

Feeding cows in spring

Answers to frequently asked questions



Foreword

This booklet contains answers to the frequently asked questions about feeding dairy cows in spring and it is not intended to be a comprehensive guide to cow nutrition.

It is a resource to help farmers make profitable and sustainable feed management decisions on pasture-based farms and has been developed within the FeedRight programme led by DairyNZ's Dr Jane Kay.



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Manatū Ahu Matua



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Contents

<i>Reproduction</i>	3
<i>Pasture</i>	4
<i>Supplements</i>	9
<i>Substitution</i>	13
<i>Once a day milking</i>	15
<i>Milk urea</i>	16
<i>Protein</i>	18
<i>Fibre</i>	19
<i>Transition cow</i>	20
<i>Minerals</i>	20
<i>Health</i>	24
<i>Index of questions</i>	26



Reproduction

Can cows get in-calf on a pasture only diet?

Yes, reproductive performance above industry targets can be achieved when cows are fed solely on good quality pastures. If there is adequate feed (pasture residuals of 1500-1600 kg DM/ha and good pasture utilisation) there are no reproductive benefits from feeding additional supplements. If there is an energy deficit, then plugging this gap can improve reproduction; however the type of supplement: starch (e.g. barley or grain) compared with fibre (e.g. silage or PKE) has no effect.

Nutrition is only one of the factors that impact reproduction. Others are genetics, bull management, heat detection, cow health, calving pattern, heifer management, non-cyclers and cow condition at calving and mating. Like making a good cake, you need to get all of these ingredients right to get the right results.

Does body condition score (BCS) affect reproduction?

BCS at mating is a key driver of cow cycling and thus the 6-week in-calf rate. This is largely set by BCS at calving, hence the importance of achieving BCS targets at calving of 5.5 for 2 and 3 year olds and 5.0 for older cows.

Cows will naturally lose body condition after calving. If cows are fed adequate amounts of good quality pasture (residuals 1500-1600 kg DM/ha) additional feed will not reduce BCS loss during the first few weeks post-calving. The main drivers of body condition loss post-calving are genetics and BCS at calving. At this time, the focus should be on achieving target grazing residuals to ensure there is good quality pasture available during mating.

Can I take out supplements during mating?

Yes, if energy supplied by pasture is adequate, there is nothing to fear from a reproductive perspective, from reducing or removing supplements during the mating period.

In fact, a research trial showed there was no impact on submission, conception, 6-week in-calf or final pregnancy rates when supplements were removed from the diet just prior to mating (cows had been eating 2 kg DM/cow/day of supplement).

Will a feed deficit reduce reproduction?

Yes, if intakes are restricted during the mating period either due to a feed deficit (residuals less than 1500 kg DM) or prolonged adverse weather and poor pasture utilisation, then reproduction can be reduced. However, the impact may not be as severe as expected. In a large scale research experiment, mixed age cows were restricted and fed 55% of energy requirements for two weeks at the start of mating. The 6-week in-calf rate dropped by 7% but there was no difference in final pregnancy rate. This would be a worst case scenario.

Will feeding supplements improve reproduction?

If residuals are 1500 kg DM/ha (or more) and there is good utilisation of high quality pasture, there is no reproductive benefit of adding supplements into the system. In a research trial, where cows were fed a pasture only diet or pasture plus 3 or 6 kg DM of a high energy concentrate from calving onwards there was no effect of feeding the supplement on any reproductive parameters. Pasture is enough if you have enough pasture.

Does feeding starch or fibre supplements affect reproduction?

No, there is no impact of supplement type on reproductive performance.

On-farm trials were conducted to investigate the effect on reproduction of feeding a high starch supplement compared with a high fibre supplement. These trials involved 950 cows and three dairy herds and it was concluded from the results that increasing the amount of starch (non-structural carbohydrates) in a pasture-based diet did not improve reproductive performance.

The theory behind using starch-based concentrates (e.g. maize grain or barley) or sugar-based feeds (e.g. molasses) to improve reproduction is based on increased concentrations of circulating hormones such as insulin and IGF-I, which, in theory, can lead to earlier cycling. However, the effect of increasing IGF-I on cycling is inconsistent and research in New Zealand indicates that 97% of the variation in time to first oestrus in New Zealand cows is related to things other than IGF-I levels. Additionally, increased IGF-I levels post-mating can lead to embryo death.

Therefore, if there is a pasture deficit during mating, the focus should be on increasing the energy (MJ ME) available to the cow. The type of supplement used to achieve this is secondary and, therefore, supplement purchase decisions should still be based on cents/MJ ME.

Pasture

For additional information on grazing management and pasture as a feed, check out the *DairyNZ Technical Series (Aug 2014)* and the *Perennial ryegrass grazing management in spring – paddock guide*.

Is it better to have a fast or slow rotation length?

The correct rotation will depend on the time of the year and the pasture growth rates, or more specifically the leaf emergence rates. A ryegrass tiller maintains up to 3 live leaves. The first leaf is the smallest and contributes approximately 25% of the total growth, the second leaf contributes another 35%, while the 3rd leaf is the biggest and makes up the remaining 40% of the total growth. Once the 4th leaf starts to grow, the 1st leaf will begin to die off. Thus in order to maximise plant growth and quality, you should aim to graze between the 2 and 3 leaf stage, or earlier if canopy closure has occurred.

If your rotation length is too short, sometimes referred to as too fast (i.e. before the 2nd leaf has emerged), then you will reduce pasture growth and, over time, reduce pasture persistence. If it is too long (or too slow), then you reduce pasture quality and pasture eaten because leaves die.

How do I maximise intake on pasture?

Maximum pasture intake depends on cow size and pasture quality. A 400 kg Jersey can eat approximately 16 kg DM (4.0% of bodyweight) of good quality pasture compared with a larger 550 kg Holstein Friesian which can eat about 18 kg DM (3.3% of bodyweight).

However, the important consideration in a pasture-based system is not to maximise short-term individual cow intake, but rather to maximise high quality pasture grown and eaten per ha throughout the season. In order to achieve target residuals (1500 kg DM/ha) and maintain top pasture growth and quality throughout the season, cows will be eating at approximately 90% of their "potential" intake.

To maximise pasture intakes, pasture offered needs to increase significantly with the result that grazing residuals will rise, pasture will be wasted and future pasture growth and quality compromised. For example, a cow eating 16 kg DM and grazing to target residuals would need to be offered an additional 10 kg DM, in order to eat an extra 1.5 kg DM. This means that 85% of the extra pasture offered is wasted (8.5 kg DM per cow). Unless corrective action is taken,

the resulting high residuals also mean a loss of energy available (pasture quality) for the next round. Research trials showed that cows that grazed to target residuals in spring (compared with cows that left higher residuals) produced more MS over the whole season due to the improved quality of pasture post spring. So, manage your pastures to look after your cows over the entire season.

Can I squeeze more into the cow's rumen if I fill it using the philosophy of rocks first, followed by pebbles, sand and then beer?

No, to say you can fit more into the rumen of a cow eating pasture (rocks) by adding in concentrates (i.e. pebbles or sand) and that there is room left for liquid feeds like molasses (i.e. the beer) is incorrect. This is because firstly the rumen is not a closed container, feed is continually being broken down (degraded or fermented) and products are absorbed through the rumen wall or passed out into the small intestine.

Secondly, intake regulation is complex; the cow's brain tells her when to start and stop eating. Products of digestion and hormones released tell the brain about how much the cow has eaten. The cow's brain then calculates how much energy she still requires and whether expending the energy to harvest the extra feed is worth it.

This is why when a grazing cow is fed supplements, she will reduce the time spent grazing – a phenomenon known as substitution. As a rule of thumb for every kg of supplement fed, the cow will graze for 12 mins less, and therefore, will leave more grass behind in the paddock.

Therefore if you add in concentrates (pebbles or sand) or molasses (beer), some of the rocks (pasture) will be left out.

How fast can a cow eat her daily intake (pasture only)?

Cows typically graze for 8 to 10 hours per day, consuming approximately 2kg DM/hr. Cows can adapt their grazing behaviour relatively quickly and increase the efficiency with which they graze. Research data indicate that when cows are offered two 4-hour bouts on pasture, they consume approximately 90% of what they would eat when on the pasture for 22 hours. This is a good rule of thumb to use when using on-off grazing principles.



Is there any benefit in trying to stretch the rumen?

No. Although there are stretch receptors in the rumen, abomasum and intestine, research data indicate that there is no relationship between gut capacity and total intake when feeding high quality forages.

However if the quality of the feed drops (i.e. neutral detergent fibre (NDF) is greater than 50%, and digestibility drops below 70%), physical factors such as gut fill become more influential, and in this scenario there is probably a small relationship between gut capacity and intake.

When cows are grazing high quality pasture, intake is primarily controlled by hormones and not by rumen size (volume). These hormones are released due to the products of digestion (i.e. volatile fatty acids) and inform the brain about:

- The nutrient content of the food the cow has eaten
- The amount of nutrients that are circulating in blood, and
- The energy stores that the cow has.

This is why a cow will lie down and stop eating, particularly after the morning grazing, even when her rumen is not full.

Because intake is not primarily regulated by rumen size, there is no benefit of trying to “stretch the rumen” as is sometimes advocated during the dry period.

Does pre-mowing increase intake? What are all the pros and cons of pre-mowing?

Mowing of pastures pre-grazing (pre-mowing) has been implemented on some farms in an attempt to increase intake. However, experiments showed no increase in energy intake or milk production.

Data from these experiments indicated that pre-mowing can decrease pasture quality and available ME. In addition, the effects of pre-mowing on subsequent pasture growth were variable, but generally suggested a decrease of total feed grown.

Like topping, tactical use of pre-mowing can help to meet target residuals and improve subsequent pasture quality, but it is not likely to be of benefit when used regularly to try to increase energy intake and milksolids production.

If I offer multiple breaks each day will this increase pasture intake?

No, not if pasture allowance stays the same. An experiment looked at the effect of offering a new break either once or 6 times every 24 hrs. Although there was an initial increase in milk yield in the first two weeks of the study, there was no overall positive effect on dry matter intake or milk production as cows adapted to the new management strategy.

Decisions about pasture allocation should be based on specific farm characteristics (e.g. paddock sizes, shape of the farm, terrain, soil types, distances walked).

Will pasture quality affect intake/MS production?

Yes, the better the quality of the pasture available, the more energy that the cow can eat during a grazing bout. The cow grazes pasture in successive layers from the top to the bottom of the sward. Stem and dead material act as a barrier to grazing, reducing bite size, biting rate, eating time and daily intake. Grazing at the 2 ½ to 3 leaf stage with pre-grazing yields less than 3500 kg DM/ha, and targeting consistent residuals to maximise leaf material will ensure there is good quality pasture available for the dairy cow throughout the season.

Typical digestibility and ME of plant components

Component	Green leaf	Soft stem	Hard mature stem	Dead material
Digestibility	70-85%	65-75%	40-50%	40-50%
Energy MJ ME/kg DM	10.5-12.5	10-11	6.5	6.5

Can I achieve 500 kg milk solids/cow on pasture only?

Yes, this is possible; however, profitable pasture-based systems are reliant on achieving high MS production per ha from pasture and there is a trade-off between this and per cow production.

High yields of milk solids from cows fed a pasture-based diet are dependent on maintaining high quality pastures throughout the season and achieving a long lactation length. Factors such as pre-grazing yield, amount of leaf material available and grazing residuals all affect pasture quality and energy intake and need to be managed within target ranges.

Why is production increased when cows eat more clover?

This is primarily due to a combination of increased voluntary intake and diet quality. Clover generally has a higher ME, and a faster passage rate through the rumen than perennial ryegrass, which results in increased energy intake when cows eat clover. Typically, the clover content of the sward needs to be greater than 25% before differences in milk production occur.

Does clover provide more minerals to the cow?

Clover is typically higher in nitrogen, calcium, magnesium, copper and cobalt than perennial ryegrass. However, the impact on the cow depends on the proportion of clover in the sward, and the status of these minerals within the herd.

Are supplements needed to balance a pasture diet?

No, supplements should only be used to fill true feed deficits in a grazing system and not to try to balance the diet. Although additional minerals and vitamins are needed at times, quality pasture provides a well-balanced feed for dairy cows, supplying energy, protein, lipids and most vitamins and minerals. It is true that cows fed a total mixed ration (TMR) will produce more milk than cows grazing pastures; however, the majority of the difference in milk production is due to the increased DM intake and reduced activity in a TMR system, and not the composition of the diet. Therefore, in a pasture-based system, if supplements are required, they should be purchased on a cents/MJ ME basis.

In dairy systems where supplements make up a high proportion of the diet and cows are producing high levels of milk solids (e.g. in excess of 2.5kg MS/day), factors other than energy may limit milk production. In these scenarios the specific diet requirements should be considered and the type of supplement that is purchased should be determined by the nutrient that is limiting milk production (e.g. amino acids, starches) and the cost/benefit of feeding that supplement.

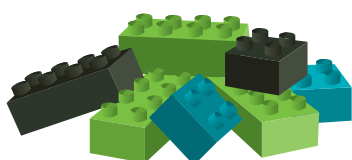
Is there enough sugar in pasture?

Yes. In theory, milk production is maximised when soluble sugars and starches are 35-40% of the diet. Although spring pasture contains less than this, the structural carbohydrates (fibre) in good quality, leafy pasture is highly digestible (70-85%) and degraded relatively quickly, thus supplying similar energy to sugar.

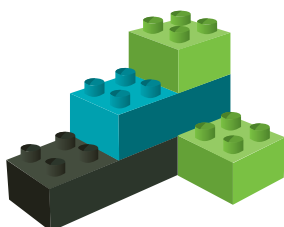
This is because the building blocks of carbohydrates (soluble sugars, starches and fibre) are essentially the same, simple sugars, and it is the chemical bond that joins these sugar molecules together that is different.

The different carbohydrates can be compared with building Lego, where the individual Lego blocks are the simple sugars. Sugar such as is found in molasses is like having a pile of Lego blocks, pulled apart and all ready to be digested. Then starch, which is found in cereal grains and vegetable wastes, is like Lego blocks that have been loosely joined together, you have to pull them apart before you can use them. Finally, cellulose/fibre found in good quality pasture, is like having an object constructed from the Lego blocks that takes time to pull apart before they can be used.

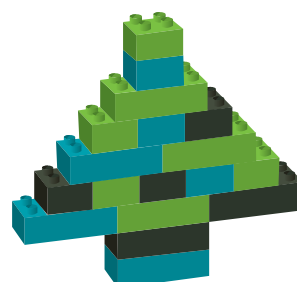
Luckily, the different bugs in the rumen are capable of breaking all of these bonds so the sugar molecules (Lego blocks) can be used for energy. Thus, replacing pasture with feeds that are high in sugar or starch does not improve the energy generated from the rumen bugs, unless it increases the total amount of energy supplied.



Sugar
(e.g. molasses)



Starch
(e.g. cereal grains/maize silage)



Fibre
(e.g. good quality pasture)

Is grazed pasture more expensive than supplements?

No. You need to consider this in the context of whether you can eat more pasture, grow more pasture or need to buy more feed. There are only minor costs associated with eating more pasture, including upskilling and allocating time for pasture management. The next cheapest option is to grow more pasture. Additional costs here include regrassing, weed control and fertiliser, and this is still typically cheaper than purchasing supplements. When no more pasture can be grown or eaten on farm, then the next option is to buy supplement or purchase more land. The correct decision in this situation will depend on the cost/return on the land compared with the cost of buying and feeding supplements.

For information on the cost of pasture, check out Inside Dairy (May 2015, page 24)



Supplements

What is the milksolids response to supplement?

Under ideal research conditions, supplementary feeds return approximately 70-80 g MS/kg DM fed. This is approximately 7.5 g MS/MJ ME offered, and in this situation, herd sizes are small, loss of supplements is limited and pastures are intensively managed to avoid wastage and maintain quality. Analyses from commercial farms report an average MS response to supplement of 55g MS/kg DM.

Although adding supplements into a pasture-based system has the potential to increase total intake and production, the actual MS response is often variable and less than expected. This is because there are several factors that affect the MS response to supplement. These include:

- the reduction in pasture intake that occurs when supplements are fed
- wastage of supplement, which will vary depending on infrastructure, supplement and method of feeding
- energy that is not partitioned directly to milk production (e.g. used for body condition gain and/or pregnancy).

Typically, the factor that has the greatest impact on the MS response is the reduction in pasture intake when supplements are fed, a phenomenon referred to as substitution.

In turn, the main determinant of substitution is how hungry the cow is, and this is reflected in the grazing residuals. Therefore, the hungrier the cow, the lower the grazing residuals, the lower the rate of substitution, and the greater the milksolids response.

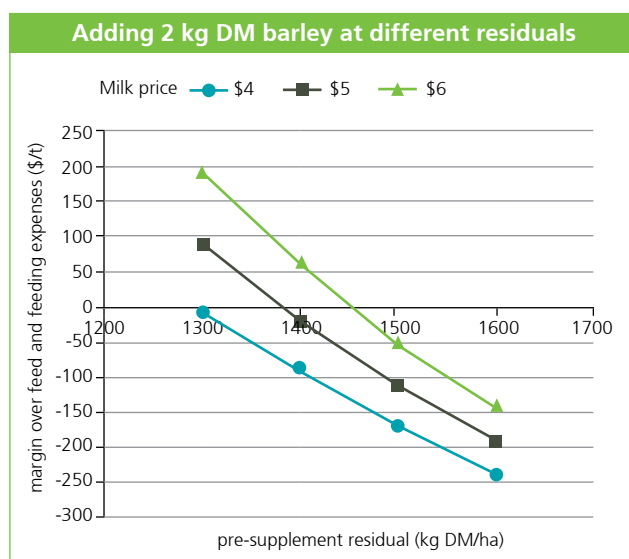
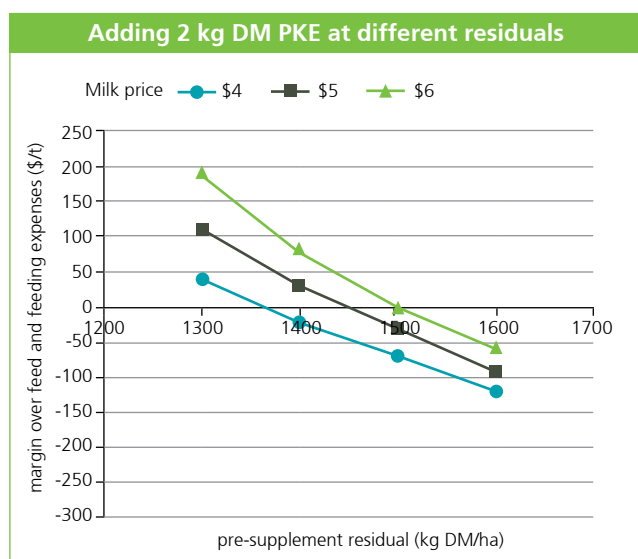
DairyNZ's online Supplement Price Calculator predicts the MS response to different supplements in various pasture-based scenarios. To use the calculator visit dairynz.co.nz/supplement-calc.

It accounts for both the immediate and deferred MS response but it does not take into account the effect of subsequent post-grazing residuals on pasture performance. DairyNZ recommends target grazing residuals of 1500-1600 kg DM/ha to maximise pasture growth and quality.

For more information on the calculator check out the DairyNZ *Technical Series* (September 2015). For more detail on substitution and factors affecting this, see section on Substitution (pg 13).

The two figures below give examples of the effect of grazing residuals and milk price on the economic response to supplement.

Note: Assume PKE is \$220/tonne delivered and is fed out in trailers in the paddock and barley is \$400/tonne delivered and fed in shed.



What are typical wastage values when feeding supplements?

Supplement wastages can occur during harvest (~10%), transport (5%), storage (10 – 20%) and feeding out (5 – 50%). Additionally, with silage, 5 – 10% of energy can be lost due to the fermentation process.

Best practice management at all phases is required to minimise losses but as a rule of thumb you can assume the following wastage (%):

Typical wastage values when feeding supplements

Supplement	Feeding method				
	In paddock in wet conditions	In paddock in dry conditions	Trailers in paddock	Feed pad	In-shed
Silages	40%	20%		10%	
PKE			15%	10%	5%
Concentrates				10%	5%

When is the best time to add supplements to a lower input system?

The best time to feed supplements is when there is not enough pasture (e.g. when post-grazing residuals are less than 1500-1600 kg DM/ha).

High quality pasture is the most valuable feed on farm. When supplements are added to the diet, the cows will leave more pasture in the paddock. If pasture is wasted this is a negative outcome; however, if cows would otherwise be grazing below 1500 kg DM/ha, this may be a desirable outcome.

The milk production response to supplements is greater in late lactation than in early lactation. This is due to increased days in milk, rather than per day production.

Are kiwi cows that are producing 2+ kg milksolids in spring lacking energy? Will they respond to increasing energy in their diet (i.e. adding supplements to pasture)?

If cows are grazing high quality pasture to residuals of 1500 to 1600kg DM/ha, which optimises pasture regrowth and quality, they will not be eating to maximum potential intake. So yes, they will produce more milk if supplements are added to the system.

However, they will leave more pasture behind in the paddock, and if pasture management is not altered, residuals will increase and subsequent pasture quality will decline. All the costs/benefits of adding supplements into the system need to be considered. Use the Supplement Price Calculator to assess costs/benefits of additional supplements.

For information on grazing management and pasture as a feed, check out the DairyNZ Technical Series (Aug 2014).

For information on feeding supplements and making money, check out the 2014 SIDE proceedings (Kay et al., 2014).

Is PKE a quality feed?

PKE is a by-product high in short and medium chain saturated fatty acid. There is no equation developed to determine ME accurately but by using similar feedstuffs, ME is estimated to be between 10 and 11.5 MJ ME/kg DM.

There are two forms of PKE, solvent extracted and physical/mechanical extracted. Although the fat content of solvent extracted PKE is much lower, there does not appear to be a large difference in milksolids response to these two products. Why this is the case is not known, but may be due to the chemicals used during the solvent extraction improving the digestibility of fibre.

Are there any short or long term detrimental effects of PKE on animal health?

No long term detrimental effects of PKE have been documented. If cows are prone to milk fever, then PKE should be limited (approximately 3 kg DM/day) to springing cows due to the high phosphorus content.

In addition, there is a risk of copper accumulation if other forms of copper supplementation are used at the same time as feeding PKE.

What percentage of PKE is digestible by the cow?

Approximately 60% of PKE is digestible in the cow. This digestibility factor is taken into account in the ME value of PKE (approximately 11 MJ ME).

Does molasses fed with PKE improve PKE digestibility?

No, feeding high sugar feeds such as molasses with PKE does not increase digestibility of PKE.

It may increase the energy (ME) of the feed slightly, but this will come at an increased financial cost. There are other reasons that people may choose to feed molasses with PKE, such as to improve palatability of PKE or to reduce dust and wastage.

Is there an advantage to having tapioca mixed in with PKE?

Some people add tapioca to PKE to help with feed flow through an in-shed system; however, as with molasses, there is no physiological advantage of mixing tapioca to PKE.

The additional tapioca will increase the ME of the diet, but as with molasses this will usually come at an increased cost. In addition, it is not recommended that you feed blends containing tapioca in trailers in the paddock. Ingestion of too much tapioca can result in rumen acidosis and cow death. If feeding via in-shed systems, using a larger auger, adding a vibrator to the feeding system or mixing other feeds with PKE can allow the feed to pass through the auger easier and allow the cows to consume their allocated feed without having to slow the platform down.

What is the value of maize silage in spring to balance high protein pasture?

Unless there is a shortage of pasture, there is no animal or financial benefit of adding maize silage in spring.

High quality pasture is a good feed for cows in spring. It is not necessary to 'balance' pasture by adding high carbohydrate supplements to the system, as is sometimes suggested.

What is best – PKE or barley?

This depends on your motive for feeding supplements.

If you want to increase milk protein percentage then barley (a starch-based feed) will be better than PKE (a fibre-based feed), which will increase milk fat percentage.

All DairyNZ data indicate that your key driver for purchasing supplements should be cents/MJ ME. In this case, barley is rarely as good value as PKE. The Supplement Price Calculator takes the impact of supplement type on milk composition into account.

Use the online Supplement Price Calculator to determine which supplement will be the most profitable
dairynz.co.nz/supplement-calc

How fast can I introduce supplements into the diet? PKE vs. maize grain vs. barley vs. wheat?

The speed at which supplements can be introduced into the diet depends on the rate at which the starch is degraded (broken down) or made available to the rumen bugs, which in turn depends on the protein structure of the specific feed. For example, the protein structure of maize grain holds the starch in place for a lot longer than wheat and, therefore, the starch in maize grain is broken down at a slower rate.

As a rule of thumb:

- Starch breaks down in maize grain at about 20%/hour
- Starch breaks down in barley at about 25-30%/hour
- Starch breaks down in wheat at about 40-50%/hour.

However, these figures depend on the processing of the grain.

Thus maize grain is a safer feed and can be introduced into the diet at a faster rate than wheat. However, it will still require a transition period. A safe rule of thumb is 2 kg DM maize grain for the first day and then increase by 1 kg DM every two to three days, until you reach maximum recommended intakes.

In contrast, because PKE is low in starch, it can be introduced to, or removed from, the diet without a transition period.

Do we need to keep feeding grain all year round to keep the rumen adjusted?

No. You can take grain in and out of the system in small amounts (up to about 2kg DM/day) without metabolic issues, as the microbes in the rumen that digest starch are always there and multiply rapidly. At low grain feeding levels, (about 2 kg DM) optimal rumen microbe performance is regained in about 48 hours, after introduction of grain.

When grain intake exceeds 2kg DM/day, acidosis could become a problem if the grain is introduced too quickly.

What are the benefits of feeding molasses?

Benefits of molasses include being a carrier for minerals and increased palatability of other feeds.

The energy value of molasses is approximately 11.5 MJ ME /kg DM

In terms of production, it is difficult to claim benefits, as research on molasses is very limited. Research conducted at DairyNZ indicated no increase in milk production or BCS gain from feeding liquid molasses to early lactating cows. This may be because rumen passage rate of molasses is fast and the inlet and outlet of the rumen are very close to each other, so the molasses may have passed through undigested. Alternatively, this may have been due to high levels of substitution. Because molasses is a sugar, the satiety signals sent to the brain would reduce pasture intake.

Is the rumen the best mixer wagon?

Yes. The rumen is perfectly capable of mixing all ingested feeds.

Current research in Australia, where grazing cows are supplemented with up to 14kg DM/d of grass silage and wheat, shows no milk production or rumen advantage to mixing the feeds compared with feeding them on their own (i.e. wheat in the shed and silage in the paddock).

The only benefit to mixing feeds before consumption is if there are multiple feeds being fed, and in particular if some of these feeds are a potential health risk to the cow (e.g. feeds high in starch such as barley). Mixing these feeds together into a ration can help ensure that each cow receives its allocated amount of forage and concentrate, and avoid cows over-eating certain feeds.

Substitution

What affects substitution?

There will always be some level of substitution or reduction in pasture intake when supplement is eaten.

Substitution can be negative (pasture wasted) or positive (pasture spared e.g. increase round length).

Predicting short term responses to supplement feeding depends on accurate estimates of substitution. On average, grazing time is reduced by 12 minutes for every kg DM of supplement that is added into the system. However, the rate of substitution can differ and is influenced by factors such as:

- season (spring vs. summer vs. autumn)
- pasture residuals and supplement intake
- type of pasture (grass-dominant vs. clover-dominant)
- supplement type and quality
- animal factors (e.g. body condition score, Breeding Worth).

Substitution means that:

- less pasture will be consumed and if management is not altered, post grazing residuals will increase
- total intake is less than expected
- the milk response is less than the theoretical maximum.

Note: the DairyNZ online Supplement Price Calculator takes substitution into account (see section on Supplements for more detail – pg 9).

How do pasture and supplement intake affect substitution?

The more pasture that is offered the greater the potential level of substitution when supplements are introduced into the system. Similarly, with increasing amounts of supplements offered, the level of substitution typically increases.

How does the time of year affect substitution?

Substitution is greatest in spring and lowest in autumn.

Research indicates that for each kg DM of supplement eaten, substitution is 0.1kg DM greater in spring than in summer and 0.1kg DM greater in summer than in autumn.

For example, if the substitution rate was 0.5 in spring, for every 1kg DM of supplement eaten, cows would reduce their pasture intake by 0.5kg DM. In summer, for every 1kg supplement fed pasture intake would be reduced by 0.4kg DM, and in autumn 0.3kg DM.

Does the type of pasture affect substitution?

Yes. Research indicates that the type of pasture offered to cows also has an effect on substitution.

At any level of pasture intake, there is greater substitution when pasture consisted of grass-dominant species than when grazing white-clover pastures. Within the same species of pasture, the greater the digestibility, the greater the substitution rate when concentrates are fed. This may be one of the reasons why substitution is greater in spring than in autumn.

Are there different levels of substitution when feeding different supplements?

Yes. Substitution is affected by supplement type. On average, cows will eat for approximately 12 minutes less with each kg DM concentrate fed, and substitution is about 10% greater with a forage (e.g. maize silage) compared with a concentrate (e.g. maize grain).

The effect of feeding different concentrates on substitution rate is not consistent.

Some research did not find any differences between concentrate types on substitution, while other research indicates that:

- starch-based concentrates result in greater substitution than fibre-based concentrates, which is likely due to differences in the production of satiety and hormones (such as insulin) from these feeds,
- substitution is greater with highly digestible concentrates (such as cereal grains), compared with whole grains or protein-based supplements.

Note: If not transitioned onto the diet properly, high amounts of soluble sugars and starches can cause rumen acidosis, which ultimately will decrease intake.

What animal factors affect substitution?

Animal factors such as body condition score (i.e. energy state) or breeding worth (i.e. genetics) can affect the level of substitution. If offered the same amount of feed, a cow with lower body condition will generally substitute less pasture than a cow with greater body condition, because the drive to eat is generally greater.



Once a day milking

Does milking cows once a day (OAD) in early lactation reduce milksolids production?

A cow that is milked OAD for a short period will produce 20% less milksolids (MS) while being milked OAD and will continue to produce less MS when switched to twice a day milking.

Research showed that when individual cows were milked OAD for 3 weeks from calving, there was a loss of 7% MS for the whole season or if milked OAD for 6 weeks, a loss of 12% over the season.

However, if applied at the herd level by milking OAD for a set time period (e.g. 3 weeks from the planned start of calving), the effect on farm total MS production is less due to the calving spread; the later calving cows have less or no time on OAD. For example, milking the herd OAD for 3 weeks from the planned start of calving reduces total season MS production by 2% and if the herd is milked OAD for 6 weeks MS production will be 3 – 5% less.

Milking cows OAD only during the colostrum period (8 milkings) will reduce total season MS production by approximately 2%. Colostrum OAD can lower the risk of milk fever but will not have carry over benefits in terms of BCS gain or reproduction.

Does milking cows once a day (OAD) in spring reduce feed demand?

No, milking cows OAD in early lactation has a minimal impact on short-term feed demand.

When cows were milked OAD for up to 6 weeks during early lactation, there was no difference in pasture intake.

Due to the decreased milk production and similar feed intake, cows milked OAD have an improved energy status compared with those milked twice a day. When OAD is used from calving the improved energy status is reflected in a small increase in body condition score (0.2 BCS units) detectable after 5 weeks post-calving. The longer the cows are milked OAD the greater the improvement in BCS, but this difference will gradually decline once animals are switched to twice a day milking.

What is the impact of milking cows once a day (OAD) during a feed shortage?

Milking cows OAD during a feed shortage causes additional losses in MS production but does not reduce feed demand. Consequently, this results in an improved energy status of the underfed cow and reduced risk of metabolic disorders such as ketosis.

In a research trial, cows (milked twice a day) were underfed by approximately 50% for 3 weeks during early lactation. The underfed cows produced 26% less MS compared with cows that grazed to standard target pasture residuals (1500 – 1600 kg DM/ha). When these underfed cows were milked OAD there was an additional 10% loss in MS production. This is because the effects of underfeeding and OAD milking on milk production act via different pathways and are partially additive. Underfeeding reduces the nutrients available to the mammary gland (i.e. acts outside the mammary gland) while OAD milking reduces the activity and number of the milk-secretory cells (i.e. acts from within the mammary gland).

Over the whole season, underfeeding cows by 50% for 3 weeks in early lactation, reduced total season production by 8%, if these underfed cows were milked OAD, total season production was reduced by an additional 5%; (i.e. 13% in total).

Milk urea

What is milk urea (MU)?

MU is a by-product of the breakdown of dietary protein in the rumen, and although MU concentration is associated with the protein content of the diet, it is not an accurate indicator of dietary protein adequacy.

The digestion of protein in the rumen releases ammonia. Excess ammonia is absorbed through the rumen wall into the blood stream and converted to urea in the liver. Most of the urea is excreted in the cow's urine although some passes into the milk.

How is MU expressed in New Zealand?

Be aware of what values you are looking at: milk companies, New Zealand labs, and universities use different units for MU or MU nitrogen (MUN). Information from other countries is often expressed differently to what is on the milk docket here.

MUN is 47% of MU. The conversion equations are:

- $\text{MU (mg/dL)} = \text{MUN (mg/dL)} \times 2.14$
- $\text{MUN (mg/dL)} = \text{MU (mg/dL)} \times 0.47$

(mg/dL = milligrams per decilitre)

Are high MU concentrations detrimental to cow performance?

Due to the crude protein content of high quality pastures, MU concentrations are typically higher in cows grazing pasture compared with cows fed a total mixed ration or high levels of supplementary feeds and can reach levels of 50 mg/dL or more.

High MU concentrations are not detrimental to milk production, cow health or reproduction and the process of converting ammonia to urea is not energetically expensive.

Are low MU concentrations detrimental to cow performance?

If MU concentrations are low (approximately less than 20 mg /dL) this may indicate there is not enough protein in the diet. As there are other factors that alter MU concentrations, laboratory analysis of feed ingredients and/or an assessment of the complete diet for protein (and amino acid availability) should be undertaken before any nutritional changes are made.

Even where dietary protein levels are lower than recommended, the total cost of feeding additional protein must be considered and compared with the predicted milksolids response before protein supplements are purchased and fed.

When should I change a diet based on milk urea (MU)?

Never, based solely on MU concentrations. Milk urea (MU) is not an accurate indicator of dietary protein content and is very variable. "Up and down like a toilet seat" is an analogy that has been used to describe the variation.

The only time that MU concentrations can be useful is when supplements make up a large proportion of the diet. In this instance, a high MU concentration (greater than approximately 30 mg/dL) may indicate the cow is being fed more protein than required. A re-evaluation of the dietary protein relative to cow requirements may allow expensive protein supplements to be removed from the diet.

Can MU values help to improve environmental footprint?

Although MU concentrations are positively associated with urinary nitrogen concentrations, the implications of small changes in the urinary nitrogen concentration on environmental nitrogen loading need to be considered with other system factors.

Numerous management and resource factors determine the environmental outcome on farm and the impact of any change needs to be determined by taking into account the whole farm system (e.g. stocking rate and intake). The addition of low protein supplements to reduce MU and subsequent intensification in the absence of changes to other inputs, management practices or infrastructure, could actually lead to increased nitrogen leaching per hectare.



Protein

Does a high protein pasture diet need supplementary carbohydrate to improve protein utilisation?

No. Good-quality high-protein pasture is highly digestible by rumen microbes.

You cannot significantly improve the efficiency of protein or, more specifically, nitrogen use in the rumen by increasing the carbohydrate load. You can improve nitrogen-use efficiency by feeding low nitrogen feeds to your cows, but this is not due to improved utilisation of nitrogen: it is due to lowering the overall level of N in the diet. So reduced nitrogen excretion when feeding more carbohydrates (e.g. maize with pasture) has very little to do with the carbohydrates, but with the reduced amount of nitrogen, eaten by the cow.

Do pasture-based cows need bypass protein during spring?

No, there is more than enough protein in good quality pasture and, even though the protein in pasture is highly degradable (70-90%), the fast rumen passage rate means sufficient protein passes through the rumen and into the small intestine to supply specific amino acids needs.

If for some reason dietary protein is lower than recommended (i.e. less than 18% CP in early lactation), consider the potential increase in milk revenue and the total cost of adding the extra protein to the diet before feeding additional protein, which is typically expensive.

Is protein:fat (P:F) ratio a measure of adequacy of feeding?

Yes and No.

Yes, the P:F ratio can indicate the energy status of the cow, but it can also be influenced by the dietary composition and is therefore not a sensitive measure of cow nutritional status.

If a cow's intake is restricted, the P:F ratio will generally decrease and, when extra energy is added to the diet, the P:F ratio will increase. However, the type of carbohydrate fed to the cow can also affect both milk protein and fat production, irrespective of energy balance.

A much better measure of whether cows have adequate feed is to consider post-grazing residuals and milksolids yield in conjunction with the P:F ratio.

Are milksolids worth more when the P:F ratio is greater?

Yes. Protein is worth more than fat in most milk payment systems; therefore, the value of each kg of milksolids increases as the P:F ratio increases.

However, the increase in milk revenue when the P:F ratio is increased is not large. For example, if protein is worth twice the value of fat, increasing the P:F ratio from 0.75 to 0.80 increases the milksolids revenue from \$4.94 to \$4.99 at a payout of \$5/kg MS and from \$6.91 to \$6.99 at a payout of \$7/kg MS. As the milksolids price declines, so does the price advantage of a high P:F ratio.

Does the P:F ratio influence reproduction?

Feeding cows to increase protein content or the P:F ratio, by itself, does not improve reproduction. There is a genetic link and in a herd of cows being fed the same diet, there is an association between higher protein percent and better reproduction. However, feeding to alter the P:F ration does not improve reproduction.

Fibre

Do cows need hay/straw during spring in a pasture-based diet?

No. There is adequate fibre in spring pasture (also adequate “effective” fibre) for the rumen to function properly.

The myth that “soft” pasture or the appearance of loose dung indicates a rumen upset or acidosis is associated with total mixed ration (TMR) or high-input systems and does not relate to cows eating a diet of at least 60% grazed pasture. The DM percentage of the pasture is lower during spring, which means that extra water passes through the rumen. This water is not absorbed in the third stomach (omasum), and results in loose dung. This is not a concern, unless the system is high input, in which case the amount of soluble sugar and starches, the fibre content (NDF) and the chop length of the diet should be checked (NDF should be at least 30% of diet).

Research investigating the role of fibre in maintaining an effective rumen environment has been conducted with cows fed a TMR. From this work, some ideas have been introduced to New Zealand pasture-based systems. However, the rumen environment of a cow fed a TMR is very different to that of a pasture-based cow. Cows that are fed a pasture-based diet have no floating “raft-layer” in the rumen. Therefore, the theory that straw will help form the raft layer and improve rumen function in pasture-based cows is not true.

Pasture-based research data indicate that there is no benefit to rumen function or milk production when fibre (straw/hay) is added to a pasture-based diet. In fact, it can actually cause a drop in production, as a low quality (low ME) feed (e.g. straw) replaces high quality (high ME) feed (e.g. pasture). Additionally, the slower passage rate of straw can increase rumen fill and reduce DM intake.

How important is fibre in cows fed a total mixed ration (TMR) and how much fibre should be in a TMR?

If NDF content drops below 30% in a TMR, you will likely see undesirable changes in rumen volatile fatty acid patterns and rumen pH. However, this is also dependent on the amount of non-structural carbohydrates in the diet (the technical term for soluble sugars and starch). There are simplistic rules of thumb for the amount of fibre needed in a TMR diet; for example, non-structural carbohydrates should not exceed 38% of the diet and NDF should not be lower than 30%. However, if feeding a TMR, then a qualified nutritionist should be used to balance the ration.

Does cow dung give us clues about whether dietary fibre is sufficient?

When a cow is primarily fed pasture, loose dung and bubbles are not an indication of rumen upset. Especially in spring, the loose dung is primarily due to the low DM content (or high water content) of pasture because the extra water is not absorbed and is excreted in the dung.

In addition, carbohydrates can pass through the rumen into the large intestine of the cow due to the fast rumen passage rates of pasture-fed cows in spring. Active fermentation occurs and acids (not lactic acid) are produced, which can appear as gas bubbles in the dung. Adding fibre (e.g. straw/hay) to pasture-based diets will not benefit rumen function; it will merely reduce the water intake and can slow passage rate.

When cows are fed a total mixed ration (TMR), the consistency of the dung can be an indicator of rumen health.

Loose, shiny dung or the presence of bubbles in the dung of a TMR-fed cow, indicates a rumen upset such as acidosis and the occurrence of hind-gut fermentation. Undigested feed (grain or fibre) passes into the large intestine where it is fermented and lactic acid is produced. The cow then brings in additional water from the bloodstream to offset the starch in the small intestine and the build-up of lactic acid. This creates watery dung that is often pale in colour. The acid produced in the large intestine shows up as tiny bubbles in the manure. If enough lactic acid passes through the large intestine, it damages the lining and the cow produces mucus to offset this. When this passes out, the manure has a shiny appearance.

Transition cow

Is it true that I should underfeed my cows before calving?

If cows are at or above their target BCS, (5 for mature cows and 5.5 for first and second calvers) prior to calving, research suggests they should be fed about 90% of their energy requirements for one to two weeks pre-calving to reduce the risk of metabolic diseases after calving. If cows are below their BCS targets, they should be fed 100% of their energy requirements.

For example, a 500 kg cow at BCS 5.0 or above needs to eat about 100 MJ ME for one to two weeks pre-calving.

For more information on feeding the transition cow, check out the DairyNZ Technical Series (June 2015).

Minerals

For information on mineral requirements in spring, check out the 2014 SIDE proceedings see *Mineral Supplements – the KISS principle* (Roche, 2014).

Is an in-line dispenser (e.g. dosatron) sufficient to meet cow requirements?

In stressful periods, it is often better to try a number of options to get magnesium into cows. Dusting is very effective, except in exceptionally wet weather. In those situations, supplements are often being fed (e.g. maize or grass silage), and magnesium can be added to this. Magnesium is the most important mineral for supplementing daily through the winter and spring (and calcium to colostrum cows).

Is there a certain level of salt that affects production?

Dietary sodium (salt) levels should be greater than 0.12% DM and ideally closer to 0.2% DM. Cows grazing most pastures will have adequate salt. Grains and maize silage are low in sodium so if fed at greater than 5 kg DM/day, then supplementation with 40 g salt/cow/day is recommended.

Should I supplement with calcium pre-calving?

No. The requirement for calcium increases by 4-fold after a cow has calved and this calcium must come from the diet (absorbed from the small intestine) or be reabsorbed from bone. It takes several days for the cow to alter the proportion of dietary calcium that is absorbed. Therefore, feeding a diet that is low in calcium pre-calving will stimulate the cow to absorb a higher proportion of the dietary calcium. Then, after calving, when a high-calcium diet is fed, calcium absorption increases and this helps prevent milk fever. Research data indicate that in addition to very low levels of dietary calcium, the risk of milk fever can also be reduced with very high levels of calcium (greater than 2% DM) pre-calving. However, in pasture-based systems, it is difficult to achieve this high dietary calcium intake pre-calving.

How much calcium do my cows need after calving?

All cows should receive at least 100 g Limeflour each day during the colostrum period, while those at increased risk of milk fever (older cows, Jerseys or those greater than BCS 5.5 at calving) should receive up to 300 g Limeflour. Lower levels can be fed via in-shed feed systems, while greater amounts need to be dusted on pasture or mixed in with molasses as a lick.

After the colostrum period, there is no benefit to supplementing with calcium unless milk fever is occurring in the milking herd, or cows are consuming large amounts of low calcium feeds (e.g. maize silage or cereal grains). If cows are being fed more than 5 kg DM of a grain-based concentrate or maize silage, they should be supplemented with approximately 150 g limeflour each day.

How much magnesium do my cows need during spring?

Recommendations are to supplement with 20g magnesium/cow/day for 2 to 3 weeks pre-calving until 4 months after calving. Magnesium is essential for the efficient absorption and reabsorption of calcium and thus plays a vital role in the prevention of milk fever post calving. It is also essential for the prevention of grass staggers in cows during spring. Magnesium can be administered in different forms and 20g magnesium is equivalent to:

- 200g of magnesium sulphate,
- 140g of magnesium chloride,
- 40g of magnesium oxide,

or a combination of the above.

Do I need to worry about phosphorus in my transition cows?

It is recommended that the diet of the transition cow does not exceed 0.3% DM of phosphorus as this mineral interferes with the synthesis of hormones required for calcium absorption.

Feeds such as PKE are high in phosphorus and, if herds are prone to milk fever, it is wise to limit feeding to less than 3 kg PKE/cow/day.

In contrast, a phosphorus deficiency can also contribute to milk fever. In some regions, fodder beet has a very low phosphorus content (less than 0.1% DM) and a phosphorus deficiency can occur. An effective prevention strategy is to supply 50 g dicalcium phosphate (DCP)/cow (9 g phosphorus) as a slurry on the supplement.

Can I graze effluent paddocks with my springers?

No, it is wise to limit pastures high in potassium, such as effluent paddocks, in the weeks prior to calving.

Dietary potassium interferes with the absorption of magnesium in the rumen and as magnesium is important for calcium absorption high levels of potassium can contribute to milk fever. However, in pasture-based systems, there are high levels of potassium and relatively low incidences of milk fever. Additionally, there was no difference in blood calcium around calving when cows were fed pastures with different potassium levels.

While it is a sensible precaution to limit high potassium pastures if possible, this is secondary in importance to supplying adequate magnesium supplementation.

Are there other minerals that cows require during spring?

There are five trace elements that are likely to be deficient in grazing dairy cows and recommended for supplementation for 2-3 weeks pre-calving until 4 months post calving. These are copper, cobalt, selenium, iodine and zinc. Consult a veterinarian to determine mineral requirements in your herd.

- **Copper**

Deficiency of copper is common in grazing cows as the content of copper in pasture is low and the absorption of this copper is also low. If cows are not receiving more than 100 mg copper/day from their diet, then they should be supplemented with 200-300 mg copper. This equates to approximately 1-2 g copper sulphate per cow/day in water or a mineral mix, 20 g bullet of copper oxide or the recommended level of injectable copper.

There needs to be caution with copper supplementation as toxicity can also occur. If copper is being supplied via high copper feeds such as PKE, indirectly via fertiliser applications or natural high concentrations in the water, then this needs to be taken into account when deciding a supplementation strategy.

- **Cobalt**

The primary reason for supplementing cows with cobalt is to ensure adequate vitamin B12 is produced by the rumen microorganisms; however, other benefits include enhancing digestion of fibrous feeds. The current recommendation is to supplement cows with 8 to 10 mg of cobalt/day. This is equivalent to 40 to 50 mg cobalt sulphate/cow/day or 5 g cobalt sulphate per 100 cows.

- **Selenium**

In general, selenium concentrations in pastures tend to be low (approximately 25% of requirements) and are not increased sufficiently with fertiliser; so supplementation is recommended. The actual requirement for selenium is difficult to predict, because many of its functions are in conjunction with vitamin E, which is available in very large quantities in fresh forages. The general recommendation is to supply 3 to 5 mg/cow/day of supplementary selenium.



- **Iodine**

Iodine is particularly important for reproduction and energy metabolism; however, requirements for iodine are poorly understood. There is large variation in pasture tests and the requirement for iodine is dependent on the status of the cow, the diet and the use of iodine-based teat spray.

On brassica crops it is recommended that cows are supplemented during winter and for 4 months post-calving. The most effective strategy is to spray iodine on the flank or rump (7 ml of a 5% tincture of iodine) once a week when cows have been offered a new break of crop. Although it is difficult to provide a definitive recommendation for iodine, DairyNZ recommends supplementing cows with approximately 10 mg iodine/cow/day for 4 months post-calving.

- **Zinc**

Zinc is an important trace element for skin and hoof development and immune function; however, pasture zinc status is very variable and can range from 20-60 mg/kg DM across farms. Because of this variability, and because the level of zinc supplementation recommended is not likely to cause ill effects, DairyNZ recommends that cows receive between 500 and 750 mg supplementary zinc/cow/day or approximately 1 g zinc oxide or 2-3 g zinc sulphate.

Cereal by-products (e.g. wheat and oat middlings) have very high concentrations of zinc (>150 mg/kg DM) and brewers grains, distillers grains, and PKE have reasonably high concentrations (>50 mg/kg DM). The zinc content of these supplements must be taken into account in calculating the likely zinc requirements of the herd as, although the recommended supplementary zinc would not make the animal sick, zinc and copper compete with each other for absorption sites in the small intestine and, therefore, high levels of zinc will lead to copper deficiency.

Are probiotics of any use? Do they have any benefits?

There is limited evidence of a benefit from probiotics and even the evidence that exists suggests that it is impossible to predict when or if they will be of benefit. There are millions of rumen microorganisms in the dairy cow and adding in a small amount of probiotics is unlikely to benefit the cow.

It is an increasing area of research and modern techniques will allow us to determine the most effective technologies to enhance specific microbial colonies.



Health

Is it possible to get subclinical acidosis in grazing dairy cows?

No. Not unless large quantities of high starch/sugar feeds are included in the diet (e.g. greater than 6kg barley) or cows are not transitioned properly onto high starch/sugar feeds. In some cases, rumen acidosis will be diagnosed based on rumen pH measurements. However, the rumen pH of cows fed a pasture-based diet can be lower than is recommended for cows fed a total mixed ration (TMR) or high levels of grain, without any detrimental effects. This is because a decrease in rumen pH in pasture-based cows is usually caused by an increase in acetic acid (such as in vinegar) and does not adversely affect digestion or microbial growth. In comparison, a drop in rumen pH in a TMR-fed cow is usually associated with increased lactic acid which can have detrimental health effects (e.g. rumen acidosis, lameness).

What impact does nutrition have on lameness and mastitis?

In our pasture-based systems, there is minimal impact.

In very high input or total mixed ration (TMR) systems lameness called 'laminitis' can be associated with too much grain or other high starch feeds in the diet.

Is Rumensin™ ever worth adding to feed?

Rumensin™ can be an effective bloat control agent for mild bloat risk situations; however it cannot prevent acute/severe bloat.

In terms of milk production, results are variable. The average milksolids response to 300 mg of Rumensin™ is about 30g of extra milksolids. However, responses range from -80g to +80g of milksolids. To date, it is not known how and why Rumensin™ causes negative or positive production responses and more experiments are necessary to gain a better understanding of the effects of Rumensin™ in pasture-fed dairy cows and the interactions with fibre and starch.

In terms of reproduction or BCS, Rumensin™ has no benefits in the New Zealand pasture-based system.

For more information on Rumensin™, check out the DairyNZ Technical series (Dec 2011).



If BOH or BHBA (β -hydroxybutyrate) levels are high, does this mean my cows have ketosis?

No, not always. Overseas data indicate that a cow has ketosis when blood BOH levels are greater than 2 mmol/L, and subclinical ketosis when BOH levels are greater than 1.2 mmol/L. However, BOH levels are also affected by the diet, and pasture-based cows have a greater basal concentration of BOH than those fed a high proportion of starch-based supplements or a TMR.

Research in New Zealand reported an association between BOH levels that were greater than 1.2 mmol/L during weeks 1 to 5 post-calving and a reduced 6-week in calf rate. This data was then used to describe a BOH threshold for sub clinical ketosis. However, these data are only an association and not cause and effect. The 6-week in calf rate for cows with BOH levels above 1.2 mmol/L was still above industry targets at 78% and there was no association with BOH level and final pregnancy rate, or milk production.

Further research is required to determine BOH threshold levels for sub clinical ketosis from cows grazing predominantly pasture diets, and the impact (if any) of treating these cows.

Therefore, when the diet is predominantly pasture, ketosis should not be diagnosed based on BOH concentrations alone. Additional indicators of energy balance, in particular free fatty acids (NEFA) and, if possible, glucose should be measured in the blood. If NEFA levels are greater, and glucose levels are lower, than recommended, then the risk of clinical and subclinical ketosis is increased. Other symptoms of ketosis include decreased DM intake and milk production and sometimes a sweet smell on the breath.

There are three main causes of ketosis:

1. Type 1 ketosis is a result of a sudden drop in energy intake. This can be due to underfeeding or adverse weather events (e.g. floods, snow storms).
2. Type 2 ketosis generally occurs post-calving when the cow is mobilising body fat to meet the demands of milk production. Cows that are too fat at calving (BCS > 5.0) are particularly at risk.
3. Silage ketosis is due to cows ingesting poor quality silage. The silage undergoes a secondary fermentation and when ingested increases the risk of ketosis.

Index

Reproduction

3

Can cows get in-calf on a pasture only diet?	3
Does body condition score (BCS) affect reproduction?	3
Can I take out supplements during mating?	3
Will a feed deficit reduce reproduction?	3
Will feeding supplements improve reproduction?	3
Does feeding starch or fibre supplements affect reproduction?	4

Pasture

4

Is it better to have a fast or slow rotation length?	4
How do I maximise intake on pasture?	4
Can I squeeze more into the cow's rumen if I fill it using the philosophy of rocks first, followed by pebbles, sand and then beer?	5
How fast can a cow eat her daily intake (pasture only)?	5
Is there any benefit in trying to stretch the rumen?	6
Does pre-mowing increase intake? What are all the pros and cons of pre-mowing?	6
If I offer multiple breaks each day will this increase pasture intake?	6
Will pasture quality affect intake/MS production?	7
Can I achieve 500 kg milksolids/cow on pasture only?	7
Why is production increased when cows eat more clover?	7
Does clover provide more minerals to the cow?	7
Are supplements needed to balance a pasture diet?	7
Is there enough sugar in pasture?	8
Is grazed pasture more expensive than supplements?	8

Supplements

9

What is the milksolids response to supplement?	9
What are typical wastage values when feeding supplements?	10
When is the best time to add supplements to a lower input system?	10
Are kiwi cows that are producing 2+ kg milksolids in spring lacking energy? Will they respond to increasing energy in their diet (i.e. adding supplements to pasture)?	10
Is PKE a quality feed?	10
Are there any short or long term detrimental effects of PKE on animal health?	11
What percentage of PKE is digestible by the cow?	11
Does molasses fed with PKE improve PKE digestibility?	11
Is there an advantage to having tapioca mixed in with PKE?	11
What is the value of maize silage in spring to balance high protein pasture?	11
What is best – PKE or barley?	11
How fast can I introduce supplements into the diet? PKE vs. maize grain vs. barley vs. wheat?	12
Do we need to keep feeding grain all year round to keep the rumen adjusted?	12
What are the benefits of feeding molasses?	12
Is the rumen the best mixer wagon?	12

Substitution

13

What affects substitution?	13
How do pasture and supplement intake affect substitution?	13
How does the time of year affect substitution?	13

Does the type of pasture affect substitution?	14
Are there different levels of substitution when feeding different supplements?	14
What animal factors affect substitution?	14
Once a day milking	15
Does milking cows once a day (OAD) in early lactation reduce milksolids production?	15
Does milking cows once a day (OAD) in spring reduce feed demand?	15
What is the impact of milking cows once a day (OAD) during a feed shortage?	15
Milk urea	16
What is milk urea (MU)?	16
How is MU expressed in New Zealand?	16
Are high MU concentrations detrimental to cow performance?	16
Are low MU concentrations detrimental to cow performance?	16
When should I change a diet based on milk urea (MU)?	16
Can MU values help to improve environmental footprint?	17
Protein	18
Does a high protein pasture diet need supplementary carbohydrate to improve protein utilisation?	18
Do pasture-based cows need bypass protein during spring?	18
Is protein:fat (P:F) ratio a measure of adequacy of feeding?	18
Are milksolids worth more when the P:F ratio is greater?	18
Does the P:F ratio influence reproduction?	18
Fibre	19
Do cows need hay/straw during spring in a pasture-based diet?	19
How important is fibre in cows fed a total mixed ration (TMR) and how much fibre should be in a TMR?	19
Does cow dung give us clues about whether dietary fibre is sufficient?	19
Transition cow	20
Is it true that I should underfeed my cows before calving?	20
Minerals	20
Is an in-line dispenser (e.g. dosatron) sufficient to meet cow requirements	20
Is there a certain level of salt that affects production?	20
Should I supplement with calcium pre-calving?	20
How much calcium do my cows need after calving?	21
How much magnesium do my cows need during spring?	21
Do I need to worry about phosphorus in my transition cows?	21
Can I graze effluent paddocks with my springers?	21
Are there other minerals that cows require during spring?	22
Are probiotics of any use? Do they have any benefits?	23
Health	24
Is it possible to get subclinical acidosis in grazing dairy cows?	24
What impact does nutrition have on lameness and mastitis?	24
Is Rumensin™ ever worth adding to feed?	24
If BOH or BHBA (β -hydroxybutyrate) levels are high, does this mean my cows have ketosis?	25

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