

UNDERSTANDING LAMINITIS

Causes and how a sensible diet can help

By Dr Tim Kempton

Laminitis is a complex disease which involves inflammation and of the horse's hoof laminae (the structures which suspend the pedal bone from the hoof wall).. When hoof laminae become inflamed they lose their integrity, and allow the weight of the horse to drive the pedal bone downward through the hoof, damaging arteries, veins, the corium of the coronet and the sole of the hoof. There can also be excessive hoof growth, so that the hoof wall grows away from the pedal bone, causing the hoof integrity to be compromised. Once the pedal bone moves the condition is then referred to as **founder**.

Laminitis and founder causes severe pain and in acute situations, euthanasia is the only humane option. Laminitis is the second most common cause of death in horses worldwide.

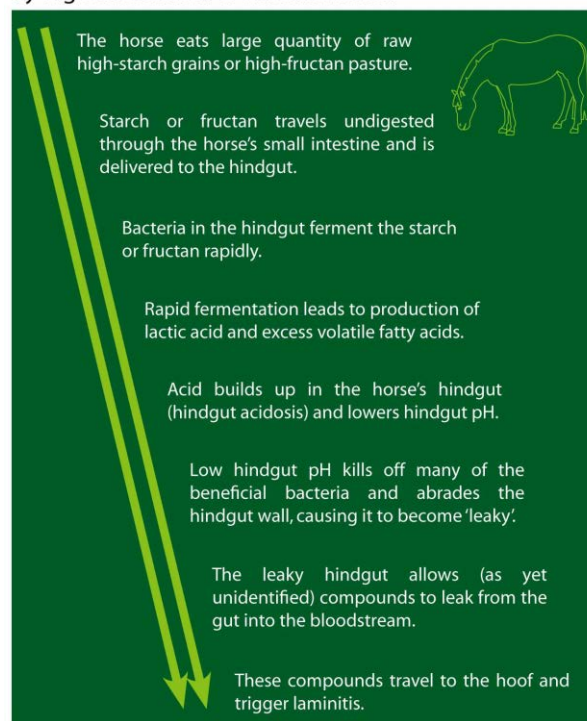
The good news is that laminitis is largely preventable. There are some simple measures that horse owners can take to help prevent it. The key to prevention is understanding what causes laminitis and avoiding the feeds and situations that may put your horse at risk.

What causes Laminitis?

There are numerous hypotheses as to the causes of laminitis. The two most common causes of laminitis are diet related.

1. **Acidosis related laminitis (hindgut acidosis)** caused by the overfeeding of high starch feeds or feeds that cause carbohydrate overload. These carbohydrates, and in particular the sugar fructan which is contained in many pastures, passes undigested into the hindgut, where it is fermented to volatile fatty acids, and lactic acid, where they cause the pH of the hindgut to decrease (acidosis). This causes major changes in the types of microbial organism living in the hindgut. Research by Pollitt

Diagram 1. The process of how laminitis can be caused by high starch and/or fructan intake.



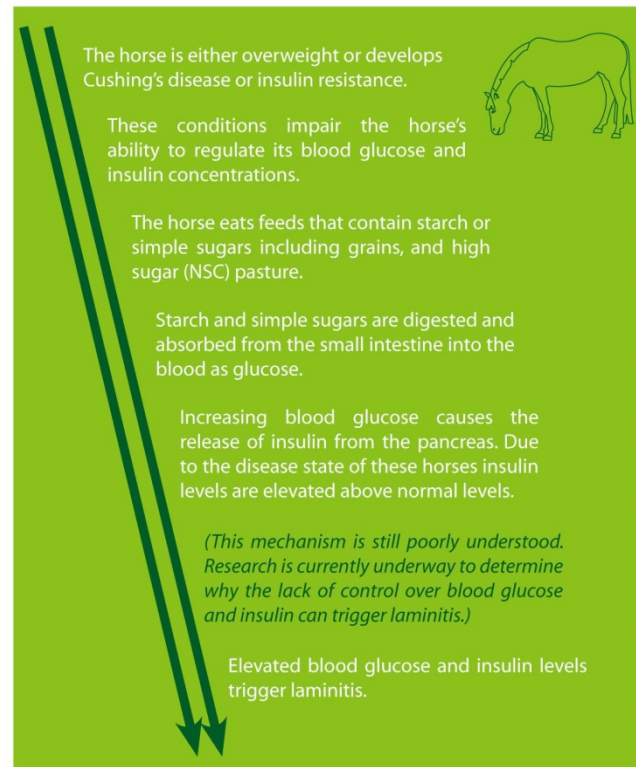
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(2008)(1) has shown rapid increases in the numbers of the bacteria *Streptococcus lutetiensis* prior to the onset of laminitis. It is suggested that the death of these organisms, and the release of microbial endotoxins is associated with the onset of laminitis. All horses are susceptible to this form of laminitis. Diagram 1 explains how laminitis is caused by starch and fructan, particularly in horses at pasture, or horses fed high starch diets.

2. High NSC feed related laminitis (Endocrinopathic laminitis). Horses that are fed high nonstructural carbohydrate (NSC) feeds that are digested in the intestines, are susceptible to this form of laminitis. (Diagram 2).

These horses are usually obese, often insulin resistant, and having Equine Metabolic Syndrome (EMS). It is generally accepted that high NSC diets (>11% NSC) will contribute to laminitis, however the science is being debated. One theory is that at a holistic level, when animals receive a balanced diet, the intestinal micro-organisms attempt to live in balance with the host animal, termed **symbiosis**. In contrast, **dysbiosis** is when there is overgrowth of these normal organisms, caused by an oversupply of digestible nutrients. The overgrowth of organisms are, thought to cause an excessively permeable intestine, and/or a perforated hindgut, termed “leaky gut syndrome” Microbial population upsets and subsequent damage to the intestinal mucosa allows leakage of sugar molecules, bacteria and pathogens into the bloodstream. The higher than normal circulating blood sugar causes the cells to become resistant to insulin, disrupting glucose transport into the cells. The high blood sugar also stimulates the adrenal gland to increase cortisol production, which may cause damage to the lamellar structures in the hooves. The net effect is inflammation, laminitis and then founder (2).

Diagram 2. The process of how endocrinopathic laminitis can be caused in horses with impaired ability to regulate their blood glucose and insulin concentrations.



How can Laminitis be prevented?

Laminitis is a preventable disease. As a basic rule of thumb, keep your horse in trim (not fat) condition, exercise, and preferentially feed low-starch, low-sugar (low NSC) feeds.

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1. **Weight management**

Do not let your horse become obese or overweight. Horses carrying excess weight are more likely to have insulin resistance, EMS and thus are more susceptible to laminitis. However, if you do need to put weight on a thin horse eg suffering from Cushing's disease, or insulin resistance, use a low NSC, low sugar feed like CoolStance, CoolBeet, sugarbeet pulp or soybean hulls.

2. **Choose fiber for energy**

Use low NSC forage and high energy fibers, such as CoolStance, to meet your horse's energy (calorie) requirements where possible, without feeding starch. If the hay has high levels of NSC, then it will have to be soaked prior to feeding. Only use grains or grain based feeds if absolutely necessary to top up your horses energy requirement.

If you do choose to feed grain, preferably only feed processed grains. This may reduce the risk of starch being delivered undigested to the hindgut. NEVER feed grain or grain-based feeds to overweight horses, horses with Cushing's disease or insulin resistance or horses that have previously had laminitis.

3. **The right pasture & forage**

Be vigilant with the type of pasture and hay you feed. Most forages have been developed as feeds for cattle, and can have high levels of NSC, such as fructan (which can cause acidosis related laminitis) and simple sugars like glucose and sucrose (the high NSC can trigger endocrinopathic laminitis). If you are concerned about the levels of these carbohydrates in your pasture or hay you can have the level of NSC tested (*see www.safegrass.org*)

If you are concerned about NSC levels in your pasture, only allow your horse to graze in the very early hours of the morning when NSC levels are lowest. Temperate pasture species like ryegrass and herbs like chicory and plantain accumulate the highest levels of NSC and should be avoided. Choose low NSC pastures, and graze when the NSC levels are lowest.

4. **Supplementary feeds.** If you supplementary feed, then select those feeds that have a low NSC and digestible fibre (see article on Selecting Suitable Feeds).

5. **It's all about balance**

The horse's hoof quality is affected by all nutritional components including protein, fat, carbohydrates, vitamins and minerals. Balancing these components is vital for overall hoof health and function. As tough as the hoof may seem, the hoof wall is primarily 95% keratin, which is an insoluble protein similar to that in hair and wool. The hoof also contains oils, which are responsible for maintaining the barrier to water loss across the hoof wall. Healthy hoof repair and maintenance therefore requires a balanced diet,

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which also provides the sulphur containing amino acids required for keratin synthesis, and oils for tensile strength and moisture content.

COOLSTANCE FOR LAMINITIS PREVENTION AND HOOF REPAIR

Farriers report that when pasture fed lame and laminitic horses were fed CoolStance, there was improvement in hoof condition and reduced lameness. The composition of CoolStance is given below. In summary, CoolStance contains <12% NSC, 22% protein (containing methionine and cystine), and 8% coconut oil, (which is rich in the medium chain triglycerides lauric and caprylic acid), and reasonable levels of copper and zinc.

The effects of CoolStance on laminitis are thought to be due to

1. **Low NSC.** The low NSC content (<11%) in CoolStance reduces the sugar and starch overload in the stomach, and the amount entering the small and large intestines. This reduces the probability of ulcers, of microbial population upsets in the intestines, and acidosis in the hindgut.
2. **Gut health.** The lauric and caprylic acids in the coconut oil are reported to have antimicrobial actions, that promote intestinal health. It is suggested that the coconut oil prevents ulcers in the stomach, and dysbiosis (leaky gut) in the intestines. The high level of the amino acid glutamine is also associated with reduced ulceration of the stomach.
3. **Hoof horn quality.** The main precursors to keratin formation for wool and hoof growth are the sulphur containing amino acids cystine and methionine. CoolStance promotes wool growth in sheep, and it is the high levels of methionine and cystine in CoolStance that promotes hoof repair and integrity in laminitic horses. The high oil content in CoolStance could also assist moisture retention in the hoof. The zinc content in CoolStance is useful to promote hoof integrity.

CoolStance

***CoolStance** is a safe feed for all horses including those suffering from, or at risk of laminitis. **CoolStance** contains less than 1% starch and less than 11% non-structural carbohydrate (NSC), meaning it will not cause acidosis related or endocrinopathic laminitis.*

***CoolStance** also contains digestible fiber, oils, and sulphur amino acids, making it a high energy feed suitable for all types of horses to reduce laminitis and improve hoof integrity.*

***CoolStance** can be fed safely to horses with Cushing's disease and insulin resistance or horses that have previously suffering from laminitis.*

COMPOSITION OF COOLSTANCE

<i>Typical composition of CoolStance® (g/kg Dry Matter)</i>	
<i>Dry Matter</i>	90%
<i>Crude Protein (min)</i>	>20%
<i>Digestible Energy</i>	1.63MCal/lb
<i>Oil (min)</i>	8%
<i>Non Structural Carbohydrates (NSC)</i>	11%
<i>Crude Fiber (max)</i>	20%
<i>Calcium (min)</i>	0.07%
<i>Phosphorus (min)</i>	0.5%

<i>Medium Chain Triglycerides in CoolStance® (%in the oil)</i>	
<i>Lauric</i>	49%
<i>Myristic</i>	18%
<i>Capric and caprylic</i>	15%
<i>Palmitic</i>	8%
<i>Oleic</i>	6%

<i>Amino acids in CoolStance® (g/kd DM))</i>	
<i>Arginine</i>	25%
<i>Asparagine</i>	16%
<i>Glutamine</i>	26%
<i>Leucine</i>	13%
<i>Cystine</i>	8%
<i>Methionine</i>	4%

References:

1. Pollitt CC (2008). *Equine Laminitis Current Concepts*. Rural Industries Research and Development Corporation, Australian Government.
2. <http://barefoothoofcare.wordpress.com/2007/01/16/relationship-of-dysbiosis-to-insulin-resistance-laminitis/>

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