USING BALE WRAP DURING FORAGE AMMONIATION

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Story in Brief

Four types of forages (corn stover, grain sorghum, native grass and wheat) were harvested as hay and ammoniated by injecting anhydrous ammonia into individual bales during wrapping of the bales with plastic stretch film. Ammoniation increased the crude protein content of the hays by about twofold, and increased *in vitro* and *in vivo* estimates of organic matter digestibility 7 to 27%. Improvement in digestibilty of the hays was less than that previously reported for very low quality roughages such as wheat straw ammoniated by the stack method. However, our results show ammoniation of roughages in association with post-harvest bale wrapping may be a viable alternative to the stack method ofammoniation.

(Key Words: Ammoniation, Forage Quality, Low-Quality Roughages.)

Introduction

The feeding value of wheat straw and other low-quality roughages is low because of their low digestibility and voluntary consumption. Ammoniation is a method of chemical treatment of low-quality roughages to increase digestibility and intake. In addition, the crude protein content is also increased. The common method of ammoniation of roughages is often referred to as the "stack method". Large round bales of forage are stacked end to end in two or more rows forming a pyramid, and the stack is then covered with a polyethylene sheet to make the containment air tight to prevent the loss of ammonia that is subsequently injected into the stack.

The increasing popularity of bale wrapping offers a possible alternative method for post-harvest ammoniation. Bale wrapping is used to preserve high moisture forage by providing a barrier to oxygen infiltration thus allowing the mass to ferment resulting in silage. This same wrapping process could be used to retain a gas such as ammonia. The primary purpose of this study was to evaluate the feasibility of bale wrapping as an alternative method in the containment of anhydrous ammonia.

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Materials and Methods

Eight bales of four forages (32 bales total) were weighed and core sampled on October 20, 1994, to determine initial forage quality and dry matter. Mean initial weight of the bales was about 1,000 lb. The forages were 1) corn stover (CS) baled mid-October after grain had been harvested, 2) grain sorghum (GS) baled late September as hay rather than harvested for grain with grain in dough stage of maturity, 3) native grass (NG) baled mid-September containing mixture of Big and Little Bluestem plus Indiangrass with all grasses predominately mature heads, and 4) wheat hay (WH) baled early June as hay rather than harvested for grain ranging from bloom to soft dough stage of maturity. All bales had been subjected to weathering (unprotected) prior to being used for this study.

On October 26, 1994, bales were individually ammoniated and wrapped. Ammonia was injected near the center of the bale using a hollowed spear after a Parmiter TR76 bale wrapper applied enough stretch film to each bale to make one complete wrap to minimize ammonia loss. Quantity of ammonia injected, approximately 3% of the dry matter, was determined by recording the weight of a supply tank suspended from a load cell. After the ammonia had been injected, bale wrapping continued until a total of at least six layers of film was applied. The bale wrapper pre-stretched the film[1] approximately 60% as it was applied with a 50% overlap. Bales were weighed before being positioned individually 2 ft apart in an exposed storage site at the South Central Research Station, Chickasha, OK.

On December 19, 1994, after approximately 8 wk in storage, all bales were weighed and core sampled. Samples were oven-dried at 55ºC for 72 h, ground in a Wiley Mill through a 2mm screen and analyzed for crude protein and *in vitro* organic matter digestibility (OMD). *In vitro* OMD was determined using a 48-h fermentation period in buffered rumen fluid followed by extraction with neutral detergent fiber solution (Goering and Van Soest, 1970). Four forages (alfalfa, kleingrass, prairie and wheat hays) of known *in vivo* OMD were included with each *in vitro* run in order to convert in vitro values to in vivo values by regression. *In vivo* OMD values of the samples were converted to *in vivo* digestible organic matter (DOM) values using OM content of the samples.

The data were analyzed by analysis of variance using the GLM procedure of SAS. Forage type, bale within forage type, ammoniation and ammoniation by forage type were included as sources of variation in the model.

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[1] AEP Sunfilm Silage Wrap

Results and Discussion

Results are shown for both untreated and ammoniated bales in Table 1. The level of ammonia application was 3% of dry matter weight of the bales except for corn stover. Because this forage was baled at such a high moisture content, excessive heating during the time between initial sampling and ammoniation decreased bale dry matter content. Therefore, the resulting level of ammonia application was 3.4% for the corn stover. Calculated retention of ammonia-N was 23.5, 31.0, 39.4 and 33.6% for corn stover, grain sorghum, native grass, and wheat hays, respectively. Previously reported values for retention of ammonia-N by wheat straw ammoniated by the stack method have ranged from 18 to 49% (Saenger et al., 1983; Nelson et al., 1985; and Zorrilla-Rios et al., 1985, 1991a,b).

Ammoniation increased ($P<.001$) the crude protein content and all *in vitro* and *in vivo* estimates of digestibility. The greatest inprovement in CP and estimates of digestibility was obtained with the native grass hay which was of lowest initial quality. This is consistent with previous research on ammoniation of low-quality roughages is which the response to ammoniation has been greater with lower quality roughages. In the studies of Zorrilla-Rios et al. (1991a,b), ammoniation increased the *in vitro* DMD of very low quality wheat straw by about 55%. In the present study, improvement in in vitro OMD and in vivo DOM from ammoniation decreased by .19 units for each one percent increase in initial in vitro OMD and in vivo DOM of the untreated roughages.

The results of this study show that ammoniation of roughages in association with bale wrapping is a viable alternative to the stack method of ammoniation. However, the mechanics and equipment used to automatically inject the ammonia into the bale must be developed.

Literature Cited

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Table 1. Effect of ammoniation on crude protein content and digestibility of four hays.

	CP[c] (% DM)		*In Vitro* OMD[d] (% DM)		*In Vivo* OMD[e] (% DM)		*In Vivo* DOM[f] (% DM)	
Forage[ab]	Control	Treated	Control	Treated	Control	Treated	Control	Treated
CS	5.7	9.8	54.6	63.9	60.5	65.9	49.0	54.1
GS	7.3	12.1	64.3	71.8	66.2	70.5	56.8	60.7
NG	5.0	11.1	42.9	54.5	53.6	60.4	50.0	56.4
WH	6.4	11.6	55.6	65.4	61.1	66.8	54.9	60.1

[a] CS = corn stover, GS = grain sorghum, NG = native grass and WH = wheat hay.

[b] Mean initial DM content of the hays was 73.5% (CS), 79.9% (GS), 91.6% (NG), and 90.2% (WH).

[c] SE = .25.

[d] SE = .92.

[e] SE = .54.

[f] SE =1.26.