Prebiotics and Probiotics: What They Can Do for Dogs and Cats

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It seems that everywhere we look these days, we see products that include probiotics or prebiotics. They can be in supplements, known as nutraceuticals; over-the-counter foods; or therapeutic diets. According to many claims about probiotics and prebiotics, they can improve the immune system and gastrointestinal (GI) function. Do you know what probiotics and prebiotics really are and what they can actually do for dogs and cats?

According to the current definitions used by the Food and Agriculture Organization (FAO) and the World Health Organization (WHO), probiotics are “live microorganisms, which, when administered in adequate amounts, confer a health benefit on the host,” whereas prebiotics are “nondigestible food ingredients that selectively stimulate the growth and activities of specific bacteria in the GI tract and exert beneficial effects on the host.” The Food and Drug Administration (FDA) defines nutraceuticals as “nondrug substances produced in a purified or extracted form and administered orally to provide agents required for normal body structure and function with the intent of improving health and well-being.”

According to these definitions, probiotics are bacteria that benefit a host, and prebiotics are substances that benefit specific bacteria in the GI tract. Millions of bacteria normally reside in the small and large intestines of healthy animals. These bacteria help digest food, maintain intestinal mucosal integrity, participate in metabolism, and stimulate local and systemic immune function. Disease, parasites, stress, and dietary changes are some of the factors that can cause an imbalance in these beneficial bacteria, adversely affecting all the body systems that benefit from the bacteria. Another common cause of changes in the GI microflora is the use of antibiotics to treat infections. When these drugs disturb the GI microflora, potentially harmful and pathogenic bacteria can become more prolific, causing diarrhea.

The Intestines

The intestines comprise approximately 70% of the total immune system. The mucosal barrier in the intestines helps block the entrance of most pathogenic bacteria into the body while allowing entrance of permeable nutrients. Because most pathogens enter the body through the mouth and then pass into the intestinal tract, the intestinal defenses must work optimally to cope with constant exposure to these pathogens.

The intestinal defenses involve the coordination of three systems:

- Resident intestinal microflora, which provide an environment favoring the growth and function of beneficial bacteria
- Intestinal mucosa, which provides a protective barrier against pathogenic bacteria
- Gut-associated lymphoid tissue (GALT)

It is difficult for clinicians to affect the intestinal mucosa or the GALT, but we can help modulate the microflora to improve the intestinal environment, positively affecting our patients. Substantial research is investigating how enteral nutrition can be used to improve GALT and the intestinal mucosa. I hope we will see the benefits of this research within the next few years. Even without definitive data, prebiotics and probiotics are currently being used to help modulate GALT and the intestinal mucosa.

Prebiotics

Typically, prebiotics are a type of carbohydrate called oligosaccharide; however, by definition, noncarbohydrates can be classified as prebiotics. The carbohydrates used most frequently are classified as soluble fibers, which were first identified as a functional food in 1995 by Dr. Marcel Roberfroid. In 2007, Roberfroid clarified that only two types of oligosaccharide (i.e., oligofructose and inulin) can be defined as prebiotics. Both are considered to be dietary fiber. Commercially, oligofructose, also called fructooligosaccharide (FOS), is produced from inulin.
Oligofructose is a 2-8 chain, fructose-based saccharide molecule that undergoes fermentation fairly quickly in the colon, nourishing bacteria there. Natural sources of oligofructose include soybeans, oats, beets, and tomatoes.

Inulin is a longer 9-64 chain, fructose-based saccharide that tends to ferment more slowly, benefiting bacteria farther into the colon. It can also be broken down into FOS by intestinal bacteria. Inulin is found in Jerusalem artichoke, jicama, and chicory root.

Oligofructose and inulin are considered minimally digestible because of their β-bond base, which connects fructose molecules. Dogs and cats lack the intestinal enzyme for breaking the β bond; instead, they usually break α-saccharide bonds. However, the resident bacteria in the colon of dogs and cats produce the necessary enzymes to break the β bond, producing short-chain fatty acids (SCFAs), the most common of which are acetate, propionate, and butyrate. If the correct bacteria are not present in the colon, SCFAs are not produced by the breakdown of β bonds.

Plants may contain more than one type of carbohydrate, so both FOS and inulin can be found in varying amounts in the same plant; however, other plants may not contain either carbohydrate. Just adding fiber to the diet may not provide prebiotic effects, depending on the type of fiber in the product.

SCFAs produced by breaking the β bond through bacterial fermentation serve as an energy source for colonocytes, lower the colonic pH, and stimulate sodium and water absorption. Butyrate is the primary energy source for colonocytes, but it may also directly enhance proliferation of normal cells while suppressing proliferation of mutated cells (i.e., those with precancerous changes). Because prebiotics are fibers, they can have adverse effects when added to the diet. High levels of FOS and inulin have been shown to decrease fecal protein digestibility.

Studies in which FOS and fructose-based inulin were added to the diet have shown generally positive effects on gut microflora, host health as evaluated through gut integrity and bacterial colonization, and animal performance as evaluated through digestion, body weight gain, and feed efficiency.

Although prebiotics are increasingly found in dog and cat foods, care must be taken to evaluate which fiber is being used and whether it provides the desired results. Just adding fiber to the diet does not necessarily benefit a patient as much as adding FOS and inulin.

**Probiotics**

Probiotics, rather than encouraging the growth of beneficial bacteria and suppressing the growth of pathogenic bacteria, actually introduce beneficial bacteria into an environment. Bacteria used as probiotics must do the following:

- Survive the acid and bile in the GI tract
- Adhere to intestinal cells or transiently colonize various areas within the GI tract
- Exclude or reduce pathogenic bacterial adherence
- Produce acids, hydrogen peroxide, and/or bacteriocins that antagonize the growth of pathogens
- Coaggregate to help achieve a normal, balanced microflora
- Be safe, noninvasive, noncarcinogenic, and nonpathogenic to the host

The GI tract of a newborn is initially sterile but is colonized by bacteria within hours of birth. These bacteria find their individual niches within the intestinal tract and reach a state of equilibrium. However, once this neonatal “grace period” is over, introduction of bacteria is significantly more difficult due to gastric acidity and the introduction of bile acids to the chyme leaving the stomach. Although yogurt and other bacterial fermented products contain beneficial bacteria, these bacteria seldom survive the stomach and, therefore, do not benefit intestinal bacteria. The beneficial effects of probiotics depend on the number of live bacteria that enter and transiently colonize the intestines.

Lactic acid bacteria, especially *Lactobacillus*, *Bifidobacterium*, and *Enterococcus* spp (Box 1), are the bacteria used most routinely in probiotic preparations for dogs and cats, but the list of beneficial probiotic bacteria is extensive. These agents are bacteria that can survive processing and have other characteristics that lend themselves to use as manufactured probiotics. These bacteria use fermentation to transform some sugars into organic acids, particularly lactic and acetic acids. These acids lower the pH in the intestinal tract and inhibit the growth of pathogenic bacteria.

Probiotics can benefit the intestinal microflora in several ways. They can increase fecal bacterial counts of beneficial bacteria while decreasing the number of pathogenic bacteria. Some probiotics have been shown to minimize (1) adherence to intestinal epithelial cells and (2) establishment...
of pathogenic bacteria. Compared with the large intestine, the small intestine has poor microflora colonization and limited barrier protection against pathogens. Therefore, probiotics can have an important beneficial effect in the small intestine.4

Probiotics can also help control diarrhea caused by bacterial overgrowth or parasitic infection. This use of probiotics follows the principle of competitive exclusion—competition for nutrients and binding sites increases the specific and nonspecific immune responses.4

One of the biggest challenges for manufacturers of probiotic products is survival of the bacteria. Most commercial products undergo tremendous loss of activity during storage. After 5 to 6 months of storage, virtually no live organisms are present.1 Bacteria that do survive storage still have to survive the gastric pH and the duodenal bile acids before they can colonize the small and, potentially, large intestines. To address these concerns, some manufacturers have developed microencapsulation processes to protect the bacteria; other manufacturers provide various bacteria within a single product to improve effectiveness (e.g., if one strain is susceptible to being destroyed during digestion, another type of bacteria may survive and make it to the small intestine to exert a positive effect).4

**Conclusion**

Because prebiotics are used as a source of nutrition for colonocytes and a source of fiber for animals, inclusion of prebiotics in the diet is fairly easy. The source of fiber should be listed in the ingredients of commercial diets, which may not specify whether it is a source of FOS or inulin. Increasing your familiarity with the different fiber sources and their relative FOS and inulin contents can help when evaluating a diet. When in doubt, contact the manufacturer for further information.

Unlike prebiotics, probiotics are usually used transiently as needed. Ideally, the body supplies the bacterial population necessary for the best intestinal health. When this does not occur or when intestinal health is challenged—for example, by a digestive problem such as diarrhea associated with garbage ingestion or stress—probiotics can be easily added to the diet to help support the existing bacteria. Unlike long-term antibiotic use, no detrimental effects have been seen with long-term prebiotic or probiotic use.4

When evaluating products for use as prebiotics or probiotics, ensure that research supports the product claims, the product has been proven to contain the stated additive levels, and the product has been proven to promote normal intestinal microflora. Weese and Arroyo1 demonstrated that few probiotics in commercial dog and cat foods meet these guidelines. Alternatively, evaluation in a controlled clinical setting can provide firsthand knowledge of product effectiveness. Some nutraceutical manufacturers recommend ensuring that the product used in a study is the same one you are using. For example, *Bifidobacterium* spp in different formulations may not behave the same way. By evaluating these products, you can ensure that you are providing the best product to support a healthy intestinal tract with a hardworking population of beneficial bacteria.

**References**