An Introduction to Equine Microflora and Probiotics

One of the many ways of categorizing animals is based on their diet and digestive physiology. Carnivores eat meat, frugivores eat fruit, omnivores eat a variety of foods from both animal and plant sources, and so on. Horses are categorized as non-ruminant herbivores, a classification that includes other species such as rabbits and elephants. Non-ruminant herbivores derive their nutrient requirements from plant sources, the majority of which is comprised of fibrous plants such as grasses. Roughages such as grass contain varying amounts of both soluble carbohydrates and insoluble carbohydrates. Individual species have varying abilities to digest these carbohydrates---for example,monogastric species (such as humans) can easily digest soluble carbohydrates, but have a very limited ability to digest insoluble carbohydrates (think of this as the "bulk" part of the diet), while ruminants species (such as cattle and sheep) can digest and survive very well on extremely fibrous foods, including wood pulp, straw, ground corn cobs, etc.

In order to digest the insoluble carbohydrates in a fibrous roughage diet, horses (and other non-ruminant herbivores) have evolved a digestive tract with an enlarged pouch called a cecum. Ingested food is first ground by the teeth, mixed with digestive juices in the stomach, then move into the small intestine. In the SI, most soluble carbohydrates are absorbed, along with minerals, vitamins, fats and proteins. Insoluble carbohydrates which are not so easily digested, as well as any undigested soluble carbohydrates, are then passed into the fermentative vat of the cecum.

The primary difference between soluble and insoluble carbohydrates is not *what* they are made up of, but rather *how* they are put together. Both soluble and insoluble carbohydrates are made up of long strings of glucose molecules, but the bonding in soluble vs. insoluble carbos is different. Animals possess the enzymes to break the bonds between *soluble* sugars, but do NOT possess the enzymes to break the different bonding between the glucose molecules in structural carbos.

So as animals have evolved, they developed a symbiotic relationship with hundreds of different species of microorganisms that DO produce the enzymes capable of breaking this particular bond, thereby making the food available to both the "bug" and the host animal. Specifically, the breakdown products of this microbial fermentation are the volatile fatty acids (from which the animal derives the majority of its energy requirements), carbon dioxide, microbial proteins, digestive enzymes and some vitamins, such as K and B-complex (which is why you normally don't have to supplement a healthy horse with extra B). This concept of microbial fermentation occurs to one extent or another in any animal that eats foods of plant origin, including humans. The species of herbivores that depend largely or entirely on fibrous plant materials enlarged the parts of thegastrointestinal tract where all this fermentation and microbial breakdown occurs---the rumen in cattle, sheep, goats, etc and the cecum and large colon in the horse, rabbit, hippo, elephant and many other species. Omnivores like bears, raccoons, people, etc still have some of the equipment for fiber digestion but don't rely on it as heavily. (BTW, in humans, the appendix is the vestiges of a cecum, but microbial fiber breakdown still occurs to a small extent in the large colon). Strict carnivores don't have a need for it and at best only have vestiges, which is why when your dog eats grass and then does the Technicolor Yawn on the rug, the grass reappears at one end or the other largely undigested).

However, this symbiotic microbial population is not a stable one. Fluctuations in the internal environment (such as changes in temperature, pH, dehydration, substrate availability or the presence of antibiotics or other medications or chemicals) may all affect or even destroy the microorganism population. At the very least, shifts in the population can affect digestive efficiency. At worst, large die-offs of certain species can release endotoxins, which may in turn contribute to colic, enteritis or laminitis.

For most horses that don't undergo a lot of stress, maintaining a reasonably healthy and stable microbial population is not a problem. However, horses under stress---like endurance horses, race horses, horses making a drastic change from one ration to another, transported, dehydrated, nervous or breeding animals---may undergo internal changes which can temporarily make the cecal environment less than ideal. As a result, a die-off may occur. Sometimes the die-off is equal among species, sometimes it can affect some species much more than others.

Here's an example of how a chain reaction can cause major problems---let's say you have a horse that normally never gets more than a pound or so of grain, and his microbial population has adapted and stabilized itself to a roughage diet. The horse gets loose one night and evil creature, tears open a bag of grain and gobbles up a great big feast of it. The grain hits the small intestine, some of the soluble carbohydrates are absorbed directly, but alot of the grain keeps going undigested and lands in the cecum. Some species of bug, primarily the Lactobacillus species, like this kind of food better than anything else and they go nuts. As they digest the grain, they excrete the volatile fatty acid lactic acid (this is where the name Lactobacillus came from) into the cecal and large colon. Being bacteria, they multiply like mad (and very quickly) to take advantage of this largesse. The population of this type of bug explodes, which in turn release more and more lactic acid, so the pH of the environment begins to drop (become more acidic). The pH drops below what some of the OTHER species of bug can tolerate and so they begin to die.

So now you have several effects going on---one, you have an unbalanced microbial population, so overall efficiency is upset. Two, as some species of bug (such as *Clostridia* species) die, they release a substance called an endotoxin ("poison from inside"). The intestinal mucosa attempts to absorb and metabolize this toxin, but is damaged itself by the toxin. The toxin that is absorbed into the bloodstream can then cause all sorts of very nasty problems, including laminitis. All from just upsetting the microbial population. All sorts of stress can also create microbial upset to one extent or another, though usually not to this extreme.

This is where the whole concept of probiotics comes in (didn't think I was ever gonna get to this part, did you?). Probiotics are either a live or freeze-dried culture (which later reactivate) of some of the "friendly" species that normally exist in the GI tract and are likely to be disturbed by stress. The concept is that even everyday stresses can affect the microbial population, and that to maintain maximum digestive efficiency, you should try to keep the bug population on as an even keel as possible. So by regularly adding small additional populations to the existing population, you hopefully fill in the gaps left by small daily upsets, and avoid major shifts in the population that can decrease efficiency and cause associated problems.

Here are some of the things that have been reported in the empirical research (which you should be aware, were done by only one research company on their own proprietary strain and may not

necessarily apply to ALL brands and types of probios)---when fed to young, growing horses, the incidence of developmental orthopedic disease was significantly reduced, possible because the bugs release enzymes that increase phosphorus utilization, which in turn benefits the quality of developing bone. Two, they found that in broodmares fed probios culture, the **amount** of milk produced did not increase, but the butter fat content did (this is also why probiotic cultures are commonly fed to dairy cows), and so foals nursing these supplemented mares grew faster and were bigger and heavier at 12 and 18 months. This may not be especially important to an endurance horse breeder, but is a big deal to say, racehorse breeders that want to sell nice, big, growthy youngsters at the sales. Three, when probios were fed to a large group of horses all undergoing a steady workload (they were lesson horses at a riding school), supplemented horses maintained or gained weight better without additional food than did horses not getting the probios. Which is of obvious benefit to endurance horses, especially since the research demonstrates that thin horses have a higher incidence of metabolic failure.

OK,this is why I *personally* happen to prefer some probios over another (and this is my OPINION only and Anyone Else Can Do Whatever They Like). A lot of the probios brands out there contain only Lactobacillus species of bugs in them. Having Lactobacillus species is very good, because to get a horse to gain weight, you have to maintain the bugs that digest grains. But, in my opinion, endurance horses especially undergo a wide variety of different kinds of stress, and Lactobacillus species are not the only ones affected in the GI tract. Also, if a horse has an upset because of grain overload (as described above) then adding in yet more Lactobacillus is the LAST thing you want to do, since it's the *other* species that are going to be adversely affected. So, I personally prefer feeding a probios that provides more than just Lactobacillus species if at all possible---no brand is going to provide everyone of the species found in the gut (or even close), but I still like having a little variety if at all possible. But that's just me.

Probiotics are an incredibly complex and fascinating field, as new research is indicating that probios also positively affect the immune system and may in the future be increasingly utilized to manipulate the microbial population to "crowd out" the bad bugs with good bugs (this is already being done in poultry flocks to eliminate Salmonella bacteria), to fine-tune digestive efficiency (important to food animal producers) and even control diseases and the spread of pathogens during food-processing for human consumption. Human baby formulas containing probiotics to boost the immune system are currently being successfully tested in Europe by Nestle Carnation Company and there is a virtual explosion of research grant money being available for further work, which is GREAT.

So, I hope this helps explain a bit more about what probiotics are and what they do.