Livestock Science 171 (2015) 52–63

Contents lists available at ScienceDirect

Livestock Science

journal homepage: www.elsevier.com/locate/livsci

Voluntary cow traffic and behaviour in the premilking yard of a pasture-based automatic milking system with a feed supplementation regime

V.E. Scott [a,*], K.L. Kerrisk [a], P.C. Thomson [b], N.A. Lyons [c], S.C. Garcia [a]

[a] Dairy Science Group, Faculty of Veterinary Science, The University of Sydney, Camden, NSW 2570, Australia
[b] ReproGen – Animal Bioscience Group, Faculty of Veterinary Science, The University of Sydney, Camden, NSW 2570, Australia
[c] Dairy and Intensive Livestock Industries, NSW Department of Primary Industries, Elizabeth Macarthur Agricultural Institute, Menangle, NSW 2568, Australia

ARTICLE INFO

Article history:
Received 18 July 2014
Received in revised form
31 October 2014
Accepted 3 November 2014

Keywords:
Automatic Milking
Behaviour
Cow Traffic
Supplementary Feeding

ABSTRACT

Operating a voluntary, pasture-based automatic milking system presents challenges not encountered in indoor-housed systems, including long walking distances, exposure to climatic changes and large herd sizes. Feed incentives can be used to encourage voluntary cow traffic in both pasture and indoor systems, and may be particularly useful at the dairy where the risk of congestion is high if cows do not progress through the system promptly. The present study investigated the effect of a supplementary feeding regime on voluntary cow traffic and cow behaviour in the premilking yard of a pasture-based automatic milking system. Cows were strategically granted access to supplementary feed given at the dairy either before (*PRE*) or after (*POST*) milking. The mean voluntary waiting time, being the length of time it took for a cow to present for milking when given uninhibited access to the robotic unit, was 21% shorter for cows in the *POST* treatment than for those in the *PRE* treatment (60.2 ± 4.6 and 76.1 ± 6.0 min respectively). Additionally, a greater proportion of hourly voluntary milkings throughout the day and early night were associated with cows in the *POST* treatment. On average, high yielding cows and cows in their first or fourth lactation spent less time in the premilking yard. Voluntary waiting time increased as queue length increased, with cows waiting (on average) less than 53 min when there were fewer than 20 cows (equivalently, 14 cows/100 m^2) in the premilking yard and more than 90 min when queue length exceeded 40 cows (equivalently, 28 cows/100 m^2). Cows in the *POST* treatment were more likely to be observed facing towards the robot and located closer to the robot entrance, and were less likely to be observed lying down in the premilking yard. Results indicated that offering supplementary feed directly following milking favourably altered cow behaviour and successfully reduced the voluntary waiting time of cows in the premilking yard, with the potential to reduce congestion in the dairy facility, as well as improve cow health and system performance.

1. Introduction

Initial studies and surveys conducted in indoor automatic milking systems (**AMS**) where cows had access to pasture demonstrated that grazing cows at pasture was

* Correspondence to: The University of Sydney, Faculty of Veterinary Science, MC Franklin Laboratory (CO4), Private Mailbag 4003, Narellan, NSW 2567, Australia. Tel.: +61 2 9351 1631.
E-mail address: tori.scott@sydney.edu.au (V.E. Scott).

http://dx.doi.org/10.1016/j.livsci.2014.11.002
1871-1413/

feasible with AMS (Ketelaar-de Lauwere et al., 1999b; Ketelaar-de Lauwere and Ipema, 2000; van Dooren et al., 2002; Munksgaard and Krohn, 2004). Since then it has repeatedly been shown that AMS can operate successfully in pasture-based operations (Jago et al., 2002; Jago et al., 2004; Davis et al., 2005, 2008; Lyons et al., 2013b). Although pasture-based AMS comprises only a small portion of the global 10,000 plus AMS farms (de Koning, 2011), it is anticipated that the presence of AMS in pasture-based regions will continue to increase, particularly as industry interest for new technology grows. Furthermore, incorporating grazing into farming practices in regions dominated by indoor-housing systems, such as in Europe, is also prevalent, fuelled by public concern for cow welfare, a desire to see cows outdoors, and pasture offering a cheap feed alternative during the summer (Mathijs, 2000; van Dooren et al., 2002). As such, there is a need for research, development and extension programs centred on improving knowledge around the incorporation of AMS into pasture-based practices.

Typically, pasture-based AMS farms operate using voluntary cow traffic, where cows can set their own daily routine, traffic (move) throughout the farm system with minimal human assistance and achieve milkings distributed across the 24 h day. Central to this voluntary movement is the requirement to encourage cows through the use of incentives. It has been described that feed is a stronger incentive, or more rewarding, than milking (Prescott et al., 1998b), and studies have investigated, with varying responses, the effects of the placement, quantity and timing of supplementary feed (Prescott et al., 1998a; Lyons et al., 2013c), pasture (Lyons et al., 2013b), and feed given at milking (Halachmi et al., 2005; Bach et al., 2007; Jago et al., 2007; Kolbach et al., 2013; Scott et al., 2014) on cow traffic within indoor and pasture-based AMS. Whilst not all studies reported an increase in cow traffic, feed is considered to be a primary incentive for encouraging voluntary cow traffic. However it is still essential that an ideal system maximizes robot utilization without limiting cow access to critical resources, such as food, water and comfortable resting/loafing areas.

In addition to encouraging voluntary cow traffic, new challenges arise in pasture-based systems. Walking distance from the paddock to the dairy, for example, can affect voluntary cow traffic (Sporndly and Wredle, 2004; Lyons et al., 2013a), and the effect is likely to be more pronounced in large herds such as those typical in Australia and New Zealand, with average herds beyond 250 and 400 cows respectively (Dairy Australia, 2013; DairyNZ and LIC, 2013). As herd size grows, the risk of congestion in areas of limiting space, such as the dairy, may increase and could result in slow and inefficient cow traffic as well as inefficiencies in system and cow performance. This may be particularly true when operating with the high-throughput robotic rotary (**RR**; DeLaval – Automatic Milking Rotary, DeLaval, Tumba, Sweden) where, unlike the traditional single-box units with multiple boxes and therefore entry points for herds exceeding approx. 150 milkings/day, the RR has a single-entry point in which all cows must pass through in order to access the milking equipment and exit the dairy. The high capacity of the RR, estimated capable of performing up to 1600 milkings/day (Kolbach et al., 2012), coupled with the single entry point, could also subject cows to altered social dynamics and pressures than when milked with single boxes, further increasing the risk of congestion, long queue lengths and long premilking voluntary waiting times. A current gap in the knowledge of voluntary cow traffic in the premilking yard of RR systems makes it difficult to predict the full impact of managing large numbers of cows as a single herd, and research into this area is encouraged in order to determine best-practice management procedures.

It is important that the behaviour of cows is considered when determining best-practice procedures for voluntary cow traffic, where cows in pasture-based systems generally have no other option but to present for milking in order to leave the premilking yard. Currently, however, very little information regarding cow behaviour in the premilking yard of pasture-based systems is available. Cow behaviour and social hierarchy can affect cow traffic and the ability of cows to volunteer for milking. In indoor systems, cows of high dominance have been shown to spend less time in the waiting area prior to milking (Ketelaar-de Lauwere et al., 1996; Melin et al., 2006; Lexer et al., 2009), although Lexer et al. (2009) found this to occur only when cows were under partially-forced cow traffic, with no effect of dominance observed when managed under free cow traffic. Furthermore, cow behaviour studies can be used to construct cow time budgets and indicate cow health, productivity and welfare (Gibb et al., 1998; Lexer et al., 2009; Kilgour, 2012), and are therefore useful in assessing suitability and cow adaptability to new management procedures.

A field experiment was conducted to study the effects of offering supplementary feed, commonly fed when pasture growth and availability cannot meet the requirements of the milking herd, either before (*PRE*) or after (*POST*) milking, on the overall efficiency of a pasture-based AMS, where cows were milked on a RR system. The effects of supplementary feed on general cow traffic and performance have been reported previously (Lyons et al., 2013c), as have the effects on cow behaviour whilst on pasture (Lyons et al., 2014). The present study reports more specifically on voluntary waiting time and cow behaviour within the premilking yard. It was hypothesized that offering feed after milking would encourage cows to volunteer for milking more readily than if feed was offered before milking, and that cows would exhibit behaviours, such as being in closer proximity to the RR entrance, indicative of a higher level of motivation to exit the premilking yard.

2. Materials and methods

Research was conducted over a five week period in September and October 2011 at the FutureDairy AMS research farm in Camden, New South Wales, Australia (Elizabeth Macarthur Agricultural Institute, New South Wales Department of Primary Industries; NSW DPI). Ethics approval was granted by NSW DPI AEC (project number M10/12) prior to the commencement of this study.