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## BRIEF COMMUNICATION

## Lactoferrin concentration is increased in milk from cows milked once-daily

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Lactoferrin is a component of milk whey, valuable for its properties as an iron-binding, bacteriostatic and anti-bacterial protein. Commonly, lactoferrin concentrations are high in colostrum and in late-lactation milk (Nonnecke & Smith, 1984). In particular, the lactoferrin content of mammary secretion is markedly increased during mammary involution when expression of the lactoferrin gene is initiated in milk-engorged, secretory alveoli (Molenaar *et al.*, 1996).

A feature of once-daily milking (OAD) is the accelerated regression of the udder that leads to an increased rate of decline in milk yield as lactation progresses (Carruthers *et al.*, 1993). This accelerated regression and attenuation of lactation is particularly notable in some cows, although others appear relatively unaffected. In addition, there are changes in milk composition commensurate with changes that normally occur at drying-off. This suggests that milk lactoferrin concentration could be enhanced during OAD.

Milk lactoferrin content has not been measured previously in cows in which milking frequency has been changed.

Eight cows (mixed breeds) in mid-lactation, grazing rye-grass/white clover pasture at No. 1 Dairy, Dexcel (Ruakura) were used in this study. They were milked twice daily (TAD) from parturition and underwent a period of three days of OAD beginning at day 123±4 of lactation, on average. Mean milk SCC before treatment was 178±53 x 10<sup>3</sup> cells/ml. Milk samples were taken before, during and after OAD and assayed for lactoferrin using an ELISA method (Bethyl Laboratories, Montgomery, Texas, USA.) Milk yield and composition were also recorded.

Lactoferrin concentration rose from 187±35 to 298±30 µg/ml (P<0.01) in milk after 3 days on OAD and slowly declined following the resumption of TAD. The maximal change averaged 60% on the first day of TAD following treatment with values remaining significantly elevated for a further 4 days. Milk yield declined from 11.7±1.1 kg/d to 10.3± 1.2 kg/d on day 3 of OAD (P<0.01). Total yield of lactoferrin (control yield 2.3±0.5 g/d) was significantly higher by day 2 of OAD rising to a maximum of 3.5±0.8 g/d (52%; P<0.01) on the first day following resumption of TAD, remaining higher for a further 4 days.

In a second experiment, milk samples were taken from Jersey and Friesian cows milked once-daily throughout lactation at Westpac Trust Whareroa Research Centre, Taranaki. Lactoferrin content was determined by the ELISA method. Jersey and Friesian herds milked OAD and control herds (grazing adjacent paddocks) milked TAD were sampled in mid-lactation (December; average

days in milk was 120±2). There were 30-40 animals per herd and the study was conducted as a farmlet trial.

Milk yields of the Jersey TAD and OAD herds at the time of sampling were 12.2 and 9.9 kg/d (P<0.01), respectively and of the Friesian TAD and OAD herds was 17.8 and 12.8 kg/d (P<0.01), respectively. Mean milk SCC (overall) was 182±27 x 10<sup>3</sup> cells /ml and did not differ significantly among breeds or treatments.

Lactoferrin concentration in milk was significantly higher (P<0.01) in Friesian a.m. samples relative to Jerseys in both TAD and OAD herds but not in p.m. samples (Table). OAD increased the lactoferrin content of Jersey and Friesian milk by approximately 50% relative to the a.m. TAD sample (Table). Lactoferrin concentration in p.m. samples was approximately 30% lower than a.m. samples (P<0.01) for both breeds (Table). Lactoferrin yield was increased significantly by OAD for Jerseys (P<0.05) with a similar trend for Friesians (P<0.09). Changes in major milk components were small in both experiments, within the ranges reported elsewhere (Davis *et al.*, 1999).

**TABLE 1.** Milk lactoferrin concentrations and yield in Jersey and Friesian cows milked once (OAD) or twice (TAD) daily.

Herd	Lactoferrin Conc. (µg/ml)		Lactoferrin Yield g/d
	a.m. sample	p.m. sample	
Jersey OAD	244±22 <sup>a</sup>		2.3±0.2 <sup>a</sup>
Jersey TAD	156±16 <sup>b</sup>	106±11	1.6±0.2 <sup>b</sup>
Friesian OAD	329±20 <sup>c</sup>		4.1±0.3 <sup>c</sup>
Friesian TAD	218±20 <sup>a</sup>	133±15	3.4±0.3 <sup>c</sup>

Values within columns with different superscripts are significantly different by analysis of variance (P<0.05).

Most changes in milk composition during OAD are small (<20%; Davis *et al.*, 1999; Cooper *et al.*, 2001) and reflect increased leakage of serum and serum components into milk due to increased permeability of the mammary epithelium. Thus the relatively large change in lactoferrin concentration and yield potentially represents a very different, regulated, phenomenon involving active induction and expression of the lactoferrin gene in the secretory epithelium (Molenaar *et al.*, 1996).

While OAD is a useful means of differentially increasing the yield of lactoferrin, the challenge is now to identify changes in the concentration of other milk components which are similarly regulated.

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