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Effects of Increasing Dietary Energy Density by Replacing Hay with Soyhulls (SH) and Dried Distillers Grains with Solubles (DDGS) on Nutrient Digestibility and Rumen Physiology

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OBJECTIVES

To determine the effects of increasing dietary energy density in lamb diets from soybean hulls (SH) and dried distillers grain with solubles (DDGS) on nutrient digestibility and rumen physiology.

MATERIALS AND METHODS

Four ruminally cannulated wethers were used in a 4x4 Latin Square design with four 15 d trial periods. In each period a 10 d dietary treatment adaptation phase occurred with lambs fed at 90 % ad libitum for data collection. Dietary ingredients for the four diets fed in this trial are shown in Table 1. For each treatment diet all ingredients were in a pellet form except for chopped long-stemmed hay. Following adaptation, daily feed intake was recorded and a sample of each diet taken for nutrient analyses. Total fecal and urine output were collected separately for 4 d following the adaptation period. Feed, fecal, and urine samples were each pooled over the 4-d collection period, then subsampled and stored frozen for subsequent analysis of dry matter (DM), crude protein (CP), ash (ASH), ether extract (FAT), acid detergent fiber (ADF), neutral detergent fiber (NDF) and digestible energy (DE). Gross and fecal energy values were determined by bomb calorimetry and DE calculated by difference. Apparent digestibility of the nutrients also was calculated by difference. On d 15 of the sampling period, rumen fluid was collected -2, 0, 1, 4, 8, 12 h relative to feeding. Immediately following collection, rumen fluid pH was recorded and a sample was prepared and stored frozen for analysis of volatile fatty acids.

Digestibility data were analyzed statistically as a Latin square design with a model that accounted for variation that resulted from lamb, period, and their interactions. Differences in least squares means for nutrient digestibility that resulted from dietary treatment were separated using the PDIFF option of SAS. Ruminal pH data was analyzed statistically as repeated measures in time with a model that accounted for variation in that resulted from lamb, period, treatment, time, and the interaction of time and treatment. Differences in least squares means for ruminal pH that resulted from the interaction of dietary treatment by time were separated using the PDIFF option of SAS.

RESULTS

Apparent nutrient digestibility values are reported in Table 2. Dry matter digestibility was higher ($P < 0.03$) for lambs fed SH40-DDGS and SH60-DDGS than lambs offered Hay-DDGS.

Nitrogen digestibility was lower ($P < 0.02$) for the diets with SH. Digestibility of OM, ADF, NDF and FAT was not influenced by diet composition. Dry matter intake for lambs receiving Hay diets averaged 795 g and 1,277 g for SH diets. The NDF and ADF digestibility was not different although numerically higher for the treatment diets with the rapidly fermentable fiber in SH. With substantially higher dry matter intake for the lambs fed SH it is remarkable that digestibility coefficients would favor these treatments. Rumen pH decreased for all dietary treatments following feeding (Figure 1). Diets with high inclusion rates of SH had lower rumen pH subsequent to feeding than diets that included hay as the fiber source. However, only when SH was included at 60% of the diet DM was rumen pH below 5.5 the threshold for concern regarding acidosis. Physical signs of acidosis were not evident for lambs on any dietary treatment.

Table 1. Diet Ingredient Composition

	HAY-SBM	HAY-DDGS	SH40-DDGS	SH60-DDGS
Item	%DMB			
Grass hay	60.00	60.00	20.00	0.00
Soy hulls	0.00	0.00	40.00	60.00
Corn	25.62	12.75	22.78	28.06
SBM	11.64	0.00	0.00	0.00
DDGS	0.00	25.39	15.34	10.00
Urea	1.00	0.45	0.40	0.40
Dical	0.39	0.05	0.40	0.60
Limestone	0.85	0.86	0.58	0.44
TMS	0.50	0.50	0.50	0.50
Total	100.00	100.00	100.00	100.00
	Nutrient Composition DMB			
CP (%)	13.85	13.85	13.85	13.85
DIP (%)	45.60	45.76	45.70	45.93
ME (mcal/kg)	2.40	2.51	2.82	2.97
Ca (%)	0.68	0.68	0.68	0.68
P (%)	0.34	0.34	0.34	0.34
NDF (%)	45.56	51.99	46.10	43.10
ADF (%)	27.60	29.49	29.54	29.53

Figure 1. Rumen pH

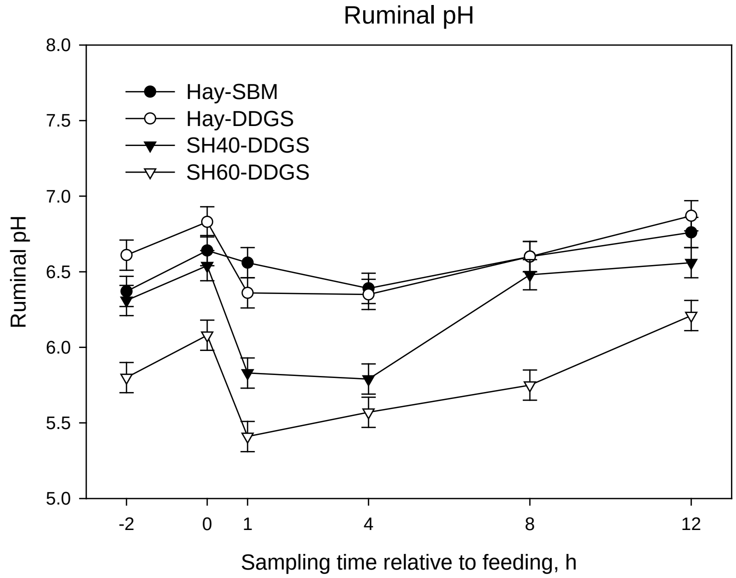

Table 2. Apparent Nutrient Digestibility

Apparent Total Tract Digestibility	Treatment HAY-SBM	HAY-DDGS	SH40-DDGS	SH60-DDGS	SE	P <
DM (%)	66.92[abc]	61.55[c]	72.84[ab]	74.84[a]	2.39	0.03
OM (%)	69.17	66.34	75.65	77.43	3.07	0.12
ADF (%)	58.44	55.38	67.64	68.12	7.28	0.54
NDF (%)	55.46	56.06	65.03	67.43	5.68	0.40
N (%)	75.66[a]	73.42[a]	69.59[b]	64.95[b]	1.67	0.02
FAT (%)	69.02	70.83	80.29	77.21	4.74	0.46
DE (mcal/kg)	2.46[c]	2.54[bc]	2.93[ab]	3.10[a]	0.14	0.05