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THE EFFECT OF FEEDING RESTRICTED DIETS ON THYROID HORMONE CONCENTRATIONS AND METABOLIC RESPONSES IN THE EXERCISING HORSE

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Caloric restriction and exercise can produce changes in peripheral thyroid hormone concentrations in humans and animals which may have the potential to affect metabolism or performance during physical activity. This study investigated the effects of short-term feed restriction and the percentage of concentrate versus roughage contained in the diet on T₄ and T₃ concentrations and metabolic responses to feeding a small meal and to exercise. Four treatments were assigned to four healthy mature Thoroughbred geldings in a 4x4 Latin square design. The four treatments consisted of 1) a nutritionally adequate high roughage ration (70:30% roughage:concentrate) [AHR]; 2) a nutritionally adequate high concentrate ration (40:60% roughage:concentrate) [AHC]; 3) a diet restricted to 70% of 1 [RHR]; 4) a diet restricted to 70% of 2 [RHC]. Diets AHR and AHC met or slightly exceeded the NRC (1989) nutrient recommendations for horses undergoing moderate work. Body weights were measured at the beginning and end of each treatment period. At the end of each period, a diet was fed which allowed for any weight loss that occurred during the feeding period to be regained. Following the 7-day weight-gaining period, the treatments were switched and the same procedure followed until all horses completed all treatments.

On day 9 of each feeding period, each horse was fed 1.0 kg of oats between 0900 and 0930 hours. Blood samples were taken pre-feeding, immediately after and 30 minutes after completion and then every hour for 7 hours for determination of thyroid hormone (T₄ and T₃), glucose, insulin and free fatty acid (FFA) concentrations. On day 11 or 12 of each treatment period, horses performed a 25 min exercise test on a high speed treadmill. Horses were not fed the morning prior to the test and all tests were conducted between 0800 and 0900 hours. The test consisted of a 17 minute warm-up phase, immediately followed by an 8 minute step test at a 10% grade, where the speed was increased every min beginning at 2 m/s and ending at 9 m/s. Blood samples obtained pre-exercise, during exercise and during recovery were analyzed for T₄, T₃, lactate, glucose, insulin and FFA concentrations.

Meal feeding produced an increase (P<0.01) in the T₄ and T₃ concentrations when horses received the AHR and AHC diets but not when they received diets RHR or RHC (Figure 1). T₄ concentrations were lowest when horses received the AHC diet. When horses received diet RHR, they had a greater increase (P<0.05) in glucose post feeding (1 kg oats) than when fed the other diets. During the exercise test, horses had

higher T_4 concentrations and a higher T_4/T_3 ratio throughout the step test and recovery periods ($P < 0.05$) when they received the RHR diet (Figure 2). T_3 concentrations tended to decline when horses received the RHR diet during the step test (Figure 2). Similarly, there was a time x diet effect ($P < 0.05$) during the recovery phase when T_3 declined in horses receiving the RHR diet. Insulin concentrations were highest ($P < 0.05$) during the step test when horses received the AHC diet. A time x diet interaction tended ($P = 0.20$) to occur with glucose during the step test when horses received diets RHR and RHC, while FFA concentrations in the horses consuming diet RHR tended ($P = 0.15$) to have a greater response during exercise.

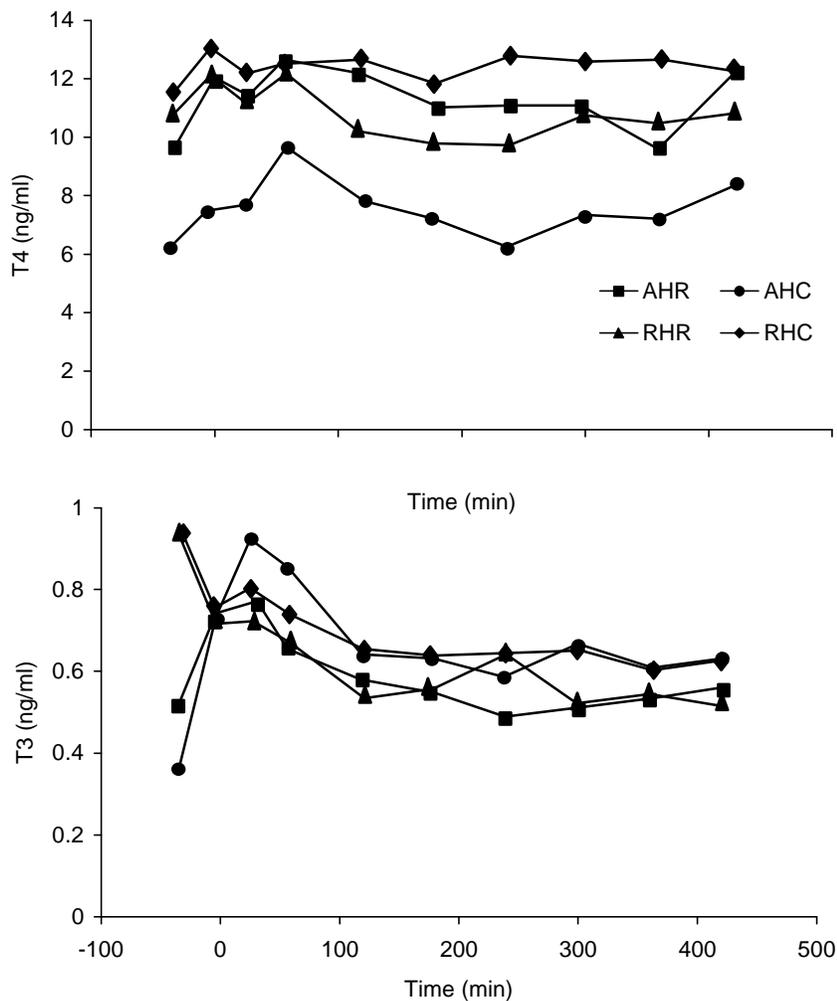


Figure 1. Mean serum concentrations of thyroxine (T_4) and triiodo-thyronine (T_3) in horses fed adequate high roughage (AHR), adequate high concentrate (AHC), 70% of intake of AHR (RHR) or 70% of intake of AHC (RHC) during a meal feeding.

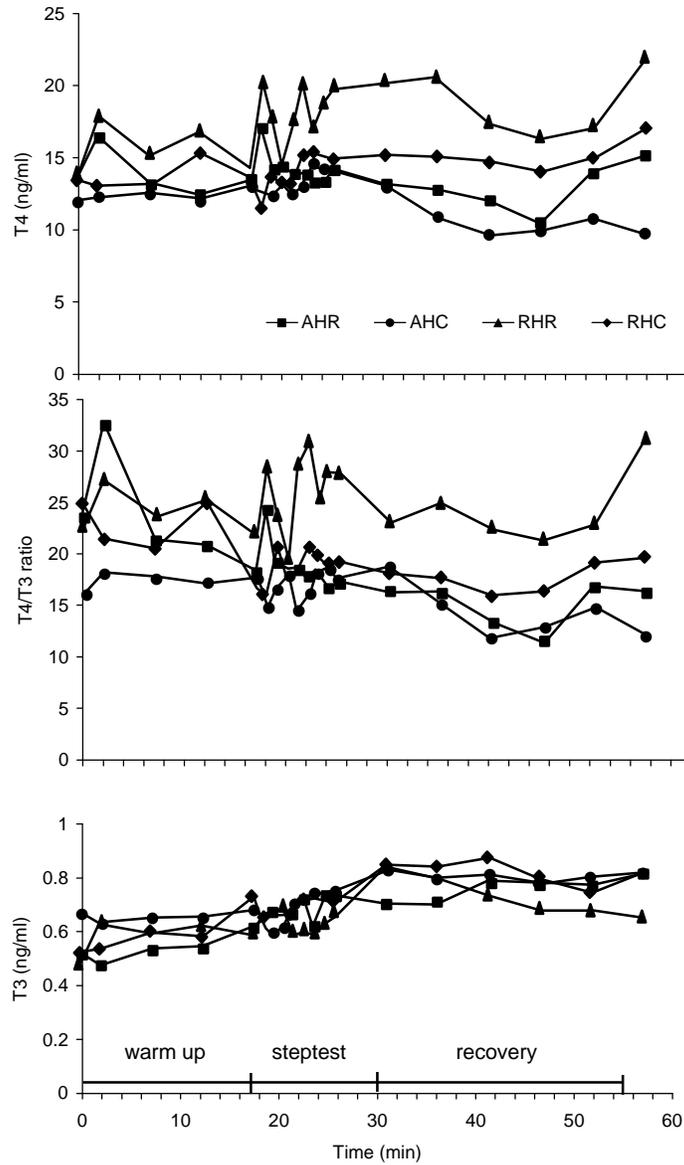


Figure 2. Mean serum concentrations of thyroxine (T_4), triiodothyronine (T_3), and T_4/T_3 ratio in horses fed adequate high roughage (AHR), adequate high concentrate (AHC), 70% of AHR (RHR) or 70% of AHC (RHC) diets during an exercise test.

These data suggest that T_3 and T_4 increase in response to meal feeding in horses receiving nutrient adequate diets, but this response may not occur when horses have been subjected to short-term feed restriction. Short-term diet restriction and diet composition may affect peripheral conversion of T_4 to T_3 in exercising horses.

