TechNote 16

Determine energy requirements

IN THIS TECHNOTE

In this resource, the "Early lactation" period starts when the cows enter the milking herd and includes the mating period. A dairy cow in early lactation requires energy to support

- maintenance,
- milk production,
- activity (walking and grazing),
- body condition gain/loss.

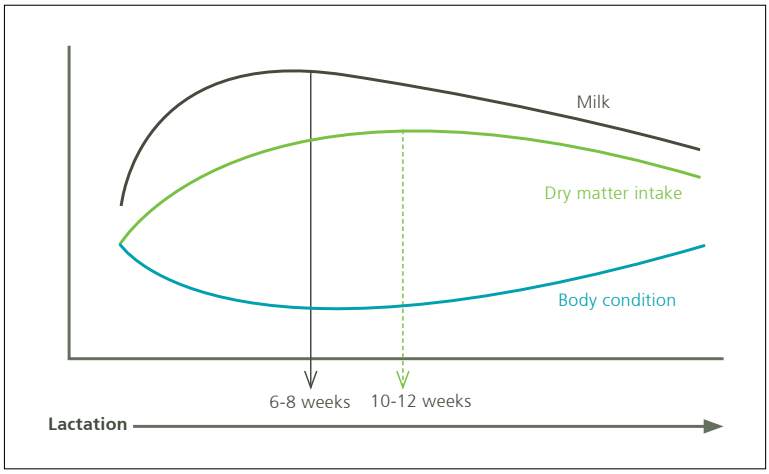
This energy comes from:

- diet (dry matter intake; DMI),
- body tissue reserves (body condition loss).

16.1 Understand what affects body condition loss in early lactation

In early lactation, a cow does not reach peak food intake until 10 - 12 weeks after calving, whereas, peak milk production occurs 6 – 8 weeks after calving. This means the cow is in a state of negative energy balance and must use body reserves (mobilise body tissue) during this period to fill the energy deficit (Figure 1).

Figure 1. *Relationship between milk yield, dry matter intake and body condition loss during early lactation.*



The magnitude of the negative energy balance is the difference between energy input (DMI x feed quality) and energy output (milk production + cow maintenance + activity). To provide the energy necessary for milk production in early lactation the cow mobilises large amounts of body tissue (primarily fat, with small amounts of protein), which is reflected in a loss of body condition. The greatest loss in body condition occurs in the first ten days after calving where cows can lose up to 0.5 BCS units (Figures 2 and 3). They continue to mobilise body reserves for approximately 8 - 10 weeks after calving, or until the point at which energy intake matches energy output.

For more details see TechNote 11: Understand the transition cow.

Figure 2. *Average body condition score (BCS) change through lactation.*

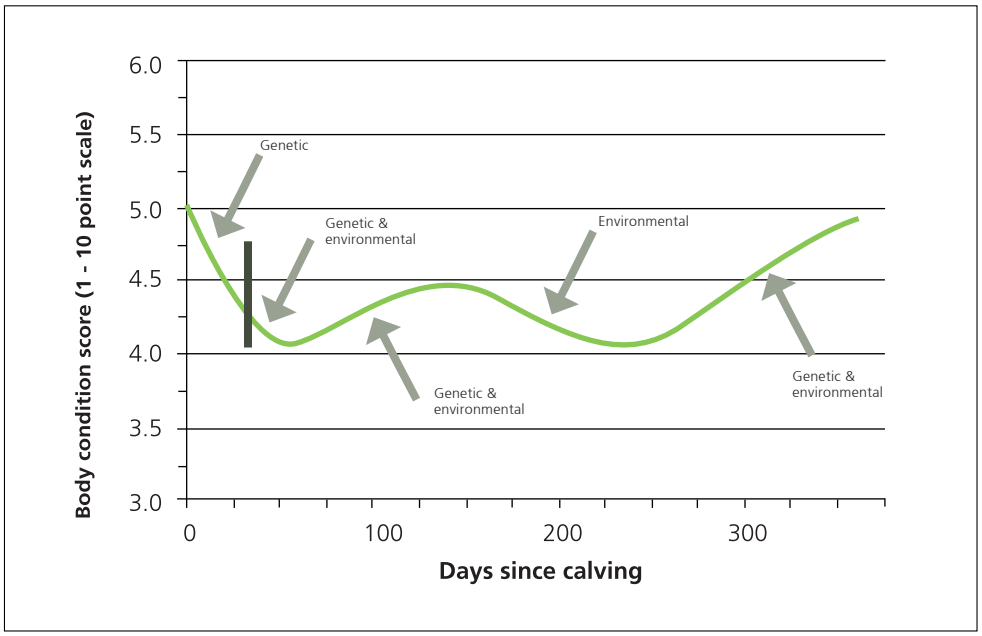
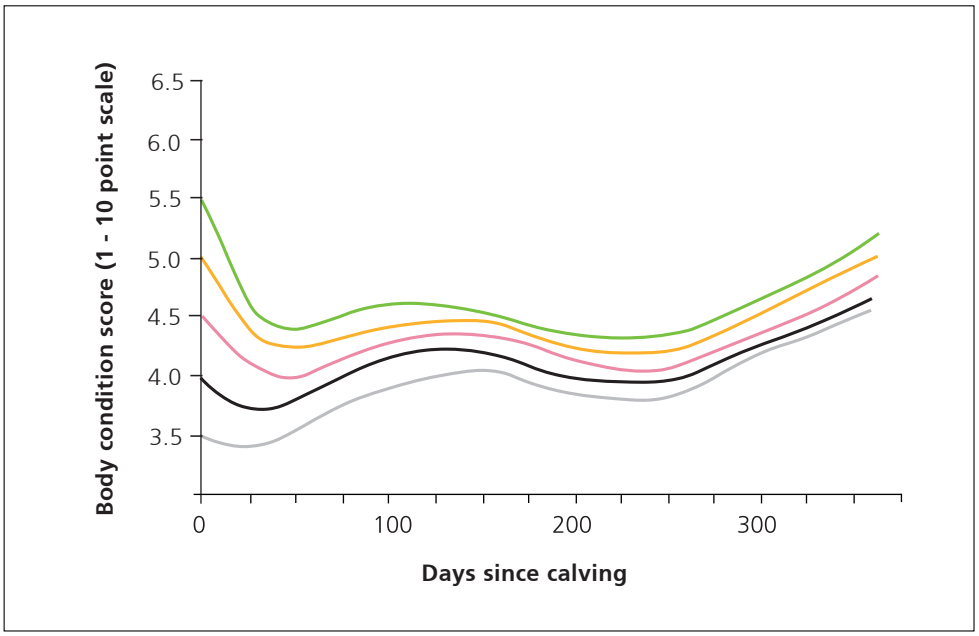
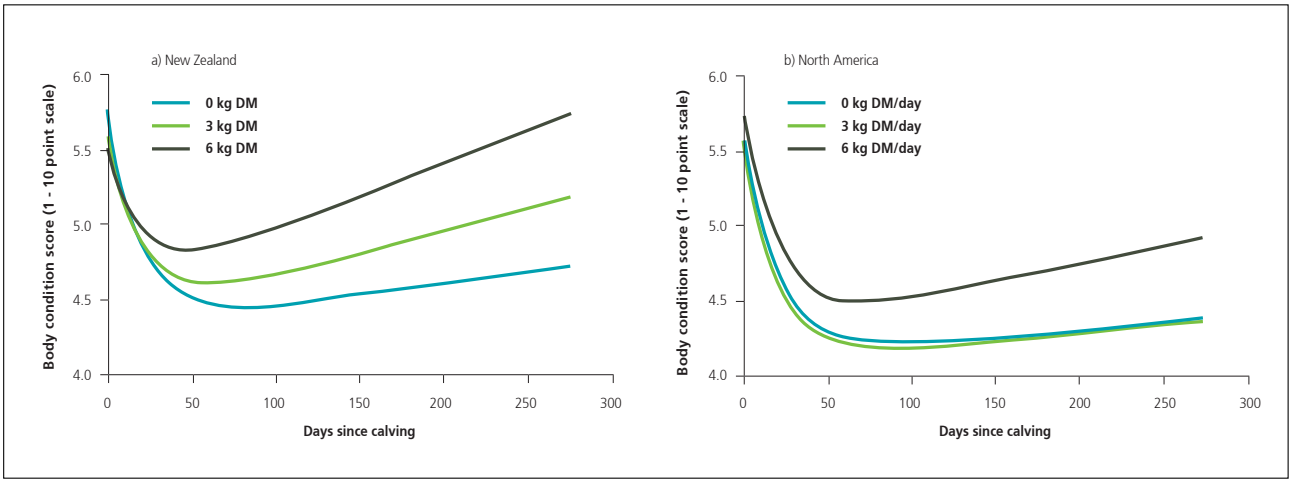


Figure 3. *Body condition score (BCS) changes for different BCS at calving.*



During early lactation, cow genetics (e.g. breed and strain; Figure 4), and BCS at calving (Figure 3) can alter the rate of BCS loss, with high producing cows or cows at a greater BCS at calving losing more BCS in early lactation than their lower producing or lower BCS counterparts.

Figure 4. *Body condition score (BCS) changes of cows with a) New Zealand and b) North American genetics fed pasture only or pasture plus 3 or 6 kg DM supplement/day.*

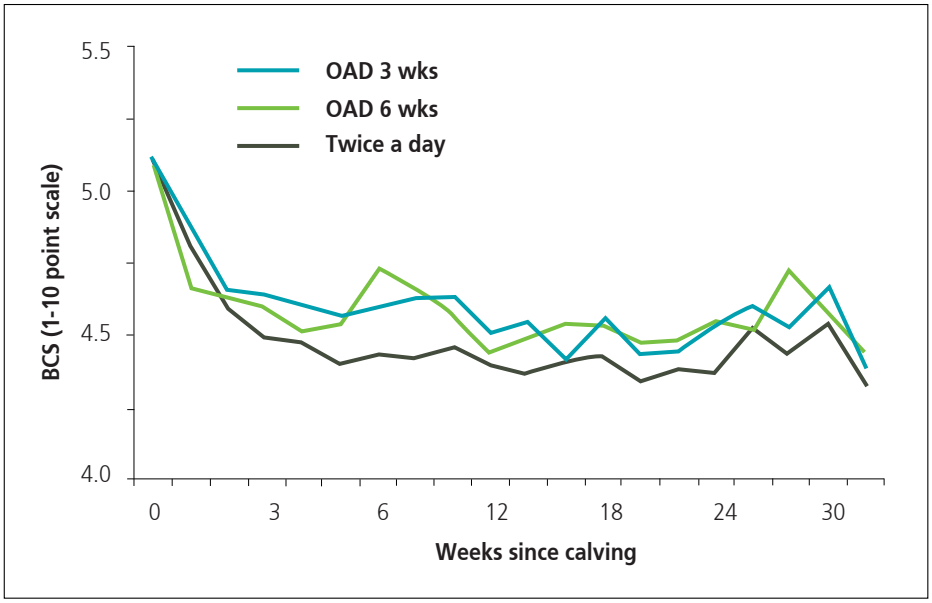


Although increasing cow intake or reducing milking frequency post-calving takes several weeks before it has an effect on BCS, these management strategies can alter the point at which BCS loss ceases (nadir), and the rate of BCS gain after this point (Figures 4 and 5). It must be noted that cow genetics, and BCS at calving, has a stronger influence on BCS loss post-calving than nutrition or milking frequency during this period. The modern-day dairy cow is genetically predisposed to produce milk at the expense of body reserves during this period. In some cows, this can mean that 2 – 3 kg per day body reserves are mobilised post-calving to support milk production.

Q: Will replacing pasture with energy dense feed such as barley reduce BCS loss?

A: Yes and No. Feeding high energy supplements post-calving does not prevent the initial loss in BCS but it can alter when BCS nadir (lowest point) occurs. Genetics, BCS at calving, and management pre-calving, have the biggest effect on BCS loss post-calving.

Figure 5. *Schematic of BCS profiles of cows milked either twice a day or once a day for 3 weeks or 6 weeks from calving.*



Ideally, a dairy cow should lose no more than 1 BCS unit from calving through to mating (Figure 2) with the aim to have all cows past the nadir (lowest point) and at a minimum BCS of 4.0 at the planned start of mating. This BCS profile will optimise milk production, while ensuring reproduction and animal health are not compromised. If this profile is achieved, additional feed or reduced milking frequency which results in BCS greater than a 4 at mating is not likely to have a positive effect on reproduction. Therefore, if cows are at target BCS during early lactation, the use of supplements should be determined based on the economics of the milksolids response to the supplement rather than any perceived benefits to reproduction.

Q: How much body condition should cows lose in early lactation?

A: Ideally, cows should lose no more than 1.0 BCS unit between calving and mating. Cows can lose up to 0.5 BCS units in the first ten days and will continue to lose body condition for approximately 8 – 10 weeks.

16.2 Know energy and nutrient requirements for the early lactating cow

An example of the energy and nutrient requirements of an early lactating cow are presented in Table 1 and 2, respectively.

These requirements can be estimated using the tables in TechNote 2, or DNZ Facts and Figures, or alternatively they can be automatically calculated using the DNZ FeedChecker.

For more details see TechNotes 2: Energy, mineral and vitamin requirements, and 18: Allocate required nutrients. To use the DairyNZ FeedChecker see www.dairynz.co.nz/feedright-feedchecker.

Table 1. *Example of daily energy requirements of a 500 kg LWT Kiwi Cross cow in early lactation, producing 2 kg MS/day, walking 2 km over rolling terrain, losing 0.5 kg LWT/day and eating a diet averaging 12 MJ ME/kg DM*

Requirement	MJ ME
Maintenance	59
Walking on rolling hills for 2 km (2 km x 3 MJ ME/km)	6
Milksolids (2 kg MS x 80 MJ ME/kg MS)	160
LWT loss (0.50 kg LWT x – 37)	-19
Total MJ ME at 11.0 ME	**206**
ME requirements reduced by 5% as 12 mg ME diet (206 x 95%)	196
Total kg DM eaten (196 ÷12 MJ ME)	**16.3 kg DM**
Total kg DM offered (if utilisation is 90%)	**18.2 kg DM**

Table 2. Daily dietary requirements of an early lactating cow grazing pasture, pasture + supplements or eating a total mixed ration.

Nutrient	Diet	% DM
Crude protein		
< 2.4 kg MS/cow/day		18
> 2.4 kg MS/cow/day		24
Fibre		
Minimum NDF	Pasture	35
Minimum eNDF	Pasture	17
Minimum NDF	Pasture + supplement or TMR	27-33
Minimum eNDF	Pasture + supplement or TMR	20
Minimum ADF	Pasture + supplement or TMR	19-21
Soluble sugars and starches (SSS)		
Maximum SSS	Pasture + supplement or TMR	38
Maximum Starch	Pasture + supplement or TMR	30
Fat		
Maximum dietary fat	Pasture + supplement or TMR	6-8
Maximum additional protected fat	Pasture + supplement or TMR	3
Maximum additional unsaturated fat	Pasture + supplement or TMR	1-2

For more details see TechNotes 2: Energy, mineral and vitamin requirements, 5: Carbohydrate metabolism, 6: Protein metabolism, 7: Lipid metabolism, 8: Fibre metabolism, and 18: Allocate required nutrients.

16.3 Further reading

DairyNZ Body condition scoring. The reference guide for New Zealand dairy farmers. https://www.dairynz.co.nz/publications/animal/body-condition-scoring-reference-guide/

NRC. 2001. Nutrient requirements of dairy cattle (7th rev. ed). Washington, United States of America: National Academy Press.

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Roche, J. R., D. P. Berry, and E. S. Kolver. 2006. Holstein-Friesian strain and feed effects on milk production, body weight, and body condition score profiles in grazing dairy cows. Journal of Dairy Science 89: 3532 – 3543.

Roche, J. R., D. P. Berry, J. M. Lee, K. A. Macdonald, and R. C. Boston. 2007. Describing the body condition score change between successive calvings: a novel strategy generalizable to diverse cohorts. Journal of Dairy Science. 90: 4378 - 4396.

Roche, J. R., N. C. Friggens, J. K. Kay, M. W. Fisher, K. J. Stafford and D. P. Berry. 2009. Invited review: Body condition score and its association with dairy cow productivity, health, and welfare. Journal of Dairy Science 92: 5769 – 5801.

Roche, J. R, K. A. Macdonald, K. E. Shutz, L. R. Matthews, G. A. Verkerk, S. Meier, J. J. Loor, A. R. Rogers, J. McGowen, S. R. Morgan, S. Taukiri, and J. R. Webster. 2013. Calving body condition score affects indicators of health in grazing dairy cows. Journal of Dairy Science 96: 5811 – 5825.

Ruminant Physiology: Digestion, Metabolism, Growth and Reproduction. P. B. Cronje, ed. Oxon, UK: CAB International.

The InCalf Book for NZ Dairy Farmers. https://www.dairynz.co.nz/animal/reproduction/incalf/