GROWTH OF WEANLING HORSES FED YEAST, SOYBEAN MEAL OR MILK BASED PROTEIN SUPPLEMENTS

D.R. Topliff[1] and T. Monin[2]

Story In Brief

Twenty-five weanlings were blocked by sex and birthdate and randomly allotted to one of five experimental treatments to test the effects of source of dietary protein on growth and development of young horses. Treatments included a control which received a base concentrate diet of oats and molasses at 1.75% of body weight daily and free access to bermudagrass hay, and four experimental treatments which received the base concentrate and hay plus one of four commercially available protein supplements fed at the manufacturers recommended level. Two of the protein supplements contained yeast as a portion of the protein, one contained soy based protein, and the fourth was a milk based protein supplement. The protein supplemented treatments were isonitrogenous while the control treatment was lower in crude protein. Weight and height measurements were taken every two weeks while radiographs of the third metacarpal for determination of presence of osteochondrosis, ultrasonic measurements of subcutaneous fat thickness and numerical body condition scores were taken at the beginning and end of the 18-week trial. Weanlings consuming one of the yeast proteins and the milk protein gained significantly faster and had better feed efficiency than the other three treatments. Results of this experiment suggest that protein quality may be critical for efficient growth when the protein to calorie ratio falls significantly below 50 g crude protein/Mcal of digestible energy, the recommended ratio for weanlings of this age.

(Key Words: Equine, Growth, Protein Requirement, Skeletal Soundness.)

Introduction

Since today's horse industry demands near maximum growth of weanlings for show or sale, horsemen are continually in search of products that will help them achieve the genetic potential of their foals. While the National Research

---

[1]Associate Professor [2]Professor, DVM

Council (NRC, 1989) has defined the nutrient requirements for growth rates to achieve mature size at about three years of age, questions still remain as to the effect of different nutrient sources on growth and soundness of young horses.

Topliff et al. (1988) has shown that weanlings can be grown at faster rates than suggested by the NRC without compromising skeletal mineralization or composition of gain so long as the protein to calorie ratio (PCR) is maintained at or above 50 g of crude protein (CP) per Mcal of digestible energy (DE). Since the commonly utilized feed grains in weanling rations have a PCR of 30 to 40, it is necessary for horsemen to supplement protein in those rations. Several commercially available protein supplements are available, each with differing protein sources as a base. It was therefore the objective of this experiment to investigate the effect of protein from yeast, soybean meal or milk on growth of weanlings over a 126-day (18-week) feeding trial.

Materials and Methods

Twenty-five foals were weaned by a partial separation method at approximately 120 days of age, blocked by birthdate and sex and randomly allotted to one of five dietary treatments for a 126-day growth trial. All foals were fed a base concentrate of oats fortified with ground limestone and trace mineralized salt. In addition, foals on four of the treatments received supplemental protein from one of four commercially available sources added to the base diet at the manufacturer's recommended level. Composition of the experimental concentrate diets is shown in Table 1. Additionally, all weanlings were fed bermudagrass hay on an ad libitum basis. Concentrate diets were offered at 1.5% of body weight divided into two equal daily feedings for the first four weeks of the experiment and 1.75% for the remainder of the trial.

At the beginning and bi-weekly throughout the remainder of the trial, weanlings were weighed individually on a conventional beam-type scale and measured for height at point of the withers using the marked stick and level technique. Additionally, ultrasonic measurements of subcutaneous fat thickness over the rump and last rib were taken at the beginning and end of the trial (Westervelt et al., 1976) using a Corometrics 210 linear array real-time unit equipped with a 5 Mhz transducer. Measurements were taken directly from the television screen of the machine using internal calipers which measured to the nearest millimeter.

Since weanlings used in this experiment were obtained from two sources and allotted to treatments without regard to origin and mixed, the first four weeks of the trial were considered an adjustment period and those data excluded from the analysis. Therefore, weight and height gains as well as feed conversion ratios were calculated over a 98-day period even though the trial was conducted for 126 days.

Table 1. Composition of experimental diets (as fed basis)[a].

Ingredient	Control	Yeast 1	Yeast 2	Soy	Milk
Oats, %	97.5	*	*	*	*
Limestone, %	1.5				
NaPO4, %	.5				
Trace mineral salt, %	.5				
Supplement, lb/day	----	2	2	1	1
DE Mcal/lb	1.27	1.32	1.32	1.32	1.32
Crude protein, %	11.0	12.5	12.5	12.5	12.5
Calcium, %	.6	.8	.8	.85	.75
Phosphorus, %	.5	.6	.6	.65	.65
CP, g/Mcal DE	40	43	43	43	43

[a] Yeast 1 and Yeast 2, Care Cubes, Provesta Corporation; Soy, Calf Manna, Carnation-Albers; Milk, Start to Finish, Milk Specialties Company.

To further document skeletal mineralization, radiographs of the front leg were taken before and after the trial (Meakim et al., 1981) and were analyzed by a Board Certified Radiologist for any signs of osteochondrosis or other bone abnormalities.

All data were analyzed by analysis of variance using a model accounting for variation due to treatment, sex, birthdate and time. When the variation due to a particular source was significant at the $P<.05$ level, least squares means were then calculated. The least significant difference procedure was then used to determine differences between means.

Results and Discussion

Least squares means for initial and final height and height gain at the withers are shown in Table 2. While significant differences in the absolute heights existed at the beginning and end of the trial, the week by treatment interaction was not significant, suggesting that weanlings gained height at the same rate regardless of treatment. Those results agree with the concept that the first priority for nutrients is for bone growth. There was also considerable variation between and within treatments in the initial heights of the weanlings.

Least squares means for initial and final weight, weight gained and feed per lb of gain are shown in Table 3. Weanlings receiving Yeast 2 and Milk gained significantly faster over the 98-day feeding trial than those on Yeast 1, Soy or Control. Mean average daily gains for Yeast 2 and Milk were 1.52 and

Table 2. Treatment least squares means for initial, final and gain of height at the withers of weanlings over a 98-day feeding trial.

Item	Treatment				
	Control	Yeast 1	Yeast 2	Soy	Milk
Initial height, inches	48.8	50.7	48.0	51.0	49.9
Final height, inches	50.6	52.1	49.7	52.1	51.2
Height gain, inches	1.8	1.4	1.7	1.1	1.3

Table 3. Treatment least squares means of initial weight, final weight, weight gained, average daily gain and feed efficiency over the 98-day feeding trial.

Item	Treatment				
	Control	Yeast 1	Yeast 2	Soy	Milk
Initial weight, lb	479	521	454	509	531
Final weight, lb	601	647	598	635	687
Weight gained, lb	122[a]	126[a]	144[b]	126[a]	156[b]
Average daily gain, lb	1.30[a]	1.22[a]	1.52[b]	1.27[a]	1.55[b]
Feed efficiency, lb/lb gain	10.5[a]	10.7[a]	9.0[b]	11.1[a]	8.7[b]

[a,b] Means in the same row with different superscripts differ (P<.05).

1.55 lb, respectively while the average daily gains for Yeast 1, Soy and Control were 1.22, 1.27 and 1.30 lb, respectively. As would be expected the feed efficiency for Yeast 2 and Milk treatments was significantly better (9.0 and 8.7) as compared to 10.5, 10.7 and 11.1 for the Controls, Yeast 1 and Soy, respectively. It should be pointed out that the means listed in Table 3 are least squares means and not arithmetic means. Therefore, average daily gains and feed efficiencies cannot be calculated from the data displayed in the table. Least squares means are adjusted to account for differences in initial weights.

Gains observed in this trial for treatments Yeast 2 and Milk are within acceptable normal range for weanlings of this age, if mature height and weight

are to be reached at 24 months of age. Gains observed in the other three treatments are somewhat low if the objective is to reach maximum growth at 24 months of age. Several researchers and veterinary pathologists have suggested that if maximum growth is to be achieved by two years of age that growth should be accomplished in a consistent manner and not in rapid bursts during the yearling year. With weanlings on treatments Yeast 1, Soy and Control, growth would have to be accelerated during the yearling year to achieve comparable size.

The explanation for the differences in average daily gain between Yeast 2 and Milk versus the controls is seemingly apparent when one considers the difference in crude protein levels (12.5 vs 11%). However, that does not explain the advantage over Yeast 1 and Soy, nor does it explain the lack of difference between Yeast 1, Soy and Control. Those results can partially be explained in two parts. First, the absolute differences in protein intake are relatively small as indicated by the protein to calorie ratios (43 vs 40 g/Mcal). Secondly and more importantly, protein quality is likely involved. The NRC recommends a protein to calorie ratio of 50 g/Mcal, so the diets fed here are protein deficient compared to their recommendations. However, the NRC recommendations are based on experiments where soybean meal was used as the protein source. Diets formulated using protein sources with a better amino acid profile may not require as high a percent of crude protein. However, the amino acid profile of Yeast 1 should have been comparable to Yeast 2 and Milk, so the inferior performance of weanlings consuming Yeast 1 is somewhat puzzling and no readily apparent explanation for those results is available. No problem with consumption, wastage, or health of the weanlings on that treatment was noted.

Treatment least squares means of condition score, backfat and rumpfat thickness at the beginning and end of the trial are shown in Table 4. No significant differences for any of the traits measured were found. This would suggest that weight gains observed during the trial were indicative of true growth and not simply subcutaneous fat accretion. The numerical condition scores tended to decrease throughout the trial across all treatments, although the magnitude of the decrease averaged about .5 condition score which translates into a body fat percentage of less than 2%. The small magnitude of that change is also borne out by the lack of measurable change in rumpfat thickness, which has the highest correlation with total body fat.

While the radiographs taken were largely unremarkable, there was some radiographic evidence of osteochondrosis (OCD) in some of the weanlings on this trial. Those occurrences appeared to be random and were not related to treatment and have no bearing on the results presented here. It has been estimated that as high as 20% to 25% of all horses have some degree of OCD, the cause of which is unknown at this time. Rapid growth, or at least the genetic ability for rapid growth, has been theorized to be the main cause, although that has not been proven at this point. Very likely there are other causes as well,

Table 4. Treatment least squares means of condition score, backfat thickness and rumpfat thickness at the beginning and end of the 98-day feeding trial.

Item	Treatment				
	Control	Yeast 1	Yeast 2	Soy	Milk
Condition score					
Initial	4.7	4.7	4.8	4.2	5.0
Final	4.1	4.0	4.4	3.8	4.3
Backfat thickness, inches					
Initial	.12	.10	.13	.13	.16
Final	.14	.16	.16	.13	.18
Rumpfat thickness, inches					
Initial	.14	.13	.14	.18	.19
Final	.14	.13	.15	.13	.18

such as nutrition. One factor that has been shown conclusively to result in skeletal unsoundness is the practice of retarding growth of weanlings and then feeding for rapid growth as yearlings.

The results of this trial indicate that acceptable growth rates in weanlings can be achieved on diets that contain less protein per Mcal of DE than is recommended by the NRC if the quality of the protein source is taken into account. This would be particularly true when feeding an oats and grass hay type of diet similar to that used in this trial, one which is very common in today's horse industry. Therefore, if diets of that type are to be fed, protein supplements that contain high quality sources such as yeast and milk could be beneficial.

Literature Cited

Topliff, D.R. et al. 1988. Growth of weanling Quarter horses fed varying levels of energy and protein. Equine Vet. Sci. 8(5):371.

Meakim, D.W. et al. 1981. Estimation of mineral content of the equine third metacarpal by radiographic photometry. J. Anim. Sci. 53:1019.

National Research Council. 1989. Nutrient Requirements of Horses. National Academy Press. Washington, DC.

Westervelt, R.G. et al. 1976. Estimating fatness in horses and ponies. J. Anim. Sci. 43:781.