Applied Animal Behaviour Science xxx (xxxx) xxx–xxx

Contents lists available at ScienceDirect

Applied Animal Behaviour Science

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

The impact of fetching at night on milking parlour visitation for pasture-based dairy cattle

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ARTICLE INFO

Keywords:
Automatic milking system
Behaviour
Cow traffic
Technology
Wellbeing

ABSTRACT

In most pasture-based automatic milking systems (AMS), three-way grazing (3WG) is utilised and cows that remain in a given paddock are fetched or encouraged to the milking facility (each paddock is cleared once per day). Fetching is ideally undertaken within 15 h of the opening of each pasture allocation, where one of these fetches would occur late at night to minimise the risk of cows having extended milking intervals (MI) which negatively impact on udder health. Farmers are understandably reluctant to fetch late at night or in the early hours of the morning (when they would typically be asleep), and the response of cows to being fetched at this time is unknown. Night fetching was undertaken on a farm managing up to 226 Holstein Friesian cows under a 3WG system. The objectives were to determine the impact of fetch timing on milking parlour visitation, cow behaviour and cow production on a pasture-based AMS to identify if automation of fetching at night would be viable for the future. Cows were fetched at two times of the night from a specific allocation ensuring that they couldn't spend more than 15 h or less than 5 h in that allocation. The herd performance was monitored over four-weeks consisting of a one-week preparation period followed by a three-week treatment period where cows in the target allocation were fetched at either 23:00 or 01:00 in a randomised block design. During the treatment period cows were fetched at the designated time of night from pasture onto the laneway, after which, cows were free to stay there (for up to 3 h) or to continue walking towards the milking facility without further encouragement. Fetching at 23:00 was associated with a lower ($P < 0.001$) milking interval and slightly more ($P = 0.009$) time spent in the pre-milking waiting area than cows fetched at 01:00. During the study the cows responded positively to being fetched at night by voluntarily trafficking along the laneway to the dairy, revealing potential for automation of this process in the future.

1. Introduction

Automatic milking systems (AMS) that are predominately pasture-based use a variety of techniques to achieve voluntary cow traffic. As feed is the most reliable incentive to generate voluntary cow traffic, AMS farmers will often incorporate a three-way grazing (3WG) management technique (Kerrisk, 2009). This involves three measured pasture allocations being made available to the cows at different times of the day with the knowledge that, as each pasture allocation becomes depleted, the majority of the cows will voluntarily exit the paddock and traffic to the dairy (Lyons et al., 2013b). In the most part, 3WG is able to encourage sufficient voluntary movement of the cows around the AMS. However, it is common for a minority of cows to remain on depleted pasture for an extended period of time, requiring intervention by the farmer (de Koning, 2010), where reductions in voluntary cow traffic may be due to individual cow (Bach et al., 2007), management (Lyons et al., 2013a) or weather factors (West, 2003). When voluntary traffic is well distributed across the day and night, farmers can attain a greater numbers of milkings which can equate to greater milk yields (MY) over time (Stockdale, 2006; Lyons and Kerrisk, 2017) and reduced labour inputs for overall improved profitability (Davis et al., 2005).

Fetching the remaining cows from depleted pasture is an important task to ensure that the cows maintain an acceptable milking frequency (MF, milkings/cow/day), and for the paddock to be cleared and prepared for the next scheduled grazing in that area. The timing of fetching from each of the three allocations impacts on farmer routine and the maximum milking interval (MI; time between two consecutive milkings) of cows within the AMS herd. Research has identified that cows

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https://doi.org/10.1016/j.applanim.2017.12.014
Received 13 April 2017; Received in revised form 27 September 2017; Accepted 5 December 2017

which exceed a MI of 16 h are at a greater risk of developing mastitis (Hammer et al., 2012) and of negative impacts on MY (Hogeveen et al., 2001; Lyons et al., 2013a) and mammary nutrient uptake (Delamaire and Guinard-Flament, 2006). In an AMS, when fetched out of each pasture allocation 14 h after it became available, the occurrence of extended MI has been reported at 27% of milking events compared to 64% when fetched 22 h after the allocation became available (Lyons et al., 2013b). Because of this, fetching from pasture would ideally be undertaken less than 16 h of each allocation being made available to cows, thereby minimising the occurrence of extended MIs. However, due to the nature of 3WG and pasture access times (8 h each), one of the ideal fetching times would generally occur late at night (after approx. 22:00) or in the early hours of the morning (before approx. 04:00). The voluntary visitation of cows to the dairy during these times is often lower than it would be during the day (Ketelaar-de Lauwere et al., 1999; Jago et al., 2004) indicating that system efficiency gains exist around these times. As many farmers choose to install an AMS (at least in part) for the lifestyle benefits (de Koning, 2010), farmers are generally, and understandably reluctant to fetch at night. Instead, they are more likely to conduct this fetch the following day (increasing MI) to suit their preferred working hours. Therefore, the potential exists for productivity gains to be captured if cows remaining in this allocation were fetched at times that minimise the risk of having MIs that exceed 16 h.

As technology is constantly evolving, the future of dairy farming is likely to progress towards further automation of repetitive and time-consuming tasks such as fetching. This is driven by the need for improved efficiencies, difficulties with attracting and retaining labour and increasing scales of operation forcing a heavier reliance on employed labour as opposed to family labour. Emerging technologies such as unmanned ground vehicles (UGV) (Underwood et al., 2013), virtual fencing (Anderson, 2013) and automatic fence walkers (Lely, 2008) show promise for future use as fetching aids. Technologies such as these could generate savings on labour required for fetching and not require the farmers to fetch at undesirable times whilst also having the added advantage or allowing cows to be fetched in a more controlled and consistent manner. Forceful movement of cows can increase their risk of pivoting and stumbling from poor foot placement which may lead to an increased occurrence of lameness (Barker et al., 2010). Automation of this process would allow for controlled fetching of cows, thereby potentially reducing the risk of lameness.

Given the diurnal behaviour of cows, it is predicted that the most challenging time to fetch cows would be during the late night or very early morning hours. Whilst this is expected to be the period of time when cows are least motivated to walk, it is also the time when the most value would be generated for the farm system and the farmer if automation of fetching were successful. Before such a concept could be implemented, there is the need to know if the cows will traffic to the milking facility at night and not simply lie down in the laneway waiting to be manually fetched.

The objectives of this study were to simulate automated fetching at night, and investigate if fetching at 23:00 and/or 01:00 influenced the performance and voluntary movement of cows from pasture to the automatic milking facility. It was hypothesised that fetching cows out of the paddock at night would stimulate them to walk to the milking facility and get milked at night (at typical low visitation times), consequently increasing MF and decreasing MI. Furthermore, as 03:00 has been associated with a peak in lying (Endres and Barberg 2007) which is closer to 01:00, we hypothesised that cows fetched at 01:00 would not respond as well to being fetched at night, taking longer to voluntarily travel to the milking facility than if they were fetched at 23:00.

2. Methodology

2.1. Farm and animal management

The study was conducted over a 28-day period during October 2014, with a commercial herd of 226 lactating Holstein Friesian cows in Victoria, Australia. The cows in the herd ranged between 2 and 11 years of age (average 4.8 years) and 9 and 532 days in milk (DIM; average 76 DIM). A large proportion of cows (43%) were in early lactation (< 60 DIM) throughout the experiment as the herd calved predominately from August to October. The cows were milked by four Lely A4 automatic milking units on a milking area of approximately 91 ha implementing 3WG. The three pasture allocations became available each day at 02:00 (A), 10:00 (B) and 18:00 (C), with each closing for access when the subsequent allocation became available. Normal farm practice was to fetch any remaining cows in the A, B and C allocations at approximately 17:00, 07:00 and 09:00 respectively. This meant that the maximum occupancy time of cows in areas A and C was approximately 15 h and area B was 22 h. For this reason the B pasture allocation was targeted for night-fetching at 23:00 and 01:00. These fetching times were chosen so that the maximum time at pasture could not exceed 15 h (01:00 fetch), and the minimum time for voluntary exiting (after area C became available) could not be less than 5 h (23:00 fetch) to reduce the number of cows being fetched without milking permission.

2.2. Design

A seven-day preparation period where all farm practices, including fetching times, remained normal was incorporated in the study and termed the pre-period. The pre-period was used as a benchmark of typical behaviour on this farm. During this time the cows were habituated to the presence of a single observer walking quietly around them with a torch in all areas of the farm system at night, taking care not to cause the cows to leave the paddock. Following this, a complete randomised block design, generated in Genstat® 16th Edition (VSN International, Hemel Hempstead, UK), was used to randomly allocate the two different fetching times, 23:00 and 01:00, across three, six-day blocks with a one-day break between each block. This design was selected to prevent the cows from predicting and learning fetching time, and also to reduce the chance of substantial weather variation between the treatments.

2.3. Observations

During the pre and experimental periods, on-farm computer software was used to capture information on the performance of each cow twice daily. The information included cow visitation to the dairy, milking time (MT, total milking stall occupancy time including teat preparation, milking and teat sanitation per visit), MF, MI, milk yield per-milking (MYM, kg/cow/milking) and MY (kg/cow/day). Time spent in different yards at the milking facility was also calculated from time-stamped electronic gate passing records for each cow from two electronic drafting gates at the milking facility. These gates were located at the entry and exit points of the dairy. Combining the gate time stamps with the milking time stamps allowed the calculation of the time spent in both the pre-milking and post-milking areas for each cow at each visit.

When fetching took place at night by the observer, individual cows and cow behaviour was recorded. The identification of the cows present on the laneway from the dairy to the B pasture allocation was recorded by the observer, noting the time and approximate distance from the dairy that each cow was located. The distance of the relevant paddock to the dairy (from 50 m to 998 m) and starting time of the night fetch were also recorded and where possible, the identification of all cows remaining in, and subsequently fetched from the paddock were documented. The observer calmly encouraged the cows out of the paddock,