Kansas Agricultural Experiment Station Research Reports

Volume 0
Issue 1 *Cattleman's Day (1993-2014)*

Article 1055

1985

High moisture corn ensiled with urea

J. Heidker

K. Bolsen

M. Hinds

See next page for additional authors

Recommended Citation

Heidker, J.; Bolsen, K.; Hinds, M.; Ilg, H.; Janicki, B.; and Young, B. (1985) "High moisture corn ensiled with urea," *Kansas Agricultural Experiment Station Research Reports*: Vol. 0: Iss. 1. https://doi.org/10.4148/2378-5977.2458

High moisture corn ensiled with urea

Authors

J. Heidker, K. Bolsen, M. Hinds, H. Ilg, B. Janicki, and B. Young

High Moisture Corn Ensiled With Urea

Jean Heidker[1], Keith Bolsen, Mark Hinds,
Harvey Ilg, Bogdon Janicki[2] and Bruce Young

Summary

High moisture corn harvested at 18 and 26% moisture, rolled, treated with 0, .75, 1.5, or 2.25% urea (DM basis), and ensiled was evaluated for fermentation rate, chemical composition, and aerobic stability. Adding urea to 26% moisture corn increased the rate and extent of fermentation as measured by lactic, acetic, and total acid concentrations. Only a very limited fermentation occurred in the 18% moisture corn. No statistically significant differences were noted in DM loss or aerobic stability among the eight corn treatments.

Introduction

Urea is commonly used as a nitrogen supplement for cattle fed high energy finishing rations. In a previous report (Report of Progress 448), high moisture corn treated with urea and ensiled in concrete stave silos had higher lactic and acetic acid concentrations and improved aerobic stability (bunk life) when compared with untreated high moisture corn. In this trial, we monitored fermentation rate, chemical composition, and aerobic stability of high moisture corn treated with various levels of urea.

Experimental Procedures

High moisture corn was harvested at 18% (LM) and 26% (HM) moisture, rolled, treated with one of three levels of urea, and ensiled in 5 gallon laboratory silos. Treatments (DM basis) were: 1) no additive (control); 2) 0.75% urea; 3) 1.5% urea; and 4) 2.25% urea. Urea was added to the corn in a urea-water solution (50:50 wt/wt) followed by mixing 10 minutes in a Harsh Mobil Mixer®. Six silos per treatment were filled (approximately 30 lb of corn per silo), packed with a hydraulic press, sealed, and weighed. Fifteen additional silos each of HM-control and HM-1.5% urea were prepared in order to follow the fermentation dynamics during the ensiling process. All silos were stored at 30 C until opened. Pre-ensiled, post-treated samples were analyzed for DM, pH, crude protein (CP), hot water insoluble nitrogen (HWIN), and non-protein nitrogen (NPN). Three silos each of HM-control and HM-1.5% urea were weighed, mixed, and sampled 1, 2, 4, 7, 21, and 158 days post-ensiling. All six silos of each of the remaining treatments were weighed, and sampled at approximately 158 days post-ensiling. Dry matter loss was determined for each silo and aerobic stability was also measured by placing 5.5 lb of ensiled corn in an expanded polystyrene container as described on page 60 of this Report. Six containers of each silo were monitored for temperature rise, with

[1]Department of Grain Science and Industry.

[2]Former visiting research assistant (1982-83) from the University of Agriculture, Bydogoszez, Poland.

three containers being removed on days 5 and 10 for determination of DM loss and chemical change. Chemical analyses for all ensiled corn included DM, CP, ammonia-nitrogen, pH, lactic and acetic acids, and ethanol.

Results and Discussion

Chemical analyses of the pre-ensiled corn are shown in Table 18.1. As expected, CP, NPN, and pH increased with the addition of urea. Dry matter losses and chemical analyses during fermentation for the HM-control and HM-1.5% urea treatments are shown in Table 18.2. The HM-1.5% urea underwent a more rapid and extensive fermentation and had a higher final pH due to ammonia from the urea. Ammonia-nitrogen values steadily increased for the HM-1.5% urea, indicating hydrolysis of the urea as fermentation progressed. Dry matter loss was not affected by treatment.

Dry matter losses and chemical analyses of the final ensiled corn for all treatments at both moisture levels are shown in Table 18.3. All LM corn underwent very limited fermentation, as indicated by low total acids and minimum pH decrease. The increased fermentation noted in the urea-treated LM corn was likely due to the slight increase in moisture content from the addition of the urea-water solution. There was no difference in protein content between the 1.5 and 2.25% urea levels after the fermentation in the LM corn, suggesting that volatile ammonia was lost during storage. All HM corn underwent a lactic acid fermentation, with the extent of fermentation increasing with the addition of urea up to 1.5 percent. Increasing levels of urea resulted in increased crude protein, ammonia-nitrogen, and pH values. Dry matter loss was numerically higher in the urea-treated HM corn. Ethanol, which is not a desirable chemical component in ensiled grain, was present in very low amounts in both the LM and HM corn treatments. All ensiled corn was stable in air for at least 5 days, regardless of moisture level or urea treatment, and very little chemical change was noted for any treatment through 10 days of exposure to air. There were no apparent benefits in the preservation of either LM or HM corn from adding urea in this trial.

Table 18.1. Chemical Analyses for the Pre-Ensiled 18 and 26% Moisture Corn

Moisture Level and Treatment	Moisture %	pH	CP[1]	HWIN[2]	NPN[2]
18% Moisture					
Control	17.5	6.07	8.8	92.9	5.2
.75% Urea	17.6	7.35	10.7	71.7	12.3
1.5% Urea	17.9	8.30	13.3	55.8	21.7
2.25% Urea	17.1	8.45	13.6	58.7	21.3
26% Moisture					
Control	25.9	5.78	9.0	90.1	1.7
.75% Urea	26.4	6.13	10.7	70.0	15.4
1.5% Urea	26.3	6.18	12.7	63.4	27.6
2.25% Urea	26.5	6.27	14.5	59.4	34.2

[1]Percent of the DM ensiled.
[2]Percent of the total corn nitrogen.

Table 18.2. Dry Matter Losses and Chemical Analyses During the Fermentation of 26% Moisture Corn Ensiled with 0 or 1.5% Urea

Time Post-Ensiling and Treatment	Moisture %	DM Loss[1]	CP[2]	Ammonia-N[3]	pH	Fermentation Acids[2]		
						Lactic	Acetic	Total
Day 0 (Pre-Ensiled)								
Control	25.9	—	9.03	—	5.78	—	—	—
Urea	26.3	—	12.73	—	6.18	—	—	—
Day 1								
Control	26.4	.91	10.31	.4	5.38	—	—	—
Urea	26.8	.84	13.78	3.7	6.32	—	—	—
Day 2								
Control	26.5	1.21	9.82	.7	5.20	trace	.10	—
Urea	26.6	.84	13.44	6.3	6.06	.36	.17	.3
Day 4								
Control	26.9	1.95	10.11	.8	5.08	trace	.15	—
Urea	26.8	1.32	13.50	13.8	7.08	.99	.22	1.20
Day 7								
Control	27.2	2.38	10.27	1.2	4.82	.27	.20	.48
Urea	27.4	2.24	13.68	16.8	6.62	1.40	.29	1.69
Day 21								
Control	27.4	2.87	10.13	3.2	4.35	1.00	.39	1.43
Urea	27.5	2.78	13.76	26.2	6.41	2.59	.52	3.24
Day 158								
Control	28.4	4.36	10.03	5.9	3.96	1.68	.43	2.36
Urea	28.5	4.59	13.35	31.4	5.12	3.67	.65	4.47

[1] Percent of the DM ensiled.

[2] Percent of the corn DM.

[3] Percent of the total corn nitrogen.

Table 18.3. Dry Matter Losses and Chemical Analyses of the 18 and 26% Moisture Corn Ensiled with and without Urea

Moisture Level and Item	Percent Urea, DM basis			
	0	0.75	1.5	2.25
18% Moisture				
Post-Ensiled Moisture, %	19.2	19.5	19.0	18.7
pH	6.02[a]	7.51[b]	8.37[c]	8.52[d]
	% of the DM Ensiled			
DM Loss	2.73[c]	2.73[c]	1.85[b]	1.20[a]
	% of ensiled corn DM			
Lactic Acid	.09[a]	.11[b]	.08[c]	.06[d]
Acetic Acid	.09[a]	.22[b]	.28[bc]	.36[c]
Total Fermentation Acids	.18[a]	.33[b]	.39[bc]	.42[c]
Ethanol	trace	trace	trace	trace
Crude Protein	9.4	11.3	12.0	12.0
	% of the Total Corn Nitrogen			
HWIN	73.8[a]	80.5[b]	66.0[c]	79.0[d]
Ammonia-N	.1[a]	1.0[b]	1.5[c]	1.8[d]
26% Moisture				
Post-Ensiled Moisture, %	28.4	28.7	28.5	28.3
pH	3.96[a]	4.34[a]	5.12[b]	7.46[c]
	% of the DM Ensiled			
DM Loss	3.36	4.52	4.59	4.16
	% of the Ensiled Corn DM			
Lactic Acid	1.68[b]	2.75[a]	3.67[a]	3.53[a]
Acetic Acid	.43[a]	.56[ab]	.65[b]	.65[b]
Total Fermentation Acids	2.36[a]	3.55[b]	4.47[c]	4.25[bc]
Ethanol	.07[a]	.08[ab]	.08[ab]	.10[b]
Crude Protein	10.0	11.7	13.3	13.4
	% of the Total Corn Nitrogen			
HWIN	66.2	57.6	56.8	50.3
Ammonia-N	5.9[a]	19.8[b]	31.4[c]	44.8[d]

[abcd]Values in the same row with differ superscripts differ (P<.05).