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Urea and Fermentrol® additives for forage sorghum silage

Abstract

Adding urea to forage sorghum greatly increased the ensiling temperature, produced a more rapid and extensive fermentation, and resulted in more shrink loss in the silo. Fermentrol®, an enzyme-inoculant additive, had very little affect on the silage temperature or chemical composition, but it did reduce the shrink loss. Calves red urea-treated silage had the poorest performance. Control and Fermentrol® silages each produced about 90 lb of calf gain per ton of crop ensiled, however urea silage produced only 60 lb. All three silages had short bunk lives throughout the trial.

Keywords

Cattlemen's Day, 1984; Kansas Agricultural Experiment Station contribution; no. 84-300-S; Report of progress (Kansas State University. Agricultural Experiment Station and Cooperative Extension Service); 448; Beef; Urea; Additives; Sorghum silage

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Urea and Fermentrol® Additives for Forage Sorghum Silage[1]

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Summary

Adding urea to forage sorghum greatly increased the ensiling temperature, produced a more rapid and extensive fermentation, and resulted in more shrink loss in the silo. Fermentrol®, an enzyme-inoculant additive, had very little affect on the silage temperature or chemical composition, but it did reduce the shrink loss. Calves fed urea-treated silage had the poorest performance. Control and Fermentrol® silages each produced about 90 lb of calf gain per ton of crop ensiled, however urea silage produced only 60 lb. All three silages had short bunk lives throughout the trial.

Introduction

In three previous trials with corn and sorghum silages (Reports of Progress 377 and 394), non-protein nitrogen (ammonia) generally increased the crude protein content by 3 to 5 percentage units, increased the amount of fermentation acids, and extended the aerobic stability (bunk life). However, ammoniating silage usually decreased cattle performance, when compared to an all-natural supplement, and decreased silage dry matter recovery. Although ammonia is a cheaper source of NPN, urea is safer to handle. Urea was often added to corn silages in the 1960's and '70's, but has seldom been used with wetter forage sorghum silages.

Our objectives were: (1) to determine the effects of urea on the quality and feeding value of sorghum silage and (2) to continue our evaluations of other silage additives that are marketed in Kansas.

Experimental Procedures

Three whole-plant forage sorghum silages were compared: (1) control (no additive); (2) urea (10 lb/ton of fresh crop); and (3) Fermentrol® (2 ounces/ton of fresh crop). Urea was applied in a 50% water solution; Fermentrol, in dry form. The silages were made by the alternate load method in 10 x 50 ft concrete stave (farm-scale) silos on September 23, 1982 from Pioneer 947 forage sorghum harvested in the hard-dough stage at 31% dry matter (DM). Ensiling temperatures were monitored for the first 40 days. The silos were opened on November 18 and 19, 1982 and emptied at a uniform rate during the following 10 weeks.

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[1] Fermentrol®, an enzyme-inoculant silage additive, is produced by Agrimerica, Inc., Northbrook, Illinois 66002. Partial financial assistance provided by Agrimerica.

[2] Visiting research assistant in the Animal Sciences and Industry Department from the University of Agriculture, Bydgoszez, Poland (July 28, 1982 to July 26, 1983).

Each silage was fed to 16 Angus and crossbred steer calves in four pens of four calves per silage. The 56-day growing trial began November 20, 1982 and ended January 15, 1983. Silages were full-fed and all calves received 2.0 lb of supplement daily. Rations were formulated to provide 12.5% crude protein (DM basis), 150 mg of monensin per calf daily, and equal amounts of calcium, phosphorus, and vitamin A.

While the farm-scale silos were being filled, 18 laboratory-scale silos were filled for each silage treatment. These silos (three per treatment) were opened on days 1, 2, 4, 7, 21, and 64 post-ensiling.

Calf weights, silage samples, and silage bunk life procedures were similar to those described on page 41 of this report.

Results and Discussion

Visual appraisal indicated that the farm silo control and Fermentrol silages were well preserved; the urea silage was not. The urea silage was a dark brown color and reached much higher ensiling temperatures than the other two silages (Figure 11.1). Fermentrol reduced the ensiling temperature slightly when compared with the control.

Chemical analyses of the farm and lab silo silages are shown in Table 11.1 and Figures 11.2 and 11.3. In general, urea gave the most rapid and extensive fermentation, the highest pH's and total acids, and lowest lactic to acetic acid ratios. Although control and Fermentrol silages had similar compositions, the slightly higher lactic to acetic ratio in the farm silages and lower ensiling DM losses in the lab silos (Figure 11.4) suggest that the Fermentrol silage fermented more efficiently.

Silage recovery and loss results are shown in Table 11.2. In the farm silos, DM lost during fermentation, storage, and feedout was lowest for the Fermentrol silage (9.8%); highest for the urea silage (13.0%). The lab silos gave similar results, except the control and Fermentrol silages had nearly identical losses.

Performance by calves fed the three forage sorghum silage rations is shown in Table 11.3. Calves fed the urea silage had the slowest gain ($P<.05$), the lowest DM intake ($P<.05$), and the highest feed to gain ratio ($P<.05$). Calves fed Fermentrol silage had the highest intake ($P<.05$) and also had a 9.6% faster gain than those fed control silage.

Also shown in Table 11.3 are calf gains per ton of forage sorghum ensiled, which combine farm silo recovery (Table 11.2) and calf performance. Control and Fermentrol silages produced nearly identical gain (90.2 and 90.8 lb per ton, respectively); urea silage gave only 60.5 lb per ton. The low production of the urea silage was due primarily to its poor feed conversion.

Throughout the feeding trial, all three silages were highly unstable — heating after only 1 to 2 days of exposure to air. The 500 to 600 lb of silage removed daily from the surface of each silo (approximately a 2 to 3 inch layer) was not sufficient to prevent surface aerobic deterioration. As a result, an additional 400 to 500 lb of silage was removed from each silo as necessary (about every 4 or 5 days) so that animals were fed fresh, undeteriorated silage. This fast feeding rate of the silages shortened the trial from 84 days, as planned, to 56 days.

Table 11.1. Chemical Analyses for the Control, Urea, and Fermentrol Silages Made in the Concrete Stave (Farm) and Laboratory (Lab) Silos.[1,2]

	Silage treatment and silo					
	Control		Urea		Fermentrol	
Item	farm	lab	farm	lab	farm	lab
Dry matter:						
pre-ensiled, %	31.0	32.8	30.5	32.8	31.3	32.6
silage, %	30.7	30.6	29.8	29.5	30.0	30.4
	% of the silage DM					
Lactic acid	4.62	2.35	4.10	2.77	4 .83	2.71
Acetic acid	.75	3.81	3.08	6.05	.77	4.37
Total fermentation acids	5.37	6.67	7.20	9.69	5.60	7.67
Crude protein	8.6	8.2	11.5	11.8	9.0	8.4
	% of the total N					
Hot water insoluble-N	71.8	68.7	59.1	49.2	68 .2	61.2
Ammonia-N	1.1	2.6	10.3	14.4	1.4	2.6
pH	3.90	4.00	5.05	4.57	3.79	3.96
Ratio:						
lactic:acetic	6.1	.6	1.3	.45	6.3	.6

[1]Each farm silo value is the mean of 10 samples.

[2]Each lab silo value is the mean of three silos.

Table 11.2. Forage Sorghum Silage Recoveries and Losses From the Concrete Stave and Laboratory Silos for the Control, Urea, and Fermentrol Silages.

Silo and silage treatment	DM recovery: Feedable	DM recovery: Non-feedable (spoilage)	DM lost during fermentation, storage, and feedout
	% of the DM ensiled		
Concrete stave silos			
control	85.6	2.4	12.0
urea	83.6	3.4	13.0
Fermentrol	87.8	2.4	9.8
Laboratory-scale silos[1]			
control	92.2	—	7.8
urea	88.3	—	11.7
Fermentrol	92.3	—	7.7

[1]Each value is the mean of six silos.

Table 11.3. Performance by Calves Fed the Control, Urea, and Fermentrol Silages and Calf Gain Per Ton of Forage Sorghum Ensiled.

	Silage treatment		
Item	Control	Urea	Fermentrol
No. of calves	16	16	16
Initial wt., lb	453	452	454
Avg. daily gain, lb	1.77[a]	1.09[b]	1.94[a]
Daily feed intake, lb[1]			
silage	10.08	9.04	11.25
supplement	1.80	1.80	1.80
total	11.88[b]	10.84[c]	13.05[a]
Feed/lb of gain, lb[1]	6.82[a]	10.08[b]	6.78[a]
Silage fed, lb/ton[2]	1712	1672	1756
Silage/lb of gain, lb[2]	18.98	27.65	19.33
Calf gain/ton of crop ensiled, lb[2]	90.2	60.5	90.8

[abc] $P<.05$.

[1] 100% dry matter basis.

[2] All values are adjusted to the same silage DM content, 30 percent.

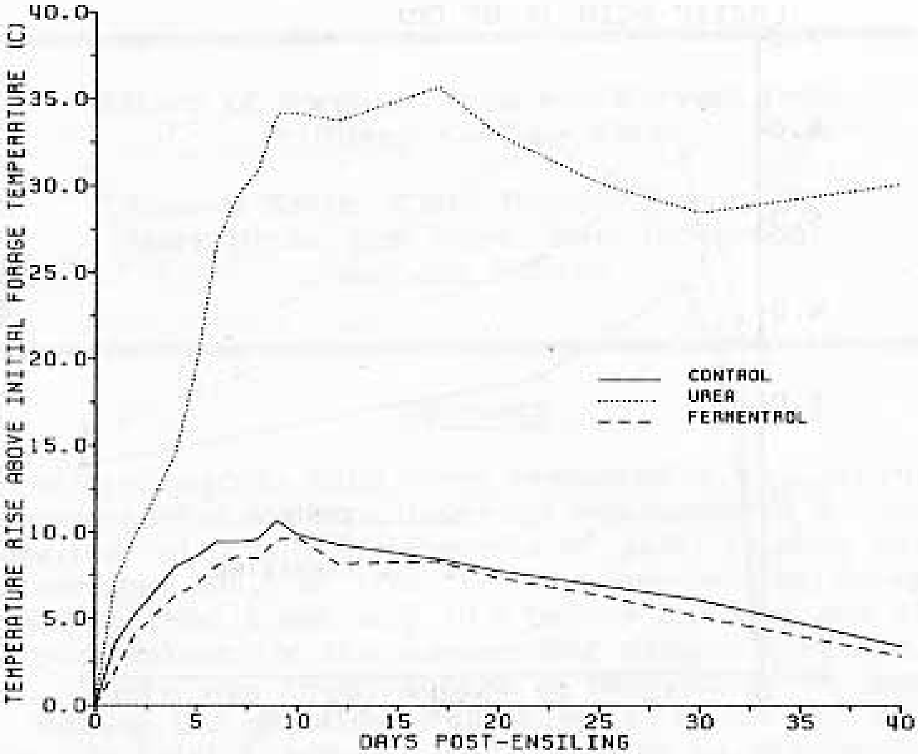

Figure 11.1. Adjusted ensiling temperature rise above the initial forage temperatures for three silages made in concrete stave silos.

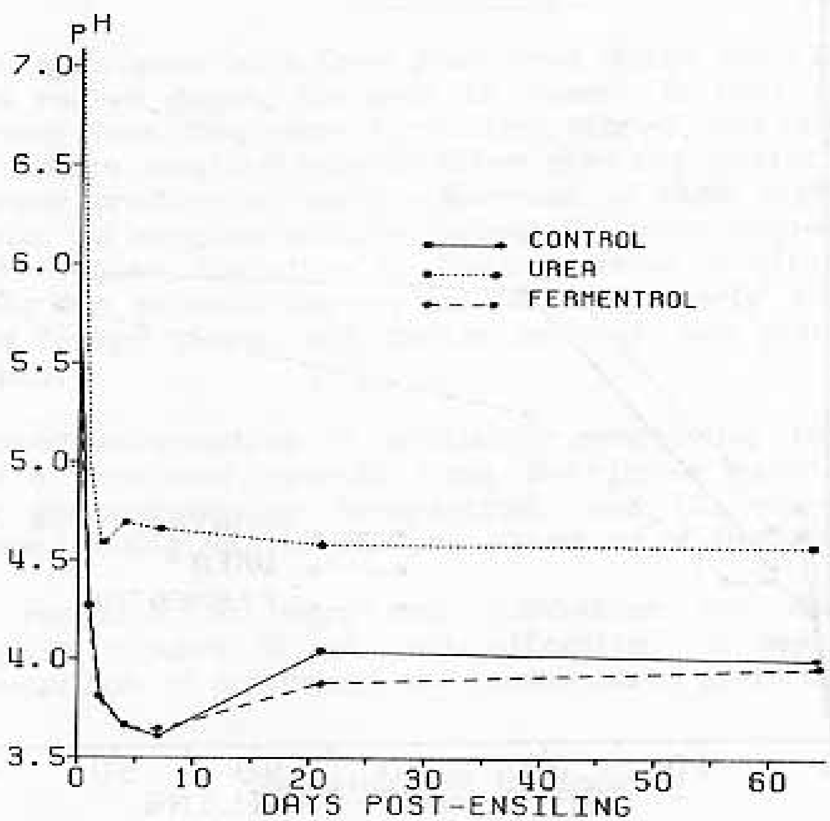

Figure 11.2. Changes in pH from 0 to 64 days for the three silages made in laboratory silos.

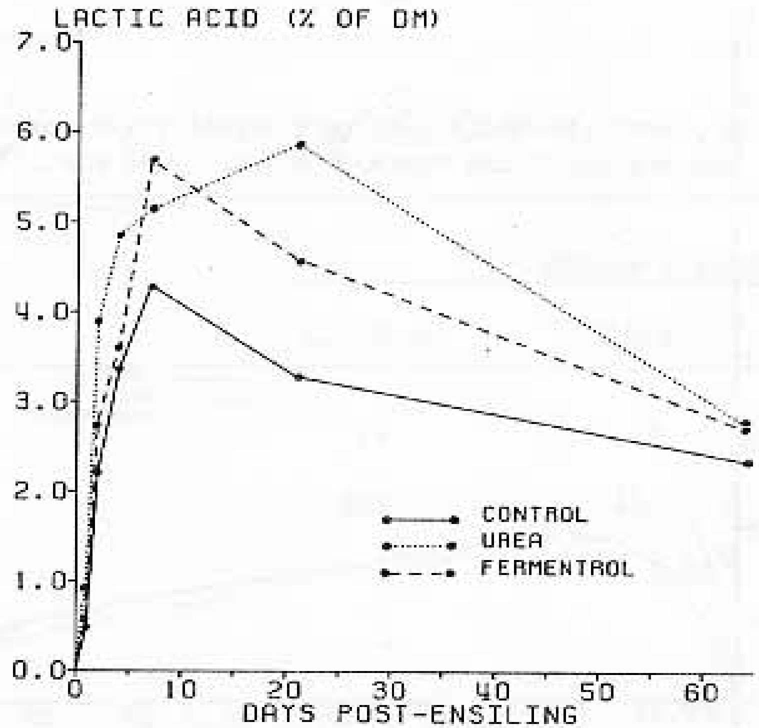

Figure 11.3. Changes in lactic acid from 0 to 64 days for the three silages made in laboratory silos.

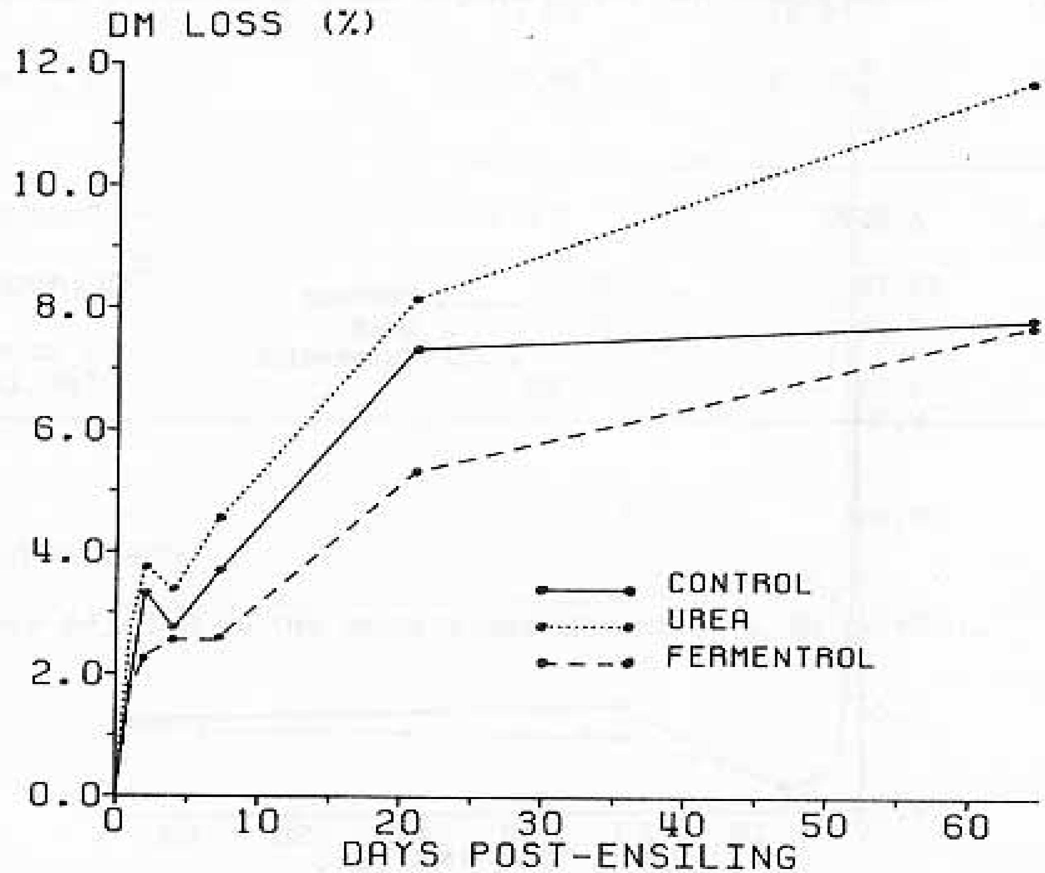

Figure 11.4. Dry matter losses from 0 to 64 days for the three silages made in laboratory silos.