Basic Equine Nutrition

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Agenda: What is the Equine Digestive System?

Nutrition

Feed

Feeding guidelines

Equine digestion

Horses are non-ruminant herbivores (hind-gut fermenters)

Horses are non-ruminant, simple-stomached herbivores. They are hindgut fermenters, meaning the large intestine and cecum is the main site of fermentation of fibrous feedstuffs.

The digestion process-

The horse is a non-ruminant herbivore meaning it eats plants and has a simple stomach with only one compartment. This makes the horse's gut fairly unique among other livestock species most livestock species are ruminants meaning, they have stomachs that are divided into compartments. Cattle, sheep, and goats are all ruminants while, horses, dogs, cats, pigs, and humans all have simple stomachs. The job of the equine digestive system is to break down food particles and absorb nutrients.

Fore gut: Enzymatic digestion

Nutrients from the different types of feed are digested in certain areas along the equine gastrointestinal tract, as well as at different rates. The digestive tract is an extremely delicate and complex system in the horse. There are two main parts to this system, the foregut and the hindgut. The foregut includes the lips, teeth, tongue, esophagus, stomach and small intestine. The hind gut includes the cecum, large colon, small colon and rectum. Imagine a 100-foot garden hose gather it all up and put it in your horse with one end at its mouth, and the other at its tail with the rest piled up its abdominal cavity.

Problems we run into with the extended length of the digestive system and the complexity involved in digestion. It is extremely important that everything works properly and remains in the right place at all times. If any part of this is not able to function properly or becomes displaced, the horse can have multiple problems including oral problems, choke, gastric ulcers, and intestinal problems.

Foregut: Mouth and Pharynx

The first part of digestion actually begins in the mouth with chewing feed materials. This feed is then mixed with saliva to further break down feed stuff. Once the food is chewed, the base of the tongue will push the food past the soft palate and into the pharynx. The pharynx connects the mouth to the esophagus.

Foregut: Esophagus

The main job of the esophagus is to move feed from the mouth to the stomach. Feed will be pushed down to the stomach through the esophagus by contractions In horses, these contractions work in only one direction, which means horses are unable to vomit. The esophagus is approximately 40 to 60 inches in length

Problem: Choke

The main problem associated with the esophagus is “choke”. While eating, horses hold food at the back of their mouth before swallowing. Food is mixed with the saliva and then propelled down the esophagus by the strong muscular contractions. Ideally there is enough saliva to help the food slides down the esophagus. However, some horses eat too fast and don't chew food completely. When this happens, food is not mixed with enough saliva and the food can become wedged in the esophagus making a horse “choke”.

Foregut: Stomach

Food from the esophagus then travels into the stomach. The horse’s stomach has a one way valve at the entrance called a “Cardiac Sphincter” which does not allow any contents in the stomach to come back up the esophagus. Only a small amount of digestion takes place in the horse's stomach. The horse has a mono-gastric stomach, meaning a single compartment or a simple stomach. The stomach contains mainly digestive enzymes and hydrochloric acid. An equine stomach can hold only about two gallons and food will remain in here for approximately 15 minutes or until it's about two-thirds full. After this, the stomach will empty into the small intestine. The horse's stomach is not very large because they were made to continuously graze and take in small amount of forage on a steady basis.

Problem 1: Ulcers

One of the problems associated with the equine stomach is gastric ulcers. Since they are supposed to continuously have food in their stomachs, the horse continuously produces hydrochloric acid to help break down feed material. When horses are meal fed, this acid can build up and become extremely acidic to the stomach lining, which increases their risk for gastric ulcers.

Problem 2: Rupture & Colic

Two other problems associated with the stomach and digestion are rupture and colic. If the stomach becomes too full, such as during a grain overload, the stomach can actually rupture. Remember horses cannot vomit, so once the food is down, it's down for good. If the stomach is too full, it can make the small intestine distend or expand, which is extremely painful and a very common cause of colic.

From the stomach, digestion moves into the small intestine. The small intestine is the main site for nutrient absorption. Digestive enzymes are used to break nutrients into smaller components that can then be absorbed into the bloodstream. Almost all dietary fat is absorbed in the small intestine, along with soluble carbohydrates, amino acids, vitamins and minerals. It is about 70 feet in length and can hold approximately 30% of the capacity of the entire digestive tract. As the small intestine is only about two inches in diameter, digestion will remain in the small intestine for about 60 to 90 minutes before moving all the way through.

With about 70 feet of small intestine in a small space, it has to be arranged in a very specific way. There are a series of folds and coils suspended by a membrane called the Mesentery. The first section is in a u-shaped curve which helps prevent digestion from being forced back into the stomach if it becomes distended. If a blockage occurs and feed plugs up into the small intestine, it can back up no farther than the stomach. The one-way valve between the stomach and esophagus keeps it from coming all the way up into the esophagus. The vessels in the mesentery can also be involved in obstruction of flow of blood or even create strangulation of the intestine in some causes of colic.

Moving from foregut to hindgut

The large intestine, or hindgut consists of multiple parts including the cecum, large colon, small colon, and rectum. In the large intestine, enzymes break down plant fiber which is then converted into fatty acids which are absorbed and provide the horse with an energy source.

Large Intestine: Cecum

The first stop in the large intestine is the cecum. Here, cellulose is converted to fatty acids and microbial fermentation takes place. The cecum is about four feet in length and can hold up to 10 gallons; digestion will move through in about five to six hours. The cecum is found in the high right flank area of the horse and it extends down and forward towards the diaphragm. If a horse overloads on a meal or has too many soluble carbohydrates, it may overwhelm the capacity of the foregut and can cause undigested food to spill into the cecum. The hindgut is not equipped to handle this overload so the bacteria in the cecum may produce excess gas from digesting food components that should have been digested earlier. This gas can cause pain and colic as well as diarrhea.

The microbial population of the hindgut is specific to the horse and its diet. This is why diet changes have to be made gradually over time.

Large Intestine: Large Colon

From the cecum, the ingesta will move into the large colon. The large colon is built for nutrient absorption and continued microbial activity. It is approximately 10 to 12 feet in length and can hold about 38 % of the digestive tract capacity, which is the largest volume of the entire tract. Food will spend 36 to 48 hours here.

Problem: Colic…again

The design of the large colon alone is a large risk factor for colic. The ventral colons has construction that resembles a series of pouches. This design facilitates digestion of large quantities of fibrous materials. The pouches can easily become twisted and filled with gas due to fermentation of feed. The ventral colon is also the lowest portion of the GI tract and the most common place for sand accumulation, if horses are eating or grazing on sandy soil. From the large colon, ingesta moves to the small colon where water and mineral absorption take place. In the small colon, the contents begin to take on a solid shape and mold into fecal balls. The small colon is 10 to 12 feet in length and about 4 inches in diameter. It has a capacity of around 5 gallons.

Large Intestine: Rectum

The final area of the equine digestive system is the rectum which is used for the storage and expulsion of feces. The rectum is about 12 inches in length.

Essential nutrients

Water

Horses drink two quarts of water per pound of hay in high temperature, hard work, or for the lactating mare the water requirement may be three to four times the normal consumption.

The most important- will not live long without it

Forages

Forages are classified as legumes or grasses.

Forage is also necessary in the equine diet from a behavioral perspective. Horses have an innate need to chew, and if there is not sufficient quality forage available they are more inclined to chew on wood, tree bark, other horse's tails, or to consume toxic plants that they would otherwise avoid.

Vitamins, mineral, fats, proteins &carbohydrates

Supplemented- Multi or concentrated

Complete feed- can also be a ration balancer

Carbohydrates

Carbohydrates are the main energy source used in most feeds. The main building block of carbohydrates is glucose. Soluble carbohydrates such as starches and sugars are readily broken down to glucose in the small intestine and absorbed. Insoluble carbohydrates, such as fiber (cellulose), bypass enzymatic digestion and must be fermented by microbes in the large intestine to release their energy sources -the volatile fatty acids. Soluble carbohydrates are found in nearly every feed source; corn has the highest amount, then barley and oats. Forages normally have only 6 to 8% starch but under certain conditions can have up to 30%. Sudden ingestion of large amounts of starch or high sugar feeds can cause colic or laminitis.

Proteins

Protein is used in muscle development, during growth or exercise. The main building blocks of protein are amino acids. Soybean meal and alfalfa are good sources of protein that can be easily added to the diet. Second and third cutting alfalfa can be 25 to 30% protein and can greatly impact the total dietary protein. Most adult horses only require 8 to 10% protein in the ration; however, higher protein is important for lactating mares and young growing foals. Signs of protein deficiency include a rough or coarse hair coat, weight loss, and reduced growth, decreased milk production, and lower performance. Excess protein can result in increased water intake and urination, and increased sweat losses during exercise, which in turn lead to dehydration and electrolyte imbalances.

Fat

Fat can be added to a feed to increase the energy density of the diet. Fat has 9 Mcal/kg of energy, which is three-times that of any grain or carbohydrate source. Fat is normally found at 2 to 6% in most premixed feeds; however, some higher fat feeds will contain 10 to 12% fat.

Vitamins

Vitamins are fat-soluble (vitamin A, D, E, and K), or water-soluble (vitamin C and B-complex). Horses usually have more than adequate amounts of vitamins in their diet if they are receiving fresh green forage and/or premixed rations. Some cases where a horse would need a vitamin supplement include when feeding a high-grain diet, or low-quality hay, if a horse is under stress (traveling, showing, racing, etc.), prolonged strenuous activity, or not eating well (sick, after surgery, etc.).

Most of the vitamins are found in green, leafy forages. Vitamin D is obtained from sunlight, so only horses that are stalled for 24-hours a day need a supplement with vitamin D. Vitamin E is found in fresh green forages, however, the amount decreases with plant maturity and is destroyed during long term storage. Horses that are under heavy exercise or under increased levels of stress may also benefit from vitamin E supplementation. Vitamin K and B-complex are produced by the gut microbes. Vitamin C is found in fresh vegetables and fruits, and produced naturally by the liver. None of these are usually required in a horse's diet. Severely stressed horses, however, may benefit from B-complex and vitamin C supplements during the period of stress.

Minerals

Minerals are required for maintenance of body structure, fluid balance in cells (electrolytes), nerve conduction, and muscle contraction. Only small amounts of the macro-minerals such as calcium, phosphorus, sodium, potassium, chloride, magnesium, and sulfur are needed daily.

Calcium and phosphorus are needed in a specific ratio ideally 2:1, but never less than 1:1. Alfalfa alone can exceed a Ca:P ratio of 6:1. Sweating depletes sodium, potassium, and chloride from the horse's system, therefore, supplementation with electrolytes may be helpful for horses that sweat a lot. Normally, if adult horses are consuming fresh green pasture and/or a premixed ration, they will receive proper amounts of minerals in their diet, with the exception of sodium chloride (salt), which should always be available. Young horses may need added calcium, phosphorus, copper, and zinc during growth in the first year or two of their life.

Concentrates

Grains, Fats, Proteins

Grains

There are a number of different grains that are commonly fed to horses. Grains, referred to as 'cereals' or 'cereal grains' are the edible seeds of specific grasses. The most common are oats, corn, and barley. Milo (sorghum) and wheat are other grains that are fed to horses as well. Grains such as oats, barley, and corn can be fed whole, though many are typically processed to increase digestibility. Examples of how cereal grains may be processed include steam flaking, crimp rolling, extruding, and cracking. Grains are in general low in fiber and high in energy (particularly if processed), but there are differences in the relative amount of different nutrients in each cereal grain. For example, corn is higher in energy than oats or barely. Oats, one of the most popular grains to feed horses, are higher in fiber than corn and barley. Processing these grains will improve digestibility; in other words, processing grains will increase the amount of nutrients that the horse can get from the grain. Grain is rarely fed by itself as a concentrate; instead, it is often incorporated into pellets or mixed with pellets to make sweet feed.

## Commercial Grain & Pellet Mixes

Commercial grain and pellet mixes are a common feed option for horses. They contain a mix of concentrates which provide energy, protein, vitamins, and minerals that are specifically balanced based on a horse's nutrient needs. Commercial mixes eliminate the guesswork of providing the appropriate amounts of minerals and vitamins in balanced quantities. Adding additional grains to commercial mixes will interfere with the nutritional balance of the feed.

## Sweet feed/textured Feed

Textured feeds are a mixture of several cereal grains and molasses (which is why it is often referred to as sweet feed). A balancer pellet is often included providing minerals and vitamins. Other ingredients may also be added such as rice bran, beet pulp and powdered fat. Sweet feed is palatable to most horses. This sweet-smelling feed may mold if stored in hot, humid areas. The addition of molasses eliminates dust and increases palatability.

## Pelleted Feed

Pelleted feeds often contain the same ingredients as sweet feeds. The ingredients are first ground, then steam-treated, and then forced through a pelleting die. Pellets stop picky eaters from sorting ingredients in their feed. Pelleted feeds have a longer shelf life and are not as likely to mold. It is important to note that hay pellets are different from pelleted feeds and are considered a form of forage, not concentrate.

## Extruded Feed

Similar to pelleted feed, extruded feeds are uniform, and the horse will not be able to pick through the ingredients. It is prepared the same way as pelleted feed but has an additional step where the feed is "cooked" under high temperature and pressure before it goes through a die. This helps to break down some of the structures within the nutrients of the feed. It often has a higher fat concentration than pellets. As well as being softer and less dusty as well.

## Complete Feed

"Complete" describes a feed that contains everything the horse needs in his diet, including the forage. Complete feeds can be fed as the sole ration. Senior horses that have lost the ability to chew hay will benefit from a complete feed. Medical conditions may require the use of complete feed, for example when dust or hay irritate the airway. Complete feeds can serve as an alternative option when good hay quality is limited.

Ration Balancers

Ration balancers are designed to be fed along with forages to horses that do not need additional energy (calories) from concentrates but do need additional protein, vitamins, and minerals. Ration balancers are a pelleted feed. They typically have low crude fiber and fat. The first ingredient is often soybean meal, making them high in protein. It is a heavily fortified feed with small daily recommended feedings. The purpose of a ration balancer is to provide your horse with the essential nutrients that are insufficient in a forage-based diet. Ration balancers provide a good amount of calcium and other key macro-minerals, trace minerals and fat-soluble vitamins. They are not intended to be fed for extra calories. They often have a high percentage of protein, but they are fed in small amounts (1-2 pounds per day). If a horse needs additional vitamins and minerals but not protein, then a vitamin/mineral supplement would be a more appropriate option.

Feeding concentrates

Be sure to follow the feeding instructions on the label. They are carefully formulated to meet a horse's nutritional needs, but only if fed in the right amount. The label will specify how much to feed based on your horse's body weight. Feeds will say per pound. Make sure you weigh your scoops. If it is necessary to cut back a horse's grain to below the recommended amount because it is gaining too much weight, then consider switching it to a ration balancer.

What does a balanced feed look like?

For maintenance, the average horse needs at least 1-2% of body weight in pound of forage. This should make 50%-100% of their diet. The other possible 50% would be a vitamin mineral supplement and possible ration balancer depending on type of forage. Most horses who are not on green pasture 24/7 need a ration balancer.

What should I feed my horse?

Have clean fresh water available at all times. A good forage that fits their nutrition needs and a grain to help supplement any lacking proteins, carbohydrates and fats.

There are multiple websites to give great advice and pointers to ensure your horse is well fed.

**https://www.standleeforage.com/tools/feed-calculator/**

And contact a Kentucky Equine Research nutritionist today for a free consultation.

https://ker.formstack.com/forms/ask_ker

And don't be afraid to ask your vet! As long as you have a current exam, most vets are able to perform nutrition consults over the phone!

**KEY**

**Nutrient**—any food component that is necessary for the support of life. Also, a chemical substance that nourishes, such as protein, carbohydrate, mineral or vitamin.

**Ingredient**—Edible material that may provide nutrients as part of food.

**Food-**Any material, usually of animal or plant origin, containing essential nutrients.

**Feed**-Food for animals.

**Feedstuff**-Any substance suitable for food, several foodstuffs are normally combined to provide a balanced diet. Any component of a diet that serves some useful function.

**Diet**-A regulated selection or mixture of feedstuffs provided on a continuous or prescribed schedule. A balanced diet supplies all nutrients needed for normal health and productive functions.

**Ration**-A fixed portion of feed, usually expressed as the amount of a diet allowed daily.

**Digestibility**—the percentage or proportion of nutrients in food available for absorption from the GI tract.

**Bioavailability**—the amount of a nutrient absorbed from the GI tract in a form the body can use.

**Roughage—**the primary foods for all herbivores existing under natural conditions, such food provides the major portion of their diet for most if not all of the year. Includes pasture, green chop, hay, chaff, silage and other forms. A bulky feed that has a low weight/unit of volume, high crude fiber content and low digestibility of nutrients.

**Digestion-**The preparation of food for absorption which may include mechanical, enzymatic and chemical actions. Overall function is to reduce food to a molecular size or solubility that will allow for absorption.

**Absorption-**Includes various processes that allow small molecules to pass through the membranes of the GI tract into the blood or lymph systems.

**Appetite**-a desire for food or water. Generally, a long term phenomenon in contrast to short term satiety. Refers to internal factors that stimulate or inhibit hunger in the animal.

**Palatability**-The overall acceptance and relish with which an animal consumes any given feedstuff or diet. A summation of many different factors sensed by the animal in the process of locating and consuming food such as appearance, odor, taste, texture, temperature.

**Taste**-To distinguish flavors between or among feed or water components.

**Satiety-**the condition of being fully satisfied with food. The opposite of hunger.

**Hunger**-The desire for food. The opposite of satiety.

*All definitions from Basic Animal Nutrition and Feeding, third edition, Church DC and Pond WG, 1988 John Wiley & Sons, Inc.*

**Colic**- Term used to describe the symptom of pain, which in horses is usually caused by problems in the gastrointestinal tract.

**Choke**- A blockage in the esophagus

**Pharynx**- The membrane–lined cavity behind the nose and mouth connecting to the esophagus.

**Mesentery** – Attaches intestines to the abdomen wall and preventing it from collapsing.

**Ingesta**- Substances taken into the body as nourishment.

**Cellulose**- Usable fiber fractions that are broken down in the large intestine; additional nutrients and energy.