

**Nutrition
and the
Performance
Horse**

Speed

Endurance

• • •
*Understanding
the special digestive
health needs of the
equine athlete*

Focus

SUCCEED™

Digestive Conditioning Program™

Success from the inside out.™

Contents



Foreword.....	3
The Equine Digestive Tract.....	4
Performance vs. Pasture.....	6
Nutrient Requirements of the Performance Horse	10
Feeding for Performance.....	13
An Equine Athlete's Digestive Health.....	16

Foreword



In every animal the digestive tract serves as a fuel line, providing essential nutrients and energy to cells, tissues, organs and muscles throughout the body. For the performance horse, this critical system supplies the most basic elements needed to run harder, train longer and move faster.

But the horse's digestive system is extremely delicate, vulnerable to imbalance and damage by the type and method of feeding, and even the day-to-day challenges of traveling and training to meet the requirements of the performance horse lifestyle.

When the fuel line is not in optimal condition, critical nutrients can be cut off, preventing the equine athlete from performing to its fullest potential. A horse experiencing digestive upset may display a range of difficult to interpret symptoms. Some may be as severe as painful episodes of colic, while others may be as subtle as

changes in temperament, mild anemia or a dull coat.

In order to promote good health for the equine digestive tract, and support optimum performance for every equine athlete, it is vital that owners and trainers understand the components of this important system, how it evolved over time and the stresses that performance and modern management place upon it. Only then can we examine the feeding program to determine how it might best enhance trainability and outcomes in the ring and on the track. The ability to support good digestive health for the horse begins with a basic understanding of each of the organs that make up the equine digestive tract. These organs have separate and unique functions that contribute individually to the vital role the entire system plays within the horse—providing the energy and nutrients essential for optimum health and performance.



The Equine Digestive Tract



The ability to support optimal digestive health for the horse begins with a basic understanding of each of the organs that make up the equine digestive tract. These organs have separate and unique functions that contribute individually to the vital role the entire system plays within the horse—providing the energy and nutrients essential for optimum health and performance.

Digestion Begins

The story begins at the mouth, where ingested feed is mixed with saliva to begin its journey through the digestive tract. The horse's back teeth grind the feed matter, crushing it into small bits that are more easily digested. Unlike some other mammals, the saliva of the horse does not

actually aid in the digestion of feed. It does, however, contain a slippery lubricant called glycoprotein and buffers that help neutralize the acidic environment of the stomach.

Once feed matter is mixed with saliva it is called ingesta. Each mouthful, or "bolus," is swallowed and travels quickly through the esophagus and into the stomach, where digestion actually begins.

The horse's stomach has two regions. The non-glandular region at the top is nearly free of digestive structures and protection from stomach acids. By contrast, the glandular region at the bottom of the stomach is covered in gastric glands, which secrete a variety of substances to aid in the protection of the stomach itself and in the digestive process. Cells in this area produce a mucus barrier that helps protect the stomach lining from the corrosive effects of acid. By contrast, the parietal cells located near the mucus cells steadily secrete hydrochloric acid, necessary to break down feed into its chemical components. An additional substance, pepsinogen, is produced in this area by gastric chief cells. Converted into the enzyme pepsin, this critical chemical is used in the digestion of proteins.

The mix of saliva, hydrochloric acid and pepsin with feed matter creates a soupy

substance, called digesta, that's ready to pass into the small intestine where the majority of nutrient absorption occurs.

Deriving Nutrients from Feed

About 70 feet in length, the small intestine is responsible for absorbing most of the nutrients gleaned from feed. This includes almost all of the fat, vitamins and minerals, 60-70% of protein, and about 65% of soluble carbohydrates. The ingesta spend, on average, less than one hour winding through the narrow passages of the small intestine. This time, however, is critical as the small intestine will provide many of the basic nutrients horses need for overall health and performance.

For example, the small intestine contains enzymes that break down simple carbohydrates – sugars and starches – allowing them to be absorbed, providing energy for cells throughout the body's systems. This enzymatic action also breaks proteins down into amino acids – used by the body for a variety of functions, including the building and maintaining of muscle mass. It is also in the small intestine that bile mixes with the ingesta to break down fat, making its vast energy stores available for the body's use.

Once the ingesta leave the small intestine, it enters an organ of particular importance to the horse. The cecum, also called the blind gut, is a special, four-foot long fermentation sack that developed in the horse over millions of years as a way to deal with its natural diet – composed primarily of grasses and other fibrous materials. It is the presence and function of this organ that gives horses their classification as "hind gut fermenters".

Bacteria and other small organisms located in the cecum work on structural carbohydrates – fibers from grass and hay – and ferment them, breaking them down into products the body can use. These products, volatile fatty acids (VFAs), provide an important source of long-burning, stamina-fueling energy for the horse.

After leaving the cecum, digestion is almost complete as the feed matter enters the colon. An extremely large organ at 12 feet in length and capable of holding up to 20 gallons of material, the colon recovers most of the water and electrolytes used during digestion that were not absorbed by the small intestine or cecum. Feed material can spend up to 48 hours in this organ, where fecal balls of undigested feed matter are created and excreted through the rectum. ●



Performance vs. Pasture



The horse's complex digestive system evolved specifically to fuel the animal as it existed for most of its history – a relatively sedate, grazing animal that spent the great majority of its time cropping grasses in wide open pastures. Today, however, we ask much more of our performance horses, and the wide gulf between the horse's natural state and its lifestyle today can create unique challenges for horses, as well as their owners and trainers.

In their natural habitat, horses spend up to 18 hours a day grazing continuously on high fiber grasses, stems and plants. While capable of bursts of energy – to outrun a predator for instance – the natural horse does not overexert itself on a regular basis. In fact, just to fuel its large frame and keep all its systems functioning properly, the

horse needs to consume large quantities of grasses. Approximately 20 pounds of grass a day is needed to provide enough energy for a grazing horse that weighs about 1,000 pounds.

Today's Equine Athlete

The management and feeding regimes of today's performance horse stand in stark contrast to the lifestyle of the natural horse. Perhaps the largest hurdle for the equine athlete is the need for more energy to fuel an activity level much higher than that of his pastoral cousins. The fact is, a horse cannot consume enough grass to provide the energy needed to train a racehorse or campaign a successful show horse. In order to achieve this higher energy level, owners and trainers must provide higher energy feeds – usually in the form of complex carbohydrate grains.

This is where the first set of challenges presents itself. The equine digestive tract simply wasn't meant to deal with high carbohydrate feeds on a regular basis. Carbohydrate-based feeds move far more quickly through the small intestine than fibrous materials like grasses. This decreased transit time gives the small intestine little opportunity to absorb important nutrients present in the feed, thus robbing the horse of nutrients essential for performance.

When ingestas move too quickly, carbohydrates (particularly starches) escape digestion in the small intestine and enter the cecum, where they are rapidly fermented. This process results in the creation of lactic acid and decreases cecal pH – making the environment in the cecum more acidic. Research suggests that these conditions may favor the proliferation of harmful microbes over beneficial ones. These pathogenic microbes could also be responsible for the production of toxins that can further damage the digestive tract, reduce immunity and affect overall health. Without a proper balance of these microorganisms in the cecum, the horse's system is less able to properly digest the fiber that is essential to the creation of VFAs – which provide 30 to 70% of the horse's total digestible energy needs.

Grain is also associated with peaks and valleys in blood sugar levels that may contribute to fluctuations in temperament and excitability. This can limit a horse's ability to concentrate during training and make the horse irritable or

hard to handle. Concentration is important because it may allow the horse to better learn and retain information from each training session.

Stress in the Horse

In a pastoral setting, adult horses encounter few stimuli that require them to learn new information. Through training, performance horses may encounter new situations and tasks every day. These can be as simple as walking over a pole for the first time or as complex as learning the cues for the canter pirouette, but they all have the potential to create stress for the horse. Stress results in the increased production of cortisol, a steroid hormone that inhibits immune function.

Training isn't the only source of stress. There are a number of other regular aspects of the performance lifestyle that can stress the horse. Trailering, whether for competitions or an event as

innocuous as a trail ride, also prompts the release of cortisol. Short trips are unlikely to adversely affect immune health, but longer trips result in increased cortisol levels and a greater risk of immune

The equine digestive tract simply wasn't meant to deal with high carbohydrate feeds...



for extended periods of time, most spend at least several hours of each day without access to food. Though a stalled horse's diet may contain enough digestible energy to sustain overall health, the digestive system simply wasn't designed to sit idle for hours at a time. Without food to stimulate saliva production, gastric acid remains unbuffered in the stomach, which places the horse at greater risk for ulceration. Exercise can exacerbate this condition by physically pushing gastric acid into the upper, non-glandular region of the stomach.

Though the addition of grain to the performance horse diet is necessary to meet the energy needs imposed by training and competition, this high-carbohydrate food source is often at odds with the horse's traditional diet of grasses and other forage. Balancing energy-dense grains with high-fiber hays helps to meet energy needs while

sustaining normal digestive function when a horse is stalled or has limited access to pasture.

Many factors constantly challenge the performance horse's digestive system. Stress may result in compromised immune function, which may reduce the horse's ability to defend the gut against pathogenic bacteria, leading to irritations in the gut lining and possibly ulcers.

The Prevalence of Ulcers

Research in the last two decades has increased awareness of the fact that horses are prone to ulcers. The stress of the performance lifestyle make active race, sport and show horses more prone to ulcers, but even pasture horses can be at risk.

Numerous research studies on gastric ulcers have shown an incidence rate as high as 90% in Thoroughbred race horses.

More recently, a study by Frank Pellegrini, DVM, revealed the presence of ulcers in the colon. About 63% of performance horses in the study were found to have colonic ulcers.

The findings of these research studies tell us that a horse's digestive system is fragile, and that most horse owners are likely facing the impact of ulcers in their horses. ●

*About
63% of perfor-
mance horses...
were found to have
colonic ulcers.*

Performance vs. Pasture (continued)

system suppression. Confinement in stalls has also been shown to increase stress.

Intermittent feeding schedules also interfere with the normal workings of the horse's digestive system, which evolved to manage a continuous supply of food from grazing. Because many horses are stalled





Nutrient Requirements of the Performance Horse



Whether maintained on pasture or kept in training, all horses utilize the same basic nutrients. Fiber, fat, carbohydrates and protein (in addition to water, minerals and vitamins) are all essential. Understanding how these elements function to meet energy requirements is critical to creating a balanced ration that provides the performance horse with sufficient digestible energy.

Fiber

The horse evolved with a large cecum to take advantage of the fiber in grasses – a readily available food source. Fiber is the primary energy source for horses. Even for the performance horse, fiber should

generally comprise at least 40% of the horse's total ration by weight. Though it is not digested until it reaches the cecum, fiber helps to slow the rate at which digesta passes through the small intestine, allowing for maximum nutrient absorption. It also retains water in the gut, helping to protect against dehydration. Horses have a psychological need for the "full" feeling that fiber provides and may develop stable vices, such as wood chewing, to satisfy that need if it is not provided in the diet.

However, an excess of fiber may produce conditions detrimental for performance. Fiber's ability to hold water in the gut decreases the risk of dehydration, but it also creates extra weight that the horse must carry. The heat produced by fermentation increases sweat losses and makes it harder for the performance horse to cool down after workouts, reducing the benefit from the additional water in the system. So while fiber is important to maintain proper digestive function, it should be balanced with other nutrients to satisfy energy needs.

Fat

One of the easiest ways to increase the digestible energy available in a horse's diet

is to add fat. An energy-dense nutrient, fat provides about 2.25 times more energy than an equal weight of carbohydrates or proteins. Absorbed in the small intestine, fats are also important for the role they play in the absorption of the fat-soluble vitamins A, D, E and K.

Carbohydrates

Horses are also able to obtain energy from non-fiber complex carbohydrates, which include starch, in the small intestine. These carbohydrates are broken down by the enzyme amylase into simple sugars, which provide the performance horse with another source of energy. However, the carbohydrates in grain may arrive undigested in the cecum, leading to numerous problems. Intake of feeds high in starch, such as corn, should be limited to avoid starch overload.





Protein

Another major nutrient required by the performance horse is protein, which is used to build and repair muscle tissue. Also, protein is a critical element in bones, connective tissue, blood, organs and the digestive system. Ingested proteins are broken down in the small intestine into amino acids and then reconstituted into proteins required by the horse. While the horse can make some amino acids on its own, others – the essential amino acids – can only be supplied in feed. Protein needs are relatively low – between 10 and 12 percent of the total ration – for mature horses in regular to intense work, respectively.

It is important to remember, however, that protein quality affects how well a particular diet meets the horse's requirements. High-quality proteins are very digestible, contain higher percentages of essential amino acids and are used by the horse more efficiently than low quality proteins.

While all these nutrients should be present in the performance horse's diet, balancing them helps to keep the digestive system healthy and functioning properly. Carbohydrates are a good source of energy, but should be fed in small amounts. Adding fat and maintaining fiber and protein intake help to balance out the effects of carbohydrates on the digestive system and provide the performance horse with the energy and muscle strength it needs to work, train and compete. ●

Feeding for Performance



The equine athlete can only perform at optimal levels when digestible energy at least meets energy requirements. Owners and trainers know that reaching this equilibrium is a challenge. Though the horse adapted to a high-fiber diet based on grasses and other forage, carbohydrate-rich grains are a necessary addition to the performance horse diet. Many horse feeds contain a mixture of cereal grains, but the primary grains included in those feeds are oats, corn and barley.

Individual Grains: Oats, Corn and Barley

Oats are the grain fed most commonly to horses, for good reason. Of the three main types, oats are the most nutrient-balanced, containing about 53% starch, 12% protein, 5% fat and 12% fiber. Depending on type, about 80 - 90% of starch from whole oats is easily digested in the small intestine, making it a good choice for avoiding starch overload in the cecum.

Another grain often included in horse feeds is corn, though most owners and trainers feed this grain with caution due to its reputation as a "hot" feed. Because corn is heavier and more energy dense than oats, a direct volume substitution will result in overfeeding and excess energy. This can be controlled by feeding corn rations based on energy content instead of equal grain volume. However, corn is not as balanced as oats in terms of nutrient content; corn contains approximately 71% starch, 8% protein, 4% fat and 2% fiber.

For the performance horse, corn is of particular concern because of its high starch content and the limited ability of the small intestine to break down that starch. Whole corn has a waxy seed coat that limits digestion of available starch in the



Feeding for Performance (continued)

small intestine. Processing increases starch digestibility, though steam flaking and grinding result in a greater improvement than breaking up the kernels (cracked corn).

Barley falls between corn and oats in terms of nutrient value for horses; it is similar to corn in energy density and digestibility but contains more fiber (5%) and protein (11%) than corn. Though barley contains 65% starch, the small intestine is only able to digest a small amount of

that starch in most cases. Barley may be included in feed mixes containing other grains or molasses, as it is less palatable to horses than oats or corn.

Balancing Grains: Sweet and Pelleted Feeds

Balancing these grains in order to obtain the ideal combination of nutrients may be extremely difficult. But many commercially available pelleted and sweet feeds are designed to balance all of the nutrient requirements for specific activity levels. For performance horses, these feeds may help to provide nutrients, such as fat and fiber, which are not available in large amounts in traditionally mixed grains.

Sweet feeds are so-named for the molasses they contain, which makes the feed more palatable. Molasses is rapidly converted to sugar in the small intestine, which can contribute to an increase in blood sugar. Horses eat feeds containing molasses more rapidly than non-molasses

feeds, resulting in a larger volume of ingesta reaching the small intestine and decreasing the transit time to the cecum. Horses are less able to properly digest and absorb nutrients from feed if it moves too quickly through the system.

Another option for the performance horse is pelleted feeds, in which all the components of the feed have been processed into a pellet. The processing these feeds undergo is believed to improve the digestibility of the nutrients they contain. However, the quality of feed ingredients in pellets may be questionable, and pellets may move through the digestive tract quickly, reducing overall digestibility.

Each type of feed will list guaranteed levels of fiber, fat and protein, among other nutrients. Owners and trainers need to determine the optimal levels of these nutrients to meet the demands made on their horses. Today's performance horse feeds are usually energy-dense, due to increased fat and fiber content, to provide the maximum amount of digestible energy in a smaller amount of feed, thus minimizing the risks associated with feeding grain meals. ●



An Equine Athlete's Digestive Health



For a horse to perform to its full potential, it is conditioned with regular exercise so that it has the stamina and strength to perform the required task, whether it's a two-minute race or four-hour trail ride. Grain helps to provide the fuel for those exertions. But to maximize the benefits and minimize the risks from this food source, the fuel line – the digestive system – must also be properly conditioned to utilize the nutrients provided.

Digestive health can be maintained by supplementing the diet with natural foodstuffs, known as nutraceuticals, to protect the intestinal tract and support good health throughout this critical system.

Mannan Oligosaccharides

To reduce the effects of starch overload in the cecum, certain yeast products may be added to the diet to help restore normal bacterial populations and promote the efficient fermentation of fiber. Products like Mannan Oligosaccharides are believed to work throughout the digestive system to flush disease-causing bacteria from the system and help maintain a healthy, functioning GI tract.

Beta Glucan

To reduce the risk of overloading the small intestine's capacity to digest carbohydrates, owners and trainers could try to reduce the size of meals fed to their horses. This can be achieved by either decreasing the amount of grain fed each day, or spreading out large meals into four or five smaller daily feedings. As both of these methods are often impractical, beta glucan – a dietary fiber found in oats and barley – may help to prevent starch overload by reducing movement of ingesta through the small intestine to more natural rates. This allows for maximum digestion of starch and other non-fiber carbohydrates before they reach the cecum.

Additionally, beta glucan moderates the release of sugars from the digestive system,

helping to prevent the sugar highs and lows associated with feeding high-carbohydrate meals. For the performance horse, this may translate into greater focus and ability to concentrate during training and other tasks. Another benefit of beta glucan is that it is known to be a naturally powerful stimulant of the immune system.

Polar Lipids and Amino Acids

Throughout the digestive system, the gut lining must be healthy and intact to maintain optimal nutrient uptake. A healthy gut also has sufficient protection from acidic gastric fluids and pathogenic bacteria that may cause or exacerbate stomach and colonic ulcers. In particular, polar lipids and two specific amino acids support the structures and integrity of the gut.

Prevalent in various plants, including oats, polar lipids are a unique fat compound essential for cell membrane function that can help to form tight connections between the cells lining the gut. Because they are both fat and water soluble, polar lipids are also known to increase the bioavailability of nutrients. When oat oil is extracted from oats, most of the polar lipids are destroyed, so only specially processed oil retains a high content of polar lipids.

The amino acids glutamine and threonine are important components of the intestinal mucosa – the lining of the digestive tract. Their presence provides an important nutrient source specifically for the GI tract, helps to protect the lining and supports the immune cells present there. Threonine is an essential amino acid (see Nutrient Requirements for the Performance Horse, pg. 10) that is necessary for the production of mucus. Glutamine is "conditionally essential" – meaning that the body cannot produce enough of this amino acid under stressful situations. Together, these nutrients protect the gut and present a unified barrier against digestive juices, toxins and pathogens.

The simple truth is that modern feeding methods often act against a horse's natural digestive needs rather than with them. Performance, appearance and temperament are all supported by a properly conditioned and functioning digestive tract, which enables the horse to perform at its full potential. By targeting gut health and promoting healthy digestive function with these nutraceutical ingredients, owners and trainers can create a diet that enhances the natural digestive process without changing the way they manage their horses. ●



SUCCEED™ Digestive Conditioning Program™



SUCCEED™ Digestive Conditioning Program™ is a unique nutritional supplement that is scientifically formulated to support complete equine digestive tract function and health regardless of training and competition schedules. The product is made up of a unique combination of ingredients that work together to create a digestive environment that is optimal for the horse's overall health and condition:

- **Polar Lipids** support the health of the gut lining and help facilitate nutrient absorption.
- **Oat Flour** is rich in beta glucan, which can promote a more natural transit rate of feed and moderate the release of sugars into the bloodstream.

- **Irradiated Dried Yeast** contains nutrients that support the normal renewal of tissue lining the gut.
- **Amino Acids**, the building blocks of protein, support a healthy mucous lining throughout the digestive tract.

Convenient to give and appealing to horses with its natural oat flavor, SUCCEED is safe and effective for all horses and, for the equine athlete, it is not a testable substance. Outward signs of good nutrition, such as a horse that is eating well, maintaining weight, and has a healthy coat and clear eyes, may be observed within 30 days of beginning daily feeding of SUCCEED. But within 90 days, a horse may exhibit an even temperament and an ability to train hard and recover fast from exercise. Kept on SUCCEED once a day, every day, a horse is better able to meet nutrient and energy needs to sustain performance. With SUCCEED, horses are healthy from the inside, out. ●

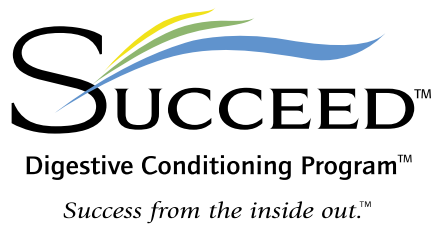


Resources

Hoffman, R.M. (2003). Carbohydrate Metabolism in Horses. In: Ralston S.L. and Hintz H.F. (Eds.), *Recent Advances in Equine Nutrition*. Ithaca, NY: International Veterinary Information Service (www.ivis.org). Document No. A1506.0803.

Lewis, Lon (1996). *Feeding and Care of the Horse*. Second Edition. Media, PA: Williams and Wilkins.

Pellegrini, F. L., "Results of a Large-Scale Necroscopic Study of Equine Colonic Ulcers." *J. Equine Vet Sci* 2005; 25:3.



www.SucceedDCP.com