BRIEF COMMUNICATION: Effect of timing of maize silage supplementation on grazing behaviour of dairy cows during a short grazing session on a ryegrass-based herbage

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Abstract

The objective of this study was to evaluate the effect of timing of maize silage supplementation on grazing behaviour of dairy cows during a short grazing session on a ryegrass-based herbage. Thirty-six dairy Holstein-Friesian × Jersey dairy cows were blocked in nine groups and randomly assigned to one of three treatments: herbage only (CTL), or supplemented with 3 kg DM/cow of maize silage at either nine (9BH) or two (2BH) hours before herbage allocation. Individuals' behaviour (grazing, ruminating and idling) was visually assessed every five min during one grazing session. Herbage intake rate was estimated as herbage intake divided by grazing time. Cows in 2BH spent more time ruminating and had lower herbage dry matter intake rate than the cows in CTL and 9BH. Maize silage supplementation at two hours before herbage allocation, increased rumination time and reduced herbage intake rate. These results help in the design of feeding management and strategies to reduce herbage substitution rates.

Keywords: dairy cows; time of supplementation; grazing behaviour; maize silage

Introduction

Dairy farming in New Zealand is primarily based on utilisation of grazed swards comprising perennial ryegrass (*Lolium perenne* L.) and white clover (*Trifolium repens* L.). Restricting time at pasture has been suggested as one management strategy to increase intake rate and grazing efficiency (Gregorini et al. 2017); however, it may constrain herbage dry matter intake (DMI), reducing milk production of dairy cows (Pérez-Ramírez et al. 2008). This restriction in DMI and milk production could be overcome by supplementing cows while off pasture (Soca et al. 2014).

Grazing behaviour of cows is generally affected by the interaction between animal internal state and sward characteristics, determining DMI of animal (Chilibroste et al. 2007; Gregorini et al. 2009). Management practices that can modulate this interaction may alter grazing behaviour, and hence, DMI of grazing animals (Chilibroste et al. 2007; Soca et al. 2014; Al-Marashdeh et al. 2016b). For example, feeding supplement at nine rather than one hour before an extensive herbage meal has been reported as a management practice to increase animal's level of hunger, and hence, herbage DMI of dairy cows (Al-Marashdeh et al. 2016b). Furthermore, restricting time at pasture has been shown to increase short-term intake rate and bite rate of grazing cattle (Chilibroste et al. 2007; Gregorini et al. 2009). While there is a substantial amount of literature describing the effects of restricting time at pasture on grazing behaviour of dairy cattle (Chilibroste et al. 2007; Gregorini et al. 2009), limited data are available on the effect of timing of supplementation combined with restrictions of time at pasture. Therefore, the objective of this study was to investigate the effect of timing of maize silage supplementation before a short grazing session, on grazing behaviour of dairy cows.

Material and methods

All the treatments and measurements in this study were approved by the Lincoln University Animal Ethics Committee # AEC 510.

Experimental site and design

This study was conducted at the Lincoln University Research Dairy Farm, Lincoln, New Zealand (43º 38'S, 172º 27'E), from 6 to 26 March 2013, on a perennial ryegrass-white clover sward grazed by dairy cows in late-lactation. Al-Marashdeh et al. (2016a) gave full details of the design, cows, treatments and management. In summary, 36 Friesian × Jersey crossbred, lactating dairy cows were blocked into nine groups of four cows by milksolids production and then randomly assigned to one of three treatments: herbage only (CTL); supplemented with 3 kg of DM of maize silage after morning milking approximately 9 h before pasture allocation (9BH); and supplemented with 3 kg of DM of maize silage before afternoon milking approximately 2 h before pasture allocation (2BH). Herbage allowance was ~15 kg DM/cow per day above a post-grazing residual herbage mass of 1,500 kg DM/ha. Cows were allocated to pasture from 1530 to 2030 h (grazing session). Cows were milked twice daily (0600 and 1430 h), and maintained on a stand-off area (a harrowed paddock with no access to herbage) with access *ad libitum* to fresh water. The experiment was conducted over a period of 21 days.

Measurements

Individual grazing behaviour was visually assessed for each cow during the grazing session on day 18 of the experiment. One of three trained observers were assigned randomly to each paddock, in which three groups of cows were grazing adjacent breaks (one observer per three groups). Grazing, ruminating and idling (not grazing or ruminating) behaviour were recorded for each cow every five minutes. Time of each activity was calculated by multiplying the activity frequency by five. Grazing efficiency was estimated as the proportion of time cows spent grazing in relation to the total time spent on pasture, in which greater proportion means higher efficiency.

Table 1 Grazing, idling and ruminating behaviour[1], intake rate, and grazing efficiency for cows grazing herbage only (CTL) or herbage with maize silage either at 9 (9BH) or 2 hours (2BH) before a short grazing session.

	Treatment			SEM	P- value		
	CTL	2BH	9BH		Trt.[4]	Time[5]	Trt. x Time
Grazing time (min)	258.5	242.9	245.4	6.83	0.12	<0.01	0.02
Idling time (min)	41.5	52.9	53.3	7.30	0.22	<0.01	0.04
Ruminating time (min)	0.0[b]	4.2[a]	1.3[b]	0.63	<0.01	0.53	0.57
Intake rate[2] (g/min)	45.3[a]	41.5[b]	44.6[a]	0.68	0.04	-	-
Grazing efficiency[3] (%)	86.2	81.0	82.0	2.28	0.13	-	-

[a-b]Means within a row with different superscripts differ ($P < 0.05$). [1]Total time of grazing, idling or ruminating during the grazing session (5 hours). [2]Average of daily herbage DM intake (g) divided by time (min) cows spent grazing. [3]Proportion of time cows spent grazing in relation to the total time spent on pasture. [4]Trt, treatment effect. [5]Time during the grazing session effect (1-5 h).

Statistical analysis

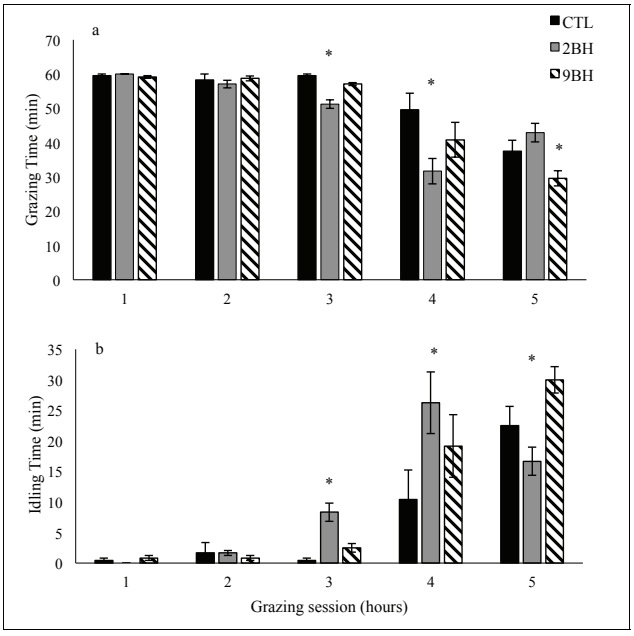
The time the cows spent grazing, idling and ruminating were analysed using repeated-measures ANOVA, with time of feeding maize silage as treatment, time of the grazing session (hour) as a repeated measure and group as replicate. Grazing efficiency and intake rate were analysed per grazing session using one-way ANOVA, with time of feeding maize silage as treatment and group as replicate. Results were declared significant at P<0.05.

Results and discussion

During the observation period, rumination time was greater (P<0.01) and herbage intake rate was lower (P=0.04; Table 1) for 2BH than 9BH and CTL, but did not differ between 9BH and CTL. This could be explained by two possible reasons. First, the rumen-fill constraints, which may have been greater for 2BH than for 9BH at the time the grazing session started. This greater rumen fill explains the longer rumination time for 2BH than 9BH during the period of observation (Gregorini 2012). In addition, increments of the rumen fill (more rumen content) were reported to accelerate satiation, reduce grazing time, bite mass and intake rate (Chilibroste et al. 2007; Gregorini et al. 2007; Gregorini et al. 2009). In the current study, although grazing time was not affected by timing of supplementation (Table 1), intake rate was greater for 9BH than 2BH. This suggests either a greater bite rate or bite mass, or a combination of both for 9BH than 2BH, as reported by Gregorini et al. (2007) and Soca et al. (2014). Second, the fasting period before the grazing session was longer for cows in 9BH compared to cows in 2BH (9 vs 2 hours, respectively). This may lead to a greater motivation to eat and thereby explain a potential greater motivation to graze for 9BH compared to 2BH, as suggested by Gregorini et al. (2009) and Soca et al. (2014). Gregorini et al. (2009) and Gregorini et al. (2007) reported that herbage-intake rate increases with time since the last meal. This suggests that time of supplementation before a short grazing session can alter intake rate, rumination time, and therefore, herbage DMI of grazing dairy cows.

There was a significant treatment × time of observation interaction effect during the grazing session for grazing (P=0.02) and idling time (P=0.04; Table 1). Cows in the CTL and 9BH spent more time grazing and less time idling than did those in 2BH during the third and fourth grazing hour (Figure 1). However, 2BH cows spent more time grazing and less time idling than 9BH cows during the last hour of the grazing session (Figure 1). This may be related to the intake rate, in which greater intake for 9BH than 2BH may have resulted in faster satiation.

Figure 1 Time of a) grazing and b) idling (min) during grazing session of five hours for lactating dairy cows grazing pasture only (CTL) or herbage with maize silage at 2 (2BH) or 9 (9BH) hours before the herbage meal. Bars indicate SEM. * indicates significant differences (P<0.05) among means at particular observation hour.



We conclude that maize silage supplementation at nine hours before herbage allocation, diminishes ruminating time and increases herbage intake rate. These results help in the design of feeding management strategies to reduce herbage substitution rates, such as allowing greater time to elapse between feeding supplements and herbage allocation.

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