The Skinny on Feeding Fat to Horses

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Take-Home Message:

- Dietary fat sources for horses include vegetable oils (e.g., corn oil, canola oil, soybean oil), high-fat feeds (e.g., rice bran, flaxseed) and commercial grain mixes with fat added.
- The addition of fat to horse rations can provide calories, modify of behavior, promote fat use and spare muscle glycogen during exercise, and reduce the horse's thermal load.
- Fat supplementation should be limited to 10% of the total diet by weight (~2 cups per day for a 1100-lb horse) and gradually introduced to the horse's diet over 2 to 3 weeks.

Introduction

If you've visited a feed store lately or skimmed the advertisements in any horse-related publication, you've undoubtedly seen a great deal of promotion for high-fat horse feeds. Marketing claims extolling the virtues of added dietary fat include "improved performance," "increased stamina," "calm energy," and "improved coat and hoof condition."

Adding fat to the diet of horses is not a new practice. For years, corn oil and boiled linseed have been added to the grain ration to bring out the luster in the haircoat. However, it's only been in the past 10–15 years that fat has been recognized as a valuable energy source, and one with many advantages over traditional hay and grain rations.

Sources of Dietary Fat

Dietary fats are made up of triglycerides, which consist of three fatty acid molecules attached to one glycerol molecule. Based on their chemical composition, fatty acids can be saturated or unsaturated. Unsaturated fatty acids can also be further classified as mono-unsaturated or poly-unsaturated. There can also be considerable variation in the size of fatty acids (i.e., the length of the fatty acid carbon chain). The type of fatty acid and its size are important because they affect the physical properties of the fat. Fats with unsaturated and/or short-chained fatty acids tend to be liquid at room temperature and are referred to as oils. Conversely, longer chain fatty acids that are saturated are usually solid at room temperature and are referred to as fats.

Fats can be of animal or vegetable origin. Vegetable oils are higher in unsaturated fatty acids than animal fats. Animal fats, such as tallow and lard, are rarely used in horse feeds. More often, fat is added to the diet of horses from vegetable sources. Fats of vegetable origin include oils commonly used for household cooking, such as corn oil, canola oil, safflower oil and linseed oil. Vegetable sources of fat also include rice bran and oil seeds (e.g., sunflower seeds, flax, and soybeans). Refer to Table 1 for a comparison of different dietary fat sources.

Unless one of the fat sources above is added to the diet, horse rations are very low in fat. Although small amounts of fat are provided in the grains and forages (pasture or hay) horses traditionally consume, such rations contain only 2 – 3% fat.

Table 1: Comparison of the total fat content and the fatty acid composition of dietary fat sources

Dietary fat	Total fat content (%)	Percentage of total fat			
		Saturated	Mono-unsaturated	Omega-6	Omega-3
Corn oil	100	13	29	57	1
Soybean oil	100	15	23	54	8
Canola oil	100	7	61	21	11
Flax oil	100	9	18	16	57
Flax seed	40	9	18	16	57
Fish oil	100				
Beef tallow	100	48	49	2	1
Lard	100	43	47	9	1
Rice bran	22	19	45	34	2

Fat as a Feed

For a horse to obtain any nutritional benefit from a particular feed, it must be palatable enough to be eaten and it must be digestible. Horses willingly consume both vegetable oil and animal fats; however, cafeteria-style taste tests have shown that horses prefer vegetable oils over animal fats, with corn oil being the favorite (Holland et al. 1998).

Supplemental fats are well utilized by the horse, despite the fact their digestive systems evolved to process low-fat, high-fiber diets. In most mammals, the gall bladder stores bile salts, which are infused into the small intestine to help breakdown and digest fats. However, horses do not have a gall bladder. To compensate for this anatomical difference, bile is continuously secreted into the small intestine directly from the liver where bile is made. As a result, fats and oils added to the diets of horses are 80 – 90% digestible (Lewis, 1995).

The horse's digestive system can manage reasonably large quantities of dietary fat. In fact, studies have shown that horses are able to digest and utilize up to 20% of the diet (by weight) as oil with little to no adverse effect on fiber and protein digestibility (Kronfeld et al. 2001). In contrast, the addition of smaller quantities of vegetable oil has been shown to have a negative impact on fiber digestibility in ruminants. Absorption of

calcium and magnesium are also unchanged by the addition of fat or oil to the diet of horses, whereas absorption of these minerals has been reported to be reduced in other species (Dunnett, 2002).

Although high levels of fat are well tolerated by horses, most equine rations are considerably lower than 20% fat, even with the use of so-called high-fat feeds. Currently, it is recommended to limit the total fat intake to 10% of the diet or less.

Does "high-fat" = heart attack?

Diets high in saturated fat and cholesterol have long been associated with the development of coronary heart disease in humans. Is a high-fat diet considered a health risk for horses? Not necessarily, because the term "high-fat" is defined differently for horses. A high-fat, high risk diet for humans would contain in excess of 30% fat. In contrast, when we feed a "high-fat" diet to horses, we are usually referring to a ration that has 5 – 10% fat. Although increasing the fat content of equine diets does increase circulating serum cholesterol and phospholipids, they are still much lower than those associated with health problems in humans. Nonetheless, the long-term effects of feeding a high-fat diet to horses are unknown. Most research investigating the effect of fat supplementation in horses has been relatively short-term (the longest being 16 months). While some caution should be used, current evidence suggests that there are few, if any, concerns associated with the use of fat in horse diets.

Benefits of Adding Fat to the Diet

Supplementation of traditional hay/grain rations with fats and oils has been shown to have many benefits:

1) Fat provides a source of essential fatty acids

Horses have the ability to synthesize some fatty acids within their own body. However, not all fatty acids can be made by the horse and, therefore, must be provided in the diet. Those that must be supplied by the diet are termed essential fatty acids, and include linoleic acid (an omega-6 fatty acid) and alpha-linolenic acid (an omega-3 fatty acid). Essential fatty acids perform numerous important functions within the body, and will be discussed in more detail later.

2) Fat aids in the absorption of fat-soluble vitamins

Some fat is needed in the diet to facilitate the absorption of the fat soluble vitamins A, D, E and K. Although horses can synthesize vitamin D from exposure to sunlight and vitamin K can be made by the microbes living in the horse's hindgut, vitamins A and E must be provided in the diet. Vitamin A and E status may be marginal when horses are maintained on hay alone, without vitamin supplementation, and without access to growing pasture. The addition of fat to the diet may assist with more efficient utilization of these fat-soluble vitamins.

3) Fat may improve the quality of the haircoat

For years, oils have been drizzled on grain rations in an effort to help horses shed their winter coats sooner and to add shine to the hair. While this effect has never been proven scientifically in horses already receiving a well-balanced diet, it might make the

difference in horses consuming marginal diets. In such cases, provision of a small amount of fat may act to correct minor deficiencies in essential fatty acids, as well as enhance uptake of fat-soluble vitamins (A, D, E and K), both of which are important to skin health.

4) Fats provide a source of concentrated energy

One of the key nutritional advantages of fat is its energy density. On a pound for pound basis, vegetable oils have about 3 times as many calories as oats and 2.5 times the calorie content of corn. Because total daily feed intake is limited (i.e., the horse can only eat so much in a day), adding fat can result in a substantial increase in caloric intake without requiring the horse to consume more food. This is especially useful when managing a hard-keeper or meeting the high-energy requirements of horses in heavy training. The energy in fat is also used very efficiently by the horse. When a typical hay/grain diet is fed, a horse is only able to utilize 50–60% of the energy in these feedstuffs. In contrast, horses can utilize more than 90% of the energy contained in a vegetable oil. Because more of the energy in fat is available to the horse, it makes an ideal supplement for putting weight on thin animals and maintaining older horses in good body condition.

5) Fat can help minimize the risk of digestive upsets associated with high-grain diets

Meeting the high energy demands of some horses (e.g., performance horses, broodmares in late gestation and early lactation) traditionally requires feeding large amounts of grain. Starch is the primary component of cereal grains. Because horses evolved to subsist on high-fiber diets, they have a limited capacity for starch digestion. This is generally not a problem at low levels of starch intake (e.g., less than 5 pounds per day), but can be problematic with heavy grain feeding. The more grain that is fed, the more starch escapes digestion in the small intestine (where it should be digested) and passes into the hindgut where it is rapidly fermented. Starch overflow to the hindgut can result in a decrease in gut pH (acidosis), disruption of the normal microbial population, and an increased risk for digestive disturbances (diarrhea, colic) and founder.

Providing a portion of the calories as oil or other high-fat feeds (e.g., rice bran) allows for a substantial reduction in the quantity of grain (& starch) in the diet. Fat contains no starch, and is predominantly digested in the small intestine without problem. Therefore, replacing some of the grain with fat can help to minimize the risk of digestive upsets associated with high-grain diets.

6) Adaptation to dietary fat may spare muscle glycogen

The horse has two primary sources of fuel to call upon during exercise: glucose and fatty acids. Fatty acids are stored in adipose tissue, as well as in and around muscle, while glucose is stored as glycogen in muscle and the liver. The type of fuel used during exercise will depend on work intensity, the duration of exercise, the horse's fitness level, and to some extent, the diet. In general, the greater the intensity (speed) of the exercise, the greater the horse's reliance on glucose as a fuel. In contrast, the longer the duration or the more fit the horse, the more fat is utilized as fuel. However, some glucose is always needed, even for submaximal exercise. Unfortunately, glycogen stores in the liver and muscle are quite limited. In fact, depletion of muscle and liver glycogen reserves contributes to the onset of fatigue.

High-fat diets can be beneficial because, after a period of adaptation to that diet, there is increased use of fatty acids as a fuel during exercise (Dunnett 2002). This increased use of fatty acids, in turn, reduces the use of liver and muscle glycogen. Essentially, the horse's body can "learn" to use fat as fuel, in preference to glucose, allowing them to maintain higher levels of muscle glycogen, and potentially delaying the onset of fatigue. It must be emphasized, however, that these alterations in metabolism will not necessarily result in improved performance.

To achieve the metabolic shift from glucose to fat use during exercise, horses must undergo a period of adaptation to an adequate level of fat in the diet. The general consensus is to provide fat at a rate of 8 – 10% of the diet (20 – 25% of the calories) for a minimum of two- to three-months before such an effect on fuel utilization is seen.

Unfortunately, there may also be a drawback to providing high levels of fat in the diets of performance horses. Specifically, there is some concern that high-fat diets may impair glycogen replenishment once the activity is complete. The horse's body cannot synthesize glycogen from fat—he needs carbohydrates from grains or fiber sources to replenish liver and muscle glycogen stores. Horses have been reported to have lower muscle glycogen stores during the initial phase of fat supplementation compared to those fed high-grain diets. However, after several weeks of fat adaptation, this adverse effect on muscle glycogen was abolished (Dunnett 2002). Some level of grain is probably needed in the diet to allow restoration of glycogen stores. Unfortunately, the optimum ratio of fat to carbohydrate for glycogen repletion has yet to be determined.

7) Fat supplementation may reduce the horse's thermal load

When a horse digests and absorbs a feed, some of the energy in the feed is lost as heat. The greatest amount of heat is produced with the fermentation of fiber, followed by protein, and then starch. The least amount of heat is produced from the digestion and assimilation of fats and oils. Energy is also lost as heat when stored fuels are mobilized during exercise. The breakdown of fatty acids is more efficient than glucose, thereby producing less heat. One report found that total body heat production decreased by 14% when horses were fed a fat-supplemented diet (Kronfeld 1996). The lower heat load associated with fat feeding lessens the need for evaporative heat loss (by sweating), thus reducing water and electrolyte loss during exercise. For horses training and competing in hot humid climates, a reduction in thermal load could provide a competitive edge.

8) Fat supplementation may favorably alter behavior

Some horses experience a level of excitability when fed large quantities of grain, similar to a "sugar high" observed in some children. Consumption of grain results in the production of insulin, which is responsible for storing the glucose absorbed from the breakdown of starch. Insulin also revs up metabolism by increasing thyroid hormone which, in turn, may be responsible for the "sugar high." In contrast, when horses consume a high-fat diet, insulin production is suppressed. One study showed that feeding horses a diet containing a combination of corn oil and soy lecithin reduced spontaneous activity and reactivity to noise and sudden visual stimuli, compared horses receiving a traditional hay/grain diet (Holland et al. 1996). In addition, many horsemen report that horses on high fat diet have a calmer, more level-headed attitude, compared to more traditional starch- and sugar-based diets.

9) Fat supplementation may benefit horses with recurrent tying-up

Nervous temperament is one of the factors contributing to tying up episodes in horses with recurrent exertional rhabdomyolysis (RER), a condition most common in racing Thoroughbreds and Standardbreds. A higher-fat diet may help in the management of horses with RER, possibly because of the "calming effect" of the higher fat diet.

A higher-fat, lower-starch and -sugar diet is also crucial in the management of horses with polysaccharide storage myopathy (PSSM), another form of chronic tying up. PSSM is associated with abnormal storage of excess glycogen in muscle, likely because these horses are more sensitive the effects of insulin (the hormone responsible for clearance of glucose from the bloodstream after a meal). The starches in grain exacerbate the problem by providing the extra glucose needed for the synthesis of glycogen in muscle. An increase in fat intake, coupled with restriction of dietary starch and sugar in grain, can be helpful in the management of horses with PSSM, because fat can provide the calories without stimulating insulin release.

Omega-3 and Omega-6 Fatty Acids

As mentioned above, horses have a dietary requirement for the essential fatty acids linoleic acid and alpha-linolenic acid. The amount of these essential fatty acids varies among the different oils. Flaxseed (or linseed) oil contains approximately 50% alpha-linolenic acid (omega-3) and about 15% linoleic acid (omega-6). Soybean oil also has a high omega-3 fatty acid content, whereas the predominant essential fatty acid in corn oil is linoleic acid (omega-6). Fish oil is also very high in omega-3 fatty acids, but instead of appearing as alpha-linolenic acid, the omega-3 fatty acids in fish oil come in the form of eicosapentanoic acid (EPA) and docosahexanoic acid (DHA). Refer to Table 1 for a comparison between different sources of fat.

Once in the body, these essential fatty acids are further metabolized to produce other fatty acids. Arachidonic acid (AA) is the predominant product of linoleic acid metabolism (omega-6) whereas eicosapentanoic acid (EPA) is a major product from alpha-linolenic acid metabolism (omega-3). In turn, AA and EPA can be metabolized to substances called eicosanoids. Eicosanoids are potent regulators of vital body functions, including blood pressure, blood clotting, immune system function and inflammatory responses. In general, the eicosanoids produced from omega-6 fatty acids tend to increase inflammatory processes and cause blood clotting, whereas eicosanoids produced from omega-3 fatty acids tend to decrease blood clotting and lessen the inflammatory response.

Omega-3 fatty acids have received a great deal of attention recently with human nutrition research. Today, our diets contain much more saturated fat and a higher proportion of omega-6 fatty acids compared to the diets of our prehistoric ancestors, which were much higher in omega-3 fatty acids. Scientists are finding that dietary supplementation with omega-3 fatty acids may be useful in the prevention and/or treatment of heart disease, thrombosis, hypertension, renal disease, rheumatoid arthritis, inflammatory disorders, autoimmune disease, and possibly cancer.

To some extent, the diets of our modern equines are also changing. Wild horses consuming all-forage diets, follow the grass to new areas for grazing as the season changes. Although grass is low in total fat content, the fat in growing grass is predominantly alpha-linolenic acid (omega-3). When we domesticated horses, we put them to work, imposing the need for grain feeding. Grains, although low in fat, contain predominantly omega-6 fatty acids, thereby shifting the balance of omega-6:omega-3 in the horse's diet. Even pastured horses probably do not fair as well as their equine ancestors, since they are fenced in smaller areas and cannot roam the land to extend their grazing season.

Because of the reported benefits of omega-3 fatty acid supplementation on human health, there has been interest in determining whether horses will respond favorably to dietary omega-3 supplementation. If omega-3 fatty acids can dampen the body's response to inflammatory stimuli, supplementation might be useful for horses with overactive immune system responses, such as heaves, equine recurrent uveitis, and recurrent allergic reactions (hives). In addition, omega-3 fatty acids may prove useful for preventing or treating upper airway disease, degenerative joint disease, and laminitis.

Many horse feed and supplement manufacturers have jumped on the omega-bandwagon, marketing products high in omega-3 fatty acids and claiming all kinds of health and performance benefits. In reality, little is known regarding the effect of this form of fat supplementation in horses. A handful of studies, have taken the first step to determine if the source of dietary fat can influence circulating fatty acids and membrane lipids. We know that we can change the lipid profile within the horse's body with omega-3 supplementation (O'Connor et al. 2003; Siciliano et al. 2003). The next step will be to determine if the higher levels of certain omega-3 fatty acids have any practical application to boost the immune system or remediate the inflammatory response. More research is needed to determine what, if any, effects omega-3 fatty acids will have on horses before reasonable recommendations can be given.

Practical Fat-feeding Recommendations

Fat can be added to the diet of horses in three ways:

1) Adding a vegetable oil to the existing diet—Top-dressing vegetable oil on your horse's current ration is the simplest approach and is reasonable when small quantities (1 cup or less) are added. However, nutritional imbalances can occur when grain mixes are substituted by 2 or more cups of straight vegetable oil. Adding fat will reduce the amount of grain needed in the diet, but because pure vegetable oils contain no protein, minerals or vitamins, intake of these nutrients will be reduced as well. This can be of particular concern in young growing horses and pregnant and lactating mares due to their higher nutrient requirements. If you choose to supplement fat at higher levels (2 cups per day) by top-dressing vegetable oil, you need to ensure the rest of the diet is adequate and can make up the lost protein, vitamins and minerals.

2) Feeding an oil-rich supplement—Some feeds, including rice bran and flaxseed, have significant oil content. Rice bran contains, on average, 22% fat and flaxseed contains approximately 40% fat. Although the fat content of rice bran and flaxseed is much higher than traditional hays and grains, you still have to feed more to get the same benefits you would from vegetable oil, which contains 100% fat (refer to Table 2 for caloric exchange rates between oils and different feeds). Another concern with rice bran is its inherently high phosphorus content, which is inverted in proportion to the calcium content. If a significant amount of rice bran (1 – 2 lbs) is added to the horse's ration, particularly if a large amount of grain is also fed, the diet will have to be balanced with supplemental calcium to avoid metabolic bone disorders.

3) Feeding a commercial grain mix with fat-added—Most feed companies have developed a premium line of high-feeds, typically containing 6 – 10% crude fat (although there are some with higher fat content). The advantage of a fat-added feed over top-dressing oil is that the commercial product is fortified with high-quality protein, minerals and vitamins, thus ensuring that the requirements for other essential nutrients are met (i.e., all nutrients are in proportion to the extra calories provided by the fat added to the mix). The fat-added mix ensures the right balance of nutrients are delivered.

Note that use of these feeds is not ideal for horses with tying up problems (RER or PSSM) because intake of grain will still be too high. In these horses, fat intake should be increased by use of top-dressing oil or rice bran to the existing ration. Additional protein, minerals and vitamins may need to be supplemented if the amount of fat fed causes an imbalance.

Table 2: Caloric exchange rates between vegetable oil and other feeds

Feed	Digestible energy (Mcal/lb of diet as-fed)	Amount (lbs) equivalent to 1 cup of oil
Oil	2.00	0.5
Oats	1.35	1.5
Barley	1.50	1.3
Corn	1.54	1.3
Commercial grain mix	1.45	1.4
Rice bran	1.75	1.0
Whole flaxseed	1.54	1.3

How much fat should you add to your horse's diet?

The ideal amount of fat supplementation has not necessarily been determined and likely differs based on the horse's intended use, how much grain you would like to replace, and/or the horse's energy expenditure. As stated above, horses can tolerate up to 20% of the diet as fat, but 10% of the diet is probably a reasonable limit. For practical purposes, it has been recommended to feed no more than 3.5 ounces of oil per 220 pounds of body weight per day (or 100 grams oil per 100 kg body weight per day). For the average 1100-lb (500-kg) horse, this would be about 2 cups. (Note that one standard measuring cup holds about 8 fluid ounces, about ½-pound of oil, or about 220 g oil)

If you are feeding a commercial high-fat feed, it will require a bit more math. Most commercial high-fat grain mixes are between 6 – 10% fat. But since your horse will also be consuming forage (which contains ~2% fat), the total fat content of the ration (grain + forage) will be lower than that listed on the grain bag (i.e., the lower fat content of the hay will dilute the higher fat content of the grain mix). Daily fat intake will depend on the amount of the grain mix fed. For example, 10 lbs of an 8% fat product will deliver about 365 grams of oil or the equivalent to almost 2 cups of vegetable oil.

Additional vitamin E may be needed high-fat diets

High fat diets increase the horse's requirements for antioxidants, such as vitamin E. If you top-dress oil or feed rice bran, then vitamin E should be added to the diet at a rate of 200 – 250 IU per cup of oil (or pound of rice bran). This should not be necessary when commercial high-fat feeds are used, however, as these products contain extra vitamin E fortification. However, vitamin E activity is rapidly destroyed by exposure to air and humidity. If feeds are to be stored for more than a few weeks in hot, humid climates, some supplementation might still be necessary.

Allow gradual adaptation to fat in the diet

To avoid digestive upset, oil should be gradually introduced in the diet over a 2 or 3 week period. In addition, the daily amount is best divided into 2 or 3 feedings. If you are top-dressing vegetable oil, start with ½ cup and increase ½ cup every 5 days until the desired level is achieved. If you are switching to a high-fat commercial feed product, you should start by replacing 25% of the old feed with the new fat-added feed and gradually increase in the amount of the new feed while decreasing the old over a 2 to 3 week period.

Finicky eaters might be a little slow to adapt to feeding fat, but by-and-large, horses readily accept fat in their diets. In addition, some horses might get a little "loose" during the early phases of oil feeding, but this problem is usually self-limiting.

Remember that metabolic adaptations that may confer enhanced athletic performance may take 2 to 3 months of fat supplementation. Therefore, while fat feeding can be started at any time, it is best to institute fat supplementation early in the year (perhaps late winter, early spring) as the horse begins training for the season.

Store your oils and feeds in a cool, dry area

Unsaturated fats can become rancid during storage. Conditions that promote the development of rancidity include high temperature and humidity, and prolonged storage. Rancid fats are less palatable (so the horse may refuse to eat it) and interfere with absorption of some of the vitamins in the horse's diet, as well as destroys the essential fatty acids. Therefore, it is important to store oils and high-fat feeds in a cool, dry area. You must also use your fat source within a reasonable amount of time (within 2 weeks for proper storage of high-fat feeds and within 2 months of properly stored vegetable oil). Buying in bulk may confer an economic advantage, but if the feed or oil goes bad before you can feed it, you are not saving any money.

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