Protecting your investment: nutrition for the foal
Megan Shepherd
Department of Large Animal Clinical Sciences, Virginia-Maryland College of Veterinary Medicine, Virginia Tech, Blacksburg, VA

Introduction
The American College of Veterinary Nutrition (ACVN)’s circle of nutrition includes three components of a nutritional assessment: patient assessment, diet/ration assessment, and feeding management assessment. For this talk I will address the three components for the foal. The nutritional goals for the foal are to maximize health (i.e. promote moderate and even growth) and prevent disease (i.e. developmental orthopedic disease). Nutrition isn’t always to blame for developmental orthopedic disease; however, ensuring adequate nutrient intake may be an easier factor to manage than other developmental orthopedic disease factors like genetics or abnormal physical stress.

Patient assessment
The two main components of patient nutrition assessment are body weight and body condition score (BCS). Body condition is important for determining whether the current body weight is appropriate or not and thus will influence what and how you feed. Although the 9-point BCS chart is not designed for foals, it is still helpful in identifying foals that are under or over conditioned. Ideal BCS for adult horses ranges from 4-6/9. A BCS of 4/9-5/9 is likely ideal for the foal. Promoting a lean body condition may promote longevity and reduce the risk of developmental orthopedic disease.

Foals achieve nearly 50% of adult body weight by the time of weaning. Therefore, malnutrition before weaning is likely to result in abnormalities more rapidly than after weaning. Tracking serial body weight over time is critical for determining if rate of growth is appropriate. While body weight increases with age, average daily gain reduces with age. Thoroughbred foal average daily gain (ADG) declines from 1.25 kg/day at 1 month of age to 0.5kg/day at one year of age. Mare’s nutritional status and season also influences growth rate. Growth rates slow if the dam’s body condition is declining and growth rates speed up during spring and summer months. Foals appear to obtain maximal wither height growth rate (cm/day) by two months of age, at which time height growth rate dramatically declines. Promoting rapid growth will not influence adult stature; size is genetically determined and only with chronic malnutrition is mature stature negatively affected. Foals display catch-up growth after periods of malnutrition; however, catch-up growth is successful when malnutrition spans over a relatively short period of time (i.e. one season). Skeletal growth, represented by gains in wither height, is complete around two years of age; therefore, growth after two years of age is soft tissue development.

The patient’s physiologic status, including signalment, life-stage (suckling, weanling, yearling), and if a clinical abnormality is present, should also be considered.

Nutrient requirements of foals
Relative requirements for energy and nutrients are higher for growth as compared to adult maintenance. Furthermore, absolute daily requirements for protein, calcium, and phosphorus are higher for a suckling or weanling foal than for an adult at the same anticipated body weight despite being at a lower body weight currently. While all nutrients are important during growth, those that have received the most press with regards to ties to developmental orthopedic disease include energy (excess, deficiency, source), protein (deficiency), calcium (relative deficiency), phosphorus (relative excess), copper (deficiency) and zinc (deficiency). Interestingly, even though the first four months of life are the most critical with respect to growth rate and consequences of malnutrition, nutrient requirements for this stage of growth aren’t well described. Therefore, requirements of the suckling foal are largely extrapolated from data on mare’s milk composition.

Energy requirements for horses is expressed as digestible energy (DE), which is simply the difference in the energy in the food and in the feces. Foal DE requirements are defined as such, (Mcal/day) as (((56.5x0.14)x(BW/1000))+((1.99+1.21x-0.02x2)xADG), where x = age in months, BW =
body weight in kg, ADG = average daily gain in kg/day. Digestible energy requirements are negatively associated with environmental temperature, particularly with low temperatures. Foals have a lower critical temperature than adult horses. Cymbaluk reported that digestible energy should be increased by 1.3% daily for each degree Celsius below the lower critical temperature. Rapid growth, influenced by both nutrition (energy excess) and genetics, has been associated with orthopedic disease in foals. 

Protein is expensive and is more costly to metabolize than carbohydrates and fats. Protein quality is important because essential amino acids must be supplied by the diet. Lysine and threonine are the first two limiting amino acids in growth. Supplementing a low protein (9% crude protein DM) diet with lysine and threonine lead to similar growth rates as for foals fed a high protein (14% crude protein DM) diet. While it is important to meet the foal’s protein requirements, excess protein has no benefit and results in excessive nitrogenous waste excretion.

Incidence of orthopedic lesions in foals was lower when the mares were provided concentrate in late gestation, vitamin/mineral supplementation of the mare’s (gestation and lactation) and foal’s diet was high, and copper zinc content of the mare’s gestation diet was high. Not only should mineral requirements be met, but done so in balance. Calcium and phosphorus are certainly important for developing bone. A relative phosphorus excess, paired with a relatively low calcium intake, can lead to developmental bone problems. Feeding a diet with an inverse calcium: phosphorus ratio leads to nutritional secondary hyperparathyroidism and osteopenia and predisposes the foal to osteochondrosis. Phosphorus can also interfere with trace mineral availability. Target a calcium: phosphorus ratio of 1:1 – 3:1, avoiding < 1:1, during growth. Copper is a cofactor for lysyl oxidase, an enzyme essential for healthy cartilage development. Milk is a poor source of copper; therefore, fetal hepatic copper storage, which is influence by the mare’s diet, is critical. Multiple studies have reported an association between low copper intake and developmental orthopedic disease in foals like physitis and osteochondrosis. Zinc deficiency has also been associated with developmental orthopedic disease; however, excess zinc could interfere with copper availability and thus should be avoided. Therefore, target a zinc: copper ratio of 3:1-5:1.

Assess the foal’s ration & feeding management

Suckling foal

Foals typically consume 15-25% body weight in milk per day at one week of age. In general, the dam’s milk will meet the nutrient requirements of the foal until about two months of age, when milk production begins to decline. However, foals typically begin consuming solid feeds as early as the first week of age.

A growth concentrate should be introduced to the foal at two months of age and fed such that it is only available to the foal(s) and not the mare(s) (i.e. creep feeding). The milk is low in trace minerals and foal tissue stores (i.e. hepatic stores) are a source of minerals during the early suckling period. These stores need to be repleted through the foal’s diet. Creep feeding also prepares the foal for solid food and may reduce the stress of weaning. The macronutrient profile of the creep feed may also reduce stress of weaning. Higher fat and fiber concentrate was associated with less distress in foals undergoing weaning as compared to foals fed a high starch and sugar concentrate. General recommendations are to feed the growth concentrate at a rate of 0.5-0.75 kg for every 100kg of the foal’s current body weight.

If the foal is an orphan then the diet and management before four months of age will be different. Milk differs among species; the author recommends mare’s milk replacers and follow label recommendations. If the milk replacer is reconstituted to a greater dilution, which is not recommended but observed, the energy density of the reconstituted milk replacer is lower and thus more needs to be fed to meet the foal’s requirement. Start feeding milk replacer at 10% of body weight per day, on an as fed basis, and gradually increase to 20-25% body weight per day by ten days of age. Daily milk/milk replacer should be divided into multiple small meals; every two to four hours during the first two weeks, reducing...
to four times per day at two to four weeks of age, then to three times per day after one month of age. Teaching the foal to drink from a bucket will make the caregiver’s life easier. Introducing milk replacer pellets in the first week of age and transitioning the orphan to milk replacer pellets early will further simplify management. Once the foal’s milk replacer pellet consumption is about 1-2% of current body weight, on a dry matter basis, introduce a suckling foal growth concentrate (labeled for suckling foals, not just weanlings, i.e. mare and foal feed) into the diet and gradually transition the foal off of the milk replacer pellets. Discontinue liquid milk replacer once the foal’s solid feed consumption is about 2-3% of current body weight, on a dry matter basis.

Weanling

In general, expected total daily dry matter intake during growth is 2.5% BW. Feeding volume of each feed should be tailored to foal BCS, energy and nutrient density of selected feeds, nutrient requirements, and other feeds in the foal’s ration. Considerations should be given to forage quality and seasonal changes in pasture forage. Forage is the basis of every ration, more so for adults (by volume). A forage only diet will typically not meet the energy and protein demands of the foal. Furthermore, mature (lower quality) forages will need to be complimented with larger volumes of concentrate to ensure the foals energy and protein requirements are met. Therefore, feeding concentrates during growth is typically warranted due to the high nutrient demands during growth. General recommendations are to feed a growth concentrate at a rate of 1.7-2 kg for every 100kg of the foal’s current body weight. Of course, this should be titrated by BCS. Ideally, concentrate should be fed individually. However, for large operations, group feeding is more practical.

Energy source, regardless of quantity, may influence growth. Gray et al. reported that Quarter Horse weanlings fed a concentrate with 52% non-structural carbohydrates (NSC) on a dry matter (DM) basis had higher postprandial glycemic and insulineamic responses and altered growth hormone secretion compared to Quarter Horse weanlings fed a 11% NSC DM. The authors proposed one mechanism to be attributed to insulin’s positive effect on hypothalamic somatostatin release, which has a negative effect on growth hormone secretion. However, the significance of this on growth has yet to be determined.

Yearling

Due to slower growth rates in yearlings, forage may meet the energy and protein requirements for yearlings provide the quality is adequate. A yearling ration could be as simple as forage complimented with a single vitamin/mineral supplement. Fresh forages are generally higher in vitamin content. Preserved forage is lower in fat soluble vitamins (i.e. vitamin E) than fresh forages; therefore vitamin supplementation is important when horses are fed preserved forages, especially if preserved forage is fed year around. The addition of salt may be needed if the vitamin/mineral supplement doesn’t meet sodium chloride requirements.

Questions
meshephe@vt.edu
Also, contact our Clinical Nutrition Consultation Service
vetnutrition@vt.edu; 540-231-4621; 540-231-6448 (fax)
http://www.vetmed.vt.edu/vth/nutrition.asp

References