

OPTIMIZING DIFFERENT HAY TYPES FOR HORSES: WHAT HAVE WE LEARNED?

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ABSTRACT

Good quality hay is the cornerstone of all horse feeding programs. Healthy adult horses can do well on diets composed entirely of good quality hay, either grass or legume. Growing horses and pregnant and lactating mares have higher nutrient requirements than other horses. Requirements for protein and calcium can often be met with adequate amounts of alfalfa, although supplementation is usually needed to meet energy or other requirements. Overweight, aged horses can suffer from insulin resistance and related maladies. To control blood glucose levels, these horses should be fed hays low in digestible carbohydrate. Cereal hays with high grain content and some cool season grasses should be avoided. Starving horses must be carefully rehabilitated. High protein, low carbohydrate hay such as alfalfa hay, fed in small, frequent meals helps prevent “refeeding syndrome” as well as provides good quality and quantity protein to replenish body tissues that were catabolized during starvation.

Key words: horses, nutrition, alfalfa, grass hay, nutrient requirements, insulin resistance, starving horses

INTRODUCTION

America’s nine million horses are as diverse as Americans themselves. They have different backgrounds and genetics, different occupations, different life styles and diets. Some are young and developing, full of promise for the future. Others are in the prime of their lives, hard working and raising the next generation. Some are overfed and underworked; they need a job and fewer calories; and some are down on their luck - malnourished and suffering from neglect.

All horses need good nutrition, health care, and a safe place to live that provides good air quality, room for voluntary exercise and a relaxing environment in the company of other horses. Pasture or hay is the main ingredient of the diet of almost all horses. Providing appropriate amounts and types of hay is the cornerstone of most horse feeding programs. Often, horses can live productive lives on diets of forage alone, but optimizing the types and amounts of hay fed will enhance a horse’s well being and productivity and can be economical as well.

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FEEDING HORSES THAT ARE GROWING, PREGNANT OR LACTATING

Despite bad press over a number of years, alfalfa still reigns as the Queen of Forages for growing horses and pregnant or lactating mares. When fed as the primary forage, alfalfa hay usually meets and often exceeds the requirements for calcium and protein for these classes of horses (Table 1). Its relatively high energy content supplies calories for growth and production with less need for grain or other supplements. In the western states, alfalfa hay is generally of good quality and is among the most consistently palatable of hays available to horses. While prices vary, alfalfa hay usually is the most economical sources of protein and calcium of all feeds available.

Table 1. Nutrient requirements of growing yearling, pregnant mare and lactating mare compared to nutrients provided by 7.5 kgs of alfalfa, orchard, wheat, bermudagrass and oat hays.

NUTRIENT RQTS (mature BW 500 kgs)	Digestible energy (Mcal)	Crude protein (g)	Lysine (g)	Calcium (g)	Phosphorus (g)
YEARLING (12 months)	18.8	846	36	38	21
PREGNANT (11 months)	21.4	893	38	36	26
LACTATION (3 rd month)	30.6	1468	80	56	36
DIETARY SUPPLY*					
Alfalfa	14.8	1159	59	81	16
Orchard grass	14.5	855	17	25	17
Wheat hay	13.8	607	26	20	13
Bermudagrass hay	12.2	679	24	32	18
Oat hay	13.8	580	20	24	14

*from 7.5 kg of hay; 1.5% of 500 kg BW for mature horses or 2.3% of yearling BW of 321 kg)
(from NRC, 2009)

Cereal hays can be used to good advantage as an excellent source of energy and fiber. While there appears to be more variability in palatability in cereal hay compared to alfalfa hay, hay that has grain in it is generally well accepted by horses. Cereal hays provide bulk in the ration, which gives horses more to eat and less time for boredom. This is especially important for horses that are idle and tend to be fat. Horses can be fed larger amounts of cereal or other grass hay than alfalfa alone and still maintain a leaner body condition. Healthy adult horses can often be maintained entirely on cereal or good quality grass hay. Many horse people like to feed various combinations of alfalfa and grass hays. They believe the high quality and quantity of protein in the alfalfa hay makes sure protein needs for growth and production are met while the grass hay gives the horse more “fill” in the diet. However, some horse people don’t like grass or cereal

hay because the hay is a bit harder to manage than alfalfa. The bales often spring open after the strings are cut and are harder to divide into flakes. There is often more waste as horses will sort through the hay, looking for grain or sorting through the stems. Cereal hay often attracts mice and snakes in the stacks, making for an unpleasant surprise when moving bales.

FEEDING HORSES THAT ARE OVERWEIGHT, INSULIN RESISTANT AND LAMINITIC

Population studies have shown that people who consistently consume diets high in carbohydrate are more likely to have detrimental health conditions such as obesity, heart disease and hypertension than people who routinely consume low carbohydrate containing foods. While horses are not usually affected by heart disease in the same way as humans, problems associated with obesity in horses are also problematic. Laminitis, colic, insulin resistance (a problem with glucose metabolism) and sometimes growth disorder are all associated, at some level, with diets that produce high levels of blood glucose or are high in easily digestible carbohydrate (primarily sugar and starch).

Over-ingestion of sugars and starch is one of the primary causes of laminitis. Laminitis is the number two (behind colic) fatal disease in the U.S. today, with over 1 million horses dying or being euthanized due to laminitis each year. Acute laminitis is often caused by acute overconsumption of grains, such as may occur when horses escape from their stalls and head for the feed storage area where they help themselves to large amounts of grain. The starch load consumed causes rapid depression of large intestine pH which upsets the balance of microbial populations and may also damage the lining of the large intestine, allowing toxins to leave the digestive tract and enter the circulation. By mechanisms not completely understood, this dramatic disturbance of the digestive tract causes massive inflammation in the tissues within the hoof, often leading to acute laminitis. While the exact mechanisms are not well known, the close relationship between acute grain overload and acute laminitis is well documented. More recently, a relationship is being considered between chronic starch intake, such as seen by long term feeding of grain in more “normal amounts” and an insidious form of laminitis. The present line of thinking is that high blood glucose or insulin concentrations are damaging to the living tissues of the hoof, but in a way that is more subtle than in the case of acute grain overload. Nonetheless, the long term effects of grain feeding, particularly to horses that are less able to manage blood glucose and levels often result in chronic laminitis or associated symptoms (dropped soles and “foot soreness”). Insulin resistance is a term often used to describe horses that produce what appear to be adequate or high levels of insulin, but the insulin is unable or insufficient to reduce blood glucose levels, in an appropriate time frame, to pre-meal levels. Insulin resistance in horses is similar in many ways to Type 2 diabetes in humans. In both horses and humans there appears to be a genetic predisposition that is manifested when the individual is overweight and with increasing age. In both horses and humans, the recommended treatments are also the same: increased exercise, weight reduction and reduced intake of foods high in starch and sugar.

How should insulin-resistant horses be fed and managed? Their caloric intake must be balanced against their exercise level to prevent or reduce obesity. Their diets should contain feeds that are relatively low in carbohydrate. What forages should be selected for or against? Feeds high in enzymatically digestible carbohydrate (sugars and starch) should be avoided. Table 2 shows that cereal hays (oat and wheat) are higher in components that reflect carbohydrate content (starch, ethanol soluble carbohydrate, water soluble carbohydrate and non-fiber carbohydrate). Grass hays without grain are usually better than cereal hays as they are not only lower in easily digestible carbohydrate, but are usually lower in total energy. Orchard, brome and timothy hay have no grain, per se. Neither does Bermudagrass hay or Teff hay. Cool season grasses, however, tend to accumulate starches, sugars and fructans (a type of carbohydrate digestible in the large intestine of the horse although not by the enzymatic means of the small intestine) than do warm season grasses. As such, cool season grasses are generally higher in total energy and particularly higher in carbohydrate content (both enzymatically and microbially digestible carbohydrate). While only enzymatically digestible carbohydrates are reduced to sugars and absorbed into the circulation, microbially digestible carbohydrate can also contribute to laminitis by the mechanism described for acute laminitis. As such, both types of carbohydrate should be avoided for horses at risk of laminitis. Table 2 shows the variability among legume, cereal (oat and wheat), cool season (grass) and warm season (bermudagrass and teff) hays in energy, protein, fiber and various measures of carbohydrate content.

Alfalfa hay can also be useful in the diets of horses with insulin resistance. Although alfalfa hay is often higher in total energy content than grass hays, most of the energy in alfalfa hay is from digestible protein and fiber, rather than from sugars, starches and fructans. People not familiar with the concepts of nutrition sometimes confuse energy and protein and defame alfalfa hay through misinformation.

Care should be taken to ensure that overweight horses placed on weight-loss regimes are not malnourished nor overworked when they are unfit or unsound. While hungry horses will eat almost any type of forage, palatability and the horse's mental health must also be considered. Simply feeding straw or only very poor quality hay will cause malnutrition through lack of many vital nutrients. Horses faced, day in and day out, with poor quality, unpalatable feed are not adequately cared for, mentally or physically. A few handfuls or small flake of alfalfa hay (and a few carrots) with each meal can help in both areas.

Table 2. Nutrient content of different hays

Nutrient content of hay	Legume hay	Oat hay	Wheat hay	Grass hay (cool season)	Bermuda grass hay	Teff [^] hay
Digestible Energy (Mcal)	1.2	.9	.9	.9	.9	.8
Crude Protein (%)	21.3	8.7	10.6	10.8	10.6	10.8
Acid Detergent Fiber (%)	30.3	37.4	36.9	39.0	35.6	40.2
Neutral Detergent Fiber (%)	38.7	58.8	60	63.2	67.2	71.1
Starch (%)*	1.9	5.1	4.3	2.3	5.8	.8
Ethanol soluble carbohydrate (%)**	7.4	11.9	12.5	7.5	7.4	4.3
Water soluble carbohydrate (%)***	9.1	16.8	16.5	10.9	7.4	6.1
Non-fiber carbohydrate (%)****	11.0	22.0	17.6	12.0	13.2	14.0

*Starch content such as found in grains

**Monosaccharides and disaccharides, digested mainly enzymatically in small intestine, contributes to blood glucose concentration.

***Monosaccharides, disaccharides and polysaccharides, primarily fructans which are largely fermented by large intestine microbes, contributes to volatile fatty acids, an energy source.

****Non-cell wall carbohydrate including starch, sugar, pectin and fermentation acids.
Calculated as 100% - (CP% + NDF% + Fat% + Ash%)

[^]Teff hay values from hay harvested in early-heading stage (from Staniar et al, 2010)
(all other values from equi-analytical.com)

FEEDING STARVING HORSES

Unfortunately, some horses are malnourished or are out-right starved. Owner ignorance and economic hardship are the most common causes. The recent downturn in our nation's economy has created an estimated 100,000 "unwanted horses" each year. Horses that are simply thin but have no underlying health problems usually recover completely when fed adequate amounts of common, nutritious feeds. Horses that are seriously malnourished, however, often suffer from a myriad of deficiencies such as low vitamin, mineral and electrolyte levels, dehydration and an empty digestive tract with few digestive bacteria. These horses often succumb to what is known as "refeeding syndrome" during the first 3 to 7 days after refeeding begins. At the root of the crisis of refeeding is insulin, which is nearly completely absent in the starving horse. However, when food is again offered, particularly high carbohydrate food, insulin levels surge to drive glucose into the body's cells. As glucose moves into cells, so do minerals, particularly phosphorus and magnesium, depleting the blood and other cells that need these electrolytes to function. Multi-system malfunctions result in seizures, cardiac, respiratory and kidney failure.

What type of hay is best to offer, in small and frequent meals to horses starting to recover from starvation? Most scientists recommend alfalfa hay. Its low carbohydrate content keeps insulin low while providing needed protein to restore catabolized body tissues. Its high generally higher mineral content helps restore depleted mineral reserves as well. However, starting to refeed a truly starved horse must be undertaken carefully, with small, frequent meals so as not to overwhelm the digestive capacity of the long-empty digestive track or upset the precarious electrolyte and other nutrient balance in the body.

RECOMMENDATIONS FOR HAY PRODUCERS

How can hay producers use this information to sell appropriate hay to horse owners? Here are some suggestions:

1. Provide top quality product. Hay should be clean, green, soft and fine-stemmed. No mold, no dirt, no weeds. Grass in hay is sometime acceptable, especially alfalfa-grass or alfalfa-oat combinations. Hay must look “good enough to eat” to the horse owner. Bales should be uniform.
2. Show educated horse owners the analyses they want to see. ADF, NDF, RFV and TDN values have less meaning to horse owners than dairy farmers. Horse owners who know about horse nutrition want to see values for digestible energy (DE, Mcal/lb or kg), crude protein (%) and some or several values that characterize carbohydrate content (sugar, starch, ESC, WSC, NFC, %).
3. Understand that different classes of horses have different needs. Growing horses, pregnant and lactating mares have large requirements for protein, energy and calcium. Their nutrient needs can be met with alfalfa hay as the sole or at least partial forage in their diet (they may need additional supplementation as well). Overweight, sedentary horses need less energy and especially less readily digestible carbohydrate. Warm season grasses may help them control their weight and blood glucose concentrations. Starved horses need alfalfa hay to prevent refeeding syndrome and rebuild body tissues. But their meals must initially be small and frequent and much intensive care is needed in the early stages of recovery.

SUMMARY AND FEEDING RECOMMENDATIONS

1. Many horses do very well on a diet composed entirely of hay.
 - a. As a rule of thumb, a horse should be fed 2% of body weight daily as air dry feed. For a 1000 lb. horse, that’s about 20 lbs. of hay/day
 - b. Intake can range from 1.5 to 3% of body weight daily. Horses should not be fed less than 1.5% of body weight as forage daily as horses need a certain amount of

fiber and ‘fill’ in their digestive tracts. Horses are unable to physically meet much more than 3% of body weight daily.

- c. Good quality grass hay alone will meet most of the nutrient requirements of healthy, adult horses. Grass hay types may be switched as hay availability and prices change, but changes should be made slowly from one hay type to another, such as over a 2 week period of time.
2. Growing, pregnant and lactating horses have higher requirements for energy, protein and other nutrients. Alfalfa hay, fed in adequate amounts, will usually meet the protein, lysine and calcium requirements of these horses.
 - a. Supplementation to meet energy or other requirements may be needed.
3. Overweight horses and horses with genetic predisposition to laminitis or insulin resistance should be managed to achieve a normal body weight by balancing feed intake and exercise. While grass hays are usually lower in energy than alfalfa hay, cereal hays should be avoided for insulin resistant horses to reduce the glucose load caused by the grain content of cereal hays.
 - a. Overweight horses must not be starved. Gradual reductions in food offered should occur. Reductions in energy content of diets should not exceed 15% per week. The same is true for increases in energy content in diets for thin horses.
4. Starved horses must be carefully managed during the early refeeding stage to prevent multi-system failure due to the actions of insulin. Alfalfa hay, fed in small but frequent meals, is recommended to provide energy, minerals and energy without provoking a large insulin response.
5. Hay analyses should show data horse owners are interested in seeing: protein, energy and carbohydrate content.

REFERENCES AND RECOMMENDED READINGS

Equi-analytical forage testing lab and common feed profiles: <http://www.equi-analytical.com/default.htm>

Forage management for laminitic horses:
<http://www.safergrass.org/pdf/CTEPforagelaminitis.pdf>

General and specific information on laminitis in horses: <http://www.laminitisresearch.org/>

Nutrient Requirements of Horses, 2009: http://www.nap.edu/catalog.php?record_id=11653

Refeeding starving horses: <http://starvinghorses.com/Refeedingsyndrome.html>

Voluntary intake and digestibility of teff hay fed to horses (Staniar et al, 2010):
<http://jas.fass.org/cgi/content/full/88/10/3296>