Ohly Application Note

Benefits of Application of Yeast β-Glucans in Ruminants

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Article Date: 16/08/2018

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Abstract: The well-known immune modulating effects of yeast β-glucans in mammals have also been demonstrated in ruminants. Dietary supplementation with yeast β-glucans improves animal productivity with respect to feed intake, feed conversion ratio and milk yield and quality. Moreover, they result in a reduction of bacterial infections and an activation of the innate immune response. Overall, yeast β-glucans provide a valuable tool to the ruminant producer as an alternative to antibiotics.

Keywords: Yeast beta-glucan, Ruminants, Antibiotic replacement

Introduction

Bacterial infections are an important problem for both animal health and productivity. Traditionally, antibiotics were used sub-therapeutically to reduce the impact of bacterial infections in livestock. However, there are increasing consumer concerns about drug residues in meat products and the rise of antibiotic resistance of pathogenic bacteria (Gadde *et al*., 2017). As a result, many countries have banned the inclusion of antibiotics in animal diets as a routine means of growth promotion. Consequently, there is an increasing demand for alternatives to antibiotics.

Beta-glucans are naturally occurring polysaccharides with well-known health benefits. They are abundantly present in the cell walls of many micro-organisms and cereals. There are different types of β-glucans. Beta-glucans from yeast and fungi, so called β (1→3)(1→6)-β-glucans, have been shown to have beneficial effects as supplements (Zhu *et al*., 2016). In contrast, β-glucans from cereals with a different structural composition, (β (1→3)(1→4)-β-glucans), have very detrimental effects on livestock health and performance (Jacob and Pescatore, 2014).

Amongst β-glucans from microbial sources, those from the yeast *Saccharomyces cerevisiae* have been found to be the most active (Raa, 2015).

After decades of studies, the health benefits of yeast β-glucans have in the meantime been well established in mammals (Zhu *et al*., 2016; Raa, 2015). An increasing body of evidence demonstrates similar benefits in ruminants (Broadway *et al*., 2015; Ma *et al*., 2014).

Improving milk yield

Milk yield and quality are the primary performance parameters monitored by dairy farmers. Dietary administration of yeast β-glucans to lactating ewes caused an increase in milk yield by up to 14% (Zabek *et al*., 2013 Zaleska *et al*., 2015) Moreover, the composition of the milk also improved, and was found to contain substantially higher amounts of fat (up to 30%) and protein (up to 11%) (Zabek *et al*., 2013 Zaleska *et al*., 2015).

Improving the development of the gastrointestinal in calves

The gastrointestinal tract of weaning calves is still underdeveloped, resulting in a suboptimal nutrient digestibility. Supplementation of yeast β-glucan to young calves' diets results in an improved composition of the intestinal microflora, with decreased numbers of pathogenic *E. coli* and increased numbers of commensal *Lactobacillus* (Zhou *et al*., 2009). Moreover, the height of the intestinal villi and the villous heights to crypt depth ratio are improved (Zhou *et al*., 2009), two parameters associated with a more efficient nutrient digestion (Ma *et al*., 2014).

Boosting the immune system of weaning and adult ruminants

Newborn calves have an immature immune system. Therefore, in the pre-weaning period calves are highly susceptible to infections by pathogens. The immune system is the host defense system that protects it against diseases. Yeast β-glucans play an important role in the activation of both innate and adaptive immune systems. They activate macrophages, a key component of the non-specific (innate) immune system. Also in ruminants, dietary supplementation with yeast β-glucans has been shown to activate macrophages (Wojcik, 2014). Moreover, yeast β-glucan supplementation enhanced the adaptive immune system of Holstein calves by increasing immunoglobin concentration in the serum (Ma *et al*., 2014). Feed formulation containing β-glucan from yeast was also shown to reduce transport stress in Holstein dairy calves taken from their mothers within 24h after birth (Eicher, 2005).

Not only weaning animals' health is affected by β-glucans supplementation. In adult lambs, the innate and adaptive immune responses are also stimulated by yeast β-glucans (Khalkhane *et al*., 2013).

Reducing mastitis

Mastitis is one of the most important diseases in dairy cows. Dietary supplementation of yeast β-glucans to lactating ruminants resulted in decreased white blood cell count in milk, indicating a better health status of the mammary gland (Zabek *et al*., 2013). Additionally, intramammary infusion of β-glucan in the udders of ewes with mastitis triggered an immune response by increasing the secretion and migration of leukocytes and macrophages to the gland (Persson Waller *et al*., 1999; 2003).

Animal performance benefits

Bacterial infections are not only an important concern for animal health, but also for animal productivity and growth. Supplementation of ruminant diets with yeast β-glucans has been demonstrated to improve growth performance. Due to yeast β-glucans supplementation, the feed conversion ratio in Holstein calves was significantly improved (Ma *et al*., 2014), and growth rate and daily body weight of lamb off-springs was higher. Fertility of ewes was also improved and resulted in a 14% higher production of lambs per mother (Zaleska *et al*., 2015).

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