has also had positive results. For example, horses supplemented with 5 mg chromium had a lower insulin response to a grain meal than when unsupplemented.[19] In addition, chromium supplementation in young horses has enhanced metabolism of glucose following an oral glucose load.[20] A protective effect of magnesium against type II diabetes has been documented in humans as noted by the association between low magnesium intake and elevated fasting insulin and insulin resistance[21] and an increased risk of metabolic syndrome.[22] Individuals with type II diabetes have benefited from magnesium supplementation, as partly indicated by improvements in fasting insulin.[23] Therefore, chromium and magnesium supplementation could benefit horses with insulin resistance and EMS by enhancing insulin's ability to draw glucose into cells.

A final nutrient that improves glucose utilization and insulin sensitivity is carnitine, which transports fatty acids into mitochondria where they are converted to energy. Carnitine improves glucose oxidation in laboratory animals.[24] Among healthy and diabetic humans, carnitine enhances insulin's ability to remove glucose.[25,26] Carnitine supplementation has also increased rates of weight loss when in conjunction with reduced caloric intake.[27]

Putting it into Practice

- To control the glycemic load, reduce or eliminate the intake of grain and other feeds high in non-structural carbohydrates.
- To establish a healthy weight, reduce total feed intake, and supplement with Platinum Performance™ Equine to maintain adequate intake of vitamins, minerals, antioxidants and omega-3 FAs.
- To help control blood glucose levels and insulin action, supplement with omega-3 FA, antioxidants and minerals, such as those provided in Platinum Performance™ Equine, Platinum Antioxidant™, Platinum Metabolic Support™ Formula, and Beta Lipox™.

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Metabolic Syndrome: Feeding to maintain health

Tara Hembrooke, PhD, MS and Meri Stratton Phelps, DVM, MVPM, DACVIM, DACVN

As an increased number of horses are being diagnosed with equine metabolic syndrome, diet strategies to prevent and reduce complications from this disease have become very important. Platinum Performance™ offers several products that provide key nutrients to help maintain proper metabolic functioning. For example, Platinum Performance™ Equine, Beta-Lip-Ox™, Platinum Metabolic Support Formula™, and Platinum Antioxidant™ are important tools in managing horses with equine metabolic syndrome.

Understanding Equine Metabolic Syndrome

The equine metabolic syndrome (EMS) has recently been recognized as an important clinical disease syndrome. Horses affected by EMS are often described as "easy keepers" and are usually overweight with a body condition score greater than 7/9. Laminitis often affects horses with EMS and can cause devastating consequences.

Excessive weight gain occurs when horses consume more energy than they require. Excess dietary energy is converted into fat, which is stored in the horse's abdominal cavity and external sites. A crested neck and fat pads on the back, around the tail, and in supraorbital areas are often noted. A genetic predisposition has been linked to EMS.[1,2] Frequently affected breeds include ponies, Paso Finos, and Morgans, but EMS has been observed in many other common breeds.[3] Age is also a factor in EMS; most horses are diagnosed between 5-18 years of age.[1,4]

A hallmark of EMS is insulin resistance, which is described as a tissue's inability to respond appropriately to insulin. Therefore, horses with EMS have abnormally high blood glucose concentrations. Serum insulin concentrations are also elevated due to its overproduction by the pancreas to compensate for poor insulin action. For this reason, fasting blood insulin is often used as a screening test for EMS.

Insulin resistance may predispose EMS horses to develop laminitis if glucose cannot be adequately delivered to hoof tissue.[5,6] An additional complication of insulin resistance occurring in humans is a decrease in peripheral vasodilation. If this same vascular change occurs in the equine hoof, laminitis could be worsened.

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Improving Outcomes Using Platinum Performance

To determine the benefits of Platinum Performance™ on metabolic parameters associated with insulin resistance or EMS, researchers at the University of California at Davis measured insulin and glucose responses of horses consuming meals of alfalfa and oat hay before and after 6 weeks of supplementation with Platinum Performance™ Equine. Fasting blood glucose was significantly lower after the supplementation period (Figure 1). Although not clinically elevated, the pre-supplementation values mirror the average resting plasma glucose values obtained in a characterization study on obese horses with insulin resistance.[3] Figure 1 also shows that in the first 60 minutes after an afternoon feeding of oat hay, blood glucose was significantly lower in horses supplemented with Platinum Performance™ Equine. In addition, peak serum insulin was 44% lower following a meal supplemented with Platinum Performance™ Equine than the non-supplemented meal (data not shown). Effects of Platinum Performance™ on fasting blood glucose have also been determined in mice genetically modified to model type II diabetes in humans. A study conducted at the University of Georgia demonstrated that, after 8 weeks, Platinum Performance™ supplemented mice had a 30% lower average fasting glucose value than non-supplemented mice (Figure 2), as well as an 8% drop in body weight, and significantly improved vascular function (data not shown).

Figure 1. **Fasting and Post-Prandial Glucose Response in Adult Horses Supplemented with Platinum Performance™ versus Non-Supplemented**

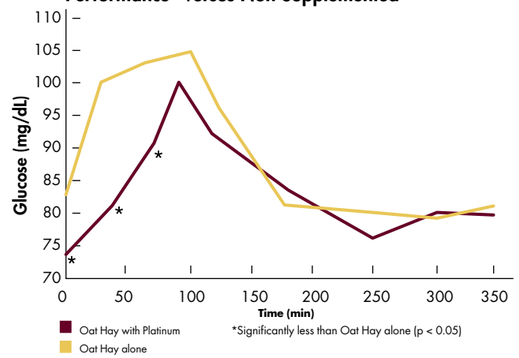
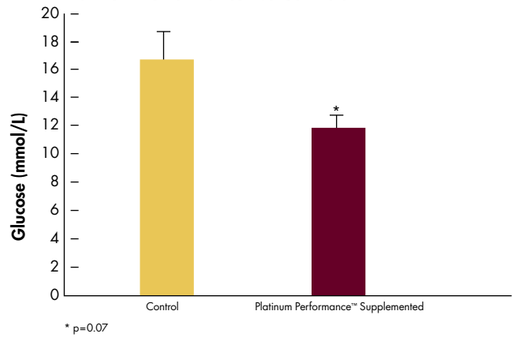


Figure 2. **Fasting Glucose in Mice Supplemented with Platinum Performance™ vs Controls**



Recent concern has been raised about possible effects of glucosamine supplementation on blood glucose levels in horses. To test this theory, researchers at Platinum Performance monitored blood glucose levels in horses consuming a meal supplemented with Ortho-Chon II HA which provides a daily dose of 7,500mg of Glucosamine Sulfate. After 3 weeks of supplementation, there was no significant rise in post-prandial blood glucose seen in the supplemented group over that seen in the non-supplemented group. Therefore, Ortho-Chon can safely be incorporated into equine joint care programs without fear of causing glucose dysregulation or increasing the risk of developing metabolic syndrome.

Managing Horses with EMS

Diet and Exercise

Calorie restriction and exercise are the predominant recommendations for the prevention and treatment of EMS.[2,7] Weight loss results in a decrease in body fat and often improves insulin sensitivity and glucose regulation. Platinum Performance™ Equine can be added to a horse's weight loss ration to ensure a balanced intake of all essential nutrients, despite the reduced feed intake.

Other management strategies exist to improve glucose regulation and decrease insulin resistance. Grain and other high non-structural carbohydrate (NSC) concentrate feeds should be eliminated. EMS horses should also have partially or completely restricted access to grass pasture to prevent consumption of fructans, a water soluble carbohydrate implicated in pasture-associated laminitis. Horses should be fed hay or a commercial complete feed with a low NSC content (e.g., <12%).[7] In addition, various supplements may prove beneficial, including omega-3 fatty acids (FA), antioxidants, chromium, magnesium, and carnitine.

Supplements

Omega-3 FAs have been shown to improve insulin sensitivity in rats[8,9] and humans[10,11] and help control glucose metabolism by optimizing cell membrane fluidity, improving insulin receptor signaling, and activating gene transcription. Omega-3 FAs also reduce systemic inflammation, which may be beneficial in horses suffering from laminitis.

Oxidative stress is a unifying factor in the occurrence of obesity, insulin resistance, and metabolic syndrome. In laboratory studies, elevations in oxidatively-damaged lipids can result in reduced insulin secretion and sensitivity.[12] Supplementation with vitamin E, a fat-soluble antioxidant, has resulted in improved glucose utilization and insulin sensitivity.[13,14] Also, insulin sensitivity improves in humans with impaired glucose tolerance supplemented with vitamin C, a powerful water-soluble antioxidant.[15] Considering the human data mentioned, as well as other animal studies, antioxidant supplementation should be considered a strong defense and offense against insulin insensitivity and subsequent disease development.

Chromium and magnesium are minerals that influence the action of insulin through facilitation of insulin signaling, which makes them critical nutrients in glucose metabolism. Supplementation with chromium has improved insulin sensitivity in animals[16,17] and humans.[18] Chromium supplementation in horses