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VETERINARY STRENGTH SUPPLEMENTS

Saccharomyces cerevisiae boulardii Probiotic Therapy For Today's Horse

The efficacy of probiotics in the horse is argued among professionals throughout the industry. Understandably so due to the variability in microbial strains, number of colony forming units (CFU) supplemented, and protection mechanism of live microorganisms from the acidic and enzymatic environment of the equine foregut.

Furthermore, the variability in study design, supplementation period, and validation methods are often unreliable in many studies; therefore, this brief paper will highlight reliable studies reviewed by nutritionists and veterinarians to determine the benefit and reliability of probiotic supplementation to improve GI health, protect against common GI pathogens, and prevent antibiotic-associated diarrhea.

What Are Probiotics?

Probiotics are live microorganisms provided in the diet with the goal of localizing in the hindgut and improving the gut microbiome. The most common probiotics used in equine diets are *Lactobacillus*, *Enterococci*, *Bifidobacterium*, and *Saccharomyces cerevisiae*, which may be in the form of brewer's yeast or *Saccharomyces cerevisiae sp. boulardii* yeast strain. *Lactobacillus*, *Enterococci*, and *Bifidobacterium* are native to the hindgut of the horse; although in quite small and arguably insignificant amounts relative to total bacterial populations. Because they are considered resident microflora, some evidence supports the ability of these bacteria to colonize the hindgut, but subsequent benefits have not been well documented[1].

Yeast strains are popular probiotics, but are not native microbes to the hindgut. This does not discount the benefits, however, because a small amount of *Saccharomyces* survival in the hindgut can have a more significant effect than a small change in native bacteria because of their role in improving digestibility, protecting against enteric pathogens, improving host immune response, and protecting against antibiotic-induced diarrhea. These are described in more detail in the following section.

How Do Probiotics Work?

Saccharomyces cerevisiae boulardii is regarded as one of the most effective live microbial strains used in animal probiotics effective in improving digestibility and protecting against antibiotic-induced diarrhea and enteric pathogens.

Digestibility

There is little support of *Lactobacillus*, *Enterococcus*, or *Bifidobacterium* strains to improve digestibility; however, *Saccharomyces boulardii* has been described in multiple studies to improve fiber digestibility (NDF and ADF), increase acetate production, increase cecal pH, and decrease lactic acid production[2].

Antibiotic-Induced Diarrhea

Antibiotic administration is used to treat infectious bacteria; however, no antibiotic activity is specific only to pathogenic bacteria. Heavy or prolonged administration of antibiotics often results in negative impacts to the hindgut microbial populations, resulting in diarrhea and associated ailments. Probiotic supplementation promotes healthy bacteria colonization of the hindgut during antibiotic administration allowing for improved immune response, appropriate digestibility of feedstuffs, and protect against dehydration.

Enteric Pathogens

Two of the most common diarrhea-causing bacteria in the horse are *Clostridium spp.* and *Salmonella spp*. *Saccharomyces boulardii* protects against infection by these bacteria through competitive inhibition, protease detoxification, and engulfment of pathogens s3[,4]. Specifically related to immune response[5], *Saccharomyces boulardii* reduces the production of proinflammatory cytokines under normal conditions. In the presence of enteric pathogens, *Saccharomyces boulardii* stimulates the release of specific immunoglobulins of the gut (sIgA) to target gastrointestinal invasion. Systemically, *Saccharomyces boulardii* supplementation increases liver macrophages and serum IgM concentrations suggesting improved immune response at both the innate and adaptive levels.

Independent of immunomodulatory effects, *Saccharomyces boulardii* localize in the hindgut close to the wall of the large intestine. The localization allows the microbe to prevent adhesion of pathogenic bacteria[5]. *Saccharomyces boulardii* also bind to common enteric pathogens including *Salmonella* and *C. difficile*, inhibiting normal cellular signaling and preventing infection.

Selecting Probiotic Strains for Efficacy

Recent work suggests that the origin of bacterial strains is not correlated with the ability of bacteria to serve as an effective probiotic; therefore, a strain chosen because of its nativity to the host gut may not be the best means of selection[3]. A strain that is native to the hindgut of the horse has the ability to maintain colonization following cessation of dietary supplementation; however, this does not mean that the gut is better protected from enteric pathogens or antibiotic-associated alterations to microbial populations. Results of *Lactobacillus* and *Enterococcus* supplementation is variable with some studies observing a negative influence including increased incidence of diarrhea in neonatal foals[6].

Yeast strains, known as *Saccharomyces cerevisiae*, are not native to the mammalian gut; however, their beneficial effects as a probiotic are more pronounced and consistently repeatable

than the *Lactobacillus*, *Enterococcus* or *Bifidobacterium* strains. Because they are not native to the hindgut, colonization does not persist following termination of supplementation thereby requiring continued dietary supplementation for benefit[7]. Although initially believed to be a negative characteristic of *Saccharomyces cerevisiae* supplementation, the risk of overgrowth is negligible, and with consistent supplementation or supplementation during periods of digestive unrest, survival in the hindgut improves forage fraction digestibility, improves milk production in mares, decreases lactic acid production on high starch diets, and digests pathogenic bacteria including *Clostridium*, *Salmonella*, and *E. coli*[2,3].

Protection of Probiotics from Foregut Environment

The foregut of the horse is a treacherous environment for live microbes beginning with the acidity of the stomach followed by exposure to bile salts and digestive enzymes. Survival of most probiotics in this environment is limited unless protected in some manner. Probiotics are generally supplemented at a rate of 10^8-10^9 with the hopes of 10^6 reaching the hindgut intact. Traditionally, probiotics are protected through processing techniques such as spray drying and emulsion. While these techniques protect the bacteria from environmental factors during storage including heat and humidity, they are not effective in protecting bacteria from the gastrointestinal environment.

Microencapsulation is a newer technology in probiotic supplementation and is a means of encapsulating the live microbes to protect them from high temperature and pressure, allowing for their inclusion into a pellet. In the small intestine, the microbes are released from encapsulation enabling them to elicit their protective mechanisms for gastrointestinal health.

Summary

Evidence suggests that probiotic supplementation improves nutrient digestibility, protects against enteric pathogens, and reduces the incidence of antibiotic-associated diarrhea. While native bacteria are popular for the very reason that they are native, the evidence of their efficacy is varied and argued among the scientific community. Results following supplementation with *Saccharomyces boulardii* are more consistent and repeatable compared to other strains, and the mechanism by which they elicit their effects are well-documented.

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