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Effect of pre- versus postmilking supplementation on traffic and performance of cows milked in a pasture-based automatic milking system

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ABSTRACT

Cows milked in a pasture-based automatic milking system tend to have a lower daily milking frequency in comparison with cows milked in indoor systems. Milking events with intervals beyond 16 h have been reported to have a negative effect on milk yield and udder health, and therefore it is important to minimize their occurrence. As feed is the main incentive to encourage cow traffic around the system, a study was conducted to compare pre- (PRE) versus postmilking (POST) supplementary feed placement strategies in a pasture-based automatic milking system. We hypothesized that PRE cows would have a stronger incentive to walk voluntarily from the paddock to the dairy facility to get milked (due to the reward being more immediate), thereby reducing their milking interval and increasing daily milking frequency and milk yield. The PRE cows returned to the dairy facility sooner (PRE = 11.9 vs. POST = 13.27 h) but had longer milking intervals (PRE = 15.3 vs. POST = 14.28 h). This was due to the additional time spent in the prefeeding area (PRE = 56 versus POST = 23 min) combined with a longer average time spent in the premilking waiting yard (PRE = 97 versus POST = 77 min). Treatment did not affect daily milk yield per cow. The result of this study demonstrates the potential of manipulating feeding management strategies to influence cow behavior and traffic in voluntary milking systems.
Key words: automatic milking system, milking interval, supplementation

INTRODUCTION

Over 10,000 farms globally have incorporated the use of an automatic milking system (**AMS**) since their introduction in the early 1990s (de Koning, 2011). In 2001 they were incorporated for the first time in a pasture-based system, with installations occurring almost simultaneously in a commercial farm in Victoria, Australia (Greenall et al., 2004) and within the Greenfield Project in New Zealand (Jago et al., 2002). In 2006, the FutureDairy Project commissioned its AMS research dairy in Australia (Garcia et al., 2007).

Automatic milking systems rely on voluntary and distributed traffic of cows. Contrary to what happens in conventional milking systems, cows in AMS are not subject to discrete milking sessions given that milkings occur throughout the day and night. Failure to achieve these conditions could have an effect on technology uptake as well as profitability and success of farmers adopting this technology.

Milk harvested per cow at any given milking is directly related to the time interval from the previous milking [milking interval (**MI**) = interval between consecutive milking events measured in hours from the previous milking]. This relationship is linear up to 16 h, but flattens thereafter (Schmidt, 1960; Delamaire and Guinard-Flament, 2006). Intervals greater than 16 h can adversely affect milk yield (in kilograms of milk accumulated and subsequently harvested per hour of MI) and udder health (Hammer et al., 2012). Thus, management decisions should aim to minimize the incidence of MI extending beyond 16 h. This does not necessarily mean increasing overall milking frequency (**MF**; the number of milking events per cow in any 24-h period), as this should be optimized to meet the farm targets with regard to robot harvesting level and overall farm productivity. Yet, it is recognized that AMS do allow for greater MF and detailed real-time data related to production and the health of individual cows.

Milking frequency has become a common key performance indicator in AMS. Given the voluntary nature of the system, in any AMS a range of MI, and therefore MF, can be observed within and among cows, which is not the case in conventional milking systems. Furthermore, cows milked in a pasture-based AMS tend to have a lower average MF in comparison with cows milked in indoor AMS (Davis et al., 2005; Jago and Burke, 2010). In pasture-based systems, around 30% of all milking events can have intervals above 16 h (N. A. Lyons, unpublished data), which is much higher than the 4.2% reported in indoor systems (Hogeveen et al., 2001). By allowing for higher potential MF, AMS could

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likely drive an increase in milk production (Garcia and Fulkerson, 2005; Stockdale, 2006) without extra labor, which is a common limitation and key contributor to the cost of production in most dairy farms (Hogeveen et al., 2004). Consequently, optimizing the frequency of voluntary milking events is a key element of AMS. Careful planning of farm layout and management of incentives is required to encourage frequent cow traffic around the system, thus creating opportunities for cows to be drafted for milking at timely intervals and frequencies. Feed is the main incentive used to encourage consistent cow traffic around the farm system (Prescott et al., 1998a,b). Modifying the timing, placement, and frequency of feed allocations (pasture or supplements or both) can enhance cow traffic. Previous studies have compared different cow traffic management options (Ketelaar-de Lauwere et al., 1998; Hermans et al., 2003, Melin et al., 2005; Bach et al., 2009) and different concentrate allowances (Halachmi et al., 2005; Bach et al., 2007) on cows' attendance to the milking station and milk production. Furthermore, from a simulation study in a cowshed, dominance level was found to influence when cows gained access to the milking unit (Halachmi, 2009). In a previous study comparing the effect of the number of feed allocations in a pasture-based AMS on animal performance, it was noted that by offering 3 pasture allocations per day (rather than 2) MF could be increased by 40% (Lyons et al., 2013). To date, no published studies have reported the effect of location of supplementary feed on MI in grazing systems, nor the time spent in different areas of the farm system (pasture, feeding area, or premilking waiting area). Previous exploration of cow traffic data from cows milked in a pasture-based AMS within the FutureDairy Project has indicated that the main factor explaining extended MI is the time it takes for cows to return to the dairy facility, where up to 94% of milking events with intervals above 16 h had return times over 14 h (N. A. Lyons, unpublished data). However, during that period, whenever supplementary feed was offered it was available after milking on the way out to the paddock. Offering supplements premilking may entice cows to come back to the dairy facility sooner, reducing total return time and therefore MI.

The aim of this study was to compare 2 different supplementary feed placement strategies, made available to cows at the dairy facility either before (**PRE**), or immediately after (**POST**) milking, on the cow traffic and milk production of cows in a pasture-based AMS. It was hypothesized that allocating supplementary feed before being milked would encourage cows to traffic voluntarily from the paddock back to the dairy facility at shorter intervals (due to the immediacy of the reward), than cows that were offered supplementary feed after milking. In turn, this would result in a lower average MI and a reduced incidence of MI exceeding 16 h.

MATERIALS AND METHODS

Animals and Treatments

A field study was conducted between September 12 and October 10, 2011, at the FutureDairy AMS research dairy (Elizabeth Macarthur Agricultural Institute, Camden, Australia). The herd comprised 175 cows (30% primiparous and 70% multiparous cows), the majority Holstein-Friesian and approximately 10 to 15% Illawara (611 ± 88 kg average liveweight ± SD). Cows were randomized into 2 groups, balanced for stage of lactation (DIM), that were managed in 1 herd throughout the study. Treatments were then allocated to each group in a cross-over design trial with 2 periods of 13 d each. Each period comprised a 7-d adaptation period followed by 6 d of data collection. Group description and treatment allocations are shown in Table 1.

Cows were drafted to either PRE or POST using automatic drafting gates. All cows were fitted with a unique electronic transponder, by which they were electronically identified at each automatic drafting gate as they trafficked around the farm system, being sorted accordingly. The transponder allowed the electronic log

Table 1. Group description and trial description (all values represent mean ± SD)[1]

Item	Group 1	Group 2
Number of cows	88	87
Treatment period 1	PRE	POST
Treatment period 2	POST	PRE
DIM[2]	173 ± 108	176 ± 117
Age[2] (mo)	60 ± 27	65 ± 35
7-d average milk yield[2] (kg/cow per day)	20.89 ± 6.98	20.48 ± 6.64
7-d average milking frequency (milking events/cow per day)	1.60 ± 0.40	1.59 ± 0.34

[1]Supplementary feed made available before (PRE) or after (POST) milking.

[2]All at trial start date.