What are we doing to our horses?

Franklin L. Pellegrini, DVM and Peter Bedding, PhD

Modern equine practice has substantially changed the way horses eat. But are we doing the right thing? In this article, we will look at how horses in the wild eat, and then take a look at how we treat them today. As you will see, we may not be doing all the right things, and this may adversely affect the very performance we are striving to enhance.

From the Horse's Mouth

Horses have evolved over the millennia to graze continuously while strolling sedately across grasslands. Although capable of great bursts of energy, unless they are being hunted by a predator, they don't overexert themselves. As they chew, their slightly alkaline saliva helps to buffer the acidity in their stomach. Don't underestimate the importance of this saliva – horses can produce up to ten gallons of it every day.

It takes a lot of grass to fuel an animal the size of a horse. The impressive bulk of that grass (around twenty pounds a day) mixes with the saliva and gastric juices to create a buffered, fibrous soup in their stomach.

The bottom portion of the horse's stomach is composed of glandular tissue which constantly produces a protective mucus layer. The top half of the stomach is not as well shielded. Nevertheless, as long as the stomach contents are buffered by saliva and fiber – and the stomach doesn't get jostled too much – the horse stays comfortable and healthy.

This roughage is massaged by the stomach muscles in a solution of hydrochloric acid and pepsin, helping to break down the fibrous material into smaller pieces for further digestion. Although liquids pass quickly through the stomach, the feed may spend several hours there, churning and dissolving in the gastric juices. There is very little nutrient absorption in the stomach, but bacteria living there will contribute to the breakdown of the forage, slightly fermenting and softening the feed before it begins its long trek through the 70 feet of small intestines.

Various enzymes are secreted into the small intestines, breaking simple carbohydrates down into sugars and proteins into amino acids. These nutrients are absorbed through the cells lining the small intestines. Bile is added to the mix from the liver, emulsifying the fats so they can mix with the watery broth. About 60% of the nutrients in the food are absorbed in the small intestine, even though it typically spends less than an hour there. It is a very efficient process, converting almost all of the simple carbohydrates into sugar before the next stage of digestion.

Whatever survives the chemical onslaught of the small intestines, including the complex structural carbohydrates found in fiber, is pushed into the large intestine. The first stop is the cecum, which is a four-foot long fermentation sack full of bacteria. It can hold ten gallons of watery, semi-digested feed. This concoction flows into the cecum and gets

thoroughly mixed with the bacteria, which feast on the fiber and release the final shot of nutrients from the roughage. The bacteria in the cecum will feed for about seven hours, releasing vitamins and fatty acids. These fatty acids help to provide energy to the horse and represent the main form of energy derived from structural carbohydrates.

Finally, the feed passes through to the colon, which is about 12 feet long and can hold up to 20 gallons. Food can stay in the colon for another two days or more, which gives the horse one last chance to eke some nutrition out of what's left. The gut then recovers the water and electrolytes out of this slurry, leaving fecal matter that gets formed into balls and excreted.

Modern Practice

Now contrast this pastoral existence with modern day horse care. First, the horse is fed intermittently. It is the rare stable that can manage even three meals a day. More typical is two times a day. This is sheer economics: each meal costs money to deliver. And that means the problem starts right at the horse's mouth. Instead of a steady flow of saliva, the stabled horse only gets two chances a day to chew. The amount of saliva produced is just a fraction of what it's used to. This can lead to an increase in stomach acidity.

To top it off, we demand a higher level of performance from our horses. In general, we ask the horse to produce much more output, whether it is running and jumping or just working and breeding. So we supplement with grain and sweet feed, which contains a higher concentration of nutrients and starches than grass or hay.

Without the grassy bulk of their natural diet, the stomach has far less fiber to buffer the stomach acids. So right at the start, we've dealt our equine friends two insults: less saliva and less fiber. To top it off, we then ask them to exercise. Again, a horse at pasture will amble along with only brief bouts of running. But we exercise them regularly, often to the extreme limits of their ability. Now the acidic environment we created with less saliva and fiber gets sloshed onto the upper part of their stomach, where the protection is minimal. It shouldn't surprise anyone that that's where the greatest damage is done, and indeed, ulcers are often found in the upper stomach and along the line that separates the upper from the lower stomach area.[1] This is not a rare problem: up to 90% of race horses are known to have ulcers.[2]

We're still in the stomach and we haven't finished listing the damage that modern feeding can impose. Because we feed intermittently, the horse must consume much larger meals over a short time. Horses often bolt grain down, and due to the small size of the stomach and their inability to vomit, the stomach can burst, almost always leading to death.

Grain is denser than hay or grass, and tends to linger longer in the stomach. This gives the stomach more time to extract starches. The extra starches now provide a smorgasbord for lactic-acid producing bacteria called lactobacillus. These go into overdrive, producing gasses and excess lactic acid, further lowering the pH. The excess lactic acid can do damage over and above ulceration: in some circumstances (especially newly weaned

foals) it can paralyze the pyloric sphincter, the valve that lets food out of the stomach. As gasses build up, the stomach can rupture.

Excess carbohydrates are implicated in a form of tying-up called recurrent exertional rhabdomyolysis (RER). Some horses are also susceptible to a condition known as polysaccharide storage myopathy (PSSM), which is also aggravated by too much dietary carbohydrate. Another bacteria may lurk in the stomach as well: helicobacter pylori. This bacteria is now known to cause most human ulcers and has recently been found in horses as well.[3] As acid levels rise, these bacteria thrive and may provide further insult to the horse's stomach.

The two feedings that most horses get present the stomach with an intractable problem: there is simply not enough time to process these large and infrequent meals, and given the small size of the stomach, the under-processed feed is expelled before it is properly prepared for the next stage of digestion.

Food is passed from the stomach to the small intestines, but now with a larger amount of starchy carbohydrates than the horse is used to. As the enzymes break down the starches, the horse gets a big shot of sugar, leading to a hyperactive state. Like a kid at a birthday party, the horse can get edgy and over exuberant, leading to behavioral problems. The pancreas, in response to this sugar rush, produces insulin to help the body consume the sugar. But this reaction often overshoots, and the result is a subsequent lowering of blood sugar, leading to lethargy. These are problems rarely seen in the wild and are a direct consequence of feeding too many starchy foods in large intermittent doses.

Because grains have less fiber than hay or grass, there is less bulking action and the feed passes quickly through the small intestine. This rapid transit means that fewer nutrients are absorbed, further reducing the effectiveness of the feed. Although there are fewer bacteria in the small than in the large intestines, there is still some bacterial digestion involved and again, their populations can be altered by starchy grains. Although it is still not well understood, many veterinarians believe that some of these bacteria can induce enteritis, a serious inflammation of the small intestines. Enteritis can lead to a fluid build-up that can rupture the small intestines.

Moving along, the digesta enters the cecum, where once again, the higher levels of starchy carbohydrates can lead to a bloom of lactobacillus. Besides lactobacillus, a bacteria called Streptococcus bovis in the colon can also convert carbohydrates into lactic acid.

These unusually high levels of lactic acid can lower the pH in the colon to an unhealthy range. The large intestines are not normally acidic, so this can lead to complications including acute laminitis. It may even give rise to ulcers in the colon. It is now understood that in addition to gastric ulcers, horses are also plagued by colonic ulcers. In fact, up to 60% of performance horses are known to have colonic ulcers, although the exact causes are not clear.[4] These inflammations may lead to colitis, which requires immediate veterinarian attention.

The existence of ulcers is troubling. Ulcers are irritating to the horse, and the pain can distract from their training and performance. Blood can be lost from the ulcer, possibly

explaining the low levels of anemia often seen in performance horses. Nutritional uptake can also be affected, since the ulcerated areas can't properly absorb nutrients.

We stuff our horses with carbohydrates to increase their performance, but the high levels of lactic acid that result may actually produce the opposite effect. Studies are now underway[5] to determine if the excess lactic acid in the gut can adversely affect the ability of the blood to clear lactic acid from the muscles. If so, then a horse may hit a performance wall, and its abilities may be limited by the excess lactic acid.

In nature, the small intestines deal with all the starches and only structural carbohydrates reach the colon. But when a horse is overloaded on starchy grains, they can pass undigested through the small intestines and make it to the hindgut as an undesired guest. The bacteria here rapidly dig in to these starches and along with lactic acid, can produce excess gas, leading to gas colic and diarrhea.

So, in our short journey through the gut, we've seen that modern feeding can lead to ulcers, anemia, hyperactivity, lethargy, tying-up, poor performance, laminitis and worst of all, colic. In short, the efforts we make to ensure that a horse is performing at its peak can often backfire on us by messing up a digestive system that has been finely tuned by millions of years of evolution. Somewhat surprisingly, some of the worst problems afflicting horses start with the gut. That is something to ponder.

What to do

So what's to be done? Should you put your horse on a low-carb diet? The quick answer is no – even the grasses and hay that your horse is evolved to eat contain high levels of carbohydrates. Horses need carbohydrates to perform and in the right measure they are perfectly natural.

There are a few rules of thumb you can follow to help out:

Feed more often: This will be difficult or impossible for many horse owners, but it is the single best change you can make in your barn.

Provide free hay: More hay, especially in between meals, is a great way to add structural carbohydrates to your horse's diet. It will provide more chewing and therefore saliva to bring your horse closer to nature.

Provide plenty of water: Your horse should never be without water. Dehydration is one of the major causes of colic.

Use fats: Start to replace some of the carbohydrates you feed with fats. Rice bran, corn oil and oat oil are packed with calories, but don't present the problems associated with starchy foods.

Introduce new feeds gradually: When changing your horse's diet, make sure you do so slowly, ideally over several weeks. The bacteria in the cecum are finely tuned to the diet of the horse. Horses are known to be finicky eaters, and this is the main reason: it can take weeks to develop a new bacterial ecology if the diet is changed. Until a new

population is established, the horse can suffer from numerous problems, not the least of which is poor nutritional uptake.

Functional Feeding

A new approach is to condition your horse with nutrition that is targeted to the gut itself. The concept is fairly new in the US, but is gaining a lot of traction in the UK and Europe. It is referred to as Functional Feeding.

Foods for the gut include the following:

Beta-glucan: This is a special carbohydrate that stimulates the horse's natural immune system to keep the bacteria in the gut well balanced. Beta-glucan also creates a gel in the small intestines, slowing down the transit time, and allowing more efficient nutrient absorption. Beta-glucan can be derived from yeast, mushrooms and oats.

Polar lipids: These are unusual components of oat oil that attract both oil and water. They can help to coat the entire lining of the gut, from stem to stern, adding an extra level of protection to the mucous layer. Because they act as emulsifiers, they can also help to increase the absorption of nutrients. A few drug companies have started to use polar lipids to improve the effectiveness of drugs by a factor of five. Due to their ability to increase absorption, you can typically lower grain feeding by 20% or more. Polar lipids also enhance the immune system.

Glutamine: This is the basic food of the cells lining the gut. They help to nourish and replenish these fast-growing cells. After intestinal surgery, it is now common practice to supplement with glutamine to speed up healing.

Threonine: This is an essential amino acid that is a component of mucus. Mucus is the body's first line of defense against pathogens, and a weakened mucus layer can invite infection.

MOS: Mannan oligosaccharides are derived from yeast and help stimulate the immune system via the gut. They also trick pathogenic bacteria into latching onto them instead of the gut cells, and they subsequently get flushed out of the system. MOS is being used in Europe to replace antibiotics in all animal feeds. It works as well as many antibiotics, but doesn't carry the risk of resistance.

Nucleotides: Because the cells of the gut are rapidly dividing, nucleotides can be used to help the process along. Although many nucleotides are digested, it is now known that if the gut is stressed, these nucleotides can be scavenged from the food and put directly to work.

There are very few functional feeds on the market, and even fewer that target the gut. But a supplement with the components listed above can help deal with the problems of intermittent feeding and starchy foods.

Functional Feeds are not drugs and won't work overnight. But regular supplementation with these natural ingredients can help stabilize your horse, slowly bringing it back into a

natural balance. From there, you can start to get the kind of performance you expect with modern feeding practices.

---

[1] Dr. Merritt

[2] Race horse ulceration

[3] Dr. Scott

[4] Dr. Pellegrini

[5] Lactic acid study