Equine Metabolic Syndrome Explained

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Equine metabolic disorders, with particular reference to Equine Metabolic Syndrome (EMS) and Insulin Resistance (IR), have received a lot of attention in the Equine press of late. EMS is the name that has been adopted to describe conditions including peripheral Cushing's syndrome, pseudo-Cushing's syndrome, hypothyroidism, and insulin resistance syndrome. Less common names included omental Cushing's syndrome or central obesity. EMS is characterised mostly by insulin resistance.

Horses that are affected by insulin resistance need special management to maintain their health, so it is important that as a horse owner, you understand what insulin resistance is, recognise the risk factors and know how to manage affected horses.

What is insulin resistance?
Insulin is a hormone produced by the pancreas to control blood glucose levels. When feed containing non-structural carbohydrates (NSC) - like simple sugars or starches - are eaten, they are digested and absorbed into the blood as glucose. Insulin is then released to signal to the muscle and liver cells to absorb the glucose, and to promote glycogen formation. Once glucose is absorbed and the glucose concentration in the blood drops back to normal levels, the insulin is broken down and insulin levels also return to normal.

Insulin resistance is where the body's cells become less sensitive to the effects of insulin on glucose uptake (1). The cells become more resistant to the effects of insulin on glucose uptake, and so higher levels of insulin are required to maintain normal blood glucose levels after a high-sugar or high-starch (high NSC) meal.

Insulin Resistance
Causes

- **Diet** – A high NSC diet can cause increased insulin resistance compared to high fiber and fat rations, even in non obese horses. The role of high NSC feeds is emerging as a major factor in the development of insulin resistance.
- **Obesity** - Overweight horses tend to be insulin resistant, as are "easy keepers" even if they are not obese. Horses that appear to be relatively lean, but have fat accumulations above their eyes, in the crest of their neck or alongside the base of the tail also appear to be at risk of insulin resistance. Horses with Equine Cushing's Disease generally exhibit some level of insulin resistance.
- **Age -** Old horses (>20 years) seem to be more prone to insulin resistance, probably secondary to pituitary dysfunction (Cushing's disease).
- **Breed -** Ponies were found to have higher degrees of insulin resistance than Dutch Warmbloods or Standardbreds. Breeds that are prone to developing cresty necks and obesity, such as Morgans and some lines of Arabians, Quarterhorses, and Thoroughbreds may be more likely to develop the problem, although a study

conducted at the University of Connecticut comparing exercising Morgans and exercising Thoroughbreds did not find a difference between breeds in insulin resistance.

- **Laminitis** - Horses with a family history of laminitis and horses that develop laminitis without an obvious cause (grain overload, sudden access to lush, green grass) may be insulin resistant

Role of NSC in Insulin Resistance

Insulin resistance is the reduced sensitivity of the cell to the effects of insulin on glucose uptake. If the supply of glucose into the bloodstream is increased, by feeding high NSC feeds, then the effect is exacerbated. High NSC feeds will supply high levels of circulating glucose. It is also postulated that the high levels of digestible sugars in the intestines can cause DYSBIOSIS, ie the overgrowth of normal populations of organisms, which can lead to "leaky gut syndrome". Under these conditions, there is flooding of sugar into the blood, which in turn causes irregular insulin production, or insulin resistance. The high levels of blood sugar can also cause the adrenal gland to increase cortisol production, in turn causing laminitis.

What happens if a horse has insulin resistance?

The most serious implication of insulin resistance is laminitis. Recent research conducted by Asplin and co-workers at the University of Queensland has shown that high levels of insulin circulating in the blood induced Obel Grade 1 laminitis within 36 hours which later progressed to Obel Grade 2 laminitis in all 4 feet in otherwise clinically normal ponies. Thus it is possible that if your horse is overweight and has insulin resistance it will be at a much higher risk of developing laminitis.

Can insulin resistance be cured?

Research suggests that exercise, a controlled diet and a healthy weight-loss program can help to restore a horse's insulin sensitivity in obese horses. In a study conducted by Freestone and co-workers in 1992, they found that within 2 weeks of commencing controlled feed intake and an exercise program (which was 1 minute of walking, 1 minute trotting and 8 minutes of extended trot or canter) the ponies lost weight and regained some of their insulin sensitivity.

For horses with a lean body but patchy fat distribution it is possible that exercise will help to reduce the severity of insulin resistance. However, for horses with Cushing's Disease, insulin resistance is part of the syndrome, and careful dietary management is required to avoid the risk of laminitis.

What should insulin resistant horses be fed?

A feeding program for insulin resistant horses should aim to:

1. Encourage weight loss where required; and
2. Avoid high NSC feeds that will cause a rise in post-feeding blood glucose and insulin concentrations.

For horses needing to lose weight, a low non-structural carbohydrate hay such as weather damaged alfalfa or a very fibrous mature grass hay and a good quality vitamin/mineral supplement is all they are going to need until their weight is under control. This diet should be combined with a gentle exercise program to help with the weight loss.

For leaner horses with insulin resistance, leaner horses that have previously had laminitis, horses prone to insulin resistance who are in work, or affected horses that just have trouble maintaining weight, a higher quality diet will need to be fed in conjunction with low non-structural carbohydrate hay or pasture. A list of suitable feeds and forages and a list of those that should be avoided for these insulin resistant horses can be found below:

Suitable Feeds	Feeds to Avoid
▪ Stemmy/mature pasture hay	▪ Ryegrass hay or any high starch hay
▪ Copra Meal	▪ Oaten hay
▪ Beet pulp (soaked then drained)	▪ Grains or grain by-products
▪ Soybean hulls & Full fat soybean	▪ Any sweetened feed (molasses, etc)
▪ Vegetable oils	▪ Pastures that are stressed

Why should these feeds be avoided?
The feeds in the 'to be avoided' list often contain high levels of sugars (often called non-structural carbohydrates or NSC). When eaten, these feeds release glucose into the horse's bloodstream which triggers the release of insulin. If a horse is insulin resistant, the amount of insulin released into the body will be far more than normal and it will stay in the blood longer. It is this persistent high level of insulin that researcher now believes leads to laminitis in susceptible horses.

The feeds that are listed here as 'suitable' contain low levels of non-structural carbohydrate and are less likely to cause a rise in blood insulin levels, making them much safer for affected horses.

Getting the balance right
Getting the dietary balance right is critical to maintaining insulin resistant horses in the best health possible. Whilst you must reduce an obese horse's calorie intake, their protein, vitamin and mineral requirements must still be met. Failure to meet these requirements can (and often does) result in poor skin, coat and hoof health and will probably predispose the horse to other diseases and health problems.

Selecting the right horse food
Are there foods that can help my horse with this condition?

Yes, many premium foods are being developed. Look for any of the new foods with a low NSC (ie less than 11%); particularly foods containing premium copra meal as it is an ideal feed for horses suffering with insulin resistance. It contains virtually no starch, very low sugar levels and instead provides energy from oil and digestible fiber.

Reference: http://www.extension.uconn.edu/ansci/ext/insulinresistance.htm

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

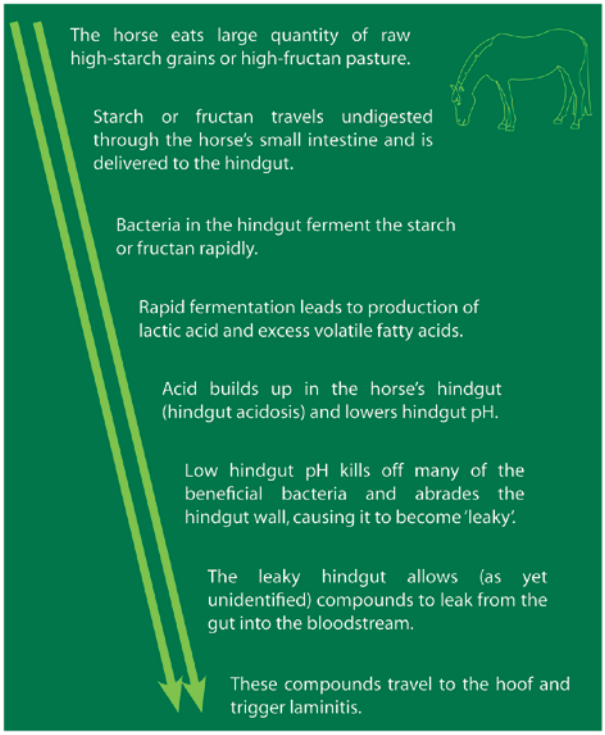

Diagram 2. The process of how endocrinopathic laminitis can be caused in horses with impaired ability to regulate their blood glucose and insulin concentrations.