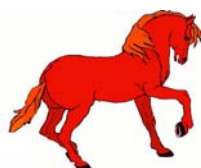


MISCELLANEOUS SPECIES RESEARCH REPORT 11



L-Lysine and L-Threonine Improves Muscle Mass in Aged and Young Horses**

Introduction

A common phenomenon in aging humans is the loss of muscle mass (Booth et al., 1994). This phenomenon has also been documented in aging horses, which is due to decline in activity, poor teeth, and a decline in the ability to digest protein (Rich, 1989; Hintz, 1995). The decline in protein digestibility could increase the dietary protein needs of the aged horse. To meet this need, the quantity of CP could be increased, which has metabolic disadvantages, or the protein quality could be improved, or limiting AA could be supplemented (Graham et al., 1994). Thus, proper AA supplementation may be necessary to improve the protein status of the aging horse to ensure an adequate AA pool for maintaining muscle mass. This could allow aged horses to maintain their vigor and stamina much longer.

Objective

The objective of the study was to evaluate the effect of supplementary AA on the ability to support muscle mass in aging horses.

Methods

Sixteen horses of light horse type were used in a 2 x 2 factorial arrangement of treatments with two age groups [≤ 10 yr (average = 9.1 ± 0.29 yr) and ≥ 20 yr (average = 22.4 ± 0.87 yr)] and two diet groups [no supplementation (N) or supplementary lysine and threonine (S; 20.0 and 15 g/d, respectively)]. Horses were fed the diets for 14 wk and received regular light exercise throughout the study. Body weight, BCS, and venous blood samples were taken every 2 weeks. Plasma was analyzed for total protein, albumin, creatinine, urea N (PUN), and an AA profile, including 3-methyl histidine (3MH) and sulfur AA. Photographs of the horses taken at the start and the end of the experiment were used to assign a subjective muscle mass score from 1 to 5 (1=lowest to 5 = highest). BCS was evaluated on a 1-to-9 point scale using a standardized system (Henneke et al., 1983).

Horses were fed a commercially available grain mix (Table 1) along with mixed timothy/orchardgrass hay in three separate meals. Diluted corn syrup (10 mL) was mixed with the supplemental AA along with the grain mix and was hand-fed to the S-group horses to ensure consumption. A similar amount of corn syrup was added to the grain mix for horses in the N-group. Horses were fed individually in box stalls at a rate of approximately 1.8% BW for forage and 0.5% BW for grain mix. Grain and hay refusals were weighed and recorded for determination of daily intakes.

** Excerpts taken directly from –
Graham-Thiers et al., JAS 2005(83) 2783-2788)

TABLE 1. Composition and analysis of concentrate and hay, as-fed basis

Item	Hay	Grain mix (%)
<i>Concentrate^a</i>		
Oats		15.0
Barley		16.0
Corn		33.0
Soybean meal, 44% CP		22.0
Molasses		6.0
Soybean oil		4.0
Dicalcium phosphate		2.0
Vitamin/mineral mix ^b		2.0
<i>Analysis</i>		
DE, Mcal/kg ^c	1.62	3.10
CP, % ^d	9.00	13.30
Arginine, % ^e	0.24	0.78
Histidine, % ^e	0.09	0.33
Isoleucine, % ^e	0.20	0.48
Leucine, %	0.39	1.08
Lysine, %	0.23	0.56
Methionine, %	0.09	0.18
Phenylalanine, %	0.25	0.61
Threonine, %	0.24	0.47
Valine, %	0.28	0.61

^aPhase 3 (Pennfield Feeds, Lancaster, PA).

^bVitamin/mineral premix (Kentucky Equine Research, Inc., Versailles, KY) provided (/kg of premix) 80 g of Ca, 80 g of P, 10 g of Mg, 10 g of S, 5 g of Zn, 1.2 g of Cu, 1 g of Mn, 0.02 g of Co, 0.02 g of I, 136.5 g of Na, 213.5 g of Cl, 0.01 g of Se, 1,3800,000 IU of vitamin A, 26,455 IU of Vitamin E, 258,000 IU of vitamin D, 701 mg of riboflavin, 3,000 mg of niacin, 66 mg of folic acid, 1,520 mg of thiamin, and 42 mg of biotin.

^cCalculated using NRC (1989) tables.

^dAnalyzed by the Dairy One DHIA Forage Testing Lab (Ithaca, NY). Values are on an as-fed basis.

^eAnalyzed by the Ajinomoto Heartland LLC Amino Acid Lab (Eddyville, IA). Values are on an as-fed basis.

Results

All horses maintained good health throughout the experiment. There was no difference in grain mix intake, hay intake, or overall feed intake between groups for age ($P = 0.62$, 0.46 and 0.51 , respectively) or diet ($P=0.42$, 0.77 , and 0.59 , respectively). There was also no difference in the intake of any of the essential AA for age and diet with the exception of lysine (58.1 vs. 34.1 ± 4.10 g/d, $P = 0.01$, respectively) and threonine (51.2 vs. 32.8 ± 3.70 g/d, $P = .005$, respectively) in the S-group vs N-group horses because of the addition of lysine and threonine to those diets.

The S-group horses tended to gain more weight ($P = 0.064$), and in fact, the N-group horses lost weight when evaluating the change in BW over the course of the experiment (Figure 1). Repeated measures analysis revealed that BCS was lower for the aged vs. the young horses ($P = 0.001$) as well as for the S- vs. the N-group horses ($P = 0.026$). The change in muscle mass score was greater for the S-group horses compared with the N-group horses ($P = 0.05$), see Figure 2.

Figure 1. Change in Weights for Dietary Treatments

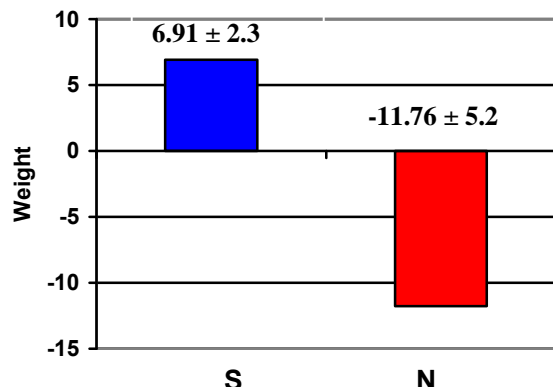
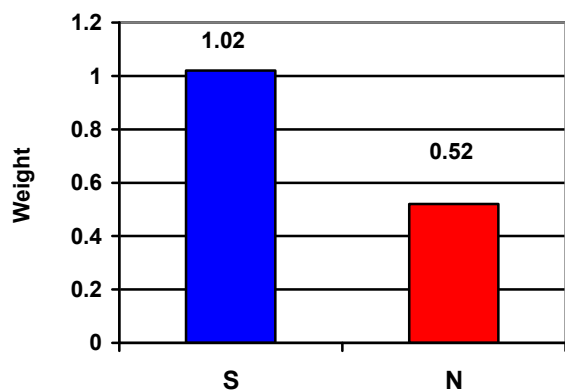


Figure 2. Change in Subjective Muscle Mass Score



Plasma creatinine was greater ($P = 0.032$), and PUN was lower ($P = 0.027$), for S-group horses compared with the N-group horses. Initial 3MH concentrations were not different; however, at the end of the experiment, 3MH was lower for the S-group horses ($P = 0.016$) compared with the N-group horses. Plasma lysine and threonine concentrations were greater for S-group horses at the end of the experiment than for N-group horses ($P = 0.023$ and 0.009 , respectively). Both 3MH and PUN concentrations were negatively correlated to lysine ($R^2 = 0.56$ and 0.60 , respectively) and threonine intake ($R^2 = 0.56$ and 0.60 , respectively) at the end of the study

Conclusion

These data suggest that horses receiving supplementary AA (L-Lysine HCl and L-Threonine) were able to maintain muscle mass better than those without supplementation, regardless of age, as evidenced by the improvement in muscle mass scores, lower BCS with no difference in BW, greater creatinine, and lower 3MH and PUN concentrations in the S-group horses.

Bibliography

Booth, F.W., S.H. Weeden, and B.S. Tseng. 1994. Effect of aging on human skeletal muscle and motor function. *Med. Sci. Sports Exerc.* 26(5):556-560

Graham, P.M., E.A. Ott, J.H. Brendemuhl, and S.H. TenBroeck. 1994. Effect of supplemental lysine and threonine on growth and development of yearling horses. *J. Anim. Sci.* 72:380-386.

Henneke, D.R., G.d. Potgter, J.L. Kreider, and B.F. Yeates. 1983. Relationship between condition score, physical measurements and body fat percentage in mares. *Equine Vet. J.* 15:371-372.

Hintz, H.F. 1995. Nutrition of the geriatric horse. Pages 8-10 in *Proc. Cornell Nutr. Conf.*, Cornell Univ., Ithaca, NY

Rich, G.A. 1989. Nutritional and managerial considerations of the aged equine. Page 121 in *Adv. Equine Management Short Course*. Colorado State Univ., Fort Collins.