RESPONSE OF LACTATING COWS TO ABOMASAL INFUSIONS OF CASEIN, METHIONINE AND GLUCOSE

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SUMMARY

Nine cows, surgically fitted with abomasal cannulae, were used in five experiments to investigate the effects of abomasal infusions of casein, glucose and methionine on milk yield and composition. Cows were offered constant amounts of high-moisture pasture silage or pasture. The milk yield and milk protein concentration of cows on the silage ration were increased by abomasal infusions of casein in five experiments. Methionine gave a similar response to casein, whereas an isocaloric infusion of glucose did not alter milk protein yield above the controls for the silage ration. Responses of cows to abomasal infusions of casein were significantly greater for cows offered silage in comparison with pasture. The studies indicate a specific response to abomasally infused casein and methionine in cows fed pasture silage.

INTRODUCTION

Cows fed high-moisture pasture silage produce less milk with a lower protein content than when fed similar amounts of digestible energy (DE) as pasture (Rogers, 1975). The experiments summarized here examined whether the quantity or quality of protein entering the duodenum of cows fed pasture silage may limit milk protein synthesis.

METHOD

A total of nine cows fitted with abomasal cannulae were used in five experiments. They were individually fed direct cut high-moisture pasture silage or pasture in stalls from 7.30 to 12 a.m. and 3.30 to 9.00 p.m. each day. At other times they rested with access to water. During the experiments the dry matter intakes of individual cows were maintained at 70 to 80% of the amount of silage consumed in a 7-day preliminary period. Infusions were during the hours of feeding. Infusates were sodium caseinate, glucose, L-methionine and saline as control. Casein and glucose were infused at concentrations of 30 g/l and 18 g/l isotonic with abomasal contents. The vehicle for methionine was saline.

RESULTS AND DISCUSSION

Responses of cows to abomasal infusions of casein in five experiments are summarized in Table 1. Infusion of 300 g/day of casein to cows fed silage resulted in a consistent increase in milk yield and milk protein concentration, improving milk protein yield by 20%. The responses were less when 150 g/day of casein was infused. These results suggest the response in milk protein yield increased with the amount of amino acids supplied post-ruminally to cows on silage rations. It is of interest that these responses were obtained at low levels of milk production even though the crude protein and energy intakes for this low production were adequate according to NRC standards.

TABLE 1: MILK PRODUCTION RESPONSES TO ABOMASAL INFUSIONS OF SODIUM CASEINATE

Expt.	*Infusate*	*Milk Yield (kg/d)*	*Milk Protein %*	*Protein Yield % above Control*
1	LC	0.31	0.09	6.3
	HC	1.38**	0.14*	20.9
2	HC	1.18**	0.13†	23.1
3	HC	0.59	0.19**	19.3
4	HC	0.63**	0.12*	21.6
5	HC	1.64**	0.18**	19.7
Av. milk yield 7.5 kg/d	HC	+ 1.08	+ 0.15	+ 20.9

HC = 300 g/d sodium caseinate
LC = 150 g/d sodium caseinate
†$P < 0.1$

To exclude the possibility that responses to abomasal infusions of casein may be independent of diet, comparisons were made when cows were offered equal quantities of DE as pasture or silage. The results summarized in Table 2 show abomasal infusions of casein increased milk yield and milk protein percentage of cows on both rations although the responses on the silage ration were greater than on pasture. When infusions of saline were administered, the levels of production show that there is a basic difference between the diets. Infusions of casein increased the DE intake of cows on both rations but to a greater extent on the silage ration. This was due to small refusals during saline infusions on the silage ration.

Because of differences in energy intake, the effects on milk yield and milk composition may be partly explicable in these terms rather than a correction of an amino acid deficiency (Armstrong

TABLE 2: MEAN DIGESTIBLE ENERGY INTAKE (DEI) MILK AND PROTEIN YIELD AND MILK PROTEIN PERCENTAGE OF COWS ON PASTURE (P) OR SILAGE (S) RATIONS AND RECEIVING ABOMASAL INFUSIONS OF 300 g/d SODIUM CASEINATE (c) OR NORMAL SALINE (s)

	Treatments				*Significance*			
Item	*Ps*	*Pc*	*Ss*	*Sc*	*Pc-Ps*	*Sc-Ss*	*(Pc-Ps)-(Sc-Ss)*	*(Ps-Ss)*
DEI (MJ/d)	83.9	89.1	84.4	96.1	*	*	NS	NS
Milk (kg/d)	10.90	11.23	9.90	11.54	NS	**	**	NS
Protein (g/d)	316	334	257	320	†	**	†	**
Protein %	2.92	3.00	2.61	2.79	*	**	NS	*

and Prescott, 1971). This possibility was examined for cows fed on silage by comparing responses to infusions of casein with infusions of glucose. The results in Table 3 show abomasal infusions of glucose to provide the same metabolizable energy (ME) as casein infusions had no effect on milk yield or milk protein content. This suggests the amino acids supplied by casein had a specific effect when silage was fed. Whether this was so in the case of pasture (Table 2) is uncertain.

Since there is indirect evidence that methionine may be the major limiting amino acid for milk synthesis (Derrig *et al.*, 1974), and methionine infusions increased intake and wool growth of sheep fed on silage (Barry *et al.*, 1973), the possibility that methionine may be the factor in casein influencing the responses of cows on silage rations was examined. The results in Table 3 show the relative effects of casein and methionine as post-ruminal

TABLE 3: DRY MATTER INTAKE, MILK AND PROTEIN YIELD, AND MILK PROTEIN PERCENTAGE OF COWS RECEIVING ABOMASAL INFUSIONS OF 300 g/d SODIUM CASEINATE (c), 290 g/d GLUCOSE (G), 12 g/d L-METHIONINE (M) AND NORMAL SALINE (S)

	Infusate				
	C	*G*	*M*	*S*	*Sign.*
DM intake (kg/d silage)	5.85 a	5.90 a	5.95 a	5.97 a	NS
Milk (kg/d)	5.47 a	5.01 a	5.23 a	4.88 a	NS
Protein (g/d)	179 a	152 b	172 a	150 b	*
Protein %	3.27 a	3.02 b	3.29 a	3.08 b	***

Means with different letters differ significantly ($P < 0.05$)

supplements on milk protein synthesis. Abomasal infusions of methionine produced a similar response in milk yield and milk protein concentration as casein infusions, suggesting methionine may be the essential amino acid that is limiting milk protein synthesis on the silage ration.

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