Probiotics and Prebiotics

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Stress, illness, and age can disrupt beneficial microflora in the horse's gastrointestinal tract; here are tips on keeping these microbes healthy.

Lately, we have seen commercials that promote striking the balance of "good bugs" in our own gastrointestinal (GI) tracts. Our local grocery likely has a variety of colorfully packaged yogurts boasting "live and active cultures." These products are designed to keep the good microflora happy and reduce the amount of detrimental bugs in our guts, but the jury is largely still out on their efficacy. Similarly, horses' GI tracts also need to reach this balance, but since these animals have a unique digestive system that enables them to process and utilize forages, different types of bugs are required.

Microbes in the hindgut (the large intestine and cecum) of the horse break down and ferment fibrous portions of roughages, producing volatile fatty acids that serve as a significant energy source. These microbes also create B vitamins and other nutrients essential to the health and well-being of the animal, and they help reduce the risk of overgrowth of potentially harmful bacteria such as *Salmonella* and *Clostridium difficile*. The microbial population (which includes bacteria, protozoa, yeasts, and fungi) of the hindgut must be healthy, and its numbers must be at appropriate levels for proper digestion. Bacteria make up the largest group, but the other good bugs play an important role.

When the levels of the good bugs wane--as in cases of stress, travel, or antibiotic administration--there are ways to replenish them with the help of probiotics and prebiotics. And while not available in your supermarket aisle, these equine products are readily available elsewhere. It's important to note there is limited scientific evidence in peer-reviewed journals on probiotics and prebiotics, so ask your veterinarian to advise you on the use of these products and where to find them.

Probiotics

Many horse owners use supplements or commercial feeds containing some of these essential microbes. These living products, called probiotics, are microorganisms that when administered in certain doses exert a positive health effect beyond that of their inherent nutritional value. Amy Gill, PhD, an equine nutritionist based in Lexington, Ky., says the purpose of feeding these is to keep the hindgut stabilized.

"It is very easy to disrupt the horse's hindgut," explains Gill. "An abrupt change in feed, or any kind of stress--even the stress of putting a horse in a trailer and taking him somewhere, a visit by the veterinarian or farrier, a strenuous showing or work schedule--can disrupt the gut. A high-grain, high-concentrate, low-fiber diet is also hard on microbes in the hindgut. This type of diet has a more negative impact than anything else."

Scott Weese, DVM, DVSc, Dipl. ACVIM, associate professor in the Department of Pathobiology at the University of Guelph's Ontario Veterinary College, has spent time examining probiotics, their contents, and their effects. He says it's unknown how much stress it would take to disrupt microflora, stressing that we have a crude understanding of gastrointestinal flora. "Molecular studies in dogs, cats, and humans have shown that a large percentage of the bacteria that are present are organisms that we don't even have a name for and that we can't culture using normal methods," he says.

Some nutritionists, including Gill, have suggested that adding probiotics on a daily basis can be helpful to horses, "We now call them direct-fed microbials (DFM)," she says. "You are directly feeding the horse the microbes it needs to sustain normal gut function. These include bacteria such as *Lactobacillus acidophilus*, *Enterococcus*, *Streptococcus faecium*, and *Lactobacillus lactis*. High-end feed manufacturers put these in most of their products, listed on the feed label."

Other researchers, however, are unconvinced that these direct-fed probiotics are useful. Several studies have shown that probiotic manufacturer labeling practices are lacking, and some products had detrimental effects when used as a diarrhea preventive measure in neonatal foals.

Direct-fed microbials are relatively new in equine nutrition circles. "They've become more routinely added during the last 10 years," says Gill. "Some are packaged as supplements."

Stephen Duren, PhD, is an equine nutritionist and founder of Performance Horse Nutrition, based in Weiser, Idaho, and he says this field of nutrition is rapidly growing. Special feeds for performance horses and older horses typically contain probiotics. "A performance horse that's traveling is always under stress, and older horses tend to lose some of their ability to digest and utilize nutrients," he says.

"I feel it's very beneficial to have a small amount of these important microbes added to the diet on a daily basis because we don't know all the things that can stress horses," says Gill. "The life cycle of these microbes within the gut is around 15 minutes. It's very easy to change the population very quickly. Thus, it's a good idea to include them in the ration. It's an inexpensive insurance policy. I feel it is better to have the microbes available in each feeding, as opposed to waiting until something bad happens and then trying to fix it."

Since these are living organisms, some people ask about shelf life of products, and whether the microbes can withstand the digestive process through the first part of the tract and actually make it to the hindgut. According to Gill, feed companies have tested the microbes' ability to withstand heat and pelleting in the manufacturing process and to get to the portion of the GI tract where they are needed. She cites studies completed by scientists at Alltech showing the

PROBIOTICS ARE NOT NEW

The term probiotic comes from Greek words "for" and "life" to describe the "good" microbes within the gut. The concept of consuming beneficial bacteria first arose in the early 1900s, according to Kyle Newman, PhD, a microbiologist and lab director at Venture Laboratories in Lexington, Ky., but he says the popularity of probiotic use has gone through ups and downs since that time.

"Every now and then people think this is new science and rediscover it," he notes. "Probiotic popularity now is because it's become more feasible to create these products and there are some good ones that have been on the market for a while."

Duren says the initial reason horse owners began using probiotics in recent years was to assist animals that had received large oral doses of antibiotics to treat disease. "We added various bacterial and yeast cultures designed to repopulate the hindgut," he says. "At first veterinary clinics collected manure from healthy horses, strained it to get some of the juice containing these microbes, and dosed the horse with that." Later, they cultured and grew the desired microbes, then added them to commercial paste products for horses recovering from illness or undergoing stress

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viability of yeast through pelleting and digestion.

"They will last quite a while in a bag of feed as long as it is stored according to directions, and kept dry, and doesn't become moldy or spoil," states Gill. "Pelleted feeds have a longer shelf life than sweet feeds, partly because they are dry. But as long as the product is fed within the manufacturers' recommended amount of time, you should be fine as far as viability of these microbes is concerned."

AMAFERM

A different sort of prebiotic (an inert substance that helps the microbial populations in the hindgut stay healthy) product now available for horses is designed to provide fungi with the active metabolites required to optimize fiber digestion.

For a long time scientists thought bacteria were the key players in forage digestion, aided by protozoa. Then some of the organisms earlier thought to be protozoa were discovered to be fungi. Research showed fungi were crucial to the start of the fiber breakdown process, since they produce fiber-degrading enzymes and are positioned in strategic locations within the fiber mat to break down cellulose bonds of plant material. This allows bacteria to better infiltrate the fiber and go to work. Without this increased surface area, digestion of fiber is slower and less efficient.

Research in the 1960s and 1970s showed that a fermentation extract from the fungus *Aspergillus oryzae* improved fermentation and digestion of low-quality roughages in ruminants. In 1968 a company (BioZyme) was formed, and it purchased the rights to develop and market this unique fungal extract. The company developed feed additives to enhance animal growth, health, and feed efficiency. Now the company is marketing products for horses and companion animals, as well as for livestock.

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However, at least one study has shown that probiotic pet foods had very low levels of probiotics and usually didn't contain what their labels stated. Weese, who performed the study, says he doubts there would be that much difference from general veterinary products to equine products. "It should be the onus of the company to prove that probiotic organisms are in their diets, using independent laboratories," he notes.

Prebiotics

Prebiotics are a newer concept than probiotics/direct-fed microbials. These are not microbes, but inert ingredients that help microbial populations in the hindgut remain stable and healthy. Scientists who coined the term define prebiotics as nondigestible food ingredients (sugars) that beneficially affect the horse by selectively stimulating the growth and/or activity of one or a limited number of bacteria in the colon (Gibson and Roberfroid, 1995). More recently, Gibson et al. proposed a new definition: selectively fermented ingredients that allow specific changes, both in composition and activity in the gastrointestinal microbiota, that confer benefits upon host well-being and health (2004). Put simply, prebiotics are a food source for good bacteria. "Some help feed and sustain the life of the microbes," explains Gill. "Prebiotics that assist beneficial bacteria mostly come from carbohydrate fiber called oligosaccarides. They include fructo-oligosaccharides (FOS) and Bio-Mos by Alltech, which is a mannan oligosaccharide (MOS)."

Duren further explains that the Food and Agriculture Organization of the United Nations held a meeting in 2007 and suggested that the following definition be adopted: A prebiotic is a nonviable food component that confers a health benefit on a horse associated with modulation of the microbiota. He adds, "In this meeting it was specifically pointed out that 'prebiotics are being examined for antipathogenic effects' (such as inhibiting adhesion of pathogenic organisms to the gut mucosa)."

Kyle Newman, PhD, a microbiologist and lab director at Venture Laboratories in Lexington, Ky., says an example of a prebiotic for humans would be the fructo-oligosaccharides present in some supplements or health foods, such as Ensure. Fructo-oligosaccharides feed beneficial bacteria in the GI tract.

"Yogurt made with a certain type of bacteria contains oligosaccharides," says Gill. "Bio-Mos contains part of the carbohydrate that's in the wall of a yeast cell. This is what is most commonly fed to horses, because we don't feed them fruits.

"MOS actually tricks bad bacteria into binding to it, rather than binding to the wall of the intestine," she explains. "It never colonizes there, and it is excreted in the manure."

This can be helpful in keeping the gut healthy, and some manufacturers who produce higher-quality products are adding MOS to their feeds.

"If people wonder why one bag of feed costs $14 versus one that costs $9, it is because of all the technology and research that has gone into making the better product do a lot more for your horse," Gill says.

Use of Prebiotics and Probiotics

Horse owners whose animals have strenuous careers often use these products in feed. "This way it's always there when the horse needs it," says Gill. "This can help make a difference in keeping a high-end performance horse functioning at his best."

She says another use for these products is re-establishing proper gut function after the horse has been ill, off feed, or treated with oral antibiotics that killed some of the beneficial microbes in the hindgut along with killing the pathogenic bacteria they were administered to target. If the gut has been compromised by stress, illness, or antibiotic treatment, or the horse is not eating, a dose of essential microbes could theoretically get proper digestion working more quickly. This was the first use of equine microbial products--dosing the horse in paste or gel form to re-establish a viable microbe population.

"You need to feed these in greater quantities to a sick horse," says Gill, who notes that horse owners should discuss use of these products with their veterinarians, even though feeding the products is "harmless at worst."

Researchers on one study, however, note that while it's likely a low risk to no risk in most populations, compromised horses or neonates might be a different story. That study showed administering a probiotic (*Lactobacillus pentosus* WE7) preventively to neonates was harmful, causing diarrhea "plus additional clinical abnormalities and the need for veterinary intervention" (Weese, et al., 2005). "Results rase concern about the variety of untested probiotic products that are commercially available," wrote the researchers. "Safety and efficacy testing needs to be performed for all potential equine probiotics."

Duren points out there are drawbacks to using antibiotics (they kill the "good guys" as well as the "bad guys") and that pathogens might develop resistance. "Now we can use probiotics and prebiotics to not only stabilize the good microbes, but also guard against harmful pathogens," he says, which could be helpful in the face of stress.

"Probiotic use started with adding strains of various bacteria to the GI tract, then progressed to adding live yeast cultures to feeds," Duren continues. "Yeasts help select against the bacteria that produce lactic acid and also stimulate use of lactic acid and fiber."

This can help prevent the pH drop in the hindgut that can lead to colic or laminitis. Newman points out that the bacteria in the extremely diverse microbial population in the GI tract far outnumber the actual mammalian cells that make up that animal. "So making sure the microbes (that remain) are good ones makes sense," he says.

Take-Home Message

The beneficial flora in the horse's hindgut are important to digestive tract health, as well as to the animal's overall well-being. Stress or illness can disrupt the normal population of these beneficial microbes, leading to digestive tract upset and even systemic illness (such as colic or laminitis). Giving these beneficial

microbes or something that helps the "good bugs" beat out the "bad bugs" in the GI tract can potentially help stressed, ill, or older horses.

Weese, however, cautions, "No commercial probiotic or prebiotic has been shown in a proper research trial to have any beneficial effect in horses. That's a very important aspect that people need to be aware of."

The jury is still largely out on some of these products, as it is with many new treatments or therapies that come down the pike. Duren says, "If anything we're ahead of the curve on this issue."

As always, discuss any changes in diet or supplements with your veterinarian or nutritionist.

THE GI TRACT AND IMMUNITY

The gastrointestinal (GI) tract not only digests food--it also protects the body against pathogens. Kyle Newman, PhD, a microbiologist and lab director at Venture Laboratories in Lexington, Ky., notes, "The GI tract ... has to sort through all the material and differentiate between good guys and bad guys and decide when it wants to attack something.

Prebiotics are inert substances that are designed to help the microbial populations in the hindgut remain stable and healthy.

Stephen Duren, PhD, an equine nutritionist based in Weiser, Idano, says it's possible to stimulate the immune system with products fed to the horse. "Alltech, a biotechnology company in Kentucky, found that certain feed additives stimulate the immune system and help protect against disease," he notes.

Newman also says research has shown that MOS can boost immunity, both cellular and humoral, and that you can boost immunoglobulins in colostrum by supplementing the dam with MOS prior to calving or foaling. "I call colostrum 'get out of jail free' cards. If there are more immunoglobulins in that first suckle, you win, as long as the newborn nurses before gut closure," he says.

New technology allows MOS and other prebiotics to be added to feed in order to benefit the immune system.

This technology is now commonly used in Europe because those countries are very restricted in legal use of antibiotics in animals. "Yet livestock still have disease risks, and stockmen need something that is not an antibiotic and will not build antibiotic resistance, yet still protect the animals. So they are feeding mannan oligosaccharides," explains Duren.

There is a big movement in the United States, too, for less antibiotic use. Thus, if we can bolster the animal's own immune system and help it sort through the good and bad microbes, he can be protected from disease and there will be less reliance on antibiotics.

"In a world where antibiotics are becoming less effective, the most you can do for the animal is improve its own immunity," says Newman. "One way to do that is by competitive exclusion, where you play musical chairs to crowd out the bad guys by feeding the good guys. The fructo-oligosaccharides (FOS) materials feed them and the MOS materials provide a binding site for the bad ones to stick to like flypaper and take them out of the animal."

Research on Bio-Mos (the only MOS product that's been tested to determine its effects on vaccination) has shown an increase in vaccination titers with certain vaccines. "A (manufacturer-conducted) trial in Texas showed that titers to Eastern/Western encephalomyelitis were greater in horses fed a diet containing Bio-Mos compared to the same diet without it," notes Newman. "While the exact mechanism is not yet known, it is thought to be due to an adjuvant activity from the Bio-Mos. Adjuvants are added to many vaccines to enhance and prolong the antibody titer in the animal."

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