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Abstract

ELPWA (a lactobacillus inoculant with antioxidant), molasses, or both combined were evaluated as additives to high moisture sorghum grain ensiled in concrete stave silos. ELPWA treated grain had the greatest temperature increase during ensiling. Final lactobacillus counts were higher in the ELPWA + molasses treated grain, however, the initial rate of increase was greatest in ELPWA or molasses treated grains. Control and molasses treated grains had the fastest decline in pH and the lowest final pH. Aerobic stability of the ensiled grain depended on the strata of the silo sampled and the temperature to which the grain was exposed but aerobically stability was adequate in all grains. Group-fed steers receiving control grain were more efficient ($P<.05$) than those receiving molasses + ELPWA treated grain. There were no significant differences among grain treatments for rates or efficiencies of gains for heifers or individually-fed steers.

Keywords

Cattlemen's Day, 1983; Report of progress (Kansas State University. Agricultural Experiment Station); 427; Beef; Molasses; Sorghum grain; Stave silo

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ELPWA[1] and Molasses Additives for High Moisture Sorghum Grain

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Summary

ELPWA (a lactobacillus inoculant with antioxidant), molasses, or both combined were evaluated as additives to high moisture sorghum grain ensiled in concrete stave silos. ELPWA treated grain had the greatest temperature increase during ensiling. Final lactobacillus counts were higher in the ELPWA + molasses treated grain, however, the initial rate of increase was greatest in ELPWA or molasses treated grains. Control and molasses treated grains had the fastest decline in pH and the lowest final pH. Aerobic stability of the ensiled grain depended on the strata of the silo sampled and the temperature to which the grain was exposed but aerobic stability was adequate in all grains.

Group-fed steers receiving control grain were more efficient ($P<.05$) than those receiving molasses + ELPWA treated grain. There were no significant differences among grain treatments for rates or efficiencies of gains for heifers or individually-fed steers.

Introduction

Previous Kansas research indicated that sorghum grain treated with a lactobacillus inoculant produced increased average daily gains and feed efficiencies in finishing cattle when compared to control, molasses, or molasses + inoculant treated grains. Grain treated with the lactobacillus inoculant was more stable on exposure to air than the other grain treatments.

Our objective was to find if adding a lactobacillus inoculant or a readily available carbohydrate source (dry cane molasses) or both would consistently improve the quality of ensiled high moisture sorghum grain and improve its utilization by feedlot cattle.

[1]ELPWA is an experimental lactobacillus inoculant product with antioxidant supplied by Pioneer Hi-Bred International, Inc., Des Moines, IA 50308.

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Experimental Procedure

Four concrete stave silos (10 ft x 50 ft) were filled with approximately 40,000 lb (as-received weight) of high moisture sorghum grain harvested at 20 to 31% moisture. Treatments were: 1) control (no additive); 2) .1% experimental lactobacillus inoculant product (ELPWA); 3) 1.0% dry cane molasses; and 4) 1.0% molasses + .1% ELPWA. Additives were applied to the grain on an as-received basis. All grain was rolled to lightly crack the kernels, then treated, mixed, and augered into one of four silos. Grain with a moisture content less than 25% had enough water added to bring it to 25% moisture. Dry grain was harvested from the same field at a later date, dried to 12% moisture in a solar grain dryer, and rolled prior to feeding.

Samples were taken from each load at ensiling. Five hundred gm samples of the grain being ensiled were placed in air-tight plastic bags. Three bags for each treatment were placed in 5-gallon containers, packed with high moisture sorghum grain, and sealed by an air-tight lid fitted with a Bunsen valve. The containers were stored in a chamber where the temperature was adjusted to correspond with the temperatures recorded in the concrete stave silos. Bags were removed at intervals, mixed, and analyzed for lactobacilli, pH, and fermentation acids.

Silos were opened after approximately 60 days. Twenty-five Hereford heifers and 71 crossbred steers were randomly allotted to give 1 pen of 5 heifers, 2 pens of 5 steers, and 4 or 5 individually fed steers per grain ration. Rations contained (DM basis) 83% of the appropriate sorghum grain, 12% corn silage, and 5% supplement. Rations were formulated to contain 11.5% crude protein, .62% calcium, .32% phosphorus and .64% potassium. The supplement supplied 200 mg of monensin per head daily. Rations were fed ad libitum twice daily. Refused feed was removed and weighed. Grain samples were collected twice weekly from the silos.

All cattle were weighed individually after 16 hr without feed or water, at the beginning and the end of the feeding trial. Intermediate weights were taken on 28, 56, and 84 days. Final weights were calculated using average dressing percentage of all cattle slaughtered on a given date.

Grain dry matter losses during fermentation, storage, and feedout were measured by weighing and sampling each load at ensiling and on removal. Ensiling temperatures were monitered for the first 38 days by six thermocouple wires evenly spaced in each silo.

Aerobic stability (bunk life) was measured as described on page 31 of this progress report. Stability was determined at room temperature of 19 and 27 C.

Results

Lactobacillus counts and pH change at different times post-ensiling are shown in Table 18.1. ELPWA + molasses treated grain had the highest initial counts; ELPWA treated grain had the fastest increase while molasses treated grain had the highest final counts. Molasses treated grain had the most rapid pH drop; molasses treated and control grains, the lowest final pH at 38 days; and ELPWA + molasses, the highest pH at 38 days.

Chemical analyses after fermentation are shown in Table 18.2. Control and molasses treated grains had similar pH's while ELPWA and ELPWA + molasses treated grains had the highest. Lactic acid was highest in the control and molasses treated grains. Acetic acid was highest in the ELPWA treated grain; lowest in the molasses and molasses + ELPWA treated grains. Ethanol was highest in the control and ELPWA treated grains and lowest in the molasses + ELPWA treated grain.

Actual ensiling temperatures are shown in Figure 18.1. Molasses + ELPWA treated grain had the highest ensiling temperature; molasses treated grain the lowest. Grains were not the same temperature upon entering the silos. Molasses treated grain was 10 C cooler than molasses + ELPWA treated grain. The temperature rises above initial grain temperatures are shown in Figure 18.2. ELPWA treated grain had the greatest increase (7.7 C); control grain, the lowest (5.6 C).

Cattle performance is shown in Table 18.3. There were no significant differences in average daily gain among any of the grain treatments. Group-fed steers receiving control grain were more efficient than those receiving dry rolled or treated grains, but there were no significant differences in animal performance among grain treatments in heifers or individually-fed steers.

Losses due to fermentation, storage, and feedout were smallest for the molasses treated grain (5.4%); control and molasses + ELPWA treated grain the greatest DM loss (14.4% and 14.3%, respectively); and DM loss of the ELPWA treated grain was intermediate (10.9%). The high DM loss may be partially explained by the long period of time between the end of the cattle feeding trials and the actual time the silos were emptied. A large portion of the grain removed when the silos were emptied was spoiled which would result in a much greater loss of grain DM.

Aerobic deterioration is characterized by dry matter loss, increased temperature and pH, and loss of fermentation acids. The stability of the grains at 19 C for the top and bottom half of the silos, respectively, were control 12 and 14 days; ELPWA 30 and 8 days; molasses 12 and 8 days; and molasses + ELPWA 7 and 10 days. When exposed to 27 C air, molasses treated grain showed no heat rise until day 15. ELPWA treated grain was stable until day 12; control was stable until day 10, while molasses + ELPWA was stable until day 7.

Table 18.1. Lactobacilli counts[1] and pH of the ensiled sorghum grains at different intervals post-ensiling

Time post-ensiling	Sorghum Grain							
	Control		ELPWA		Molasses		ELPWA + molasses	
	Lactobacilli	pH	Lactobacilli	pH	Lactobacilli	pH	Lactobacilli	pH
Hours:								
0	2.4×10^{4}	6.03	1.2×10^{4}	6.13	1.8×10^{4}	6.15	1.2×10^{5}	6.13
8	1.6×10^{5}	6.08	1.4×10^{7}	5.90	3.2×10^{6}	5.98	4.0×10^{6}	6.26
16	2.7×10^{6}	6.10	2.2×10^{7}	5.67	1.6×10^{8}	5.45	5.8×10^{7}	5.92
24	2.4×10^{7}	5.83	5.2×10^{7}	5.53	2.8×10^{8}	5.24	1.4×10^{8}	5.71
48	1.4×10^{8}	4.34	1.6×10^{8}	5.16	2.8×10^{8}	4.59	2.1×10^{8}	5.38
96	2.2×10^{8}	3.90	9.2×10^{7}	4.33	3.0×10^{8}	4.34	1.8×10^{8}	4.90
Days:								
7	6.8×10^{7}	3.95	1.4×10^{8}	4.15	3.5×10^{8}	3.93	2.5×10^{8}	4.62
14	6.2×10^{7}	3.89	1.1×10^{7}	4.00	6.1×10^{7}	3.85	1.3×10^{8}	4.13
38	-------	3.86	-------	3.92	-------		-------	4.10

[1]Lactobacilli counts are given as lactobacilli/gram of grain (wet basis).

Table 18.2. Chemical analyses of control, ELPWA, molasses, and molasses + ELPWA ensiled sorghum grain[1,2]

Sorghum grain	Control	ELPWA	Molasses	Molasses + ELPWA
Chemical Analyses				
%DM	66.11	69.46	70.69	73.45
pH	3.97	4.11	4.01	4.16
	% of DM			
Lactic acid	2.16	1.76	2.09	1.54
Acetic acid	.40	.53	.29	.28
Propionic acid	.04	.06	.03	.02
Valeric acid	.06	.07	.07	.05
Ethanol	.49	.50	.34	.26

[1]Each dry matter value is the mean of 16 samples; all other values are the mean of 7 samples.

[2]All analyses were determined using wet grain samples.

Table 18.3. Performances by heifers and yearling steers fed the five sorghum grain rations

Item	Control	ELPWA	Molasses	Molasses + ELPWA	Dry
	Sorghum grain ration				
Heifers:[1]					
Number	5	4	5	5	5
Initial wt., lb	789	806	794	789	781
Final wt., lb	987	1043	1000	991	1012
Avg. daily gain, lb	2.53	2.99	2.58	2.55	2.92
Avg. daily feed, lb[2]	19.96	22.13	20.64	23.05	21.23
Feed/lb of grain, lb[2]	7.89	7.40	8.00	9.04	7.27
Group-fed steers:[3]					
Number	10	10	10	10	10
Initial wt., lb	786	792	791	775	789
Final wt., lb	1115	1104	1112	1062	1113
Avg. daily gain, lb	2.99	2.83	2.92	2.61	2.95
Avg. daily feed, lb[2]	20.51	19.97	21.08	20.72	21.04
Feed/lb of gain, lb[2]	6.86[b]	7.05[ab]	7.22[ab]	7.94[a]	7.12[ab]
Individual-fed steers:[4]					
Number	4	4	4	4	5
Initial wt., lb	950	956	952	958	971
Final wt., lb	1190	1206	1187	1202	1214
Avg. daily gain, lb	2.89	3.00	2.82	2.95	2.93
Avg. daily feed, lb[2]	21.18	21.90	22.23	22.33	23.56
Feed/lb of gain, lb[2]	7.33	7.30	7.92	7.57	8.04

[1] 79-day trial; January 22 to April 12, 1982.
[2] 100% DM basis.
[3] 110-day trial; January 22 to May 12, 1982.
[4] 83-day trial; February 18 to May 12, 1982.
[a,b] Values with different superscripts differ significantly ($P<.05$).

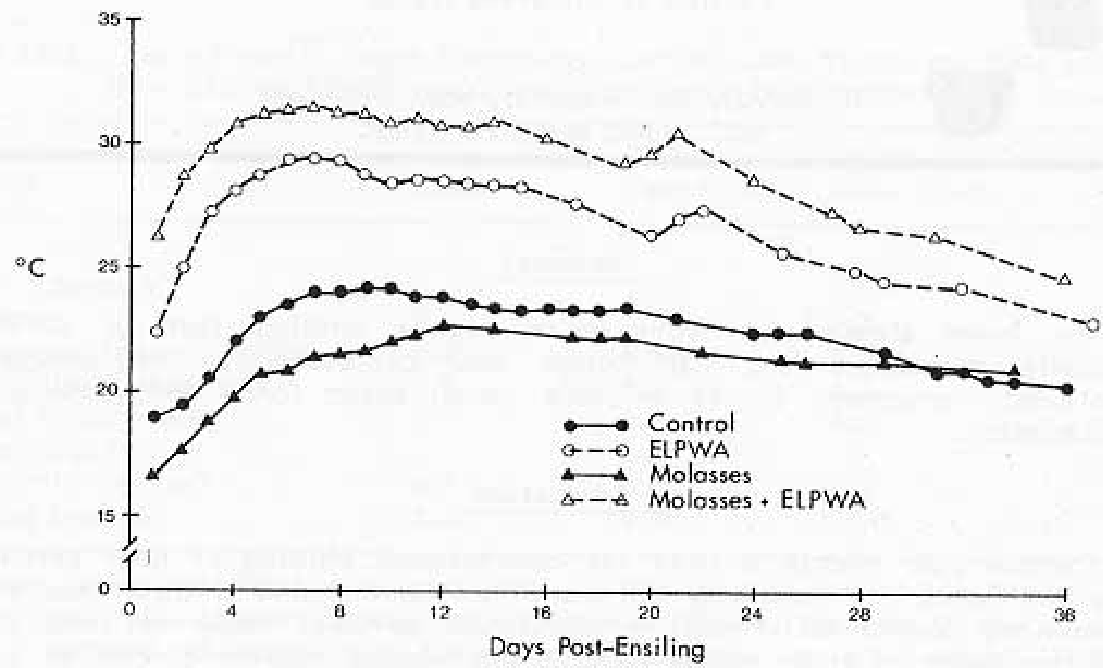

Figure 18.1. Ensiling temperature for the four sorghum grains at various days post-ensiling

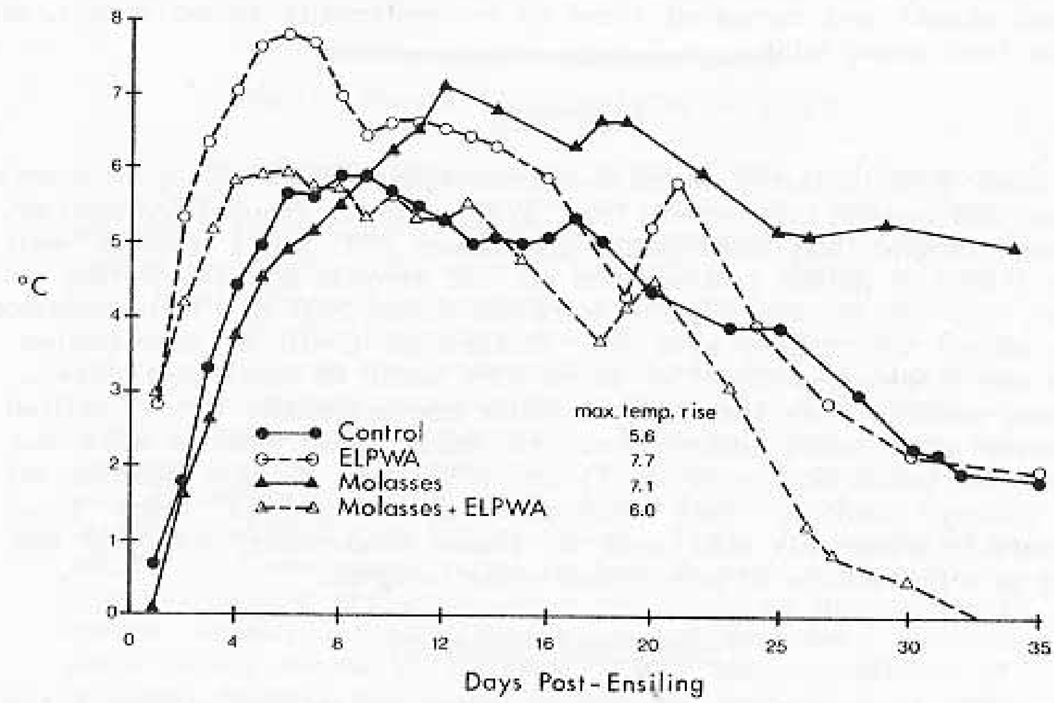

Figure 18.2. Ensiling temperature (degrees above initial temperature) for four sorghum grains at various days post-ensiling.