

## QUESTION: Does a Low Glycaemic Index Carbohydrate Replace Muscle Glycogen Post-Exercise Comparable to Sucrose?

### Background

- Glycogen is a carbohydrate stored in muscles for use as an energy source during exercise. Replacement of muscle glycogen following exercise is dependent on many factors including the amount of glycogen used, the type and quantity of food material available, time to recovery and the presence of insulin.
- Foods with a high glycaemic index (GI), such as those containing high amounts of dietary starch, release sugar rapidly. This tends to promote glycogen production due to an increased insulin response, which increases cell membrane permeability to glucose<sup>1</sup>.

### Aim of Study

To investigate if a low GI carbohydrate solution (slower energy release) can restore muscle glycogen post-exercise as well as a high GI solution (sucrose).

### Study Design

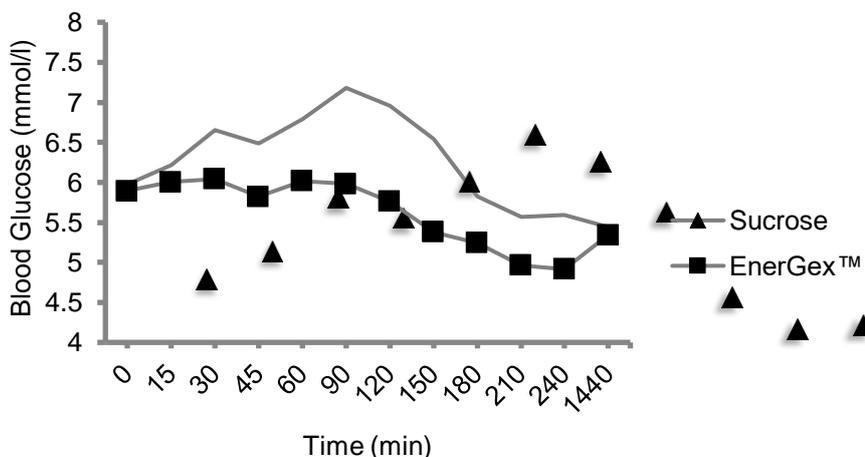
- *Blinded* = researchers did not know which carbohydrate solution horses received.
- *Randomised* = which horses were given placebo was pre-determined by a random system rather than a person deciding at the time of seeing a horse. This removes bias in the results caused by selecting only certain horses (e.g. less lame horses) to have a particular treatment.

### Study Outline

Muscle glycogen replacement was studied in 11 horses which underwent treadmill exercise to deplete muscle glycogen followed by a carbohydrate replacement treatment. Treadmill exercise consisted of 15 min at a heart rate of 130-140 bpm with a treadmill incline of 6-10°, 15 min at a slope of 6-10° and heart rate between 150-180 bpm, and then 5 min at a slope of 0-10° with a heart rate between 180-200 bpm. Horses were rested for 30 min and then performed six 1 min sprints at a slope of 4-10° with a target heart rate of 200-220 bpm, with 5 min walking at the same slope between sprints. Thirty minutes after exercise horses were randomly allocated to receive either a low glycaemic index or high glycaemic index carbohydrate solution by stomach tube. The low glycaemic index carbohydrate supplement consisted of 1.3 g/kg EnerGex (Science Supplements). The high glycaemic index carbohydrate supplement was given as an equivalent calorie, same volume solution of sucrose. Muscle biopsies were taken from the middle gluteal muscle, at a depth of 8 cm, in each horse before exercise, immediately post-exercise, and at 24 h following treatment. Blood samples for glucose and insulin analysis were taken before, and at 0, 15, 30, 45, 60, 90, 120, 150, 180, 210, 240, and 1440 min after supplementation.

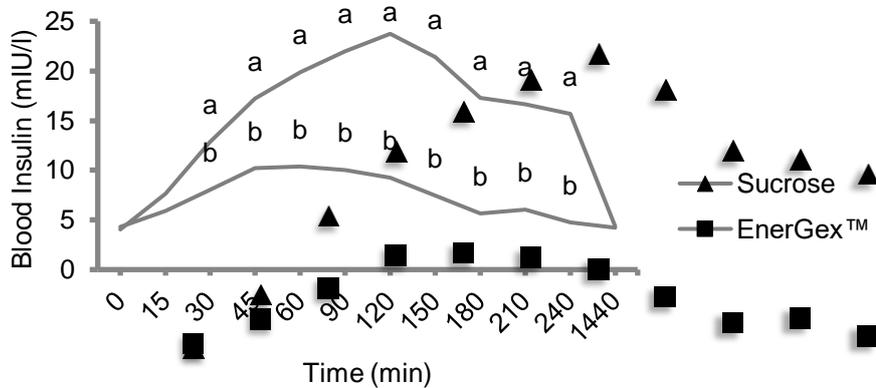
### Study Results

- There was no significant difference in pre-exercising blood glucose concentrations in horses administered sucrose or EnerGex (Fig. 1) indicating that any changes during the trial were due to the carbohydrates given.

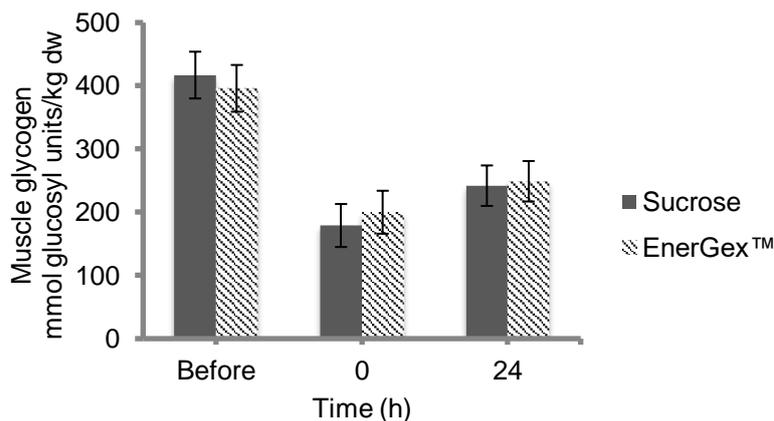


**Figure 1:** Blood glucose concentration post-exercise following nasogastric administration of EnerGex™ or sucrose.

- Sucrose caused a significantly higher insulin response than EnerGex (Fig. 2). Blood glucose and insulin were both elevated for significantly longer in horses treated with sucrose versus EnerGex.
- Muscle glycogen replacement was similar for both carbohydrate supplements (Fig. 3). At 24h following exercise, muscle glycogen recovery was 63% with EnerGex compared to 58% with sucrose.



**Figure 2:** Blood insulin concentration post-exercise following nasogastric administration of EnerGex™ or sucrose. Timepoints with different letters denotes significantly different mean blood insulin concentration ( $P < 0.05$ ) between sucrose and EnerGex supplemented horses.



**Figure 3:** Effect of EnerGex™ and sucrose supplementation on mean ( $\pm$ SEM) muscle glycogen concentration before (pre-exercise), 0 h (post-exercise but prior to supplementation) and 24 h (24 h post-exercise). dw= dry weight.

### Take Home Messages

- The low GI carbohydrate (EnerGex) replaced the same amount of muscle glycogen as the high GI solution (sucrose) within 24 h of intense treadmill exercise.
- Administration of sucrose to horses resulted in higher blood glucose levels, which stimulated an increased insulin response. In contrast, EnerGex supplementation elicited a significantly lower insulin response, possibly due to a slower, steadier glucose digestion and absorption in the small intestine.
- EnerGex given before and during aerobic exercise may preserve glycogen stores for a longer duration of time, thus delaying time to fatigue. Additionally, due to the lower blood insulin response to EnerGex, there is a greater potential for the body to utilise fatty acid oxidation during exercise, thus sparing muscle glycogen.

### Reference

1. White M.G., Snow D.H. Quantitative histochemical study of glycogen depletion in the maximally exercised Thoroughbred. *Equine Vet J.* 1987 19(1):67-9.