TechNote 23

Allocate required nutrients

IN THIS TECHNOTE

During mid lactation, energy is generally the limiting nutrient in a pasture-based system. However, in summer-dry, non-irrigated regions, pasture quality declines, and low protein supplements (e.g. maize silage) are often fed. In this scenario, protein content of the diet may not meet requirements.

23.1 Determine the limiting nutrient

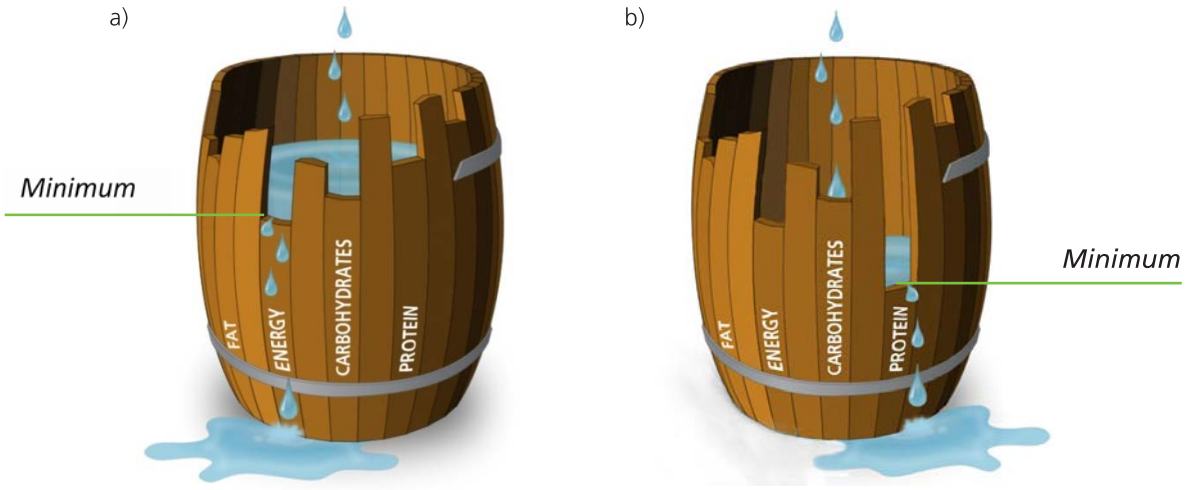
The analogy of the barrel with staves of unequal length (Figure1) and determining the limiting nutrient in the dairy cow is explained in more detail in TechNotes 10 and 18. Briefly, using Liebig's law of the minimum, the ability of the barrel to hold water is limited by the shortest stave. It does not matter how much longer the other staves are, the barrel will still not hold more water. Consistent with this, greater milk production can only be achieved, if the nutrient in shortest supply is increased. Increasing the supply of other, non-limiting nutrients will not increase production.

In a pasture-based system, energy is generally the limiting nutrient; however, in summer-dry, non-irrigated regions, if pasture quality and quantity declines, and low protein supplements (e.g. maize silage) are incorporated into the diet, protein may become the limiting factor to production (Figure 1).

Q: How much protein do my cows need in mid lactation?

A: As a rule of thumb, cows required approximately 14 – 16% DM crude protein in mid lactation. However, even if protein is limiting, consider the economics before increasing protein in the diet.

Figure 1. Liebig's law of the minimum with a) energy or b) protein as the limiting factor.



For more details see TechNotes 10: Response to supplements, and 18: Allocate required nutrients.

23.2 Understand protein requirements

As a rule of thumb, protein requirements for a mid-lactation cow are 14-16% crude protein (CP; Table 1).

Table 1. Rule of thumb for protein requirements.

Requirements	Total protein (% of DM)	Rumen degradable protein (% of protein)	Undegradable dietary protein (% of protein)
Mid lactation	14-16%	65%	35%

However, there are several factors that affect this requirement:

Energy status of the cow	Cows losing condition require more dietary protein to maximise milk production than cows gaining condition
Milk production level	The greater the milk production the greater the demand for dietary protein
Energy content of the feed (MJ ME/ kg DM)	Cows offered high ME feeds require greater levels of dietary protein and in particular, rumen degradable protein
Amino acid profile of the diet	Some supplements may be deficient in specific amino acids, even if they met crude protein requirements
Ambient temperature	Heat stressed cows reduce DMI, and expend energy trying to cool, therefore energy is generally limiting milk production and not protein
Activity	Cows that walk further distances expend energy on activity and are less likely to require additional protein

In regions that have a high rainfall or are irrigated, summer pasture should meet protein requirements (Table 2). However, in summer-dry, non-irrigated regions, the crude protein content of ryegrass and kikuyu can fall below this level. In addition, supplements that are incorporated into the diet of grazing cows through this period (and into late lactation) are sometimes low in protein (Table 2).

Table 2: Protein content of commonly used feeds used during mid lactation (summer).

Feed	Crude protein (% DM)
Pasture	
Irrigated/wetland	18 - 30
Dryland - leafy	15 - 22
Dryland - stalky	9 - 15
Kikuyu – leafy	16 - 20
Kikuyu – stemmy	6 - 10
Maize silage	8
PKE	14 - 18
Turnips	12 - 18
Fodder beet	6 - 9
Chicory	20 - 26

The protein in summer pasture is approximately 70 – 90% degradable in the rumen. Thus if protein is limiting production in a pasture-based system, supplements high in undegradable dietary protein (UDP) are required to generate a milksolids response. Feeding supplements that are high in rumen degradable protein (RDP) or non protein nitrogen (NPN) will not improve production.

When considering protein supplementation in summer, always consider the economics of feeding the supplements first.

Q: Should I use urea as a protein supplement in summer?

A: No, urea or other sources of non protein nitrogen will not improve performance in cows fed primarily on pasture and/or silages

More details on the economics of protein supplementation are in TechNote 24.
For more details see TechNotes 3: Feed components, 6: Protein metabolism and 24: Use supplements profitably.

23.3 Understand the impact of fibre on performance

The lactating dairy cow has a minimum requirement for fibre to ensure efficient rumen function (Table 3).

During the summer months, particularly in summer-dry, non-irrigated regions, fibre (NDF and ADF) in pastures is generally greater than this and can increase to more than 60% DM. High NDF levels such as these reflect a build-up of lignin in the pasture, which can result in reduced digestibility of carbohydrates, lower energy values and reduced intakes.

Table 3. Minimum fibre requirements.

	Minimum requirement (% diet DM)		
Diet	**NDF**	**eNDF**	**ADF**
Pasture	35	17	19
Pasture + supplement/TMR	27	20	19

Although misleading, an equation that was derived from cows in confinement systems fed a total mixed ration (TMR), is sometimes promoted in NZ as a means of determining the impact of dietary NDF on cow intake. The equation that is incorrectly used is:

Dry matter intake = (120 ÷ NDF%) ÷ 100 x liveweight

For example: If a ration has an NDF of 30%, then maximum intake for a 500 kg cow is predicted to be:

(120 ÷ 30) ÷ 100 x 500 = 20 kg DM

This equation may have some relevance for cows eating a TMR in a confinement system; however, analyses of pasture diets in NZ, indicate that dietary NDF content explains less than 10% of the variability in intake.

For example: Applying the above equation to a 500 kg cow grazing good quality pastures that have a NDF of 45% would mean a maximum intake of 13 kg DM which equates to milk production from pasture of 1.0 kg MS/d.

(120 ÷ 45) ÷ 100 x 500 = 13 kg DM

In reality, a 500 kg cow eating good quality pasture with an NDF of 35 – 45% DM can produce 2 kg milksolids or more, with maximum intakes in the range of 17 - 20 kg DM.

Therefore, the above equation DOES NOT provide an accurate prediction of intake in pasture-based system. This is because the NDF in good quality pastures is generally highly digestible and rapidly degraded.

If NDF levels are very high (60% or more), which occurs with poor quality hay, silages, some tropical grasses (e.g. kikuyu) or poor quality ryegrass (e.g. during a drought), pasture quality will decline, digestibility and degradation rates decrease, and NDF will play a bigger role in regulating intake.

Therefore, although weather (low moisture and high temperature) can increase the NDF content of pasture, a key to maintaining high quality pastures and good energy intakes during summer is to focus on good pasture management during spring.

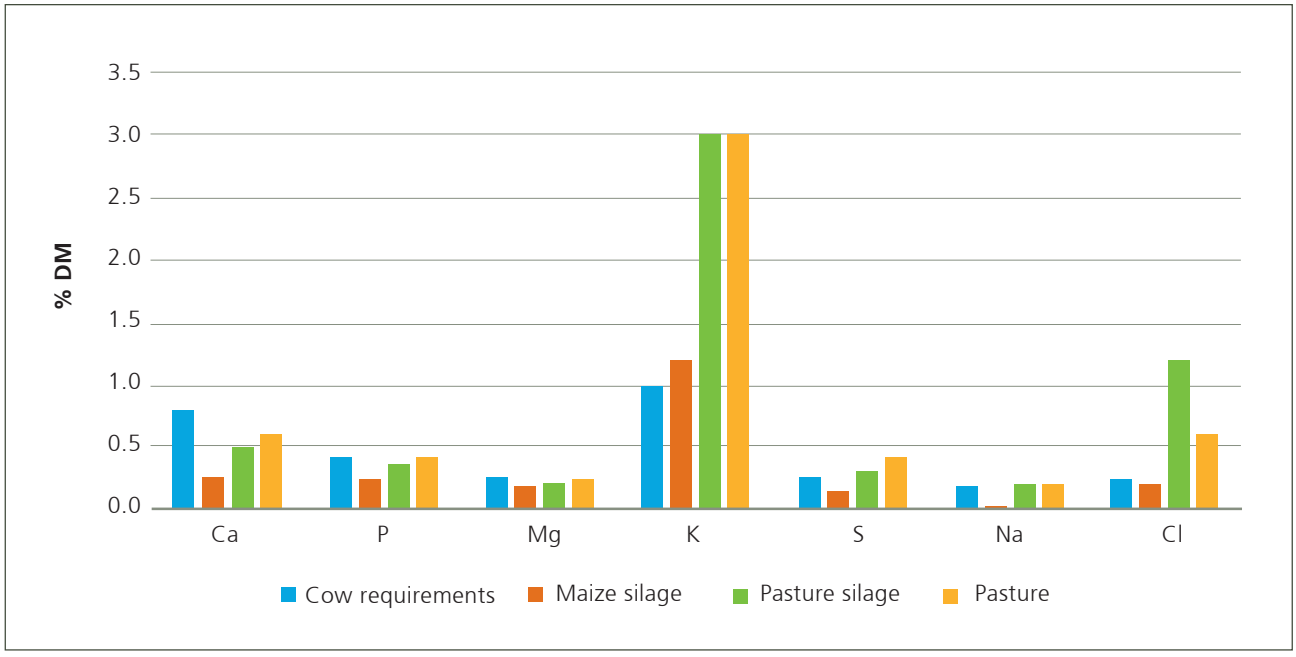
If very high levels of supplement, that are low in effective fibre (e.g. fodder beet, maize grain and/or PKE) are incorporated into the diet during the summer period, there is a risk that minimum fibre (NDF and eNDF) requirements may not be met (Table 4). Cows require approximately 27% DM as NDF and 20% as eNDF. The NDF content of the diet can be calculated using DairyNZ 's FeedChecker, or information gained from DairyNZ's Facts or Figures.

For more details on Fibre see TechNotes 3: Feed components, 5: Carbohydrate Metabolism, and 8: Fibre Metabolism.
For more details on pasture management see TechNotes 17: Allocate spring pastures correctly, and 22: Manage summer pastures correctly.

23.4 Supplement minerals to meet requirements

Mineral supplementation in summer depends on the diet being fed and cow requirements. The mineral composition of some commonly used feeds during summer, and cow requirements are highlighted in Figure 2.

Figure 2. *Mineral composition of pasture, and maize and pasture silages, and cow mineral requirements during mid lactation.*



Compared with cow requirements, maize silage is low in magnesium, calcium, phosphorus, and sodium. Recommendations are that if more than 3 kg maize silage is being fed during mid/late lactation, supplementation with these minerals is an inexpensive insurance against possible deficiencies that can negatively affect production and increase the risk of metabolic disorders (e.g. staggers). As the amount of maize silage in the diet increases, the requirement for certain minerals also increases (Table 4).

Table 4. Amounts of commonly used mineral supplements to provide the required minerals for different amounts of maize silage eaten.

Maize silage eaten	Limeflour	CausMag	AgSalt	DCP*
3 kg DM	**60**	**40**	**15**	**20**
3 – 5 kg DM	70	45	25	35
5 – 8 kg DM	80	45	40	50

* DCP = dicalcium phosphate

In addition, fodder beet is very low in phosphorus. Phosphorus supplementation (e.g. DCP) may be required if phosphorus content of the total diet is below requirements (approximately 0.3% DM). See TechNote 13 for more details on fodder beet, and phosphorus supplementation. The DairyNZ FeedChecker can also be used to check if mineral requirements are being met.

23.5 Further reading

DairyNZ Facts and Figures. www.dairynz.co.nz/publications/dairy-industry/facts-and figures/

DairyNZ FeedChecker. www.dairynz.co.nz/feedright-feedchecker.

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