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Colostrum for calves: why is it so important?

Colostrum, the sticky, yellow “milk” produced during the four days after calving, is designed for newborn calves. It contains antibodies that target and disable bacteria and viruses.

Unlike human babies, young ruminants (calves, lambs and kids) are born without any antibodies. They rely on colostrum for their early immunity, and have a brief but critical window for colostrum feeding to give effective disease protection. Calves with insufficient colostrum are more likely to be unthrifty, more prone to infection when disease outbreaks occur, and more likely to develop secondary problems such as pneumonia.

Antibodies are proteins that are too large to cross from gut to bloodstream in adults; but newborn ruminants have microscopic holes in the gut wall that antibodies can pass through. Their ability to absorb antibodies decreases as these pores close – 90% have closed by 12 hours old. By then the calf’s stomach is secreting acid and digestive enzymes which denature antibodies and also limit their absorption. So if calves don’t get enough colostrum in the first 12 hours of life, they miss out on essential disease protection. Instead they must activate their own immune system early, and that takes 3-4 weeks to become fully functional.

Best quality colostrum (“gold colostrum”) comes from a cow’s first milking after calving. Gold colostrum has 21% total solids – more than double that in normal milk – and the solids content of Day 3 colostrum is 13%. Protein accounts for more than half of total solids. ‘Gold colostrum’ has 11% protein, of which nearly half is antibodies. Antibody concentrations fall rapidly - they are almost gone by the second day after calving. So save the ‘gold colostrum’ for newborns!

Colostrum quality varies between cows. Older cows produce more antibodies than heifers. Induced cows and cows in poor body condition produce less colostrum - their first milk is not ‘gold colostrum’. While it has to be withheld from supply, it is not good enough to feed to newborns and should be used for older calves. Previous treatment with dry cow antibiotics will not affect colostrum quality provided the withholding period has been met; but mastitis colostrum and milk, and milk from cows being treated with antibiotics within the milk-withholding period should not be fed to calves.

The amount of antibody for specific diseases can be boosted by immunising the cow. This is the basis of vaccines to manage rotavirus – giving the vaccine several weeks before calving boosts the amount of specific antibodies against the virus in colostrum.

Experimental work from the United States has shown that disease protection is maximised when calves receive 6% of their bodyweight as colostrum within the first 6 hours, and a total amount of 12% of their bodyweight within the first 12 hours of life. This means a 30 kg calf should get at least 1.5 litres at its first feed, and an overall total of 3.6 litres by 12 hours of age. Some calves will not drink this amount voluntarily. Leaving them until the day after pick-up, in the hope that hunger will make them easier to feed, is not a solution – it is too late then for absorption. Tube feeding calves with ‘gold colostrum’ soon after pick-up is the best way to ensure they get enough. Though labour-intensive, this practice will greatly improve many calves’ start in life. New Zealand studies show that one third to one half of calves are not well protected – either they do not get enough colostrum, or they get it too late. Leaving newborn calves on cows is not insurance against problems – in one study,
a third of calves left with their dams had not suckled after 6 hours, and 20% had not sucked after 18 hours\(^5\). While this may seem surprising, many dairy cows have poor mothering ability. Calves become separated within a herd or by walking under electric tapes, and cold and wet weather causes hypothermia, making calves slow to find a drink after birth.

Even with good practice, some calves do not manage to absorb sufficient antibodies. This may be due to poor curd formation in the calf’s stomach which reduces antibody absorption. Adding rennet to colostrum (2 tsp of rennet to 1 litre of colostrum) will assist clot formation – but add it just before feeding or the milk will clot in the calf feeder!

Colostrum uptake can be measured directly by testing serum for antibodies; but this is expensive, so indirect tests are more common. Most often the protein γ-glutamyl transferase (GGT) is measured in serum\(^8\). It is secreted in colostrum and absorbed alongside antibodies. Total serum protein can also be measured with a refractometer. These are tools used to investigate disease outbreaks. Providing good systems for frequent calf pick-up and tube feeding are in place, routine testing should not be needed; but where calves fail to thrive, or there is higher than expected disease incidence, the effectiveness of newborn calf management should be assessed. Purchase contracts for calves sold for rearing often include testing GGT levels in a sample of calves as evidence of good colostrum feeding management.

A dairy cow produces 16-20 litres of colostrum, but only 4-6 litres are needed to supply the calf with antibodies. Provided ‘gold colostrum’ is saved for newborn calves, the rest can be sold; however, colostrum is still a valuable feed even after 12 hours of age. Colostrum fats are more easily digested, colostrum is energy rich (40-50% more energy than the equivalent amount of whole milk) and antibodies provide some protection by acting locally in the gut e.g. in a rotavirus outbreak. This means that the potential income from colostrum sales should be carefully weighed against the potential benefits on calf rearing and good growth rates. Getting calves off to a good start will help to ensure well grown heifers coming into the herd in two years’ time!

Colostrum stores well, although any containing blood should be fed fresh. It will keep for a week in cold weather or stored in a refrigerator. For medium term storage it can be fermented using yoghurt as a starter (1 litre of yoghurt, or one packet of yoghurt starter/20L colostrum, and stir twice daily). Do not put mastitis colostrum or colostrum containing antibiotics into yoghurt mixes - the antibiotics kill the starter culture. The yoghurt mix can be diluted before feeding at a rate of 2 litres colostrum/1 litre of hot water. Use the culture to start the next batch. For long term storage, colostrum should be frozen. Allow it to thaw slowly – microwaving it will denature the antibodies.

References

Disbudding

Removing the horns of cattle is a necessary farm practice to prevent the risk of injuries to stockpersons and other animals.

Cautery disbudding of young calves before the horn bud develops and becomes fixed to the skull is preferable to amputation dehorning as it is considered to be less painful. However, disbudding also causes significant pain, tissue damage and distress for calves and the New Zealand Veterinary Association (NZVA) guidelines recommend the use of appropriate analgesia.

Despite evidence that has demonstrated the benefits of using analgesics, in New Zealand it is still common practice to disbudd calves without pain relief. This is mainly due to practical and economic factors on-farm. The Painful Husbandry Procedures Code of Welfare (2005) requires all animals from nine months of age to be given a local anaesthetic before any dehorning procedure. Although this means that it is legal to disbud young calves without pain relief in New Zealand, an increasing awareness of on-farm welfare by consumers locally and overseas means that some of our farm practices are coming under scrutiny. This increased consumer pressure has led to many overseas countries making it a legal requirement to use anaesthetics during painful procedures such as disbudding, irrespective of age.

Collaborative work between AgResearch and DairyNZ has shown that infrared thermography can be used as a non-invasive tool to detect pain. As blood flow around the body is altered during a painful experience, a hand held infrared camera can detect changes in the heat emitted around the eye region.

The main approach of the work was to compare responses of calves disbudded with and without local anaesthetic and with and without a non-steroidal anti-inflammatory drug (NSAID). An NSAID acts to reduce the inflammatory-related pain associated with the tissue damage. The results showed that responses to pain following disbudding without local anaesthetic included a rapid drop in eye temperature (Figure 1) and changes in cardiac responses such as a prolonged increase in heart rate for up to 3 hours (Figure 2). When calves were disbudded with local anaesthetic, the immediate responses were prevented, but a drop in eye temperature, reduction in resting and ruminating behaviour, and an increase in heart rate were detected when the local anaesthetic wore off after two hours, due to the onset of pain at this time. This increase in heart rate did not occur in those calves that received NSAID (Figure 2). Therefore, although local anaesthetics provide benefits in reducing the immediate pain, an NSAID was required to mitigate the pain once the local anaesthetic had worn off.

Studies from Massey University have shown that the level of pain, once the local anaesthetic has worn off, is less for calves disbudded by cautery (hot iron) than for calves disbudded using a scoop dehorning device. When this method was used, a combination of local and NSAID were required to provide effective pain relief for both the acute pain and the longer term pain associated with amputation dehorning.

Infrared image of the eye region of a dairy calf.

Temperatures are measured at the Lacrimal caruncle designated by * in the image.
Conclusion

In conclusion, it is recommended that pain relief be used during disbudding wherever possible and preferably a combination of local and NSAID which is more effective at alleviating the pain caused by disbudding than local anaesthetic alone. Different NSAIDs vary in the length of time they are effective. A longer acting NSAID such as meloxicam, with a half life of approximately 26 hours in bovine plasma, is recommended to ensure an appropriate length of pain relief.

References


Figure 1. Eye temperature (°C) for calves handled with a sham disbudding procedure; (■, n=8), given local anaesthetic with a sham procedure (▲, n=8), disbudded with local anaesthetic (□, n=8) and disbudded without local anaesthetic (●, n=6). The dashed vertical line indicates the time (-10 min) that local anaesthetic and/or sham procedures were administered and 0 min indicates the time of disbudding.

Figure 2. Heart rates (beats/min) for calves disbudded without local anaesthetic (light green), disbudded with local anaesthetic (dark green) and disbudded with local anaesthetic and non-steroidal anti-inflammatory drug (black). The dashed line indicates the approximate time that local anaesthetic wears off and 0 min indicates the time of disbudding.

Guidelines for good practice to minimise pain from disbudding:

1. Disbudding should be carried out between one and six weeks of age
2. Disbudding using a cautery iron is the preferred method
3. Disbudding should only be performed after effective “blocking” of the cornual nerve with local anaesthetic
4. All calves should be observed for a period of two weeks after disbudding to monitor for signs of infection
5. If practical, appropriate long acting analgesia should be given at the time of disbudding.
Supplements — the facts to help improve your bottom line

**Key messages**

- Although an excellent feed for dairy cows, there are times when pasture growth is not high enough to meet cow demand. In these situations, supplements can be used profitably, if purchased at the right price and wastage of supplement is minimised.
- However, supplements should only be used to improve pasture management. They should be used to:
  - extend rotation length to grow more grass
  - ensure grazing residuals are not lower than 1,500 kg DM/ha (7 clicks on the Rising Plate Meter [RPM])
- By focusing on pasture utilisation, profit from supplement will be maximised and dairy cows will be well fed.
- The increase in milksolids (MS) from supplements is dependent on grazing residual. The lower the grazing residual, the greater the MS produced/kg supplement.
- Supplements do not magically get cows in calf or prevent body condition score (BCS) loss.
- Supplements high in soluble sugars and starch (SSS) and low in fibre result in more milk protein and less milk fat. Supplements high in fibre and low in SSS result in more milk fat and less milk protein.
- High fibre and high fat feeds (e.g. grass silage and PKE) are very effective supplements for BCS gain in dry cows.
- Use metabolisable energy (ME) content (MJ/kg DM) to rank supplements but also consider the SSS to get best value for your investment.

**Background**

More than 100 years ago in Germany, Gustav Kuhn and Oskar Kellner proved that average daily weight gain in ruminant animals was the same when fed either starch or cellulose (i.e. fibre). These results, therefore, suggest that cows fed the same amount of energy from fibre (e.g. pasture, pasture silage, palm kernel [PKE]), starch (e.g. cereal grains, potatoes) or sugar (molasses) should secrete the same amount of energy in milk (i.e. the same amount of MS).

Results from research at DairyNZ have confirmed this, when dairy cows produced no more MS when the energy from fibre was replaced with the same amount of energy from a mixture of starch and sugar or starch. In addition, replacing pasture fibre with starch or sugar did not:

- increase rumen microbial protein yield,
- improve indicators of dairy cow health,
- reduce BCS loss in early lactation.

However, although total MS output should be the same, irrespective of the type of supplement fed, the makeup of the additional MS produced is generally affected by the type of supplement fed:

- when cows are fed a starch- or sugar-based supplement, more of the additional MS are protein and lactose,
- when cows are fed a fibre-based supplement, more of the additional MS is fat.

Because milk protein is generally worth two to three times more than milk fat, this effect of supplement type has implications for the revenue generated from the supplement used.
Profitably using supplements

Profitable use of supplements requires the farmer to purchase the right supplement for the right price, and feed it at the right time with minimal wastage. The aim of this article is to provide advice on these three points, with the main assumption being that the farmer’s goal is to improve profitability.

The right supplement

The right supplement will depend on the farm infrastructure and the price paid for milk fat relative to milk protein.

Infrastructure for feeding supplements

If the farm lacks infrastructure for feeding cows, feed wastage rates will be least with baleage, hay and pasture silage, because of the longer chop nature of the feed, and greatest with small-particle feeds like PKE and grain. Maize silage is likely to be in the middle because approximately 70% of the energy comes from the grain, the loss of which will be higher than the fibre component.

Trailers can be used to feed small-particle feeds in the paddock, minimising the outlay of capital expenditure and reducing the wastage rate relative to feeding in the paddock without trailers. However, group feeding of feeds high in SSS (e.g. cereal grains) in this way increases the risk of rumen acidosis.

Feed-pads facilitate good utilisation (>85%) of feeds like grass silage, maize silage, PKE and other by-products (e.g. potatoes), but are limited in their usefulness for feeding cereal grains and other feeds high in SSS because of the risk of acidosis from group feeding. They also allow the feeding of liquid feeds, although the risk of acidosis remains a concern in such situations also. In addition, the capital outlay is expensive ($/cow) relative to other systems.

In-shed feeding systems offer flexibility around the feeding of small particle feeds or liquids and allow selection of feeds based on price, quality and availability, while reducing the risk of acidosis. The cost of the system generally reflects the shed type (herringbone vs. rotary) and the complexity of the system (simple vs. computerised: single feed vs. multiple-feeds).

Price paid for milk fat relative to protein

From a nutrition standpoint, the limiting nutrient in the majority of circumstances on New Zealand dairy farms is energy. Energy can be provided by carbohydrate (fibre, starch, sugar), fat, or protein.

Metabolisable energy is the standard measure of energy used for ruminant diets in New Zealand and is the amount of energy available to the animal’s tissues for productive purposes. The efficiency with which ME is used for milk production (i.e. the amount of ME that ends up as net energy in milk) is independent of the type of feed being fed. This allows comparison of the value of feeds by estimating the amount of ME/kg DM.

However, although the same amount of energy ends up in milk when cows are fed the same amount of energy from fibre or SSS, the fat to protein ratio of the additional MS varies with the makeup of the supplement. If two feeds have the same amount of ME, the supplement with more SSS will generally produce more milk protein and less milk fat than the fibre-based supplement.

The value of fat and protein in milk changes over time. At current milk component prices, therefore, a MJ ME from SSS is worth more than a MJ ME from a fibre-based supplement. The estimated milk revenue from 1 tonne DM of different supplements used efficiently is presented in Table 1. These data suggest that feeds high in SSS (e.g. barley, wheat) can command a greater premium over fibre-based feeds (e.g. PKE) than is simply implied by the ME difference. Feeds that supply energy from both SSS and fibre (e.g. maize silage) are intermediate in value delivered per MJ ME.

This premium should be considered in systems where alternatives can be efficiently fed without additional infrastructure (e.g. both PKE and barley can be fed in many in-shed feeding systems, and maize silage and PKE can be fed with similar efficiency on feed-pads).
(cont’d from p7)

Table 1. Estimated milk revenue ($ in blue) from 1 tonne DM of different supplements at different payouts grazing residuals 1,550 kg DM/ha

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<th>Percent of extra MS</th>
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<td></td>
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<td>Protein</td>
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<td>PKE</td>
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<td>Wheat/Maize</td>
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<td>400</td>
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<td>12 clicks on RPM</td>
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</tr>
<tr>
<td>10.5</td>
<td>175</td>
<td>315</td>
<td>460</td>
</tr>
<tr>
<td>15 clicks on RPM</td>
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<td>12</td>
<td>290</td>
<td>480</td>
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Table 2. An estimate of how much can be paid ($/tonne) for different supplements at different milk prices and grazing residuals.

<table>
<thead>
<tr>
<th>Price/kg MS</th>
<th>ME, MJ/kg DM</th>
<th>Feeding system</th>
<th>Grazing residuals</th>
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<td>1,700 kg DM/ha</td>
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<td>In-shed</td>
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<td></td>
<td>Feed pad</td>
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<tr>
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<td>Trailer</td>
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<td>$6.50 Maize silage 10.5</td>
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<tr>
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<td>Paddock</td>
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<td>Paddock</td>
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<tr>
<td>$7.50 Barley 12</td>
<td>In-shed</td>
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<td>575</td>
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</table>

| $7.50 PKE 11 | In-shed | 255 | 430 | 610 |
|             | Feed pad | 235 | 405 | 570 |
|             | Trailer  | 220 | 375 | 535 |
| $6.50 Maize silage 10.5 | Feed pad | 270 | 465 | 665 |
|             | Paddock  | 210 | 380 | 550 |
| $5.50 Barley 12 | In-shed | 415 | 675 | 940 |

a. PKE and Barley in $/tonne fresh. Maize silage in $/tonne DM
b. Does not include capital cost for change in feeding system
c. Profit margin of $50/tonne supplement included.
The right time - when to feed supplements

This is probably the most simple and, arguably, the most important factor in determining if a farmer makes money or loses money when feeding supplements. However, the steady stream of articles about feeding dairy cows 'better' and the constantly increasing population of "nutritionists" to help achieve this aim, serve to confuse the issue.

There are no magical properties in the supplements offered to dairy cows. Provided grazing residuals are greater than 1,500-1,600 kg DM/ha (7-8 clicks on RPM), they will not improve animal health, reproduction, or BCS loss or gain to any appreciable extent.

Profitable use of supplements in farm systems revolves around managing pasture:

1. Using supplements to extend rotation length. When short of pasture, the fastest way to grow more is to extend the rotation length ("grass grows grass"). However, if already short of grass, the cows are underfed. If the rotation was extended, the cows would be under a more severe feed restriction. In such situations, supplements can be used effectively to extend the rotation and ensure that cows are adequately fed;

2. Using supplements to manage post-grazing residuals. If post-grazing residuals are less than 1,500 kg DM/ha (except during winter), pasture re-growth is delayed. It is, therefore, important to keep residuals at 1,500-1,600 kg DM/ha (7-8 clicks on RPM). Supplements can be used to help achieve this aim. However, if residuals are greater than 1,500-1,600 kg DM/ha, using supplements will result in lower pasture quality in subsequent rotations and lower milk production from pasture;

3. Using supplements to increase/hold stocking rate. Supplements can be used strategically in the autumn to allow a longer lactation with more cows or, tactically, to temporarily allow an increase in stocking rate in autumn, thereby allowing a portion of the farm to undergo pasture renewal and taking advantage of improved pasture genetics, increasing the amount and quality of pasture grown;

4. Alternatively, supplements can be used strategically to increase the overall stocking rate on the farm, which, when properly applied, can increase both pasture grown (through longer rotations and higher pre-grazing pasture mass) and pasture utilisation; these two factors are strongly related to farm profitability.

In summary, supplements should be used to manage pasture. In so doing, cows will be better fed.

The right price

The value of a supplement depends on the amount of milk fat and protein produced when the supplement is fed. The price paid for the supplement must include an allowance for the variable cost of the supplement, other costs associated with feeding the supplement (e.g. labour, fuel, electricity, interest, repairs and maintenance, etc) and a reasonable profit margin for the farmer. The maximum price paid for supplement must, therefore, reflect the milk price and the increase in MS from feeding the supplements.

How much can you pay for supplements?

DairyNZ research results suggest that the maximum economic price that should be paid for a supplement is 0.45% of the MS price/MJ ME or 5% per kg DM. In other words, when milk price is:

- $7.50/kg MS, the maximum price paid for supplements should be (0.45*7.50) = 3.4c/MJ ME. This means:
  - an 11 MJ ME supplement should be purchased for less than $375/tonne DM
  - a 12 MJ ME supplement should be purchased for less than $410/tonne DM.

- $5.50/kg MS, the maximum price paid for supplements should be (0.45*5.50) = 2.5c/MJ ME. This means:
  - an 11 MJ ME supplement should be purchased for less than $275/tonne DM
  - a 12 MJ ME supplement should be purchased for less than $300/tonne DM.

These data are based on experimental evidence and assume that grazing residuals are no more than 1,500-1,600 kg DM (7-8 clicks on RPM) and that wastage is minimised (<15%).

If the on-farm situation is different from this scenario, the decision rule also changes. For example, when grazing residuals are less than 1,500 kg DM (7-8 clicks on RPM), a higher price can be paid for supplements because the MS response will be greater. In situations where grazing residuals are greater than 1,600 kg DM, the price paid for supplements must be less than the reported decision rule because the amount of MS produced/kg supplement will be less. These factors are considered in Table 2.

In addition to the grazing residual, the SSS and fibre content of the supplement must be considered, because supplements high in SSS result in more milk protein and less milk fat and supplements higher in fibre result in more milk fat and less milk protein. As milk protein is considerably more valuable than milk fat at current milk prices, this also plays a role in the price that can be profitably paid for supplements. This factor is also included in Table 2.

(cont’d p10)
Conclusions

Supplements should only be used when pasture residuals are lower than 1,300 kg DM/ha (5.5 clicks on RPM) or to restrict the area offered to the cows to increase rotation length. In general, when grazing residuals are greater than 1,500-1,600 kg DM/ha, responses to supplements are too low to justify their use, as pasture is wasted and subsequent pasture quality will be reduced.

Supplements high in SSS result in more milk protein, while fibre-based supplements increase milk fat. As milk protein is two times more valuable than milk fat currently, the SSS content of the feed should be considered along with the feed’s ME content.

Supplements are unlikely to increase pregnancy rates when grazing residuals are 1,500 kg DM/ha or greater (>7 clicks on RPM) and the increase in BCS from feeding supplements to milking cows is small.

Additional things to consider

There are a few other factors to be considered when choosing the correct supplement.

1. Feeds that are high in sugar or starch must be introduced gradually to the cow to avoid rumen acidosis. In addition, feeds containing mainly sugar (molasses) should be limited to less than 0.75 kg DM/feed because of the risk of rumen acidosis

2. Too much fat in the diet can reduce the digestion of fibre in the rumen. Therefore, feeds that are high in fat should be fed sparingly. A simple rule of thumb would be to limit the amount of additional fat in the diet to less than 3% of the cow’s DM intake. For example, a crossbred cow could be fed up to 6 kg fresh PKE before maximum dietary fat levels are exceeded. This amount will vary depending on the type of fat in the supplement and the fat content of the other dietary ingredients

3. Liquid feeds (e.g. molasses, Proliq, whey) may not result in the amount of milk production predicted from their ME content. Because the moisture content of spring pasture is so high, the passage rate of small particles from the rumen is also very high. Published values suggest a liquid passage rate of about 11-12%/hour. Experiments at Lincoln University have measured liquid passage rates of more than 30%/hour in cows fed highly digestible pasture in spring. In these situations, the liquid supplement will pass from the rumen too quickly to be fermented. The cow does not possess the enzymes to digest sugar and so it is likely that a lot of the energy in liquid feeds may be lost in these circumstances. This is consistent with results from a recent DairyNZ experiment. Cows in early lactation offered maize grain or wheat middlings produced 4.5-5.0 g additional MS/MJ ME eaten. However, cows fed 0.75 kg molasses morning and evening (1.5 kg molasses/cow per d) produced no more MS than cows on pasture alone.

(see references on p11)
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References


What are the impacts of milking once a day during early lactation?

Key messages

• Milking once a day (OAD) for a short period in early lactation can reduce a cow’s potential to produce milk throughout lactation.

• The total production loss depends upon the duration of OAD and is due to both immediate and long-term reductions in daily milk solids (MS) yields:
  - cows milked OAD for 3 wks in early lactation produce approximately 8% less total MS over the entire lactation
  - cows milked OAD for 6 wks post-calving produce 12% less total MS over the entire lactation.

• OAD milking post-calving improves cow energy status, but there is very little improvement in body condition score (BCS) until after 5-6 weeks in milk.

• Milking cows OAD during a temporary feed shortage in early lactation decreases MS yield by more than the feed restriction on its own. While OAD milking improves cow energy status during a feed restriction, it does not prevent BCS loss.

• Although OAD milking reduces potential MS production, it allows farmers more time to focus on other important management issues (i.e. springers and colostrum cows, labour shortages, difficult weather conditions and feed allocation). Depending upon the individual farm system, the benefits from getting these management decisions right could offset the negative effects of OAD on cow milk production.

Background

Once-a-day milking for a short period in early lactation may provide labour, lifestyle and animal health benefits on individual farms as it is an especially busy and challenging time of year. Seasonal calving results in a rapid influx of fresh cows, which puts pressure on staff and cow management processes. Strategic use of OAD milking during this time reduces the workload associated with milking and can help farmers get systems in place to manage springers and colostrum cows, calves, animal recording, adverse weather events and labour shortages. This article describes the impact of using OAD milking on factors influencing farm productivity and profitability, including the long-term effects of this strategy on milk production.
Will OAD milking in early lactation affect total lactation yield?

Milking cows OAD for as little as three weeks during early lactation has long-term negative effects on MS production. DairyNZ research results indicate that milking cows OAD for three weeks, either immediately after they calve\(^1\) (Figure 1) or from week 5 post-calving\(^2\), reduces daily MS yields by about 20% immediately and by about 6-8% when cows are subsequently switched to twice-a-day (TAD) milking. These combined negative effects reduce total lactation MS production by about 8%, compared with milking TAD for the whole season\(^1,2\). This loss occurs irrespective of whether herd production levels are high or low (500 vs. 330 kg MS/cow/year). Furthermore, the loss in total MS production increases to 12% when cows are milked OAD for six weeks post-calving\(^1\). When OAD milking is continued for 10 weeks post-calving, total MS yield per year is about 20% lower than TAD milking for the entire season\(^1\). Use of OAD milking during early lactation will, therefore, lead to losses in total milk revenue per cow.

Milking OAD decreases the udder’s ability to extract nutrients from the blood for milk production, reduces the activity of cells that produce milk and milk components (fat, protein, lactose), and ultimately decreases the number of cells that produce milk by promoting cell death\(^4,5\). The number of mammary cells and milk synthesis activity within mammary cells remains reduced even after cows change from OAD to TAD milking\(^4\). These effects indicate why milking OAD for a short period in early lactation reduces a cow’s potential to produce milk throughout lactation.

Figure 1. Milking mature cows OAD for either 3 weeks (OAD_3wks) or 6 weeks (OAD_6wks) after they calved reduced total kg MS/cow per year by 7 or 12%, respectively, compared with whole season TAD milking (TAD). Green and grey arrows indicate end of OAD milking for 3 and 6 weeks post-calving, respectively.

Will OAD milking improve cow BCS and energy status in early lactation?

Milking cows OAD during early lactation does not affect BCS loss during the first four weeks post-calving\(^1,6\). Physiological mechanisms ensure that body tissue is mobilised following calving to support milk production, and nutrition\(^7\) and management (i.e. OAD milking\(^6,8,9\)) do not alter BCS loss until 5 to 6 weeks post-calving. Data in Figure 2 demonstrates that by week 5-6 onwards, cows milked OAD post-calving have a greater BCS compared with cows milked TAD\(^1\). Cows milked OAD lost 0.55 BCS units during the first five weeks post-calving, whereas cows milked TAD lost 0.7 BCS units. By late lactation, the differences in BCS from short-term OAD milking are negligible (Figure 2)\(^1\).

Milking OAD during early lactation does, however, improve cow energy status relative to TAD milking\(^6,8,10-12\). This is probably because the reduction in feed intake by cows being milked OAD is not as great as the reduction in milk production\(^6,8,11\). A recent DairyNZ experiment\(^10\) indicates that cow energy balance post-calving is improved (based upon blood metabolite and hormone profiles) both during and after a short period (three or six weeks) of OAD milking. Furthermore, gene expression profiles in the same study\(^13\) indicate that more body fat production genes are switched on in cows milked OAD post-calving relative to those milked TAD, consistent with greater BCS from Week 5-6 post-calving\(^1\).

Figure 2. Milking mature cows OAD for either 3 weeks (OAD_3wks) or 6 weeks (OAD_6wks) after they calved improved body condition score (BCS) from weeks 5-6, compared with whole season TAD milking (TAD). Cows milked OAD lost 0.55 BCS units during the first five weeks post-calving, whereas cows milked TAD lost 0.7 BCS units.
**Will milking cows OAD in early lactation improve herd reproduction?**

Latest NZ research results indicate that milking cows OAD for the first three or six weeks of lactation did not reduce the number of days before a cow resumes cycling post-calving; neither did OAD improve submission, first-service conception, 6-week in-calf, or final pregnancy/empty rates. While a much larger study is required to fully explore the reproductive performance of cows milked OAD relative to TAD post-calving, the lack of an effect of short-term OAD on subsequent fertility and reproduction was also apparent in previous Irish work.

A longer duration (> six weeks) of OAD milking from calving, or a closer proximity of OAD to the breeding period, may be required to provide benefits in reproduction. Cows milked OAD for ten weeks post-calving started cycling seven days earlier and required fewer CIDRs than cows milked TAD. In a four year trial, cows milked OAD for the whole season had greater three week submission and pregnancy rates, conceived three days earlier on average, and required fewer CIDRs than cows milked TAD, despite having reduced pasture allowances due to a 17% greater stocking rate. When used as a strategy to improve reproductive function in non-cycling cows, four weeks of OAD milking around the planned start of mating (PSM) increased the percentage of cows detected in oestrus; however, it was not as effective or economical as using CIDRs, which also reduced the intervals from PSM to first insemination and conception.

**What is the effect of milking OAD during a feed shortage?**

Once-a-day milking is a management strategy often used to alleviate nutritional stress when pasture quality or quantity is reduced. However, research consistently demonstrates that reduced nutrition and OAD milking regulate different mechanisms within the cow, causing separate and significantly additive negative effects on MS production. Milking cows OAD affects the capability of the udder to synthesise milk. In comparison, a feed restriction limits the nutrients available to the udder to produce milk.

These effects mean that the MS loss due to OAD milking is over and above that caused by feed restriction alone. In a DairyNZ experiment, cows that were milked TAD and feed restricted by 40% for 3 weeks in early lactation produced 9% less total MS (20 kg MS/cow) for the lactation compared with TAD cows that grazed to 1,600 kg DM/ha (unrestricted). Cows that were feed restricted and milked OAD, produced 14% less total MS (30 kg MS/cow) compared with TAD unrestricted cows. Thus, there was an additional loss of 10 kg MS/cow when cows were milked OAD compared with TAD during the restriction. In addition, milking cows OAD did not prevent the BCS loss resulting from the feed deficit; however, it did improve cow energy status during both the feed deficit and after intakes had returned to normal.

**What are the benefits of OAD milking to the farm system?**

The studies described above have highlighted the immediate and long-term effects of OAD milking in early lactation on MS production, BCS and cow energy status. Anecdotal evidence from farmers is that OAD milking allows them to focus on other aspects of the farm system, and the benefits of getting...
these decisions right may compensate for the negative effects of OAD on milk production. These aspects will vary with individual farms and can include dealing with springers, colostrum cows, calves, animal health (e.g. metabolic problems), records, weather, grazing management, and labour problems. Additionally, there are factors specific to each farm that will alter the impact of OAD milking on MS production, BCS and energetic state, including farm size, walking distance, terrain, herd size, and climate.

Although these factors do not change how OAD milking alters mammary physiology and, therefore, its impact on the cow’s potential to produce milk, they can lower the potential milk production of cows being milked TAD. Thus, using OAD milking as a strategy to ensure these tasks are managed more effectively than in previous years, could decrease the negative impact of OAD milking. For example, large herds often walk long distances to be milked twice daily; this reduces the energy available for milk production and time available for grazing, and can lower the potential for MS production. If these animals were milked OAD, the negative impact on MS production may be less than indicated from research trials.

DairyNZ research over the next two years aims to determine the effects of OAD milking during early lactation on farm productivity and profitability under multiple scenarios. Strategies to minimise the total milk revenue loss on-farm will also be examined, such as applying OAD milking on a herd basis for the first three weeks after the planned start of calving date, using a shorter duration of less than three weeks, or only during the colostrum period. Preliminary calculations indicate that milking the herd OAD for three weeks after the start of calving reduces total MS production by about 4%, equating to approximately $12,540 lost revenue/100 cow herd (assuming 400 kg mature cow MS and $7.50/kg MS). This practice reduces MS loss compared with milking each cow OAD for three weeks after they calve; however, it may exacerbate the loss in production from heifers, who make up a greater proportion of early calvers and tend to be more sensitive to the negative effects of OAD milking than mature cows.

Conclusions
Milking cows OAD for a short period in early lactation results in lactation-long reductions in MS production, but allows more time for working on other aspects of the farm system, such as grazing management and animal health. Improvements in these areas will depend upon individual farms, but can help offset the negative effects of OAD milking on lactation production potential.

References
Focus on international research

The following is a brief summary of some key science papers recently published


Feed conversion efficiency (FCE; kg milksolids/kg DM intake) was greatest at 60 days in milk (DIM) and lowest at 530 DIM of a 670-d extended lactation. Increasing grain to 3.5 or 6 kg DM/cow/d increased FCE in late summer-autumn, but did not affect FCE in spring. Marginal milksolids responses to supplementation were greatest in summer-autumn compared with spring.

**DairyNZ comment:** In New Zealand studies, North American Holstein-Friesian cows supplemented with 3 to 6 kg DM grain/cow/d were able to maintain a high gross FCE in an extended lactation system compared with NZ Holstein-Friesians, who were more efficient in a normal 12-month calving system.


The aim of this study was to better understand risk factors associated with subclinical endometritis (i.e. a uterine infection that displays no obvious signs). On average, 26% of cows suffered from the condition (range: 4.8 to 52%). The main herd-level risk factor was the type of housing and bedding in early lactation. Cow level risk factors were cow age, other illnesses (ketosis and acute metritis), and milk yield in the first four weeks of lactation (higher milk yield was associated with a greater risk of sub-clinical endometritis).

**DairyNZ comment:** DairyNZ data indicate a prevalence of subclinical endometritis similar to that reported in this study (20-40%) and conception rate to first service is significantly reduced in these animals. Understanding risk factors associated with subclinical endometritis is important to help improve fertility and is the subject of an ongoing DairyNZ and government-funded programme of work.


Researchers investigating the impact of milk consumption on breast cancer risk in humans have reported that drinking cows’ milk prior to the onset of puberty may actually prevent mammary tumour formation in rats. The study’s authors propose that natural hormones in cows’ milk stimulate mammary development, and that these changes may render a level of breast cancer protection to the mammary gland.

**DairyNZ comment:** Previous studies have presented conflicting information regarding links between milk consumption and risk of cancer. Although the current study supports a role for cows’ milk in influencing mammary development, the results suggest that this may not be a bad thing, effectively ‘conditioning’ mammary tissue to resist cancer development.


Dairy cows that were re-grouped and moved to another pen decreased intake and rumination time by 9% after re-grouping, but intakes of cows that stayed in the same pen did not change after re-grouping. Cows that were moved to another pen displaced other cows at the feeder twice as frequently after re-grouping, but this was not evident in cows that stayed in their home pen.

**DairyNZ comment:** Re-grouping of dairy cows can alter cow behaviour and production ability, especially when moved to new surroundings. The relevance of this research to pasture-based systems requires investigation, but likely indicates that re-grouping of cows should be kept to a minimum.