TECH TALK

Prebiotics in Livestock Production Systems: A Functional Role for Natural Carbohydrates

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Richard Murphy, Ph.D.
Research Director
Alltech Bioscience Centre, Dunboyne, Co. Meath

Targeted nutrition, starting with the development and maintenance of the intestine, results in the production of stronger, healthier animals. For many years now, it has been known that the use of carbohydrates isolated from the cell wall of specific yeast strains plays a central role in modulating immune responses, preserving gut tissue integrity and eliminating pathogens from the intestine.

The intestinal microbiome plays several crucial roles in the animal, including the regulation of cell turnover in the gut wall, competition for nutrients, the modification of digestion, competitive exclusion of pathogens, the metabolism of mucus secretions and modulation of mucosal immunity. It is critical that the microbiome functions to its fullest capability in order to maintain gut health and maximize growth.

Mannoproteins and mannanoligosaccharides account for more than 40% of the carbohydrate in the cell wall of Saccharomyces cerevisiae and are one of the most widely studied functional prebiotics used in animal feeds. The application of prebiotic mannan structures present in yeast cells fed to animals was first studied by Alltech in 1993 with the development of Bio-Mos? (Newman et al 1993). An extremely large set of studies clearly establishes that the use of first-generation mannose-based (MOS) cell wall fractions, such as Bio-Mos®, in animal feeding strategies can have beneficial effects on animal health and productivity (Spring et al, 2015).

The best-characterized activity of Bio-Mos® is its ability to agglutinate or aggregate pathogenic bacterial cells containing Type 1 fimbriae. In the gastrointestinal tract, lectins (carbohydrate-binding proteins) on bacterial cells bind to complementary carbohydrates on animal epithelial cell surfaces. This process is critical to the initiation of bacterial colonization and any associated pathogenesis. Bacterial pathogens can also attach to Bio-Mos® due to its unique structure, enabling the feed additive to act as a decoy, providing a first level of protection by blocking attachments to intestinal cells (Jacques and Newman, 1994).

Distinct from original first-generation MOS products such as Bio-Mos, the second-generation Bio-Mos® 2 is best described as a natural growth permitter. Bio-Mos® 2, a bioactive mannose-rich fraction (MRF), is derived from the outer cell wall of a specific strain of yeast selected by Alltech (Spring et al, 2015). Depending on the target species, their ages and the protocol chosen, Bio-Mos® 2 is included in ruminant diets at a rate from 2 to 20 grams per head per day. Due to its enhanced bioactivity, it can be supplemented at lower levels than those typically seen when using generic MOS products.

The effects of Bio-Mos® 2 supplementation on health and performance have been studied comprehensively, and this second-generation MRF product has proven extremely effective at improving weight gain and feed conversion efficiencies while also supporting gut integrity and strengthening defenses against pathogens.

More recent studies on Bio-Mos® 2 have focused on the product's effects on the overall bacterial community of the gut — not just specific bacteria — and such work has shown that supplementation with Bio-Mos® 2 can modulate intestinal microflora (also known as the microbiome), enabling it to function to its fullest capability (Corrigan and Murphy, 2016; Corrigan et al, 2018, Franklin et al, 2005; Heinrichs et al, 2003; Quezada et al, 2007).

Commercial trial work using Bio-Mos® 2 has demonstrated that gut function becomes normalized following the enhancement of overall microbial diversity. Reproducible and consistent alterations in microbiota have been noted, resulting in enhanced microbial diversity. The greater the diversity of the microbes, the healthier the gut, and the use of Bio-Mos® 2 enables the gut to "police" itself through promotion of microbial diversity, thereby reducing issues associated with pathogen colonization.

A drawback of antibiotics is their non-specific effect on the microbiome and the reduction in overall microbial diversity noted with their use. Given the ability of Bio-Mos® 2 to enhance the overall gut microfloral diversity, it is an ideal solution to combat the negative consequences of diversity reduction following antibiotic administration.

When comparing first- and second-generation MOS- and MRF-based products such as Bio-Mos® and Bio-Mos® 2, it is important that the end user understands that form defines function. Individual MOS- and MRF-based products will have widely differing compositions, and while attempts have been made to compare products based on their total mannose content, studies have shown that not only the extent but the type of carbohydrate branching in these products is the key factor in controlling efficacy. Essentially, not all MOS or MRF products will act in the same manner. Innovative analytical tools developed by Alltech, such as ELMAA and ELLA, enable the detection of Bio-Mos® 2 in feed and measure its biological activity, allowing for traceability and quality control management.

Having spent more than 30 years researching gut health, Alltech is recognized for its leadership and expertise in the field of glycomics, with the accumulation of more than 700 research studies, including over 150 peer-reviewed papers, on the effects of carbohydrate fractions such as Bio-Mos® 2 in animal production systems (Spring et al, 2015).

Closing the gap between ideal and actual performance is essential to maximize profitability. Bio-Mos® 2 is a cost-effective, safe, traceable and natural growth permitter. From start to finish, it is a key part of a strategic feeding program.

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