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BACKGROUND

The struggle to maintain the balance between concentrate and roughage concentration in finishing diets while optimizing animal performance and preventing digestive disorders continues to be a subject of concern in modern livestock feeding operations. High concentrate diets increase propionate production, the only gluconeogenic VFA and the most efficient at converting feed energy to energy useable by ruminants. However, in order to maintain rumen function and keep dry matter intakes up, a minimum amount of fiber/roughage must be present in the diet. Due to the rising cost of standard livestock feeds over the past decade, there has been an increased interest in using nontraditional feeds sources to offset rising costs of traditional feeds. Corn stover (harvest residue consisting of cobs, stalks, husks, and leaves) is a source of crude fiber comparable to that of traditional hays (NRC, 2007). Already used in the Great Plains as a source of winter grazing for livestock, corn stover's functionality as a fiber source in growing-finishing diets has not been greatly explored.

OBJECTIVES

To evaluate the effect of varying levels of treated corn stover on the dry matter intake and growth performance of growing lambs.

MATERIALS AND METHODS

This trial was conducted at the South Dakota State University Sheep Unit with forty-eight crossbred lambs (initial BW 89.33 ± 9.26 lb). Lambs were blocked by weight into a light block and a heavy block. Within each block, lambs were assigned to one of eight pens resulting in three lambs per pen and sixteen total pens. Pens were assigned one of four dietary treatments resulting in 4 pens per treatment or 2 pens per treatment by block. Lambs were housed in outdoor, dirt lot research pens (3.66 X 4.88 m).

Dietary treatments (Table 1) were increasing amounts (0, 10, 20, and 40% CST DM basis) of treated corn stover blend that was pelleted and balanced to be isonitrogenous and have similar metabolizable energy values. All diets were formulated to meet or exceed NRC nutritional requirements. The CST stock product was prepared by Iowa Biofibers (IABF Harlan, IA), and shipped to SDSU in pellet form. The CST was reconstituted and pelletized with the ingredients listed in the formulations shown in Table 1. All treatment diets were offered as completely pelletized.

Table 1. Dietary Treatments

	% of Diet, DM basis			
Item	Control	10%CST	20%CST	40%CST
Alfalfa Pellets	27.05	0.00	0.00	0.00
Soy Hulls	50.00	66.80	56.52	38.15
CST[a]	0.00	12.80	25.48	50.95
SBM	0.00	0.00	0.00	0.00
DDGS	20.00	17.30	15.50	9.05
Micro Mix	0.25	0.25	0.25	0.25
Biuret	0.20	0.35	0.25	0.10
Dical	0.40	0.40	0.40	0.40
Limestone	1.00	1.00	0.50	0.00
White Salt	0.50	0.50	0.50	0.50
Deccox	0.10	0.10	0.10	0.10
NH_4CL	0.50	0.50	0.50	0.50
	Analyzed Nutrient Composition (AS-is Basis)			
%DM	90.5	89.3	88.9	87.9
	Analyzed Nutrient Composition (DM Basis)			
%CP	18.7	19.0	19.9	18.9
%ASH	7.1	6.7	7.6	8.9
%Ca	1.2	1.1	1.1	1.1
%P	0.4	0.4	0.4	0.4
%NDF	53.6	52.9	52.0	53.0
%ADF	41.3	40.5	38.5	38.1
	Calculated Nutrient Composition (DM Basis)			
%DIP	61.4	62.5	64.5	70.4
ME (Mcal/lb)	1.2	1.2	1.2	1.2

[a]Iowa Biofibers product IABF Harlan, IA. Product containing treated corn stover and other corn by-products.

Lambs were allowed ad libitum access to feed via self-feeders, and feed was added in 50 lb increments at intervals so that feeders were never empty. Weights of feed going into the feeders, and feed remaining at the end of the trial were recorded in order to determine feed intake. Lambs had ad libitum access to water throughout the study.

Lambs were weighed at 0800 h at two week intervals over the course of a 27 day feeding period. Feed and water were not withheld before weights were recorded. Weights and feed intake data were used to determine average daily gain (ADG) and feed:gain ratios (F:G). Feed samples were taken from random spots in the feeders at two week intervals and stored for analysis. Statistical analysis of data was completed using GLM procedure of SAS.

RESULTS AND DISCUSSION

Raw lamb performance data are reported in Table 2, and treatment means are reported in Table 3. Dietary treatment had no effect on ADG, feed intake or total gain ($P = 0.2, 0.3, 0.2$ respectively). Dry matter intake across treatments exceeded the investigators expectations despite the level of CST in the diet. Average DMI tended to be decreased ($P = 0.09$) for the 40%CST treatment group compared with the 20%CST treatment group, however average DMI did not differ among other treatment groups. Feed: Gain was worse for lambs consuming the 40%CST diet when compared with those consuming the control, 10%CST, or 20%CST diets ($P < 0.05$) (Table 3). There was no treatment by block interaction on ADG, intake, or total gain ($P = 0.6$). However, there was a treatment by block interaction on F:G. Lambs in the heavy block consuming the 40%CST treatment had greater F:G ratios than lambs in light block ($P < 0.05$) (Table 4). The F:G for lambs assigned to the control diet, which contained no treated stover, also differed between weight blocks ($P < 0.05$). For lambs fed 10%CST and 20%CST, F:G did not differ significantly ($P > 0.20$) between the heavy and light blocks, however a similar numeric trend for poorer F:G was observed for the heavy block compared with the light block in each case. This observation suggests that high-roughage growing diets, regardless of roughage source, result in differences in F:G depending on the weight (stage of growth) of the animal. Higher stover inclusion likely will result in less difference in growth and feed intake in younger growing lambs when compared with older finishing lambs.

Table 2. Individual pen observations

PEN	TRT[a]	BLK	DMI, %BW	Total DMI, lb	PEN AVG GAIN, lb/hd/d	ADG, lb/hd/d	F:G	ADMI, lb/hd/d
1	C	H	3.96	126.09	20.33	0.75	6.20	4.67
2	10	H	3.78	116.55	19.33	0.72	6.03	4.32
3	20	H	3.94	124.71	21.00	0.78	5.94	4.62
4	40	H	3.69	112.34	14.00	0.52	8.02	4.16
5	C	L	3.98	118.27	26.00	0.96	4.55	4.38
6	10	L	3.99	112.90	21.00	0.78	5.38	4.18
7	20	L	4.18	119.24	23.34	0.86	5.11	4.42
8	40	L	3.80	108.36	20.67	0.77	5.24	4.01
9	C	H	3.77	109.80	16.00	0.59	6.86	4.07
10	10	H	3.45	107.84	18.67	0.69	5.78	3.99
11	20	H	3.36	103.45	17.33	0.64	5.97	3.83
12	40	H	3.63	108.77	15.00	0.56	7.25	4.03
13	C	L	4.17	112.59	20.00	0.74	5.63	4.17
14	10	L	4.26	117.80	21.00	0.78	5.61	4.36
15	20	L	4.24	122.06	21.00	0.78	5.81	4.52
16	40	L	3.74	98.72	19.67	0.73	5.02	3.66

[a] All CST inclusions were on a DM basis.

Table 3.Growth performance of lambs fed increasing amounts of treated corn stover product

	Dietary Treatment[1]				
Item	Control	10%CST	20%CST	40%CST	SEM
Pens	4	4	4	4	---
Trial length , d	27	27	27	27	---
ADG, lb/d	0.76	0.74	0.77	0.65	0.04
ADMI, lb/d	4.32^{xy}	4.21^{xy}	4.35^{x}	3.96^{y}	0.14
F:G	5.81^{ab}	5.70^{a}	5.71^{a}	6.38^{b}	0.21
GAIN, lb	20.58	20.00	20.67	17.34	1.09
DMI, lb	116.69	113.77	117.37	107.05	3.88

[1] All CST inclusions were on a DM basis.
[ab] Means having different superscripts within a row differ ($P < 0.05$) as a result of CST inclusion.
[xy] Means having different superscripts within a row tend to differ ($P = 0.09$) as a result of CST inclusion.

Table 4. Interactions of increasing treated corn stover product and body weight block

	Dietary Treatment[1]								
	Control		10%CST		20%CST		40%CST		
BLK	H	L	H	L	H	L	H	L	SEM
Pens	2	2	2	2	2	2	2	2	---
Trial length, d	27	27	27	27	27	27	27	27	---
Initial Wt, lbs	94.8	82.0	96.0	82.5	96.5	84.0	97.4	81.5	1.99
Final Wt, lbs	113.0	105.0	115.0	103.5	115.7	106.2	111.9	101.7	2.99
ADG, lb/d	0.67	0.85	0.71	0.78	0.71	0.82	0.54	0.75	0.06
F:G	6.5^{a}	5.1^{b}	5.9^{ab}	5.5^{b}	6.0^{ab}	5.5^{b}	7.6^{c}	5.1^{b}	0.30
ADMI, lb/d	4.37^{x}	4.27^{xy}	4.15^{xy}	4.27^{xy}	4.23^{xy}	4.47^{x}	4.10^{xy}	3.83^{y}	0.20
GAIN, lb	18.15	23.0	19.0	21.0	19.2	22.2	14.5	20.2	1.54
DMI, lb	118.0	115.4	112.2	115.3	114.1	120.6	110.6	103.5	5.49

[1] All CST inclusions were on a DM basis.
[abc] Means having different superscripts within a row differ ($P < 0.05$) as a result of CST inclusion.
[xy] Means having different superscripts within a row tend to differ ($P = 0.09$) as a result of CST inclusion.

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