptosporidiosis, occupational and environmental health. For the search, a temporal cut of publications related to the theme between the years 2010 and 2022 was made. The inclusion and exclusion criteria were defined based on the proposal guiding the research, the identification of relevant studies through different sources, the composition of the explanatory content based on the search and inclusion/exclusion criteria, and the extraction of data related to the research question, including general information about the study.

Articles referring to the impacts caused by Bovine Cryptosporidiosis were analyzed, covering its importance as a zoonotic disease, representing risks to public, environmental, and occupational health. About 10 articles were selected and analyzed for the completion of the work, aiming to understand the impacts generated by the disease. Studies that referred to the impacts caused by Cryptosporidiosis as a whole and that encompassed its importance as a zoonosis, bringing risks to public health, were introduced into the analysis. About 10 articles were selected and studied for the completion of this work, always aiming to clarify all the problems caused by the disease.

Results and Discussuion

Bovine Cryptosporidiosis is a highly transmissible parasitic disease that contaminates animals and humans. Being a zoonosis, it also becomes a public health concern, as diarrheal episodes are common in immunocompetent children and adults, often leading to spontaneous recovery. The disease can spread at a rate that exceeds control measures. Moreover, the continuous human encroachment into natural habitats, whether through population growth or tourism, provides opportunities for humans to move into new ecological environments and create new exposures to zoonotic diseases [6,10].

Bovine Cryptosporidiosis is a parasitic disease with a high potential for spreading among herds, whose transmission occurs through the oral-fecal route, by ingesting pasture and water contaminated with pathogenic sporulated oocysts. In addition to its importance for the sector's economy, it stands out as a zoonotic disease, which makes it a concern for public health authorities [3].

The appearance of clinical signs in infected cattle is directly related to lesions present in the animals' gastrointestinal tract, resulting from ruptures caused by enterocytes. Moreover, other factors such as age, the host's immune status, and the species of the parasite responsible for the infection must be taken into consideration [4]. Cattle, especially the younger ones, are considered the main hosts responsible for the transmission of zoonotic Cryptosporidiosis, as they play a significant role in the epidemiological chain of the disease [6].

Abundant, watery, and yellowish diarrhea is considered the most common sign of the infection and generally affects young animals around 30 days old, with its pathogenesis being directly related to the age, immune status of the host, failure to ingest colostrum, and the species of protozoan involved in the infection. Diarrhea consists of a significant loss of body fluids and electrolytes, thus causing dehydration which, if aggravated, can lead to weight loss, potentially evolving into hypovolemic shock and even the death of the animal [9]. Moreover, the biological cycle of *Cryptosporidium* requires only one host. The increase in the number of parasites inside intestinal cells can cause poor digestion and absorption. Diarrhea occurs due to changes in epithelial cells, villous atrophy, and loss of digestive enzymes. The complete cycle can have an evolution process lasting 72 hours [15].

Cattle are natural reservoirs of the disease, being capable of eliminating large quantities of oocysts during the patent period of the illness, which enables the dissemination of the infective form of the protozoan in the ecosystem, thus contaminating the environment and consequently increasing the probability of human infection [10].

Contact with infected calves is the main cause of Cryptosporidiosis outbreaks in people involved in the production process, such as veterinarians and those responsible for general animal handling. The findings of this study highlighted the need for adequate environmental sanitary management on farms, aiming not only at maintaining the health of cattle herds but also at preserving human health, especially occupational health, involving veterinarians, handlers, and milkers [3,10].

Moreover, it is imperative to emphasize the need for joint action between sanitary technicians and livestock farmers to implement

sanitary vaccination schedules, in order to prevent infection by the parasite and reduce the number of oocysts released in feces, as no drugs capable of combating the disease have been reported. Thus, adequate preventive management becomes essential for the control of Bovine Cryptosporidiosis [8]. Moreover, it is important to highlight the need to promote sanitary education actions for the rural population about the zoonosis caused by this protozoan, raising awareness about the precautions that should be taken, not only with animals that present the clinical disease but also with the sanitation of water, the consumption of hygienized and safe food; as well as with their cross-contamination [7].

Regarding animal health, it was found that *Cryptosporidium* spp., when associated with different etiological agents such as viruses and bacteria, expresses a higher potential for morbidity and mortality, especially in newborn calves or immunosuppressed animals [13]. Thus, the results obtained here highlight the importance of studies related to *Cryptosporidium*, which indicate the need for proper sanitary management on properties, aiming not only at animal health but also at human health [10].

It has been found in previous studies that *Cryptosporidium*, when correlated with different etiological agents such as viruses and bacteria, expresses a high mortality rate, especially in newborn calves. In addition to causing serious economic losses to livestock, such as stunted growth and medication expenses [15,20]. This finding reinforces the urgency of preventive measures and highlights the complexity of interactions between pathogenic agents in the manifestation of Cryptosporidiosis, emphasizing the importance of effective management strategies [13,16]. These factors, along with the continuous evolution of pathogenic agents, suggest that infections may continue to increase, highlighting the urgent need for surveillance and control [14].

There is a vaccine still under research called Bovilis Cryptium, developed by MSD Animal Health, which is administered to pregnant cows to produce antibodies against a protein expressed by *Cryptosporidium parvum* in bovine colostrum. The vaccine induces a strong immune response against parasites for at least the first two weeks of life. Later, they can develop their own immunity, so it's not such a big problem - the animals can still be carriers, but not have active disease [7].

Finally, the need to inform the population about the zoonosis caused by the parasite in question is recognized, raising awareness about the importance of the precautions that must be taken, not only with animals that show clinical signs but also with proper hygiene for the consumption of food and water, thus contributing to the effective prevention of Cryptosporidiosis and the promotion of public health [10].

Conclusion

Despite the significant economic losses and the impacts on public, occupational, and environmental health, Bovine Cryptosporidiosis is still underdiagnosed. This occurs, in the vast majority of cases, due to a lack of knowledge about the disease and the laboratory tests available for effective diagnosis. Furthermore, a high potential for the spread of *Cryptosporidium* and the ease with which infections occur have been observed, which are associated with the lack of a specific procedure to combat or reduce the agent's resistance in the environment.

It is inferred, therefore, that proper management, in partnership with good herd management practices, respecting the environment, significantly reduces the prevalence of the disease and the spread of the pathogen. With this, the need to reduce the housing pressure in the facilities is seen, with the aim of minimizing environmental contamination and the incidence of the disease and, consequently, limiting the economic losses caused by mortality and medication expenses.

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