



Effects of different systems of feeding supplements on time budgets of cows grazing restricted pasture allowances



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ABSTRACT

Farm systems that use a feed-pad for delivering mixed-rations to dairy cows are becoming more common in countries with primarily pasture-based dairy systems, such as Australia. However, feeding a ration on a feed-pad may alter cows' key daily behaviours such as grazing, ruminating and resting, due to extended time off-pasture. The objective of this study was to compare the time budget of multiparous grazing cows fed partial mixed-rations (PMR) on a feed-pad with that of cows fed supplements during milking and in the paddock (Control). A total of 16 groups of early-lactation, Holstein-Friesian dairy cows consisting of eight cows per group were randomly assigned to each of two dietary treatments (Control and PMR). Control cows were supplemented with wheat grain during milking and grass silage in the paddock, whereas PMR cows received supplements as a mixed-ration on the feed-pad for 80 ± 25 min/day after milking. Both diets were isoenergetic and equivalent in dry matter (DM) amounts. Within each feeding system, two groups were randomly assigned to one of the four amounts of supplement (8, 10, 12, 14 kg DM/cow/day). Thus, the experiment comprised two main treatments twice replicated and four amounts of supplement in each replicate. Following a 14-day adaptation period, data were collected for 18 days. The posture (lying/standing) and eating behaviour (grazing/ruminating/idling) of each cow was recorded every 10 min for 24 h over 4 days. Concurrently, IceTag™ activity monitors were used to measure the number and duration of lying bouts. There was no effect of feeding system or amount of supplement on daily lying time (PMR = 10.6, Control = 10.4 h; $P > 0.05$) and number of lying bouts per day (PMR = 9.3, Control = 9.4 h; $P > 0.05$). Daily grazing time was lower in PMR cows than Control cows (PMR = 5.2, Control = 4.0 h; $P < 0.05$) and declined with increasing level of supplement. Ruminating time was not affected by ration but increased with increasing amount of supplement (7.9, 8.7, 8.9, 8.9 h respectively; $P < 0.05$). The time interval between the arrival on pasture after milking and the first lying bout was longer in Control cows (PMR = 1.3, Control = 2.0 h; $P < 0.05$), and was significantly longer after morning milking across both treatments. Integrating grazed pasture with supplements fed as a PMR on a feed-pad for approximately 1.5 h a day slightly changed the time budget of pasture-based dairy cows with no indication of negative consequences for cow welfare.

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1. Introduction

The amount of time spent lying and resting by dairy cows can substantially affect their comfort and welfare (Overton et al., 2002). Several studies have demonstrated

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cow lying time influences milk production (Hart et al., 1978; Munksgaard and Lovendahl, 1993), foetal development (Nishida et al., 2004) and clinical health (Fisher et al., 2002). The way cows are managed can influence their lying behaviour (Fisher et al., 2003). Dairy feeding systems are continually evolving to cope with increased environmental variation, in an attempt by herd managers to remain profitable. Traditional systems for feeding supplements to grazing cows involve feeding grain-based concentrates in the dairy at milking times. More recently, however, systems that offer cows high amounts of supplements as a mixed-ration on a feed-pad before they go to graze have become increasingly common; such systems are defined as PMR systems (partial mixed ration system, Bargo et al., 2002a). These systems can offer nutritional advantages over 'slug' feeding of concentrates during milking (Auld et al., 2013; Bargo et al., 2002b).

When cows are fed mixed-rations on a feed-pad twice daily after each milking, they spend more time away from pasture than when they are fed grain in the dairy during milking. This may be accompanied by increased walking to and from the pasture, and increased time standing on concrete; during these periods cows do not have opportunity to lie down. Metz (1985) showed that 3 h of lying deprivation increased the need for lying in cows and that the motivation to lie down was strongest immediately after the deprivation. As grazing and lying down are mutually exclusive behaviours, there is direct competition for the time allocated to each of them, particularly during the times when pasture is scarce. Thus, there is an interest in comparing the daily lying and grazing times of dairy cows receiving supplements in different ways, to ensure there are no adverse effects of these emerging feeding systems.

Increased rumination in dairy cattle has been associated with increased saliva production, which helps buffer the acidic conditions in the rumen (Owens et al., 1998). Although rumination can take place concurrently with standing, most rumination takes place while cows are lying (Beauchemin, 1991). Phillips and Leaver (1986) reported that cows normally spend 6–7 h/day ruminating while lying and only 1.5–2.5 h/day ruminating while standing. Concordantly, Nielsen et al. (2000) found that the proportion of time ruminating while standing decreased as lying time in cows increased. In addition, Cooper et al. (2007) reported that the total time spent ruminating decreased with increasing lying deprivation time, suggesting that there is an association between cow lying and ruminating times. Due to the imposed management of cows in these different supplementary feeding systems, we were also interested in quantifying the ruminating behaviour of PMR cows compared with cows fed grain in the dairy and silage in the paddock.

This is the first experiment to investigate time budgets of dairy cows offered a restricted pasture allowance and managed in different supplementary feeding systems. Thus, the experiment was conducted with the aim of testing the following null hypotheses: (i) that the lying time of pasture-based dairy cows would not be affected by feeding system nor amount of supplement offered at restricted pasture allowances; (ii) that the grazing time of pasture based dairy cows would not be affected by feeding

system; (iii) that the grazing time of these cows would not be affected by amount of supplement offered at restricted pasture allowances; (iv) that the proportion of time per day spent ruminating while lying down would not be affected by feeding system nor the amount of supplement offered at restricted pasture allowances.

2. Material and methods

This experiment was conducted at the Department of Primary Industries (DPI), Ellinbank Centre, Victoria, Australia (38°24'S, 145°94'E) during October and November (spring) 2010, with the approval from the DPI-Victoria Agricultural Research and Extension Animal Ethics Committee and in accordance with the Australian Code of Practice for the Care and Use of Animals for Scientific Purposes (National Health and Medical Research Council, 2004). The experiment was part of a larger experiment investigating milk production responses to PMR (Auld et al., 2012), which comprised a 14-day adaptation period followed by an 18-day measurement period.

2.1. Cows and treatments

A total of 128 multiparous, seasonally-calving Holstein-Friesian dairy cows were used in this experiment. All cows were kept on pasture for about 20 h a day and were milked twice daily between 07:00–08:30 h and 15:00–16:30 h.

Immediately prior to the experiment, these early lactation (70 ± 15.2 days in milk, mean \pm SD) cows were divided into 16 groups of eight cows, with groups balanced for age (4.5 ± 1.63 yr), body condition score on an 8-point scale (4.6 ± 0.27 ; Earle, 1976), live weight (561 ± 55.2 kg) and milk yield in the previous lactation (6896 ± 950.8 kg/cow). One of the two dietary treatments was then randomly assigned to each of the 16 groups. The treatments were;

- (i) *Ration 1 (Control)*: This treatment was assigned to eight groups that grazed perennial ryegrass (*Lolium perenne* L.) supplemented with rolled wheat (*Triticum aestivum*) grain fed twice daily in the dairy and grass silage provided in the paddock. The total supplement comprised 72% DM wheat grain and 28% DM pasture silage. The pasture allowance was approximately 14 kg DM/cow/day.
- (ii) *Ration 2 (PMR)*: This treatment was assigned to the remaining eight groups. Cows grazed an equal allowance of perennial ryegrass pasture as the Control group (14 kg DM/cow/day) and received the same amount of supplement, but as a mixed-ration fed twice daily on a feed-pad after each milking for 80 ± 25 min per day (Fig. 1).

The feed-pad used in this experiment was a permanent feed-out area with a concrete surface and had a total length of 50 m. There were two parallel concrete feed troughs on the feed-pad and each trough allowed cows to eat from both sides. The distance between the dairy and the feed-pad was about 0.5 km.

The PMR provided approximately the same metabolizable energy as the supplement offered in the Control

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