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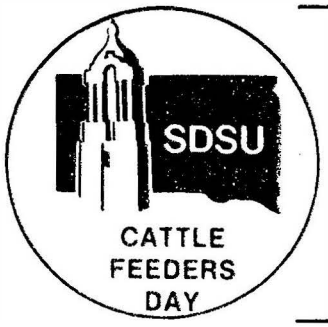

CORN STOVER RESIDUE AND ALFALFA PRODUCTS FOR WINTERING BEEF STEERS

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Summary

Ground alfalfa hay, dehydrated alfalfa meal and pelleted alfalfa press-cake (a by-product of the leaf protein concentrate, Pro-Xan) were each fed with corn stover silage and ground corn stover. The stover was either chopped with a silage cutter or stacked with a Hesston stacker. The chopped stover was reconstituted with 11 cubic feet of water per ton and packed into a cement bunker silo. The Hesston stacks were ground as needed. A factorial feedlot experiment was conducted with beef cattle for 101 days to determine feed efficiency and average daily gain. Two total collection digestion-nitrogen balance trials were also conducted with beef cattle on the same rations. In the first digestion trial, all alfalfa supplements were fed with a stover silage based diet. The second trial utilized alfalfa supplements with a ground stover based diet.

Results of the feedlot trial showed that steers fed the alfalfa press-cake and dehydrated alfalfa supplemented ration had improved feed efficiencies and average daily gains over the steers fed the alfalfa hay rations. The dehydrated alfalfa resulted in the highest average daily gain, while the press-cake resulted in the lowest feed per pound of gain (highest efficiency).

Organic matter digestibility coincided with the dry matter intake in both digestion trials. Alfalfa hay had the highest digestible energy of all alfalfa supplements in the stover silage rations. No differences were noted in the ground stover rations. Crude protein digestibility was highest with the alfalfa hay ration followed in order by the dehydrated alfalfa and the alfalfa press-cake ration. The order was reversed, however, in terms of nitrogen retention. The alfalfa press-cake may have exhibited some rumen by-pass qualities which could explain the improved feed efficiency in the feedlot trial.

Introduction

It has been estimated that 2,850,000 acres of corn were harvested for grain in South Dakota during 1979. With the increased costs of corn production, it may become more necessary to utilize the entire plant. Corn stover grazing, a commonly used practice in the wintering of ruminants because of its convenience, is not an efficient method of utilizing the entire plant as two-thirds of the residue remains in the field. Necessary supplementation of corn stover is also difficult under grazing conditions.

Alfalfa hay, dehydrated alfalfa meal and alfalfa press-cake could be used as supplements to corn stover. Alfalfa press-cake is a by-product of Pro-Xan[1], a leaf protein concentrate extracted from green-chopped alfalfa. Pro-Xan contains the high protein and xanthophyll fraction desirable in poultry rations. According to Enochian[2], xanthophyll from Pro-Xan is utilized 1.7 times more efficiently in poultry rations than xanthophyll from dehydrated alfalfa. If the high fiber, press-cake by-product of the Pro-Xan process can be utilized in ruminants as efficiently as dehydrated alfalfa, the press-cake may be a suitable substitute for the dehydrated alfalfa. The objective of this study was to conduct a feeding trial where each of the alfalfa products was compared in rations containing stover silage and ground stover stacks for wintering beef cattle. These studies were then complimented with two digestion-nitrogen balance trials.

Procedure

Cornstalks were gathered into windrows in early November, 1979, with a 12 E Ford rotary scythe. The material was then either chopped with a silage cutter equipped with a forage head or stacked with a Model 3600 Hesston stacker. The chopped forage (approximately 1/2 inch diameter) was elevated into a 25 x 50 foot concrete bunker silo with water added during the delivery. Only 7 cubic feet of water per ton of chopped stover could be added during delivery. An oscillating garden sprinkler was placed on the pile at the end of the first and second day of filling. A total of 11 cubic feet of water per ton was added in the entire reconstitution process. To insure proper fermentation of the chopped stover, two tractors continuously stacked and packed. Twenty-one Hesston stacks were prepared at the same time and were ground as needed. Ground medium-bloom alfalfa hay, sun-cured dehydrated alfalfa meal (17% protein type) and pelleted alfalfa press-cake served as the corn stover supplements.

Seventy-two Angus x Hereford crossbred cattle were purchased for a 2 x 3 factorial feedlot experiment with two replications per treatment and six steers per replication. The steers averaged 570 lb. and were allotted to 12 pens. The animals were implanted with Ralgro and placed on the rations for a 2-week adaptation period (rations listed in table 1). All animals received trace mineral salt on a free-choice basis. Filled and shrunk weights were taken at the beginning and the end of the 101-day trial. Feed refusals and feed samples were collected periodically. Average daily gains and feed efficiencies were determined for all treatments.

Two digestion-nitrogen balance trials were also conducted with the feedlot rations (table 1). The first digestion trial utilized 12 Simmental x Hereford crossbred cattle. These steers averaged 660 lb. and were assigned four animals per alfalfa treatment with all animals receiving stover silage. The steers were allowed 3 weeks to adjust to the rations. They were then placed in the metabolism crates and allowed 4 days to adapt before the 5-day

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[1] Pro-Xan is a commercial product marketed by Valley Dehydrators, Sterling, Colorado.

[2] Enochian, R. V., G. O. Kohler, R. H. Edwards, D. D. Kuzmicky and C. J. Vosloh, Jr. 1980. Producing Pro-Xan (Leaf Protein Concentrate) from Alfalfa: Economics of an Emerging Technology. USDA, Ag Econ Report 445.

Table 1. Percentage Composition of Feedlot and Digestion Trial Rations on Dry Basis

Feedstuff	Percent of ration	Crude protein, %
Stover silage	48	2.0
Alfalfa hay	52	9.1
	100	11.1
Stover silage	54	2.3
Dehydrated alfalfa	46	8.8
	100	11.1
Stover silage	47	1.9
Alfalfa press-cake	53	9.1
	100	11.0
Ground stover	48	2.1
Alfalfa hay	52	9.1
	100	11.2
Ground stover	54	2.4
Dehydrated alfalfa	46	8.8
	100	11.2
Ground stover	47	2.0
Alfalfa press-cake	53	9.1
	100	11.1

collection began. The steers were fed twice daily with feed refusals taken in the morning. Urine and feces were collected daily with a 10% aliquot of each saved for chemical analysis. One steer refused to eat and had to be removed from the trial. The second trial was conducted with the same alfalfa supplements in the same manner except that all animals received the ground stover stacks in place of the stover silage. Another animal was added to the second trial to replace the previously removed steer. Dry matter, organic matter, crude protein, energy digestibilities and nitrogen retention were determined. Chemical analyses of total nitrogen, ash and total energy were determined on composites of the feed, orts, feces and urine samples using Association of Official Analytical Chemists procedures.

Results

Feeds Used in Feedlot and Digestion Trials

Table 2 shows the composition of stover coming out of the bunker silo and of the stover stacks taken at various times throughout the trial. The ground stover was higher in crude protein, ether extract, nitrogen-free extract and ash content. The ash content of the ground stover was over twice as high as the ash content of the stover silage. This was probably due to higher amounts of soil picked up in the grinding and feeding of the stover stacks. Crude fiber was higher in the stover silage than in ground stover. Two layers of

Table 2. Chemical Composition of Feeds on Dry Basis

Item	Stover silage	Ground stover	Alfalfa hay	Dehydrated alfalfa	Alfalfa press-cake
Dry matter	42.95	73.64	90.99	92.62	93.90
Crude protein	4.17	4.38	17.47	19.19	17.24
Crude fiber	40.18	32.89	36.81	21.38	24.29
Ether extract	.73	1.32	1.60	4.41	2.77
Ash	5.84	12.12	8.93	12.88	12.30
Nitrogen-free extract	49.08	49.29	35.19	39.07	43.40

mold coinciding with the levels at which the garden sprinkler was employed were also noted in the bunker silo. The moisture added by the garden sprinkler did not appear to penetrate very far into the chopped stover to aid in achieving the desired moisture content. However, moisture content of the reconstituted stover was adequate for fermentation to occur. The average moisture content of the stover silage coming out of the bunker was 57%. The fairly high initial moisture plus moisture absorbed from outside storage (26%) contributed to some spoilage in the stover stacks. The stover material from the stacks upon grinding tended to heat. This made it necessary to grind only a few stacks at a time to keep spoilage at a minimum. Spoilage also increased toward spring for both the stover silage and stacks. In comparing the alfalfa products as shown in table 2, it should be noted that the press-cake and the alfalfa hay had very similar protein values (17.24 and 17.47), while the dehydrated alfalfa was higher in protein (19.19). The press-cake had the highest nitrogen-free extract of the alfalfa supplements. The dehydrated alfalfa was higher in ether extract and lower in fiber content than the press-cake or alfalfa hay. The alfalfa hay was rather high in crude fiber and low in ash as compared to the other alfalfa supplements.

Feedlot Performance

Results of the feedlot study are listed in table 3. Average daily gain and feed efficiency were improved with steers fed the dehydrated alfalfa and the alfalfa press-cake rations over that for steers fed the alfalfa hay rations. The steers fed the dehydrated alfalfa rations exhibited improved average daily gain, especially with the ground stover. This was also true for feed efficiency with respect to the press-cake ration. Daily intake of steers was highest with the dehydrated alfalfa rations (average, 15.3 lb.) followed in order by alfalfa hay (average, 13.8 lb.) and press-cake (average, 13.7 lb.). Overall, the steers fed ground stover rations exhibited a slightly higher average daily gain and had higher feed requirements than the steers fed the stover silage rations.

Digestion Trials

Alfalfa hay with stover silage (table 4) exhibited the highest digestible dry matter, crude protein, energy and organic matter of the three alfalfa supplements. Conversely, the press-cake had the lowest digestibilities of the three supplements. The digestibilities coincided with dry matter intake.

Table 3. Feedlot Performance of Residue-fed Cattle
(March 14-June 23, 1980--101 Days)

	Alfalfa press-cake		Alfalfa hay		Dehydrated alfalfa		Average of all stover silage	Average of all ground stover
	Stover silage	Ground stover	Stover silage	Ground stover	Stover silage	Ground stover		
Number of animals	12	12	12	12	12	12	36	36
Initial shrunk wt., lb.	570	580	561	566	577	553	569	566
Final shrunk wt., lb.	650	670	632	625	660	659	647	651
Avg. daily intake (DM), lb.	13.0	14.4	13.0	14.6	13.7	16.8	13.2	15.3
Avg. daily gain (shrunk), lb.	.80	.89	.66	.60	.82	.95	.76	.81
Feed/lb. gain (shrunk), lb.	16.2	16.2	19.7	24.3	16.7	17.7	17.5	19.4

Table 4. Digestibility of Corn Stover Silage With Various Alfalfa Products in Steers--Trial 1

Item	Alfalfa hay	Dehydrated alfalfa	Press-cake
No. of animals	4	4	3
Avg. wt., lb.	660	658	662
DM intake, lb.	9.9	11.8	12.0
N intake, g.	86.7	101.0	93.5
Digestibility, %			
Dry matter	60.28	56.53	55.62
Crude protein	66.93	59.95	52.78
Energy	58.60	56.58	53.95
Organic matter	61.61	57.50	57.02
N retention			
Fecal N excreted	28.6	40.5	44.2
Urinary N excreted	42.1	41.1	30.5
Total N excreted	70.7	81.6	74.7
Percent N retained	18.6	19.3	20.0

In trial two (table 5) with ground stover, digestibility of crude protein was significantly lower for press-cake than for the other two supplements, even though dry matter intake was lower for steers fed press-cake. There were no differences in digestible dry matter, organic matter and energy between the alfalfa supplements. This suggests that the Pro-Xan fraction extracts the higher quality protein and perhaps more soluble proteins, leaving the less digestible proteins in the press-cake fraction. Crude protein as determined by Kjeldahl nitrogen analysis does not evaluate protein quality.

Crude protein digestibility was lower for the press-cake ration than for alfalfa hay or dehydrated alfalfa meal with either stover silage or ground stover. However, nitrogen retention was slightly higher for the press-cake product. The processes involved in the preparation of the press-cake may have rendered the protein less soluble, giving it the properties of a rumen bypass protein. Such protein, although less digestible, may be absorbed in the small intestine more efficiently than other alfalfa products which are subjected to microbial digestion in the rumen. This could explain why the press-cake rations gave similar average daily gains to the dehydrated alfalfa rations in the feedlot trial and were utilized more efficiently.

On the basis of steer performance on the various alfalfa supplements to corn stover, alfalfa press-cake appears to have potential as a protein supplement. Alfalfa press-cake would be a suitable substitute for dehydrated alfalfa on an equal basis if the costs of producing dehydrated alfalfa became prohibitive.

Table 5. Digestibility of Ground Stover Stacks With Various Alfalfa Products in Steers--Trial 2

Item	Alfalfa hay	Dehydrated alfalfa	Press-cake
No. of animals	4	4	4
Avg. wt., lb.	675	675	653[a]
DM intake, lb.	12.3	14.5	12.0
N intake, g.	121.7	146.3	99.6
Digestibility, %			
Dry matter	56.95	55.53	57.31
Crude protein	66.19	61.66	54.13
Energy	60.15	60.61	60.94
Organic matter	61.41	60.97	61.33
N retention			
Fecal N excreted, g.	41.1	56.2	45.7
Urinary N excreted, g.	56.5	58.0	30.5
Total N excreted, g.	97.6	114.2	76.2
Percent N retained	19.8	22.0	23.3

[a] One steer from first digestion trial replaced with a lighter steer.