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Additive-treated corn silage, harvestore cornlage, and sodium bicarbonate supplement for yearling steers (1983)

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Additive-treated Corn Silage, Harvestore Cornlage, and Sodium Bicarbonate Supplement for Yearling Steers[1]

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Summary

Steers fed Silo Guard II® treated corn silage gained 3.5% faster and were 8.3% more efficient than those fed the control silage. Cornlage (54% dry matter corn silage in an oxygen-limiting structure) produced numerically slower and less efficient gains than either treated or untreated silage, but differences in silages were not statistically significant. Steers fed sodium bicarbonate throughout the trial consumed 8.5% more silage, gained 14% faster ($P<.05$), and were 3% more efficient than those not fed bicarbonate; performance of steer fed bicarbonate for the first half of the trial was intermediate. Steers fed cornlage had a higher rumen fluid acetate:propionate ratio ($P<.05$) than those fed the control or Silo Guard II silages but there were no significant differences due to bicarbonate in rumen fluid volatile fatty acids.

Silage DM recoveries and aerobic stabilities were similar for the control and Silo Guard II silages. Cornlage was less stable in air than the other two silages.

Introduction

Calves fed high silage rations generally consume less dry matter than calves fed hay. Research conducted at the Hays Branch Experiment Station (Kansas Agriculture Expt. Sta. Bull. 556) showed that steers fed sorghum silage rations supplemented with 100 gm of sodium bicarbonate ($NaHCO_3$) consumed 4% more dry matter and gained 8% faster than steers not receiving bicarbonate. Similar results were reported by South Dakota researchers; however, they found that the effect of bicarbonate was not sustained, suggesting that maximum benefit from bicarbonate may be in the early silage feeding period. To find out how long its effect lasts, we evaluated bicarbonate supplements for calves fed corn silage for 4 or 8 week periods. Additional objectives were to continue our evaluation of commercial additives for corn silage and to compare the nutritional value of early-harvested corn silage made in a stave silo with late-harvested cornlage made in a Harvestore.

Experimental Procedures

Three whole-plant corn silages made in the late summer, 1981 were compared: 1) ensiled in a concrete stave silo with no additive (control); 2) ensiled in a concrete stave silo with Silo Guard II® applied at 1.0 lb per ton of fresh crop (Silo Guard II); and 3) ensiled in a Harvestore without an additive.

[1] Silo Guard II is an enzyme and its co-factors, produced by International Stock Foods, Inc., Waverly, NY 14892. Partial financial assistance were provided by International Stock Foods, Inc. and A.O. Smith Harvestore Products, Arlington Heights, IL 60006.

(cornlage). The corn, Ferry-Morse 3020, was grown under irrigation near Manhattan. Its grain yield was 153 bushels per acre. Harvest began on August 19 using a Field Queen harvester adjusted to a 3/8-inch chop length. To reduce variation among silages, a similar number of rows from each area in the field was used to fill each structure.

The control and Silo Guard II silages were made on August 19, 20, 21, and 24 in two 14 x 60 ft silos which were filled by the alternate load method. The corn was in the dent stage of maturity. Silo Guard II was applied in a dry, granular form with a continuous-feed applicator attached to the silage blower. Average dry matter (DM) of the crop was 40%. Six plastic container silos and three nylon bags were filled with fresh crop while filling each concrete stave silo. Details of the procedures are on page 32 and 33 of this Progress Report.

The cornlage was made in a 14 x 40 ft Harvestore on September 1, 4, and 7. The harvest was delayed 3 days by a heavy rain on September 1. The average stage of maturity of the corn was glaze to flint. To exclude air, approximately 200 lb of dry ice (a carbon dioxide source) was placed in the air space above the crop at the end of each filling day. Average DM of the crop was 54%.

All three structures were opened in early November, 1981 and the silages were fed over a 6-month period. Although occasional interruptions in feeding occurred, samples of each silage were collected every 4 or 5 days.

Each silage was full-fed to 12 yearling Hereford and Simmental steers during a 57-day growing trial from January 4 to March 2, 1982. All steers were individually fed twice and received 2.0 lb of supplement, daily (Table 16.1). Four steers fed each silage received the control supplement throughout the trial; four steers fed each silage received the bicarbonate throughout the trial; and four steers, the bicarbonate supplement for the first 29 days and the control supplement for the last 28 days. Sodium bicarbonate was added to the supplement to provide 112 g per steer daily. Rations were formulated to contain 11.75% crude protein, .5% calcium, and .3% phosphorus and to supply 150 mg of monensin per steer daily.

All steers were weighed individually after 16 h without feed or water on 2 consecutive days at the start and again at the end of the trial. Two days before the initial and final weighings, all steers were fed the same amount of feed (12 lb of ration dry matter). An intermediate weight was taken on day 28 after the steers were without feed or water for 16 hours. Rumen fluid samples were collected via stomach tube from all steers approximately 4 h after feeding on days 29 and 58.

Two aerobic stability (bunk life) measurements were made on each silage as described on page 32 of this Progress Report.

Results

The two silages and cornlage were preserved and each had undergone normal lactic acid fermentations. Chemical analyses are shown in Table 16.2. The pH values were relatively low and, not surprisingly, the higher DM cornlage had about 50% less lactic acid than the corn silages. There were no clostridial fermentations, as evidenced by low NH_3-N and butyric acid values. Silo Guard II corn silage had more lactic acid and hot water insoluble nitrogen than control corn silage. The cornlage was much less stable in air than the other two corn silages (Table 16.3).

Steers fed Silo Guard II corn silage gained 3.5% faster and 8.3% more efficiently than those fed control corn silage (Table 16.4). Although the differences were not statistically significant, these results agree with two previous trials which showed improved rate and efficiency of gains from Silo Guard treated corn and sorghum silages (Progress Report 377, Kansas Agriculture Expt. Station). Steers fed control corn silage and cornlage had similar performances, however those fed cornlage consumed nearly 1.0 lb less dry matter, due at least in part, to a greater refusal of the cob and husk portion of the drier cornlage. Studies at other universities have shown that the digestibility of whole-plant corn silage increases to a maximum at the dough-dent stage and decreases only slightly as the corn matures through the dent, glaze, flint, and mature stages. Although bicarbonate numerically improved gain and feed intake, the only statistically significant improvement was a faster rate of gain for steers fed bicarbonate throughout the trial.

Rumen fluid analyses results are shown in Table 16.5. The addition of bicarbonate did not consistently alter rumen fluid pH or VFA's when fed in combination with the corn silages or cornlage. Corn silage treatments had no significant effect on rumen fluid pH. The molar proportion of acetate was highest for steers fed cornlage and propionate was highest for steers fed control corn silage. Steers fed control corn silage also had the lowest acetate to propionate ratio; those fed cornlage, the highest. Since cattle use acetate less efficiently than propionate, this could partially explain the slower gains for steers fed cornlage.

Dry matter recoveries for the control and Silo Guard II corn silage were similar (Table 16.2). Results of four previous trials showed consistent improvements in DM recovery with Silo Guard silages compared with control silages (Progress Reports 377, 394, and 413, Kansas Agriculture Expt. Station).

Table 16.1. Composition of the Supplements Fed with the Two Corn Silages and Cornlage

Ingredient	Supplement	
	Control	Sodium bicarbonate
	lb/ton	
Soybean meal	1500	1545
Rolled sorghum grain	320	---
Sodium bicarbonate[1]	---	275
Salt	42	42
Dicalcium phosphate	80	80
Limestone	28	28
Tallow	20	20
Trace mineral premix	5	5
Vitamin mineral A[2]	2.5	2.5
Rumensin-60[3]	2.5	2.5

[1]Added to provide 112 g/steer daily.
[2]Added to provide 30,000 IU/steer daily.
[3]Added to provide 150 mg/steer daily.

Table 16.2. Chemical Analyses and Dry Matter Recoveries for the Two Corn Silages and cornlage.

Item	Corn silage		Cornlage
	Control	Silo Guard	
Dry matter:			
Pre-ensiled	39.48	40.02	54.13
Silage, %	40.92	41.81	54.25
pH	3.65	3.69	4.07
	% of the DM		
Lactic acid	7.12	7.60	3.95
Acetic acid	2.11	1.87	1.40
Propionic acid	.01	.01	.01
Butyric acid	.07	.03	.01
Total fermentation acids	9.27	9.62	5.63
Crude protein	8.49	8.53	8.39
	% of total N		
Ammonia-N	8.27	8.08	8.46
Hot water insoluble-N	39.85	42.95	50.03
	% of the DM ensiled		
Dry matter recovery:			
Buried bag	95.42	96.59*	---
5-gallon silo	94.53	94.67	---

*Only one bag recovered.

Table 16.3. Changes in Temperatures and Losses of Dry Matter During Air Exposure for the Three Corn Silages

Replication and silage	Day of initial temp. rise above ambient temp.*	Maximum temp.	Loss of DM**
Replication 1[a]:			
Control	6.5	44	5.1
Silo Guard II	6.5	46	4.0
Cornlage	.9	49	12.1
Replication 2[b]:			
Control	9.0	47	<1.0
Silo Guard II	10.0	42	<1.0
Cornlage	.9	48	10.4

*1.7 C rise or higher.
**Percent of the DM exposed to air after 7 days.
[a] Silage removed from the structures on January 27, 1982.
[b] Silage removed from the structures on March 24, 1982.

Table 16.4. Performance of Steers Fed the Whole-plant Corn Silages and Cornlage and Supplement Treatments (57 Days: January 4 to March 2, 1982).

	Whole-plant corn			Supplement		
	Corn silage					
	Control	Silo Guard II	Cornlage	Control	Sodium bicarbonate	Sodium bicarbonate control
No. of steers	12	12	12	12	12	12
Initial wt., lb	588.4	587.8	588.4	588.1	590.4	586.3
Final wt., lb	717.5	721.2	709.5	707.8	726.6	714.0
Avg. daily gain, lb	2.26	2.34	2.12	2.10[b]	2.39[a]	2.24[a b]
Avg. daily feed, lb						
silage	15.11	14.17	14.15	13.83	15 .01	14.59
supplement	1.80	1.80	1.80	1.80	1.80	1.80
total	16.91	15.97	15.95	15.63	16.81	16.39
Feed/lb of gain, lb[1]	7.55	6.92	7.68	7.42	7.20	7.54

[1] 100% dry matter basis.
Values with different superscripts differ significantly (P<.05).

Table 16.5. Molar Proportions of Rumen Volatile Fatty Acids for Steers Fed the Whole-plant Corn Silages and Cornlage and Supplement Treatments

	Whole-plant corn			Supplement	
	Corn silage				
	Control	Silo Guard II	Cornlage	Control[1]	Sodium bicarbonate[2]
	day 29				
pH	6.50	6.38	6.51	6.45	6.47
A/P ratio	2.13[b]	2.28[b]	2.41[a]	2.25	2.28
	Molar %				
Acetate	57.1[b]	57.1[b]	59 .9[a]	57.8	58.1
Propionate	27.0[a]	25.4[b]	25.0[b]	25.9	25.8
Butyrate	12.5[b]	14.3[a]	11.8[b]	13.1	12.8
	day 58				
pH	6.44	6.57	6.41	6.46	6.51
A/P ratio	2.13[b]	2.50[b]	2.65[a]	2.49	2.49
	Molar %				
Acetate	59.0[b]	61.1[b]	61.9[a]	60.8	60.6
Propionate	25.7[a]	24.7[a]	23.8[b]	24.9	24.6
Butyrate	11.2	10.6	10.4	10.7	11.0

[1] Average of 12 steers for day 29 and 24 steers for day 58.
[2] Average of 24 steers for day 29 and 12 steers for day 58.
[a b] Values with different superscripts differ significantly (P<.05).