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Effects of Increasing the Energy Density of a Lactating Ewe Diet by Replacing Grass Hay with Soybean Hulls and Dried Distillers Grains with Solubles

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Effects of increasing the energy density of a lactating ewe diet by replacing grass hay with soybean hulls and dried distillers grains with solubles[1]

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Summary

The objective of this experiment was to determine the effects of increasing the energy density of a lactating ewe diet by replacing grass hay (GH) with soybean hulls (SH) and replacing soybean meal (SBM) with dried distillers grains with solubles (DDGS) on ewe body condition, milk production and nutrient composition, and lamb performance. Sixteen 2-year-old ewes were selected based on a common lambing date. All diets contained 60% roughage and 40% concentrate. Dietary roughage source, however varied from completely GH to completely SH, and SBM was replaced by DDGS. Diets were formulated to contain 13.9% CP and an increasing amount of dietary energy as SH and DDGS replaced GH and SBM. The control diet for this experiment was composed of 60% GH and 11.6% SBM **(GH-SBM)**. Treatment diets were 60% GH and 25.4% DDGS **(GH-DDGS)**; 20% GH, 40% SH, 15.3% DDGS **(SH40-DDGS)**; and no GH, 60% SH, 10% DDGS **(SH60-DDGS)**. The SH, protein concentrate, and mineral portion of the diet was pelleted and mixed with the chopped GH, when GH was included in the diet. The SH60-DDGS diet was a completely pelleted diet. Ewes were offered feed twice daily, and a weigh-suckle-weigh technique was performed weekly throughout the 8-week lactation to quantify production and characterize nutrient composition milk in the ewe. Ewe BW and BCS was recorded at the beginning and end of the trial and lamb growth performance was monitored weekly. Replacing GH and SBM with SH and DDGS increased milk production without decreasing ewe BW and BCS during lactation. Although, total milk solids, protein, and fat were decreased when SH and DDGS replaced GH and SBM, lamb growth performance was improved. Increased milk production that resulted with the inclusion of SH and DDGS in the diet was sufficient to overcome the lesser nutrient composition of the milk to result in differences in lamb growth. These data are consistent with the hypothesis that replacing GH and SBM with SH and DDGS increases dietary energy density and results in increased milk production and lamb growth without compromising ewe BW and BCS.

Introduction

Lactation presents a tremendous demand for nutrients to the lactating ewe. If the nutrient composition of the diet is inadequate or the ewe is unable to consume an adequate quantity of the diet, the ewe will begin to draw-off her body stores to support milk production. In an intensive-management system where producers are trying to achieve multiple lambings per year, quite often ewes are not in adequate body condition to re-breed, and the subsequent lamb crop is compromised. Additionally, quantity and nutritional composition of milk produced by the ewe can be compromised during lactation. This then limits the overall growth performance of the nursing lamb. Many factors influence milk production including the protein and energy content of the lactation diet. Ewe diets also must contain an adequate amount of fiber to maintain rumen function and milk composition. However, forages are lower in energy than grain and can limit nutrient availability for milk production and body condition maintenance. When compared to GH, SH and DDGS contain more CP and energy and are composed of highly-digestible fiber. Previous research conducted by Ely et al. (1991) indicated that milk from DDGS-supplemented ewes contained 16.5% more fat compared to milk from SBM-supplemented ewes; higher milk-fat content can result in better nursing-lamb growth. These characteristic make co-products valuable for feeding to ewes because

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they can increase the nutrient density of a diet during a production phase where requirements are high. Additionally, the highly digestible fiber component in SH and DDGS should maximize nutrient digestibility without the negative associative effects that result from the inclusion of high-starch grains (Klopfenstein and Owen, 1987; Hoover, 1986). In the previously reported metabolism trial, increasing SH in the diet did decrease rumen pH but did not depress fiber digestion. Increased inclusion of SH also alter volatile fatty acid profiles to favor greater propionate concentrations. Because these factors can influence milk production and composition, this experiment was designed to evaluate the effects of increasing the energy content of the lactation diet by replacing GH and SBM with SH and DDGS on milk production, milk nutrient composition, lamb growth, and changes in ewe BW and BCS.

Materials and Methods

Sixteen 2nd parity 2-year-old, Polypay-sired ewes were selected based on a common lambing date. Each ewe and her twin lambs were housed individually in a 150 ft² pen and assigned to a dietary treatment at lambing. Diets were formulated, on the basis of laboratory analysis of ingredients, to contain 13.9% CP and an increasing amount of dietary energy as SH and DDGS replaced GH and SBM. All diets were formulated to contain 60% roughage and 40% concentrate. Dietary roughage source however, varied from completely GH to completely SH, and SBM was replaced by DDGS. The control for this experiment was composed of 60% GH and 11.6% SBM **(GH-SBM)**. Treatment diets were 60% GH and 25.4% DDGS **(GH-DDGS)**; 20% GH, 40% SH, 15.3% DDGS **(SH40-DDGS)**; and no GH, 60% SH, 10% DDGS **(SH60-DDGS)** (Table 1). The SH, protein concentrate, and mineral portion of the diet was pelleted and

Table 1. Ingredient composition of diets fed to lactating ewes

	Dietary Treatment[1]			
	GH-SBM	GH DDGS	SH40-DDGS	SH60-DDGS
	%Diet, DM basis			
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[2]	0.50	0.50	0.50	0.50
	Nutrient composition, DM basis[3]			
CP,%	13.85	13.85	13.85	13.85
DIP,%[4]	45.60	45.76	45.70	45.93
ME, mcal/lb	5.28	5.52	6.20	6.53
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

[1] GH-grass hay, SBM-soybeam meal; DDGS- dried distillers grains with solubles; SH-soyhulls.
[2] Sodium chloride 92.6 ≤ 77.4%, zinc 8,999 ppm, manganese 7,199 ppm, iron 1125 ppm, iodine 90 ppm, cobalt 18 ppm, selenium 90 ppm, vitamin A 400,000 IU/lb, vitamin D3 40,000 IU/lb, vitamin E 2,000 IU/lb.
[3] Calculated from laboratory nutrient analyses of ingredients
[4] Degradable intake protein as a percent of dietary CP

fed mixed with the chopped GH, when GH was included in the diet. The SH60-DDGS diet was a completely pelleted diet. Ewes were offered feed at 3.5% of body weight on a DM basis in 2 equal aliquots at 0830 and 2030 h throughout the 8-week lactation. A weigh-suckle-weigh procedure was used to estimate daily milk production throughout the 8-week lactation. At 0300 h, lambs were penned away for their dams in their respective pens. At 0600 h, the lambs were allowed to nurse their dams in a portion of the technique called udder zeroing. At 0900, 1200, 1500, and 1800 h, lambs were weighed, allowed to nurse until they were content, and weighed again. The cumulative weight gain of the twin lambs during the 12-h sampling period was multiplied by 2 to determine total daily milk production. The following day at 1500 h, a 50 ml sample of milk was collected from each ewe and subsequently analyzed for milk total solids, protein, and fat.

Weekly, lamb and ewe BW were recorded to determine growth performance. Beginning and ending ewe BCS were measured by two individuals. Each was given a score ranging from 1 (thin) to 5 (obese) with increments of 0.5 between BCS. The average of the individual scores was used for statistical analyses. Lamb and ewe performance data were analyzed statistically as a completely randomized design. The model accounted for variation that resulted from dietary treatment. Differences in least squares means for performance that resulted from dietary treatment were separated using the PDIFF option of SAS. Milk production and milk composition data were analyzed statistically as repeated measures in time with a model that accounted for variation that resulted from ewe-lamb pairs, treatment, week of lactation, and the interaction of treatment and week of lactation. Differences in least squares means for milk production and milk composition that resulted from treatment and week of lactation were separated using the PDIFF option of SAS.

Results and Discussion

Table 2. Effect of replacing GH and SBM with SH and DDGS on milk production and composition, and ewe and lamb performance

	Dietary Treatment[1]					
	GH-SBM	GH-DDGS	SH40-DDGS	SH60-DDGS	SE	P≤
Ewe BW, lb						
Initial	185.7	189.2	191.0	194.9	5.21	0.95
Final	159.3	170.1	175.3	177.1	6.29	0.80
change	-26.4	-19.3	- 15.8	-18.0	2.21	0.46
Ewe BCS[2]						
Initial	3.1	3.1	3.2	3.1	0.23	0.98
Final	2.1	2.3	2.7	2.8	0.29	0.30
BW change	-1.0	-0.81	- 0.50	-0.25	0.25	0.21
Milk Composition						
Production, lb/d	4.55[b]	4.29[a]	5.65[c]	7.19[d]	0.07	0.001
Total solids, %	16.31[a]	18.65[b]	16.35[a]	15.52[a]	0.27	0.001
Protein, %	5.25[a]	5.63[b]	5.19[a]	5.03[a]	0.10	0.001
Fat, %	5.66[ab]	7.28[c]	5.45[a]	4.58[a]	0.33	0.001
Lamb Performance						
Initial wt., lb	13.90	15.51	14.01	15.55	0.41	0.40
Final wt., lb	35.16[a]	38.21[b]	42.09[c]	46.31[d]	0.65	0.001
BW gain, lb	21.25[a]	22.70[a]	28.07[b]	30.76[c]	0.64	0.001
ADG, lb/d	0.38[a]	0.40[a]	0.50[b]	0.55[b]	0.04	0.005

[1] GH - grass hay, SBM - soybeam meal; DDGS - dried distillers grains with solubles; SH -soyhulls.
[2] BCS – Body condition score: scale 1= emaciated 5= obese.
[abcd] Means within a row having different superscripts differ ($P \leq 0.05$) as a result of dietary treatment.

Milk production and ewe body condition. Dietary treatment did not affect ewe BW change or change in BCS during lactation (Table 2). Replacing GH and SBM with SH and DDGS, however, resulted in increased milk production ($P \leq 0.001$). These data indicate that replacing GH and SBM with SH and DDGS results in increased milk production without compromising BCS or BW of the ewe. Minimal changes in ewe BW and BCS are advantageous in an accelerated lambing production system. Maintaining these measures could result in greater conception on first service, higher lambing rates, and fewer late-gestation nutritional disorders with subsequent pregnancies.

Nutritional composition of ewe milk. Nutritional value of the ewe milk was decreased as indicated by decreased milk protein ($P \leq 0.001$), total milk solids ($P \leq 0.001$) and milk fat percentage ($P \leq 0.001$), with the inclusion of SH and DDGS in lactating ewe diets (Table 2). The additional amount of milk produced, however, was sufficient to overcome differences in nutrient composition as the lambs gained more weight when GH and SBM was replaced with SH and DDGS.

The results for milk production and milk nutrient composition are supported by the volatile fatty acid and rumen pH data reported in the previous metabolism trial using these same diets. Several factors known to depress fat content of milk were evident in this study. These factors include finely chopped forages, a low forage:concentrate ratio, low ruminal pH, and inclusion ingredients with unsaturated fatty acids (NRC, 2001). Bauman et al. (1971) reported 50% reduction in milk fat percent when feeding high-grain, low-fiber diets to lactating dairy cows but concluded that the milk fat depression was not the result of decreased acetate production, as acetate production remained relatively constant across a variety of forage inclusions (Esdale et al., and Davis, 1967). Recent reports in the dairy NRC (2001) suggest that milk fat depression is a result of changes in ruminal biohydrogenation of fatty acids and not changes in ruminal volatile fatty acid patterns. Low ruminal pH in combination with unsaturated fatty acids results in the formation of trans-fatty acids (TFA), and TFA have been reported to decrease milk fat synthesis in the mammary gland of dairy cows. Our metabolism trial indicated that replacing GH with SH resulted in lower ruminal pH, and replacing SBM with DDGS provided an increased supply of unsaturated fatty acids. This dietary combination may have resulted in the low milk fat for the ewes.

Lamb performance. Lamb BW increased ($P \leq 0.01$) with the inclusion of DDGS and SH in the diets (Table 2). In summary, despite poorer nutrient composition of the milk, lambs performed better when the GH and SBM were replaced with SH and DDGS because the apparent increase in energy density resulted in greater milk production.

Implications

These data imply that quantity and nutritional composition of ewe milk can be influenced by ingredient selection. However, the important consideration is lamb performance given differences in quantity and nutritional composition of the milk. Additionally, because the ewes consuming the SH-DDGS diets were able to produce more milk and maintain BW and BCS, their likelihood of conception at re-breeding is greater. Other advantages of using the SH–DDGS diets are that they are easier to store and mix when compared to a diet containing long-stem hay. Also, pellets prevent the ewe from sorting ingredients from her diet resulting more uniform nutrient consumption. Because SH-DDGS can be pelleted these diets potentially could be delivered to the ewe via self-feeders thus decreasing the labor. However, more research is warranted to evaluate the effects of allowing *ad libitum* intake of completely pelleted diets with SH as the only fiber source, as rumen pH and acidosis may become a concern.

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