VETERINARY FORMULA
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Probiotic vs. Prebiotic: Understanding the Difference

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The term "probiotic" is used and misused to identify a growing number of nutritional supplements for horses. In order to understand the varying claims and uses of probiotics, it is critical to define the term as succinctly as possible. To begin, we divide the word into its prefix and root word. The prefix "pro" is a descriptor meaning "supporting or being in favor of," while "biotic" relates to a living organism. Even this root word, biotic, can have a variety of implications: it can mean relating to a living organism and it can mean something produced by or affected by a living organism. For this reason the term "probiotic" can be vague at best and misleading at worst.

One definition specifically identifies a probiotic as "a substance or preparation that supports the growth of microorganisms living in the intestinal tract." [16] This definition is an often-used description that implies a probiotic is the same as a prebiotic. Most scientists agree that the term prebiotic refers to a substance that supports the growth of resident microbiota, or food for microbes, in the simplest terms, whereas a probiotic is itself a living organism that provides for the growth and health of the host organism, in this case the horse. This is the definition more scientists and nutritionists are recognizing as a true probiotic and the definition that most effectively describes the therapeutic product lyophilized *Saccharomyces boulardii*.

Prebiotics are "selective ingredients that allow specific changes both in the composition and/or activity in the gastrointestinal microflora." [8]

Probiotics are "viable microorganisms, sufficient amounts of which reach the intestine in an active state and thus exert positive health effects…via modulation of the intestinal microflora of the host, as well as interaction with the immune system directly." [8]

In point of fact, these definitions effectively distinguish *S. boulardii* from preparations of *S. cerevisiae* and other microbial products currently referred to as probiotics. *S. boulardii* directly modulates tissues and cellular functions of the host, unlike *S. cerevisiae*. Herein lies the therapeutic value of *S. boulardii* to the equine host.

S. boulardii and *S. cerevisiae:* Significantly Different

Saccharomyces boulardii is in fact a strain of *Saccharomyces cerevisiae*, the latter being the more commonly recognized in both human and animal nutrition;[11] however, *S. boulardii* is fast becoming the most clinically researched probiotic due to its highly effective biotherapeutic activities. *S. boulardii* was discovered by French scientist Henri Boulard in the 1920s when he isolated the organism from tropical fruits after observing indig-

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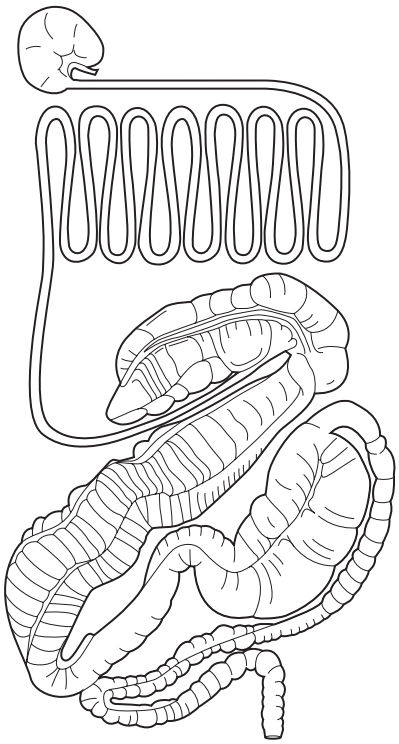
enous people in Indochina chewing fruit skin in order to ease symptoms of gastrointestinal maladies such as Cholera.[5]

S. boulardii is taxonomically, metabolically, and functionally different from *S. cerevisiae*. Many researchers contend that *S. cerevisiae* is not a probiotic, while they do recognize *S. boulardii* as an effective and therapeutic probiotic. This dichotomy stems from the different definitions of probiotic. The more often recognized definition states that a probiotic is composed of live and viable microorganisms and is of benefit to the host organism." [8] *S. cerevisiae* may support the healthy functioning of other microorganisms within a host organism; however, there is limited research to suggest that *S. cerevisiae* directly modifies the health and well-being of the host.

Clinical Distinctions

Chronic diarrhea is a major concern in many equine clinics, due to the constant use of cleansing agents and broad-spectrum antibiotics. *Clostridium difficile* toxins are implicated as the most serious cause of antibiotic-associated diarrhea, as its spores are resistant to most cleaning agents and the toxins find easy prey in a gut that has had most of the natural microflora eliminated via antibiotic administration. Dozens of clinical trials have demonstrated that *S. boulardii* administration attenuates chronic and acute diarrhea, and in fact binds the toxins produced by *C. difficile*.[4, 19] Preparations of *S. boulardii* are fast becoming the remedy of choice for clinics looking to overcome this increasingly common malady.



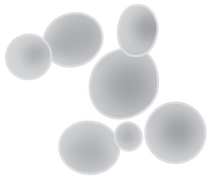
S. boulardii plays an active role in supporting the intestinal environment.

Other types of diarrhea and gastrointestinal upsets are a result of organisms adhering to intestinal membranes and interrupting the functionality of those tissues. Researchers have also studied the ability of *S. boulardii* to mitigate adhesion of pathogenic bacteria such as *Salmonella* and *E. coli* to the tissues of the intestines. In vitro studies have revealed that both *Salmonella* and *E. coli* have a high affinity for the mannose receptors on the cells of *S. boulardii*.[20] Therefore, these pathogens are carried away as bound passengers on transiting *S. boulardii* cells rather than attaching to intestinal cells of the brush border membrane, thereby preventing disruption of intestinal functions.

More Than a Cure

S. boulardii can do more than prevent disease and gastrointestinal dysfunction. For decades scientists have observed improvement of the mucosal tissues lining the gastrointestinal tract when the host organism ingests *S. boulardii*. [9] This suggests that *S. boulardii* is more than a preventive agent but also plays an active role in supporting the intestinal environment. Since the mid-1980s researchers have realized administration of *S. boulardii* expresses trophic or beneficially stimulatory effects on the cells of the small intestine. Specifically, research has demonstrated that oral administration of the lyophilized yeast results in a stimulation of

brush border membrane enzymes, including lactase, sucrase-isomaltase, maltase-glucoamylase, and α,α-trehalase.[5] The stimulation of these enzymes is the key to understanding the mode of action by which *S. boulardii* is an effective therapeutic agent in the small intestine.



Ingested *S. boulardii* secretes factors while transiting through the gastrointestinal tract of the host organism, which have been identified as being pro "motogenic."

The most recent research focuses on the mode of action by which *S. boulardii* improves the functionality of and expedites healing of the intestinal lining and enteroluminal spaces. Reported in March 2011, researchers devised protocols to determine the means by which *S. boulardii* improves intestinal cell restitution.[6] In this matter, restitution refers to "the process by which cells migrate to restore epithelial continuity in the repair of damaged colonic mucosa." Restitution is followed by proliferation and maturation of cells. Researchers concluded that ingested *S. boulardii* secretes factors while transiting through the gastrointestinal tract of the host organism, which have been identified as being pro "motogenic."[6] That is, these factors enhance the movement of intestinal cells in the process identified as restitution, or are commonly understood as the first step in repairing damaged cells in the gut epithelium.

Prebiotics: Unlocking the Potential

The mere existence of commensal microbes does not necessarily ensure adequate digestive function nor immune competency. The resident microbiota of the horse are present to provide thorough fermentation of feedstuffs otherwise indigestible by the horse's own gastric acids and enzymes. Through decades of research, aided by the emergence of molecular techniques, it has become increasingly obvious that the gastrointestinal microbiome plays a critical role in supporting not only the health of the cells and tissue with which they reside, but also the overall well-being of the host via modulation of various parameters of the immune system.

As previously described, particular probiotics exert direct influence on both the resident organisms and the cells/tissues responsible for immunity, absorption, digestion, etc. Prebiotics indirectly influence and sustain the same systems and processes of the gastrointestinal tract by nourishing the resident microbes. Prebiotics are recognized as fermentable carbohydrates that are indigestible by the host and resistant to gastric acid, enzymatic digestion, and intestinal absorption.[17] Prebiotics should selectively promote the growth and activity of intestinal bacteria.[15]

The more common prebiotics used in the horse nutrition industry are derived from components of lysed yeast cell walls, the primary components of which include mannon oligosaccharides (MOS) and beta-glucans. In vitro and in vivo research has clearly demonstrated that these components are both indigestible by the horse's digestive processes, yet are highly fermentable and utilized by the commensal bacteria for energy.[22] In addition, these prebiotic carbohydrates can indirectly modulate various facets of the immune system, including NK-cell activity, the secretion of interleukin-10 and interferon, and the lymphocyte proliferation.[1, 12, 18, 21]

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Prebiotics (and probiotics) can also inhibit the ability of transient, pathogenic bacteria from adhering to host tissue.[2, 13] Most notably, prebiotics have demonstrated the ability to bind with strains of harmful bacteria such as *E. coli*, *Campylobacter* and *Salmonella* both in vitro [10] and in various species.[3, 7, 14] By selectively supporting the beneficial populations and activities of the residential bacteria, while simultaneously shuttling bound pathogens out of the intestinal lumen, prebiotics work double duty to ensure a balanced and highly functioning digestive system.

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