Kentucky Equine Research®
World Leaders In Equine Nutrition

Advances in Equine Nutrition

Volume I

Edited by

J.D. Pagan

THE EFFECT OF FEEDING AFTER EXERCISE ON GLUCOSE AND GLYCOGEN RESPONSES IN THE HORSE

T. BREWSTER-BARNES, L.M. LAWRENCE, L.K. WARREN, P.D. SICILIANO, A. CRUM AND K. THOMPSON
University of Kentucky, Lexington, Kentucky, USA

Carbohydrates, especially muscle glycogen, are key sources of energy for working muscle and when muscle glycogen is depleted during exercise, fatigue occurs rapidly. Because glycogen is a valuable substrate during exercise, replenishment of its stores is extremely important. Diets high in soluble carbohydrate should have a positive effect on muscle glycogen repletion but some studies have noted that glycogen resynthesis in horses is slow even when high grain diets are fed. If repletion to pre-exercise levels does not occur, subsequent performances may be negatively affected. In humans, feeding carbohydrates soon after exercise affects the uptake of glucose by muscle and increases the synthesis of muscle glycogen as compared to feeding a carbohydrate source several hours after exercise. Typically, horses are not fed the grain portion (soluble carbohydrate source) in the diet during the early (< 1.5 hours) post-exercise (PE) period. However, feeding the grain meal closer to the end of exercise may be more beneficial for the horse, if muscle glycogen resynthesis can be affected. Enhanced glycogen resynthesis after exercise could be important for horses that compete on consecutive days, such as 3-day eventers. In this experiment, four conditioned Thoroughbred geldings were used in a 4X4 Latin square experiment to determine the effect of feeding a carbohydrate source during the early or late post-exercise (PE) period on blood glucose and muscle glycogen responses. In each collection period, three horses were exercised for 1 hour and one horse served as an unexercised control. Each exercised horse received a meal of oats at a different times PE; either 1.5 hours PE, 4 hours PE or divided into two smaller meals at 1.5 and 4 hours PE. The unexercised control horse received a meal of oats at a similar time of day as the exercised horses. Venous blood samples were taken every 30 minutes for 6 hours after consumption of the test meal. Blood samples were analyzed for plasma glucose and serum insulin. Muscle biopsies were taken at rest, after exercise, prior to feeding, 6 hours after feeding and 26 hours after the initial biopsy. After feeding, exercised horses had a lower glucose peak and insulin concentrations post-feeding ($P<0.05$) than the controls. These results suggest that exercise has a residual effect on the horse that produces altered glucose and insulin responses to a meal. In humans, exercise is known to have an effect on glucose transport into muscle and the same effect may occur in the horse. Feeding at different times after exercise also affected glucose and insulin responses. When the horses were fed 4 hours PE they had lower insulin concentrations, plasma glucose peak and slower glucose clearance rate than when they were fed 1.5 hours PE ($P<0.05$). The exercise test

resulted in limited glycogen depletion (< 20%). Muscle glycogen concentrations were lower at 4 hours PE as compared to immediately after exercise or 1.5 hours PE (P<0.05). At 6 hours post-feeding, glycogen concentrations continued to be lower in horses fed 4 hours PE than in horses fed 1.5 hours PE (P<0.05). The results from this experiment suggest that feeding 1.5 hours PE, as opposed 4 hours PE, prevents the further depletion of muscle glycogen stores. Although there were some differences in glucose metabolism, time of feeding after exercise did not affect the muscle glycogen concentrations in biopsies obtained 26 hours PE. The absence of an effect was possibly related to the low level of glycogen depletion produced by the exercise test. Even though the horses worked over a distance of 18 km, the work intensity was minimal. A more strenuous test that produces more severe glycogen depletion should be used in subsequent studies to evaluate the effect of the feeding program on muscle glycogen resynthesis in the horse.

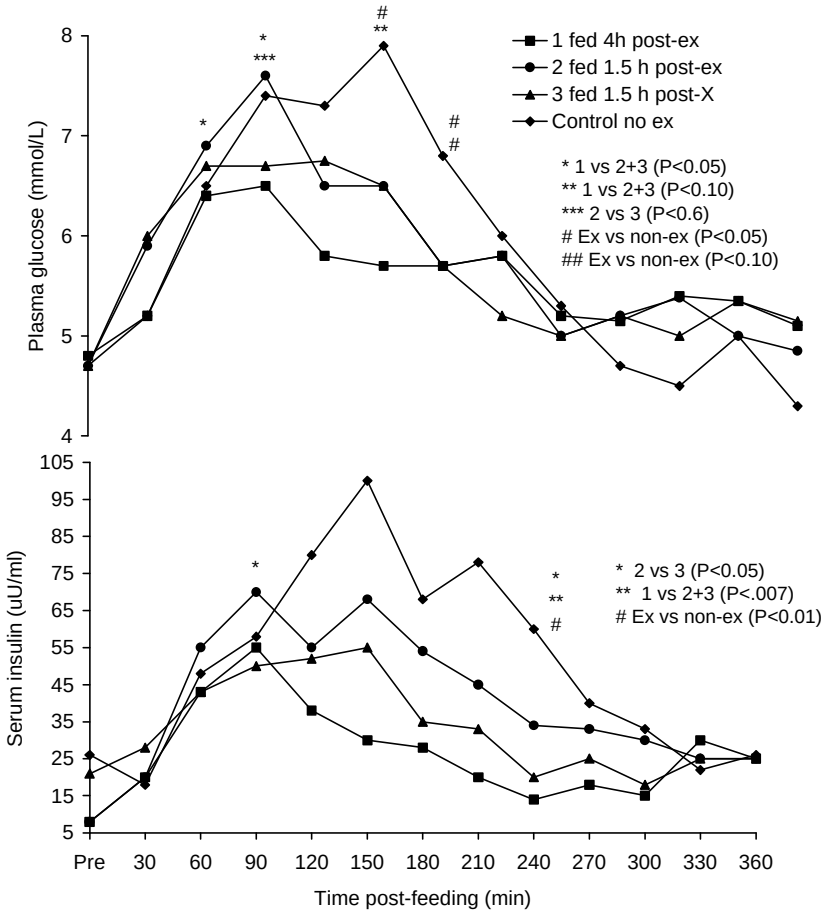

Figure 1. Plasma glucose and serum insulin concentrations after feeding

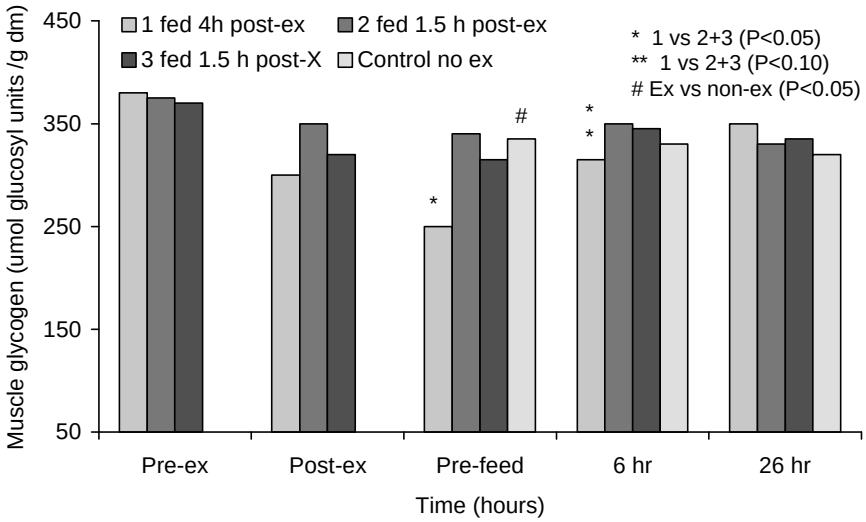

Figure 2. Muscle glycogen concentrations before and after exercise, prior to feeding, 6h post feeding and 26h post feeding


Kentucky
Equine
Research®