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ENERGY REQUIREMENTS OF LACTATING MARES AND SUCKLING FOALS

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Lactation places higher nutrient demands on the mare than any other stage of her life. Mares in early lactation produce large quantities of milk rich in protein, energy, vitamins and minerals. One of the most common mistakes made by horsemen is to underfeed mares during this period. Therefore, an understanding of the energy requirements of mares for milk production is essential to correct this problem and reduce associated reproductive disorders.

Satisfying the mare's requirements for milk production may only be part of the solution to feeding lactating mares and their foals. Does mare's milk provide enough energy and nutrients to support the type of foal growth expected by today's horse breeder? Recent research suggests that it may not. This article will evaluate energy requirements for lactation in mares and present data showing that supplemental feed for the foal is necessary to support optimal foal growth.

Energy requirements for lactation

The energy requirements of lactating mares are usually calculated using a factorial method which estimates:

1. The mare's maintenance energy requirement.
2. The added energy required to produce milk.

The amount of energy needed to produce milk is in turn calculated based on estimates of:

1. Milk yield.
2. Milk energy content.
3. Efficiency of utilization of dietary energy for milk production.

The current NRC Nutrient Requirements for Horses (5th edition, 1989) makes the following estimates of these parameters:

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1. Maintenance DE (Mcal/day) = 1.4 + 0.03 BW (kg)
2. Mares of light breeds produce milk equal to 3.0% BW/day during early lactation (1-12 weeks)
3. Mare's milk contains 475 kcal GE/kg of milk
4. Mares convert DE into milk energy (GE) with 60% efficiency.

Using these assumptions, a 500 kg mare would require 16.4 Mcal DE for maintenance + 11.9 Mcal DE to produce milk, or a total daily DE requirement of 28.3 Mcal DE/day.

In addition to the NRC, there are a number of other systems that have been used to estimate energy requirements for lactation in mares. In an excellent recent review, Doureau *et al* (1988) in France summarized these various systems (Table 1). The assumptions used in the calculation of each set of requirements vary somewhat from country to country, but overall estimates of energy required for lactation are remarkably similar. Only Abrams' (1984) estimate from the United Kingdom varied significantly from the others. This estimate, however, was based on a fairly low milk yield.

The French group has done extensive research on energy requirements in the horse. Their estimate of 30.4 Mcal DE/day is higher than any the other groups, but it agrees with DE intakes commonly seen in lactating mares under field conditions (Pagan, unpublished data) and with a large body of research data collected at Purina's research facility in Grey Summit, Missouri.

At Purina's research farm, research has been conducted for many years on the energy requirements of mares and their suckling foals. The results from 7 years of study including 164 lactation records are summarized in Table 2. Many of the same mares were included in the study over a number of lactations. None the less, these data represent the most information accumulated to date on energy requirements in lactating mares.

The mares in the Purina study consumed an average of 33.44 Mcal DE/d and gained an average of 0.25 lbs/d during the 35th through 91st day of lactation. Assuming that this weight gain was all fat deposition and that horses utilize DE for fattening with an efficiency of 55% (Pagan and Hintz, 1986), then 1.92 Mcal DE/d was used for weight gain by these mares. Therefore, these Quarter horse mares needed 31.5 Mcal DE/d to maintain zero energy balance during the second and third months of lactation. Adjusted to a 1100 lb (500 kg) mare weight, this DE requirement would equal 30.6 Mcal DE-d, 16.4 Mcal for maintenance and 14.2 Mcal for milk production. If these mares produced 3.0% for their body weight per day as milk (15 kg), and this milk had a GE content of 525 kcal/kg (a reasonable GE content for this stage of lactation), then these mares would convert DE to GE in milk with an efficiency of about 55%. This GE content is higher than used by the NRC and the efficiency of absorption is slightly lower. These assumptions, however, are in agreement with the French system. It appears from these data that the DE requirements for lactating mares is about 8% higher than estimated by the NRC.

Table 1. ENERGY REQUIREMENTS ACCORDING TO DIFFERENT SYSTEMS FOR A 500 kg (1100 LB) LACTATING MARE¹

	<i>Total requirements (Mcal DE/day)</i>	<i>Maintenance Basis for calculation</i>	<i>Requirements (Mcal DE/day)</i>	<i>Lactation Basis for calculation</i>	<i>Requirements (Mcal DE/day)</i>
Norway (Nedkvitne, 1976)	28.9	DE (Mcal/d) = 138.3 BW (kg) ^{0.75}	14.6	Milk yield = 18 kg Milk GE - 476 kcal/kg NE/DE = 0.60	14.3
U.S.A. (N.R.C., 1989)	28.3	DE (Mcal/d) = 1.4 + 0.03 BW (kg)	16.4	Milk yield = 15 kg Milk GE = 475 kcal/kg NE for milk /DE = 0.60	11.9
F.R.G. (Meyer, 1979)	27.5	DE (Mcal/d) = 140 BW (kg) ^{0.75}	15.0	Milk yield = 13.5 kg Milk GE = 550 kcal/kg NE for milk /DE = 0.66	12.5
United Kingdom (Abrams, 1984)	23.0	12.1 Mcal DE for 450 kg horse, linear relationship with weight	13.5	Milk yield = 10 kg Milk GE = 524 kcal/kg NE for milk /DE = 0.65 ME/DE = 0.85	9.5
France (I.N.R.A., 1984)	30.4	DE (Mcal/d) = 147 BW (kg) ^{0.75}	15.5	Milk yield = 15 kg Milk GE = 550 kcal/kg NE for milk /DE = 0.65 ME/DE = 0.85	14.9

¹Adapted from Doreau *et al* (1988)



Table 2. SUMMARY OF 164 MARE LACTATION RECORDS^{1,2}

<i>Variable</i>	<i>Mean</i>	<i>Std. Dev.</i>	<i>Minimum</i>	<i>Maximum</i>
Mare weight (lbs) ³	1132.50	96.90	884.00	1382.00
Mare DE intake (Mcal/d)	33.44	3.34	24.79	39.97
Mare ADG (lbs/d)	0.25	0.55	-1.16	1.61
Foal DE intake ⁴ (Mcal/d)	3.05	1.77	0.02	8.63
Foal ADG (lbs/d)	2.41	0.40	1.23	3.21

¹ Data from Purina Mills, Inc. research farm

² Records for 35-91 days of lactation

³ 7 day postpartum mare weight

⁴ Foal DE intake as supplemental feed

Supplemental energy required by the suckling foal

The 1989 NRC does not give specific feeding recommendations for the suckling foal other than to say that supplemental feed prior to weaning may be desirable in foals nursing mares that are poor milkers. This differs from the previous NRC edition (1978) which recommended that suckling foals three months of age receive 6.89 Mcal DE/d as supplemental feed.

What is the expected growth rate of a foal of this age and does the mare produce enough milk to support this growth rate?

The 1978 NRC suggested that a 3 month old foal weighing 341 lbs should gain 2.64 lbs./day. Hintz *et al* (1979) reported on growth rates in 1,992 Thoroughbred foals. These foals averaged about 2.65 lbs gain/day during the second and third months of lactation. Quarter horse foals in the Purina study averaged about 2.41 lbs ADG over this same time period. These foals consumed an average of 3.05 Mcal DE per day as supplemental feed over this two month period. Regression analysis of these data (weighted for mare weight) yields the equation:

$$\text{Foal ADG (lbs./day)} = 2.08 + 0.109 (\text{foal DE (Mcal DE/d)})$$

Using this equation, foals would need to consume 5.23 Mcal of supplemental DE/day to gain 2.65 lb/day during the second and third months of lactation. No supplemental feeding would result in a growth rate of 2.08 lbs/day. These figures agree with Doureau *et al* (1982) who stated that foals require 15 kg of milk per kg liveweight gain at 8 weeks of lactation. Fifteen kilograms per day is the expected lactation. Thus, milk alone during this period of lactation could only be expected to support a growth rate of 2.1-2.2 lbs./day, a growth rate which is below that desired by today's horseman.

Figure 1 describes the relationship between suckling foal growth and supplemental

DE intake during the second and third months of lactation. Typical foal concentrates contain around 1.5 Mcal DE/lb. Therefore, a foal of this age would need to eat about 3.5 lbs. of this type feed per day to support the type of growth rate typically seen under commercial conditions. It is not known how much hay and pasture a suckling foal will consume, but these energy sources should be kept in mind when deciding how much supplemental grain to feed. Ideally, weighing the foal regularly can aid in adjusting its grain intake.

It should also be noted that higher supplemental DE intakes may result in elevated growth rates which are undesirable since accelerated growth at this early age may contribute to developmental orthopedic disease in foals. It would therefore seem unwise to allow suckling foals free access to supplemental feed in a "creep" feeding arrangement. Instead, the foal should be fed a weighed amount of supplemental feed when the mare is fed. This can easily be accomplished by simply tying up the mare at meal time. It is a good management practice to feed both the mare and the foal at least twice daily, and three or four times per day if possible.

In conclusion, 1100 lb mares require about 30.5 Mcal DE/day during the first three months of lactation. 16.4 Mcal DE would be required by the mare for maintenance and 14.2 Mcal DE would be required to produce 15 kg of milk. This level of milk production is inadequate to support optimal foal growth during the second and third months of lactation. Around 5 Mcal supplemental DE would be required by a three month old foal. In using the rule of thumb of 1 lb. of feed per month of age would seem to satisfy the suckling foal's supplemental DE requirement.

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