

**Dietary Protein Moderates Acid-Base Responses  
to Repeated Sprints in Exercising Horses**

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**ABSTRACT**

Restricting dietary protein may help moderate acidogenic effects of exercise by reducing the endogenous acid load and widening the dietary cation-anion difference (DCAD). Ten to twelve Arabian horses were used in two experiments. Horses in experiment one were fed diets with 10% supplemental corn oil and either low protein (7.5% crude protein, LP) fortified with .5% lysine and .3% threonine or high protein (14.5% crude protein, HP). Horses in experiment two were fed high and low levels of crude protein similar to experiment one but the diets contained either 10% supplemental corn oil (HF) or no additional fat supplementation (LF) forming four diets: LPHF, LPLF, HPLF, HPHF. Experiment one lasted nine weeks and included nine weeks of conditioning. Experiment two lasted 26 weeks beginning with four weeks of an accommodation period followed by eleven weeks of conditioning with three weeks of standard exercise tests (SET) and an eight week deconditioning period at the end.

In both experiments, horses underwent similar interval training and standard exercise tests. Also in experiment two, horses performed an SET prior to conditioning. The SET consisted of warm ups at the walk and trot followed by six repeated sprints separated by walks and concluding with a 30 minute recovery at the walk. All of the sprints were at 10 m/s except the SET prior to conditioning in experiment two, which were at 7 m/s. Blood samples were taken in both experiments every two weeks during the conditioning periods and as part of the SETs (rest, last 15 sec. of each sprint and 5, 10, 20, and 30 min. of recovery). Samples were analyzed for pH, pCO<sub>2</sub>, pO<sub>2</sub>, Na<sup>+</sup>, K<sup>+</sup>, Cl<sup>-</sup>, lactate, total protein (TP), albumin, creatinine and plasma urea-N (PUN). Bicarbonate and strong ion difference (SID) were calculated. Strong ion

difference was calculated as the algebraic sum of  $\text{Na}^+$ ,  $\text{K}^+$ ,  $\text{Cl}^-$  and lactate while total weak acids ( $\text{A}_{\text{tot}}$ ) was estimated from TP.

Plasma urea-N concentrations were higher in the HP group compared to the LP group. Plasma creatinine was not different between the HP and LP groups in experiment one but was higher in the LPHF group compared to the others in experiment two. The PUN effect was therefore attributable to nitrogen intake. Also, the LPHF group had a low body condition score and the same weight, compared to other groups, so had a higher lean body mass reflected in the higher creatinine levels. Plasma albumin and TP were not different in experiment one. Plasma albumin was also not different in experiment two however, TP was higher in the HF groups. Higher dietary fat delays gastric emptying which may have improved protein digestion and utilization. High fat may also reduce stress and result in higher globulin levels compared to low fat with similar albumin levels.

Protein moderated acid-base responses to SETs in both experiments. The LP group had higher pH and bicarbonate levels as well as a tendency for a higher SID in experiment one as well as in the SET prior to conditioning for experiment two. Lower lactate levels were also observed in the LP group in experiment one. Following conditioning in experiment two, the LP group had higher pH and bicarbonate levels but only in combination with HF. Fat adaptation may spare protein catabolism and production of acid. There was also a time X protein interaction for SID in experiment two that found the LP group with higher SID during the latter stages of the SET. Lactate levels were lower in the HF group compared to the LF group and suggests more reliance on fat metabolism compared to the LF group.

Fatigue is related to lower pH, low blood glucose and low muscle glycogen. Restricting dietary protein can increase pH and bicarbonate levels and high fat has been shown to improve fatty acid oxidation and spare muscle glycogen. Therefore, restricting dietary protein especially in combination with high fat may be beneficial for the exercising horse.