Alternative feeds for racehorses

Easier digestibility is among the benefits of using processed feeds over sweet grain mixes

by Amy Gill, Ph.D.

FEEDING racehorses correctly is an art and a science. One of the most delicate areas to balance is the safe feeding of horses that are in intense exercise programs but also are confined to stalls and must consume high-concentrate rations to meet their energy requirements. Often, racehorses require more than 50% of the diet as concentrate to maintain body condition.

However, this type of diet makes horses prone to gastrointestinal and other metabolic disorders such as recurrent exertional rhabdomyolysis, or tying up. In addition, some horses are sensitive to increases in blood sugar and often become less tractable and excitable when fed high-grain diets.

In the past 20 years, nutrition research has contributed to a better understanding of how to provide the racehorse with sufficient nutrients safely and efficiently while reducing the risk of causing metabolic and behavioral disorders. Some of the most profound improvements include the use of concentrate rations that contain higher fat and fiber fractions and the manufacturing of various combinations of feed ingredients that are processed in various ways to stabilize and enhance the nutritional value of the product.

Processed feeds, such as those that are cubed, pelleted, steamed, flaked, cracked, extruded (heated under pressure), or micronized (infrared waves heat and vibrate the starch molecule to restructure or gelatinize it) are a good choice for racehorses because they are more easily digested and absorbed in the digestive tract. In addition, the starch in processed grains is more readily absorbed before it reaches the hindgut than that found in sweet feed. This vastly lowers the risk of colic, laminitis, tying up, and other metabolic disorders related to fermentation of starch in the hindgut.

Other useful alternative feeds include complete feeds that combine fiber and concentrate in a pellet or cube, hay cubes, and pellets. Haylage, which is hay baled at a moisture content of 50% to 60% and then vacuum-packed and fermented, is another interesting alternative feed available for racehorses.

Grain and starch overload

The level of starch in the diet of racehorses is an area of concern for managers. Straight sweet feed rations contain the highest levels of starch of all equine feeds, generally in the range of 60% to 75%. Starch digestibility ranges between 87% and nearly 100% over the total digestive tract, but the capacity for starch digestion and absorption in the small intestine can easily be surpassed.

The rate and extent to which starch is digested in the foregut (stomach and small intestine) in the horse is largely affected by several factors. These include the structure of the starch granule, processing of the starch granule through heat and pressure, and other types of feed present in the tract when starch is ingested.

The amount of concentrate fed at one time (single-concentrate meals containing more than 0.4% of the horse's bodyweight increase transit time through the small intestine) also affects starch digestion due to reduced exposure to acids and enzymes available in the stomach and small intestine. Starch that escapes digestion in the small intestine can alter microbial fermentation in the cecum and colon (hindgut) and can lead to acidosis in the horse, a condition that might result in colic or laminitis.

Acidosis occurs when soluble carbohydrates such as starch are rapidly fermented, causing a rapid fall in the pH of the hindgut, which must be closely regulated to maintain the health of the microbial populations that reside there. A drop in pH in the hindgut causes rapid changes in the types of microbes that are present, and abnormal alterations in the percentages of volatile fatty acids produced there occurs.

Lactic acid production increases further due to increased lactic acid-producing bacterial populations proliferating in the cecum and colon. Increased acidity in the hindgut leads to mucosal damage, which leads to the release of histamine, an event that can precede the onset of laminitis.

Additionally, many organisms in the hindgut that normally use lactic acid as an energy source are highly intolerant of the acidic environment, and if these organisms die, endotoxins are released and subsequently absorbed by the damaged mucosa. Endotoxins are vasoreactive compounds that can lead to further complications associated with the availability of oxygen to tissues as occurs during acute laminitis. Therefore, the digestion of starch in the small intestine is an extremely important factor in the digestive health of racehorses, and safely feeding concentrated starch sources to avoid soluble carbohydrate overload should be a focal point of all feeding programs.

Benefits of grain processing

Processing of grains can have a significant effect on starch digestibility in the horse. An investigation of the pre-ilieal (last section of small intestine) digestion of oats, corn, and barley starch in relation to grain processing showed that oat starch was most digestible, followed by corn and barley. When the grains were simply rolled or crushed without heating, no improvement in digestibility was seen but popping the grains (like popped corn) improved digestibility. The effect noted through popping was probably due to the restructuring of the grain; the starch granules are altered and partly disintegrated, which makes them soluble in water and more readily absorbed in the small intestine.

Another study examined the effect of corn processing on glycemic response in horses. Glycemic response is a measure of the rise in blood glucose levels following a meal containing starch. The effect of grinding, cracking, or steaming was evaluated using glycemic response as an indirect measure of pre-cecal starch digestibility. Glycemic response was measured for each grain using a glycemic index where the increase in blood glucose concentration was analyzed statistically and compared with the rise in blood glucose that resulted from feeding cracked corn.

The greatest glycemic response and peak glucose was seen for steam-flaked corn as opposed to cracked or ground corn. The results of this study showed that steam-flaking corn increased digestibility of starch before it reached the hindgut (pre-cecal) more than cracking or grinding. Higher peak concentrations of glucose indicate that steam flaking improved small intestinal starch digestion, which is preferable to avoid starch fermentation in the hindgut. This result is considered desirable from a digestion standpoint, but high glycemic response also has been linked to behavioral problems in horses sensitive to elevated blood glucose concentrations.

Starch content of grains

The various grains fed to horses contain differing levels of starch.

Oats: Oats are favored in grain mixes because they are extremely palatable and are nutritionally compatible with the requirements of the horse. Oats contain about 53% starch, 12% protein, 5% fat, and 12% fiber.

The horse, via enzymes secreted in the stomach and small intestine, easily digests oat starch. About 83% of the starch in oats will be digested and absorbed in the small intestine after ingestion of a grain meal that does not exceed 0.4% of the horse's bodyweight, but oats will cause and increase in blood glucose levels for about four hours after consumption.

Corn: Recently, corn has gotten a bad rap as a feed ingredient for horses, and some of the scrutiny can be justified. Corn is very energy dense (high caloric content) and should be used judiciously in equine rations. Corn contains about 71% starch, 8% protein, 4% fat, and only 2% fiber.

Unlike oat starch, corn starch is not digested at all in the foregut unless it has been processed (ground, steam-flaked, pelleted, or extruded). Corn starch left undigested in the foregut will proceed along the tract and become fermented in the hindgut.

Barley: A hard-shelled grain that is not easily chewed by horses, barley should be processed when included in concentrates. Often, barley is "rolled" to crack open the hard seed coat when used in rations.

Barley contains approximately 60% starch, 11.5% protein, 2% fat, and 5% fiber. Rolled barley has a low pre-cecal starch digestibility of about 21% in horses. Therefore, it can be concluded that when grains are used in diets for horses, oats can be fed whole but corn and barley must be processed before feeding.

Grain mixes versus processed feeds

The composition of textured or sweet feeds can vary greatly from those that are simply a mix of grains with a molasses content ranging from 4% to 12% to more elaborate mixes that contain vitamin and mineral fortification. Straight grain mixes that are not balanced with a vitamin and mineral pack can be

Methods of processing feed

Steam extrusion: Ingredients used in the mix are milled, steamed, pressure-cooked, and oven-roasted for a short period of time at carefully controlled temperatures. The final product can vary in size but resembles dog or cat food nuggets.

Steam extrusion alters starch, protein, and fats, making them highly susceptible to degradation by the digestive enzymes in the stomach and small intestine. Manufacturers of steam-extruded feeds generally use heat-stable vitamins and minerals that are not affected during processing. Steam-extruded nuggets are very stable and nutrients are protected from rancidity and oxidation due to the nature of this type of processing. Most steam-extruded products contain only about 8% moisture, which helps to prevent mold development, whereas grains are usually in the range of 11-13% moisture.

Dry extrusion: Steam extrusion differs from dry extrusion in that no moisture is added during the latter process, thus requiring much higher intensities of heat to achieve gelatinization of starch. Unfortunately, this process causes some amount of heat damage to protein and loss of some vitamins and minerals.

Micronizing: In this process, infrared light waves are used in a short burst to heat and vibrate the starch molecules to reconfigure their shape, making them more digestible. When exposed to rapid internal heating, starch molecules swell, fracture open, and gelatinize.

Both steam extrusion and micronization afford the horse a better quality and safer feed that is less likely to cause excitability. Research has shown that both of these processes can improve digestibility by up to 30% over ordinary pelleted feeds.—*Amy Gill, Ph.D.*

dangerous to feed for extended periods due to imbalances and shortages of vitamins, minerals, and protein required by the racehorse in training.

Sweet feeds are highly palatable to horses, help to cut down on dust, and are useful when feeding supplements or medication. However, horses quickly consume sweet feeds, which can contribute to lower digestibility in the foregut due to increased rate of passage. Molasses adds to the sugar content of the feed and also to a rise in blood glucose.

Some textured feeds now contain inclusion of alternative soluble fibers such as beet pulp, rice bran, and soybean hulls, which serve as energy sources that do not add to the starch content of the feed. For those that prefer textured feeds, products containing soluble fiber and lower starch are a much better choice because the fiber is fermented in the hindgut and will not cause digestive or metabolic disorders.

Pelleted feeds

Pelleted feeds can contain high-quality byproducts from the food industry that normally would not be available to horses. However, it is difficult to identify ingredients in pelleted feeds, which should only be purchased from a reputable manufacturer. Many of these high-quality byproduct ingredients are readily available on domestic grain markets and are competitively priced as compared to whole grains.

Ingredients that are used in pelleted feeds include:

- Wheat middlings, a byproduct of flour milling in which the flour portion has been removed from the wheat seed;
- Brewer's and distillers grains, a byproduct of the brewing and distilling industries respectively; and
- Corn gluten feed and meal. Corn gluten feed is the part of shelled corn that remains after removing most of the starch, gluten, and germ. Corn gluten meal is similar but contains less of the bran fraction found in corn gluten feed and contains slightly less fiber.

All these byproducts are relatively high in good quality protein and are high in digestible energy.

Horses better digest pelleted feeds than sweet feeds due to the heating of ingredients during manufacturing. Pelleted feeds contain little or no molasses and have a much longer shelf life than sweet feeds. They are also easier to handle, with less clumping and caking in the winter, and attract no flies in the summer.

Pelleted feeds do not cause as much of a rise in blood glucose when fed because heating helps to gelatinize or restructure the starch molecule, making it more digestible. Additionally, many pelleted feeds contain highly digestible fiber sources such as alfalfa meal, soybean hulls, beet pulp, and rice bran, which are substituted for grain as sources of energy.

One of the most important features of pelleted feeds is the inability of the horse to sort out the more palatable ingredients in the feed and leave the less palatable but important components of the mix, such as the vitamin and mineral premix. Pelleted feeds are excellent for horses that have difficulty chewing or are off feed because the feeds can be wetted and made into a mash.

Steam extrusion

Steam-extruded feeds are the most highly digestible of all products available to the horse industry. The process of steam extrusion produces a stabilized product that serves to preserve the nutritional value of all the ingredients used in the product.

For example, flaxseed meal is a popular conditioning supplement used by many trainers at the racetrack. It is high in essential fatty acids, which provide nutrients needed to produce healthy skin, hair, and hoof. They also are powerful antioxidants, which boost the horse's immune system.

Because essential fatty acids are easily oxidized when exposed to oxygen, it is recommended that whole flaxseeds be ground just prior to feeding to obtain the best nutritional value from them. When ground flax meal is included in an extruded feed product, the essential fatty acids are stabilized and preserved, eliminating the need for grinding just prior to feeding. Shelf life can be three to six months, making extruded products extremely easy to store and feed as well as superior in nutrition when compared with unprocessed feeds.

Processed forage

Processed forage that could potentially be useful when feeding racehorses is haylage, or grass silage. Haylage is produced by baling grass plants that are cut, partially wilted until moisture content is about 50%, and then placed in a silo or container (usually a plastic bag) where exposure to oxygen is eliminated. The plants use up the remaining oxygen in the bag, resulting in fermentation, which causes a drop in the pH. At this point, the forage goes into a suspended state and remains stable.

Haylage is very palatable and has a higher nutritional content than traditionally cut and cured hay. Because of the acid pH produced by fermentation, good quality haylage will contain little or no dust and mold.

Careful packaging is the key to making good-quality haylage because if exposure to oxygen occurs after the grass is put in plastic bags—if the bag is punctured, for example—a second fermentation occurs and will cause spoilage in the areas of exposure. Because horses consuming spoiled haylage could be in danger of contracting botulism, horses fed haylage should be vaccinated for the disease.

However, the risk of problems from feeding good-quality haylage is minimal. Correctly cured haylage can be a wonderful feed for racehorses. It is particularly useful for horses that are sensitive or allergic to mold, pollen, and dust, such as those that are bleeders or suffer from chronic obstructive pulmonary disease or heaves. As many as 60% of the horses that are continuously stabled are estimated to suffer from some type of respiratory disorder.

Complete feeds

Complete feeds combine both the forage and concentrate portions of the diet into one. Forages alone also can be processed into cubes and pellets. Complete feeds and cubed/pelleted forages are convenient to use, especially when shipping, and they help reduce variability in hay that often results when traveling.

Quality of ingredients in complete feeds and processed forages is generally very high, so they have the potential to work nicely when formulating rations for racehorses.

One source of concern in using this type of product with stabled horses is the long periods of time the horses have between meals without feed to consume. Complete feeds and cubed/pelleted forages eliminate the need for extensive chewing of fiber, so the horse consumes them quickly. The shortened timeframe required to ingest a meal could lead to long periods of boredom for the horse, which may encourage the development of aberrant behaviors. This type of diet also may predispose racehorses to ulcers, since acid production in the stomach continues after the conclusion of a meal.

Processed feeds have greatly enhanced our ability to provide the highest-quality nutrition safely to equine athletes. Though sweet grain mixes have had a stronghold on the industry as a traditional concentrate feed for many years, the manufacturing technology present in the industry today offers a superior product.

Convenience of use, higher digestibility through starch gelatinization, high palatability, low dust/mold content, nutrient stability, and increased product shelf life make the use of processed feeds in the racehorse diet a good choice.

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