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THE EFFECTS OF NIACIN SUPPLEMENTATION ON NIACIN STATUS AND EXERCISE METABOLISM IN HORSES

A.L. PARKER, L.M. LAWRENCE, S. ROKURODA AND L.K. WARREN
University of Kentucky, Lexington, Kentucky, USA

The National Research Council (1989) currently does not list a dietary niacin requirement for horses because hindgut synthesis and niacin naturally occurring in feeds are believed to be adequate to meet the needs for most horses. However, because niacin plays a key role in energy metabolism, many exercising horses receive dietary niacin supplementation. Two studies were conducted to examine the effects of niacin supplementation on the exercising horses.

In the first trial, 4 mature Thoroughbred geldings were used in a two period cross-over design exercise trial to examine the effects of acute nicotinic acid (NA) dosing on exercise metabolism. The basal diet consisted of 60% timothy hay and 40% heavy racehorse oats and a commercial vitamin mineral supplement and contained approximately 27 mg NA/kg DM. Horses were housed in box stalls and exercised 4 d/wk on a high-speed treadmill. Horses performed two exercise tests on the treadmill 7 days apart. Prior to the first exercise test, horses were randomly assigned to a control group or NA dosed group. NA dosed horses received 4.5 g NA mixed with 25 g applesauce orally 2 hours before performing the exercise test. Applesauce was used as a carrier for the NA. Horses were fasted 12 hours prior to the beginning of the test. The exercise test consisted of an 18 minute warm-up phase (12 minutes at 3% grade and 4.0 m/s, and 6 minutes walk at 0% grade and 1.9 m/s), followed by a 7 minute step test at 10% grade. The step test began at 2.0 m/s and the speed was increased 1 m/s every minute until a final speed of 8 m/s was reached. At the conclusion of the final step, the speed was decreased to 1.9 m/s and the treadmill was lowered to 0% grade. Heart rate (HR) and blood samples were obtained before the beginning of the exercise test, every 3 min throughout the warm-up, at the end of each step of the step test and every 5 minutes during a 30 minute recovery phase. No differences were found for plasma FFA or plasma lactate concentrations between the two treatments. Mean plasma lactate concentrations were 7.0 ± 3.1 and 6.7 ± 2.1 mmol/L when horses received the control diet or were dosed with 4.5 g NA, respectively. A time by treatment interaction was detected ($P < 0.05$) for plasma glucose concentrations during the warm-up phase. However, this effect was absent during the step test and recovery phases. Furthermore, point-by-point analysis failed to demonstrate differences ($P > 0.05$) between the two treatments. Heart rates were similar between the two groups throughout the exercise test. The mean maximum HR achieved was 190.3 ± 4.6 and 191.0 ± 8.5 beats/min when horses received the control diet or the 4.5 g NA, respectively.

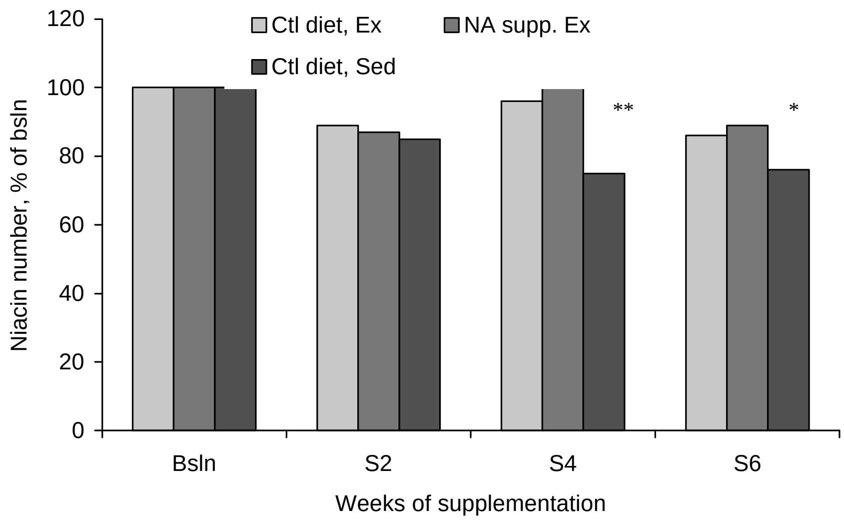

Figure 1. Niacin status as a percentage of week 0 (baseline) (**P<0.05; *P<0.1). Time effect (P<0.01). Time * trt interaction (P<0.1).

In humans, the determination of the NAD:NADP ratio in red blood cells has been used to assess niacin status, which can be increased with niacin supplementation. Using this method, a preliminary study showed horses to be niacin "deficient" by human standards. To determine the effect of 6 weeks of niacin supplementation on niacin status and exercise metabolism in the horse, a second experiment was conducted using 11 mature Thoroughbred geldings in a randomized repeated measures design experiment. Horses were assigned to one of 3 groups: 1) sedentary, no nicotinic acid supplementation, 2) exercise, no NA supplementation and 3) exercise, 3 g/d NA supplementation. The basal diet consisted of 58% timothy hay and 42% concentrate and contained approximately 29 mg of NA/kg DM. Sedentary horses were kept in 3x12 m sheltered pens and received no forced exercise. Exercised horses were housed in box stalls and were exercised 5 times/wk on a high-speed treadmill. Blood samples were obtained prior to supplementation (week 0) and at 3, 5, and 7 weeks of supplementation for determination of NAD and NADP levels. On weeks 0 and 7, the exercised horses performed a 30 minute exercise test on the treadmill. Horses were fasted 12 hours prior to the beginning of the exercise test, which consisted of a 15 minute warm-up (12 minutes at 3% grade and 4.0 m/s, and 3 minutes at 0% grade and 1.9 m/s), followed by a 14 minute step test at 10% grade beginning at 2 m/s and increasing 1 m/s every 2 minutes until a final speed of 8 m/s was reached. Blood samples were obtained before the start of the exercise test, every 3 minutes throughout the warm-up phase, at the end of each step of the step test and every 5 minutes during a 30 minute recovery phase. Plasma FFA concentrations were higher at week 7 than at week 0 for both exercised groups. However, the differences were significant only for the exercised control group during the step test (time by week; P<0.01) and recovery phase (time by week; P<0.1). In the recovery phase, FFA concentrations in the control group tended to be higher (P<0.1) 15 minutes post-exercise and were higher at 20 (P<0.05), 25 (P<0.01) and 30 minutes (P<0.01) post-exercise in the week 7 versus week 0 exercise test. Plasma FFA concentrations in exercised NA supplemented horses were not increased (P>0.05) at week 7 compared to week 0. Plasma lactate concentrations did not differ (P>0.05) from week 0 to week 7 for either exercised group. Mean plasma lactate concentrations at the end of the step test were 12.15 ± 2.08 mmol/L at week 0 and 11.19 ± 1.92 mol/L at week 7 for control horses. For horses receiving the NA supplemented diet, mean plasma lactate concentrations at the end of the step test were 18.50 ± 10.36 mmol/L at wk 0 and 17.81 ± 8.88 mmol/L at week 7. Differences in niacin status existed between treatment groups at week 0. Thus, all niacin status values were expressed as a percentage of week 0 (baseline), allowing each group to serve as its own control (Figure 1). No differences were observed between exercised groups over the 6 week period. However, sedentary control horses had lower (P<0.05) niacin status than either exercised group at week 4 and week 6. At week 6, horses in the sedentary control group tended to have a lower (P<0.1) niacin status than the exercised control group, but not the exercised NA supplemented group. A time effect (P<0.01) was observed, and a tendency (P<0.1) for a time by treatment effect occurred, reflecting the lower niacin status values in the sedentary control group at week 4 and week 6.

In summary, neither acute nor chronic NA supplementation appears to affect exercise metabolism in the horse. Furthermore, niacin status in the horse was not affected by 6 wk of NA supplementation.