WHAT ARE THE DYNAMICS OF THE HORSE MARKET?

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ABSTRACT

An estimated 625,000 horses in California could eat as much as 2.5 million tons of hay per year. Alfalfa hay is a controversial horse feed; many believe its high protein and calcium concentrations are detrimental. However, claims of its contribution to developmental orthopedic disease in young horses have been refuted by research findings. Grass hay is generally lower in energy and protein and higher in fiber than legume hay. It is often more variable in quality and palatability than alfalfa hay. The content of nonfiber and nonstructural carbohydrate in hay affects is energy content. Some horses have metabolic diseases that impair proper metabolism of carbohydrate and should be fed hay that is low in nonfiber carbohydrate. Education of horse owners about nutrient content and characteristics of hay will help them make good decisions when buying hay.

Key Words: horse, alfalfa, grass hay, nutrient requirements, nonstructural carbohydrate

SIZE OF THE HORSE MARKET

In order to speak about the dynamics of the horse hay market, it is desirable to try to estimate the size of the potential horse hay market. This is not easy to do. There is no government agency in California that counts the number of horses in the state. The American Horse Council conducted a nation wide survey and estimated that there were 6.9 million horses in the U.S. California was ranked by this survey as the second biggest horse state in the U.S., behind Texas, with an estimated number of horses of 400,000. Other, less official, estimates have reported recent state horse populations as low as 270,000 and as high as 1,000,000. A four-fold range in horse numbers is not helpful.to estimate the potential horse hay market in our state.

Some interesting statistics are reported from the 2002 U.S. Pet Ownership and Demographic Sourcebook (2002) about formulas for estimating pet numbers based on the number of households in a state. For horses, a factor of .017 is multiplied by the number of households to estimate the number of horses in an area. The 2002 California census (2002) reported 12,507,767 households in California. Multiplying this number by 0.017 yields a state horse population of just over 625,000. Testing this formula on our national population with 119,302,132 households, the U.S. horse population is estimated as just

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less than 6 million horses. This number is not far from the American Horse Council's 1996 estimate of 6.9 million horses in the U.S.

Starting with an assumption of about 625,000 horses in California, one can estimate the potential for hay sales for horses by knowing approximate feed consumption by horses. A rule of thumb for horse nutrition is that a horse will eat approximately 2 percent of its body weight daily as air-dry feed. The 1989 National Research Council's Nutrient Requirements of horses recommends that a horse in maintenance condition should consume about 1.6% of its body weight as air dry feed. Horses that are not in maintenance condition, which would include growing, pregnant, lactating and working horses would require a larger feed intake to meet energy needs. If 625,000 horses weighed, on average, 1100 lbs. each and consumed 2.0% of body weight daily, total hay (although all other feeds are included in this estimate) fed to horses might be just over 2.5 million tons of hay per year. Estimating hay intake at only 1.6% of body weight would yield a state wide potential hay intake by horses at just over 2 million tons per year. Horses eat other feeds besides hay, but forage intake should not be less than 50% of the total ration to ensure digestive tract health, and while there are no statistics on this, it might be reasonable to assume that for the majority of horses, hay is the largest component of the diet. This may be assumed for several reasons: 1) horses in most physiologic states can meet their nutrient needs on a diet of good quality hay alone, 2) hay is usually less expensive than other dietary components, and 3) in the relatively arid environment of most of California, few horses are likely kept on pasture sufficient to meet their nutrient requirements and therefore hay, of some type or in some form, is the primary feed for most California horses.

Horse owners generally recognize two general types of hay for horses: legume and grass. Each has its place in feeding horses. The relative merits of these two types of hay depend on the nutrient requirements of the horse and the nutrient content of the feed. However, many non-nutritional factors also influence the horseman's choice of hay for his horse. These include price, availability, palatability, and unfortunately, also hearsay and old wives tales.

FEAR OF ALFALFA

California horse people are often divided in their opinion about the value of alfalfa hay for horses. Some recognize it as a rich source of protein and calcium and a good source of energy compared to other forages. Some horses are fed only alfalfa hay with no apparent ill effects. However, other horse owners feel strongly that alfalfa hay is imbalanced in its nutrient composition compared to the nutrient requirements of the horse and should be fed sparingly, or not at all.

Don Blazer, well known horse trainer and promoter, defames alfalfa hay on line with no referenced substantiation for his claims, as contributing to the following conditions in horses: 1. Interference with parathyroid gland function causing "thumps", muscle cramps and "tying up"; 2. Hypothyroidism causing horses to be fat and shiny, but cranky and belligerent, resistant to bending and flexing, very lazy and emotionally unstable; 3. Problems with bones including epiphysitis (in young horses) and osselets, spavins, and

navicular condition (in older horses); 4. Imbalanced calcium: phosphorus ratio and high protein leading to kidney stones and enteroliths. He summarizes by stating that, in general, horses fed alfalfa hay experience more severe diseases than horses fed grass hay.

Susan Garlinghouse, DVM, cautions against feeding alfalfa hay as the primary forage for endurance horses in an article posted on her website. She refers to research by others that have reported an increased incidence of metabolic failure in endurance and three-day-event horses fed high protein diets, as well as an inverse relationship between dietary protein concentration and racing performance of racehorses. She describes the need for increased water intake and urine output in horses fed excess protein and the possibility of ammonia accumulation in stalls of alfalfa fed horses, which can be harmful to the equine respiratory system. She implicates excess protein as a cause of "patchy", thick sweat, less efficient in cooling the horse than thinner, more watery sweat. She further contends that the high calcium content of alfalfa hay can contribute to disorders of muscle contraction during strenuous work.

Alfalfa has been blamed for contributing to metabolic bone disorders in growing horses. Its protein, energy and imbalanced calcium: phosphorus ratio have been alleged to cause aberrations in cartilage formation or bone replacement of a cartilage model in growing bones, although the physiologic link between dietary excess and cartilage and/or bone malformation have yet to be established.

Alfalfa hay is considered by some veterinarians are a primary contributor to enteroliths in horses. An article in an on-line newsletter from the Center for Equine Health at the University of California, Davis recommends that alfalfa hay be avoided to reduce the incidence of enteroliths. The reason behind the recommendation is because 98% of the horses found at the veterinary hospital to have enteroliths consumed a diet of at least 50% alfalfa hay. Enteroliths are composed of concentric layers of struvite (composed of magnesium, ammonia and phosphate) around a central nidus (a small object such as grain of sand, piece of plastic or twine or hair). The relatively higher concentration of magnesium and protein (which can be degraded to ammonia by microbes of the large intestine) compared to grass hays are thought to contribute to struvite and enterolith formation.

RESEARCH FINDINGS – IN DEFENSE OF ALFALFA

Research has not addressed most of the claims against alfalfa hay for horses. The relative merits or shortcomings of alfalfa hay differ depending on the nutrient requirements and management of the horse. However, as research findings from several studies accumulate, some of the allegations against alfalfa hay have been refuted.

Much research on growing horses has not revealed alfalfa hay to be a villain. In a summary of research on growth and growth disorders, Harris and co-authors (2004) examined some research findings on the interaction of various nutrients and developmental orthopedic disease. Diets that exceed the energy requirements of growing horses by approximately 30% have been shown in some, but not all studies, to increase

the incidence of developmental orthopedic disease in growing horses. Not just the amount, but also the type of energy in the diet and the management of feeding may be factors that can increase orthopedic disease. In nature, horses graze almost continuously on high water, nutrient dilute pastures. In confinement, however, horses are often fed "meals" twice or three times daily of grain rich diets. The effect of "bolus' consumption of high starch diets causes large fluctuations in blood concentrations of glucose and insulin. These fluctuations are thought to influence cartilage and/or bone development by influencing secretion and circulating levels of growth related hormones such as thyroid hormone, growth hormone and insulin-like growth factor.

Although multi-factorial in regulation, rapid growth, in general, appears to be associated with development orthopedic disease. Despite its essentiality for optimal growth, neither high nor low dietary protein content has been implicated directly in developmental orthopedic disease. Similarly, although imbalanced calcium and phosphorus ratios have been broadly blamed for abnormal bone growth, research has not produced clear evidence that excess calcium or marginal phosphorus cause developmental orthopedic disease. Magnesium, also, has not been implicated in causing growth disorders, although very high levels may inhibit copper absorption. Low levels of copper have been shown, at least in population studies, to be associated with higher incidence of developmental orthopedic disease.

All of this exonerates alfalfa hay as forage for growing horses. Its high protein and energy values support growth to a greater extent than comparable amounts of grass hays. Its excessive, compared to nutrient requirements, levels of protein and calcium have not been implicated as agents for developmental orthopedic disease. While alfalfa hay is higher in digestible energy than grass hays, its nonstructural carbohydrate composition is low compared to concentrate feeds (and relatively lower than grass hay), and the blood glucose response it produces is similarly low.

The low nonstructural carbohydrate content of alfalfa hay may be beneficial for refeeding starving horses, as well as to decrease metabolic bone disease in growing horses. Starved horses, like starved humans can suffer from "refeeding syndrome" as a result of sudden ingestion of digestible carbohydrate. A high starch diet stimulates insulin secretion, which drives not only glucose into cells, but also minerals, particularly phosphorus. Blood phosphorus concentration can fall to fatally low levels, causing irreversible nerve (brain) damage. Carolyn Stull and coworkers (1997) conducted a study at the University of California, Davis to compare three diets for refeeding chronically starved horses. Alfalfa hay was found to be superior to oat hay or a combination of oat hay and a senior lifestyle horse feed comprised largely of grains and grain by products. Alfalfa hay is higher in digestible energy than oat hay, but lower in starch and sugar content. As such it provides energy to the horse without promoting the insulin response associated with the refeeding syndrome.

GRASS HAY VS. ALFALFA HAY

Grass hay offers a lower calorie, protein and calcium alternative to alfalfa hay. Grass hays are popular as horse feed but sometimes its nutrient content is inadequate, particularly for horses with high nutrient requirements.

Despite research that largely exculpates alfalfa hay as a prime causative agent of growth disorders, many breeders still avoid alfalfa for growing horses. Breeders of large, fast growing breeds, more prone to growth disorders, are particularly suspicious of alfalfa hay. While trying to avoid the rapid growth associated with cartilage and/or bone malformation, breeders find themselves in a situation where, without alfalfa hay, their diets are often low in digestible energy and protein, and in this nutritional scenario, instead of "paced growth", some young horses are malnourished. To compensate for the lower energy content of the forage, energy must be supplemented to the diet. Traditionally, this has been done by the addition of grains, which are high in nonstructural carbohydrate (primarily sugars and starch), which has been implicated in growth disorders. More recently, by-product feed such as beet pulp and soy hulls, with added vegetable oil to increase energy density have been formulated as "low carb" energy supplements. Rice bran is similarly marketed, although without added fat as it is high in fat itself. Many of these supplements are flavored to increase palatability.

Low carbohydrate, low protein forages are also favored by some trainers of performance horses. The dilemma, however, is the same as for the growing horse, that is, low energy density of the forage and the need for significant energy supplementation. Large quantities of grain, or large quantities of high fat, low soluble carbohydrate feeds are fed to these horses also. The former can cause laminitis, acidosis, and a whole milieu of conditions broadly described by some as "metabolic syndrome", while the latter is sometimes unpalatable and may lack the carbohydrate "kick" needed for sprint work and/or glycogen repletion after work. A more energy dense, low soluble carbohydrate grass hay that was routinely palatable would be a useful forage for both growing and working horses. Alfalfa hay would fill this role, except for its undesirable high protein content.

Sedentary or pleasure horses can meet most if not all of their nutrient requirements on a diet composed largely (or entirely) of grass hay. The high fiber, low energy density of grass hays helps prevent obesity, while still providing bulk in the diet. The horse's digestive tract "wants" to be full. A less energy-dense forage will allow the horse to feel full without excess caloric intake. Having more to eat also reduces boredom. Both gut fill and activity help prevent horses from seeking nonfood items to each such as wooden fences, manes and tails of other horses, dirt, or other potentially harmful materials.

Oat hay, bermudagrass hay, mixed cereal grains, and assorted cool season grass hays are all usually readily consumed by horses with good result. However, compared to alfalfa hay, grass hays are highly variable in palatability, particularly oat hay. Visual appearance of the hay does not appear to offer a clue to palatability. No research has shown a link between chemical composition of the hay and palatability to the horse, although sugar

and starch content have been shown to be associated with palatability in cattle, sheep and goats (Mayland, H.F. and co-workers).

Grass hays are sometimes undesirable to horse owners for reasons that have little to do with nutrition. Variable availability, quality and palatability are sometimes issues for horse owners, particularly to owners who buy hay frequently in small quantities. Stacked oat hay attracts mice, and mice attract snakes, an often-unpleasant surprise to the horse owner moving bales. Grass hay tends to fall apart after the strings are cut, making it messy to feed. Oat hay can be "slippery" to walk on when loose on the floor or in the feed wagon. People with little agricultural background own the majority of horses. Convenience and anthropomorphic factors (does it look good to me to eat?) play an important role in hay buying choices. Considering this, price is not usually a motivating factor for choosing hay. Hay with lower nutrient composition need not necessarily be priced lower, if the horse owner believes that is what his/her horse needs or prefers.

Nitrate accumulation happens sometimes in oat hay. Fortunately, horses are fairly tolerant to nitrates.

GRASS HAY: QUESTION OF CARBOHYDRATE

Table 1 shows the nutrient composition of hays submitted to a commercial laboratory that specializes in analyses of horse feeds. Nutrient compositions of thousands of hay samples have been compiled to form the date shown below. These data can be used here as a quick reference to see some of the common nutrient differences between legume and grass hays fed to horses.

Table 1. Nutrient composition of hay fed to horses
(% nutrient, dry matter basis)
(from www.equi-analytical.com/CommonFeedProfiles/).

	DE*	CP	ADF	NDF	NFC	NSC	Ca	P	Mg
Legume hay	1.2	21.1	30.0	38.6	30.7	11.3	1.56	.28	.31
Alfalfa cubes	1.1	18.9	33.5	43.2	26.7	10.2	1.47	.23	.28
Grass hay	.91	10.6	39.1	63.7	19.7	13.8	.54	.25	.21
Bermuda hay	.95	10.6	35.5	67.6	13.5	13.5	.51	.20	.20
Oat hay	.91	8.9	37.7	58.9	24.5	22.1	.37	.22	.16

- Mcals/lb.

Key: DE (digestible energy), CP (crude protein), ADF (acid detergent fiber), NDF (neutral detergent fiber), NFC (nonfiber carbohydrate), NSC (nonstructural carbohydrate), Ca (calcium), P (phosphorus), and Mg (magnesium).

The lower protein and digestible energy content of grass hays compared to legume hay and alfalfa cubes are shown. One should note, however, that despite its lower energy

content, grass hays are higher in nonstructural carbohydrate (NSC) than legume hays; most notably higher is oat hay, presumably because of its oat grain content. Horse owners and horse nutritionists have become very aware of the carbohydrate content of grasses (and legumes) recently, both nonfiber and nonstructural carbohydrate.

Carbohydrates in plants can be classified, generally, in two different ways: Fibrous carbohydrates (primarily cellulose and hemicellulose) and non-fiber carbohydrate (sugars and starches, and also fructans, pectins, and other carbohydrate-like compounds). The fibrous carbohydrates are found primarily in the cell walls and are not digestible by the horse's own enzymes, although they are variably digested by the microbes of the large intestine. Fibrous carbohydrate content is measured as NDF, neutral detergent fiber. The nonfiber carbohydrates are found inside the plant cells and sometimes between the cells. Nonfiber carbohydrate content is not measured directly, but rather by difference, that is by subtracting everything else from 100%, with the idea that everything that is not something else is nonfiber carbohydrate. A common formula for calculating nonfiber carbohydrate is as follows:

$$NFC\% = 100\% - (CP\% + NDF\% + EE\% + Ash\ \%)$$

Some of the chemical compounds contained in nonfiber carbohydrate are digested in the small intestine (enzymatic digestion) and some are digested in the large intestine (microbial digestion). Sugars and starches (compounds that are digested in the small intestine) are sometimes measured directly, and collectively called nonstructural carbohydrates (as shown in Table 1). The other compounds in nonfiber carbohydrate, pectins, fructans and beta-glucans, are digested primarily in the large intestine by microbes (Hall).

Different terminology and different laboratory techniques for measure carbohydrate content of plant materials makes the subject confusing. The details are beyond the scope of this paper. Suffice it to say, that nonstructural and nonfiber carbohydrate content of plants, particularly grasses, is variable.

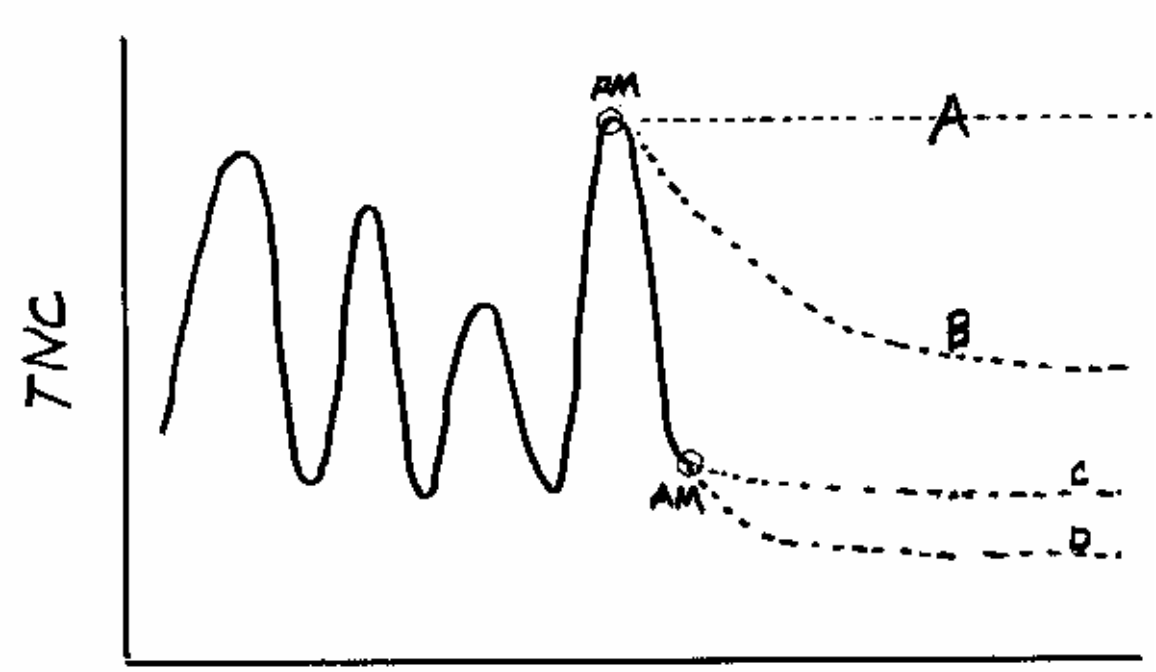
Several factors affect carbohydrate content of grasses including:

1. Time of day – sugar and fructan content rises during the day and decreases at night.
2. Temperature – daytime sugar accumulation is increased when nights are cold (less than 5^{o} C).
3. Sunlight – clear sunny days cause greater sugar accumulation than cloudy overcast days.
4. Stage of growth – in simple terms, sugar content is higher in young, growing plants with a high percentage of leaves while sugar content is lower in mature, woody plants with a higher percentage of stem.
5. Type of plant – cool season grasses tend to accumulate sugar to a greater extent than warm season grasses.

a. High accumulators (cool season)– rye grass, brome grass, orchard grass, quack grass, bent grass, fescue, clover (legume), oat hay (at least in the grain portion).
b. Lower accumulators – blue grass, buffalo grass, bluestem, bermuda grass, other warm season grasses (Watts and Chatterton).

Figure 1 demonstrates that sugar content of grasses (and legumes) change in a diurnal pattern. Sugar accumulates during the day, and becomes lower (being transformed into other plant materials) during the night. Several species of plants cut in the evening have been found to have higher nonstructural carbohydrate content than when the plants are cut in the morning.

Figure 1. Conceptual model of total nonstructural carbohydrates (TNC) as a function of time before harvest and after harvest.
(from http://www.nwisrl.ars.usda.gov/mayshew/clues.shtml)



Curve A represents total nonstructural (nonfiber) carbohydrate (TNC) level if PM-cut (afternoon or evening) forage was immediately frozen. Curve B represents gradual drying of PM-cut forage that would slowly decrease the cut forage's respiration rate and allow carbohydrate content to diminish. Curve C represents AM-cut (morning) forage immediately frozen, and curve D represents gradual drying AM-cut forage.

Why do horse owners and nutritionists care about nonfiber carbohydrate content of grass? Firstly, because high nonfiber carbohydrate content generally is associated with increased digestible energy content of the feed, and secondly, because certain horses appear to be quite sensitive to the nonfiber carbohydrates in grasses (particularly pasture, but also hay) and can suffer serious metabolic consequences if over-consumption occurs.

The positive aspect of nonfiber carbohydrate content of hay is that it increases the energy content of the hay (or grass). In healthy growing, pregnant, lactating and working horses, this is generally considered a plus, as the forage component of the diet can provide more digestible energy to the horse and the amount of energy supplementation needed in the diet is reduced. In dairy cows, it was found that cows ate about 8% more of a total mixed ration containing 40% afternoon-cut alfalfa hay than one containing morning-cut alfalfa hay and produced about 8% more milk (Mayland and others). An increase in consumption and performance or production from forage is generally considered to be good.

The negative aspect of nonfiber carbohydrate content of hay is that it can cause problems in horses that are unable to appropriately metabolize glucose, or, in horses that are more sensitive to organic acid production in the large intestine. The site of digestion (small or large intestine) of nonfiber carbohydrate in the horse depends on the composition of the carbohydrate; sugars and starches (nonstructural carbohydrates) are, for the most part, enzymatically digested in the small intestine while pectins, beta-glucans and fructans are usually digested by microbial fermentation in the cecum and colon (large intestine).

Like the human population, much of the horse population is overweight. Also like humans, some horses develop health problems associated with the overweight condition. Some nutritionists and veterinarians have attempted to identify horses with insulin resistance (a characteristic seen in humans with Type II diabetes). Some veterinarians also are linking overweight condition and insulin resistance to other diseases or syndromes including Cushings disease and “Metabolic syndrome”. Whether horses have the same disease processes as humans has yet to be established, but many of the symptoms are similar. Additionally, whether all of these diseases or syndromes are physiologically linked in the horse is still a matter of some speculation. Anecdotal evidence favors the association of all of these conditions with advanced age and obesity. Horses with these symptoms appear to have problems with glucose metabolism. Glucose levels rise in response to eating feeds with high levels of sugar and starch (nonstructural carbohydrate) and while insulin levels rise in response to increasing glucose levels, the insulin is inefficient in moving glucose into the body cells. Insulin resistant horses often exhibit elevated insulin levels, even hours after eating, when insulin levels would normally be expected to be low. How insulin resistance is related to Cushings disease, “metabolic syndrome” and/or laminitis has not been clearly elucidated. Again, while not easily explainable, all of these conditions appear to be related to laminitis, an often life threatening condition in the horse. The percent of the population of horses that suffer from insulin resistance and/or these other conditions has not been determined. Certainly, it is a minority of the horse population. But for this minority, finding a type of hay with low structural carbohydrate (sugar and starch) content would be important. The factors relating to nonstructural carbohydrate accumulation in plants suggest that for this population of horses, Bermuda grass would be a more appropriate hay than oat hay.

The second negative aspect of feeds high in nonsfiber carbohydrate concerns the digestion and metabolism of components that are not considered to be sugars and

starches. Sometimes called "soluble fiber", these components include fructans (polymers of fructose), pectins and beta-glucans. These compounds cannot be digested by the enzymes of the small intestine (to yield glucose), but are rapidly digested by the microbes of the large intestine, yielding organic acids. Fructan fermentation appears to yield higher amounts of lactic acid than fermentation of pectins or beta-glucans (Hall).

High concentrations of fructans in forage yield rapid production of lactic acid in the large intestine. Lactic acid build up causes the large intestinal pH to drop, killing many types of bacteria and allowing other bacterial types to proliferate. The combination of the acid environment and the imbalanced microbial population allows toxins to be formed in the large intestine and enter the circulation, and ultimately cause disturbances in the circulation in the hooves and initiate laminitis. This theory, while yet unproven, is the most popular at present. A newer theory relates circulatory problems in the hoof to damage to capillaries in the hoof caused by high levels of glucose and/or insulin. Both of these theories incriminate high levels of carbohydrate as a contributor to laminitis.

Despite a lack of information about disease process, many horsemen are anxious to take steps to minimize predisposition or causes of all of the above conditions. Towards this end, many nutritionists and feed companies advocate that overweight, laminitic and elderly horses be fed diets low in nonfiber carbohydrates. An entire website devoted to this topic can be found at www.safergrass.org. In England, a group called the Laminitis Trust has established an approval mark for horse feeds to indicate feeds considered (by the Trust) to be safe for laminitic or pre-laminitic horses. The determination is based largely on the feed's content of nonfiber carbohydrate (they call it nonstructural carbohydrate at their website). Feeds with total nonfiber carbohydrate content less than 40% are generally approved for horses susceptible to laminitis. Most forages meet this criterion while most cereal grains do not. Mixed feeds may or may not achieve the mark of approval depending on the composition of the mix.

Legumes tend to have higher nonfiber but lower nonstructural carbohydrate content than grasses (Table 1). The primary nonfiber carbohydrate of alfalfa hay is pectins, which is not presently implicated as a causative factor in laminitis. The higher nonfiber and nonstructural carbohydrate content of oat hay is presumably due to its grain (starch) content. The higher nonfiber content of legumes comes from a higher percentage of "soluble fiber", the exact composition of which is likely variable.

THE PERFECT HAY….?

The perfect hay for horses would meet the exact nutrient requirements of the horse in all life stages. It would have optimal energy density to provide sufficient energy and sufficient bulk at the same time. It would always be palatable, consistent in physical form and nutrient composition, free of mold and contamination, easy to stack and feed, and would be inexpensive (or better yet, free).

After all is said, alfalfa hay is still a very good feed for horses. Its protein, lysine, energy, and mineral contributions to the diet are valuable. While excessive in protein and

calcium compared to nutrient requirements, these excesses are not primary nutritional causes of developmental orthopedic disease in growing horses. It high nonfiber carbohydrate content indicates it has relatively high levels of digestible fiber. Mature, working horses excrete the excess protein and minerals, but do utilize the higher energy content of alfalfa hay (compared to grass hays) to meet energy demand for athletic performance. A balance of grass hays and alfalfa hay may be found to meet the nutrient requirements for most classes of horses.

A mixture of grass and alfalfa grown together, or fed separately but in different meals can give flexibility to the forage diet. Higher energy grass hay may be very useful for the healthy growing, pregnant, lactating and/or working horse, but increasing energy content by increasing nonstructural carbohydrate (sugars and starches) might be harmful to laminitic horses or horses with some types of metabolic disorder. Very low energy hay, that was still palatable, would be good for the obese horse. Obese horses might benefit from unpalatable hay so they would eat less, but the horse owner wants to see the horse eat - he or she just doesn't want the horse to get any energy from eating.

SELLING HAY TO HORSE PEOPLE

In general, horse owners are not stupid. The American Horse Council's survey of the U.S. horse population, besides counting horses, collected demographic data on horse owners. The survey found that 90% of horse owners had had at least some college. On the whole, horse owners are devoted to the well being of their horses, and will spare little expense to ensure their well being. With that being said, horse owners are not always educated about even the basics of nutrition. Many have only feed store personnel and magazine ads as sources of information. A hay sales person who can speak knowledgeably about the nutrient content and characteristics of hay and the nutrient requirements of horses, can be a wonderful resource for the horse person, helping the hay buyer to make an informed decision.

The following points may be useful to keep in mind when talking to horse owners about hay:

1. The size of the potential horse market is large, perhaps up to 2.5 million tons/year.
2. Alfalfa hay, despite its excess protein and calcium content (compared to nutrient requirements), has not been implicated directly as causative of developmental orthopedic disease in growing horses.
3. Grass hay is lower in energy and protein, and higher in fiber than legume hay. It is frequently more variable in quality and palatability than legume hay.
4. Grass hay is lower in nonfiber carbohydrate but higher in nonstructural carbohydrate (sugars and starches) than legume hay, particularly oat hay.
5. For horses that are overweight, laminitic or prone to metabolic disease, keeping nonstructural carbohydrate content of the diet low may be important. For this purpose, Bermuda grass may be more suitable than oat hay. Alfalfa hay may also be useful to these horses.

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