Effects of Incorporating Clinoptilolite in Colostrum on the Immunity and Diarrhoea in Newborn Calves

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Abstract
Clinoptilolite, a naturally occurring zeolite present in sedimentary rock, has significant potential as an essential component for the removal of toxins inside the gastrointestinal system. Its detoxifying, antioxidant, haemostatic, anti-diarrheic, growth-promoting, and immunostimulant characteristics render it very applicable in animal biotechnology and veterinary medicine. In recent years, clinoptilolite has become more popular in animal nutrition, particularly for its ability to enhance performance and promote overall health. Diarrhoea in neonates is a very widespread ailment that leads to significant mortality rates and cost ramifications. Bovine colostrum plays a crucial role in the early feeding of calves, and the incorporation of clinoptilolite into colostrum has been shown to reduce the likelihood of diarrhoea syndrome. Clinoptilolite-based products are being used more often in the fields of veterinary and human medicine due to their beneficial features, such as their capacity to facilitate ion exchange and adsorption. The objective of the study was to examine the characteristics of clinoptilolite included into colostrum in neonatal calves, specifically focusing on its impact on immunity and the occurrence of diarrhoea.

Keywords: clinoptilolite, colostrum, diarrhoea, immunity, newborn calves.

1. Introduction

Colostrum from cows is regarded as the initial milk produced after giving birth, or as the milk from the mammary gland until the third day. A wide range of nutrients and physiologically active substances, including immunoglobulins, proteins, nucleotides, vitamins, growth factors, carbohydrates, and enzymes, are found in colostrum, which has a high nutraceutical value.
These substances are essential for supporting immunological defence, nutrition, and the growth and development of infants, even though their physicochemical composition varies greatly and is influenced by several factors, including age, genetics, nutrition, and the environment [1].
The control of colostrum is crucial to calves' health and survival. Even though there has been development over the last 20 years, many dairy producers still have a lot of room to enhance their colostrum management techniques, which will benefit the animals' performance and health both now and in the future. In the first few hours of life, farms should provide calves with an adequate amount of clean, high-quality colostrum. Multiple feedings and prolonged colostrum or transition milk feedings following gut closure may yield further benefits. If no clean, high-quality maternal colostrum is available, colostrum replacers are helpful resources [2].
The colostral period is a critical time for infants, especially in ruminants. In these species, immunoglobulins (Ig) in sufficient levels must be consumed and absorbed to develop passive immunity. Managing this phase effectively is critical to initiating a solid defence against newborn illnesses. Passive immunity failure is still high in young ruminants due to various factors affecting the colostrum immunoglobulins absorbed [3,4]. Figure 1 presents the constituents of bovine colostrum:

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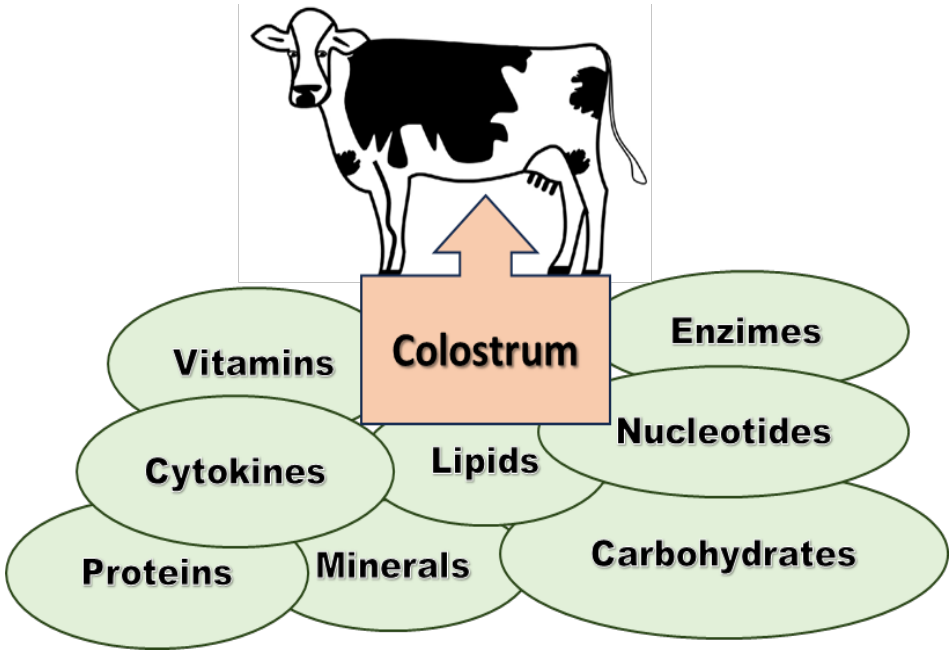

Figure 1. Constituents of bovine colostrum

Low blood immunoglobulin concentrations have been found to have a clear correlation with both long-term calf performance and illness and mortality in calves. Sadly, insufficient passive immunity transmission occurs all too frequently in newborn calves, leading to high rates of illness and mortality. According to reports in the literature, zeolites added to colostrum can improve passive immunity and lessen newborns' susceptibility to infections [5].

Zeolites are naturally occurring, hydrated, crystalline aluminosilicates made of SiO_4 and AlO_4 joined by oxygen atoms to form three-dimensional frameworks resembling a microspore-filled honeycomb. Of the various varieties of natural zeolites, clinoptilolite is the most commonly found and researched due to its biologically active nanoporous structure [6].

Clinoptilolite is useful in veterinary medicine for its antiviral, antimicrobial, and antidiarrheic qualities [7]. Clinoptilolite from volcanic or sedimentary deposits may now be added to farm animal feedstuffs with temporary authorization from the European Commission [8]. Neonatal calves receive their immunoglobulins from colostrum through passive immunity transfer because they are born without any in their bloodstream. Neonatal calves' health and survival depend heavily on passive immunity [6].

Effects of zeolites in animal nutrition could be influenced by different lengths of administration, different types, particle size, and purity of the zeolitic material, and by other physiological processes involved in the digestion of feed in young and adult animals [6].

The purpose of our investigation was to provide information regarding the impact of clinoptilolite added to colostrum on immunoglobulin absorption and the occurrence of diarrhoea in neonatal calves.

2. Results and discussions

Neonatal calf diarrhoea syndrome, sometimes referred to as enteritis or calf scours, is a frequent illness that primarily affects calves that are one to three weeks of age [9]. The cause of this disease is complex, and it negatively affects farm welfare and economics.

The pathogens present, the general condition and calf susceptibility, the quality environment (stress factors), protection from the weather, the quality of colostrum management, nutrition (insufficient or inadequate nutrition), and the general level of preventive measures implemented on a farm all influence the subsequent course and severity of diarrhoea [10]. While severe cases can result in profuse diarrhoea, dehydration, and potentially fatal electrolyte imbalances, mild bouts of

diarrhoea may only cause a few loose or watery stools [11].

Additionally, diarrhoea can have detrimental impacts on calf growth and development, such as decreased weight gain, delayed weaning, and decreased feed efficiency. These effects can cause farmers and producers to suffer large financial losses [12,13].

In newborn calves, diarrhoea can have a variety of causes, both contagious and non-contagious elements. Early detection and suitable care can bring about favourable results. keeping track of the calf's development, including improvements in general health and symptoms, is crucial for assessing the efficacy of the method of therapy.

Symptomatic therapy was utilized to alleviate the discomfort, without a precise diagnosis. The secret to managing is using prevention techniques of diarrhoea in calf newborns, including appropriate handling of colostrum to guarantee sufficient passive antibody transfer, preserving a sanitary and tidy atmosphere, putting healthy eating and nutrition into practice, and following biosecurity guidelines [13]. There are studies on the beneficial effects of zeolite supplementation on passive immunity and on biochemical parameters in calves still in the neonatal stage. Zeolites are used at varying doses and lengths of time, but not in greater quantities in colostrum [3].

Research shows that adding 1.0 g clinoptilolite per kg body weight per day in colostrum can reduce diarrhoea incidence and severity in newborn Holstein calves. Using more than 1.0 g/kg body weight per day of clinoptilolite in colostrum and milk was considered excessive [6].

Clinoptilolite can function as a detoxicating (including heavy metals and mycotoxins), antioxidant, haemostatic, anti-diarrheic, growth-promoting, antiviral, antibacterial, and immunostimulant drug, as demonstrated by its application in veterinary medicine [14,15]. Numerous zeolites have been investigated as potential carriers of antibacterial ions [16].

Adding clinoptilolite in colostrum or milk reduces faecal score and its severity. Clinoptilolite retarding effect on intestinal passage rate and their water adsorption property leads to the appearance of drier and more compact faeces [6.]

Figure 2 presents the benefits of administering zeolite and bovine colostrum in feeding newborn calves:

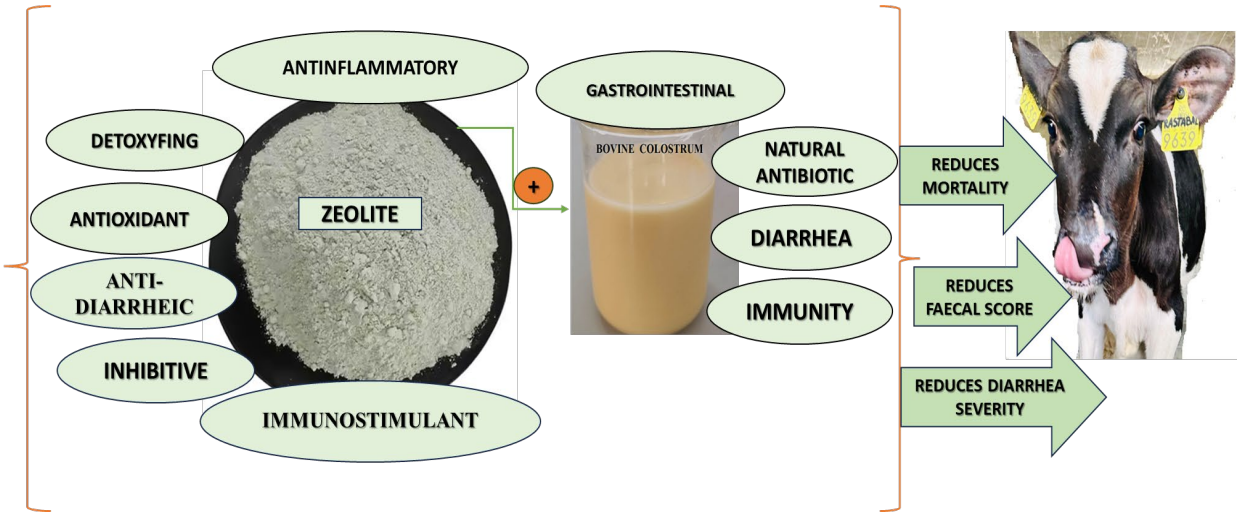

Figure 2. The benefits of administering zeolite and bovine colostrum in feeding newborn calves

In the study conducted by Pourliotis et al. in 2012 [17], they demonstrated that the blood serum of calves receiving clinoptilolite exhibited increased antibodies against E. coli compared to the control group. Furthermore, calves that were given 2 g/kg of clinoptilolite in their colostrum from cows performed better than those that received 1g/kg. Clinoptilolite is widely known to raise the levels of immunoglobulins in the blood serum of newborn calves when fed colostrum, albeit its effects on calves' absorption of particular antibodies against infectious illnesses have not yet been studied [17].

Also, it is unclear how clinoptilolite might improve the intestinal absorption of antibodies by dairy calves. According to the first theory, clinoptilolite binds to intestinal colostral protein degradation products such as ammonia and improves intestinal immunoglobulin absorption efficiency by limiting their detrimental effects on intestinal epithelial cells [17, 18].

3. Conclusions

Studies reveal that when clinoptilolite is given to cow colostrum in the right amounts, it increases body mass and decreases the frequency, intensity, and length of diarrhoea in newborn calves. Products based on clinoptilolite are becoming more common in the veterinary and human medical domains because of their advantageous qualities, namely their ability to promote ion exchange and adsorption at the intestinal level.

4. References

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