

PREBIOTICS AND PROBIOTICS IN PET FOODS

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Last month's column discussed flatulence – the excessive production of gas in the digestive tract of the dog. I concluded that article by stating that one strategy for reducing flatulence is to alter the types of bacteria residing in the dog's intestinal tract. This month's column will discuss two products designed to achieve this goal: prebiotics and probiotics.

Let's start with some definitions. According to the Food and Agriculture Organization of the United Nations (FAO):

Prebiotics are: "non-digestible substances that when consumed provide a beneficial physiological effect on the host by selectively stimulating the favorable growth or activity of a limited number of indigenous bacteria".

Probiotics are: "live microorganisms which when administered in adequate amount confer a health benefit on the host".

So prebiotics are foods that stimulate the growth of good bacteria in the gut whereas probiotics are live bacteria which when consumed provide health benefits.

THE ROLE OF BACTERIA IN THE DIGESTIVE TRACT

Because we can't see bacteria, we tend to underestimate their importance in our lives. To put things in perspective, your body is composed of about 10 quadrillion cells, but is host to about 100 quadrillion bacterial cells. (A quadrillion is 1,000,000,000,000,000). About a trillion bacteria live on your skin – more than 100,000 for every square centimeter of surface area. Your digestive tract is home to more than 100 trillion bacteria, representing over 400 different species.

The acidic conditions of the stomach and the digestive secretions in the small intestine create unfavorable environments for most types of bacteria. Bacterial concentrations are

therefore low in these early segments of the digestive tract but their numbers increase towards the lower end of the small intestine. Microbial populations are very high in the dog's colon.

The microbes in the colon have a very important function. They complete the digestion process, breaking down nutrients that were not digested and absorbed in the dog's small intestine. All dietary fibre bypasses digestion in the upper gastrointestinal tract and is therefore available for fermentation by bacteria in the colon. Although high quality proteins, fats and digestible carbohydrates are generally broken down and absorbed in the small intestine, there may be times when impairment of the digestive or absorptive processes allows these nutrients to pass unabsorbed into the colon. Poor quality diets may also contain nutrients which cannot be digested or absorbed in the dog's small intestines. As discussed in last month's column on flatulence, bacterial fermentation of undigested protein leads to the production of several odoriferous intestinal gases: indole, skatole, volatile amines, hydrogen sulfide and ammonia.

GOOD VERSUS BAD BACTERIA

The bacteria in the gut can be helpful, harmful or neutral.

Some of the harmful species are likely familiar to you. Seven people died and more than a thousand were taken ill when the drinking water in Walkerton, Ontario became contaminated with *Escherichia coli* in 2000. The botulism toxins produced by *Clostridium botulinum* are among the most poisonous natural substances known to man. Other *Clostridial* species, including *Clostridium perfringens* and *Clostridium difficile*, cause severe diarrhea, intestinal cramps and colitis. "Salmonella poisoning" is a term understood by most people. Many different species of *Salmonella* can cause food poisoning,

however the most common bacterial cause of food poisoning in humans is *Campylobacter* spp. (In fact, 67% of all food borne illnesses in humans are caused by viruses, particularly Norwalk-like viruses, but the bacteria listed above account for 72% of all food-poisoning deaths). These are the most common species of "bad" bacteria.

On the list of "good" bacteria are *Bifidobacteria*, *Lactobacillus acidophilus* and other *Lactobacilli* strains. These bacteria exert many beneficial effects on health, both by their direct interaction with the cells lining the intestinal tract, as well as by producing beneficial products through metabolism. For example, when these bacteria digest dietary fibre, they produce short chain fatty acids which are crucial to gut integrity, immune function and mineral absorption. These short chain fatty acids are a primary source of nutrition for the cells lining the dog's colon.

PREBIOTICS – FOODS THAT PREFERENTIALLY PROMOTE "GOOD" BACTERIA

Prebiotics are foods that promote the growth of healthy bacteria in the gut, at the expense of harmful bacteria. There are three major types of prebiotics: fructo-oligosaccharides, inulin and oligofructose. These three terms are often inappropriately used interchangeably so some clarification is in order.

Fructo-oligosaccharide, or FOS, is one type of prebiotic. The word fructo-oligosaccharide literally means small (oligo) sugar (saccharide) that contains fructose (fructo). Fructose is a 5-carbon sugar found in honey.

FOS contains one glucose unit attached to a chain of fructose units, with a maximum chain length of 5 units. FOS is commercially produced from the natural fermentation of sugar cane. It is 95% pure active prebiotic. On a pet food ingredient list, it is identified as fructo-oligosaccharide.

Inulin is a second type of prebiotic. (Note:

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inulin should not be confused with the hormone insulin). Inulin is found naturally in ingredients such as chicory root, garlic and onions. It is technically not a fructo-oligosaccharide since more than 90% of its saccharide chains are more than 10 units in length. On a pet food ingredient list, look for the few ingredients that contain inulin, for example chicory root extract or garlic powder.

Oligofructose is a third type of prebiotic which is derived from the enzymatic breakdown of inulin. It consists mostly of linked fructose units, with some glucose-terminated chains. Oligofructose saccharide chains contain between two and seven units. The glucose terminals and short chain length are extremely important to the fermentability and functionality of the prebiotics. In vivo studies show that both FOS and inulin support the growth of a wide variety of Bifidobacteria and Lactobacilli strains but do not support the growth of most species of harmful bacteria. By providing a substrate that only healthy bacteria can use, prebiotics allow good bacteria to thrive, crowding out the bad species. This is known as competitive exclusion. Furthermore, the short chain fatty acids produced by the bacterial fermentation of prebiotics lowers the pH inside the colon, which makes the gut environment more unfavorable to harmful bacterial strains.

PROBIOTICS – LIVE BACTERIAL CULTURES

For centuries, fermented dairy products like yoghurt, which contain live active bacterial cultures, have been believed to confer health benefits to humans. Recent scientific studies substantiate these beliefs. Clinical studies in humans have shown that probiotics can help manage lactose intolerance, prevent and treat various diarrheal diseases in children and adults (including acute pediatric diarrheal disease, Traveler's diarrhea and Clostridium difficile diarrhea) and can help to manage chronic inflammatory bowel disease and antibiotic-related diarrhea. Researchers are now showing far broader applications, including the management of hypersensitivity disorders (for example atopic dermatitis) and

respiratory disease (including asthma). Probably the most exciting work however deals with the use of probiotics to treat infectious diseases. With the increased prevalence of antibiotic-resistant bacteria, probiotics may prove to be the safest, most effective, natural way to crowd out harmful bacteria, and replace them with strong, beneficial bacterial competitors.

PREBIOTICS AND PROBIOTICS IN PET FOODS

Prebiotics are easy added to pet food and many high quality dog foods already contain fructo-oligosaccharides, chicory root and/or garlic. Probiotics of course present a greater challenge. While there are many probiotic supplements on the market for both humans and dogs, there are very few controlled studies that have evaluated the viability of the bacteria they contain. Many of the studies that have been done have produced disappointing results.

In 2003, CBC Marketplace purchased four popular yogurt brands and two brands of live probiotic supplements in capsule form and had each product analyzed twice for live bacteria by an independent laboratory. The first analysis was done when the products were fresh off the shelf, the second a few weeks later as the products approached the end of their shelf life.

The initial bacterial counts in the yoghurt brands ranged from 794,000,000 live cultures per gram, to less than 120,000 live cultures per gram. Both capsule supplements had bacterial counts well below their label claims. All products showed a massive drop in viability by the time of the second analysis. In some cases, almost two thirds of the bacteria had died within a two week timeframe.

One study involving dog food showed even less impressive results. This study found that the normal pet food manufacturing process killed more than 99% of the Bacillus bacteria they had added to the food. Even when the researchers tried coating the kibble after the manufacturing process, there was still a 40% loss of viability simply from applying the

powder. Another more recent study had much better results due in part to the extreme care that was taken in applying the probiotics and in storing the dog food afterwards. This included drying the food to less than 2% moisture and storing the food in bags which prevented exposure to air.

Prebiotics such as FOS and inulin are not affected by the manufacturing process. As long as they are present in the diet at sufficient levels to be effective, they will be available to the microbes residing in the dog's colon. Probiotics may prove to offer the same exciting benefits to dogs that have been documented in humans, but at the moment there are still a number of challenges that need to be overcome to ensure that enough live bacteria consistently reach the large intestine. As CBC Marketplace clearly showed, there is no way for consumers to know whether the product they buy is supplying the live bacterial cultures its label claims to supply. A probiotic by definition must supply living bacteria in adequate amounts to confer a tangible health benefit.