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Prepartum Selenium for Colostrum and Calf Diarrhea

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Abstract

Calf diarrhea has a high morbidity and mortality rate. Newborn calves do not have sufficient immune function and are completely dependent on immune proteins (transitional antibodies) from the mother cow via the colostrum for some time after birth. Newborn calves can absorb the antibodies transferred within hours of birth, so it is necessary to get the right amount of colostrum early after birth. Ig in the calf's colostrum makes it less susceptible to calf diarrhea. Prepartum selenium supplementation has a positive effect on the enhancement of antioxidant status and immune response in calves.

Keywords: *Selenium; Transition Cattle; Colostrum; Calf Diarrhea; Immunoglobulin*

Calf diarrhea is a major cause of morbidity and mortality and occurs when calves are 3 to 16 days old. Calf prevalence now reaches up to 34%, a major cause of productivity and economic loss for cattle producers around the world. The causative agent of calf diarrhea is the pathogen of one or more viruses (rotavirus, coronavirus), bacteria (*E. coli, Salmonella*), or protozoa (*Cryptosporidium parvum*, amelia) isolated in feces [1]. Rotavirus causes the calf's intestinal tract to secrete water, causing severe dehydration and electrolyte imbalance. Coronavirus also destroys the cells that line the intestinal tract, causing malabsorption, resulting in severe diarrhea and lack of nutrient absorption. Signs of diarrhea are diarrhea, dehydration, loose stool, foul odor of stool and/or blood and mucus. Pathogen testing is a test of feces for the presence of viruses, bacteria, protozoa and parasites [2]. Improvements in the calf rearing environment (cleaning and disinfection, proper straw) have reduced the incidence and extent of calf diarrhea [3].

Colostrum is important as the first source of nutrition for postnatal calf. Colostrum is rich in antibodies that protect the calf from disease until the calf's own immune system functions. Placental transfer of immunoglobulin (Ig) is minimized in cattle as a result of a thick epithelial villous placenta. Newborn calves do not have sufficient immune function and are completely dependent on immune proteins (transitional antibodies) received from the mother cow via the colostrum for some time after birth.

Colostrum is rich in immunologically and physiologically active ingredients such as immunoglobulins, white blood cells, lactoferrin, lysozyme, cytokines, other immunomodulatory factors, growth factors, hormones and oligosaccharides. Therefore, the biological function of the colostrum the newborn with immune protection against pathogens and promotes its physiological performance, growth and development. The main components of the colostrum are immunoglobulin G (IgG) (subtypes IgG1 and IgG2), immunoglobulin A (IgA) and immunoglobulin M (IgM), which account for 85 - 95% of the total Ig concentration. Calves are rapidly passively immunized when they ingest the colostrum containing the appropriate levels of Ig. Calves should consume their colostrum as soon as possible, as IgG transfer is

significantly reduced every hour after birth [4].

Nutritional management is important during the transition period, as colostrum is composed of lacteal secretions and serum components, especially a mixture of Ig and other serum proteins. In particular, trace minerals (copper, zinc, manganese, selenium, etc.) and vitamins A and E are required for normal immune system function. These deficiencies in the colostrum increase the incidence of calf diarrhea. Colostrum protects the intestinal mucosa, suppresses calf diarrhea, and determines calf health and survival. Supplementing Se to late-gestation cattle improved the antioxidant status and immune response of calves without adversely affecting other micronutrients or energy status [5]. Se supplementation to colostrum increased IgG amount and Se concentration in blood plasma in newborn calves [6]. Successful transmission of passive immunity through colostrum is important in calf rearing. In order to increase specific antibodies in the colostrum, the dam can be vaccinated against *Salmonella*, enterotoxigenic *E. coli* (ETEC), rotavirus and coronavirus 2 - 6 weeks before partum.

Late pregnancy in cattle increases nutritional demands to support fetal growth and subsequent initiation and maintenance of lactation. However, the energy intake from feeding could not be covered becomes negative energy balance (NEB). That is, the weight is lost and the body condition score (BCS) also decreases. A long-term negative energy balance causes metabolic disorders such as ketosis and fatty liver, which reduces not only milk production but also fertility. Metabolic and infectious diseases of transitional mother cows are responsible for the progression of the inflammatory state immediately after calving. During infection, the process of killing pathogens produces free radicals and affects cattle experiencing NEB. Postpartum release of inflammatory cytokines should be avoided to prevent these diseases.

Due to metabolic changes during the transition period, the body's natural antioxidant system is unable to balance reactive oxygen species (ROS) production. Continued overproduction of ROS leads to the development of oxidative stress. It also leads to the development of infectious diseases such as mastitis that occur during the transition period. ROS production may exceed the required threshold [7]. To deal with this situation, antioxidants need to be supplied externally to the cows. Natural antioxidants such as selenium and vitamin E can restore normal health by minimizing the harmful effects of excessive ROS production. Selenium is an essential trace element with antioxidant and immunomodulatory effects [5]. Glutathione peroxidase (GSH-Px) is a selenoprotein that plays an important role in the antioxidant defense processes of mammals and cells. Increased GSH-Px activity reduces the incidence of pathogenic microorganisms in whey. Selenoprotein has a wide range of immunological and antioxidant roles and helps in dairy cow udder health and prevention of asymptomatic mastitis. Se regulates several important antioxidant genes (TOAX, GPX, CAT, SOD, GSH, etc.) to relieve oxidative stress [8]. The SOD gene releases oxidative stress by quenching superoxide radicals, transferring them to less toxic hydrogen peroxide (H_2O_2), then breaking them down into water and oxygen and using the enzyme catalase (CAT) to prevent DNA damage [9]. Se supplementation reduces the incidence of postpartum endometritis and ovarian cysts and reduces embryo mortality in early pregnancy. Ren., *et al*. has demonstrated that selenium improves gluconeogenesis and enhances antioxidants, resulting in a reduced incidence of metabolic diseases such as fatty liver and ketosis in peripartum dairy cows [10].

Supplementation of selenium to cows during the transition period enhances the immunity of the colostrum and suppresses the development of calf diarrhea.

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