

Effect of Ammoniation on Weight Gains and Straw Intake of Yearling Steers

D. W. Pace¹, G. W. Horn² and K. S. Lusby³

Story in Brief

Forty-four crossbred yearling steers that weighed 514 lb were fed untreated wheat straw and 0.8, 1.0 and 1.2 lb supplemental crude protein per day or ammoniated wheat straw and 1.0 lb supplemental crude protein per day during a 100-day study. Gains of steers fed untreated wheat straw were about .57 lb/day and were not influenced by amount of supplemental crude protein. Steers fed ammoniated wheat straw and 1.0 lb of supplemental crude protein per day gained 1.25 lb/day. Ammoniation of wheat straw increased intake of straw by 27 percent. The use of ammoniated wheat straw would be an alternative feeding strategy in emergency feeding programs for yearling stocker cattle.

Introduction

Because of the high quality of wheat forage, gains of stocker cattle on wheat pasture are potentially good. A common problem of wheat pasture stocker enterprises, which was faced by many stocker operators during the fall of 1982, is inadequate amounts of wheat forage for fall grazing. Producers who purchase cattle well ahead of the wheat pasture turn-out date frequently must turn to alternative feeding strategies until adequate forage is available for grazing.

Large amounts of crop residues (primarily wheat straw in Oklahoma) are available as a potential feedstuff. Both the digestibility and crude protein content of wheat straw are generally low, and can be increased by treatment with ammonia. The objective of this study was to compare weight gains and straw intake of yearling steers fed untreated and ammoniated wheat straw and varying amounts of supplemental crude protein.

Experimental Procedure

The study was conducted from January 5 to April 15, 1982 (100 days) at the Range Cow Research Center, Stillwater, Oklahoma. Forty-four crossbred (mixed British breeds) yearling steers with a mean initial weight of 514 ± 45 lb were randomly assigned to four treatments of 11 steers each in a completely random design. Treatments are shown in Table 1.

Large round bales of untreated and ammoniated wheat straw were fed on a free-choice basis in panel-type feeders on concrete pads. About 3.5 lb (as-fed) of corn and soybean meal based supplements, which contained 24.8, 31.8 or 38.5 percent crude protein (dry basis) and 4.3 percent dicalcium phosphate, 1.4 percent trace-mineralized salt and 5700 I.U. of vitamin A/lb of supple-

¹Graduate Assistant ²Professor of Animal Science ³Associate Professor of Animal Science

Table 1. Treatments

Straw: Treatment:	Untreated wheat straw			Ammoniated wheat straw
	1	2	3	4
Supplement, lb DM/hd/day	3.12	3.15	3.23	3.15
Crude Protein content of supplement, % of DM	24.84	31.83	38.48	31.83
Supplemental crude protein, lb/hd/day	.80	1.0	1.2	1.0

ment, were fed to the steers daily in individual feeding stalls. Actual amounts of supplements that were fed were varied as shown in table 1 according to crude protein analyses of the supplements. Steers fed ammoniated straw received 1.0 lb supplemental crude protein (i.e., supplement number 2) in an attempt to gain some information in regard to the "feeding value" of the increased crude protein of ammoniated wheat straw.

The wheat straw was ammoniated by the "stack method" similar to that described by Sundstøl et al. (1978). Twenty-eight large round bales of straw (two rows of 14 bales placed end-to-end per row) were rolled onto one edge of a 40 ft × 100 ft sheet of black plastic (.20 mm thick). The remaining 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 off with nylon cord after a one-half inch (O.D.) black pipe had been placed into the stack. Anhydrous ammonia (3.5 percent w/w of straw DM) was injected into the sealed stack through the black pipe that opened into half an empty 55 gal oil drum in the middle of the stack. 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 placing the bales in the panel-type feeders. Samples were stored in double plastic bags in a freezer until analyses were completed. Crude protein content of the samples was determined by the macro-Kjeldahl procedure prior to drying to avoid loss of ammonia. In vitro dry matter digestibility (IVDMD) was determined by the Tilley and Terry (1963) procedure with urea (.5 g/liter) added to the buffered rumen fluid (1 part strained rumen fluid:1 part McDougall's buffer, 1948) and a 24 h acid-pepsin digestion phase. Residual DM was collected by use of a Buchner funnel fitted with pre-weighed, oven-dried Whatman No. 4 filter papers.

Steers were weighed after being held off straw, supplements and water for 24 hours. To minimize differences in fill of steers among treatments, a maintenance level of good-quality alfalfa hay was fed to all steers for 5 days at the end of the trial. The steers were reweighed after an 18-hour shrink without feed and water.

Voluntary consumption of wheat straw by steers of treatments 2 and 4 was measured during days 55 through 68 of the trial. Steers were fed 6 grams chromic oxide in their daily allotment of supplement during 9-day preliminary and 5-day fecal collection periods. Fecal samples were collected from the rectum each time the steers were fed supplement, and were composited across days, within steers, on an equal wet weight basis for drying at 60 C and subsequent analyses. Fecal outputs were estimated by chromium dilution.

Results and Discussion

Crude protein content and IVDMD of untreated and ammoniated wheat straw are shown in Table 2. Crude protein content of wheat straw was increased from 6.03 to 13.56 percent by ammoniation. Calculated recovery of ammonia injected into the stack during ammoniation was 34.4 percent, which is similar to 33 percent reported by Sundstøl et al. (1978). The IVDMD of wheat straw was increased about 29 percent by ammoniation.

Gains of steers (Table 3) fed untreated wheat straw (i.e., treatments 1, 2 and 3) were about .57 lb/day and were not ($P > .01$) influenced by amount of supplemental crude protein that was fed. The similar gains of steers fed untreated wheat straw indicate that gains were limited by energy consumption rather than amount of supplemental crude protein. Gains of steers fed ammoniated wheat straw and 1.0 lb of supplemental crude protein per day were 1.25 lb/day, and were about 2.2-fold greater than gains of steers fed untreated straw. Gains of steers (calculated after feeding alfalfa hay for 5 days at the end of the trial) were .73 lb/day (mean of treatments 1, 2 and 3) and 1.39 lb/day for steers fed ammoniated wheat straw. Ammoniation of wheat straw increased gains about 1.9-fold. Consumption of straw by steers was increased about 27 percent (2.17 vs 1.71 percent of body wt) by ammoniation (table 3). The increased consumption of straw as a result of ammoniation is a major factor in the improved performance of cattle fed ammoniated crop residues.

Table 2. Composition of straw

Item	Untreated straw	Ammoniated straw
Crude protein, % of DM	6.03	13.56
IVDMD, %	33.8	43.6
Recovery of ammonia-nitrogen, %	—	34.4

Table 3. Weight gains and wheat straw intake of steers

Treatment:	Untreated straw			Ammoniated straw
	1	2	3	4
Supplemental crude protein, lb/hd/day	.80	1.0	1.2	1.0
Initial wt of steers, lb	517	513	517	509
Daily gain of steers, lb				
1/5/82-4/15/82 (100 days)	.53 ^a	.61 ^a	.56 ^a	1.25 ^b
1/5/82-4/20/82*	.67 ^a	.80 ^A	.71 ^a	1.39 ^b
Straw DM intake				
lb		9.49		13.04
Percentage of body wt		1.71		2.17

*After feeding alfalfa hay for 5 days.

^{a,b}Means with different superscripts are different ($P < .01$).

While the gains of steers fed ammoniated wheat straw would be on the low end of profitable gains of stocker programs, they would exceed gains of many emergency feeding programs. Utilization of ammoniated wheat straw would be one alternative feeding strategy in emergency feeding programs for yearling stocker cattle.

Literature Cited

McDougall, E. I. 1948. *Biochem. J.* 43:49.
Sundstol, F. et al., 1978. *World Animal Review.* 26:13.
Tilley, J. M. A. and R. A. Terry. 1963. *J. Brit. Grassl. Soc.* 18:104.

Experimental Procedure

Twenty crossbred weanling with a mean initial weight of 32 pounds were allotted by weight to four treatments. The lambs had been fed corn-based feed and 40 percent of a soybean meal based supplement for 10 days prior to allotment to treatment. Lambs were individually fed corn-based feed, rice mill feed, soybean hulls or pea pulp as shown and 40 percent of a supplement that contained 40 percent soybean meal, 32 percent distillers phosphorus, 7 percent trace-mineralized salt, 1 percent and experimental vitamins A and D. Consumption of roughage by the lambs was measured for 14 days. Total fecal excretion of the lambs was measured by use of fecal collection bags during the last 5 days of the trial. The roughages were fed at a level of 5 percent of body weight for 5 days prior to the fecal collection period and during the trial collection period. The quantity of roughage DM and ADF was estimated by difference (Barnes and Faint, 1975). The quantity of supplement DM and ADF of 40 and 30 percent, respectively, was measured in the calculations. The lambs were weighed at the beginning and end of the trial after feed and water were withheld for 24 and 48 hours, respectively.