Alfalfa Silage Versus Red Clover Silage or a Mixture of Alfalfa and Red Clover Silage as the Sole Forage for Lactating Dairy Cows

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Introduction

The large proportion of CP in alfalfa silage (AS) that is present as NPN substantially reduces the efficiency of protein utilization by lactating dairy cows (Nagel and Broderick, 1992). Red clover silage (RCS) typically has a much lower content of NPN than AS (Albrecht and Muck, 1991). In a previous feeding study (Broderick and Sterrenburg, 1996 USDFRC Res. Sum.), we found that DMI and milk yield were greater on AS than on RCS, but this result was confounded by the fact that the CP content of the AS was seven percentage units greater than that of the RCS. Therefore, we repeated the comparison of AS versus RCS as the only forage for lactating cows, but with added solvent soybean meal (SBM) to equalize dietary CP content. Also, a third diet containing silage harvested from a co-culture of alfalfa and red clover (AS + RCS) was included in this trial. No supplemental bypass protein was used in this study. Our objective was to compare the lactational performance of cows fed AS, RCS or AS + RCS as their sole source of dietary forage.

Materials and Methods

A replicated 3 x 3 Latin square lactation trial was conducted. First cutting red clover was wilted to about 40% DM, chopped and ensiled in a concrete stave silo. Second cutting alfalfa was wilted to about 50% DM, chopped and ensiled in an upright tower silo. A mixture of alfalfa and red clover planted together, also from first cutting, was wilted to about 50% DM, then chopped and ensiled in a concrete stave silo. Based on the CP contents of initial samples of each silage obtained when the silos were opened, three diets were formulated with equal NE_L containing 60% DM from one of the forages, 32 or 36% DM from (unground) high moisture corn, plus sufficient SBM to give about 16.5% CP (Table 1). Twenty-one multiparous cows (including three with ruminal cannulae), averaging 65 DIM, were blocked into seven groups of three cows by DIM and randomly assigned to diets in replicated 3 x 3 Latin squares. Diets were fed for 4-wk periods before switching to the next diet (total 12 wk); production and intake data were analyzed from the third and fourth wk of each period. Apparent digestibility of DM and NDF was estimated from fecal grab samples using indigestible ADF as an internal marker. Ruminal sampling was done on the last day of each period.

Results and Discussion

The CP contents of the silages changed through the course of the trial — the AS declined and the RCS increased from the CP levels used to formulate the diets. Thus, the AS diet is slightly lower, and the RCS diet slightly higher, than the target of 16.5% CP; the AS + RCS diet contained very nearly the desired level of CP (Table 1). The relative CP levels of the AS and the RCS were similar to what was observed previously, when we found that RCS was about 1 to 2 percentage units lower in CP than AS. As expected, RCS had lower NPN: RCS was 19% and AS + RCS was 23% lower in NPN than the AS. The RCS and AS + RCS were, respectively, 2.3 and 4.2 percentage units lower in NDF than the AS (Table 1). Based on its chemical composition, AS + RCS was more like RCS than AS. Intake of DM was lower on the RCS and AS + RCS diets than on the AS diet, but apparent digestibilities of DM and NDF (estimated using indigestible ADF as internal marker) were higher (Table 2). Using these data, intakes of digestible DM were computed to be 14.4, 14.8 and 16.4 kg/d on the diets containing, respectively, AS, RCS and AS + RCS. There were no differences in milk composition or in production of milk and milk components among the three diets (Table 2). However, the similar milk yields at lower DMI resulted in significantly higher efficiencies (milk : DMI) on the RCS and AS + RCS diets.

Although milk urea and ruminal ammonia were not different among the three diets, concentrations of blood urea tended to be lower on the RCS and AS + RCS diets (Table 2), despite their higher levels of CP. This suggested that efficiency of utilization of CP was greater on the two diets containing RCS.

Summary and Conclusion

Results from this trial indicated that, although DMI was lower on diets containing RCS or AS + RCS as the sole forage, DM and fiber digestibility were greater and yield of milk and milk components was similar in cows producing about 33 kg of milk/d. Milk production per unit DMI was higher, and blood urea was depressed, suggesting that energy and CP utilization were more efficient on diets containing RCS or AS + RCS than on diets containing AS. These results suggest that the energy and protein in RCS may be used more efficiently than in AS.

References

Albrecht, K. A. and R. E. Muck. 1991. Proteolysis in ensiled forage legumes that vary in tannin concentration. Crop Sci. 31: 464-469.

Nagel, S. A. and G. A. Broderick. 1992. Effect of formic acid or formaldehyde treatment of alfalfa silage on nutrient utilization by dairy cows. J. Dairy Sci. 75:140-154.

Table 1. Composition of forages and diets[1].

	Forage		
Item	AS	RCS	AS + RCS
DM, %	52.0	35.8	49.0
CP, % of DM	19.1	17.9	17.4
NPN, % of total N	50.0	40.3	38.7
NDF, % of DM	46.2	43.9	42.0
ADF, % of DM	36.2	33.6	31.9

	Diet		
Item	AS	RCS	AS + RCS
	- - - - - - - - -	% of DM	- - - - - - - - -
Alfalfa silage	60.0	. . .	. . .
Red clover silage	. . .	60.0	. . .
Alfalfa + red clover silage	. . .	. . .	60.0
HMC	36.2	32.3	32.3
Soybean meal	2.7	6.6	6.6
Minerals & vitamins	1.1	1.1	1.1
Chemical composition			
CP	16.0	16.8	16.4
NDF	33	32	31
NE_L , Mcal/kg DM	1.59	1.59	1.59

[1]AS = alfalfa silage, RCS = red clover silage, AS + RCS = alfalfa plus red clover silage (grown together), HMC = high moisture corn (unground).

Table 2. Effect of feeding forage as alfalfa silage (AS), red clover silage (RCS) or a mixture of AS and RCS (grown together) on DMI, BW gain, apparent DM and NDF digestibility, production of milk and milk components, and concentrations of blood glucose, blood and milk urea, and ruminal pH and ammonia.

Item	AS	RCS	AS + RCS	SEM[1]	P > F[2]
DMI, kg/d	25.5[a]	23.0[b]	24.2[b]	0.4	0.011
BW change, kg/d	0.38	0.03	0.29	0.15	0.294
DM digestibility, %	56.3[c]	64.1[b]	67.6[a]	0.9	< 0.001
NDF digestibility, %	42.7[b]	49.9[a]	51.3[a]	0.5	< 0.001
Milk yield, kg/d	32.0	32.7	33.6	0.6	0.742
Fat, %	3.36	3.42	3.59	0.13	0.648
Fat, kg/d	1.08	1.12	1.21	0.04	0.817
Protein, %	3.04	3.02	3.03	0.02	0.284
Protein, kg/d	0.98	0.99	1.02	0.02	0.729
Lactose, %	4.77	4.81	4.81	0.03	0.859
Lactose, kg/d	1.54	1.58	1.63	0.03	0.820
SNF, %	8.52	8.55	8.56	0.03	0.514
SNF, kg/d	2.75	2.81	2.90	0.06	0.753
Efficiency[3]	1.27[b]	1.43[a]	1.40[a]	0.04	0.049
Blood glucose, mg/dL	55.0	55.9	54.5	0.5	0.086
Blood urea, mg N/dL	13.13[a]	12.89[ab]	12.40[a]	0.39	0.052
Milk urea, mg N/dL	9.92	10.46	9.60	0.40	0.292
Ruminal pH	6.15	6.05	6.15	0.05	0.232
Ruminal ammonia, mM	9.30	8.56	6.94	0.95	0.218

[a,b,c]Means within the same row without a common superscript differ ($P < 0.05$).
[1]SEM = Standard error of the mean.
[2]Probability of a significant effect of diet.
[3]Milk yield : DMI.