

## New Zealand Society of Animal Production online archive

This paper is from the New Zealand Society for Animal Production online archive. NZSAP holds a regular annual conference in June or July each year for the presentation of technical and applied topics in animal production. NZSAP plays an important role as a forum fostering research in all areas of animal production including production systems, nutrition, meat science, animal welfare, wool science, animal breeding and genetics.

An invitation is extended to all those involved in the field of animal production to apply for membership of the New Zealand Society of Animal Production at our website [www.nzsap.org.nz](http://www.nzsap.org.nz)

[View All Proceedings](#)

[Next Conference](#)

[Join NZSAP](#)

The New Zealand Society of Animal Production in publishing the conference proceedings is engaged in disseminating information, not rendering professional advice or services. The views expressed herein do not necessarily represent the views of the New Zealand Society of Animal Production and the New Zealand Society of Animal Production expressly disclaims any form of liability with respect to anything done or omitted to be done in reliance upon the contents of these proceedings.

This work is licensed under a [Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License](http://creativecommons.org/licenses/by-nc-nd/4.0/).



You are free to:

**Share**— copy and redistribute the material in any medium or format

Under the following terms:

**Attribution** — You must give [appropriate credit](#), provide a link to the license, and [indicate if changes were made](#). You may do so in any reasonable manner, but not in any way that suggests the licensor endorses you or your use.

**NonCommercial** — You may not use the material for [commercial purposes](#).

**NoDerivatives** — If you [remix, transform, or build upon](#) the material, you may not distribute the modified material.

<http://creativecommons.org.nz/licences/licences-explained/>

## BRIEF COMMUNICATION: The effect of re-milking following extended non-milking periods on lactation in dairy cows

K Singh<sup>a\*</sup>, K Swanson<sup>a</sup>, HV Henderson<sup>a</sup> and K Stelwagen<sup>b</sup>

<sup>a</sup>AgResearch Ruakura, Private Bag 3123, Hamilton 3240, New Zealand; <sup>b</sup>SciLactis, Waikato Innovation Park, Ruakura Road, Hamilton 3240, New Zealand

\*Corresponding author. Email: kuljeet.singh@agresearch.co.nz

**Keywords** involution; mammary gland; milk production; dairy cow

### Introduction

In dairy cows, the cessation of milk removal for extended periods, such as drying-off, initiates the process of mammary gland involution. This results in a decline of mammary secretion and changes in secretion composition. Morphological changes in the mammary gland occur within the first week of non-milking, with extensive re-modelling by the third or fourth week. However, many alveolar structures are retained (Hurley 1989). Thus, involution may be reversible following extended non-milking periods (Noble & Hurley 1999). Milk yield is fully restored by re-milking following seven days non-milking (Dalley & Davis, 2006), but is only partially recovered following an 11 day non-milking interval (Noble & Hurley, 1999). The aim of this study was to determine the effect of extended non-milking periods in pasture-fed cows on recovery of milk yield and composition.

### Materials and methods

Friesian primiparous non-pregnant dairy heifers (n = 6 per group; 97 ± 2 days in milk) that were pasture-fed, milked twice daily and free of

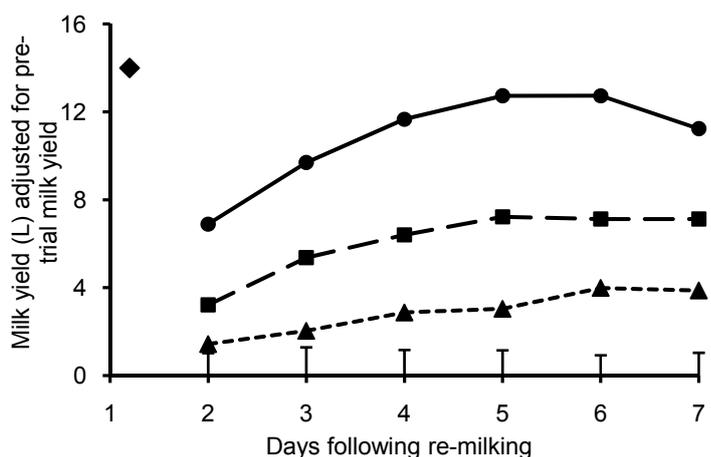
intramammary infection, indicated by no *in vitro* bacterial growth and a mean somatic cell count (SCC) of 48,980 cells/mL (range 17,000 to 134,000), were used. Groups were subjected to non-milking intervals of 7-, 14- or 28-days, followed by re-milking twice daily for seven days prior to slaughter. To prevent mastitis, a systemic antibiotic was administered to heifers for three consecutive days prior to both the non-milking intervals and to re-milking. All procedures were approved by the Ruakura Animal Ethics Committee. Daily milk yields were recorded (Alfa Laval Cow Management System, Ruakura Dairy, AgResearch Limited, Hamilton). Milk samples were collected for measurement of fat, protein and lactose content by near infrared spectroscopy and SCC by flow cytometry analysis (Fossomatic equipment, LIC Herd Testing Station, Hamilton). Pre-trial milk values were calculated as the average of seven days prior to non-milking intervals; and composition and SCC as the average of three days. Data were analysed by ANOVA in GenStat (Payne et al. 2009) and reported as means by non-milking interval groups, adjusted for mean pre-trial values, and standard errors of difference.

### Results

Milk yields, pre-trial (14.0 ± 2.5 L/d) and throughout the re-milking interval are presented in Fig. 1. The milk yield was negligible for some cows on Day 1 of re-milking. By Day 2, the 7-day non-milked group had a greater milk yield recovery (P < 0.05) than the 14- and 28-day groups. From Day 3, all groups were different from each other (P < 0.05). By Day 6 of re-milking, the milk yield recoveries were 91, 51, and 29% for the 7-, 14- and 28-day non-milked groups, respectively, with only the 7-day non-milked group not significantly different (P = 0.11) to pre-trial values.

Milk composition for samples taken at Day 7 re-milking are presented in Table 1. The pre-trial fat, protein and lactose contents were 3.9 ± 0.5, 3.5 ± 0.2 and 5.0 ± 0.2%, respectively. At seven days re-milking, the fat content for the 28-day non-milked group was lower than pre-trial (P < 0.01) and the 7- and

**Figure 1** Milk yield from cows re-milked for seven days following extended non-milking intervals of 7 (●), 14 (■) and 28 (▲) days (n = 6 per group) at mid-lactation. The pre-trial value (◆) represents the average of seven days prior to the non-milking intervals. Data are expressed as mean values adjusted for pre-trial milk yields of seven days prior to the non-milking period, with standard error of the difference shown as vertical bars.



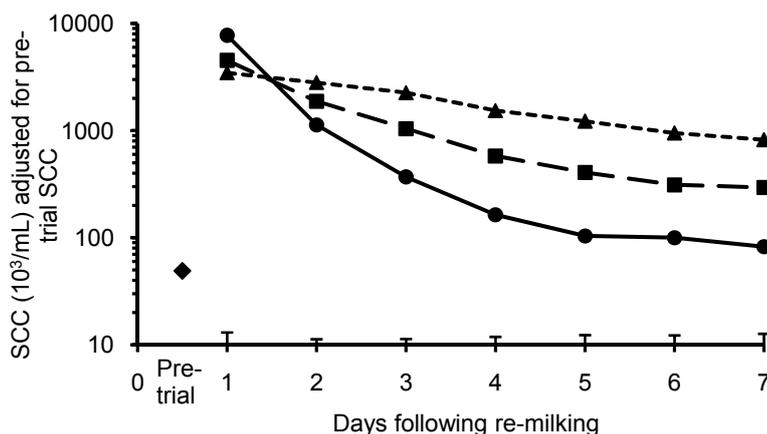
**Table 1** Milk composition of dairy cows re-milked for seven days following extended non-milking periods of seven, 14 and 28 days (n = 6 per group) at mid-lactation. The re-milked composition values are presented as means, calculated as the average of three days prior to non-milking intervals, adjusted for pre-trial values with the standard error of the difference. <sup>a,b</sup> means of re-milked groups in the same row with different superscripts differ (P < 0.05).

Component	Non-milking interval			Standard error of difference
	7 days	14 days	28 days	
Fat (%)	4.1 <sup>ab</sup>	4.3 <sup>a</sup>	3.0 <sup>b</sup>	0.6
Protein (%)	3.9 <sup>a</sup>	4.2 <sup>b</sup>	4.2 <sup>b</sup>	0.1
Lactose (%)	4.8 <sup>a</sup>	4.6 <sup>a</sup>	3.8 <sup>b</sup>	0.2

14-day non-milked groups (P < 0.05). The protein content for the 7-day non-milked group was lower (P < 0.05) than the 14- and 28-day non-milked groups, at seven days re-milking, although all groups had greater (P < 0.001) concentrations than pre-trial. The lactose content was not significantly different (P = 0.08) for the 7-day non-milked group and pre-trial at seven days re-milking, although the 14- (P < 0.01) and 28-day (P < 0.05) non-milked groups were lower than pre-trial. At seven days re-milking, lactose for the 28-day non-milked group was lower (P < 0.05) than the other two groups.

Milk SCC data are presented in Fig. 2. On Day 1 of re-milking, the SCC was high and similar for the three groups but by Day 2 re-milking, all groups were different from each other (P < 0.05). The SCC declined to less than 400,000 cells/mL by Day 3 and Day 6 re-milking for the 7- and 14-day non-milked groups, respectively, but remained greater than 800,000 cells/mL in the 28-day non-milked group. By Day 7 re-milking, SCC for the 7-day non-milked group was not different from pre-trial values (P = 0.12).

**Figure 2** Milk somatic cell count (SCC) of cows re-milked for 7 days following extended non-milking intervals of 7 (●), 14 (■) and 28 (▲) days (n = 6 per group) at mid-lactation. The pre-trial value (◆) represents the average of three days prior to the non-milking intervals. Data are expressed as mean values adjusted for pre-trial values of three days prior to the non-milking period, with standard error of the difference shown as vertical bars.



**Discussion**

These data indicate that a near full recovery of milk yield in dairy cows is possible following a 7-day non-milking period and that partial recovery occurs following 14- and 28-day non-milking in a pasture-based system during mid-lactation. The loss of milk production increases with increasing non-milking intervals. Previous studies have demonstrated a full recovery of lactation upon re-milking following seven days non-milking (Dalley & Davis 2006) and a partial recovery by resuming milking for three days following an 11 day non-milking interval (Noble and Hurley 1999). However, the data presented here indicate that these days re-milking may not have been sufficient for full lactation recovery. Alternatively, some alveoli may have already begun to involute and, therefore, full recovery of lactation may not have been possible (Noble & Hurley 1999). Regulation at an alveolar level has been demonstrated in mammary tissue from lactating cows where a small population of alveoli are involuting, and during milk stasis there is retention of regions of alveoli that are actively expressing milk proteins (Molenaar et al. 1992). The reversibility following extended non-milking intervals in bovine mammary function may be due to this heterogeneity.

Milk composition did not completely return to pre-trial composition upon re-milking. Instead, following re-milking, the protein content remained high in all groups. Although milk protein expression decreases during involution, there is an increase in mammary protein concentration due to an increase in serum-derived proteins and *de novo* synthesis of lactoferrin (Hurley, 1989). The lactose composition remained lower than pre-trial values upon re-milking for the 14- and 28-day non-milked groups and the fat content remained lower for the 28-day non-milking. Previous studies reported a rapid

decline in lactose and a slower decline in fat concentration in secretions produced during involution. Furthermore, there is a decrease in activity of enzymes involved in lactose and fat synthesis in mammary tissue during involution (Hurley, 1989). Changes in milk composition suggest a decline in secretory activity following extended non-milking intervals. In addition, an increase in mammary cell death is evident by 72 hours post-milking, suggesting the mammary gland has entered the process of involution (Singh *et al.* 2008). However, the retention of alveolar structures ensures that, unlike in rodents (Jaggi *et al.* 1996), lactation can still be re-initiated in the bovine mammary gland after extended non-milking periods.

The SCC, an indicator of udder health and milk quality, remained higher in all re-milked groups than the pre-trial values, although these values were below the New Zealand penalty limit of 400,000 cells/mL in the 7- and 14-day non-milked groups by Day 3 and 6 of re-milking, respectively. Davis & Dalley (1996) have demonstrated similar recovery times, with 7-days non-milking resulting in less than 400,000 cells/mL by Day 5 re-milking. In the present study, the 28-day non-milked group had SCC values above 400,000 for the entire seven day re-milking period. The elevated SCC are likely to be due to an enhanced influx from the blood, as the alveolar structures break down, as well as due to a concentration effect because of the lower milk volume.

Together these results suggest that the process of involution can be near fully reversed following seven days of milk stasis. More extended periods of non-milking prevent the complete recovery of lactation, probably through a decrease in milk-secreting mammary epithelial cell number and/or activity.

## Acknowledgements

Financial support from the Ministry of Science and Innovation (MSI) and the Agricultural and Marketing Research and Development Trust (AGMARDT) is gratefully acknowledged.

## References

- Dalley DE, Davis SR 2006. Effect of an extended milking interval on recovery of milk yield and somatic cell count in dairy cows. *Proceedings of the New Zealand Society of Animal Production* 66: 241–244.
- Hurley WL 1989. Mammary gland function during involution. *Journal of Dairy Science* 72: 1637–1646.
- Jaggi R, Marti A, Guo K, Feng Z, Friis RR 1996. Regulation of a physiological apoptosis: mouse mammary involution. *Journal of Dairy Science* 79: 1074–1084.
- Molenaar AJ, Davis SR, Wilkins RJ 1992. Expression of  $\alpha$ -lactalbumin,  $\alpha$ -S1-casein, and lactoferrin genes is heterogeneous in sheep and cattle mammary tissue. *The Journal of Histochemistry and Cytochemistry* 40: 611–618.
- Noble MS, Hurley WL 1999. Effects of secretion removal on bovine mammary gland function following an extended milk stasis. *Journal of Dairy Science* 82: 1723–1730.
- Payne RW, Murray DA, Harding SA, Baird DB, Soutar DM 2009. *GenStat for Windows*, 12th Edition. Introduction. Hemel Hempstead, VSN International.
- Singh K, Davis SR, Dobson J, Molenaar AJ, Wheeler TT, Prosser CG, Farr VC, Oden K, Swanson KM, Phyn CVC, Hyndman DL, Wilson T, Henderson HV, Stelwagen K 2008. cDNA microarray analysis reveals antioxidant and immune genes are up-regulated during involution of the bovine mammary gland. *Journal of Dairy Science* 91: 2236–2246.