NUTRITION—
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Ammoniated Wheat Straw for Wintering Beef Cows

**G. W. Horn, D. W. Pace,
C. L. Streeter and K. S. Lusby**

Story in Brief

Effects of ammoniation of wheat straw on performance and straw intake of non-pregnant, non-lactating cows in drylot were studied. Forty-eight mature Hereford cows (812 lb) grazed dormant native range pasture (treatment 1) or had ad libitum access in drylot to either untreated (treatment 2) or ammoniated (treatment 3) wheat straw. All cows were individually fed 2.1 lb/day of a cottonseed meal-based supplement that supplied .70 lb of crude protein. Ammoniation increased crude protein content and in vitro dry matter digestibility (IVDMD) of straw from 4.2 to 8.7 percent and from 40.9 to 53.9 percent, respectively. Cows on native range gained .52 lb/day and improved in body condition by about .5 units (9 point scale). Cows fed untreated straw maintained body weight and condition. Gains of cows fed ammoniated wheat straw (.40 lb/day) were similar to those of cows that grazed native range, but the cows did not improve in condition as much as cows grazing native range. Ammoniation increased intake of straw about 20 percent. Ammoniated wheat straw would be an alternative feed for wintering cows when amounts of dormant native range are inadequate.

Introduction

Large amounts of wheat straw are available as a feedstuff each year in Oklahoma. The digestibility and crude protein content of wheat straw are both low. Treatment of crop residues with chemicals can increase digestibility, voluntary feed intake and animal performance. When ammonia is the chemical used for treatment, it (1) can reduce the chemical cost of treatment, (2) can increase the crude protein content of treated residues and (3) does not pollute the environment. Effects of ammoniation of wheat straw on body weight and condition changes of cows in drylot were examined in this study.

Experimental Procedure

The trial was conducted from December 2, 1980, to January 29, 1981 (58 days), at the Range Cow Research Center, Stillwater, Oklahoma. Forty-eight (48) non-

pregnant, nonlactating Hereford cows that were 5 years old and weighed 812 ± 52 lb were stratified by weight and randomly assigned to three treatments with two replications per treatment. The cows grazed dormant native range pasture (treatment 1) or had ad libitum access in drylot to either untreated wheat straw (treatment 2) or ammoniated wheat straw (treatment 3).

The wheat straw was ammoniated by the "stack method" similar to that described by Sundstφl et al. (1978). Two separate stacks of 28 large round bales per stack were ammoniated. The bales of straw (2 rows of 14 bales placed end-to-end per row) were placed on one edge of a 40 × 100 foot sheet of black plastic (.20 mm thick). The free portion of the plastic sheet was pulled over the bales, and the edges were rolled together and sealed. The ends of the stack were tied closed with nylon cord after a 0.5 inch (O.D.) black pipe had been placed in the stack. The end of the black pipe entered an empty oil drum in the middle of the stack. Anhydrous ammonia (3.7 percent w/w of straw DM) was injected into the sealed stack through the pipe. Straw was ammoniated during cool weather of the fall, and the stack remained sealed for 30 days after injection of ammonia. Untreated and ammoniated bales of straw were sampled with a forage probe immediately prior to feeding in panel-type feeders. Samples were stored in double plastic bags in a freezer until analyses were completed.

All cows were individually fed 2.1 lb/day of a supplement that contained 34 percent crude protein. Ingredient composition of the supplement is shown in Table 1. The cows were weighed after being held off feed and water for 24 h on days 0, 16, 46 and 58 of the trial and assigned a body condition score of 1 to 9 (1 = very thin, 9 = very fat) on days 0 and 58.

Table 1. Composition[a] of supplement fed to cows

Ingredient	% as-fed
Cottonseed meal	90.5
Molasses	3.1
Calcium carbonate	2.7
Dicalcium phosphate	1.2
Trace mineralized salt	2.5

[a]Vitamin A added (11,917 IU/lb of supplement).

Voluntary consumption of wheat straw by the cows in drylot was measured during days 28 through 42 of the trial. Cows were fed 11.6 g chromic oxide in their daily allotment of supplement during 10-day preliminary and 5-day fecal collection periods. Fecal samples were collected each time the cows were fed supplement and were composited across days, within cows, on an equal wet weight basis for drying at 60 C and subsequent analyses. Fecal outputs were estimated by dilution of the chromium. Yearling Hereford steers, fitted with fecal collection bags and harnesses, were used to adjust for incomplete or cyclic recovery of chromium. At the start of the preliminary period, three steers were placed in one pen of each group of cows fed untreated or ammoniated straw and were fed the same amount of chromic oxide containing supplement as the cows. Acid-insoluble ash (AIA) was used as an internal marker, and the AIA content of feces, straw, and supplement was used to calculate straw intake. Fecal AIA concentrations were corrected for fecal recovery of AIA (94.2 percent) obtained in a previous straw feeding trials with lambs. The 2N HCL procedure (Van Keulan and Young, 1977) was used for analysis of AIA.

Results and Discussion

Crude protein content and in vitro dry mater digestibility (IVDMD) of untreated and ammoniated straw are shown in Table 2. Crude protein content of straw DM was increased from 4.2 to 8.7 percent by ammoniation. Calculated recovery of ammonia injected into the two stacks was only 23.4 ± 3.7 percent. This is lower than the 33 percent reported by Sundstφl et al. (1978). Ammonia may have been lost through small punctures in the plastic. Punctures in plastic are an important practical problem with ammoniation by the stack method. Recovery of ammonia might be greater if lower levels of ammonia were used. The IVDMD of wheat straw was increased about 32 percent (Table 2) by ammoniation.

Table 2. Composition of untreated and ammoniated wheat straw fed to cows

Item	Untreated	Ammoniated[a]
Crude protein, % of DM	4.2	8.7
NH_3-N recovery[b], %		23.4 ± 3.7% (N = 2)
IVDMD[c], %	40.9	53.9

[a]3.7% NH_3 w/w of straw DM.
[b]$\frac{\text{Increased N content of straw in stack}}{\text{Amount of } NH_3\text{-N added}} \times 100.$
[c]In vitro dry matter digestibility.

Body weight gains and condition score changes of the cows are shown in Table 3. Cows on native range gained .52 lb/day and improved in body condition by about .5 units. Cows fed untreated wheat straw maintained body weight and condition. Rate of gain of cows fed ammoniated wheat straw in drylot was similar to that of cows that grazed native range, but the cows fed ammoniated straw did not improve in condition as much as cows grazing native range. Part of the improved condition of the range cows may have been due to the consumption of cool-season annual grasses that remained green during the extremely mild winter weather.

Digestibility and intake of wheat straw DM, calculated using AIA as an internal marker, were increased, respectively, from 65.4 to 72.8 percent and 2.48 to 2.92 percent of cow body weight by ammoniation (Table 4). These unrealistically high values are probably due to sorting of straw by the cows and consumption of straw

Table 3. Mean body weight gains and condition score changes of cows

		Drylot	
	Native range	Untreated straw	Ammoniated straw
No. of cows	16	16	16
Average daily gain, lb	.52[a]	.09[b]	.40[a]
Condition score[c]			
Initial	4.94	4.97	5.00
Final	5.42	5.02	5.12
Change	+.48	+.05	+.12

[ab]Means with a common superscript are not different (P>.05).
[c]1 to 9 scale; 1 = very thin, 9 = very fat.

Table 4. Effect of ammoniation on intake and digestibility of wheat straw by cows in drylot

	Untreated Straw	Ammoniated Straw
No. of cows[a]	15	16
Method of estimating in vivo digestibility (and/or intake of straw)		
AIA[b]		
Straw DM digestibility, %	65.4	72.8**
Straw DM intake		
lb/day	19.9	24.4**
% of body wt	2.48	2.92*
IVDMD[c]		
Straw DM digestibility[d], %	47.0	56.6
Straw DM intake		
lb/day[e]	12.3	15.1**
% of body wt	1.50	1.81**

[a]Data of 1 and 2 cows fed untreated and ammoniated straw, respectively, were deleted because of extremely high fecal AIA concentrations.

[b]Straw intake, lb DM/day = $\frac{\text{Acid—insoluble ash (AIA) in feces from straw, lb}}{\text{AIA content of straw, \% of DM}}$

[c]In vitro dry matter digestibility.

[d]Calculated from regression equation of Oh et al. (1966):
In vivo DMD, % = 16.7 + .74 (IVDMD).

[e]Straw intake, lb/day = $\frac{\text{Fecal output (lb) corrected for Cr recovery and indigestibility of supplement}}{\text{1-(in vivo DMD/100)}}$

**P<.01.
*P<.05.

containing less AIA than the samples of straw obtained with the forage probe. Failure to account for AIA content of refused feed has been identified (Block et al., 1981) as a problem where AIA is used as a marker. This was not possible in the present study where cows had ad libitum access to large round bales of straw in panel-type feeders.

Intakes of straw, calculated from in vivo DMD estimates from IVDMD values, were 1.50 and 1.81 percent of body weight (Table 4). Irrespective of which procedure was used to estimate straw intake, ammoniation increased intake of straw (percent of body wt) about 20 percent. This value agrees with other studies (Horton and Steacy, 1979; Saenger et al., 1981) with ammoniated crop residues.

Results indicate that ammoniated wheat straw is an alternative feed for wintering cows when amounts of dormant native range are inadequate.

Literature Cited

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