The Role of Speedi-Beet for Racehorses

Energy metabolism

At rest energy needs of racehorses are met by mainly carbohydrate and fat metabolism. Some protein metabolism provides energy but it is mainly a by-product of protein regeneration. In the forage fed horse the carbohydrate faction is derived from bacterially fermented fibres in the large intestine, with small amounts of lipid absorbed from the small intestine. In the working horse high quality carbohydrate and fat sources are fed with a greater potential for providing the energy required to maintain high levels of exercise.

The horse, however, can only generate limited amounts of carbohydrates lysing enzymes and there is always a danger of over providing carbohydrates, which, if fermented in the large intestine, can lead to nutritional disorders. Increasingly in the feeding of the performance horse incorporates the use of fat to provide high-energy alternatives to carbohydrates.

Feeding fat does have the advantage of reducing heat production in the large intestine from fermenting starches and, by influencing the rate of glucose breakdown allowing the build up of glycogen in the muscles and liver.

When a horse is undergoing heavy exercise, glucose in the muscles is rapidly oxidised releasing energy in the form of ATP (Adenosine Tri-Phosphate), which drives muscular contraction. Additionally fats are also oxidised which provide energy. As exercise continues and blood levels of glucose and fatty acids drops, these precursors are regenerated from the breakdown of glycogen (gluconeogenesis) and from fat mobilization. Due to the efficiencies of these two mechanisms rapid exercise is mainly driven by gluconeogenesis whilst endurance exercise is driven by fat catabolism.

It is due to this for the racehorse, where competitive exercise consists of maximum muscular activity for relatively short periods of time, supplementation takes the form of highly digestible carbohydrates. In order to aid the breakdown and absorption of these products the use of micronized materials provide gelatinized starches, which are significantly less resistant to enzymatic breakdown.

During rapid, sustained exercise absorbed glucose, circulating in the bloodstream undergoes glycolysis to tricarboxylic acid, which enters the Krebs cycle; the entire process generates ATP, which is utilized in muscle contraction. Carbohydrates from fermentable fibre enter this process and cycle at various points therefore contributing lower levels of ATP. As it is a oxidative process adequate oxygen is required to help fuel the process.

For short periods of exercise (as in the case of a wild horses avoiding a predator) this energy generation is sufficient and the animal can return easily to rest, ready to resume activity immediately. For longer periods – such as that undergone in racing – exercise exceeds the ability of the bloodstream to supply sufficient oxygen to completely oxidise glucose and glycolysis will start to proceed without oxygen (anaerobically). Instead of TCA (Tri-Carboxylic acid) entering the Krebs cycle glucose is broken down to lactic acid, which must be removed from the system. The presence of lactic acid acidifies the muscles interfering with enzymatic function of muscle contraction and leads to fatigue.

Energy requirements

The energy requirements of horses are well documented. Whether it is NRC (National Research Council) recommendations or those by companies supplying complete horse feeds it is reasonably easy to calculate the energy requirements of a horse in various forms of exercise. Where problems arise is in the need to provide extra energy for an animal, which has a poor appetite in relation to its size. The stomach of a horse is small and its requirement of a minimum amount of fibre as forage (in order to allow correct functioning of the hind gut) often means a compromise between intake of readily available energy, as starch or fat, and hind gut fermented energy.

The horse has evolved to provide the bulk of its energy from carbohydrates, which are the result of fibre fermentation in the hind gut. The racehorse has been bred to exert itself over relatively short distances and, in doing so, expends high levels of energy. For example daily maintenance energy requirements of a 500kg horse is approximately 68MJ of Digestible Energy (DE) per day. A further 80MJ of DE/day is required for a horse training and racing, more than doubling the energy intake needed per kilo of feed fed. Only by reducing forage intakes and offering cereal/oil-based diets can this be achieved.

Muscle recovery rates

A further factor for consideration when planning the feeding of a racehorse is the recovery from fatigue. As mentioned earlier fatigue is a physiological result of the build up of toxic end products, such as lactic acid, in the muscles. Lactic acid results from inefficient oxidation of glucose breakdown and will accumulate in the muscles unless removed, either physically via the bloodstream or by enzymatic metabolism back to glycogen.

Additionally deamination of adenine nucleotides result in a rise of NH3 in the plasma, which interferes with enzymatic control of the Krebs cycle allowing a build up of pyruvate, which is converted to lactic acid. These build ups of lactic acid occur initially when insufficient oxygen reaches the muscles and will continue after the animal stops exercising. When activity ceases oxygen flow will enable the reversal of lactic acid build up through gluconeogensis and conversion to glycogen (glycogenolysis).

Recent research has shown that, during the period immediately after exercise that the animal's ability to clear glucose from the bloodstream and generate glycongen is greater than if the animal was not exercised. However if carbohydrate or fat rich diets were fed prior to exercise the rate of glucose uptake was reduced, due to a build up of metabolites such as Glucose-6-Phosphate, diverting to glucose metabolism to glycogenolsis. Although glycogen is critical in maintaining energy for muscular activity, using glucose directly is more energy efficient.

The fibre constituent of feed may also affect the glucose/glycogen supply to the muscles. When Lucerne was fed to a 24 hr fasted horse there was an increase in catecholamines during exercise, an increase in fat mobilisation and a sparing on glycogen reserves; these factors improve muscle recovery rates.

Feeding various fibre sources, contrary to popular conception, does not affect racing performance. High fibre diets do not adversely affect heart rate, respiration rate and lactate concentrations before or during exercise, changing the source of fibre has no effect on cardiorespiratory and metabolic function or on endurance performance. However when using low quality forage such as straw can lead to increased lactate levels and hypoglycemia. As feeding diets high in carbohydrates can affect glycolysis by diverting glucose catabolism to glycogenolysis, and therefore reduce glucose available for instant muscular exercise it is sensible to maintain fibre intakes which can maintain glycogen reserves without reducing the levels of blood glucose.

Benefit of Speedi-Beet
Speedi-Beet is a unique, heat processed sugar beet pulp which has several benefits, both as a traditional fibre source and as a supply of high quality soluble NSP.

Because it is high in pectin's and low in Arabinoxylans and B-glucans it contains readily degradable carbohydrates. The cellular structure is disrupted giving easily available nutrients for enzymatic digestion and a greater availability of fibre for hind gut fermentation. In addition soaking time is drastically reduced and the water binding capacity of Speedi-Beet in the gut is likewise reduced.

Feeding high levels of roughage to racing horses has been discouraged as the fibrous load not only bulks the gut but also thickens the gut wall adding non-productive weight to the animal. Speedi-Beet does not bulk the gut due to its reduced water binding capacity. Disrupted insoluble fibre and high levels of pectin's do not thicken the gut wall; indeed in some species such as pigs pectin's have been shown to improved nutrient passage across the gut wall. Feeding Speedi-Beet will not bulk the racing horse.

Even when feeding good quality cereals, with high carbohydrate levels there is a danger of introducing anti-nutritional soluble NSP. Wheat, barley and maize have high levels of pentosans compared with Speedi-Beet (60% c.f. 30%), non-digestible oligosaccharides and, in the case of barley, mixed link B-glucans. Feeding hay may introduce poor quality fibre, which may affect glycogen sparing.

By including Speedi-Beet in the diet, as partial substitution for both forage and the cereal rich component the nature of the diet can be modified to: -

1) Avoid over supply of carbohydrate and therefore glucose depression.
2) Replace the negative effects of soluble NSP, such as pentosans and B-glucans
3) Provide good quality fermentable fibre which has no negative effects on high exercise respiration but and improve glycogen recovery rates through glycogen sparing. In addition the fibre characteristics will maintain optimum hind gut function.
4) Provide a highly palatable top dressing, which will encourage appetite.

Speedi-Beet can be substituted for up to 25% of hard feed and/or 30% of forage. Equal substitution of forage (e.g. 1kg) and hard feed (e.g. 1kg) by speedibeet (e.g. 2kg) will provide similar protein and energy, with the added benefits of beneficial soluble fibre, improved muscle recovery rates and non bulking fibre.

Speedi-Beet provides a cost effective flexibility to feeding performance horses, without the drawbacks of feeding conventional sugar beet or fibre sources.

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