An analysis of the relative value of lucerne and red clover silages for lactating cows

G.A. BRODERICK
USDA, ARS, US Dairy Forage Research Center, 1925 Linden Dr. West, Madison, WI 53706, USA.

INTRODUCTION

When ensiled, 50 to 60% of the CP in lucerne typically is broken down to nonprotein N (NPN). High levels of NPN depress protein utilisation by lactating dairy cows. Red clover, a forage legume similar to lucerne, forms less NPN in the silo. Its lower yields, poorer persistency, and slower field drying rates limits widespread use of red clover in North America. However, red clover appears to be well adapted to Northern Europe. Over a number of years, five lactation trials were conducted at our Center to determine the relative feeding value of lucerne silage (LS) and red clover silage (RCS) for dairy cows. Although the trials had several diets, each contained at least one direct comparison of LS to RCS fed at equal dietary DM. This report summarises results of an analysis of the relative production of dairy cows fed LS or RCS over all five studies.

MATERIALS AND METHODS

Results were from five Latin square feeding studies that are already published (Broderick et al., 2000; Broderick et al., 2001). Data were obtained by feeding LS and RCS harvested at various cuttings during 1992 through 1998. Generally, forages were cut using conventional mower conditioners, field wilted to 30 to 50% DM, chopped to a theoretical length of 2.9 cm, and ensiled without additives in either upright concrete stave silos or in plastic bags. Diets were formulated to contain equal DM from either LS or RCS; overall mean dietary compositions were weighted for the number of dairy cows used in each trial. Average dietary composition was (DM basis): 63% silage, 34% high moisture maize, 2% solvent soyabean meal, 1% mineral plus vitamin supplements, and 33% NDF. Because LS contained greater CP, LS diets averaged 17.7% CP versus 15.8% CP for RCS diets. A total of 104 animal observations were made on each diet. Data from all five trials were analyzed using proc GLM in SAS with a model that included period(trial), trial, forage, and forage by trial interaction. Least square means are reported.

RESULTS AND DISCUSSION

The RCS contained less CP and ADF than LS (Table 1). There was a trend for lower pH in RCS, suggesting that it fermented more rapidly. The NPN in RCS accounted for only two-thirds as much N as in LS; ammonia N also was lower in RCS. These differences were observed in all five trials. The RCS contained 1.6-percentage units more ADIN than LS; ADIN may form through action of polyphenol oxidase, the plant enzyme that accounts for lower NPN in RCS. Least square means from the five lactation studies are in Table 1. Cows consistently ate more when fed LS; overall DM intake was 1.5 kg/d lower on RCS. Responses due to silage source were variable among trials. For example, milk yield was greater on LS in two trials, not different in two trials, and greater on RCS in one trial. However, there was no significant overall effect of silage source ($P \geq 0.16$) on yield of milk or protein despite differences in feed intake. There were trends ($P \sim 0.10$) for greater weight gain and lower fat yield on RCS than LS; also, milk fat content was reduced ($P = 0.05$). These results suggested that replacing dietary LS with RCS may lead to fat being redirected from mammary secretion to body deposition. Efficiency of capture of feed N in milk was greater ($P < 0.01$), and both milk and blood urea levels were lower ($P < 0.01$), on RCS diets. Although confounded by dietary CP, these differences suggested that N losses may be reduced through feeding of RCS or other low NPN silage. Higher feed efficiency was associated with greater nutrient digestibility: apparent digestibility of DM, OM, NDF, and ADF all were higher ($P < 0.01$) on RCS. Moreover, replacing LS with RCS reduced ($P < 0.01$) faecal DM output by 19%. A reduction of this magnitude, if milk yield were not altered, would decrease the amount of manure solids needing to be disposed of on the dairy farm. Metabolisable energy (ME) requirements for maintenance, weight gain, and milk secretion (based on milk composition) were used to compute forage energy values. Mean ME requirements were nearly identical (average 194 MJ/d). Subtracting ME contributed from dietary concentrate yielded estimates of ME supplied by LS and RCS. Per unit DM, LS was computed to have 7.9 MJ/kg versus 8.8 MJ/kg for RCS, indicating that RCS contained 11% more ME, despite the two forages having equal NDF (Table

1). Although DM intake differed, digestible OM intake was nearly identical on the two silages: 14.4 kg/d on LS and 14.5 kg/d on RCS. This indicated that the cows ate to constant energy supply.

Table 1. Composition of lucerne and red clover silages and effect of feeding diets with lucerne silage or red clover silage on production and digestibility in lactating dairy cows.

Item	Lucerne	Red Clover	SE	*Probability*
Silage composition				
DM, %	41.3	40.3	1.2	0.55
CP, % of DM	20.9	17.9	0.4	< 0.01
NDF, % of DM	43.3	43	0.5	0.63
ADF, % of DM	33.8	32.1	0.4	< 0.01
pH	4.62	4.49	0.05	0.07
NPN, % of total N	53.1	35.8	1	< 0.01
Ammonia N, % of total N	9.3	7.7	0.3	< 0.01
ADIN, % of total N	3.5	5.1	0.2	< 0.01
Production				
DM intake, kg/d	22.9	21.4	0.3	< 0.01
Weight gain, kg/d	0.02	0.2	0.07	0.08
Milk, kg/d	32	31.2	0.5	0.27
Fat, %	3.66	3.51	0.06	0.05
Fat, kg/d	1.12	1.08	0.02	0.1
Protein, %	3.03	3	0.02	0.29
Protein, kg/d	0.93	0.91	0.01	0.26
Milk/DM intake	1.42	1.47	0.02	0.1
Milk N/N intake	0.236	0.271	0.003	< 0.01
Milk urea, mg N/dl	12.5	8.7	0.2	< 0.01
Blood urea, mg N/dl	14.2	9.3	0.3	< 0.01
Fecal DM, kg/d	8.8	7.14	0.15	< 0.01
Apparent digestibility, %				
DM	61.5	66.6	0.7	< 0.01
OM	63	67.9	0.6	< 0.01
NDF	43.1	52.5	0.7	< 0.01
ADF	44.5	52.2	0.7	< 0.01

CONCLUSIONS

Over five lactation trials, RCS averaged 3.0 and 1.7 percentage units lower in CP and ADF but contained only 67% as much NPN (as a proportion of total N). When fed at equal contents of the diet, cows consumed less DM on RCS than on LS but equal amounts of digestible OM. Yields of milk and protein were equal when RCS replaced LS, despite lower intake. Milk fat content was lower, and there were tendencies for greater weight gain and lower fat yield on RCS. Replacing LS with RCS increased apparent digestibility of dietary nutrients and N efficiency. Utilisation of both energy and CP in RCS exceeded that of LS. These results suggest that feeding RCS instead of LS will improve nutrient efficiency and lower environmental N loss.

REFERENCES

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