Introduction to Equine Diet and Lifestyle

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Horses evolved over millions of years living in small herds on open range. They are well adapted for traveling over a large area seeking out water and sparse forage. Studies of feral horse herds indicate that horses may travel up to 15 - 20 miles per day in search of food. Their hooves are shaped and worn by the environment they live in, which may vary by season or climate.

The equine digestive system is designed to process a continual intake of low nutrient forage. It's normal for horses to spend most of their time eating. Although the natural diet is low in protein, fats, and carbohydrates, under normal conditions the total amount of forage consumed can add up to adequate intake for those nutrients.

In the wild, horses graze and browse a wide variety of plants. Even tree bark can provide certain nutrients. Horses will seek out naturally occurring mineral deposits in the soil. The forage they eat varies by season and geographic location.

Natural diet and lifestyle vs. domestication

Under domestication, most equine diets are limited to what is locally available. Instead of consuming a wide variety of plants and grasses, many horses eat the same hay for months at a time, with limited or no access to grazing. Pastures are often planted with certain types of specialized grasses that are designed for fattening cattle and would not be available in the wild.

In addition to a limited variety in the diet, horses are often fed for rapid growth and athletic performance. Race horses need a high energy diet heavily dependent on grain, while horses shown at halter are fed for bulky muscle production. It's common to see equine diets that have little resemblance to what they would naturally eat. Many horses are obese and laminitic from too much food and not enough exercise.

Domestic horses are often confined with inadequate opportunity to move and exercise. The lack of movement and stimulation to the feet leads to poor circulation and underdeveloped hoof structures.

Unnatural diets and living conditions can cause serious health and hoof problems. By recognizing what horses are designed to eat and how to manage that diet under domestication, many health and soundness problems can be avoided.

Basic Nutrition - Digestion

Digestion starts at the mouth, with chewing food. Horses chew best when fed at ground level, the same as if they were grazing. Chewing stimulates saliva production, and more chewing time creates more saliva, which helps buffer stomach acid and reduces the incidence of choke.

Upon swallowing, food enters the stomach. Horses have a relatively small stomach for their size, with a capacity of about 2-4 gallons, but the stomach begins to empty when it is only 2/3 full. This is one reason why horses do best on small, frequent meals. Some digestion of protein and fat takes place in the stomach, along with very limited fermentation of soluble sugars, but the majority of digestion and absorption of nutrients takes place in the small and large intestines. Although the stomach empties after food has been in it a very short time (about 20 minutes), having some food in the stomach at frequent intervals helps absorb stomach acids and prevent ulcers. A free choice forage based diet does the best job of avoiding stomach ulcers.

The small intestine is about 70 ft. long and is where the majority of protein digestion and absorption takes place. Digestive enzymes break down proteins, carbohydrates, and fats. Between 30-60% of carbohydrate digestion and absorption and almost all amino acid absorption occurs in the small intestine. Calcium, some phosphorus, and fat soluble vitamins A, D, E, and K as well as some B vitamins are also absorbed in the small intestine. Transit time through the small intestine is about 30 – 90 minutes.

Digestion

Food leaves the small intestine and enters the cecum. The cecum is a large fermentation vat that can hold as much as 8 gallons. Digestion is accomplished by bacteria and other organisms. Food passage slows down in the cecum and can take as long as 7 hours to pass through. The microbial populations in the cecum become specific for the type of food that the horse normally eats. Sudden changes in feed or an overload of starch can wreak havoc on the balance of these microbes, resulting in colic and laminitis. High fat diets can suppress bacterial levels, affecting digestion of fiber. Fiber is fermented and broken down into volatile fatty acids (VFA) which are absorbed through the gut wall and can be used for energy or converted by the liver to glucose.

Partially digested food passes from the cecum to the large colon where microbial fermentation continues. The large colon has a capacity of 14 – 16 gallons and food stays in the large colon the longest length of time. Absorption of B vitamins, phosphorus and some minerals takes place in the large colon.

Once food leaves the large colon and enters the small colon, the majority of nutrients have been extracted and what remains is undigested matter. Excess water is absorbed in the small colon and the remaining material is formed into fecal balls, passing to the rectum and expelled as manure.

Protein

Protein is essential to the horse for building and repairing tissue, including hair and hoof formation. Proteins are composed of 22 amino acids, assembled in chains. The types of amino acids and length of the chains differentiate one protein from another. Of these 22 amino acids, 10 are considered “essential” and cannot be manufactured by the horse. These “essential” amino acids must be present in the horse’s diet and at the same time. If one essential amino acid is present, but in insufficient quantities, it is referred to as a “limiting” amino acid because it will limit protein synthesis. Ensuring adequate intake of these essential amino acids is most crucial to pregnant mares and growing horses. The only essential amino acid that has been studied enough in the horse to determine minimum intakes is lysine, but methionine is considered an important amino acid for hoof horn growth and structure. Grass hay may be too low in lysine to supply the needs of broodmares and growing horses, and need to be supplemented.

In addition to crude protein levels, the quality and digestibility of protein in the horse’s diet should be a prime consideration. High fiber mature grass hays can have lower protein digestibility. Diets deficient in protein will result in stunted growth, muscle loss, and poor quality hair and hoof horn.

Excess dietary protein can be converted to energy, but it is an inefficient process producing much more heat than the breakdown of carbohydrates and fats and yielding less energy. This might be an advantage in a very cold environment (i.e. feeding some alfalfa during a winter cold spell), but could be a disadvantage during the hot summer months. For horses working in hot climates, keep the total dietary crude protein levels under 10%.

Carbohydrates

Carbohydrates provide energy and fuel muscles for athletic activities. There are two primary sources of carbohydrates in the diet: simple carbohydrates (sugars and starches) and complex carbohydrates derived from fermenting fiber in the large intestine.

Simple carbohydrates are also referred to as non structural carbohydrates (NSC) or water soluble carbohydrates (WSC). Think of dissolving a teaspoon of sugar in a glass of water, or boiling a pot of spaghetti on the stove until it turns to mush. Simple sugars and starches are mostly digested in the small intestine by digestive enzymes and immediately absorbed through the intestinal walls, but if too much is present (e.g. sudden diet change to a high carbohydrate diet or rich pasture) the excess is passed on to the cecum where it is processed into not only volatile fatty acids (VFA), but also lactic acid. The increased lactic acid creates a low gut ph, setting the stage for bacterial die off and release of endotoxins. The result can be colic and laminitis.

The breakdown of fiber (complex carbohydrates) in the cecum and large colon produces lactate and volatile fatty acids (VFA), which can provide up to 70% of a horse's maintenance energy needs. VFAs provide a steady source of energy to the horse, avoiding the high insulin levels that simple sugars and starches can trigger. VFAs are also converted by the liver to either glucose or fat.

Fat

Horses do well on a low fat diet. Hay normally contains around 3% fat. Fat digestion begins in the stomach, but most occurs in the small intestine. While the horse does not have a gall bladder, the liver secretes bile and horses can digest a surprising amount of fat if gradually accustomed to it. Pound for pound, fat contains almost 2 ½ times the energy as an equivalent amount of grain. However, 20% total dietary intake is probably the limit before negatively affecting hindgut bacteria.

Horses can be conditioned to convert fat to energy and feeding fat does not raise the lactic acid levels in the hind gut the way grain can. Some fat in the diet is needed for absorption of the fat soluble vitamins A, D, E and K. However, fat contains no protein or minerals and diets with fat substituted for other energy sources may need to be supplemented accordingly.

Minerals

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Minerals are required for bodily functions and structure. They are divided into two classifications: “major” and “trace”, which simply categorizes them by the amounts needed by the body, not their importance. The most important source of minerals in the diet is from forage. Grains and brans can contribute phosphorus, but are generally low in other minerals. Most mineral absorption takes place in the small and large intestines. Minerals interact and have key relationships where excesses of one can affect absorption of others. Deficiencies during gestation and growth can have permanent effects on skeletal formation and soundness. Mineral intakes also affect hoof growth and structure.

The horse can synthesize certain amino acids and vitamins, but minerals must be present in the diet and in adequate quantities. The body has some ability to regulate uptake in the presence of excess, but cannot manufacture minerals that are deficient in the diet.

Minerals –

major and trace minerals that are important in a horse's diet

MAJOR:

Calcium - Cellular membranes, blood coagulation, enzyme regulation, muscle contraction, bones and teeth. Interacts with phosphorus and magnesium.

Phosphorus – Formation of bones, interacts with calcium

Magnesium – Formation of bones, muscle contraction, interacts with calcium

Potassium – Intercellular cation (a positively charged ion), maintains acid-base balance and osmotic pressure. Interacts with sodium

Sodium – Extracellular cation (a positively charged ion), maintains acid-base balance, osmotic regulation of body fluids. Critical for normal function of nervous system. Interacts with potassium.

Minerals –

major and trace minerals that are important in a horse's diet

TRACE:

Chloride – Normally present with sodium in the form of salt. Involved with acid-base balance and osmotic regulation. Component of bile and hydrochloric acid used for digestion.

Sulfur – Component of sulfur containing amino acids methionine and cysteine, biotin and thiamine, chondroitin sulfate, heparin, insulin

Iron – Oxygen transportation, hemoglobin and myoglobin formation.

Zinc – Energy and protein metabolism, immunity and antioxidant activity, vitamin A absorption, synthesis of collagen and keratin. The hoof wall cells and blood vessels require zinc for cell reproduction, maintenance and repair.

Copper – Involved in synthesis of elastic tissues, melanin, mobilization of iron stores

Manganese – Essential for carbohydrate and fat metabolism, synthesis of chondroitin sulfate needed for cartilage formation.

Cobalt – Synthesis of vitamin B-12 in the large intestine

Iodine – Synthesis of thyroid hormones that regulate basal metabolism

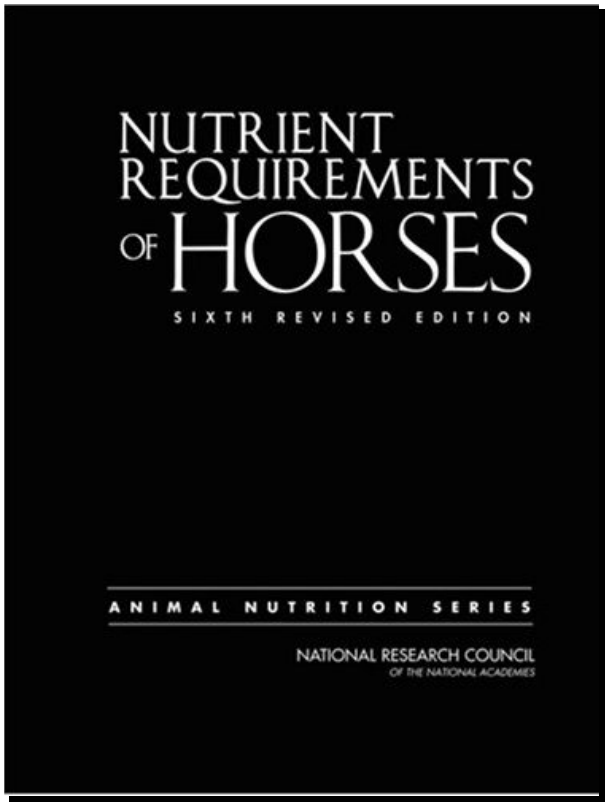
Selenium – Antioxidant, aids in control of thyroid hormone metabolism

Vitamins

Vitamins are divided into 2 groups – fat soluble and water soluble. Fat soluble vitamins can be stored in the liver and include A, D, E and K. Water soluble vitamins are the B group and C.

With the exception of vitamins A and E, healthy horses are able to synthesize all of the vitamins that they need. Vitamin A is not commonly deficient in equine diets and green pasture supplies adequate vitamin E. Horses living exclusively on dry hay, however, can benefit from vitamin E supplementation.

NRC Guidelines



The accepted standard reference for equine nutrition is the National Research Council's publication "Nutrient Requirements of Horses", last updated in 2007. This book is a compilation of the most recent research and findings about equine nutrition and metabolic issues. It includes tables listing the minimum requirements for horses at different life stages and activities. It also includes references to the nutrient content of common feeds and ingredients in equine diets. When the term "NRC guidelines" is used, it's referring to this book. "Nutrient Requirements of Horses" can be purchased online at amazon.com. The NRC guidelines are generally considered to be the "bare minimum" for maintaining health in the horse. The book should not be considered the absolute last word in equine nutrition, but it's the place to start and refer back to when formulating or reviewing a horse's diet. Most equine nutritionists recommend using 150% of the values for minerals.

The NRC charts and tables list nutrients in either grams or milligrams. For instance, a mature 1,100 lb (500 kg) horse may require 720 grams of protein and 400 mg of zinc for maintenance.

How diet and lifestyle affect hooves and health

As hoof care providers, it's important to study and recognize how diet, lifestyle and living conditions can affect horses' hooves.
With only a few exceptions, in today's horse world it is more common to see problems created by excesses and imbalances in the diet, rather than true deficiencies. High iron in the food and water, coupled with inadequate intake of copper and zinc can cause hoof walls to separate and crack.
Many owners unknowingly buy supplements that only make matters worse by contributing to the imbalances.

Confinement and the way many young horses are raised can have a negative impact on hoof development and soundness. Many well meaning owners aren't aware of this and we have a duty to educate them so that they can make the necessary changes for their horses' well being.

How diet and lifestyle affect hooves and health

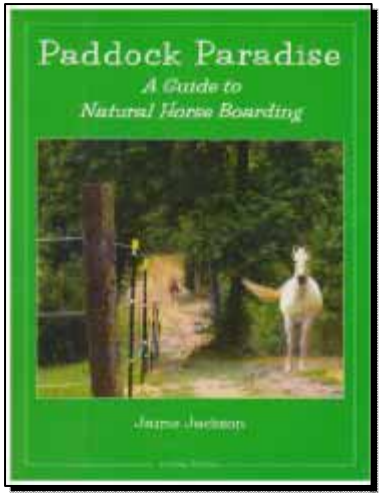
Diets high in soluble carbohydrates (sugars and starch) can lead to problems ranging from weakened laminae to full blown laminitis and founder. Rich pasture, high sugar hay and concentrated grain feeds need to be tightly restricted or eliminated. Obesity is the #1 enemy of sound feet, and the extra weight alone puts added stress on the joints, tendons and ligaments of the lower leg and foot. Sub clinical laminitis can be present without the horse being obviously lame. Shortened strides, reluctance to move out and/or bend in turns, even unwillingness to lift a foot for

cleaning can be warning signs. Many times the horse is diagnosed as arthritic or sore in the shoulders, when it's actually a foot problem. Signs of chronic laminitis can be obvious growth rings in the walls, redness in the white line, and separation in the wall/solar junction. For a more detailed description of the signs of laminitis, plus excellent photos go to http://www.healthyhoof.com/articles/Laminitis/LaminitisSymptoms.html

How diet and lifestyle affect hooves and health

Horses do best in a clean, well drained environment, with a variety of rocky/gravelly surfaces to stimulate the hoof. Horses standing on constantly hard, flat surfaces have poorer circulation and tend to develop an excessive build up of retained sole, while horses living in soft, wet environments often have weak hooves and thrushy frogs. It may take some persuasion to get an owner to have gravel hauled in and spread, but once they see the positive changes in the feet, they'll be glad they did.

One of the most important influences that hoof care practitioners can have is convincing owners to give their horses more exercise and room to move in their environment. The mental stress alone of living in stall confinement can adversely affect the feet. Jaime Jackson's book, "Paddock Paradise" is an excellent tool for giving horse owners ideas for creating better living conditions and should be in every trimmer's vehicle. Making simple changes, such as moving the water trough as far from the hay source as possible is a good place to start.



How diet and lifestyle affect hooves and health

The Paddock Paradise system uses “tracks” to encourage movement similar to the pattern that wild horses use on a daily basis as they follow their natural living patterns of travel from feeding areas to rolling and napping locations, mineral licks and watering holes. Creative owners have been able to Creative owners can develop an environment that encourages movement by opening up or narrowing the track (horses move more slowly through the wider areas and more quickly in the narrow areas), providing graveled or sandy areas for hoof stimulation and rolling, distributing hay at separate locations, etc. One owner with a 4 acre paddock paradise was able to track her horses movement using GPS monitoring, and they were traveling an average of 12 miles a day! This movement has long term benefits for the horse’s entire system, including their hooves.

Recognizing the signs of Insulin Resistance

"Insulin resistance" is a term used to describe horses that have a poor ability to utilize soluble carbohydrates in the diet and respond by over producing insulin. These horses are often the "easy keeper" types and tend to be of the pony/arabian/morgan/mustang/saddlebred and gaited breeds. They are genetically designed to be able to survive on sparse food and hard work. These horses do well when exercised regularly and often excel in endurance type events, but when inactive and fed a high sugar/starch diet become obese and are prone to laminitis. Most insulin resistant (IR) horses exhibit physical characteristics that are easy to spot, although the only way to accurately diagnose IR is through blood testing for glucose and insulin levels. The classic signs of IR are a hard, cresty neck, fat deposits on odd areas of the body, particularly at the tail head, and filled-in areas above the eyes (supra-orbital fossae) that would normally be sunken.

Recognizing the signs of Insulin Resistance

Obesity commonly accompanies IR, but not all IR horses are obese, nor are all obese horses IR. In fact, it's not uncommon for seriously IR horses to be thin, while still retaining their fat pads and cresty neck. They may be cranky and sluggish. Laminitis is a frequent symptom of IR and any horse that has had laminitis for nonspecific causes should be tested for IR. A simple, non fasting blood test checking levels of glucose and insulin is all that is necessary. The good news is that IR can be easily managed with a strict diet and exercise program. Often daily exercise and eliminating all grazing, grains and sugary treats is all it takes.

IR is often associated and confused with Cushing's disease, which is caused by a benign tumor on the pituitary gland. Horses with Cushing's often develop IR as the disease progresses, but not all IR horses have or will develop Cushing's disease.

Nutritional Factors Affecting Hoof Health

Healthy feet are a reflection of a good overall nutrition program that avoids excesses and deficiencies. Adding nutrients to an already adequate and balanced diet won't have any effect on hoof growth in a normal horse.

However, supplementation with several nutrients that are commonly lacking in equine diets can have a favorable influence on hoof quality and growth. High quality digestible protein, including the amino acid lysine, and sulfur containing amino acids Methionine and cysteine, is crucial to producing good hoof horn.

Minerals need to be present not only in adequate amounts, but also in the proper ratios.

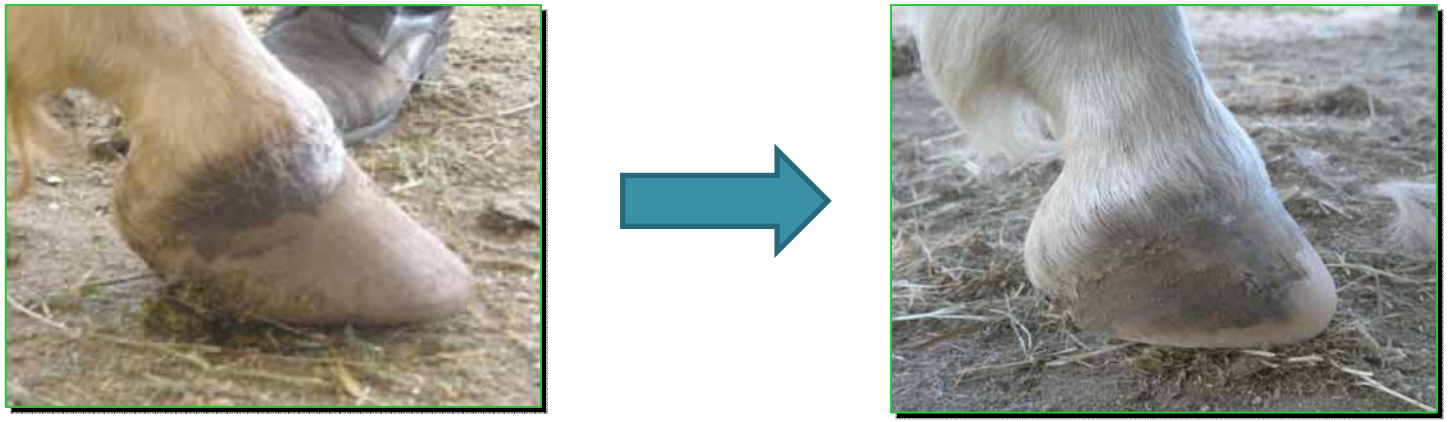
Nutritional Factors Affecting Hoof Health

An excess of one can have a negative effect on absorption and utilization of others. For example excess calcium, such as in a high alfalfa diet can interfere with absorption of zinc. High levels of iron can interfere with copper and manganese. The trace mineral copper tends to be low in most hay and usually needs to be supplemented. Using a hay analysis is the best way to determine what needs to be supplemented and balanced in a horse's diet. However, if hoof horn is weak and cracking, despite a good environment and trimming practices, a hoof supplement with high levels of copper and zinc may be helpful. Copper and zinc should be kept balanced to each other as high levels of one can interfere with absorption of the other. A good ratio is 4:1 zinc to copper. Always check for soil selenium levels where the hay was grown and supplement if it came from a marginal or deficient area. Manganese varies considerably and needs a hay analysis to determine intakes.

Nutritional Factors Affecting Hoof Health

Many hoof supplements contain biotin, a B vitamin that is synthesized in the hind gut by intestinal microbes. There are no published studies establishing a requirement for biotin above what is synthesized in the large intestine, but some studies have shown an improvement in hoof horn structure after daily supplementation of 10-30 mg of biotin for 6-9 months. There are no reported adverse effects to biotin supplementation, even at high doses, so it's probably a "can't hurt, might help" nutrient. For horses recovering from laminitis, a good hoof supplement containing biotin may be helpful.

As mentioned earlier, reducing simple carbohydrate (sugars and starch) intake can have a significant effect on lamina health and integrity.



Evaluating a Ration - HAY

The first place to start with evaluating a ration is the hay. Most adult horses do well on good quality grass hay, fed at the rate of 1.5 – 2% of body weight. That amounts to 15-20 lbs. of hay per day. Unless a horse is in work, it should be able to obtain all of its energy and protein requirements from hay alone. Grass hay should be fine stemmed and cut before fully mature. Some alfalfa may be fed to increase protein, calcium and energy levels if needed, but high alfalfa diets generally provide more energy, protein and calcium than mature horses need.

Insulin resistant horses and ponies should not be fed alfalfa, and horses living in California eating high alfalfa diets are at risk of developing enteroliths. On the other hand, broodmares in the last trimester of pregnancy, lactating mares, and growing horses have higher energy and protein needs, so alfalfa can be a beneficial portion of their diets.

Evaluating a Ration - HAY

The advantage to feeding grass hay is that it is generally lower in calories, so more can be fed. Keeping the horse busy eating, with a steady supply of fiber moving through the digestive system is a good way to avoid boredom, ulcers and colic. Low sugar hay keeps insulin levels steady, avoiding the spikes that a high sugar/starch meal can trigger. Providing hay free choice or at multiple small meals allows for more natural feeding. Distributing small piles of hay over a large area encourages horses to keep moving, which is beneficial for digestion, hoof health and mental activity. There are special feeders and hay nets designed to slow down the rate of eating, making the meals last longer. More chewing time creates more saliva, providing a buffer against stomach acids.

Whenever possible, hay should be tested to ensure that it is appropriate for the horses it will be fed to.

Testing provides the information needed to ensure the horse is getting adequate levels of nutrients and energy, and tells us what nutrients need to be supplemented. The sugar and starch levels should be considered for horses prone to laminitis (IR) and kept below 10% total. The cost of testing is small compared to the savings that can be realized by not buying unnecessary or inappropriate supplements. Many hay growers already test their hay, or will provide a cored sample that can be sent to a lab for testing. More information about testing hay is available at http://www.equi-analytical.com/default.htm

Pasture

Grass is the horse's natural food and green grass provides important vitamins, protein and minerals, all in an easily digested package. Horses love to graze, and abundant green pasture is often referred to as "Dr. Green" for its' beneficial effect on a horse's physical and mental well being. The constant intake of fresh grass is soothing to ulcers and the high water content allows the gut to function without the worry of dry hay creating an impaction. Green grass is a rich source of beta carotene, vitamin C, E, and omega 3 fatty acids. Older horses with worn teeth find it easier to chew than coarse hay.

So, what is there to worry about while watching horses munch to their hearts' content on lush green grass? Plenty! Green grass can have dangerously high levels of simple carbohydrates, namely sugar. Today's pastures bear little resemblance to the sparse native grasses, plants and herbs that horses evolved to eat. Most varieties of pasture grasses have been genetically selected and bred to produce sugar for fattening beef cattle or high milk production in dairy cattle. Beneath that pretty green color lays potential danger for horses and their feet, as the warm midday sun creates the perfect setting for the grass to synthesize simple sugars in its leaves. Cool nights and warm days stimulate maximum carbohydrate storage, and when freezing nights, lack of water or nutrients stress the plants, sugar content can skyrocket. The same can be said for hay grown under similar conditions and cut at peak sugar production. There is no visual difference between low and high sugar forage – it all looks the same.

Pasture

orses allowed to graze green pasture after a long winter of eating plain, dry hay need to be introduced to it slowly, if at all. Peak sugar production begins when the sun comes up and continues throughout the day. The grass stores carbohydrates to be used for energy during the night, but when temperatures drop below 40 degrees the plant does not use them and they accumulate in the leaves and stems. Insulin resistant horses and ponies should not be allowed to graze, or can be fitted with a grazing muzzle when out in pasture to limit intake. Even metabolically normal horses need to be monitored carefully for carbohydrate overload, especially in spring and fall when the new grass comes in. An immediate "red flag" that the horse is consuming too much sugar is "ouchy on gravel" syndrome, especially in horses with normally sound feet. Removing the horse from pasture and feeding low sugar hay usually resolves the problem, but full blown laminitis can develop before the problem is noticed.

Concentrates and Supplements

Many horse owners supplement their horses' diets with various commercial feeds and supplements. When assessing the health of the hooves and trying to determine the cause of hoof problems, particularly laminitis, it's important to look at everything the horse is fed, no matter how small the quantity being fed. When in doubt, eliminate anything with grains, molasses, and alfalfa. That includes sweet treats, carrots and apples.

Most grain mixes and concentrates are high in starch. Even products labeled as "safe" or "low carb" can be too high in simple carbohydrates for horses prone to laminitis. The feed company should be able to supply actual figures for "NSC" or starch and sugar if it isn't listed on the label. Often these products are high in fat (over 3%), which can worsen IR. In fact, supplemental fat feeding should be restricted to no more than a few ounces per day for an IR horse. Many commercial feeds are also high in iron and do not provide the amounts or kinds of trace minerals needed to balance what is lacking or excessive in the hay. The vitamin and mineral supplements found on feed store shelves range from fairly good to absurd, some with dangerously high levels of vitamin A. "Blood builders" usually contain high levels of iron and should not be fed. Hoof supplements are generally a good source of copper and zinc, which are recognized as essential for healthy skin, hair and hooves and commonly deficient in forages. With the exception of vitamin E for horses with no access to green pasture, most horses do not need or benefit from supplemental vitamins.

Concentrates and Supplements

On the subject of fat, if a horse must be supplemented it's best to choose a source that supplies some good nutrition, rather than refined oils that have been stripped of everything in the name of shelf life. Horses benefit from the omega 3 fatty acids found in flax, either stabilized or freshly ground. There are several good stabilized flax products on the market if fresh grinding is not possible. Rice bran is a good source of fat, but is high in omega 6 fatty acids, which a horse on a normal diet is seldom deficient in. Omega-3 fatty acids help reduce inflammation and omega-6 fatty acids tend to promote inflammation.

Concentrates and Supplements

he ratio of omega 3 fatty acids to omega 6 fatty acids in the horse's natural grass diet appears to be approximately 4:1. Look for unrefined oils, such as Uckele's CocoSoya oil http://www.cocosoya.com/ to provide quality fat, rather than processed supermarket oils.

Beet pulp can be used as an additional energy source. When served moistened it makes a good carrier for supplemental minerals and salt. On a dry weight basis, beet pulp can supply nearly the same amount of calories as a corresponding amount of plain oats, but in the form of soluble fiber rather than starch, avoiding the glycemic rise caused by grain feeding.

Concentrates and Supplements

Beet pulp can be fed dry, but is more beneficial when soaked and drained. It's a good source of calcium and can be mixed with hay pellets for feeding an older horse with poor teeth. The soluble fiber in beet pulp, converted to VFAs by fermentation in the hindgut, provides a steady, safe source of energy for the horse. When feeding beet pulp to IR horses, choose molasses-free beet pulp or soak thoroughly, drain and rinse to remove the molasses. Molasses is often added to beet pulp for dust control, but not listed on the label, so always soak, drain and rinse to remove it. Lab testing has shown that soaking for one hour, then draining/rinsing can reduce sugars in beet pulp by 50%.

Salt and Electrolytes

Horses need salt on a daily basis, especially in hot weather. The minimum daily requirement is 2 ounces per day (about 3 tablespoons), which can be supplied loose or in a block form. The problem with blocks is that many horses do not consume enough salt from them. If a horse is getting 2 ounces per day from a block, it should be going through a 5 lb. block in 7 weeks. If the horse isn't doing that, supplemental salt should be added to the daily ration. It's easy to add a heaping tablespoon of salt to the morning and evening feed. Salt helps to ensure that horses drink enough water in both cold and hot climates.

Many horse owners buy "trace mineral" salt blocks in the belief that it supplies their horses' mineral needs. Unless those blocks are formulated specifically for horses, not cattle and livestock, nothing could be further from the truth. Livestock mineral blocks are extremely low in copper, which has a very narrow safety range for sheep, and tend to be high in iron. That is the exact opposite of what is needed to balance the hay our horses eat. Much better to put a plain white block out in the paddock and add plain salt to the diet on a daily basis to ensure adequate intake. Iodized salt may be used to supply adequate iodine intake if needed.

Hay and pasture is an excellent source of potassium and often supplies more than a horse needs for maintenance. Many horse owners mistakenly add electrolytes to their horses' feed, when in reality the horse only needs salt. Unless the horse is working hard in hot weather, skip the electrolytes and add salt to restore losses from sweat.

How to Read a Feed Label

Feed and supplement labels list the ingredients in a product, along with a “guaranteed analysis” of most, but not necessarily all nutrients in that product.

Protein, fat and fiber, plus major minerals are listed in percentages, while trace minerals are listed as “ppm”, which stands for “parts per million”, or how many milligrams are in each kilogram (about 2.2 lbs.) of feed.

Below is a typical feed tag analysis for a commercial grain mix:

Crude protein		14.0%
Crude fat		6.0%
Crude fiber		6.5%
Calcium (min)	0.6%	
Calcium (max)	0.9%	
Phosphorus (min)		0.5%
Copper		55.0 ppm
Zinc		220.0 ppm
Selenium		0.6 ppm
Vitamin A		3,000 IU per lb.

Feeding Directions: 5-10 lbs per day depending on work

Ingredients: Whole oats, flaked barley, cracked corn, de-hulled soybean meal, corn flour, wheat middlings, molasses, brewers grains, calcium carbonate, salt, dicalcium phosphate, soybean oil, dried whey, vitamin E supplement, sodium selenite, choline chloride, citric acid, vitamin A supplement, ferric oxide, vitamin B-12 supplement, riboflavin supplement, vitamin D-3 supplement, niacin supplement, ferrous carbonate, manganous oxide, zinc oxide, copper sulfate, magnesium oxide, ferrous oxide, calcium iodate, cobalt carbonate, DL-methionine, L-lysine.

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How to Read a Feed Label

Ingredients: Whole oats, flaked barley, cracked corn, de-hulled soybean meal, corn flour, wheat middlings, molasses, brewers grains, calcium carbonate, salt, dicalcium phosphate, soybean oil, dried whey, vitamin E supplement, sodium selenite, choline chloride, citric acid, vitamin A supplement, ferric oxide, vitamin B-12 supplement, riboflavin supplement, vitamin D-3 supplement, niacin supplement, ferrous carbonate, manganous oxide, zinc oxide, copper sulfate, magnesium oxide, ferrous oxide, calcium iodate, cobalt carbonate, DL-methionine, L-lysine.

If you asked an owner what was being fed to their horses and were shown that feed label, what would you think? The first 6 ingredients are grain, followed by molasses. This is a high starch and sugar feed that would probably test around 60% starch – not exactly a healthy diet for a horse. After these first ingredients, you'll notice quite a few minerals listed, such as iron in the form of ferric oxide, ferrous carbonate and ferrous oxide. But, there is no mention of iron content in the analysis. The same thing goes for manganese and magnesium, so you would have no idea how much of those minerals the horse was consuming, either. If you were trying to limit additional iron in the diet, this feed probably wouldn't help much. You can try contacting the feed company and ask for the full analysis.

Doing the Math

Calculating dietary intakes seems to confuse many people, but no matter how mathematically challenged you are, if you can use a calculator then you can figure out what a horse is consuming based on a feed label or forage analysis.

To convert percentages to grams, grab a calculator and do this simple math:

First, move the decimal point over 2 places to the left.

Example: 14.0% would become .14

Multiply .14 X 454 (there are 454 grams in a pound) = 63.56 grams of protein in one pound of that feed. If more than one pound is fed, multiply by the number of pounds fed. 5 lbs. of 14% protein feed would supply 317.8 grams of protein.

To convert ppm, to milligrams per pound, simply divide by 2.2

Example: 55 ppm divided by 2.2 = 25 mg per pound

These same simple formulas can be used to convert numbers on a hay analysis, too. Equi-Analytical does the math for you on their forage analysis – you can request the figures in metric or “English”. Always use the “As Sampled” numbers when calculating a ration.

Forage Analysis – putting it all together

Since forage comprises the greatest portion of the horse’s diet and can supply all of its energy needs, a good hay analysis is a valuable tool in evaluating and building a diet. A good analysis should provide figures for digestible energy (calories), protein, simple sugars and starch, major and trace minerals.

An actual hay analysis from Oregon

Analysis performed by:

equi-analytical laboratories

730 Warren Road
Ithaca, NY 14850
1-877-819-4110
www.equi-analytical.com

Lab Sample No:

Analyzed for:

Lab Desc:	103
Date Sampled:	7/27/2006
Date Received:	8/2/2006
Date Printed:	8/7/2006
Description 1:	2006 CROP MIXED GRASS
Description 2:	
Statement ID:	

Visit our website **www.equi-analytical.com** for information c
interpreting and using your results.

% Moisture	7.3
% Dry Matter	92.7

	As Sampled		Dry Matter	
Digestible Energy (DE), Mcal/lb		.85		.91
	%	g/lb.	%	g/lb.
Crude Protein	9.1	41.5	9.9	44.7
Estimated Lysine	.32	1.4	.34	1.6
Lignin	3.9	17.5	4.2	18.9
Acid Detergent Fiber (ADF)	33.8	153.3	36.4	165.3
Neutral Detergent Fiber (NDF)	57.4	260.5	61.9	281.0
Sugar	10.5	47.5	11.3	51.2
Starch	.0	-.2	.0	-.2
Non Structural Carbo. (NSC)	10.4	47.3	11.3	51.1
Non Fiber Carbo. (NFC)	14.1	63.9	15.2	68.9
Crude Fat	3.1	14.2	3.4	15.3
Ash	8.9	40.5	9.6	43.6
	%	g/lb.	%	g/lb.
Calcium	.31	1.42	.34	1.53
Phosphorus	.16	.71	.17	.76
Magnesium	.13	.61	.14	.66
Potassium	1.90	8.63	2.05	9.31
Sodium	.035	.160	.038	.172
Chloride	.34	1.54	.37	1.66
Sulfur	.10	.45	.11	.49
	ppm	mg/lb.	ppm	mg/lb.
Iron	106	48	114	52
Zinc	15	7	17	8
Copper	3	1	3	1
Manganese	157	71	170	77
Molybdenum	1.09	.50	1.18	.53
Cobalt	.24	.11	.26	.12
	As Fed		100% Dry	
PPM Selenium	.01		.01	

Hay Analysis

	As Sampled hay	NRC Daily Nutrient Requirements
Digestible Energy (Mcal)	17	15.2
Crude protein	830 g	540 g
Lysine (estimated)	28 g	23.2g
Calcium	28.4g	20.0g
Phosphorus	14.2g	14.0g
Magnesium	12.2g	7.5g
Potassium	172.6g	25.0g
Sodium	3.2g	10.0g
Iron	960mg	400mg
Zinc	140mg	400mg
Copper	20mg	100mg
Manganese	1420mg	400mg
Molybdenum	10mg	n/a
Cobalt	2.2mg	0.5mg
Selenium	.2mg	1.0mg

As we can see by comparison, 20 lbs of this hay will adequately supply energy, protein, and major minerals, except salt.

When we get to the trace minerals, it's a different story. The amount of iron is over twice the minimum level, and manganese more than 3 times the needed amount. Zinc and copper, on the other hand are deficient. Therefore, it's obvious that adding a supplement containing additional iron and manganese would not be indicated, but additional zinc and copper levels need to be increased. Selenium is also low and needs to be supplemented.

As seen from the NRC chart, a ratio of 1:4:4:4 copper to iron, zinc and manganese would be the ideal. Since excess manganese is excreted in bile, while iron is not, balancing against the high iron would be the best solution. Adding 220 mg of copper and 820 mg of zinc would balance the iron in this hay.

Conclusion and Links

The information provided in this course should help hoof care providers in evaluating and formulating an appropriate diet for horses. For further study and information, use the reference links below.

Links and References for further study

http://nrc88.nas.edu/nrh/ **NRC online nutrient calculator**

http://www.equi-analytical.com/default.htm **feed testing laboratory**

http://www.hoofrehab.com/diet.htm **Pete Ramey's article on diet**

http://www.safergrass.org/ **information about pasture and forage**

http://www.drkellon.com/home.html **advanced online nutrition courses**

http://www.swedishhoofschool.com/ **slow feeding ideas**

http://www.thehorse.com/ViewArticle.aspx?ID=702 **more information about feed labels**

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