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Increasing Feed Conversion Efficiency in Automatic Milking Systems: The Impact of Grain-Based Concentrate Allocation and Kikuyu (*Pennisetum clandestinum*) Pasture State on Milk Production

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Introduction

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 fibre (neutral detergent fibre, NDF) pasture. In addition, grain-based concentrate (GBC) is allocated independently to this pasture state. The ability to increase feed conversion efficiency and AMS herd milk production by targeted GBC supplementation to cows accessing differing pasture states is unknown. Therefore, the aim of the current experiment was to determine the impact of pasture state and GBC allocation on dairy cow milk production.

Methods

Ninety mixed-age dairy cows in mid-lactation were offered kikuyu grass (*Pennisetum clandestinum*) of differing states after the morning (AM) and evening (PM) milkings. Grain-based concentrate was offered as two equal allocations to each cow in the bails at each milking. Treatments are shown in Table 1. After 6 days of adaptation, milk production was recorded daily and milk samples collected for fat and protein content on day 1, 4 and 7 of the experimental period. Pasture samples were collected from each paddock and then dried at 60^0C for 48 h, weighed and ground (1 mm) for *in vitro* ruminal incubation (Wang *et al*. 1999) to determine *in-vitro* dry matter digestibility (IVDMD). Data were fitted with linear mixed models using pasture and GBC as fixed effects and cows as random effect, and parameters were estimated using the restricted maximum likelihood procedure.

Results

Overall, there was an increase in milk production with increased GBC (P<0.01) and there were differences in milk production with pasture state (P<0.01). There was also a significant interaction between GBC and pasture state (P=0.03, Table 2). For cows offered consistent allocations of fresh or depleted pasture, milk production levels were similar (P>0.05) when GBC was increased from 2.7 to 5.4 kg/cow/day. In contrast, further GBC supplementation from 5.4 to 8.1kg DM/cow/day significantly increased milk production by 1.0 L/kg DM GBC and 1.3 L/kg DM GBC for consistent fresh and depleted pasture state allocations, respectively. Milk production for cows offered an

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

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

F is allocation of 60kgDM/cow/day to ground level per cow, D is 40 kg DM/cow/day to ground level per cow

Table 2 Milk production (L/cow/d) of cows offered different pasture states and grain-based concentrate allocations

Pasture state (AM, PM)	Grain-based concentrate (kgDM/cow/day)		
	2.7	5.4	8.1
Fresh, Fresh (L/cow/day)	22.7a	22.9a	25.5b
Depleted, Depleted (L/cow/day)	20.1a	21.5a	24.9b
Fresh, Depleted (L/cow/day)	20.8	22.5	22.6
Depleted, Fresh (L/cow/day)	20.1a	23.0b	23.7bc

Superscripts denote if means within rows are significantly different (P<0.05) inconsistent pasture state of fresh/depleted was similar across all GBC levels. Milk production for the depleted/ fresh group increased when GBC was increased from 2.7 to 5.4 kg/cow/day, however there was no further increase in milk production as GBC level increased from 5.4 to 8.1 kg DM/cow/day.

There was no significant effect (*P*>0.05) of GBC level or pasture state on milk fat and protein content. The IVDMD of fresh pasture (70.3%) was significantly greater (*P*=0.02) than depleted pasture (66.5%).

Conclusions

Under the conditions of this experiment, pasture state, and the consistency of that pasture state affected the milk production response to GBC. The milk production response to GBC for cows accessing a consistent pasture state (~1.2 L/kg GBC) occurred at high levels of GBC supplementation and was similar to levels reported by Bargo *et al*. (2002). In contrast, the milk production response to GBC for cows accessing an inconsistent pasture state (~0.9 L/kg GBC) primarily occurred at lower levels of GBC supplementation. These initial findings pave the way for future research to develop AMS feeding systems to increase FCE and optimise farm profitability. Such systems could determine the consistency by which particular AMS cows access pasture states and target GBC accordingly.

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