Effect of an extended milking interval on recovery of milk yield and somatic cell count in dairy cows

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ABSTRACT

The objective of the study was to determine whether lactation could be re-initiated after several days without milking. Thirty-six cows in mid lactation were subjected to a single period without milking of either 2, 4 or 7 days. Following these periods twice daily milking resumed. Two days after resumption of twice daily milking, milk yield was depressed to 92, 80 and 51% of pre-treatment (twice a day milking) rates in the 2, 4 and 7-day treatments. The 2- and 4-d treatments achieved pre-treatment milk yields 3 and 4 days after the resumption of milking, respectively. The 7-d treatment failed to achieve pre-treatment yields in this time period. However, 6 days after the resumption of twice-daily milking there was no difference in average milk yield between the 3 groups. Following the resumption of milking, SCC exceeded 2 million cells/ml for the first day in all treatments. Within 3 days the SCC for the 2 and 4-day treatments were below the 400, 000 cells/ml penalty threshold. However, it took five days milking to achieve this level for the 7-day treatment. The results indicate that successful lactations can be re-established after up to 7 days without milking in mid-lactation, with minimal carry-over effects on milk yield for the rest of the lactation.

Keywords: milking interval; pasture; milk yield; dairy.

INTRODUCTION

When milking of the bovine udder ceases, the involution process is initiated which sequentially involves cessation of milk secretion, modifications in milk composition and mammary structure and, ultimately, remodelling of the mammary gland to prepare it for the next lactation (Capuco and Akers, 1999). In cows, this process can take over 30 days (Hurley, 1989).

Several experiments examining effects of longer non-milking intervals have demonstrated that, following cessation of milking for as long as 11 days (Noble & Hurley, 1999), resumption of milking can reinitiate lactation, albeit at an impaired level. However, with shorter non-milking periods full recovery of milk yield can be expected (Hamann and Reichmuth, 1990). Farr *et al*. (1998) concluded that milk secretion rates were impaired by extended milking intervals of 24 and 40 h but recovery was relatively swift with frequent milk removal (24-48 h). The scientific question remains as to how long milking can be suspended before irreversible impairment of secretion occurs.

Recent flooding incidents have raised the issue as to what happens to cow productivity if farmers are unable to milk their cows for extended periods. In order to determine the effect of increasing duration without milking on grazing dairy cows, this study examined the changes in milk secretion rate and somatic cell count after 2, 4 and 7-day milking intervals.

MATERIALS AND METHODS

Thirty-six, low (< 100 000 cells/ml) somatic cell count (SCC) cows in mid lactation (118 ± 15.8 DIM), averaging 15.5 ± 0.58 l/day were used. Only cows free of intramammary infection (no *in vitro* bacterial growth) were used in the study. Cows grazed on ryegrass/white clover pastures and before the experiment were milked twice daily at 6.30 am and 3.30 pm. Three treatment groups, each of 12 cows, were balanced for age, milk production, breed and liveweight. The treatment groups were subjected to single intervals without milking of 2, 4 or 7 days, following which all cows returned to twice-daily milking (13 Dec 2004) for the remainder of the season. The last milkings were on the morning of the 11th, 9th and 6th December for the 2, 4 and 7-d treatments respectively. Throughout the experiment the cows were offered a minimum of 15 kg DM/cow/day as pasture.

Milk yield was recorded at each milking and milk samples collected at the first nine milkings following resumption of twice-daily milking. These samples were analysed for somatic cell count using a fluorometric cell counter (Fossomatic, Foss Electric, Hillerod, Denmark).

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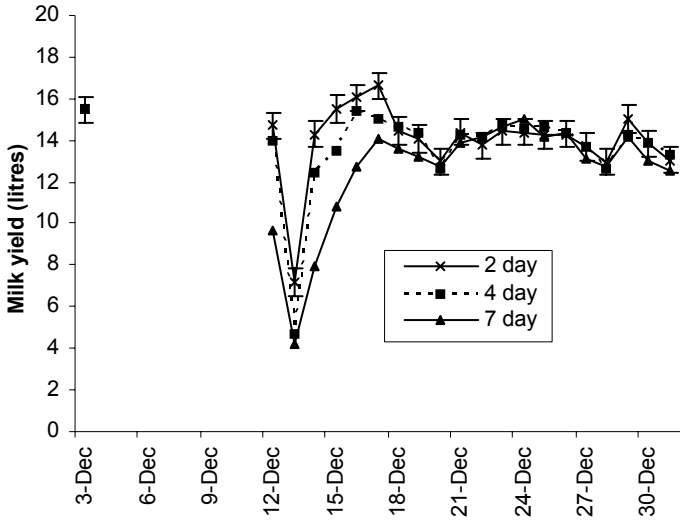
The repeated measurements on each cow were analysed by fitting a mixed model with pre-trial covariate, date, treatment and interaction of date with treatment as fixed effects and cow and date within cow as random effects using an autoregressive covariance structure of order 1 allowing for heterogeneity of variance at the different dates, to model the repeated measurements on each cow. Residual maximum likelihood (REML) was used to fit this model using GenStat 8.1.

There was a significant interaction of treatment with date so the data at each date is presented to illustrate this interaction.

RESULTS

The 2-d and 4-d treatments had significantly more milk ($P<0.001$) accumulated in the udder at the first milking post treatment (Figure 1) than the 7-d treatment. During the next 24-h period, milk secretion rates, relative to previous milk yield, declined for all treatments (Figure 1). Cows on the 7-d treatment produced significantly less milk ($P<0.001$) than those on the other two treatments for 6 days following resumption of milking (Figure 1).

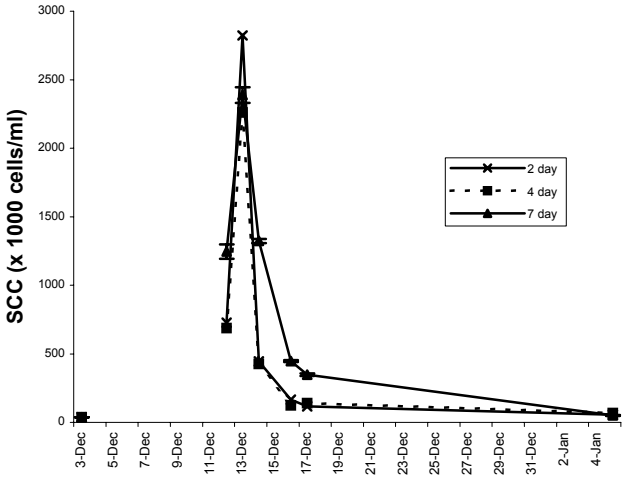
FIGURE 1: Recovery of milk yield following 2, 4 and 7 days of milk accumulation (milking ceased on the 11th, 9th and 6th Dec for the 2, 4 and 7-d treatments, respectively). Error bars are the average SED for factors treatment and date.



Within 3 and 4 days, after the resumption of milking, yields for the 2 and 4-d treatments, respectively, were similar to those measured on the 3 December, viz 15.5 ± 1.15 and 15.4 ± 1.18 litres, respectively. On 18 December the average milk production for all three groups was 14.3 ± 0.64 litres/cow. Average lactation milksolids yields were 307 ± 13.9, 292 ± 26.2 and 298 ± 17.5 kg MS/cow for the 2, 4 and 7-day treatments respectively. This compares with an average production of 298 ± 35.0 kg MS/cow for the remainder of the herd not used in the trial.

Following the resumption of milking SCC peaked over 2 million cells/ml on 13th December for all treatments (Figure 2). Within three days the SCC for the 2 and 4-d treatments were below the 400, 000 cells/ml penalty threshold, but it took 5 days to achieve this level for the 7-d treatment. Three cows in the 7-d group developed clinical mastitis when milking resumed.

FIGURE 2: Somatic cell count (SCC) of cows after milking was ceased for 2, 4 or 7 days (milking ceased on the 11th, 9th and 6th Dec for the 2, 4 and 7-d treatments respectively). Data presented are back-transformed $\log_{10}$ SCC and error bars the SED between the 2 and 7-day treatments.



DISCUSSION

Mammary gland involution in grazing dairy cows was reversed by reinstating twice daily milking after up to 7 days of non-milking in mid-lactation. The 2 and 4-d treatments achieved pre-treatment milk yields 3 and 4 days after the resumption of milking, respectively. The 7-d treatment failed to achieve pre-treatment yields in this time period. However, 6 days after the resumption of twice-daily milking there was no difference in average milk yield between the 3 groups.

Farr *et al.* (1998) showed that the instantaneous rate of milk secretion was around 50% of previous after 40h of non-milking but recovery to 80% was obtained in the next 4 milkings (24h). Wheelock *et al.* (1965) showed full recovery of yield after 60 h of non-milking and the process of recovery took 4 milkings to achieve.

Noble and Hurley (1999) re-milked after 11 days 'dry' and overall recovery was low and variable, only 28% of previous yield, on average, after 3 days. Re-initiation of lactation following extended milk stasis has also been demonstrated in beef animals (Lamb *et al.* 1997).

The ability of involuting tissue to regain lactation function suggests a certain degree of flexibility in physiological and functional capabilities of the bovine mammary gland. The time at which mammary gland involution becomes irreversible has yet to be determined. In the early phase following cessation of milking, the udder becomes full of milk and secretion ceases within 24-36h of the last milking (Davis *et al*., 1998). There is also an invasion of leucocytes into the udder. At around 3 days of mammary engorgement, inter-cellular seals between cells break down and milk mixes with interstitial fluids and the process of resorption of milk is initiated (Hurley, 1989). Cellular changes occur including cell death and tissue remodelling over the subsequent period (Capuco and Akers, 1999).

Our study indicates that effectively complete recovery of yield can be obtained if re-milking is initiated within 7 days of the last milking i.e. after several stages of glandular changes have occurred. Following this time, the data of Noble and Hurley (1999) suggest that the involution process becomes increasingly irreversible.

Dairy companies around the world routinely include SCC as a measure of milk quality. In New Zealand the penalty limit is 400, 000 cells/ml. In the current study resumption of milking after 2 and 4 days of non-milking resulted in SCC exceeding the industry penalty threshold for three days. In contrast the SCC of cows in the 7-d treatment remained above 400, 000 cells/ml for five days. Cows commencing once a day milking (OAD) have significant increases in SCC (Kamote *et al*. 1994; Stelwagen and Lacy-Hulbert, 1996; Lacy-Hulbert *et al.* 2005). The increase in SCC can be accounted for by a 'concentration effect' as milk yield falls while the number of cells secreted remains constant (Kamote *et al.* 1994). Interestingly, it was the second milking following milk stasis in the current experiment that experienced the highest SCC and correspondingly the lowest milk yield. SCC yield peaked 36 hours after the resumption of milking for all treatments and declined steadily from this point. Stelwagen and Lacy-Hulbert (1996) observed a substantial increase in yield of cells in milk from cows on OAD milking that had low initial SCC.

It could be hypothesised that the increase in SCC following an extended period without milking in commercial dairy herds would be greater than that observed in the current work, since the cows selected for the current trial were bacteriology-negative. Similarly, a higher incidence of mastitis in the 2 and 4-d treatments may occur relative to the incidence observed here. A much larger study is required to determine the true effect of non-milking intervals on the incidence of mastitis.

CONCLUSION

This trial has demonstrated that successful lactations can be re-established after up to 7 days of non-milking in grazing cows in mid-lactation and with minimal carryover effects on milk yield for the rest of lactation.

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