

## **BRIEF COMMUNICATION: Changes to cow behaviour when transitioning from twice a day to a 3-in-2 milking schedule**

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### **Abstract**

The objective of this study was to assess changes to cow behaviour when decreasing milking frequency from twice a day (TAD) to three milkings in two days (3-in-2). CowManager SensOor™ ear tags were attached to cows (n=29) for 15 days before, and 30 days after, transitioning to 3-in-2. To investigate general trends, paired t-tests were used to compare means between activity types (time spent active, highly active, not active, eating or ruminating) and milking frequency. After transitioning to 3-in-2 milking, the total time active was greater (+32.3 mins/cow/day; SEM 6.46), whilst the time spent eating (-16.2 mins/cow/day; SEM 7.57) and ruminating (-12.7 mins/cow/day; SEM 3.59) decreased. These differences were inconsistent between daylight and dark hours. These results indicate that the extra time spent in the paddock by the cows due to a 3-in-2 milking schedule was spent active, potentially due to social interaction and feed-searching behaviours, with a decrease in rumination and eating behaviours.

**Key words:** Milking frequency; behaviour; activity; transition.

### **Introduction**

An increasing number of dairy farmers are using a 3-in-2 milking schedule, where cows are milked three times in two days (DairyNZ 2018). A 3-in-2 milking schedule results in 25% fewer milkings than traditional twice-a-day (TAD) milking, changing the structure of the day for people and cows on farm. For cows, reducing milking frequency results in less time walking, standing in the yard and milking parlour, and allows more time in the paddock every second day. As cows prioritise certain behaviours, such as lying time over social interaction and grazing (Munksgaard et al. 2005), it is unknown whether 3-in-2 milking frequency affects the proportion of time per day spent on certain types of behaviour compared with TAD. This study aimed to investigate the differences in cow behaviour when the milking schedule was changed from TAD to 3-in-2.

### **Materials and methods**

Data were collected from 29 cows between 15/11/2019 and 30/12/2019 at the Lincoln University Research Dairy Farm, Canterbury, New Zealand (approved by the Lincoln University Animal Ethics Committee). The study was part of a wider research programme investigating the effect of milking interval on farming systems. The herd was established from calving and was milked TAD at 6 am and 4 pm until 30/11/2019 through a 12-aside double-up herringbone parlour (DeLaval, Tumba, Sweden). On 1/12/2019 the milking schedule was changed to 3-in-2, with milking times of 5 am, 5 pm (day 1) and 11 am (day 2). Cows were on average 85 days in milk and producing an average of 21.2 kg milk/cow/day over the TAD experimental period and 18.1 kg milk/cow/day over the 3-in-2 period. Cows were exhibiting signs of oestrus over this time and were being artificially inseminated.

The herd consisted of nine heifers and 20 mixed-aged cows. The farm's available mixed-aged cows were

randomly selected and then blocked for milk production in the previous milking season, and the whole herd for genetic merit, calving date and breed and randomly selected for the experimental herd. Cows were stocked at 3.5 cows/ha on paddocks containing predominantly perennial ryegrass and white clover. Cows were given a fresh pasture allocation after each milking proportional to the milking interval, therefore timing of a fresh allocation changed with milking frequency but daily allocation did not change. Pasture allowance was 0.38 ha/day with pre-grazing cover target averaging 3000 kgDM/ha before and after the change in milking frequency. When pasture cover was insufficient to meet the target allocation, cows were supplemented with pasture silage in the paddock.

Each cow was fitted with a CowManager SensOor™ ear tag (Cowmanager BV, Harmelen, Netherlands) which partitioned the day into high-active, active and not-active, eating and ruminating time, in minutes per hour (Periera et al. 2018). Active behaviour is defined as when the cow is stood upright and walks or moves her body. High active is associated with oestrus behaviour. Lying behaviour is included in both the rumination and not-active categories.

Data were summarised for individual cows as daily averages of the time spent in each recorded behaviour (in minutes per day) for the TAD (15 days) and 3-in-2 (30 days, which allowed for any adjustment to behaviour) period.

To investigate general trends, paired t-tests (Genstat, 21<sup>st</sup> Edition, VSN International, Hemel Hempstead, UK) were used to compare means between types of behaviour and milking frequencies. For each cow, behaviour data were also separated into daylight and dark hours, to analyse any effect of milking time changes. Daylight was defined as the hours between 6 am and 9 pm. Paired t-tests were also used to compare average time (minutes per hour) spent on each recorded behaviour during daylight and dark hours for the two milking frequencies.

## Results and discussion

On average, the cows spent about a third of their day eating, and a third ruminating (Table 1), which is similar to previous results for grazing cows wearing CowManager Sensors (Mangwe et al. 2020). Small but consistent changes in behaviour ( $P < 0.05$ ) occurred when cows changed from a TAD to a 3-in-2 milking frequency, with 25% fewer milkings. Cows milked 3-in-2 spent more time active (+32.3 mins/cow/day; SEM 6.46) and less time eating (-16.2 mins/cow/day; SEM 7.57) and ruminating (-12.7 mins/cow/day; SEM 3.59) compared with when they were milked TAD. The time spent not active did not change significantly after transition to 3-in-2.

Potential reasons for a cow to be active include social interactions, feeding, and walking to the dairy. With fewer milkings per day during a 3-in-2 milking schedule, the amount of time spent walking to the dairy decreases, so it was expected that the overall time active would also decrease, however, this was not supported by the results. One possible explanation for more time active is the change in pasture allocation when switching from TAD to 3-in-2. Cows were given a fresh allocation of pasture after each milking, so for cows milked on 3-in-2 the number of fresh pasture allocations per day decreased and the size of the allocation offered increased. This may account for increased activity as cows increase their feed searching behaviour when given feed once a day compared to twice (DeVries et al. 2005). Further, cows prioritise lying and eating behaviours over social interaction (Munksgaard et al. 2005), therefore, the extra time in the paddock, as a result of fewer milkings, may allow for more social interaction which is reflected by the longer time spent active. Another plausible explanation for greater activity is the adjustment to the change in the daily routine and resulting disturbance when other cows on the farm (still on a TAD schedule) were being moved for milking. Udder distention, as a result of the increased milking interval of 3-in-2 should not significantly alter behaviour (Stelwagen et al. 2013). The greater time spent active suggests that the cows in this study, when milked TAD, were not fatigued at this stage of lactation as a result of milking, although the average distance walked per day was relatively small, at 2.8 km during TAD and 1.9 km during the 3-in-2 schedule.

On average, the cows were spending approximately 120 minutes per day (8% of total time) in behaviour categorised

as high active, regardless of milking frequency (Table 1). These data indicate a potential for misclassification between high active and active behaviours, as high active is thought to relate mainly to oestrous behaviour (Pereira et al. 2018). The measurement period coincided with the mating period so the cows were displaying oestrous behaviour over this time, but with 8% of total time in this category, it appears high. The high-active category has not been validated, so it is possible that non-oestrous behaviours are being attributed to this category. Despite this, differences between TAD and 3-in-2 for this category were not significant and, therefore, should not affect conclusions drawn about the other behaviours.

The time spent eating (-16.2 mins/cow/day; 3.5%) and ruminating (-12.7 mins/cow/day; 2.6%) decreased when cows were transitioned to the 3-in-2 milking schedule. These results differ to those of O'Driscoll et al. (2010) who compared the behaviour of cows on either once-a-day (OAD) or TAD milking over a whole lactation and recorded longer grazing times in the OAD group. Those authors noted that cows established their grazing cycles and adjusted grazing time and intake rate according to disruptions such as being milked. The reduction in grazing time in the current study may be indicative of carry-over of established grazing patterns from TAD milking and a small adjustment of grazing time to meet a declining energy demand. Alternatively, a decrease in production and time spent eating and ruminating may also be attributed to a change in pasture quality at this time of year, particularly increasing neutral detergent fibre percentage (Beauchemin 2018). More analysis is needed to investigate this further.

When cows were milked 3-in-2, eating time was less (-1.99 mins/hour/cow) during daylight hours and greater during dark hours (+1.57 mins/hour/cow) when compared with when they were on the TAD milking schedule (Table 2). Ruminating time was not different during daylight but was less during dark hours (-1.64 mins/hour/cow) for cows milked 3-in-2 (Table 2). The diurnal changes and total time spent grazing is supported by other studies, indicating behaviour was still in a normal range (Sheahan et al. 2011). Eating bouts most frequently occur after a milking event and when fresh feed is offered (Beauchemin 2018). When cows were milked TAD a new pasture allocation was provided every afternoon instead of every other afternoon during the 3-in-2 schedule. This could justify a change in

**Table 1** Average time (minutes per day) spent on each behaviour (active, not active, eating, ruminating, and high active) for cows at pasture (n=29) milked under two different milking frequencies (twice a day (TAD) and 3 milkings in 2 days (3-in-2)).

Behaviour (total mins/day)	Milking Frequency		Difference between means	SEM	P value
	TAD	3-in-2			
Active	155	187	+ 32.3	6.46	<0.001
High Active	123	121	-1.49	2.82	0.602
Not Active	224	222	-2.15	4.72	0.652
Eating	456	439	-16.2	7.57	0.042
Ruminating	488	475	-12.7	3.59	0.001

**Table 2** Average time (minutes per hour) spent on each behaviour (active, not active, eating, ruminating, and high active) for cows at pasture (n=29) milked under two different milking frequencies (twice a day (TAD) and 3 milkings in 2 days (3-in-2)) in daylight and dark hours.

Behaviour (mins/hour)	Daylight					Dark				
	TAD	3-in-2	Diff	SEM	P value	TAD	3-in-2	Diff	SEM	P value
Active	8.49	10.3	+1.83	0.392	<0.001	3.04	3.68	+0.64	0.102	<0.001
Not active	4.99	5.33	+0.34	0.181	0.073	16.5	15.9	-0.64	0.296	0.039
High Active	6.22	6.06	-0.16	0.139	0.247	3.33	3.41	-0.07	0.144	0.620
Eating	27.6	25.6	-1.99	0.458	<0.001	4.60	6.17	+1.57	0.212	<0.001
Ruminating	12.9	12.9	0.00	0.133	0.998	32.7	31.1	-1.64	0.333	<0.001

timing for eating behaviour and perhaps a preference for lying and ruminating whilst environmental temperatures are higher during the day and eating during the cooler temperatures of dark hours.

The time spent active increased during both daylight (+1.83 mins/hour/cow) and dark hours (+0.64 mins/hour/cow) when cows were milked 3-in-2 compared with TAD (Table 2). The mean minimum and maximum temperature over the TAD and 3-in-2 experimental period were not significantly different (The National Climate Database 2019), suggesting that environmental temperature was not a factor that influenced active behaviour change in this experiment. The increase in active behaviour was greater during daylight hours compared to dark hours, indicating the timing of the 3-in-2 milkings influenced this, as the increased paddock time provided by 3-in-2 was during daylight hours.

Overall, the extra time in the paddock provided by the 3-in-2 milking schedule was spent active by cows in this study, suggesting the cows studied were not fatigued at this stage of lactation. Possible explanations for the increase in active time include social interactions and feed-searching behaviours in cows that are milked less frequently and therefore, spend more time in the paddock. Time spent eating and ruminating decreased, potentially due to decreased pasture intake and quality, or a decreased energy demand for milk production. Differences in time spent within each behaviour classification were not consistent between daylight and dark hours. This study was an initial exploration of the differences in behaviour when cows are milked TAD or 3-in-2. A more detailed analysis and broader dataset is required to explore these further.

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