THE EFFECTS OF TWO LEVELS OF CONCENTRATES SUPPLYING THE SAME AMOUNT OF PROTEIN ON SILAGE INTAKE AND MILK PRODUCTION IN COWS GIVEN TWO GRASS SILAGES

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ABSTRACT
The objective of this trial was to investigate the effects of two levels of concentrate (5 and 10 kg) supplying the same amount of protein on feed intake, milk production and rumen fermentation in cows given two different grass silages. The silages were ensiled either with a formic acid based additive (F) or with a mixture of acids and lignosulphonates (L). Fermentation quality and digestibility were better in F silage than in L silage. There were no significant differences between the silages in feed intake, milk yield and milk composition. Feeding F silage increased rumen ammonia concentration and molar proportion of butyrate as compared with L silage. The increase in concentrate level decreased silage intake but increased total intake, milk yield, yield of milk constituents, dry matter digestibility, concentration of VFA and molar proportion of butyrate in the rumen. No significant interactions were observed between the main effects.

KEYWORDS
Cow, grass silage, intake, milk production, protein, concentrate level

INTRODUCTION
Although protein content of diet is quite high when good quality grass silage is fed, high yielding dairy cows needs protein supplementation to balance the amino acid supply from the diet. An increase in protein concentration of concentrates increases milk production when silage based diets are fed. This is due to an increase in silage intake, improved balance between amino acids and energy and enhanced microbial activity in the rumen. Energy supply, which also is critical for a high yielding cow, can be increased using two different feeding strategies: increasing the level of concentrate fed or improving (maximizing) intake of good quality grass silage. The objective of this trial was to investigate the effects of and interactions between the two levels of concentrates supplying the same amount of protein and two silages ensiled with different additives on feed intake, milk production and rumen fermentation in cows.

MATERIALS AND METHODS
Two separate trials were undertaken. Twenty-four Friesian cows were used in a production trial with 4 treatments in a 2x2 factorial arrangement. Two concentrate levels (5 or 10 kg concentrate/d as fed; C5, C10) supplying the same amount of protein were fed with two grass silages. Silages were made from timothy and meadow fescue (first cut), and ensiled either with a formic acid-based additive (5 l/t; 800 g/kg formic acid; F) or with a mixture containing (g/kg) lignosulfonates (500), formic acid (375) and acetic acid (125)(5 l/t; L). The experiment lasted for 100 days. In the second trial six ruminally cannulated cows were used in a partially balanced change over design with four periods and six diets. The six diets comprised the four diets used in the first trial and in addition two diets in which 1 liter of a mixture (560 g dry matter (DM)/d) of polyol (by-product of xylitol) and fractionated vinasses (betaine removed) was given mixed with both silages and 5 kg of concentrate. The purpose was to study if the solution could stimulate silage intake. Each experimental period lasted for 21 days. Diet digestibility was determined by using acid insoluble ash as an internal marker.

RESULTS AND DISCUSSION
Crude protein (CP) contents were 176, 172, 290 and 141 g/kg DM for grass silage F and L, and for concentrates C5 and C10, respectively. Fermentation quality of F silage was better compared with L silage in terms of lower pH (3.97 vs 4.42), lower concentration of fermentation acids (lactic acid 44 vs 52, acetic acid 23 vs 41 and butyric acid 0.9 vs 4.5 g/kg DM) and lower proportion of ammonia N in total N (75 vs 134 g/kg).

The results for feed intake, milk production, DM digestibility and LW changes (trial 1) are shown in Table 1. No significant interactions were observed between the main effects. Although silage DM intake was significantly increased with C5 Diet, total DM intake was 2.3 kg/d smaller with C5 diet compared with C10 Diet, and consequently milk yield was 3.4 kg less with C5 Diet. Average milk yield increment was 0.78 kg milk per kg concentrate DM. There was no difference in milk fat content when concentrate level was increased from 5 to 10 kg, which is in accordance with similar ratio of glucogenic to lipogenic VFA in the rumen (Table 2). Generally increasing concentrate level increases milk protein content but in the present trial protein content was not affected by the amount of concentrate, probably because the same amount of protein was supplied by both concentrate levels. Milk urea content was significantly increased with C5 Diet compared with C10 Diet. Due to the increased milk yield also the yields of fat, protein and lactose were significantly increased with C10 Diet. There was a tendency showing a smaller LW change with C5 Diet. DM digestibility was significantly increased when C10 was fed. Silage additive had no effect on feed intake, milk yield or milk composition probably because the difference in the extent of silage fermentation was rather small. In other studies restricting silage fermentation has increased both milk fat and protein content. DM digestibility was lower with L silage than with F silage, especially at the lower level of concentrate supplementation.

Rumen fermentation parameters (trial 2) are presented in Table 2. Higher level of concentrate decreased significantly average rumen pH values and simultaneously increased significantly VFA concentration. The lowest post prandial pH value (a mean of C10 diets) was about 5.9. Average rumen ammonia concentration was almost double when the lower level of concentrate was fed compared with the higher level of concentrate. F silage Diet produced a significantly higher ammonia concentration than did L silage. Feeding L silage tended to have higher propionate and had significantly lower butyrate proportion in the rumen compared with F silage. The higher molar proportion of butyrate with F silage was most propably due to the higher sugar content in F silage. Although these changes were significant, the differences between the treatments were small. However, milk fat content tended (P=0.16) to increase in trial 2 with F silage compared with L silage.

CONCLUSIONS
Despite the differences in the extent of silage fermentation, there were no differences in feed intake and milk production between the silages. Reducing concentrate intake while maintaining the amount of crude protein supplied from concentrates increased silage DM intake but decreased total DM intake and milk yield suggesting the milk production was limited by energy supply in the conditions of the present study.

Table 1
The effects of levels of concentrates on feed intake, milk yield and composition, yields of milk constituents, DM digestibility and LW change in cows given grass silages (trial 1).

	Treatment					Significance[2]	
	C5F	C5L	C10F	C10L	**SEM**[1]	C5 vs 10	F vs L
Silage, kg DM/day	13.6	13.9	11.7	11.7	0.35	***	
Concentrate, kg DM/day	4.3	4.3	8.6	8.7	0.04		
Total intake, kg DM/day	17.9	18.3	20.3	20.4	0.33	***	
Milk yield, kg/day	26.2	26.6	29.7	29.9	0.59	***	
Milk composition g/kg							
Fat	39.2	38.0	39.5	41.0	1.27		
Protein	30.3	30.4	31.5	30.3	0.95		
Lactose	48.0	47.4	47.5	48.1	0.46		
Urea, mg/100ml	44.0	43.8	25.4	28.1	2.02	***	
Yield g/d							
Fat	986	956	1167	1232	42.8	***	
Protein	759	775	907	892	16.2	***	
Lactose	1229	1240	1361	1424	38.5	***	
LW change, kg/d	-0.11	-0.13	0.00	0.00	0.091	P=0.15	
DM digestibility	0.736	0.699	0.742	0.727	0.0075	*	**

[1]SEM=Standard error of means; [2]Statistical significance: * P<0.05; ** P<0.01; *** P<0.001

Table 2
The effects of levels of concentrates on rumen fermentation parameters in cows given grass silages (trial 2, mean of seven sampling times).

	Treatment							Significance[2]	
	C5F	C5F+	C5L	C5L+	C10F	C10L	**SEM**[1]	C5 vs 10	F vs L
pH	6.40	6.48	6.48	6.46	6.20	6.23	0.051	***	
NH_4N, mmol/l	18.6	19.3	16.7	17.3	10.0	9.2	0.90	***	*
VFA, mmol/l	128	125	124	126	134	132	2.2	**	
Molar proportion of VFA's, mmol/mol									
Acetate	669	669	675	670	673	669	6.4		
Propionate	181	176	182	187	172	182	5.2		P=0.11
Butyrate	104	112	99	100	120	114	2.7	***	**

[1]SEM=Standard error of means; [2]Statistical significance: * P<0.05; ** P<0.01; *** P<0.001