PARTIAL SUBSTITUTION OF ALFALFA HAY WITH GRASS HAY (SUDANGRASS, ELEPHANT GRASS) IN DIETS FOR LACTATING DAIRY CATTLE: DIGESTIVE FUNCTION.

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Introduction

Elephant grass (*Pennisetum purpureum*) is a tall leafy perennial that is characteristic for its high biomass yield (>3000 kg/hectare). The nutrient composition of elephant grass has comparatively little variation between cuttings, even when cut infrequently (Chaparro and Sollenberger, 1997). In this study we are evaluating the feeding value of Promor A, a new elephant grass variety selected for its superior agronomic characteristics (growth, tillering, closing in, ratooning ability, drought tolerance and ease of cutting), and for its higher CP:NDF ratio. Alvarez et al (2000) observed that in steam-flaked corn-based growing diets containing 20% forage (DMB) as Promor A, alfalfa hay (early bloom), or sudangrass hay, DMI and ADG were greater for diets containing Promor A. The observed net energy value of Promor A (1.19 and .63 Mcal/kg for maintenance and gain, respectively) was consistent with predicted values based on its crude protein and fiber content. Virtually all of the improvement in ADG was attributable to superior palatability or acceptability of elephant grass versus sudangrass and alfalfa hay. The objective of this study was to evaluate the replacement value of Promor A in diets for lactating dairy cows in terms of ruminal and total tract digestion of OM, NDF, protein, and energy.

Materials and methods

Four lactating Holstein cows with cannulas in the rumen and proximal duodenum were used in a 4 x 4 Latin square experiment. Cows were fed a steam-flaked corn-based diet containing (DMB): 1) 49% alfalfa hay; 2) 24% alfalfa hay and 16% sudan grass hay; 3) 24% alfalfa hay, 8% sudan grass hay, and 8% elephant grass hay; and 4) 24% alfalfa hay and 16% elephant grass hay. Diets were formulated to contain 30% NDF (DMB). Experimental periods consist of a 10-d diet adjustment period followed by a 4-d collection period. During the collection period duodenal and fecal samples were taken from all cows, twice daily as follows: d 1, 0750 and 1350; d 2, 0900 and 1500; d 3, 1050 and 1650; and d 4, 1200 and 1800. Individual samples consist of approximately 700 mL duodenal chyme and 200 g (wet basis) fecal material. Samples from each cow and within each collection period were composited for analysis. During the final day of each collection period, ruminal samples were obtained from each cow at 4 h after feeding via the ruminal cannula. Upon completion of the trial, ruminal fluid was obtained from all cows and composited for isolation of ruminal bacteria via differential centrifugation (Bergen et al., 1968). Samples were subjected to all or part of the following analysis: DM (oven drying at 105 C until no further weight loss); ash, Kjeldahl N, ammonia N (AOAC, 1975); purines (Zinn and Owens, 1986); NDF (Chai and Uden, 1998) and ADF (Goering and Van Soest, 1970); chromic oxide (Hill and Anderson, 1958) and starch (Zinn, 1990). Microbial organic matter (MOM) and N (MN) leaving the abomasum is calculated using purines as a microbial marker (Zinn and Owens, 1986). OM fermented in the rumen (OMF) is considered equal to OM intake minus the difference between the amount of total OM reaching the duodenum and MOM reaching the duodenum. Feed N escape to the small intestine is considered equal to total N leaving the abomasum minus ammonia-N and MN and, thus, includes any endogenous contributions. The trial was analyzed as a 4 x 4 Latin square. Treatment effects were tested for the following orthogonal contrasts: alfalfa vs. grass hay, linear effects of elephant grass substitution with sudangrass, quadratic effects of elephant grass substitution with sudangrass (Hicks, 1973).

Results

Treatment effects on characteristics of digestion are shown in Table 1. Consistent with Alvarez et al (2000), partial substitution of alfalfa hay with grass hay did not influence ($P > .10$) ruminal digestion of OM, and NDF. Microbial efficiency was greater (18%, $P = .07$) for alfalfa hay than for grass hay substituted diets. Nonammonia N flow to the small intestine as a percentage of N intake (ruminal N efficiency) was lower (linear effect, $P < .10$) for elephant grass than for sudangrass hay. In contrast, Alvarez et al (2000) observed greater N efficiency with growing-finishing diets containing 20% of elephant grass vs. 20% sudangrass.

Discussion

There were no treatment effects ($P>.10$) on postruminal and total tract digestion of OM, and NDF. Although, apparent total tract N digestion was greater (5%, $P<.05$) for alfalfa hay than for grass hay substituted diets. This difference in apparent N digestibility can be largely explained by differences in N content of the diet (Holter and Reid, 1959). Digestible energy content of the diet was lower (4%, P< .05) for alfalfa hay than for the grass hay substituted diets.

Conclusions

1. Substitution of a portion (40%) of alfalfa hay for grass hay in diets for lactating cows may slightly decrease ruminal microbial efficiency. However the impact on ruminal and total tract digestion of OM and NDF are small. Because of differences in NDF content of alfalfa hay versus grass hays, the substitution of a portion of the alfalfa hay with grass hay will result in less total dietary forage, permitting greater dietary energy density.

Table 1. Influence of partial substitution of alfalfa for hay grass (sudangrass, elephant grass) on digestive function in diets for lactating dairy cattle. Treatments[a]

		Sudangrass: Elephantgrass, ratio			
Item	Control	100:00	50:50	00:100	SEM
Intake, g/d					
DM	15055	15054	15347	15115	122
OM	13617	13818	13657	13418	119
NDF	4065	4230	3699	3643	32
N	390	327	384	366	3
Flow to the duodenum, g/d					
OM[c]	9008	8345	8486	8290	263
NDF	2983	2717	2576	2480	209
N[bd]	417	362	401	380	10
NAN[ed]	396	345	381	362	9
MN	200	169	197	169	12
Feed N[f]	177	183	193	6	197
Ruminal digestion, % of intake					
OM	48.3	51.7	52.6	50.9	2
NDF	26.1	35.7	30.4	32	5.5
Feed N[g]	49.7	45.8	52.6	47.6	1.7
MN efficiency[ch]	30.4	23.9	27.4	24.8	1.9
N efficiency[fi]	1.01	1.06	0.99	0.98	0.03

Postruminal digestion, % of flow to duodenum

OM	52.6	50.9	51.1	53.1	2.5
NDF	19.6	13.9	12.5	10.8	7.9
N	70.5	68.8	69.7	69.3	0.6

Total tract digestion, % of intake

DM	67.1	67.1	66.7	67.9	0.9
OM	68.7	70.3	69.9	71.4	1
NDF	41.7	45.4	40.2	43.5	2.5
N[b]	68.6	65.3	68.6	68.4	0.8
DE, Mcal/kg[e]	2.71	2.85	2.78	2.9	0.04
Digestible Energy, %[e]	64.6	67.3	66.8	68.5	1

[a] Treatments: Control, 49% alfalfa hay; 100:00, 24% alfalfa hay and 16% sudangrass hay; 50:50, 24% alfalfa hay, 8% sudan grass hay, and 8% elephant grass hay; and 00:100, 24% alfalfa hay and 16% elephant grass hay.

[b] Linear effect of grass hay, P < .05.

[c] Alfalfa vs. grass effect, P < .10.

[d] Quadratic grass hay effect, P < .10.

[e] Alfalfa vs. grass effect, P < .05.

[f] Linear effect of grass hay, P < .10.

[g] Quadratic grass hay effect, P < .05.

[h] Microbial N, g/kg OM fermented.

[i] Nonammonia N leaving the abomasum/N intake.

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