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Calf Note #72 – NRC Energy Requirements for Calves fed Milk or Milk Replacer Plus Starter

Introduction. This Calf Note is a continuation of [Calf Note #71](#), where we looked at the energy requirements of calves fed only liquid feed (milk or milk replacer). This Note follows the NRC calculation of the energy requirements of calves fed both liquid feed (milk and milk replacer) and calf starter.

The ME requirement of calves fed only milk or milk replacer is fairly straightforward – the amount of ME required for maintenance and body weight gain are estimated for the animal and the ME content of the liquid feed is calculated. However, in the case of multiple feeds, we need to calculate the ME requirement and the ME content of each feed.

Calculating the ME requirement. The calculation of the ME requirement of a calf fed multiple feeds is a little more difficult. The folks who developed the new guide made several assumptions about the diet the calf consumes (which affects its ME requirement) as well as the efficiency with which the ME from starter and milk are used for maintenance and gain.

The overall calculation of MEm was calculated as: $0.086 \times BW \text{ (kg)}^{0.75} \div 0.825$. The amount of ME required for body weight gain (MEg) was calculated as: $[(0.84 \times BW^{0.355} \times BW \text{ gain (kg)}^{1.2}) \times 0.69] \div 0.652$. The total ME requirement is the sum of MEm and MEg and is shown in the last column in Table 1.

If you compare the values in Table 1 with those of Table 1 in Calf Note #71, you will notice some different ME requirements for calves of the same body weight and rate of gain. For example, the total ME requirement for a 40 kg calf gaining 400 grams per day eating starter plus milk replacer is 2.76 Mcal/day. If this calf was consuming only milk (see Table 1 from Calf Note #71), the ME requirement is 2.63 Mcal/day. So why the difference?

BW (kg)	ADG (g/d)	MEm (Mcal/d)	MEg (Mcal/d)	ME (Mcal/d)
30	200	1.34	0.43	1.77
30	400	1.34	0.99	2.33
35	200	1.50	0.46	1.96
35	400	1.50	1.05	2.55
40	200	1.66	0.48	2.14
40	400	1.66	1.10	2.76
40	600	1.66	1.78	3.44
45	200	1.81	0.50	2.31
45	400	1.81	1.14	2.96
45	600	1.81	1.86	3.67

Table 1. ME requirements for calves fed milk or milk replacer plus calf starter.

Well, the difference between the two groups of calves lies in the manner in which they utilize energy. Calves fed calf starter can utilize the ME that they consume less efficiently than energy derived from milk or milk replacer. That's because at least some of the carbohydrate and protein in starter feed must be fermented in the rumen prior to being digested by the calf. As rumen activity increases, the amount of heat produced

by the animal increases as well. Because heat is a by-product that is not captured by the body, it is considered a loss.

We can calculate the expected growth of a calf consuming milk replacer and calf starter. For example, let's select a calf that weighs 45 kg and is consuming 454 grams of milk replacer and 500 grams of a good quality calf starter daily: Our first step is to calculate the total ME intake by the calf on a 100% dry matter basis:

- Intake of CMR = 454 grams of powder \times 95% DM = 431 grams of DM
- Intake of starter = 500 grams of powder \times 88% DM = 440 grams of DM
- Assume that CMR contains 4.74 Mcal of ME/kg of DM: $0.431 \times 4.74 = 2.04$ Mcal of ME
- Assume that starter contains 3.3 Mcal of ME/kg of DM: $0.440 \times 3.30 = 1.45$ Mcal of ME
- Total ME intake = $2.04 + 1.45 = 3.49$ Mcal/day
- MEm requirement = 1.81 Mcal/day (From Table 1)
- ME available for growth = $3.49 - 1.81 = 1.68$ Mcal/day.
- From Table 1, we can estimate the growth would be between 400 grams/day (which requires 1.14 Mcal of ME) and 600 grams/day (which requires 1.86 Mcal of ME). To do a more exact calculation, we would need to use the equation:
 $ME_g = (0.84 \times BW^{0.355} \times ADG^{1.2} \times 0.69) / 0.652$ – we can then manipulate the equation to calculate the expected growth rate.
 $1.68 = (0.84 \times 45^{0.355} \times ADG^{1.2} \times 0.69) / 0.652$
 $1.095 = 0.84 \times 3.863 \times ADG^{1.2} \times 0.69$
 $1.587 = 0.84 \times 3.863 \times ADG^{1.2}$
 $1.889 = 3.863 \times ADG^{1.2}$
 $0.489 = ADG^{1.2}$
 $0.551 = ADG$
- Therefore, the calf will gain 551 grams per day when fed this diet under “typical” conditions. If the calf cannot gain 551 grams per day, then there are other outside factors that are restricting growth, including extreme cold temperatures, disease, stress, overcrowding and many other possible factors.

It is also possible to use the same set of equations to calculate the amount of calf starter to feed to calves to achieve a target growth rate. However, the ME content of the diet changes as different proportions of starter and milk replacer are fed. This complicates the calculations considerably. In this case, the CD that is comes with the Nutrient Requirements is very helpful in assisting with the calculations.

The bottom line. Calculation of the energy requirements of young calves is partitioned into different groups, based on the state of metabolic development. Estimates of the energy requirements of calves can be calculated from the equations listed in this Calf Note. For more information, you can go to <http://books.nap.edu/catalog/9825.html> to view an on-line version of the NRC guide.

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