EFFECTS OF VARYING FORAGE SOURCE IN A CONCENTRATE DIET ON THE METABOLISM AND APPARENT RETENTION OF CRUDE PROTEIN BY LAMBS

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ABSTRACT

Twenty-one Rambouillet wether lambs (average initial body weight (BW) = 41 kg) were used in a metabolism trial to evaluate the digestibility of three different concentrate diets each containing one of the following: alfalfa pellets (*Medicago sativa* L.), bermudagrass-clipping (*Cynodon dactylon* L.) pellets, or Coastal bermudagrass hay (*Cynodon dactylon* L.) pellets. Treatments were arranged in a completely randomized design for dry matter intake (DMI), fecal excretion, and dry matter digestibility (DMD) using analysis of variance. Analysis of covariance was used for N intake, (g/d), fecal N, (g/d), fecal N, (% of intake), urinary N, (g/d), urinary N, (% of intake), N absorbed, (g/d), % N absorbed, N retained, (g/d), and N retained, (% of intake). Prior to the study, lambs were housed in pens and fed the control diet containing alfalfa pellets. A five day adaptation period was followed by a seven day collection period. Intake by lambs was limited to 2.5% of BW. Dry matter intake and dry matter digestibility were not different (P > .05) among treatment groups. Nitrogen intake, apparent absorption, and apparent retention expressed as percent of intake and g/d did not differ among lambs fed their diets. Initial weight was used as a covariate in the N data to account for any unwanted variation within treatment groups. Based on the absorption and retention data, bermudagrass-clipping pellets are an adequate forage source at 10% of the diet for lambs on a concentrate diet.

KEYWORDS: bermudagrass, metabolism, digestibility, lamb

INTRODUCTION

Proper amounts of forage are necessary for the development of lambs consuming a concentrate diet. It is suggested by the NRC (1985) that lambs between the ages of 4 and 7 months of age weighing approximately 30 kg should receive a diet consisting of 60% concentrate and 40% forage. Alfalfa is often the forage used in these concentrate diets because of the high nutritive qualities that it can provide to the animal. Crude protein in high quality alfalfa commonly exceeds 18% (Weder, 1999). Alfalfa also is high in calcium and phosphorus as well as vitamin A. These are minerals and vitamins that are necessary for proper development of growing lambs (NRC 1985). All of these qualities make alfalfa an excellent forage source to use in the diets of livestock.

Bermudagrass grown in domestic lawns is maintained under near optimal conditions to provide a high aesthetic value to homes. This aesthetic value increases the value of the home, but generally provides no other value. After these lawns are cut, the grass-clippings are disposed. Laboratory analysis has determined that grass clippings from these highly maintained lawns can provide some of the same nutritive characteristics as alfalfa. Crude protein levels of samples taken from these lawns have reached as high as 24% (Starbuck, 2003). Calcium and P levels also have shown to be similar to alfalfa through laboratory analysis.

While alfalfa is an excellent forage source for livestock; planting, growing, fertilizing, harvesting, baling, and transporting can become costly. Bermudagrass grown in domestic lawns on the other hand is grown for reasons other than providing forage to livestock. Therefore, research was conducted to determine if bermudagrass-clippings can provide an alternative forage source to alfalfa. The objective of this study was to evaluate the apparent absorption and retention of CP by lambs fed a concentrate diet containing alfalfa pellets, bermudagrass-clipping pellets, or Coastal bermudagrass hay pellets at 10% of the diet.

MATERIALS AND METHODS

Animals, Diets, and Management: Twenty-one Rambouillet wether lambs (average initial BW=41 kg) were used to evaluate the effect of forage source in a concentrate diet on the metabolism and retention of CP by lambs. Prior to the study, lambs were vaccinated, drenched, and placed in a feedlot style pen where they had free access to water and began to receive the control diet (Table 1) at 1.36 kilograms per head. Lambs were fed in the feedlot pen for 2-week period for adjustment to the diet. Lambs were then randomly assigned to treatment groups (seven lambs per treatment) in a completely randomized design and placed in metabolism crates. Metabolism crates were designed to allow a full collection of unconsumed feed, urine, and fecal material. The crates included an individual water source, removable feed bunk, fecal tray and collection bin, and a urine pan that funneled urine into a storage container. Diets consisted of: alfalfa pellets, Coastal bermudagrass hay pellets, or bermudagrass-clipping pellets at 10% of the total ration. Alfalfa pellets and bermudagrass hay were obtained from a local feed company. Bermudagrass-clipping pellets were obtained through a local landscape company. All clippings were obtained from one sight. Tables 2 and 3 list the ingredient composition of the treatment diets. Chemical composition of experimental diets fed to lambs is listed in Table 2. Lambs remained in metabolism crates for 12 d. Day 1 through 5 was considered an adaptation period and day 6 through 12 was the collection period. Table 3 shows the collection schedule of samples taken and the days of the collection period when samples were taken. Initial weights were used to calculate the daily quantity of feed (2.5% of BW) to be offered to the lambs for the duration of the 12 d period. After lambs were placed in metabolism crates, they were offered half of their daily allotment of feed. Lambs were fed twice daily at approximately 0800 and 1700 daily. A feed sample from each diet was On day 5 through 11, unconsumed feed was transferred to numbered buckets, weighed, and stored for later laboratory analysis.

Table 1. Ingredient Composition of Diets (% of diet, DM basis)

Item	Alfalfa Diet	Coastal Hay Diet	Grass Diet
Ingredient			
Cracked Corn	64.70	64.37	64.87
Cottonseed Meal 41% CP	5.75	5.75	5.75
Soybean Meal 44% CP	2.05	2.05	2.05
Cottonseed Hulls	10.50	10.50	10.50
Pelleted Bermudagrass-Clippings	0.00	0.00	10.00
Coastal Bermudagrass Hay Pellets	0.00	10.00	0.00
Alfalfa Pellets	10.00	0.00	0.00
Calcium Carbonate	1.30	1.30	1.30
Ammonium Chloride	0.50	0.50	0.50
Cane Molasses	5.00	5.00	5.00
Urea	0.17	0.50	0.00
Premix[a]	0.03	0.03	0.03

[a]Premix included Vitamin A, Selenium, and Decox at levels recommended by NRC (1985)

Table 2. Chemical Compositions of Experimental Diets Fed to Lambs

Item	Alfalfa Diet	Coastal Hay Diet	Grass Diet
DM, %	86.6	87.25	87.8
Ash, %	7.61	8.27	8.45
CP, %	13.82	13.71	13.65
Ca, %	1.2	1.05	1.14
P, %	0.39	0.38	0.41

Table 3. Collection Schedule of Samples Obtained

	Samples Obtained[a]				
Day	Body Weight	Feed	Refusal	Fecal	Urine
0	+	x	x	x	x
1	x	x	x	x	x
2	x	x	x	x	x
3	x	x	x	x	x
4	x	+	x	x	x
5	x	+	+	x	x
6	x	+	+	+	+
7	x	+	+	+	+
8	x	+	+	+	+
9	x	+	+	+	+
10	x	+	+	+	+
11	x	x	+	+	+
12	x	x	x	+	+

[a] + = sample taken; x = no sample taken

After completion of the study, each sample was ground through a 2mm screen in a Wiley mill and dried overnight in a 100° C oven to determine dry matter. The quantity of the dry unconsumed feed was then subtracted from the quantity of dry feed offered from day 4 to 10 to determine the actual amount of dry feed consumed.

Urine samples were obtained from each lamb on day 6 through 12 of the collection period. Prior to the P.M. feeding, urine containers (one gallon plastic jugs) from each crate were removed. To ensure that no urine was lost, another container containing 100 mL of 20% (vol/vol) HCl immediately replaced the old container. HCl was added to each container to prevent loss of N to the atmosphere through volatilization (Salisbury et al., 2004). The quantity of urine excreted by each lamb was weighed daily and a 20% sub-sample was taken. The sub-samples were then transferred to a plastic container and stored in a refrigerator. At the end of the study, storage containers were frozen for later laboratory analysis. Upon analysis, a 3-mL sample was used to determine N content by Kjehldahl analysis (AOAC, 1990).

Fecal samples were obtained on d 6 through 12. At the conclusion of the trial, fecal samples were placed in a freezer for later laboratory analysis. Upon analysis, samples were dried overnight in a 100° C oven to determine dry matter. Samples were then ground through a 2mm screen in a Wiley mill and analyzed for N content via LECO analysis.

Statistical Analysis: Dry matter intake g/d, fecal excretion g/d, and percent dry matter digestibility were analyzed as a completely randomized design in the GLM procedure of SAS (1999). Animal was considered the experimental unit with seven replications per treatment group.

N intake g/d, fecal N g/d, fecal N percent of intake, urinary N g/d, urinary N percent of intake, N absorption g/d, percent N absorbed, N retained g/d, N retained percent of intake, and N retained percent of absorbed was analyzed as a completely randomized design using initial body weight as a covariate in the GLM procedure of SAS (1999). Initial body weight was used as a covariate to account for any unwanted variation within treatment group. Animal was again considered the experimental unit and there were seven replications per treatment group.

RESULTS

Dry matter intake, fecal excretion, and dry matter digestibility were not significantly different ($P > .05$) among the alfalfa diet, Coastal hay diet, and bermudagrass-clipping diet. Nitrogen intake, (g/d), fecal and urinary N excretion, and apparent absorption and retention (g/d or percent of intake) did not differ among diets ($P > .05$). Initial weight, expressed as a covariate, was not significant at the ($P < .05$) level for any N analyses, but began to approach significance ($P < .15$) for N intake, fecal N g/d, urinary N g/d, and N absorbed g/d. Therefore, initial weight expressed as a covariate was left in the model to account for the unwanted variation within treatment groups. Results from the metabolism trial are listed in Tables 4 and 5.

DISCUSSION

Lambs in this study were placed in metabolism crates to determine digestibility of diets as well as CP retention and absorption. Results indicate that each diet offered to the lambs within each treatment provided the same amount of digestibility as well as retention and absorption of protein. Previous research by Galloway et al., 1991; and Buxton et al., 1995 found that cool-season grasses usually contain higher concentrations of crude protein and lower concentrations of NDF than warm season-grasses. This can also be said for legumes such as alfalfa which is a cool season plant. Preliminary laboratory analysis of alfalfa pellets, bermudagrass-clipping pellets, and Coastal bermudagrass hay; (Table 6) shows that the alfalfa has higher crude protein values than that of the Coastal bermudagrass hay and the lowest percent neutral detergent fiber values. This would lead to believe that the alfalfa diet would be the most digestible. However, because the results reflect no differences ($P < .05$), we conclude that because the forage source only made up 10% of the diet, it was not substantial enough to effect digestibility, protein retention, or absorption.

Table 5. Treatment Effects On Nitrogen Metabolism By Lambs Consuming Three Different Forage Sources

	Treatment			
Item	Alfalfa Diet	Coastal Hay Diet	Grass Diet	SEM
Lambs per treatment	7	7	7	-
Nitrogen intake, g/d	18.09[a]	18.63[a]	19.99[a]	1.26
Fecal N, g/d	5.96[a]	5.57[a]	7.07[a]	0.60
Fecal N, % of intake	32.50[a]	30.24[a]	35.12[a]	2.09
Urinary N, g/d	10.49[a]	9.76[a]	9.31[a]	0.85
Urinary N, % of intake	60.77[a]	53.44[a]	47.05[a]	5.80
N absorption, g/d	12.13[a]	13.05[a]	12.91[a]	0.92
N absorption, %	67.49[a]	69.75[a]	64.87[a]	2.09

N retained, g/d	1.63[a]	3.29[a]	3.60[a]	1.15
N retained, % of intake	6.72[a]	16.30[a]	17.81[a]	6.33
N retained, % of absorbed	9.36[a]	22.93[a]	26.51[a]	9.16

[a] Means within the same row with different superscripts differ (P < .05)

While fecal N g/d is not different (P < .05) between the three diets, it approaches significance (P = .09) between the coastal and grass diet. The grass diet has the highest numerical value for fecal N g/d, but has the lowest numerical value for urinary N g/d. While the differences from the diets are not significant (P < .05) for fecal and urinary N, assumptions can be made that lambs on these diets may have been synthesizing microbial protein at a slightly higher rate. Antoniewicz et al., 1980; and Lindberg et al., 1989 supported this by stating that urinary N excretion is an indicator of microbial protein synthesis. However, N intake was also numerically higher for lambs on the grass diet. Nitrogen absorbed and nitrogen retained were also not significantly different (P < .05) between treatment diets.

Table 6. Chemical Composition of Alfalfa Pellets, Bermudagrass-Clipping Pellets, and Coastal Bermudagrass Hay Pellets[a]

	Alfalfa	Coastal Hay	Bermudagrass
DM, %	92.81	92.1	89.25
Ash, %[a]	12.3	6.08	15.35
CP, %[a]	18.81	10.65	24.23
Ca, %[a]	1.19	0.43	1.12
P, %[a]	0.22	0.15	0.3
NDF, %[a]	45.52	72.31	58.51

[a] DM Basis

IMPLICATIONS

Bermudagrass-clippings used in this study were a viable forage source in the diets of lambs when used at 10% of a concentrate diet. While there were no differences ($P < .05$) in digestibility, N retention, and apparent N absorption, further studies need to be conducted with higher percentages of forage sources to determine differences amongst treatments.

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