Effects of the digestibility of hay on milk production by cows grazing on restricted pasture

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ABSTRACT

Sixteen cows were randomly allocated to the two treatment groups; one was given high digestibility hay (57% DMD and the other low digestibility hay (52% DMD). Hay was available to appetite during the daytime, while the cows grazed on a common pasture allowance (12 kg DM per cow) at night.

Cows offered high digestibility hay ate more hay ($P<0.01$) but less pasture ($P<0.05$) than those on the low digestibility hay. Pasture intake was reduced by 0.2 kg DM for each increase of 1 kg DM eaten as high digestibility hay.

Cows offered the high digestibility hay produced slightly more milk than those on the low digestibility hay. This difference average 1.3 L per cow daily, but was significant only in week 1. The composition of milk did not differ between the two groups. The cows offered the high digestibility hay also gained significantly more liveweight.

The data show that the quality of supplementary hay has an effect on milk production, but that the effect is smaller than might have been predicted because of the increased substitution of hay eaten instead of pasture by cows given the higher quality hay and because of increased liveweight gain by these cows. The probable economic value of high digestibility supplement is discussed briefly.

Keywords Hay, digestibility, supplement, milk production, grazing cows.

INTRODUCTION

Silage, and in some cases hay, are important dietary components, together with limited grazed pasture, for cows which are lactating during winter (Baldwin, 1989). The digestibility of hays and silages varies widely between farms in the range 53% to 75%, with mean values of about 56% and 65% for hay and silage respectively (Baldwin, 1989; Betteridge and Sedcole, 1981).

Many experiments have demonstrated the increases in milk production caused by increases in digestibility of silage, for cows on a diet of silage and concentrates (eg. Castle, 1975; Gordon, 1980). One experiment has shown a similar effect for cows eating restricted quantities of cut pasture (Rogers and Robinson, 1984).

The effect of supplement digestibility on milk production by cows grazing on restricted pasture does not seem to have been studied previously; the present paper describes such a study.

MATERIALS AND METHODS

The experiment was carried out at the Dairy Cattle Research Unit, Massey University, during September and October, 1988. Sixteen Holstein Friesian cows were selected on the basis of their initial milk yield (average 20 l/cow daily) and date of calving (average 27 days prior to the start of the experimental period), and were randomly allocated into two treatment groups (given either low or high digestibility hay).

During the experimental period of 4 weeks the cows were grazed on pasture at night and given hay indoors during the day. In the period 5 pm to 7 am, the cows were grazed on the same paddocks but in two separate groups and offered a restricted pasture allowance of 12 kg DM/cow per 24 hours.

In the period 8 am to 4 pm, the cows were housed in individual stalls and given *ad libitum* access to hay of either high or low digestibility. Water was available at all times.

The quantities of hay offered and left uneaten by each cow on each day were weighed, and sampled for

measurement of DM concentration. The pre- and post-grazing herbage masses were measured on nine occasions. Five quadrats were cut to ground level per treatment, and the cut herbage was washed, dried and weighed. Daily pasture intake was calculated from the difference between the pre and post grazing herbage masses.

Milk yield and composition were measured on two consecutive days each week. Liveweight was measured and body condition score was assessed, for each cow on two consecutive days both before the experiment began and again 48 hours after the experiment had finished.

The two samples of hay were purchased, having been identified to be of "high" or "low" digestibility on the basis of visual assessment of their concentrations of leaf material. The digestibility of the hays was measured *in vivo*, using six sheep fed at maintenance. The digestibility of the hays and pasture was also measured *in vitro* (Roughan and Holland, 1977). Nitrogen concentrations were measured by the Kjeldahl method. The values are given in Table 1.

TABLE 1 Mean values for composition of the hays and the pasture.

	Low digestibility hay	High digestibility hay	Pasture
Digestibility of DM (%)			
in vivo	52.0	57.3	-
in vitro	54.0	57.7	70.8
Concentration of crude protein (%)	6.9	17.7	18.2

RESULTS

The herbage allowances actually offered (per 24 hours) were 11.0 and 10.7 kg DM/cow for the low and high digestibility groups respectively; the corresponding values for residual herbage matter were 1100 and 1130 kg DM/hectare. Differences between treatments were not significant and pre-grazing herbage mass averaged 1750 kg DM/hectares.

Mean values for DM intakes are given in Table 2. The "high" group ate more hay but slightly less pasture than the "low" group. The net result was an increase in total daily intake of 1.6 kg/cow by the "high" group.

TABLE 2 Mean values for dry matter eaten as hay and pasture (kg DM/cow daily)

	Digestibility of hay Low	High	SEM	Significance of difference
Dry matter eaten				
as Hay	6.5	8.7	0.3	**
as Pasture	4.3	3.9	0.2	*
Total	10.9	12.5	0.4	**

The mean values for yields of milk, fat and protein are given in Table 3 for weeks 2, 3 and 4 of the experimental period. Although the "high" group produced slightly higher yields than the "low" group (by 5 to 8%) none of these differences were significant ($P>0.05$) (except for milk yield in week 1, when the "high" group produced 1.8 L/cow more than the low group ($P<0.01$). There were no significant differences in milk composition between the two groups ($P>0.05$).

TABLE 3 Mean values* for daily yield of milk, fat and protein in weeks 2, 3 and 4 of the experimental period (kg/cow).

	Digestibility of hay Low	High	SEM	Significance of difference
Milk				
Week 2	15.0	16.1	0.6	NS
Week 3	14.3	15.4	0.6	NS
Week 4	14.2	15.2	0.5	NS
Fat				
Week 2	0.65	0.72	0.02	NS
Week 3	0.63	0.64	0.02	NS
Week 4	0.61	0.66	0.02	NS
Protein				
Week 2	0.45	0.49	0.02	NS
Week 3	0.45	0.49	0.01	NS
Week 4	0.45	0.50	0.01	NS

* Mean values after adjustment by covariance to a common initial yield for both groups.

Mean values for initial liveweight and body condition score, and for changes in these parameters are shown in Table 4. The "high" group gained more weight and body condition during the experimental period than the "low" group. (The differences for change in condition are complicated by the fact that the initial body condition of the "high" group was significantly lower than that of the "low" group).

TABLE 4 Mean values* for initial liveweight and body condition score, and for changes in liveweight and body condition score.

	Digestibility of hay Low	High	SEM	Significance of difference
Initial liveweight (kg)	404	408	0.02	NS
Initial condition score	4.3	3.8	0.2	*
Gain in liveweight (kg/day)	0.30	0.62	0.1	*
Gain in condition score (per month)	0.2	0.4	0.1	**

* Mean values after adjustment by covariance to common initial values for both groups

DISCUSSION

The original intention was to conserve two samples of silage from common pastures with digestibilities of about 60% and 70%; this was not achieved and purchased hays were used instead.

Although the hays differed in their digestibilities, they also differed in other respects in association with the difference in "leafiness", e.g. in crude protein concentration, colour and texture. It is not possible to strictly ascribe any effects on animal production directly to only one characteristic of the hays.

The increased intake of the "high digestibility" hay agrees with results of Kaiser *et al.* (1987), Castle (1975) and Gordon (1980) for lucerne hay and pasture silages fed to cows receiving concentrates. The present increase of 0.4 kg DM for an increase of 1% unit in digestibility is the same as that observed by Rogers and Robinson (1984) with cows given silages and restricted cut pasture.

However a decrease in pasture intake (-0.4 kg DM) was associated with the additional increase in hay intake (+ 2.2 kg DM) by the high group in the present experiment. This represents a "substitution rate" of 0.2 kg pasture DM per 1 kg extra hay DM eaten, which is at the lower end of the range quoted in several studies (Wills and Holmes, 1988; Rogers, 1988).

The small, but not significant, increases in yields of milk by the cows which ate the "high digestibility" hay represented an increase of 0.23 kg milk for an increase of 1% unit in DDM. This is identical to the average calculated from several previous experiments (Sangsritavong, 1990). The present increases in milk yield, liveweight and body condition can be explained in terms of the increased intake of metabolizable energy.

The overall responses to the additional 2.2 kg hay DM eaten by cows in the "high" group were (expressed per kg extra DM eaten):

- + 0.5 kg milk
- + 0.018 kg milkfat
- + 0.15 kg liveweight

which are similar to the responses reported by Rogers (1985) from studies in which cows were either given pasture only or pasture plus supplements.

The present results indicate that in the short term, 9 kg DM from the high digestibility hay was "worth" about 1 litre of milk more than 7 kg DM from the low digestibility hay. These data, plus the fact that high digestibility hays and silages will generally be associated with lower yields of DM/hectare (Rogers and Robinson, 1984), suggest that the overall economic benefits of high digestibility supplements for total farm production will not be easy to predict.

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