Feeding the Laminitic Horse: Dietary Management is Vital in the Recovery Process and Long-Term Wellness of Horses afflicted with Laminitis.

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You come home from a long day of work and head out to the barn for a little equine decompression therapy. When you arrive, you find your gelding has added breaking and entering to his rap sheet. He's in the feed room, his head completely submerged in a bag of sweet feed you recall just opening that morning. His head surfaces, but rather than looking smug and proud of himself, he looks a little "green." Later that night he's standing with his weight rocked back off his front feet and he doesn't want to move. Your veterinarian confirms your worst fears—your gelding has foundered.

Laminitis (commonly referred to as founder) is a serious and sometimes life-threatening condition in the horse's feet. Unfortunately, it is not all that uncommon. Also unfortunate is the fact that once damage occurs in the laminae of the hoof, the risk for future episodes of laminitis remains high.

What you feed your horse after a bout of laminitis can have a positive—or negative—impact on their recovery and long-term soundness. This article will offer guidance on how to manage the diet of a horse with laminitis. Because many of the feeding tips also apply to the prevention of laminitis, you may find the discussion useful even if your horse does not currently have this condition.

What is Laminitis?
In simple terms, laminitis is inflammation of the sensitive laminae in the hoof. The laminae provide attachments between the hoof wall and the coffin bone. These attachments work to suspend the coffin bone within the hoof capsule where it provides the greatest mechanical advantage. Inflammation of the laminae causes the attachments to fail, resulting in separation of the coffin bone from the hoof wall. The upward pulling of the deep digital flexor tendon, coupled with the downward weight of the horse, can cause the coffin bone to rotate within the hoof capsule. The term "founder" is usually reserved for horses that have rotation of the coffin bone. Rotation can progress to such an extent that

Horses that are laminitic should have limited access to grass pastures and should be fed a grass or grass/legume hay.
the tip of the coffin bone punctures through the sole of the foot (often referred to as a "sinker").

The degree of damage to the laminae resulting from a bout of laminitis varies from mild to severe. More severe cases are characterized by a large loss of lamellar attachments, often resulting in coffin bone rotation. In more mild cases, some loss of lamellar attachment is still evident. Such damage persists and can accumulate with successive episodes of laminitis, each time further weakening the link between the hoof wall and the coffin bone. Eventually, enough of the attachments are broken, permitting the coffin bone to rotate. While all episodes of laminitis are serious, the prognosis for the future soundness of the horse is more guarded when coffin bone rotation occurs.

Reestablishment of the lamellar attachments can be difficult, if not impossible. Therefore, it is very important to manage the laminitic horse so that further damage does not occur. Timely medical treatment by a veterinarian and therapeutic shoeing by a qualified farrier are critical. Providing a well-balanced, low-starch diet is also vital to the long-term health of the hooves.

Risks for Developing Laminitis
The exact mechanisms by which certain events trigger laminitis are still being investigated. Nonetheless, several risk factors for laminitis have been identified. The factors that are most closely associated with feed-

ing are described in more detail below.

• High grain diets
The feeding of greater than 5 lbs/day of a feed containing large amounts of cereal grains has been associated with a greater risk of laminitis. Cereal grains, including oats, corn and barley contain large amounts of starch (>65%). In moderation, starch poses no problem for a horse. Consumed in excess, the capacity for starch digestion in the small intestine becomes overwhelmed, permitting excess starch to flow into the hindgut. Rapid fermentation of starch by microorganisms in the

Excess body weight puts an equine at greater risk for laminitis.
hindgut results in the production of excessive amounts of acid which, in turn, negatively affects the microbial population. Death of certain microorganisms results in the release of endotoxins into circulation, which act on the hoof to cause laminitis.

• Feeding mistakes
Although it occurs, breaking into the feed room and gorging on sweet feed is not the most common accidental cause of laminitis. Instead, laminitis is more likely to be the unintended consequence of a feeding mistake. Failing to make adjustments in the quantity of feed given when switching to a new product and failing to provide adequate time to adjust to a new feed are more common mistakes. For example, pellets are typically denser than textured feeds, so a scoop of pellets will weigh more than the same scoop filled with sweet feed. The end result is that the horse gets more feed than it is used to, which can cause digestive upset and laminitis. Formulations between feeds also vary greatly, so be sure to know what's in the bag and how it compares to your old feed before you give it to your horse.

• Lack of adaptation to lush pasture
Lush pasture, typically found in the spring, is characterized by a high nutrient content. Although high protein is often blamed for causing a horse to founder, this is a myth. Instead, the culprits are high levels of specific carbohydrates. In Florida and much of the southeast, the warm-season grasses (e.g., bahia, bermudagrass) growing in our pastures can contain high levels of starch in the spring. In contrast, the cool-season grasses (e.g., fescue, orchardgrass) present in pastures located in more temperate climates can accumulate fructans. Excessive amounts of starch or fructans both result in the same thing—rapid fermentation in the hindgut, followed by acid formation, microbial death and endotoxin release. For horses that are adapted to the "green up" of pastures in the spring, these carbohydrates generally do not pose a problem. For carbohydrate sensitive horses and those who have been turned out on lush pasture without a period of adaptation, sudden intake of large amounts of starch or fructans can result in laminitis.

• Insulin resistance
Horses that are insulin resistant have a greater risk for developing laminitis than normal horses. Insulin is needed to drive glucose into cells. In an insulin resistant horse, the cells "ignore" insulin resulting in less glucose being taken up by the cell. The laminae in the hoof are obligate glucose users (i.e., they can only use glucose to support their function). Because insulin resistance prevents laminae from taking up glucose, they starve. Other biological events associated with insulin resistance also conspire to increase the risk of laminitis in these horses, including factors that affect blood flow to the hooves.

• Overweight horses
Excess body weight also puts a horse at greater risk of laminitis. Much of this risk stems from the fact that overweight horses are also often insulin resistant. Additional risk comes in the form of mechanical trauma. Carrying around extra body weight puts extra pressure on bones and joints, including those in the hoof. Overweight horses are also more likely to be sedentary, which impacts blood flow up and down the leg.

Although the focus of this article is nutrition, it is not the only cause of laminitis. Laminitis can also result from mechanical trauma (also known as "road founder"). A famous example of mechanical failure of the laminae was Barbaro, who developed laminitis in the limb opposite the one he injured in the Preakness Stakes. Referred to as contralateral limb laminitis, this condition is common in horses who have acquired an injury that requires them to support more of their weight on their healthy limbs. Additional causes of laminitis include bacterial endotoxins associated with a retained placenta, treatment with excessive amounts of corticosteroids (e.g., dexamethasone) and contact with black walnut bedding. Finally, older horses, as well as certain breeds (e.g., ponies) have a greater predisposition towards laminitis.

Despite the cause, the end result is similar—the laminae become inflamed and the attachments between the hoof wall and coffin bone become damaged. An appropriate feeding program is not only important for the recovery of the hoof, but also for preventing reoccurrence.

Guidelines for Feeding a Horse with Laminitis

Because diet can be a trigger of laminitis, feeding management of the laminitic horse is critical, even if diet was not the original cause of the condition. Based on the discussion above, most of the nutrition-related risk for developing laminitis is rooted in carbohydrates, particularly starch. Therefore, the goal for feeding the laminitic horse will be to minimize their consumption of starch.

In order to achieve this goal, you must gain control of your horse's diet. Unfortunately for the horse, this usually means no more free-choice grazing on pasture, no more starch-rich feeds, and in some cases, dietary restriction to lose excess body weight. Your horse may not like this. You may not like this. But each time you feel like giving in to those sad puppy-dog eyes, remember the consequences. Remember the intense pain your horse could suffer with another bout of laminitis. Remember that it can be fatal.

The following are a list of diet modifications and feeding management guidelines that need to be instituted when feeding a horse with laminitis:

1) Limit turnout on pasture

Gaining control of the horse's diet means being accountable for everything they eat. This is difficult to do this if the horse has unlimited access to grazing. A laminitic horse is not necessarily excluded from having pasture time—after all, grazing is a natural activity for the horse and the exercise gained by foraging for food will be good for maintaining circulation to the hooves. However, it does mean he can't be turned out 24/7 on pasture. Instead, pasture turnout will need to be limited to 1-4 hours per day and strategically timed to avoid certain carbohydrates (discussed in more detail next). It is important to note, there are some cases of laminitis that are so severe that the horse will never be allowed to set foot on pasture again. In addition, for a period of weeks to months immediately following a bout of laminitis, pasture turnout may not be an option.

2) Implement a strategic pasture turnout plan

The carbohydrate levels (either starch or fructans) in pasture forage fluctuate with different seasons, as well as throughout a 24-hour period. In general, starch and fructans are highest in the spring, again in the fall, at times when the grass is "stressed" (e.g., by drought or several cloudy days in a row) and from mid-day through early evening. Pasture turnout should be adjusted to avoid exposure to the higher levels of carbohydrates at these times. In the spring and fall, pasture turnout should be limited to only 1 or 2 hours per day. In the summer and winter, you may be able to extend turnout for another 1 or 2 hours. Regardless of the season, turnout on pasture should be scheduled to occur sometime between one hour after sunset and 10:00 a.m. the next morning when starch and fructan levels are lower. To accommodate your work schedule, you might consider splitting the daily turnout time. For example, turn your horse out for an hour before you go to bed and again for an hour in the morning before you leave for work. A grazing muzzle, which slows the rate of grazing, might also be used to extend the amount of turnout time (only by another hour or so). But

beware, veterans to grazing muzzles become very adept at foraging with the device until it eventually no longer slows them down. Finally, horses with a history of laminitis should not have access to pastures that have been over-seeded with winter annuals (e.g., annual ryegrass), due to the potentially high carbohydrate content of these grasses.

3) Select mid-maturity grass hay or grass/legume hay

When not turned out on pasture (which, unfortunately, will be the vast majority of the time), the laminitic horse will need to be confined to a stall or, more preferably, a drylot paddock that contains no grass. This means the nutritional needs of the laminitic horse will be met predominantly with hay; therefore, hay selection is important. Of all the things we feed horses, hays are the lowest in starch (or fructans). That being said, the carbohydrate content of hays can vary dramatically. In general, you should select a mid- to late-maturity grass hay (e.g., Coastal bermudagrass, timothy, orchardgrass). If the horse is thin, you can consider using a grass/legume mix hay (e.g., timothy/alfalfa) or perennial peanut hay. A consistent hay supply is very critical for laminitic horses, so as not to disturb gut function. Therefore, whenever possible, you should purchase hay in quantities that can last you 2 to 3 months and remember to slowly adjust the horse to each new batch of hay. In general, the horse should receive about 2% of his body weight in hay per day (about 20-25 pounds for the average sized horse). This amount may need to be reduced to 1.5-1.75% of body weight if the horse is being fed a commercial feed or is spending some time on pasture.

Another alternative to baled hays are bagged forage feeds. Unlike baled hays, bagged forage feeds offer a guaranteed analysis and are very consistent from bag-to-bag. These chopped forages differ from traditional hays in that they are high-temperature dried rather than sun-cured, thus eliminating weather from playing a role in the time the hay is harvested. Additionally, the mixing of hay types occurs in the mill rather than in the growing process, allowing a more exact mixture and a better variety of hay types. These differences create a much more consistent nutrient profile than traditional hay resulting in a higher margin of safety for your horse, and the need to store large quantities of hay is eliminated.

4) Avoid high-starch feeds (and treats)

Commercial feed products that are cereal grain based should be avoided, due to the high starch content of the grains. Low-starch feeds that are high in digestible fiber (from beet pulp or soybean hulls) or high in fiber and fat (from soybean oil, flaxseed, or rice bran) are more suitable for the laminitic horse. The advantage of a commercial low-starch feed, as opposed to creating your own mixture, is that the feeds are regularly tested to ensure a low starch content. They are also fortified with minerals and vitamins to create a well-balanced ration. If your laminitic horse is overweight, a ration balancer such as Seminole Equalizer should be fed instead of a traditional commercial feed. Ration balancers are a concentrated source of protein, vitamins and minerals, but are low in starch. They are designed to be fed at a rate of 1-2 pounds/day and are tasty enough to be fed alone (which can convince the dieting horse that he is not being cheated).

5) Maintain a healthy body weight

Because excess body weight puts a horse at greater risk for laminitis, you should maintain your horse in moderate body condition. This means you should be able to easily feel individual ribs, but not see them when the horse is standing. If your horse is already overweight, you need to institute a weight loss program. This can be quite a challenge with a laminitic horse, because their ability to exercise may be limited. Nonetheless, exercise is important for weight loss, as well as increasing the circulation within the hoof. As soon as it is permitted by your veterinarian, you should increase the activity level of the horse, even if it is limited to hand-walking for 30 minutes. Commercial feeds and high-calorie treats should be exchanged for ration balancing pellets (see #4 above) and healthier treats, such as hay cubes (but not too many!) Hay should be more stemmy and gradually adjusted downwards to produce weight loss. For example, over the course of one month you might start by feeding hay at 2% of current body weight, drop to 1.5% of current body weight, and then drop to 1.5% of ideal body weight. Until the weight problem is under control, pasture turnout

should be avoided.

6) Consider feeding a high-quality hoof supplement
Several nutrients are important for maintaining the health of the hoof. In particular, the B-vitamin biotin and trace minerals such as zinc and copper are needed for proper hoof development. It is unknown if laminitic horses require more of these nutrients than healthy horses. Nonetheless, it may be prudent to include a high quality hoof supplement in the diet of a foundered horse. Research in healthy horses has demonstrated some positive effects on hoof growth when fed 30 mg of biotin per day for at least 6 months. Many hoof supplements also contain zinc and copper, and when coupled with a commercial feed or ration balancing pellet, this should suffice. Your farrier or equine nutritionist may be able to suggest a hoof supplement they have had success with when treating laminitic horses.

Remain Diligent
Laminitis is a serious and dynamic disease. No matter how mild, once damage has occurred in the laminae, the hoof is susceptible to further insult. In addition to working with your veterinarian and farrier to mitigate the damage, consideration of your horse's diet is vital to recovery and long-term soundness. Many of the changes that have to be made, such as restricting or even eliminating pasture turnout are not fun for the horse and generally mean more work for you. But to avoid the pain and frustration of future episodes, you must stick to a strict dietary plan. Gain control over the diet by limiting grazing to short periods at strategic times. Feed a mid-maturity grass hay or bagged forage, select low-starch feeds or ration balancing pellets, and maintain your horse in a healthy body condition. Consult with an equine nutritionist to create a feeding plan tailored for your horse. Above all, be diligent about the diet of your laminitic horse—he's depending on you.