
THE PROCEEDINGS OF THE
NEW ZEALAND SOCIETY
OF
ANIMAL PRODUCTION
VOLUME 62 2002

Reduction in SCC and colostrum levels in milk after calving

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ABSTRACT

Somatic cell count (SCC) and immunoglobulin G_1 (IgG_1) content were determined in mammary secretions of 15 Friesian x Jersey cows and 5 heifers at each milking for 10 d following natural calving. Milk yields for cows on d 1 were 20.2 l/d, declined sharply on d 2 to 14.4 l/d, then increased slightly, reaching 17.9 l/d by d 10. In contrast, heifer milk yields were low on d 1 (6.6 l/d) but increased steadily to 11.9 l/d by d 10. The SCC and IgG1 levels were extremely high on d 1 (1.50 x10^6 cells/ml and 24.0 g/l IgG_1) but declined rapidly within 48 h of calving. Average SCC and IgG_1 reduced below the penalty levels by d 4 for cows, and d 5 for heifers, confirming that milk should be withheld from the bulk tank for 4 d and 5 d after calving for cows and heifers respectively. Individual cows may exceed these levels for short periods.

Keywords: milk; colostrum; SCC; Immunoglobulins; postpartum.

INTRODUCTION

There are increasing pressures to improve the quality of raw milk used for manufacturing food products. Mammary secretion, or colostrum, in the first days of lactation contains very high levels of somatic cells (SCC) and immunoglobulins, in particular immunoglobulin G_1 (IgG_1; Newstead, 1976). The presence of these blood derived components adversely affects milk processability (Munro *et al.,* 1984; Barbano *et al.,* 1991) and, in New Zealand, milk suppliers are legally required to withhold colostrum from the raw milk supply. Current minimum requirements are that milk produced in the first 4 d (8 milkings) after calving, or 5 d or 10 milkings for first lactation heifers, be withheld from the raw milk supply. Penalties, based on SCC and IgG_1 content of the bulk milk, are imposed to ensure that the requirements are adhered to. The penalty levels are currently set at •400,000 cells/ml for SCC and at •1.35 g/l for IgG_1. However, at the same time new products are being developed which make use of milk components which were previously rejected, such as IgG_1.

Mastitis also causes substantial increases in SCC and IgG_1, and in the near future SCC penalty levels may be reduced below 400,000 cells/ml to encourage the production of low (<150,000) SCC milk. Information, concerning the compositional changes occurring in the healthy gland, is essential if the payment scheme is to remain equitable and effective. This study was designed to characterise the reduction in SCC and IgG_1 content for cows with a low incidence of mastitis.

METHODS

Samples of udder secretion were collected twice daily from 20 Friesian x Jersey cattle, including 5 primiparous heifers, for the first 10 d of lactation following natural calving. Sampling commenced at afternoon milkings, between 3 and 27 h post parturition. Representative morning and evening samples were collected using in-line milk meters (Tru-test Ltd., East Tamaki, Auckland), fixed with 0.1% potassium dichromate and refrigerated before analysis. Cows entered the milking herd 5 d after calving, and heifers 6 d after calving.

Milk yields were measured using a computerised in-line flow metering system (RMH, InterAg, Te Rapa, Hamilton). The SCC was determined using a Fossomatic automated cell counter (Foss Electric, Hillerood, Denmark). Colostrum content was estimated by the concentration of IgG_1 using a commercial kit ('Coltest' radial immunodiffusion test; Immunochemical Products Ltd., Auckland). For the first few milkings, concentrations of IgG_1 often exceeded the range of the kit so affected samples were diluted 1:10 with distilled water, on a volume for volume basis, prior to analysis.

Milk yields, SCC and IgG_1 concentration were determined on a per milking basis and composite 24 h daily values derived on a volume weighted basis. Student t-tests were used to compare daily values for cows and heifers. Bacteriological examination of quarter foremilk, collected aseptically within 7 d of calving, indicated that all cows were free of intramammary infection by a major mastitis pathogen, such as *Staphylococcus aureus, Streptococcus dysgalactiae* or *Str. uberis*.

RESULTS

Mean values for daily milk yields following calving differed significantly (P<0.01) between cows and heifers throughout the 10 d period (Figure 1). Milk yields on day 1 after calving showed a wide variation across the group with multiparous cows giving, on average, 3 times as much milk as the heifers (Mean ± SEM; Cows: 20.2 ± 1.85 l/d vs.

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Heifers: 6.06 ± 2.03 l/d; P<0.001). Milk yields for cows reduced by 25% on day 2, then stabilised over the next 6-7 d at approximately 80% of the d 1 yields. In contrast milk yields for heifers increased steadily after d 1, reaching more than 10 l/d by d 5 after calving. No significant relationship was observed between milk yields on d 1 and time (h) between calving and the first machine milking.

The average SCC for cows was lower on d 1 (P<0.05) than for heifers (Figure 2) and remained so throughout the sampling period. The total daily production of cells remained similar for both cows and heifers during the 10 d period, suggesting that the lower SCC observed for cows after calving was due to a greater dilution effect resulting from their higher milk yields, compared with heifers. The average SCC reduced below 400,000 cells/ml by d 3 for cows, compared with d 5 for heifers.

Concentration of IgG_1 was highest for both cows and heifers on the first day after calving but showed a 10 fold reduction by d 2 (Figure 3). The IgG_1 for heifers remained significantly higher (P< 0.05) than for cows for the first 4 d after calving. By d 4 for cows, and d 5 for heifers, the average IgG_1 for each group had declined to below the colostrum penalty level of 1.35 g/l. Total yield of IgG_1 was substantially higher for cows than for heifers on d 1 (cows: 441 ± 96 g/d vs. heifers: 228 ± 66 g/d; P = 0.13) but reduced to similar levels for both cows and heifers by d 2 onwards (30.5 ± 3.0 g/d vs. heifers: 23.8 ± 2.4 g/d).

FIGURE 1: Milk yields (± SEM) for cows and heifers between d 1 and d 10 postpartum. Values differed significantly (P < 0.01) between cows and heifers each day after calving

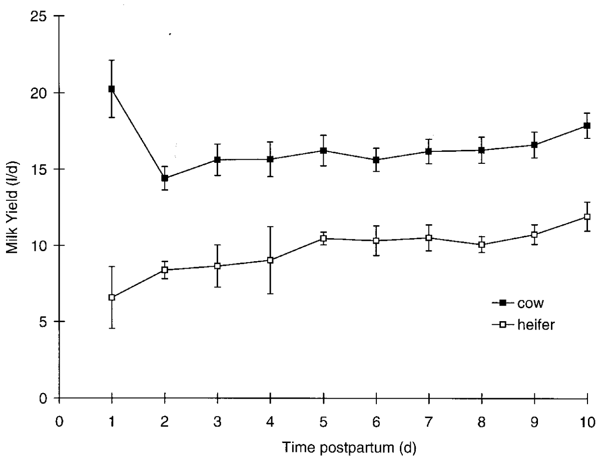


FIGURE 2: Milk SCC (± SEM) for cows and heifers between d 1 and d 10 postpartum. Values differed significantly (P <0.05) between cows and heifers on d 1 after calving.

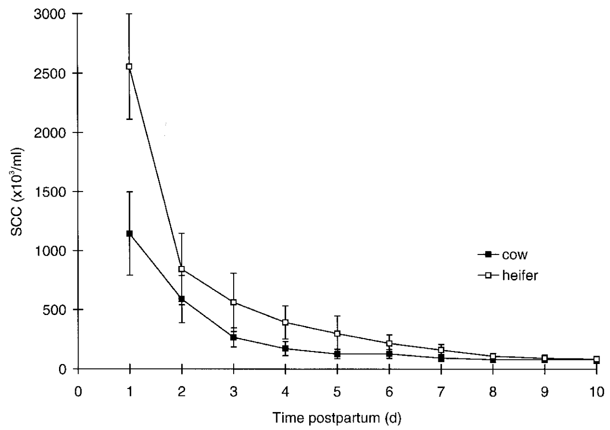
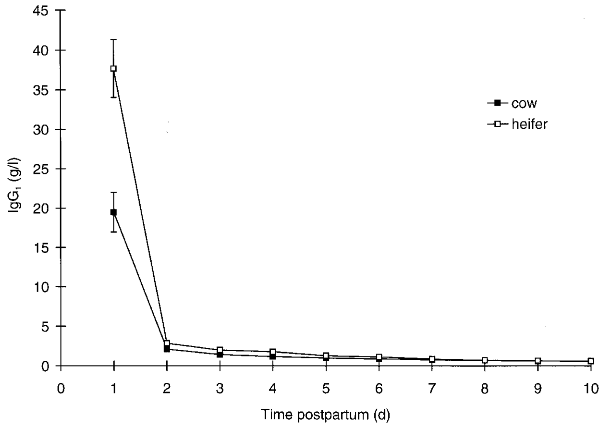


FIGURE 3: Milk IgG_1 (± SEM) concentration for cows and heifers between d 1 and d 10 postpartum. Values differed significantly (P < 0.05) between cows and heifers on d 1 - 4 after calving.



The proportion of animals exceeding the SCC penalty level, when entering the milking herd, was relatively low (7% of cows and 20% of heifers) compared with the number exceeding the IgG_1 penalty level (27% of cows and 60% of heifers; Table 1). Reducing the SCC penalty level to a hypothetical value of 250,000 cells/ml caused a slight increase in the number of animals exceeding the criteria (20% of cows and 40% of heifers). These percentages however, were still smaller than the percentage exceeding the IgG_1 penalty level. It should be emphasised that these observations were based on only a small number of animals and there were no major pathogen intramammary infections among the group.

DISCUSSION

The results confirm that, on average, both cows and heifers require a minimum of 4, and 5 d, respectively of twice daily machine milking before the milk becomes acceptable for supplying to the factory. Milk yields on d 1 for the cows were much higher than during the subsequent days of production, suggesting that some accumulation of milk had occurred within the glands prior to calving. In contrast heifers showed little evidence of milk accumulation, or 'bagging up', prior to calving. The low milk yields observed on d 1 for heifers may reflect less effective milk ejection and removal for the first milkings after calving.

TABLE 1: Proportion of animals producing milk which exceeded the SCC (current and hypothetical) or IgG_1 penalty levels when entering the milking herd at 5 or 6 days after calving.

	SCC •400,000/ml	**SCC •250,000/ml**	**IgG_1 •1.35 g/l**
Cows (d 5)	1/15 (6.7%)	3/15 (20%)	4/15 (27%)
Heifers (d 6)	1/5 (20%)	2/5 (40%)	3/5 (60%)

Rapid declines in SCC and IgG_1 following calving were in accordance with previous results (Muller & Ellinger, 1981; Auldist et *al.,* 1993). Concentrations of somatic cells and IgG_1 in the first 3 d after calving were similar to levels normally associated with mastitis although bacteriological analysis of the milk determined that these glands were uninfected. The observed changes were typical of the natural processes occurring at the commencement of lactation when colostrum must be produced for the newly born calf and constituents of dry cow secretion be removed from the gland (Lee *et al.*, 1980).

The adverse effects of high SCC and IgG_1 on milk processing properties have been well documented (Munro *et al.*, 1984; Kitchen, 1981). However, IgG_1 might be harvested for novel products using mammary secretion produced in the first 1-2 days after calving. Of the total IgG produced in the first 5 days after calving, 70% was produced at the first milking, 10% at the second, and less than 5% produced at the subsequent milkings.

Mammary secretion clearly undergoes marked changes in the first few days after calving. These changes cannot be prevented or avoided and are a necessary part of the commencement of lactation. Minimising the risk of grading for SCC or IgG_1 in the first days of lactation requires that milk is withheld for 4-5 d after calving. This period could be extended if a high proportion of the milk is derived from heifers that have not had an effective milk let down during the first days after calving, a factor which will slow the rate at which colostrum is cleared from the gland.

Cows entering the milking herd with undetected, subclinical infections may also increase the risk of penalties. Identifying infected quarters, using a conductivity meter or other cow-side tests, followed by treatment with antibiotics, may be warranted before cows are included in the milking herd. Future reductions in the SCC penalty level should not unduly increase the risk of grading for low infection herds but would present a more serious problem for herds with intramammary infections.

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