

IMPROVING STRAW QUALITY WITH ANHYDROUS AMMONIA

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According to the 1980 issue of North Dakota Agricultural Statistics, North Dakota farmers harvested more than twelve million acres of small grain. According to the same source, there were approximately two million head of cattle on North Dakota farms in January 1980. Figuring a conservative yield of one third ton of straw per harvested acre, livestock producers have a potential feed source of approximately two tons per head. Cereal straws in their natural state have low protein levels and poor digestibility which limits their use in rations for cattle to some percentage of the ration, usually less than fifty percent. Straw digestibility and intake by cattle can be improved by treatment with Sodium Hydroxide (NaOH) or Anhydrous Ammonia (NH₃). Research by Dr. Hugh Nicholson at the University of Saskatchewan indicates an improvement from 4% crude protein for untreated straw to 10-12% for straw treated with 3.5% Anhydrous Ammonia. He also reports a 7-10% increase in total digestible nutrients to a level of 45 to 48% for treated straw. This level of crude protein and T.D.N. is about equal to most medium quality hays. This improvement in straw quality could be worth many dollars to North Dakota grain and livestock producers.

In the fall of 1979, a trial was designed to evaluate the treatment of wheat straw with 3.5% Anhydrous Ammonia. Steer calves fed a backgrounding ration were used to evaluate treatment effects.

Coteau Wheat Straw was field baled with a New Holland big roll baler, and hauled to the experiment station feedlot. A moisture sample was taken and the bales were sampled for quality. Sixteen bales were weighed and adjusted to a 100% dry matter content, averaging 686 pounds per bale. Average moisture content in the bales was 6 percent. The bales were lined up side by side on a sheet of 4-mil black plastic, which was then wrapped over the bales and sealed to make an air tight package. Used rubber tires were piled on top and along the sides of the stack to prevent wind damage. An Anhydrous Ammonia nurse tank was furnished by the local Farmers Union Oil Company. After calibration of flow rate under water, each bale was injected with as close to 3.5% by weight of NH₃ as possible. Injection was made into the core of each bale using a four foot perforated metal pipe that was sealed and brought to a point on one end. The other end was fitted with an adaptor that allowed the injection pipe to be connected to the nurse tank delivery hose. Extreme care and safety was exercised while handling the liquid NH₃.

Anhydrous injection took place on the 24th of September. The treated bales remained sealed until the 20th of November, a period of 57 days. The plastic cover was then removed and any free NH₃ allowed to escape. The straw was processed through a tub grinder prior to feeding. The additional cost of NH₃ at \$195.00 per ton plus the cost of the plastic at \$47.50 per roll amounted to \$15.50 per ton of straw treated.

On November 27, 1979, 36 head of 450-550 pound Hereford steer calves were allotted to six uniform lots of six head per lot. Two lots received a complete mixed ration of oats, mixed hay and minerals and served as the control. Two lots received a mixed ration that contained 30% NH_3 treated straw; while another two lots received a complete mixed ration containing 30% untreated straw.

Rations fed were formulated with the aid of AGNET to promote gains of 1.5 to 2.0 pounds per head per day.

The steers on trial were weighed every 28 days and were sold at backgrounded weights of 750-800 pounds at the local auction market. Results of the trial are shown in Table 1.

Discussion:

Calves on the ammoniated straw ration failed to either gain more or consume more than the control steers. This can be explained in part by the fact that a feed analysis failed to show any improvement in either crude protein level or estimated digestibility (TDN). It appears that moisture level in straw at the time of ammonization should be rather high, approaching 20% for maximum treatment effects, according to Dr. H. Nickolson (personal visit). During the trial, no problems were noticed with the acceptance of the ammoniated straw by the steers.

Summary:

Coteau Wheat Straw was ammoniated with NH_3 at the rate of 3.5% of dry weight. After a 57 day reaction period sealed in plastic, the straw was uncovered, processed through a tub grinder and mixed in complete mixed rations for backgrounding steer calves. The straw was fed at the level of 30% of ration. Samples of feed, analyzed for crude protein and TDN, failed to show any advantage for the ammonia treatment.

Steers on the control ration of all mixed hay and grain gained the fastest at 2.31 lbs/hd/day. Steers fed either treated or untreated straw at the level of 30% gained at 2.08 or 2.02 lbs/hd/day.

The trial will be continued in 1980-81 with straw having a higher initial moisture content.

Table 1. Results From the Feeding Trial With Ammoniated Straw – 1980

	30% Ammoniated Straw		30% Untreated Straw		All Hay-Control	
	Lot 2	Lot 6	Lot 3	Lot 5	Lot 4	Lot 7
No. head	6	6	6	6	6	6
Final wt. Apr. 22	846	749	757	824	838	818
Initial wt. Nov. 27	513	474	472	518	507	474
Gain/lbs.	333	275	285	306	331	344
Days fed	146	146	146	146	146	146
ADG/lbs.	2.28	1.88	1.95	2.10	2.26	2.36
Actual market wt.	818	723	750	818	818	783
Avg. market value	\$484.86	\$452.08	\$461.25	\$482.32	\$484.86	\$485.66
Percent shrink	3.25%	3.45%	.9%	.8%	2.3%	4.3%
Feed Information:						
Lbs/hd/day:						
Barley	3.71	3.50	3.61	4.10	--	--
Oats	2.73	2.97	2.66	2.88	7.19	7.21
Alfalfa	3.22	3.05	3.14	3.57	--	--
Mixed Hay	4.03	4.17	3.95	4.27	13.33	13.46
Straw	5.50	5.57	5.35	5.99	--	--
Di cal	.02	.02	.02	.01	0.11	0.11
Limestone	.01	.02	.01	.01	0.11	0.11
White salt	<u>.11</u>	<u>.13</u>	<u>.11</u>	<u>.12</u>	<u>0.42</u>	<u>0.42</u>
Lbs/hd/day	19.33	19.44	18.85	20.96	21.15	21.31
Feed cost/hd \$	102.96	103.28	94.52	105.12	113.99	114.07
Return/calf \$	381.90	348.80	366.73	377.20	370.87	371.59
Market value-fed						
Avg. feed \$/Cwt gain \$	30.89	37.56	33.16	34.47	34.46	33.15
	34.22		33.81		33.80	

**Table 2. Two Year Combined Results From the Feeding Trial
With Ammonia Treated Straw**

	30% Ammoniated Straw	30% Untreated Straw	All Hay-Control
No. head	24	24	24
Final wt.	798	776	847
Initial wt.	507	508	508
Gain	291	268	340
Days fed	148	148	148
ADG/lbs.	1.96	1.82	2.29
Pounds feed/lb/gain	9.81	11.02	9.28
Actual market wt.	768	759	815
Avg. market value	\$465.75	\$458.10	\$495.90
Percent shrink	3.8%	2.2%	4.0%
Pounds feed/hd/day	19.1	19.6	21.2
Avg. feed cost/hd/day	.76	.73	.91
Avg. total feed cost/hd	\$112.58	\$108.86	\$135.16
Feed cost/cwt gain	\$ 38.69	\$ 40.62	\$ 39.75
Return/calf	\$353.16	\$349.24	\$360.75

Discussion:

Results of the first years' feeding using ammoniated straw indicated that steers failed to either gain more or consume more than the calves fed untreated straw. This can best be explained in part by the fact that the feed analysis failed to show any improvement in either crude protein level or estimated digestibility.

However, results from the second years' feeding seem to indicate both an improvement in rate of gain and in feed efficiency. Evidently the higher initial moisture content of the straw allowed for improvement in digestibility. We have not noticed any problems with calves rejecting the ammoniated feed since total feed intake was comparable with the non-treated straw ration. The biggest problem with treatment of straw appears to be the difficulty in getting the straw baled at moisture levels approaching 20%.

Summary:

Wheat straw, packaged in large round bales, was treated with anhydrous ammonia at the rate of 3.5% of dry weight while sealed in plastic. After a 60 day reaction period, the straw was uncovered, processed through a tub grinder and mixed in complete mixed rations for background feeding to steer calves. The straw was fed at the level of 30% of the ration.

In 1979-80, steers on the control ration of all mixed hay and grain gained the fastest at 2.31 lbs/hd/day. Steers fed either treated or untreated straw at the level of 30% of the ration gained at 2.08 or 2.02 lbs/hd/day.

In 1980-81, steers on the control ration of all mixed hay and grain again gained the fastest at 2.26 pounds per head per day. Their feed efficiency averaged 9.38 pounds per pound gain and the return per calf over feed cost averaged \$350.26. Steers fed the ammoniated straw gained 1.84 pounds per head per day with an average feed efficiency of 10.28 pounds per pound gain. Return per calf over feed cost averaged \$340.98. Steers fed the untreated straw as 30% of the ration gained the slowest at 1.60 pounds per head per day with an average of 12.15 pounds feed per pound of gain. They returned an average of \$326.51. This was \$14.47 less than similar steers fed the ammoniated straw. The two year averages as shown in Table 2 show the all hay mixed ration having the fastest average daily gain at 2.29 and the best feed efficiency at 9.28 pounds of feed per pound gain. Dollar return over feed was \$360.75. Steers fed the ammoniated straw gained faster (1.96 vs. 1.82) and were more efficient (9.81 vs. 11.02) and returned more net dollars (\$353.24 vs. \$349.16) than steers fed untreated straw.

The trial will continue in 1981-82 to better substantiate the results gained to date.