Smart ways to reduce milking times

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Summary

- Recent research on raising the threshold setting for automatic cup removers (ACR) or setting a maximum time limit for milking slow cows has opened up new possibilities for milking herds more quickly, with no apparent adverse effects.
- The aim should be to milk *most* cows as completely as possible, within a reasonable time, at every milking.
- These guidelines apply only to herds with a somatic cell count (SCC) below 200,000 cells/ml.
- Increasing the ACR take-off setting from 0.2 to 0.4kg/min will reduce cow milking duration by around 10%.
- Do not wait for slower milking cows, instead remove clusters from these cows based on their expected maximum milk out time outlined in SmartSAMM Technote 5 (www.dairynz.co.nz).
- Case study farms in Australia and New Zealand have reported time savings of between 15 and 60 minutes per milking when applying a maximum milking time to slower milking cows.
- Knowledge gaps remain in the application of higher ACR threshold settings or maximum milking time for herds with a SCC >200,000 cells/ml, those with a high prevalence of *Staphylococcus aureus*, or with *Streptococcus agalactiae*, both highly contagious pathogens.

Introduction

The on-going expansion of dairy herds, combined with a desire to keep working hours such that people are attracted to dairy farming, is exerting pressure on milking infrastructure and labour resources. Milking the herd remains one of the most significant and time consuming tasks on the majority of New Zealand dairy farms despite advances in dairy technology. One option to improve efficiency, which does not require capital investment, is to optimise milking routines. The last major change to milking routines in New Zealand that resulted in substantial efficiency gains across the industry occurred during the 1980s with the removal of regular pre-milking washing and stimulation of the udder and teats (Phillips 1987). Recent research has focussed on end-of milking decisions and the effect this has on overall milking performance. Two approaches have been tested: raising the ACR activation threshold and setting maximum milk out times for slower cows.

Studies carried out in Denmark (Rasmussen 1993) and then in the USA (Stewart *et al.* 2002, Magliaro and Kensinger 2005) demonstrated the potential of higher ACR thresholds to reduce cow milking time by up to 11% without affecting yield, somatic cell count (SCC) and rates of clinical mastitis, despite more milk being left in the udder as measured by post-milking strip yields. These results were obtained using high yielding cows, in some cases milked three times daily, with thorough pre-milking teat preparation. Higher ACR settings were readily adopted by US farmers and it is now common for take-off settings to be up to 1.0kg/min with a delay time to activation of <5s once the threshold is met. Subsequent research in Australia explored the potential of setting a maximum milking time for slower milking cows, which was likely to have the most benefit for herds milked in herringbone dairies or rotaries without ACR. That research was conducted in pasture-based systems that use minimal pre-milking routines and lower yielding cows, conditions that are similar to those in New Zealand dairies. The studies demonstrated that setting a maximum milking time based on the herd average yield and 80% of cows being milking out completely can be an effective means to achieve shorter herd milking times with no apparent adverse effects on yield or mastitis (Clarke *et al.* 2004, 2006), thus providing an excellent strategy to improve milking efficiency.

Despite the research outcomes some farmers and practitioners in New Zealand have concerns that the greater strip yields will result in higher SCC and an increased incidence of clinical mastitis, a view that is supported by some older research (Schalm and Mean 1943, Napper and Williamson 1982, 83). In this paper the recent New Zealand studies are reviewed as well as the relevant Australian research (conducted between 2008 and 2012), that has explored the effects of either an elevated ACR threshold or applying a maximum milking time to slower milking cows on milking duration, milk production and mastitis.

Effects on milking times

The standard setting for ACR in New Zealand dairies is 0.2kg/min (40% of herds) or 0.3kg/min (46% of herds) with a delay time to activation of up to 15s (Jago unpublished) in a survey of 80 farmers milking herds in rotary dairies equipped with ACR. Doubling the ACR setting from 0.2 to 0.4kg/min reduces average milking duration by around 10%, with daily milk yield appearing to have little effect on the magnitude of this reduction (Table 1). This was similar to the 10.6% reduction reported by Rasmussen (1993) for cows yielding 26.5kg/d and milked following a full preparation routine. However, the exception were the results reported by Clarke *et al.* (2004) that raising the ACR threshold had only a small effect, even when raised to 0.5kg/min, though they did report that combining an increase in ACR setting with pre-milking stimulation reduced milking duration by around 10%. Recent New Zealand studies found no interaction between increase in ACR setting and pre-milking treatment on milking duration (Edwards *et al.* 2012). Even greater reductions in milking time can be achieved by increasing the ACR threshold to 0.6 or 0.8 kg/min with the magnitude of the reduction appearing to be greater for lower yields (Edwards *et al.* 2012, P. Edwards unpublished).

Reference	**Yield (kg/d)**	**ACR Setting (kg/min)**			
		0.4	**0.5**	**0.6**	**0.8**
Clarke *et al.* 2004[1]	15.1	7.0	10.0		
Clarke *et al.* 2004	18.1	-1.0	4.0		
Jago *et al.* 2010a	12.5	10.8			
Burke and Jago 2011	16.9	11.4			
Edwards *et al.* 2012	13.9	14.9		21.7	25.6
P. Edwards unpublished	22.3	11.8		14.7	21.4

[1] Stimulation applied before cluster attachment
[2] L/d

Table 1. Summary of recently published reductions (% of time) in milking duration when ACR was increased from a base of 0.2kg/min

Increasing the ACR threshold affects all cows while applying a maximum time affects only those cows that are still milking when that time limit is reached. The early Australian maximum milking time research targeted the slowest 20% of cows and reported a 35% reduction in milking time for these cows (Clarke *et al.* 2004). Subsequent New Zealand studies applied a more rigorous maximum time, truncating the milking of 30% of the herd (Jago *et al.* 2010b), and recorded similar reductions in milking times (30-40%). A second New Zealand study extended these results by applying the maximum time treatment from the start of lactation (after the colostrum period). Time savings measured as an average across all animals, not just those reaching the maximum time, were in the order of 14 to 20% in the early stages of lactation and 7 to 10% in later lactation (Jago *et al.* 2010a).

On farm, case studies involving 20 Australian farms that implemented a maximum milking time strategy showed savings of about 15 minutes per milking could be achieved with no effect on production or quality (Darold Klindworth pers comm). The results of three New Zealand case studies were reported by Jago and Burke (2010). Milking times were reduced by 45 to 60 minutes on a farm milking 600 cows through a 36-aside herringbone dairy. On a smaller farm of 288 cows and a 24-aside herringbone dairy, savings of 15 minutes per milking were achieved. Finally, on a third farm milking around 650 cows through a 50 bail rotary time savings were in the order of 35 to 50 minutes per milking.

Effects on milk production

Milking times can be reduced substantially by either increasing the ACR threshold or applying a maximum milking time, however, these time savings must be weighed against any impacts on production. In older studies losses of about 3% loss were reported when 0.5kg of available milk was left in the udder (Dodd and Griffin 1979, Hamann and Dodd 1992). These studies were undertaken to examine the effects of machine stripping, a practice that has not been routinely carried out on New Zealand farms for more than 30 years (Phillips 1987). Historically, farmers have been willing to sacrifice small losses in lactation yield to obtain the major benefits of improved labour productivity.

A 1% loss in average daily milk, milk solids and protein yields, but not fat yield, was reported by Burke and Jago (2011) when the ACR setting was raised from 0.2 to 0.4kg/min for cows yielding 17kg/d at the start of the experiment. Conversely, in all other recent experiments where the ACR threshold has been increased from 0.2kg/min, no significant effects on production have been detected (Clarke *et al.* 2004, Jago *et al.* 2010a), even when the ACR threshold has been set to 0.8kg/min (Edwards *et al.* 2012, Edwards unpublished). Similarly, in the majority of studies in which a maximum milking time was applied no appreciable differences in daily yield have been detected. These included commercial herds with higher producing cows yielding more than 25kg/d (Clarke *et al.* 2006), those in which up to 30% of cows milkings were shortened over a 26 week period starting at peak lactation (Jago *et al.* 2010b), and when a maximum time was applied from the start of lactation (Jago *et al.* 2011). Overall, the effects of either strategy to reduce milking times on milk production appear to range from small to none.

Effects on mastitis and teat condition

Higher ACR thresholds result in more milk remaining in the udder when measured by machine stripping (Table 2). In general, around 0.26kg remains in the udder cistern when the cluster is removed at a flow rate of 0.2kg/min. This increases to an average of 0.38kg at an ACR threshold of 0.4kg/min. The effect is not consistent and three of the five experiments recorded no change in strip yield when the ACR threshold was doubled. At the even higher ACR thresholds (0.6 and 0.8kg/min) greater strip yields were recorded for lower yielding cows in late lactation compared to higher yielding cows in early lactation (Table 2).

Applying a maximum milking time to the slowest 20% of cows resulted in strip yields approximately double those recorded for an ACR setting of 0.2kg/min (Clarke *et al.* 2004). Jago *et al.* (2010a) also reported relatively high strip yields (>1kg) when a maximum time was applied in the first 15 weeks of lactation but with the same cows later in lactation strip yields were no different from the control group that were milked with an ACR setting of 0.2kg/min.

Reference	Yield (kg/d)	ACR setting (kg/min)			
		0.2	0.4	0.6	0.8
Jago *et al.* 2010a (wk 12)	10.9[1]	0.20[a]	0.61[b]		
Jago *et al.* 2010a (wk 27)	7.5[1]	0.24[a]	0.26[a]		
Burke and Jago 2011	16.9	0.19[a]	0.35[b]		
Edwards *et al.* 2012	13.9	0.42[a]	0.42[a]	0.59[ab]	0.72[b]
P. Edwards unpublished	22.3	0.27[a]	0.27[a]	0.41[ab]	0.57[b]

[1] a.m. milking yield
[a,b,c] Means with different subscripts within a row are different

Table 2. Summary of strip yields from recently published studies when cows were milked with minimal pre milking preparation and ACR set to 0.2, 0.4, 0.6 or 0.8kg/min

Teat condition can also improve when ACR settings are increased (O'Callaghan *et al.* 1998, Rasmussen 1993) although other studies report no change (Clarke *et al.* 2004, Jago *et al.* 2010a). Damage to the teat end increases the susceptibility of the teat to invasion of some mastitis-causing bacteria.

The most comprehensive evaluation of the impact of applying a maximum milking time on udder health was carried out by Australian researchers, where six case studies on five commercial farms evaluated the impact on rates of clinical and subclinical mastitis (Clarke *et al.* 2006). The treatments were applied for between two and five months on cows yielding between 10 and 23kg/d at the start of the case study. In no cases were statistically significant differences apparent between experimental treatments. The results of the New Zealand studies support these findings and there have been no published reports of significant increases in either SCC or incidence of clinical mastitis when maximum times were applied from peak lactation (Jago *et al.* 2010b) or immediately following the colostrum period (Jago *et al.* 2010a).

The majority of published studies report no significant increase in SCC or rates of clinical mastitis when the ACR threshold is increased from 0.2kg/min to 0.4, 0.5, 0.6 or 0.8kg/min at a range of milk yields (Rasmussen 1993, Clarke *et al.* 2004, Burke and Jago 2011, Edwards *et al.* 2012, Edwards unpublished). One study, where the cows were milked with ACR set at 0.4kg/min, reported a higher SCC than the control group (0.2kg/min), although temporal trends for SCC throughout the season and rates of clinical mastitis were similar for all treatments (Jago *et al.* 2010a). In the same study applying a maximum milking time resulted in post-milking strip yields greater than the higher ACR setting treatment but without a corresponding increase in SCC.

The impact of higher strip yields on the SCC of individual infected quarters of differing aetiology was investigated by Clarke *et al.* (2008). Higher strip yields (ACR set to 0.8kg/min) resulted in no significant increase in quarter SCC in either infected or uninfected udder quarters. Cow strip yield, but not change in SCC, was positively related to SCC, or the number of infected quarters/cow. The authors concluded that infection results in both high strip yields (via uneven quarters) and high SCC. Alternatively, high SCC causes high strip yield and increasing strip yield does not increase cell count.

In summary, one of the main concerns farmers have regarding higher strip yields is the perceived risk of clinical mastitis and elevated somatic cell count. While some earlier research supported this view (Schalm and Mean 1943, Napper and Williamson 1982, 83), the more recent Australasian and New Zealand studies outlined above, as well as international research (e.g. Rasmussen 1993, Billion *et al.* 2009), have shown that a small amount of milk remaining in the udder does not lead to increased mastitis. It should be noted that the SCC of herds used in most of the reported studies was below 200,000 cell/ml and, therefore, reflective of a low mastitis incidence. There has not been sufficient research on applying either an increased ACR setting or a maximum milking time in herds with high rates of clinical mastitis or high SCC, therefore, at present it is recommended that these strategies should be applied in herds with a SCC less than 200,000 cells/ml. As more research is undertaken these guidelines may be relaxed particularly in situations where poor teat end condition and over milking may be contributing to mastitis risk.

When and how to apply

Operators should follow the steps set out in Table 4 to decide if a shorter milking times strategy is appropriate. The time savings will depend on the dairy type, herd size and current milking routines. When increasing the ACR setting it is advisable to make incremental changes of 0.1kg/min per week. Most of the benefit of increasing ACR threshold is only realised in rotaries if the platform is also sped up. Recent benchmark data indicate that many farmers are setting the platform speed to achieve 5-10% of cows requiring a second rotation, rather than based on a sustainable maximum speed taking into account the skill of the cups-on operator. Increasing the ACR threshold will reduce the number of cows requiring a second rotation at the current speed, but if the operator is sufficiently efficient, further gains can be made if the platform speed is increased so that a similar percentage of cows require a second rotation to complete milking, with the ACR set at the higher rate.

To implement a maximum milking time strategy it is suggested that operators use a simple timer for a few milkings to become more familiar with the milking times of the slower cows. Marking the slower milkers can also help. In practice, however, it can be difficult for farmers to implement this approach (e.g. how to measure it, how to set it, how to apply it, and how to use a timer or similar). An alternative simple, practical method of incorporation has been suggested by Australian advisors (Dyson, pers. comm.).

In herringbone dairies, operators should not to wait for the last X number of cows on each side – where X is a proportion of the number of units on each side. Remove the cluster from these cows when the rest of the cows in the row have been had their clusters removed as normal. A simplified version of maximum milking time can be applied at the 15-20% level, meaning in a 20-a-side, do not wait for the last three or maybe four cows.

In a rotary dairy, operators should select a platform rotation time based on the maximum milking time guidelines shown in Table 3 (allowing for the time lost across the bridge from cups off to cups on), then not allow cows to go around twice unless there is a specific reason' (e.g. kicked the cups off). These maximum times are based on 80% of cows milking out to the same extent as if ACR are set to 0.2kg/min.

Average milk yield at a single milking (L/milking)	Maximum milking time. Time in which 80% of cows should have completed milking (minutes)
10	6.3
12	7.2
14	8.0
16	8.8
18	9.5
20	10.2

Table 3. Guidelines for maximum milking times for cows of different production levels (from SmartSAMM Technote 5)

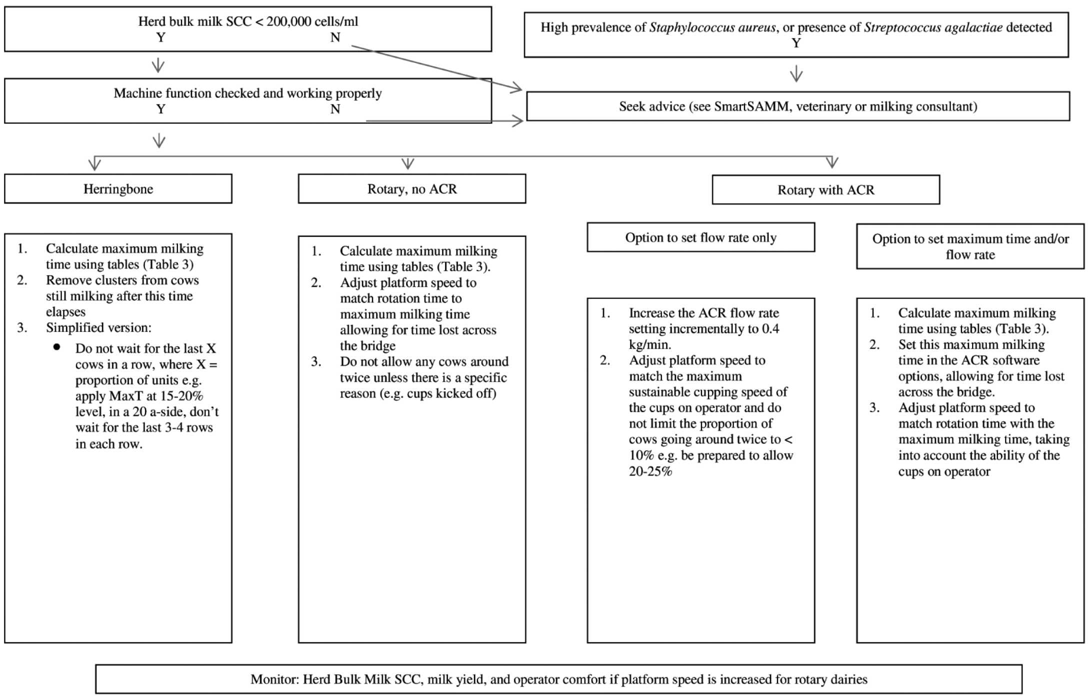

Table 4. Summary of how to apply a maximum milking time and/or increase the ACR threshold setting in herringbone or rotary dairies

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