The impact of grain-based concentrate allocation and ryegrass pasture sward on intake and milk production

R. KAUR[A], C.E.F. CLARK[A], L.O. MILLAPAN[B], A. HORADAGODA[A], H.M. GOLDER[AC], K.L. KERRISK[A], S.C. GARCIA[A], M.R. ISLAM[A]

[A]Dairy Science Group, Faculty of Veterinary Science, the University of Sydney, Camden, 2570, NSW, Australia
[B]Department of Animal Production, Faculty of Agronomy, University of Buenos Aires, Buenos Aires 1417, Argentina
[C]SBScibus, Camden NSW 2570

ABSTRACT

This study determined the impact of varying proportions of grain-based concentrate (GBC) allocation and ryegrass pasture sward on herbage and DM intake and milk production. Ninety cows were allocated to two consistent (fresh-fresh and depleted-depleted) and two inconsistent (fresh-depleted and depleted-fresh) treatments of ryegrass pasture with three different amounts of GBC (2.7, 5.4 and 8.1 kg DM/cow.day). Milk production was recorded for a seven-day period after an adaptation period of five days. Three cows were randomly selected from each treatment group within the experimental herd and dosed with synthetic alkanes to determine herbage intake and total DM intake (n=36). Greater ($P<0.001$) milk yields were measured in cows grazing fresh ryegrass and with higher GBC allocation independently as there was no interaction between pasture treatments and GBC allocations. Similar results were obtained for herbage and total DM intake. These findings suggest that GBC can be offered independent of the pasture sward in automatic milking systems, and milk yield response was higher when fresh strip of pasture was offered in the afternoon.

Keywords: Intake, grain-based concentrate, milk, pasture sward, ryegrass.

INTRODUCTION

Low DM intake is a major limitation to milk production in pasture-based systems. Several studies have shown that nutrients from pasture alone are insufficient to maximise production potential of dairy cows (Kolver and Muller 1998, Bargo *et al.* 2003). Therefore, supplementary feeds have been offered to overcome these limitations. Numerous studies have reported increase in total DM intake and milk production with concentrate supplementation.

Pasture is typically offered to dairy cows in three allocations in pasture-based automatic milking systems (AMS) However, due to voluntary cow movement and distribution of milkings, some dairy cows access fresh pasture and other cows access depleted (stale) pasture. The first cows moving to an allocation of fresh pasture are offered *ad-libitum*, high quality pasture as opposed to cows arriving to the same allocation during the middle or end of the day accessing poorer quality, high neutral detergent fibre (NDF) depleted pasture. Further, in AMS systems, GBC have been allocated independently of the pasture sward. To date, the ability to increase feed conversion efficiency and AMS herd milk production by targeted GBC supplementation to cows grazing differing pasture sward is unknown. The hypothesis was that dairy cows offered inconsistent allocations of pasture (fresh-depleted and depleted-fresh) will have a poor milk response to additional GBC when offered at high levels than consistent allocations (fresh-fresh and depleted-depleted) of pasture. Therefore, the objective of the current experiment was to determine the impact of ryegrass pasture sward and GBC allocation on herbage and total dry matter intake and milk production in dairy cows.

MATERIALS AND METHODS

This study was conducted at the University of Sydney's Corstorphine dairy research farm, Camden, NSW, Australia.

A group of 90 Holstein-Friesian cows (62 ± months, 675± kg liveweight, 211± DIM and producing 26± kg milk/day) were randomly assigned to treatments that consisted of a combination of four different pasture treatments and three different amounts of GBC (Table 1). Ryegrass (*Lolium multiflorum*) pasture sward comprised two consistent (namely fresh-fresh, and depleted-depleted) or two inconsistent (namely fresh-depleted, and depleted-fresh) offered after morning (AM) and afternoon (PM) milking respectively. Fresh pasture referred to an average allowance of 80 kg DM/cow.day to ground level, whereas depleted pasture represented an average allowance of 59 kg DM/cow.day to ground level (depleted refers to pasture already grazed by fresh group of cows a day prior to entrance of experimental cows to strips). The GBC was offered half in the morning (AM) and half in the afternoon (PM) milking. The study comprised a 5-d adaptation period followed by 7-d of data collection.

Table 1: The number of cows (n), pasture sward (F[1]=Fresh, D[2]=depleted) and grain-based concentrate (GBC) (kg DM/cow.day) offered for each treatment.

			Pasture sward	
Treatment	**n**	**GBC**	**AM**	**PM**
1	7	2.7	F	F
2	7	5.4	F	F
3	7	8.1	F	F
4	7	2.7	D	D
5	7	5.4	D	D
6	7	8.1	D	D
7	8	2.7	F	D
8	8	5.4	F	D
9	8	8.1	F	D
10	8	2.7	D	F
11	8	5.4	D	F
12	8	8.1	D	F

[1] Allocation of 80 kg DM/cow.day to ground level per cow, [2]59 kg DM/cow.day to ground level per cow

Three cows within each of the 12 treatments (total of 36 cows in the herd) were randomly selected and dosed with synthetic alkanes to estimate pasture intake. Rectal grab samples were collected twice daily after milking for 7 consecutive days and analysed for alkane content as described by (Mayes *et al.* 1986). Herbage dry matter intake was calculated according to Dove and Mayes (1991).

Data were analysed using linear mixed modelling in GenStat 14th Edition (VSN International, UK). The statistical model included the interaction between pasture sward and concentrate, using pre-experimental milk yield as a covariate. Cow and day were included as a random effect. Significance was determined if $P < 0.05$.

RESULTS

Pasture sward affected ($P<0.001$) milk production (Table 2), although there was no interaction between pasture sward and level of supplementation concentrate amount. Within the consistent pasture allocation, cows produced 2.0 L more milk production when accessing fresh-fresh compared with depleted-depleted pasture, while there was greater milk production in cows accessing depleted-fresh compared with fresh-depleted within the inconsistent pasture allocation. Milk production also increased ($P<0.001$) by 2.4 L when GBC increased from 2.7 kg GBC to 8.1 kg DM/d (Table 3).

Table 2: Milk yield (L/cow/d) and intake (kg DM/d) by cows offered different pasture sward

Pasture sward (AM/PM)	**Milk yield**	**Herbage Intake**	**DM Intake**
Fresh-Fresh	27.6^{a}	14.4^{a}	19.8^{a}
Depleted-Depleted	25.8^{bc}	9.9^{b}	15.3^{b}
Fresh-Depleted	25.4^{c}	10.1^{b}	15.5^{b}
Depleted-Fresh	26.8^{ab}	13.5^{a}	18.9^{a}

Superscript denotes means within columns are significantly different ($P<0.05$)

Cows ate 4.5 kg more herbage dry matter ($P<0.001$) when offered fresh-fresh pasture compared with depleted-depleted pasture in the consistent allocation, while herbage dry matter intake was 3.4 kg greater in cows accessing depleted-fresh pasture compared with fresh-depleted pasture (Table 2). Cows reduced herbage dry matter intake by 2.8 kg ($P=0.03$) when GBC increased from 2.7 to 8.1 kg DM/d (Table 3). Similar to milk production, there was no significant interaction between pasture sward and level of GBC supplementation observed on daily herbage intake.

Table 3: Milk yield (L/cow/d) and intake (kg DM/d) by cows offered different grain-based concentrate (GBC) allocations

GBC (kg DM/d)	**Milk yield**	**Herbage Intake**	**DM intake**
2.7	25.0^{a}	13.4^{a}	16.1^{a}
5.4	26.8^{b}	12.0^{ab}	17.3^{ab}
8.1	27.4^{b}	10.6^{b}	18.7^{b}

#GBC was offered half in the morning (AM) and half in the afternoon (PM) milking; Superscript denotes means within columns are significantly different ($P<0.05$)

DISCUSSION AND CONCLUSIONS

The primary objective of this study was to determine the impact of varying levels of GBC supplementation and ryegrass pasture sward on DMI and milk production by grazing dairy cows. Overall, we found that milk production was greater in cows accessing fresh-fresh pasture sward, and cows receiving increasing levels of GBC. Similarly there was greater total DM intake with fresh-fresh pasture, and greater GBC allocation. When inconsistent pasture sward were allocated, offering

fresh pasture in PM increased herbage intake which led to increased total DM intake. As a result milk production also increased when fresh pasture was offered in PM. In contrast, offering depleted pasture in PM reduced herbage intake, thus total DM intake, which ultimately reduced milk yield.

The key findings of this study were that if inconsistent pasture sward were offered, cows should access depleted pasture in the morning followed by fresh pasture in the afternoon in order to maximise pasture intake without affecting milk yield. Offering fresh pasture strip in the afternoon improved milk responses both in consistent and inconsistent groups as afternoon pasture might have higher water soluble carbohydrate content and/or longer grazing activity (Gregorini *et al.* 2012). Further, GBC can be offered independent of the pasture sward in automatic milking systems due to lack of interaction between pasture sward and GBC amount offered.

ACKNOWLEDGEMENTS

The authors would like to thank the Dairy Research Foundation for its support of the Dairy Science Group and the investors of FutureDairy, Dairy Australia, NSW Department of Primary Industries, The University of Sydney and DeLaval.

REFERENCES

Bargo F, Muller LD, Kolver ES, Delahoy JE (1998) Invited review: Production and digestion of supplemented dairy cows on pasture. *J. Dairy Sci.* **86**, 1-42.

Gregorini P (2012) Diurnal grazing pattern: its physiological basis and strategic management. *Anim. Prod. Sci.* **52**, 416-430

Islam MR, Clark CEF, Horadagoda A, Kaur R, Kerrisk KL, Garcia SC (2014) The impact of grain-based concentrate allocation and pasture state on ryegrass pasture digestibility. Submitted to Australasian Dairy Science Symposium to be held in New Zealand from 19-21 November 2014.

Kolver ES, Muller LD (1998) Performance and nutrient intake of high producing Holstein cows consuming pasture or a total mixed ration. *J. Dairy Sci.* **81**, 1403-1411.

Mayes RW, Lamb CS, Colgrove PM (1986) The use of dosed and herbage n-alkanes as markers for the determination of herbage intake. *J. Agric. Sci.* **107**, 161-170.

Dove H, Mayes RW (1991) The use of plant wax alkanes as marker substances in studies of the nutrition of herbivores: a review. *Aust. J. Agric. Res.* **42**, 913-952.

Garcia SC, Pedernera M, Fulkerson WJ, Horadagoda A, Nandra K (2007) Feeding concentrates based on individual cow requirements improves the yield of milk solids in dairy cows grazing restricted pasture. *Aust. J. Exp. Agric.* **47**, 502-508.