Milk Production from Once-a-Day (OAD) Milking

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Executive Summary

1. Once-a-day (OAD) milking for a whole lactation decreases milk and milksolids (MS) yield per cow by 20-30% compared with twice-a-day (TAD) milking.
2. Jersey cows have a smaller MS yield loss than Holstein Friesians (20 vs. 30%) when milked OAD for a whole lactation.
3. The negative effects of OAD milking on MS yield per ha can be partially offset in farm systems by adopting higher stocking rates, or by using OAD milking for part-lactation only.
4. OAD milking increases milk fat and protein by 2.8 and 1.5 g/l, respectively; and decreases milk lactose by 1.5 g/l.
5. MS yields of greater than 1200 kg MS/ha/year have been achieved from pasture-only, whole lactation, OAD milking systems using Jerseys or crossbred cows with a breeding worth (BW) of higher than 130.
6. A MS yield of greater than 400 kg MS/cow/year is a feasible target for whole lactation OAD milking systems.

Introduction

Cows on an OAD milking regime produce less milk than those milked TAD. The scale of this loss is an important factor in the profitability of OAD milking, and a barrier to the further adoption of this technology in the New Zealand dairy industry. This paper summarises research on the effects of OAD milking on milk yield and composition; presents the first two years of results from a three-year experiment comparing whole lactation OAD milking with TAD milking until mid-summer, followed by OAD for the remainder of the season; and outlines a case study of a OAD milking farm achieving good MS production per cow from a high-feed input system.

Research on Milk Yield and Composition

Research since 1980 has identified the key effects of OAD milking on milk yield, and these can be summarised as follows:

- OAD milking for a whole lactation decreases milk and MS yield per cow by 20-30% compared with TAD milking.
- Jersey cows have a smaller MS yield loss than Holstein Friesians (20 vs. 30%) when milked OAD for a whole lactation.
- Individual cows vary greatly in their response to OAD milking, and milk loss (%) is unrelated to initial milk yield.
- Heifers are more affected by OAD milking than older cows, but neither age group show any negative effects in their subsequent lactations.
- The negative effects of OAD milking on MS yield can be partially offset in farm systems by adopting high stocking rates, or by using OAD milking for part-lactation only.

The key effects of OAD milking on milk composition can be summarised as follows:

- OAD milking increases milk fat and protein by 2.8 and 1.5 g/l, respectively; and decreases milk lactose by 1.5 g/l (Remond & Pomies, 2005).
- Casein and whey protein concentrations are increased by OAD milking, but casein/whey protein ratio is decreased by about 10% (Davis *et al*., 1999).
- OAD milking increases somatic cell count (SCC), but not the incidence of mastitis.

Many of the minor changes in the composition of OAD milk compared with TAD milk can be explained by the increased permeability of tight junction complexes between mammary epithelial cells under OAD milking. This increased permeability allows components to leak from blood into milk and vice versa. Further information to support these conclusions can be found in reviews by Davis *et al*. (1999), Rémond & Pomiès (2005), Stockdale (2006) and a four-year whole lactation study (Clark *et al*., 2005).

Waimate West Demonstration Farm (WWDF) OAD Milking Trial

Aim
To compare whole lactation OAD milking with part-lactation OAD milking (i.e., TAD milking until mid-summer, followed by OAD milking for the remainder of the season; TAD/OAD) in two farmlet systems using Jersey cows.

Design
On 1 June 2004, two herds of 101 (OAD) or 44 (TAD/OAD) cows were established at the WWDF in Taranaki (Table 1). The stocking rate of the OAD milking herd was set 10% higher (4.4 vs. 4.0 cows/ha) than the TAD/OAD milking herd to allow for the expected lower intakes of the former. The LIC OAD selection index was used to identify and select cows from the herd for each age group that were best suited to OAD milking. These selected animals were milked OAD for the full season, i.e., a whole lactation. The remaining cows were milked TAD until the average TAD/OAD herd production dropped below 1.2 kg MS/ha and then cows were milked OAD to the end of the season. Heifers entering the WWDF herd were also selected using the OAD Index with the top two thirds entering the OAD herd and the remainder entering the TAD/OAD herd. Pasture cover was determined weekly during lactation, and fortnightly while the cows were dry. Daily grazing management for each farmlet was based on this information, and feed quality was determined on a quarterly basis. Milk production was measured on a herd basis daily, using twin vats, and all cows were herd tested, weighed and condition scored monthly.

Table 1. Herd size, stocking rate, planned start of calving date and genetic merit for the WWDF farmlets as at the start of the trial on 1 June 2004, where cows were milked once a day for a full- (OAD) or part- (TAD/OAD) season.

	OAD	TAD/OAD
Number of cows	101	44
Farmlet size (ha)	23.2	11.2
Stocking rate (cows/ha)	4.4	4.0
Planned start of calving	9 July	9 July
Breeding Worth	135	103
LIC OAD Index	1388	1004

Results and Discussion

On average for the two years, the TAD/OAD milking herd produced significantly more MS per cow (12%) and per ha (5%) than the OAD milking herd (Table 2). The OAD milking herd produced milk with a significantly higher fat (+ 0.34% units) and protein concentration (+ 0.26% units) than the TAD/OAD herd (Table 2). Days in milk averaged 267, with no difference between the two treatments.

Table 2. Effect of whole lactation once-a-day (OAD) milking and part-lactation OAD milking (TAD/OAD) on milk yield and composition for the first two years. All comparisons between OAD and TAD/OAD milking are significantly different at ($P<0.001$) for both years, except for days in milk.

Treatment	OAD	TAD/OAD	OAD	TAD/OAD
Year	2004/05	2004/05	2005/06	2005/06
Days in milk	270	270	262	266
Milk yield (kg/cow)	2360	2920	2649	3207
Fat yield (kg/cow)	156	177	163	189
Protein yield (kg/cow)	106	123	120	135
Milksolids (kg/cow)	262	300	272	321
Milksolids (kg/ha)	1142	1179	1182	1261
Fat content (%)	6.72	6.33	6.17	5.90
Protein content (%)	4.57	4.36	4.51	4.20

Table 3. Changes in milksolids yield (kg MS/cow/d) between the various stages of lactation, including around peak lactation, transition from TAD to OAD milking and in late lactation, for cows milked once a day for a full- (OAD) or part- (TAD/OAD) season. Data are presented from the 2005-06 season.

Stage of lactation	OAD	TAD/OAD
Peak – 25 Sep.	1.45	1.85
Post peak – 25 Oct.	1.4	1.6
Transition – 16 Jan.	1.1	1.3
Post transition – 9 Feb.	0.85	0.85
Late lactation – 1 Apr.	0.5	0.5
Late lactation – 30 Apr.	0.7	0.85

The TAD/OAD milking cows had a 28% higher peak MS than OAD milking cows (Table 3). However, one month later the difference was only 14%, indicating the capacity of OAD milking cows to maintain a more even MS yield throughout early lactation. The latter difference was maintained until the transition of TAD cows to OAD milking in mid-January, at this stage their MS yield dropped by 35% in three weeks compared with 23% for the cows that remained on OAD milking. Both herds were affected by poorer pasture quality at this time - but the OAD milking cows to a lesser extent. By 1 April both herds were producing 0.5 kg MS/cow/day and were almost ready to be dried off. Autumn rains led to improved pasture quality and both herds were able to increase MS yield by 40 and 70% for the OAD and TAD/OAD milking cows, respectively. These results support farmer experience that pasture or supplement quality is a key factor in maintaining milk yield in OAD milking cows

through the second half of lactation. When quality feed is available the higher body condition score (BCS) of OAD milking cows (Figure 1) can be used profitably by extending days in milk.

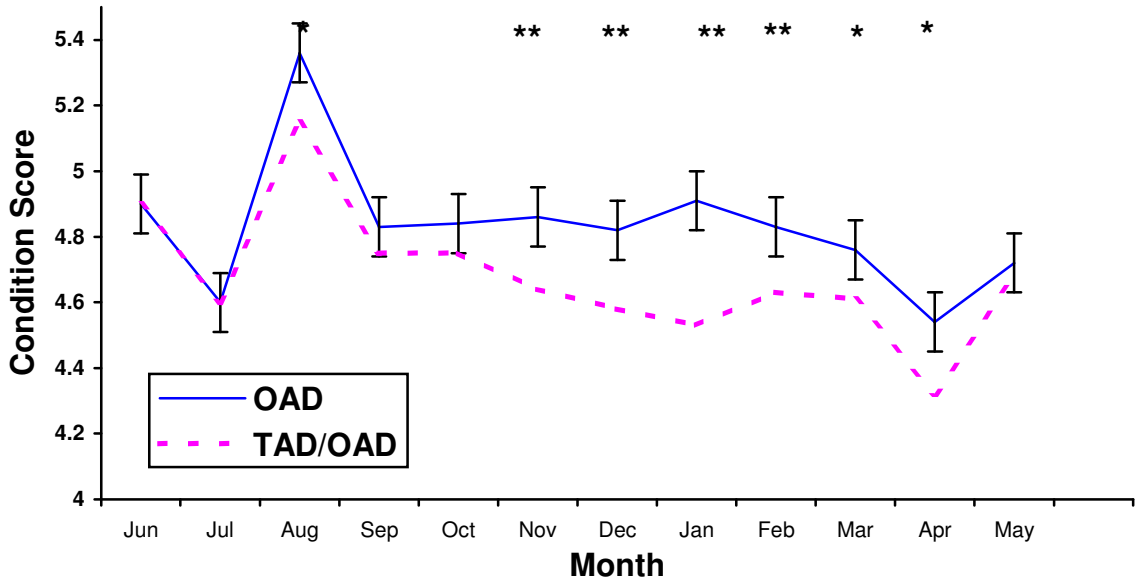

Figure 1. Effect of milking cows once a day for a full- (OAD) or a part- (TAD/OAD) season on average monthly body condition score (BCS). Data are presented for the 2005-06 season. Treatment differences in BCS are shown by *P<0.05, **P<0.01.

Despite the 10% higher stocking rate for the OAD milking herd, cows in this herd had higher BCS by one month post-calving than their TAD/OAD milking counterparts, and this difference continued to exist until a month before drying off (Figure 1). Drying-off decisions ensured that the two herds entered winter with approximately the same BCS.

This research trial has demonstrated that it is possible to produce close to 1200 kg MS per ha by using cows of high genetic merit milked OAD throughout the year, coupled with a moderate (10%) increase in stocking rate. The same yield can be reached by using average genetic merit cows in a TAD/OAD milking system. This trial supports previous research work and farmer experience, with profitable changes in milk composition and excellent BCS for OAD milking cows.

Case Study – A high-feed input OAD milking system

Brian and Bridget Frost farm 74 effective hectares of consolidated peat at Tauhei, north of Hamilton. They progressed from a TAD milking System 5 (25-35% of total feed imported and fed all year round) in 2003/04 to a full OAD milking system 5 by 2005/06 (Table 4). In 2003/04 stocking rate was 4.3 cows/ha, producing 416 kg MS/cow and 1772 kg MS/ha. In 2005/06 stocking rate was 4.9 cows/ha (32% heifers), producing 300 kg MS/cow and 1460 kg MS/ha. MS production per cow and per ha had reduced by 28 and 18%, respectively, with the switch to OAD milking. However, Brian and his consultant, Andrew Goold, were confident that with a lower proportion of heifers, a high BW = 138, a crossbred herd, and high quality feed inputs, the 2006/07 season would see a return to the MS produced per ha under TAD

milking. Table 4 shows a predicted production of 1700 kg MS/ha and 345 kg MS/cow for the 2006/07 season despite a very dry late summer. After allowing for brought-in feed the farm is producing greater than 1200 kg MS/ha/year from pasture grown on-farm.

Brian's farm management aims to make full use of all pasture before supplements are used, and to use winter grazing-off to support an early calving date of July 4th with a compact calving spread. The high stocking rate allows spring pasture to be fed direct to cows with no pasture silage conserved, little topping, and N fertiliser used at rates up to a maximum of 260 kg N/ha as feed budgets dictate. Turnips are used to provide a high quality summer supplement and to assist re-grassing with perennial ryegrass and tall fescue, the latter being grazed with a 20% shorter round length. This management has led to the MS production curve shown in Figure 2. The much better MS production in the second full year on OAD milking compared with the 2005/06 season can be attributed to higher peak production (1.6 vs. 1.3 kg MS/cow/day), with this advantage continuing through to early March.

The target for the 2008/09 season is 1800 kg MS/ha and 400 kg MS/cow at a stocking rate of 4.5 cows/ha. To meet this target there will be continued emphasis on increasing the TAD milking BW of the herd, an increased use of turnips in late summer and a continuing search for ways to turn BCS into milk towards the end of lactation. To achieve their target of 400 kg MS/cow at 4.5 cows/ha will require peak yields of 1.75 kg MS/cow/day, and producing 0.15 kg MS/cow more per day than currently, from peak to 1 March (when yields should still be 1.2 kg MS/cow per day) through to dry off in mid-May at 0.7 kg MS/cow per day. These are by no means 'soft' targets, but with the combination of high BW cows and sufficient high ME feed they are certainly not impossible. An added incentive to achieve high late lactation production is to avoid the high SCC that can sometimes lead to grading or early drying off of some cows.

Table 4. Actual and target milksolids (MS) production and farm data for 2003/04 – 2008/09 for Brian and Bridget Frost's farm.

	03/04	**04/05**	**05/06**	**06/07**	**07/08 Target**	**08/09 Target**
Max. no. of cows milked	315	319	360 (32% heifers)	364	355	333
Cows/ha	4.26	4.31	4.86	4.92	4.8	4.5
Total MS	131,137	116,151	108,073	126,000*	133,200	133,200
Kg MS/ha	1,772	1,570	1460	1700*	1800	1800
Kg MS/cow	416	364	300	345*	375	400
Once-a-day milking	None	August onwards for 200 young Xbred cows	100% of herd - All Season	100% - All Season	100% - All Season	100% - All Season.
Total brought-in feed (t DM)**	440	540	470	540	440	400
Empty rate (%)	7.6	3.5 for Xbreds, 9.5 Friesians	7	7	5	5
Induced rate (%)	6.5	0	0	0	0	0
CIDR use (%)***	18	3.5 for Xbreds, 7 for older Friesians	10	11.5	10	10

* Full year prediction based on production to 20 March 2007.
** Winter grazing, maize silage, palm kernel extract, and mixed vegetables.
*** Before the planned start of mating.

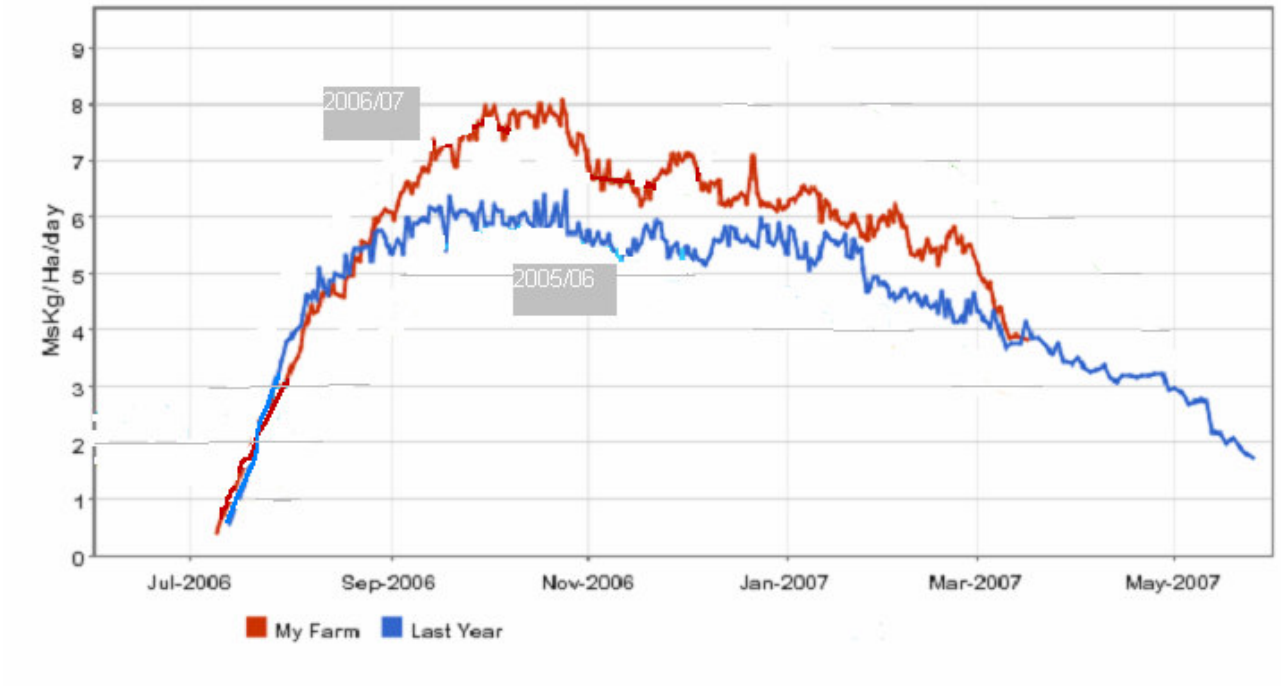

Figure 2. Milksolids production (kg MS/ha/day) on the Frost farm for the 2005/06 and 2006/07 seasons.

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