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Effect of milking frequency and nutritional level on milk production characteristics and reproductive performance of dairy cows

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Introduction

Milking cows twice a day (TAD) is a time-constraining task for dairy farmers. Once a day (OAD) milking may offer a major opportunity to improve labour output and reduce costs. If once daily milking was proven as a satisfactory alternative to the normal twice daily milking regime, reduced milking frequency could have the following potential benefits for different sectors of dairy farmers: (i) increased labour productivity and reduced costs (including that of hired labour); (ii) permit the uptake of alternative employment or alternative business interests; (iii) improved management of large herds in terms of milking time and cow walking distance on fragmented land bases, (iv) ease of work in terms of ergonomics together with shorter time input to the dairying operation and (vi) an easier lifestyle. However, such a potential alternative system should be critically examined from both management and economic viewpoints.

Few full lactation studies on OAD milking have been undertaken. New Zealand studies by Holmes *et al*., (2002); Cooper (2000) and French studies by Remond *et al*., (2004) have shown that OAD milked cows produced less milk with higher fat and protein contents compared to TAD milked cows. However, nutritional management may influence the consequences of reduced milking frequency. It is also considered that reduced milking frequency may influence reproductive performance of cows (though very few studies have examined these response variables) and affect the quality (somatic cell count [SCC]) of milk produced. Thus, the objective of the current trial was to compare once daily and twice daily milking regimes at two different nutritional levels for milk production and quality and reproduction parameters, over a complete lactation.

Brief description of study

Sixty spring-calving, pluriparous Holstein-Friesian cows were blocked according to expected calving date, parity and previous lactation milk yield. Cows were assigned to a factorial arrangement of treatments after calving; twice a day (TAD) milking on a high (TH) or low (TL) nutritional level (NL); once a day (OAD) milking on a high (OH) or low (OL) NL. High and low NL were defined by concentrate offered while cows were indoors on grass silage after calving (7 and 4 kg, respectively), by a combination of concentrate offered (4 and 1 kg, respectively) and post-grazing height (75 and 55 mm, respectively) during the first 26 days at pasture (22 March to 16 April), by post-grazing height (75 and 55 mm, respectively), during the main grazing season (17 April to 2 October), and by a combination of concentrate offered (3 and 1 kg, respectively) and post-grazing height (75 and 55 mm, respectively) during the late grazing period (3 October to 27 November). Cows on the high and low NL received a total of 420 kg and 137 kg of concentrate per cow, respectively, throughout lactation. Mean calving date was 11 March. Cows were bred by one AI technician during a 13-week breeding season commencing on 26 April 2004. A strict drying-off policy was adhered to, where milking ceased for cows on reaching a milk yield of 7 kg per day or a time interval of 10 weeks to calving.

Measurements

Milk yield was recorded daily, while milk composition was measured weekly. Cow live-weight (LWT) and body condition score (BCS) were recorded weekly and fortnightly, respectively. Somatic cell count (SCC) was analysed weekly up to 1 May and subsequently on a fortnightly basis. Clinical mastitis incidences were recorded. Milk samples were collected thrice-weekly post-partum for progesterone analysis to determine the commencement of luteal activity (CLA) (CLA; $\geq$3ng/ml in 2 consecutive samples). Submission, conception and pregnancy rates were recorded. Data were analysed according to factorial design using the PROC Mixed procedure in SAS.

Results and Discussion

OAD milking and a low NL reduced milk yield and yield of milk solids (MS) ($P<0.001$) compared to TAD milking and a high NL, respectively, (Table 1). Fat and protein contents of milk were increased ($P<0.001$) with OAD compared to TAD

milking. Fat content was not affected by nutritional level, but protein content was reduced (P<0.05) at the low compared to the high NL. Milk lactose content was not significantly affected by MF or NL. Milk yield was 26% lower, while MS yield was 20% lower with OAD milking compared to TAD milking. Cow LWT at the end of lactation was higher with OAD milking (P<0.01) and with the high NL (P<0.001). Cow BCS at the end of lactation was also higher with OAD milking (P<0.001) and with the high NL (P<0.001). Grass removed per cow (measured on a group basis) during the main grazing season (17 April to 2 October) was recorded as 19.7, 19.0, 15.4 and 14.9 kg DM/cow/day, respectively. Thus, grass removed per cow was reduced by a similar level (3-4 %) by OAD milking at both nutritional levels.

Table 1. Effect of milking frequency (MF) and nutritional level (NL) on mean milk production, live-weight (LWT) and body condition score (BCS) of cows

	Milking frequency (MF)		Nutritional level (NL)		Sig. MF	Sig. NL
	TAD	OAD	High	Low		
Milk yield (kg/cow)	6013	4437	5669	4780	***	***
Milk solids yield (kg/cow)	437.0	351.1	428.8	359.4	***	***
Fat (g/100g)	3.99	4.40	4.17	4.22	***	NS
Protein (g/100g)	3.29	3.53	3.46	3.36	***	*
Lactose (g/100g)	4.55	4.52	4.55	4.52	NS	NS
LWT at 275 DIM[1] (kg)	627	678	680	624	**	***
BCS at 275 DIM	2.73	3.49	3.31	2.92	***	***

[1]Days in milk

** = P<0.01, *** = P<0.001, NS = P>0.05

The onset of ovarian cyclicity was evaluated by two measurements – the number of days to commencement of luteal activity (CLA) and the proportion of cows that had commenced luteal activity pre-MSD (mating start date). OAD milked cows tended to have an earlier CLA (P<0.10) and a greater proportion of them had commenced luteal activity pre-MSD (P<0.05) compared to TAD milked cows (Table 2). Submission rate in the first three weeks after MSD and first service conception rate were not significantly affected by either milking frequency or nutritional level.

However, the overall pregnancy rate was higher with OAD (P<0.10) and the high NL (P<0.05) compared to TAD milking and a low NL, respectively. Caution must be exercised with these results involving limited experimental units, and these measurements need to be repeated. However, preliminary conclusions suggest no detrimental effects and some possible beneficial effects of once daily milking on reproductive performance. These findings are in agreement with other results using milking frequency models, from our Research Centre (Patton *et al*., 2005).

Table 2. Effect of milking frequency (MF) and nutritional level (NL) on reproductive performance indicators of cows

	Milking frequency (MF)		Nutritional level (NL)		Sig. MF	Sig. NL
	TAD	OAD	High	Low		
CLA [a] (d)	30.4	25.3	27.6	28.1	+	NS
Cows with CLA pre MSD [b] (%)	60	87	73	73	*	NS
Submission rate (21 d) (%)	63	73	63	73	NS	NS
First service conception rate (%)	50	40	50	50	NS	NS
Overall pregnancy rate (%)	73	90	93	70	+	*

* P<0.05, + P<0.10, NS = P>0.05;
[a] CLA=commencement of luteal activity based on milk progesterone,
[b] MSD=mating start date

The incidence of new mastitis infections was similar for TAD and OAD milked cows at 19 and 18 cases, respectively. While mean SCC in all treatment groups was considerably below the EU standard of $400x10^3$ cells/ml, some increase in milk SCC of OAD compared to TAD milked cows was observed, particularly with the low NL and when cows were in late lactation (Figure 1). The strict drying-off policy may have assisted in maintaining late lactation milk SCC within the EU standard.

Conclusions

Milk yield was reduced by OAD milking and by a low nutritional level. Increased concentrations of fat and protein together with improved live-weight and body condition score at the end of lactation were observed with OAD milking. OAD cows had better reproductive performance than TAD cows. Finally, OAD milking may

provide an alternative management option on-farm, but this strategy needs to be repeated using first lactation animals and over successive lactations.

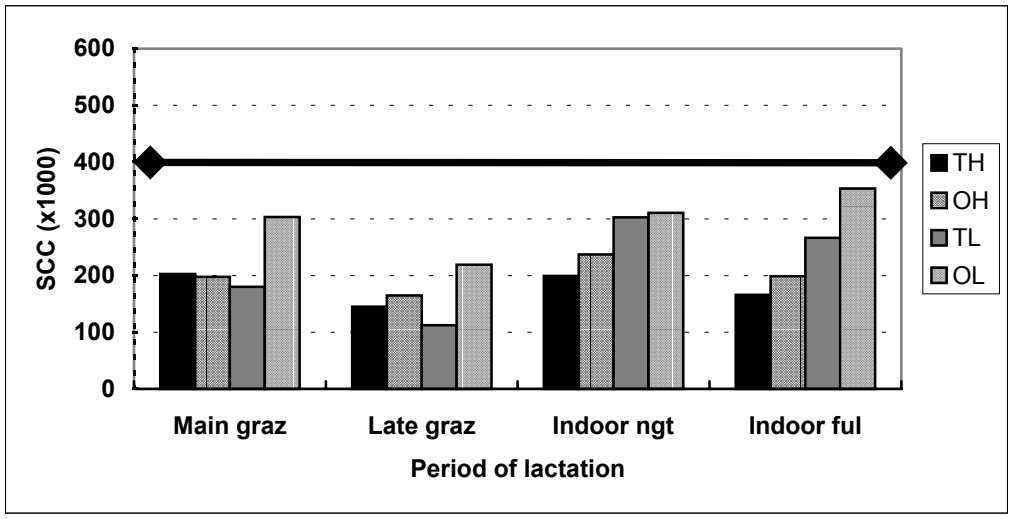

Figure 1. Effect of milking frequency and nutritional level on mean somatic cell count (SCC) during various stages of lactation

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