Kentucky Equine Research®
World Leaders In Equine Nutrition

Advances in Equine Nutrition

Volume I

Edited by

J.D. Pagan

PROTEIN AND ENERGY REQUIREMENTS OF GROWING HORSES

LES BREUER
L.H. Breuer & Associates, East Alton, Illinois, USA

Introduction

There are several good sources of information on feeding young horses including the NRC Nutrient Requirement of Horses (NRC, 1989), textbooks (Cunha, 1991; Evans, Borton, Hintz and Van Vleck, 1977; Lewis, 1995) and various university extension publications. Since most feeding recommendations are based directly or indirectly on NRC nutrient recommendations, the NRC recommendations will be evaluated for accuracy and adequacy for feeding horses in the real world of the commercial horse industry. This paper will attempt to approach the subject with practical concerns of the horse producer in mind.

Some questions of practical concern are:

1. How important is mare feeding to milk production and foal growth?
2. Is it necessary to supplemental feed (creep feed) suckling foals?
3. How much protein should creep feeds and weanling feeds contain?
4. How much hay and how much concentrate should be fed to weanlings and yearlings?
5. Do colts and fillies need to be fed differently?
6. Can young horses be harmed by overfeeding? By underfeeding?

The values used in the discussion to follow are intended to apply to typical Thoroughbred, Standardbred, Quarter Horse and other light breeds with mature body weights of 1150 to 1200 lbs. The values can be lowered or raised for smaller and larger horses.

Rates of gain are used which have been observed in horse operations which are competitive in their segment of the horse industry. Discussions about whether moderate growth would be better than rapid growth are useful and this area deserves much more study. However, horse operations which are producing animals for weanling and yearling sales, halter shows, two and three year old racing, or just want horses which “look” competitive really have little choice. Their goal has to be rapid growth,

if not maximum growth, with as few developmental and health problems as possible. Rapid growth rates obviously require liberal amounts of energy and protein. The questions are: When? How much? In what form? To answer these questions, it is helpful to break the entire growth period into the management phases of suckling, weanling, yearling and 2 year old.

Suckling foals

The most growth in the shortest period of time occurs in the foal from birth to weaning. It is normal on successful commercial horse farms for foals to grow from about 10% of mature body weight at birth to nearly 50% of mature body weight at weaning (Hintz, Hintz and Van Vleck, 1979; Thompson, 1995). Daily gains are 2.3 to 2.4 lb. per day during the suckling phase for foals weaned at 6 months of age and even greater for earlier weaned foals. The weights shown in the NRC tables for weanlings appear to be 10% to 15% below the industry norm.

Mare milk is the only significant food the suckling foal receives during the first few weeks of its life and normally continues to be its major source of nutrients until the foal is 4 to 5 months of age. NRC concluded from their data review that mares produce an amount of milk equivalent to about 3% of their body weight for the first 12 weeks of lactation and an average of about 2% of their body weight during the next 12 weeks. Lactation studies (Zimmerman, 1981) in which mare caloric intakes required to maintain body weight are determined while producing milk to support rapid growth rates in their foals indicate that NRC DE recommendations for lactating mares are 10% to 12% low. Calculations based on weight gains of foals receiving mare milk and known amounts of supplemental feed indicate that mares are producing milk in the 4%-3% of body weight range rather than the 3%-2% range assumed by NRC. The additional milk would account for the higher DE requirements observed in the lactating mare studies.

Rapid growth rates in foals result in rapid increases in body weight, and consequently rapid increases in DE requirements for maintenance, while at the same time milk production by the mare begins to decline. Clearly, the foal must have other sources of nutrients if it is to continue to grow at rapid rates. Pasture studies with mares and foals (Breuer, 1974) indicate that older foals get significant amounts of nutrients from high quality pasture. The same would be expected when high quality hay is available to the foal. Under such conditions, foals consume supplemental concentrate at a rate of about 1% of body weight. Calculations indicate that under pasture conditions, older foals probably consume about 3% of body weight as feed dry matter, approximately equally divided between mare milk, pasture or hay, and concentrate. When pasture or hay is limited or poor quality, or mare milk production is low, voluntary concentrate intake will increase (Zimmerman, 1981).

Weanlings

To feed weanlings properly requires good management and the application of more nutritional knowledge than that required for any other class of horse. It is not unusual to see weanlings which are thin and pot-bellied with rough hair. Foals are seen which have been weaned two or three months and have gained little or no weight since weaning. Some owners accept such poor performance in weanlings as normal and unavoidable. It may be normal for some and it is arguable as to whether this is harmful to the horse but it can be avoided by paying attention to the following:

1. Psychology of weaning.
2. Health care.
3. Rations with proper nutrient density and balance.

The first two factors are outside the scope of this paper but are important in order to reduce psychological and physiological stressors to a minimum during the weaning period. Conversely, a balanced diet and a full belly will probably increase immunity to and/or help with recovery from some of the disease problems and possibly help with the psychological problems as well.

Daily weight gains for weanlings of 1.4 to 1.9 lbs. per day suggested by NRC appear to be reasonable based on experimental (Breuer, Kasten and word, 1970; Breuer, 1974) and farm observations (Hintz, *et al*., 1979; Thompson, 1995). However, NRC suggested dry matter intakes for weanlings of up to 3.5% of body weight appear to be too high. Practical and experimental observations indicate that 450 lb. to 500 lb. weanlings will consume a maximum of 2.8% to 2.9% of body weight of air dry matter. Thus, the total air dry matter intake for a 500 lb. foal can be expected to be about 14.5 lb. per day after a 2 to 3 week adjustment period. NRC estimates that the DE requirements of a 500 lb. weanling are 15.2 Mcal and 17.7 Mcal DE per day for weight gains of 1.4 and 1.9 lbs. per day, respectively. Therefore, the caloric densities required in 14.5 lbs. of feed theoretically should be about 1.05 and 1.22 Mcal DE per lb. for weight gains of 1.4 and 1.9 pounds per day. Using good hay and grain, a caloric density of 1.05 Mcal per lb. can be achieved with a ration composed of about 70% hay and 30% grain. Anyone with experience feeding weanlings knows they won't gain 1.4 lbs. per day on this ration. It will definitely take a lower hay:grain ratio to realize this moderate rate of gain. So where does theory go wrong? A couple of possibilities are: (a) hay DE is used less efficiently for gain than grain DE, i.e., net energy for gain in young horses is a lower percentage of digestible energy in hay than in grain, as is well recognized in ruminants and/or, (b) weanlings need more DE for gain than estimated by NRC.

Experimental data indicate that weanlings require about 5% more DE for gain than NRC recommends and that the percentage hay in the ration can be no more than 20%

to 25% for rapid gains of 1.8 lbs. to 1.9 lbs. per day and 35% to 40% hay for more moderate gains of 1.3 lbs. to 1.4 lbs. per day. NRC recommends a constant 30% hay in the ration regardless of whether moderate or rapid gains are expected.

Yearlings / 2 year olds

Normal weight gains in yearlings range from 0.75 to 1.25 lbs. per day depending on prior feeding and development history. Yearlings which have been fed for rapid gains during the suckling and weanling phases and fed for rapid gains as yearlings will become obese, especially in the case of fillies. Yearlings which have been underfed previously may need to be fed for rapid growth similar to weanlings according to body weight rather than age. This should be done carefully to avoid DOD problems.

Experiments with yearlings which have been fed for rapid gains as suckling foals and for moderate or rapid gains as weanlings similar to common industry practice indicate that NRC recommendations for DE for gain in yearlings are as much as 15% below requirements. It may be that the NRC equation for DE requirements for growth which has a correction factor based on age doesn't adequately account for differences in previous feeding and growth histories. Possibly the equation could be improved by using body weight as a correction factor. Higher maintenance requirements due to the high level of activity in yearlings may also contribute to the apparent higher DE requirement for growth in yearlings.

Data from breeding farms (Hintz, *et al*., 1979; Thompson, 1995) and experimental results show that colts and fillies grow at similar rates up to about a year of age but colts appear to continue to grow into their yearling year at slightly higher rates than fillies. Colts need to be fed enough additional feed to account for higher gains of 0.2 lbs. to 0.3 lbs. per day as well as any higher maintenance requirement due to the large amount of voluntary activity in yearling colts which are kept in groups or are allowed to exercise in groups.

Similar to yearlings, amounts to feed 2 year olds depend on how close they are to reaching mature weights which in turn depends on previous feeding and development history. A gain of 0.25 lbs. per day will add 100 lbs. of weight a year which should be adequate under most practical conditions. This will need to be modified if horses are put in training.

Protein requirements of growing horses

Protein requirements for growth in horses are primarily determined by requirements for the amino acids contained in the protein. This author and coworkers (Breuer and Word, 1967; Breuer and Word, 1968; Breuer, *et al*., 1970; Breuer and Golden, 1971) demonstrated a lysine requirement in young horses thirty years ago which has been

confirmed by numerous researchers (Borton, Anderson and Lyford, 1973; Hintz, Schryver and Lowe, 1971; Hintz, Schryver and Lowe, 1971;Ott, Asquith, Feaster and Martin, 1979, Ott, Asquith and Feaster, 1981; Potter and Huchton, 1975). The NRC lysine recommendations are based on a ratio of lysine to digestible energy which is decreased slightly as horses progress from weanlings to yearlings and 2 year olds. Actually these ratios only apply to a rather narrow range of weight gains and will underestimate lysine requirements in young, rapidly growing horses and overestimate requirements in older, slow growing horses. An analysis of studies on lysine requirements in horses shows that the lysine to digestible energy ratio varies widely with differences in growth rates as shown in the following table:

Daily Gain (lb./day)	*Lys:DE Ration (gm/Mcal)*	*Ration Protein %*
1.00	1.27	11.0
1.25	1.59	12.5
1.50	1.91	14.0
1.75	2.22	15.5
2.00	2.54	17.0
2.25	2.86	18.5
2.50	3.18	20.0

The NRC values for lysine to DE ratios of around 2 gm lysine per Mcal DE would be expected to support weight gains of 1.5 lbs. to 1.75 lbs. per day which are usually satisfactory gains for 6 month old foals. However, higher lysine levels are needed in rations for orphan foals or early weaned foals and in creep feeds, especially if mare milk is severely restricted.

The ration protein levels required to meet the amino acid requirements are determined by the amino acid content and availability in the ingredients used in the ration. The values shown in the table are based on a corn-oats-soybean meal feed. Values can be lowered if higher quality protein sources or synthetic amino acid supplements are used. It should be noted that the protein levels apply to the complete ration. If a significant amount of hay is fed, the protein level in the grain feed may need to be adjusted depending on the protein content of the hay.

Studies of other amino acids in horses are limited. The other amino acids do not appear to be of much practical significance in feeding young horses. Lysine is the first-limiting amino acid in typical horse ration ingredients and if the lysine requirement is met using these ingredients, the requirements for the other amino acids will likely be met. If large amounts of unusual ingredients or synthetic amino acid supplements are used, then levels of other essential amino acids may be a concern. A recent study (Graham, Ott, Brendemuhl and TenBroeck, 1994) in yearling horses showed that threonine at 80% of the lysine level was adequate. Adequacy of other essential amino

acid levels have to be evaluated in animal studies and/or by comparing to known requirements in simple stomached species such as swine, rats, and humans.

Lowering protein levels to reduce growth rates to help with DOD problems in young horses is a common recommendation in the horse industry. This practice will reduce weight gains as well as bone growth as measured by wither height. There is no question that gross over-feeding or over-consumption of high protein grain feeds will help precipitate DOD problems in susceptible horses. However, there are no definitive data showing that the feeding levels and growth rates recommended by NRC or in this paper are likely to raise the incidence of DOD problems. Practical experience with numerous feeding trials, controlled and uncontrolled, indicate that selection of the proper ration for the class of animal with respect to its amino acid and mineral content, and feeding the ration at the recommended level, will result in minimal DOD problems. There should be a concern of how nutrient restrictions will affect the expression of the genetic potential of the horse for size and structure. Reducing protein intake without a concurrent reduction in caloric intake should change the composition of gain to more fat and less muscle. If possible, it would be preferable to reduce both caloric and protein intake and try to maintain a normal muscle and fat content at the lower rate of gain.

Summary

Protein and energy nutrition can be used in horse farm management to regulate the growth and development of young horses. It does not have to be a largely uncontrolled process as is often the case. At a time when horse farm economics are a great concern, the proper application of nutritional knowledge in developing horses can result in the production of the desired animal with the highest possible feed efficiency.

References

Breuer, L.H., and J.D. Word. 1967. Studies on complete pelleted rations for horses. Proc. 22nd Texas Nutr. Conf., p.188.

Breuer, L.H., and J.D.Word. 1968. Studies on the dietary amino acid requirement of the equine. Fed. Proc. 27:730.

Breuer, L.H., L.H. Kasten and J.D. Word. 1970. Protein and amino acid utilization in the young horse. Proc. 2nd Equine Nutr. Physiol. Symp., p.16.

Breuer, L.H., and D.L. Golden. 1971. Lysine requirements of the immature equine. J. Anim. Sci.33:227.

Breuer, L.H. 1974. Feeding the breeding and the growing- developing horse. Proc. Maryland Nutr. Conf., p.102.

Borton, A., D.L. Anderson and S. Lyford. 1973. Studies of protein quality and quantity in the early weaned foal. Proc. 3rd Equine Nutr. Physiol. Symp., p.19.

Cunha, T.J. 1991. Horse Feeding and Nutrition, 2nd ed., Academic Press, NY.

Evans, J.W., A. Borton, H.F. Hintz and L.D. Van Vleck. 1977. The Horse. W.H. Freeman, San Francisco.

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

Hintz, H.F., J.E. Lowe and H.F. Schryver. 1969. Protein sources for horses. Proc. Cornell Nutr. Conf., p.65.

Hintz, H.F., H.F. Schryver and J.E. Lowe. 1971. Comparison of a blend of milk products and linseed meal as protein supplements for young growing horses. J. Anim. Sci.33:1274.

Hintz, H.F., R.L Hintz, L.D. Van Vleck. 1979. Growth rate of Thoroughbreds:Effect of age of dam, year and month of birth. J. Anim. Sci. 48:480.

Lewis, L.D. 1995. Horse Feeding and Nutrition, 2nd ed., Academic Press, NY.

NRC. 1989. Nutrient Requirements of Horses, 5th ed., Nutrient Requirements of Domestic Animals. National Research Council. National Academy Press. Washington, DC.

Ott, E.A., R.L. Asquith, J.P. Feaster and F.G. Martin. 1979. Influence of protein level and quality on the growth and development of yearling foals. J. Anim. Sci. 49:620.

Ott, E.A., R.L. Asquith and J.P. Feaster. 1981. Lysine supplementation of diets for yearling horses. J. Anim. Sci. 53:1496.

Potter, G.D., and J.D. Huchton. 1975. Growth of yearling horses fed different sources of protein supplemented with lysine. Proc. 4th Equine Nutr. Physiol. Symp., p.19.

Thompson, K.N. 1995. Skeletal growth rates of weanling and yearling Thoroughbred horses. J. Anim. Sci. 73:2513.

Zimmerman, R.A. 1981 Energy needs of lactating mares. Proc. 7th Equine Nutr. Physiol. Symp., p.127.


Kentucky
Equine
Research®