UD COOPERATIVE EXTENSION
UNIVERSITY OF DELAWARE
College of Agriculture & Natural Resources

Date: May 15, 2009
David L. Marshall, VMD
Delaware Equine Extension Veterinarian

# Pasture Associated Laminitis
# "Between a Rock and a Hard Place"

To say that one is stuck "between a rock and a hard place" emphasizes that there are two opposing alternatives or forces which are restricting one's ability to make a wise decision. Many times the opposing alternatives or forces are in their own right, both good. One such situation commonly occurring in equine management is the pasture turnout decision, especially spring turnouts. The evidence is undeniable and the health benefits are unsurpassed for our horses to be turned out on pasture 24/7. But equally undeniable, unrestricted grazing of lush pastures is a formula for disaster. The spring turnout situation places horse owners between a rock and a hard place, forcing us as horse caretakers to make a choice that we do not want to make. Horses and horse pastures together offer the prerequisite for a "perfect storm". Unfortunately, the ship wreck to follow is predictably troublesome health consequences with either option. If we find ourselves within the pasture-turnout "between a rock and a hard place", the greater understanding we possess of the biology at work and of the unwanted consequences of our lack of understanding, the greater the chances we have of avoiding a preventable medical disaster. Let's start by answering the question: *Just what are the predictable and dangerous consequences of either keeping my horse in confinement or giving him free access to pasture?*

Horses by design and function are animals adapted to the wide open spaces. They are social animals constantly on the move. As grazing animals, they are what we call "continuous grazers" or "trickle feeders". This means their entire digestive system, from teeth to stomach to small intestines to large intestine to fecal balls is designed to consume, process, and eliminate small quantities of roughage type foods continuously throughout the day and night. This is in contrast to ruminant grazers such as cows, sheep, deer, etc.; who graze a more limited locality then find a place to lay down and re-chew [ruminate] what they have just grazed. Research demonstrates, horses with free access to food will voluntarily go longer than 1½ hour between

meals. Therefore, to remove a horse from its designed intent; that is, to remove a horse from their natural environment of continuous feeding, constant movement, social contact, and non-confinement is to effectually place stress upon that horse. These stresses act as triggers of disease, and depending upon which system in the horse undergoes the greatest stress, that system is most likely to exhibit a functional breakdown . . . disease. Some of the most common confinement stressor-associated diseases are colic, gastric ulcers, repetitive movement problems [so called stereotypy's], sleep deprivation, foot-hoof problems such as contracted heals or under-run heals, respiratory diseases [such as heaves], teeth problems, nutritional deficiencies, and the list goes on. For instance, we have solid research to verify that horses will not lie down unless they are confident about their surroundings. Solitary stall confinement housing for many horses is not comfortable surroundings. Stall size, lack of herd mate interaction, ventilation issues, bedding issues all contribute to confinement stress. The confinement may lead to sleep deprivation and poor performance. Research also confirms horses are designed to be in groups. Grouped horses may experience levels of stress, but this is normal, or natural, or a good stress; a solitary confined horse experiences bad stress! A possible resultant confinement disease: repetitive movement problems…so called stereotypy…also called "vices" [things like weaving, stall-walking etc]. Keeping in mind that stereotypy or vices are a complex disease with scores of influencing triggers; despite that, many repetitive movement problems can be significantly helped or eliminated by increasing turnout time, social interaction, and exercise.

We have solid research indicating pasture is curative for equine gastric ulcer syndrome for a high percentage of the cases. The cure is generally within two weeks of pasture turnout with no supplementary medication. Research authenticates in the young, developing horse, that free access to open space is essential for bone, ligament, and tendon developmental health. We also know horses on pasture have far fewer colic episodes and far fewer respiratory issues. The conclusion is firmly fixed; horses were designed for turnout and are healthiest when they have free access to wide open spaces with plenty of horse to horse interaction. So where is the situational "between a rock and a hard place"? The snag is the horse is equally not adapted to what I'll call "free-choice lush pasture access". By free-choice lush pasture access, I am referring to the east coast horse pasture state of affairs that is nutrient dense, succulent, and plant thick. This type of pasture allows a horse to lower his head at sunrise and eat until sunset with hardly taking a step. Herein lies the predicament: an "eat-till-you-burst" pasture condition is

regarded as the most powerful trigger recognized for laminitis [founder] in the horse; we are between a rock and a hard place. The question becomes: How can we manage this pasture challenge to prevent us from getting "*up the creek without a paddle"?* From a health-management perspective, it appears as though we are in a position we cannot untangle: laminitis or gastric ulcers, laminitis or colic, laminitis or a stereotypy, laminitis or heaves, and so on. I can assure you the management solution is not simple and there is no "one size fits all" solution. Let us start by trying to better understand the pasture-horse biological complexity that is such an effective trigger for "pasture associated laminitis" [PAL].

Delaware horse owners and regional veterinarians report that the emotional and financial toll associated with laminitis in our area is great. Nationwide, the USDA National Animal Health Monitoring System [NAHMS], reports that nearly 50% of the reported cases of laminitis in the United States occurred in animals kept on pasture; that is, pasture as the causative trigger to laminitis. In contrast, the NAHMS report identified situations typically associated as common triggers to laminitis such as grain overload, colic, diarrhea, and retained placenta caused less than 15% of the U.S. laminitis-founder cases. A recent comparable research paper out of The United Kingdom [England] reported that 61% of their laminitis cases were pasture associated. What is it about our pastures that on the one hand are so healthy for our horses, and on the other hand, potentially so devastating? The answer lies partially in the plant's biology, and partially in the horse's biology.

Pasture plants use the energy from sunlight to produce simple sugars; examples being glucose, sucrose, fructose, and the like. Plants then take these simple sugars and utilize them to build more complex structural carbohydrates such as cellulose, hemicellulose, lignin, etc. Cellulose, hemicellulose, and lignin are called structural carbohydrates because they are put to use within the plant's structural support system of the leaves, stems, and hulls; they hold the plant upright and give supporting shape to the plant leaves. These structural carbohydrates are commonly known to us as fiber or roughage. When plants produce simple sugars in excess of their need for building structural carbohydrates, they convert these excess sugars into storage carbohydrates and sequester them in storage parts of the plant to be used later. Plant seeds like oats, corn, and so on, many of which we use as horse feeds, are themselves plant carbohydrate storage vessels. The storage carbohydrates are more chemically complex than simple sugars, but not as chemically complex as the structural carbohydrates. Two key examples of storage

carbohydrates are starches and fructans. Starch is nothing more than a whole bunch of glucose sugar molecules hooked together in a chain; held in the chain by a chemical bond. Starch is the major storage carbohydrate produced by plants. Interestingly, common cool season grasses, such as timothy, Kentucky bluegrass, fescue, orchard grass, and perennial rye, accumulate the unique carbohydrate 'fructan' as one of their storage carbohydrates. Fructans bestow cold tolerance to the cool season grasses [antifreeze, if you will], as they bind to fragile cell membranes and prevent them from being damaged by freezing. On the other hand, common warm season grasses like Bermuda grass, crabgrass, and many of the native grasses accumulate starch as their principal storage carbohydrate. That is a very simplistic overview of pasture plant biology. Now for a quick summary of equine digestion, specifically carbohydrate digestion, before we link the two biology's together and form some pasture management principles.

As continuous grazing animals, horses are designed to digest plant structural carbohydrates as their essential source of energy. Keep in mind, the major structural carbohydrates for the horse are the cellulose and hemicellulose parts of the plant. These structural carbohydrates, cellulose and hemicelluloses are the most important source of fiber or roughage for our horses. Cellulose and hemicelluloses are not digested in the horse's small intestine; rather they pass on through the small intestine and end up in the large intestine, what we call the hindgut of the horse, specifically the cecum and large colon. Here they are acted upon by microflora [principally fermentation species of bacteria] living within the horse's hindgut large intestine. These special fermentation bacteria are especially adapted to digest the fiber that the horse would otherwise be incapable of digesting. Through a fermentation process, the cellulose and hemicellulose is converted into usable energy molecules called volatile fatty acids [VFA's]. The horse's hindgut large intestine will absorb these VFA's where they can be directly used for energy by some cells [like muscle cells]. By and large, most of the VFA's are turned into glucose within the liver for later energy use. A normal horse will obtain from 30-70% of their daily energy needs from VFA's; these percentages being highly dependent upon the horse's diet, such as the amount and ratio of grain and hay/pasture the horse is receiving daily. The more roughage-fiber a horse eats, the more he will use VFA's for energy; and we understand, the more our horse uses VFA's for energy, the healthier he will be.

Starch that plants produce, in contrast, is digested within the horse's small intestine. Inside the horse's small intestine, digestive enzymes split the starch into the elemental parts

[glucose sugar] for absorption. Keep in mind, the horse, being foremost a grazer, has a gut naturally programmed to digest structural carbohydrates, i.e. roughage-fiber. The biological effect of a digestive system adapted to digesting forage leaves and stems is such that the same system is adapted very poorly as a starch digester. This means when a horse is on a high starch diet [grains or rich grasses], it is to be expected that much of the starch will escape digestion in the small intestine, and find its way back to the hindgut large intestine. Here it creates havoc by entering into the fermentation cycle. Starch arriving at the hindgut goes through the fermentation process much too quickly, releasing harmful gasses, acid products, and other toxic products. These toxins continue killing off the good digestive bacteria ultimately altering the sensitive fermentation environment. This fermentation-altering development may lead to a fermentation crisis. A crisis, if left unchecked, will ultimately set into motion a cascade of events [a biological breakdown if you will], which in the end results in laminitis [founder].

Recall the earlier statement concerning cool season grasses and their production of the antifreeze called fructan; horses do not contain any enzyme within the small intestine to digest this fructan. This means 100% of fructans a horse eats reaches the hindgut. Here the fructan undergoes rapid fermentation, initiating that aforementioned cascade of events leading to laminitis. Research has clearly verified the fact that feeding large amounts of starch and/or fructan and their subsequent fermentation in the hindgut cecum and large colon can cause laminitis.

Knowing this little bit of plant biology and horse digestive biology, how can we then better manage our horses to "have the best of both worlds"; that is, to permit our horses as much access to the great, healthy benefits of pasture without overfilling them with too much fructan and starch leading to laminitis?

Most cases of pasture associated laminitis [PAL] occur in the spring and fall! Why? Plants are biologically preprogrammed at this time of year to make large amounts of carbohydrates, including starch and fructans. We all, through personal lawn care experiences, know this biological truth; our lawns like our pastures are lush in the spring and fall. This means if our horses overeat when pastures are lush, depending upon the pasture plant species, many fructans and/or starch will get into the hindgut fermentation cycle. A second question to then ask: just how easy is it for our horses to over eat? **Fact: For most horses and ponies at minimal work, grazing on lush pastures for just 6 hours grazing-time supplies 100% of the**

**horse and pony's daily energy requirements.** However, even though our horse or pony have ingested enough energy calories in 6 hours to meet their daily energy requirements, your horse has not fully satisfied his biological chewing needs. As a trickle feeder constantly on the move, horses appear to have a biological need to chew for 12-14 hours per day or more. Deny your horse his biological chewing need and he will head for the fence or stall door to chew upon. This means we must somehow limit free access to lush pastures [or our horses and ponies will over eat], but at the same time, satisfy their hard wired biological requirements for social interaction, chewing time, and freedom to move about.

We can manage our catch-22 in several ways; the least acceptable is putting your horse in a stall for the many reasons listed above. Now you see the management "caught between a rock and hard place". Sacrifice lots, muzzles, or poor quality pastures offer some alternatives. Leaving your horses to eat for 6 hours and then fast for 18 hours is bound to lead to many problems. Therefore, if restricting grazing time is your management choice, I suggest restricting grazing to 2-4 hours per day. This will supply approx. 50% of the horse or pony's energy needs. Then complete the diet by feeding your horse or pony 1% of their body weight with a laboratory tested average quality grass hay. This will provide adequate chewing time, especially if you divide the hay into two equal amounts. One can also graze warm season grasses at high-risk times of year; this effectively reduces the fructan level, but does not necessarily reduce the overall starch amount. Your horse can still be taking in too much lush pasture. Previously foundered horses or ponies require special management attention along with your veterinarians input; they may need to be completely restricted from lush spring and fall pastures.

Not all horses are equally sensitive to pasture associated laminitis [PAL]. Horses differ in their phenotype [body type] and metabolic profiles…the so called "easy keeper". These guys require special precautionary attention. The same is true with horses with high body condition scores [BCS], that is, an overweight horse or pony. Likewise, for ponies and horses having or suspected of having metabolic syndrome and/or insulin resistance, these animals require proactive precautionary steps. It appears that being overweight and/or having insulin resistance lowers the trigger threshold to PAL for horses and ponies. The just described "easy keeper" horse that has a pattern of overeating season after season is an example of a probable PAL horse developing over years versus one spring turnout. The management health decisions we make today may very well have long term consequences [good or bad] on our horse's life-long health.

A couple of additional points to keep in mind in closing:

- It takes 2-3 weeks for large intestinal microbe adaptation [i.e. the fermentation bacteria] to occur when changing to a different feed type or source; therefore when switching pastures, introducing horses to new pastures, introducing new hays, changing hays, or introducing horses to new feed sources of any type, make changes slowly and gradually over two or three weeks. For new pasture introductions, starting off at one hour per day is plenty…then gradually increase grazing time by increments not to exceed 1 hour per day or 1 hour every other day to your set goal grazing limit. I also suggest feeding some hay prior to daily turnout as this will somewhat satisfy your horse's appetite, and he will be less likely to gorge on fresh grass.
- Provide free access to fresh water and salt.
- If additional vitamins, minerals, or protein are necessary to balance a pasture based diet, use a vitamin mineral protein supplement designed for "pasture" supplementation, or for "horses on a forage-based diet".
- Monitor body condition score and weight monthly. Re-calculate feed amounts [grazing time allotments] monthly, based on changes noted and desirable BCS and body weight.
- Muzzle you horse or pony if you can't restrict pasture time and for horses and ponies with high BSC horses. Muzzles permit horses and ponies to graze small amounts of grass continuously throughout the day, dramatically limiting total pasture intake. Horses can drink while wearing a muzzle, Muzzles may rub creating sores, horses may rub the muzzles attempting to get them off creating sores, and horses get muzzles caught on things when they rub them. For these reasons, muzzles do require close animal supervision as not all horses tolerate wearing a muzzle.
- If your horse[s] have a minimal need for pasture forage, you may not need to have an aggressive pasture fertilization program. Be careful with this recommendation, as neglecting pasture maintenance may lead to stressed pasture plants followed by weed invasion. Also, poorly maintained pastures tend to die out in summer, leaving your horse nothing but an overgrazed pasture for food.
- Remember: Starch and fructan concentrations are difficult [if not impossible] to predict on pastures and it is impossible to know the tolerances of individual horses; be proactive!
- Exercise…Exercise…Exercise… Most of our horses get insufficient exercise, remember the natural horse illustrated in the beginning of this paper: It is accepted that "Horses by design are animals adapted to the wide open spaces. They are social animals constantly on the move". Recently, scientists have monitored horse movements in the wild using GPS technology. They have made the discovery that horses routinely walk 25, 50, up to 100 miles per day in their travels from place to place and activities interacting with other horses. This is one reason why horses in the wild rarely founder; they are in constant motion and constantly on the move. As we previously stated, the natural horse is programmed to eat a little, and then move a little and so on. You can use this knowledge to relieve confinement stress even when feeding hay in your stall. Instead of throwing all their hay in a pile, spread it around the wall perimeter of the stall, it will take a little extra effort, but your horse will be less stressed having been given the opportunity to move as he eats. You can also use our biological horse knowledge as encouragement for you to exercise you horse on a regular basis; I suggest at least 5 days per week. As to how far; how long? Horses were designed to move, you and I must provide the opportunities.