Technical Bulletin

Utilizing Beta Mos™ as a Natural Alternative to Enhance Both Immunity and Overall Performance in Dairy Calves

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Introduction

The dairy industry continues to evolve at a rapid pace. As this evolution occurs interest in the area of "natural additives" continues to grow. Such alternatives need to both perform similar to conventional antibiotics and be cost-effective. Although no one product can replace the need for good management and first day of life protocols for newborn dairy calves, the use of such alternatives warrants attention. In the United States over 41% of dairy heifer calves lack adequate serum antibody levels and therefore fall into the category of failure of passive transfer or FPT (NAHMS, 2002). For dairy bull calves this number exceeds 50%. These numbers reinforce the fact that today's dairies are not feeding an adequate amount of colostrum (immuno-globulins) to newborn calves, have poor quality colostrum, and/or are not administering colostrum in a timely matter. The type of environment in which the calf is born can greatly influence the risk of disease exposure as well. Enteric pathogens such as the gram-negatives, E. coli and Salmonella are not uncommon on most dairies and depending on the conditions, may be numerous in the maternity pen. Over 62% of calf mortality is attributed to diarrhea or other digestive maladies (NAHMS, 2002). Because maternity pen management and colostrum management are simply two more areas for today's dairymen to focus on, the use of products that can assist the young calf in terms of fighting disease and enhancing overall performance are justified.

Discussion

There has been much discussion about the use of mannan oligosaccharides (i.e. MOS or D-mannose) in calves to help reduce the risk of enteric diseases caused by certain species of E. coli and Salmonella. MOS can be referred to as a prebiotic offering competitive exclusion within the gastrointestinal environment. The concept is that these harmful pathogens are bound by MOS within the gastrointestinal tract before they can cause problems for the young calf. A mode of action that is not discussed in great detail however is the ability of such products to influence the immune system. Beta Mos™ contains an equilibrated blend of MOS and (1-3)/(1-6) ß-glucans. The ß-glucans are known immunostimulants. Furthermore, they are not digested or broken down in non-ruminating animals. The greatest period of risk for E. coli and Salmonella related scours is within the first few days to first couple of weeks of life, respectively. This also coincides with the pre-ruminant stage of development in the growing calf. So how do mannan oligosaccharides/ß-glucans work?

MOS contain portions of the cell wall from *Saccharomyces cerevisiae,* a Brewer's dried yeast. These specific fragments are obtained via autolysis, separation and processing with subsequent spray drying. The mannan portion of the cell wall fragment is the primary antigenic component *(C.E. Ballou, 1970)*. Many gram-negative bacteria attach themselves to intestinal epithelium using mannose-specific fimbriae *(I. Ofek et al., 1977)*. MOS therefore offers an alternative binding site for such enteric pathogens. Because MOS can survive the digestive environment found within the small intestine MOS attracts these harmful pathogens flushing them away before they bind to the intestinal wall.

The ß-glucans stimulate immunity by binding to specific white blood cells, most notably macrophages via their CR3 receptor sites. These activated macrophages release intercellular signaling molecules such as cytokines, chemokines, leukotrienes, and prostaglandins. Intercellular signaling molecules in turn activate nearby cells such as NK-cells, T-cells and B-cells (lymphocytes), and monocytes. The cytokines that activate the lymphocytes in turn increase the production of antibodies. Overall, the process of phagocytosis (engulfing of cells and foreign particles) by tissue

macrophages is enhanced. A reduced pathogen or challenge level should lead to better growth and performance.

Research

Although research in the area of ruminants and pre-ruminants is ongoing, studies have documented the benefits of feeding MOS to dairy calves. A recent study conducted at The Pennsylvania State University suggests that antibiotics in milk replacers can be replaced with compounds such as mannan oligosaccharides to obtain similar calf performance (Figures 1, 2, 3).[1] Seventy-two Holstein calves were fed a 20% protein, 20% fat milk replacer containing either: (1) antibiotics (400 g/ton neomycin + 200 g/ton oxytetracycline), (2) MOS (4 g/day), or (3) no additive (control) for 5 weeks.

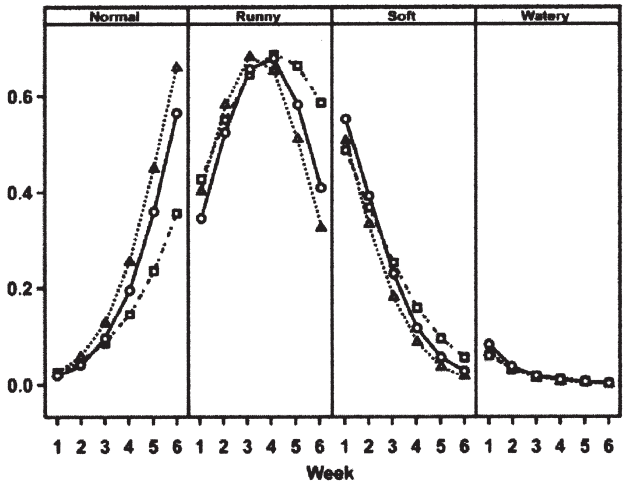

Figure 1. Probability of fecal fluidity scores by week of age for calves fed milk replacer containing antibiotic (❍), MOS (△), or no additive (❑).

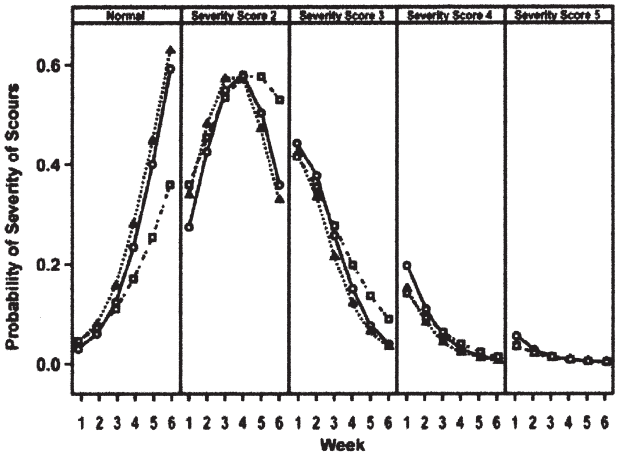

Figure 2. Probability of fecal scours severity scores by week of age for calves fed milk replacer containing antibiotic (❍), MOS (△), or no additive (❑).

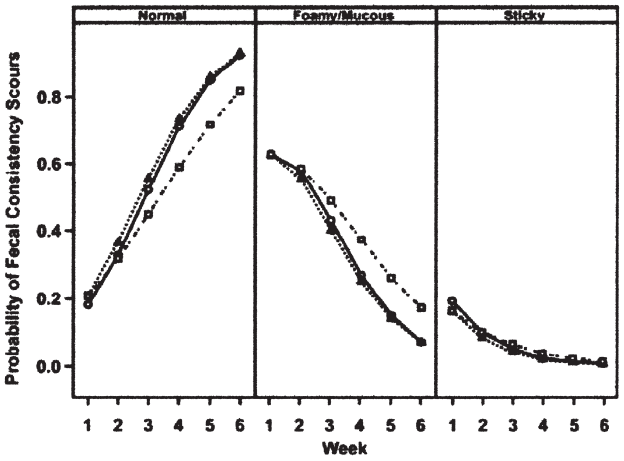

Figure 3. Probability of the observed fecal consistency scores by week of age for calves fed milk replacer containing antibiotic (❍), MOS (△), or no additive ❑).

The fecal data shows that the addition of either an antibiotic or MOS to the diet reduced scours. The increased slope ($P<0.01$) of lines representing the probability of normal fecal scores supports the fact that antibiotic and MOS treated scouring calves recovered at a faster rate than control calves.

Research on the ability of beta-1,3-glucan to support the immune system dates back to the 1940's. It wasn't until the late 1980's when Dr. Joyce Czop at Harvard University described the mode of action relevant to macrophage stimulation[2]. Studies utilizing mice at Baylor College of Medicine also support the effectiveness of beta-glucan to stimulate nonspecific immunity[3].

Summary

Beta-1,3-glucan/MOS is a safe (category GRAS according to the FDA) and suitable nutritional supplement. Not only is there the potential for specific enteric pathogen binding within the gastrointestinal tract but there is also nonspecific immune enhancement via macrophage stimulation. The direct stimulation of macrophages activates a cascade of events that turns the body into an arsenal of defense. Research in dairy calves is continually being explored.

Reference:

1. A.J. Heinrichs, et al., 2000; Journal of Dairy Science 86:4064-4049.
2. Czop JK, Austen KF: A ß-glucan inhibitable receptor on human monocytes: its identity with the phagocytic receptor for particulate activators of the alternative complement pathway. JImmunol 1985; 134: 2588-2593.
3. Wyde P. NSC-24™: Research report on oral and intraperitoneal applications in mice. 1989. ImmuDyne, Inc. Unpublished.

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