EVALUATION OF THE PROTEIN CHARACTERISTICS OF FOUR DIVERSE GRASSES

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Summary

Forage protein characteristics in four grasses were evaluated by the nylon bag method. All of the forages used (Bermudagrass hay, brome hay, forage sorghum hay, and prairie hay) were of relatively low quality, except the Bermudagrass, which was of average quality. The forages differed in the size of different protein fractions and in the rate and extent of protein degradation. Predicted extent of ruminal protein degradation (i.e., ruminal protein availability) was lowest for prairie hay, intermediate for Bermudagrass and forage sorghum hay, and highest for the brome hay.

(Key Words: Forage, In Situ Analysis, Protein, Degradable Intake Protein.)

Introduction

Forages are the primary sources of nutrients for beef cattle in the United States and throughout the world. However, meeting the nutritional requirements of beef cattle grazing low-quality forage often requires protein supplementation. The amount of supplemental protein needed is related directly to the amount and availability of forage protein as well as the amount of forage consumed and its digestibility. Therefore, it is important to have precise information on protein characteristics of different forages. Currently, information of this type exists for relatively few forages, and this limits the ability of newer feed formulation systems to predict nutrient requirements and animal performance. The objective of this study was to characterize the proteins of Bermudagrass hay, brome hay, forage sorghum hay, and prairie hay.

Experimental Procedures

Four ruminally fistulated beef steers (avg BW = 1142 lb) were used in a Latin square design to determine the rate and extent of protein degradation in Bermudagrass, brome, forage sorghum, and prairie hays using a nylon bag (i.e., *in situ*) procedure. Steers were fed hay twice daily (1.5% of BW daily). During each period, forage samples were weighed into nylon bags and incubated in the rumen of a steer consuming the same forage type for 2, 4, 8, 16, 24, 36, 48, 72, and 96 hours. Following incubation, the residue in the nylon bag was analyzed for protein remaining at each time-point. The washout at 0 hours (that removed by rinsing) was assumed to be fraction A (i.e., the soluble, rapidly degradable protein). The protein remaining after incubation for 96 hours was assumed to be fraction C (i.e., the ruminally unavailable protein). Size of fraction B (i.e., the insoluble, potentially ruminally degradable protein) was determined by difference (B = 100% – A – C). The ruminally undegradable fraction was subtracted from the protein remaining at each time point, and the natural logarithm of the resulting value was regressed against time to estimate the degradation rate (K_d) of the B fraction of each forage. Degradable intake protein (DIP) was calculated (Table 1) based on the fraction sizes, the K_d, and an assumed rate of passage for the forage (.03/hour).

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Results and Discussion

Sizes of the soluble, rapidly degradable fraction (fraction A) and the ruminally undegradable fraction (fraction C) were similar among Bermudagrass, brome, and forage sorghum hays, whereas prairie hay had a smaller (P<.01) fraction A and a larger (P<.01) fraction C. Forage sorghum hay had a larger (P<.03) insoluble, potentially ruminally degradable fraction (fraction B) than prairie hay, and the B fractions of bermuda and brome hays fell between these two extremes. In contrast, the K_d was similar among Bermudagrass, forage sorghum, and prairie hays but fastest (P<.01) for brome hay. The rapid degradability of the insoluble, potentially ruminally degradable fraction of brome hay resulted in the greatest (P<.02) extent of ruminal protein degradation (i.e., larger DIP content). Bermudagrass and forage sorghum hays had higher (P<.01) concentrations of DIP than prairie hay. Relative to the other forages, the large ruminally undegradable and small soluble, rapidly degradable protein fractions in prairie hay were the primary contributing factors leading to the low DIP content of this forage.

Identification of the size of each protein fraction, as well as the rate and extent of degradation of the insoluble, potentially ruminally degradable fraction, provides valuable information for nutritionists and producers. This is especially true for those interested in using the 1996 Beef Cattle NRC guidelines for evaluating diets and predicting performance of forage-fed beef cattle.

Table 1. Fractions, Degradation Rates, and Extent of Protein Degradation in Bermudagrass, Brome, Forage Sorghum, and Prairie Hays

Item	Bermuda	Brome	Forage Sorghum	Prairie	SEM[a]
DM[b]	92.7	94.5	88.9	93.0	
CP[c], % of total DM	7.8	5.3	4.5	4.8	
NDF[d], % of total DM	72.2	70.6	62.3	67.5	
Nitrogen fractions, % of total CP[e]					
A	32.0[k]	32.8[k]	29.9[k]	22.3[l]	1.14
B	39.1[kl]	39.9[kl]	45.8[k]	34.8	2.26
C	28.9[k]	27.3[k]	24.3[k]	42.9[l]	2.52
K_d[f], per hour	.027[l]	.046[k]	.028[l]	.025[l]	.003
DIP[g], % of total protein[h]	50.5[k]	57.2[l]	52.0[k]	36.4[m]	1.07

[a]Standard error of the mean for treatments without missing values.
[b]Dry matter.
[c]Crude protein.
[d]Neutral detergent fiber.
[e]A is the soluble, rapidly degradable fraction assumed to be removed by rinsing alone (zero hour); C is the 96-hour residue, assumed to be the ruminally undegradable fraction; B is the insoluble, potentially degradable fraction, determined by difference (i.e., B = 100% – A – C).
[f]K_d = degradation rate of fraction B.
[g]Degradable intake protein.
[h]Degradability was calculated using the equation:
$DIP = A + B\{ K_d/(K_d + K_p)\}$, where K_p = rate of passage = .03 per hour.
[klm]Means within a row without common superscripts differ (P<.03).