



Effect of restricting time at pasture and concentrate supplementation on herbage intake, grazing behaviour and performance of lactating dairy cows



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ABSTRACT

Restricting time for grazing and concentrate supplementation affects feeding motivation, altering grazing behaviour, and performance of grazing ruminants. This study evaluated the combination of three lengths of restricting time at pasture and two levels of concentrate supplementation on behaviour, intake, and productive performance of dairy cows. Times out of pasture were 0, 4 (0800–1200 h) and 8.5 (0800–1630 h) hours. Levels of concentrate supplementation were 3 and 6 kg DM/cow/day. Measurements were: herbage dry matter intake and digestibility, grazing, ruminating and idling time, bite rate, milk yield and composition, as well as changes in live weight and body condition score. Restricting time at pasture increased ($P < 0.01$) grazing time and length of the initial grazing bout ($P < 0.01$) and reduced ($P < 0.01$) rumination and idling times. Restricting time at pasture did not affect herbage intake or milk yield; however, it reduced milk fat concentration ($P < 0.01$). Supplementation level reduced ($P < 0.05$) grazing time, but did not affect rumination and idling times. Bite rate was the greatest in cows that were not restricted and had the lowest level in $R_{8.5}S_6$ groups ($P < 0.01$). Supplementation reduced herbage dry matter intake, and herbage and total organic matter digestibility ($P < 0.01$). Supplementation increased milk yield ($P < 0.05$) without effects on milk composition. Modulation of grazing behaviour in response to restricting time at pasture maintained herbage dry matter intake. Changes in grazing behaviour in response to restricting time at pasture plus concentrate supplementation counteract restrictions of restricted time at pasture and thereby help to maintain herbage and energy intake without negative effects on milk production.

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1. Introduction

The interaction between the animal' internal state (a.k.a. hunger) and sward characteristics determines foraging behaviour (Pittroff and Soca, 2006) and thereby herbage dry matter intake (HDMI) (Pittroff and Soca, 2006;

Chilibroste et al., 2007; Gregorini et al., 2009). This interaction can be modulated through feeding practices and, thus, intake pattern aiming to manage HDMI (Chilibroste et al., 2007).

Restricting time at pasture increases the hunger level of cattle (Gregorini et al., 2009). For example, Gregorini et al. (2009) reported increasing levels of ghrelin (an orexogenic hormone) as the restricted time at pasture increased. Restricting time at pasture has been shown to increase short-term HDMI rate, bite mass and bite rate of grazing cattle (Patterson et al., 1998; Perez-Ramirez et al., 2009; Dobos et al., 2009). For example, Patterson et al. (1998) reported increments of 53%, 27% and 22% of HDMI rate, bite mass and bite rate, respectively, during the first meal of the day for grazing dairy cows restricted from pasture for 1–13 h.

Concentrate supplementation often has a negative effect on total daily HDMI and DM intake rate at grazing bout level. Such a negative effect relates to an immediate satiating effect exerted by concentrates (Roche et al., 2007); which reduces the motivation to eat in the next grazing bout after the supplement is fed, thereby reducing eating and searching time while grazing (Krysl and Hess, 1993; Soca, 2006). Despite the reduction in HDMI, concentrate supplementation can be strategically used to either substitute herbage during periods of herbage shortage and/or to enhance total energy intake to increase milk production (Bargo et al., 2003).

There is a substantial body of literature related to foraging ecology and grazing management, as well as research on the effects of supplementation types, management and rates on milk production performance of dairy cattle (Bargo et al., 2003). Previous research studied how grazing time, HDMI and DMI rates are influenced by two sward heights (10 and 13 cm) and grazing durations (1, 2, 4, 8 and 15 h) (Dobos et al., 2009) or changes in moment and time to grazing access (Kennedy et al., 2011; Mattiauda et al., 2013). However, there is little information regarding how grazing behaviour and milk production/composition are affected by the interaction of both, restricted grazing and supplementation levels, which are among the most frequent changes in feeding of dairy cows (Perez-Ramirez et al., 2009). The restricting grazing time was associated with changes in grazing behaviour and selectivity to meet daily forage intake (Soca, 2006). This behaviour plasticity helps to maintain animal performance and could contribute to reduce metabolic and energetic costs of cows grazing with forage restriction.

We postulated the hypothesis that, during the summer period, restricted time at pasture up to 8.5 h modifies grazing behaviour but not intake or milk production. Therefore the objective of this study was to evaluate the effect of a factorial arrangement of periods of restricted time at pasture and concentrate supplementation levels on HDMI and total intake, grazing behaviour, diet and herbage digestibility and productive response of lactating dairy cows.

2. Materials and methods

2.1. Experimental site and pastures

The study was conducted at the experimental station "Oromo", University of Chile (40°8'S, 73°2'W). Pastures

were on the region of volcanic origin (Central Valley Trumao) type soil. The botanical composition of the sward determined by manual separation of forage was *Lolium perenne* (70%), *Dactylis glomerata* (15%), *Anthoxanthum odoratum*, *Bromus sp.*, *Trifolium repens*, and *Achillea millefolium* (5%) and other species (10%). There was no change in the ranking of the main pasture species during the experiment.

2.2. Animals, treatments and management

Thirty-six lactating Holstein-Friesian cows (157 ± 10.0 DIM; 550 ± 50.0 kg BW; 2.7 ± 0.5 points BCS, scale 1–5) were grouped by age, DIM, milk production (24 ± 2 l/cow), BW and BCS, and randomly assigned to one of the six treatments ($n=6$ /treatment) based on a factorial arrangement of the following factors:

R=Restricting time at pasture.

R₀=No restriction – free access to pasture at all times.

R₄=Restriction period 0800–1200 h (after the morning milking).

R_{8,5}=Restriction period 0800–1630 h (between the morning and the afternoon milking).

S=Level of concentrate supplementation.

S₃=3 kg DM/cow/day

S₆=6 kg DM/cow/day

Restricting time at pasture took place on stand-off pads contiguous to the milking parlour. During the restricted time at pasture, cows had unrestricted access to shade and fresh water. Cows were milked at 0700 and 1530 h during approximately 1.5 h. Grazing observation was done during 17:00–23:00 PM, 5:30–7:00 AM and 8:30–14:30 AM–PM.

Concentrate and mineral supplements were individually fed during milking at equal amounts during the morning and the afternoon milking. The concentrate (as DM) consisted of corn grain (60%), sorghum grain (20%), citrus pulp (10%), fishmeal (5%), vitamins and minerals (5%). Concentrate supplement had 11.6 MJ ME/kg DM and 19.5% CP. Cows were rotationally grazed with four days residence time per paddock. Planned herbage allowance was 7.5 kg of herbage DM (ground level) /100 kg BW/ day and kg DM/ha/day respectively. Herbage allowance was set by adjustments of paddock size with an area of 0.66 ± 0.08 ha, during the experimental period. The groups of cows of each treatment grazed in separate pastures.

The duration of the experiment was 95 days, with 10 days of adaptation to the treatments and 85 days of measurements. Before adaptation, the cows grazed similar sward as a single group and supplemented daily with 4 kg of same the supplement used during the experimental period. The experimental design and settings allowed no need for cows to return to previously grazed plots. Treatments were replicated in space and the experimental paddocks were set 200 m apart.

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