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Ensiled High-Moisture Corn Inoculated with a Biological Additive for Growing-Finishing Lambs

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ENSILED HIGH-MOISTURE CORN INOCULATED WITH A BIOLOGICAL ADDITIVE FOR GROWING-FINISHING LAMBS

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Summary

The effect of a biological silage additive, Lactobacillus plantarum[b], on the feeding value and chemical characteristics of high-moisture (24.6%) corn was determined in a 123-day trial with growing-finishing lambs. Lambs (62 lb. average) fed untreated or inoculated corn performed similarly in terms of body weight gain, feed intake or feed efficiency. The corn treated with the microbial preparation was of higher quality as indicated by the lower pH and higher titratable acidity at feeding compared to the untreated corn.

(Key Words: Silage additive, High-moisture corn, Fermentation Characteristics).

Introduction

The harvest of high-moisture grains for use in cattle and sheep feeding programs offers certain advantages to the feedlot operator. Earlier harvesting of grain can be achieved with reduced field losses, particularly when conditions for natural drying are adverse. Energy cost for drying by artificial means is a further consideration in harvesting and storing high-moisture grain.

Research conducted in the late 1950's and early 1960's shows that high-moisture corn fed to cattle as grain or as ground ear corn consistently improved feed conversion as compared to dry forms of corn. In contrast, live weight gains were more variable. Included in the research were such factors as type of storage structure, level of roughage fed with high-moisture corn, moisture content of corn at storage and treatment with organic acid preservatives. Even with all these comparisons, reduced feed requirements were almost always observed.

High-moisture grains have high potential for heating and for the development of molds during storage. Problems of this nature increase the need for management decisions which include the use of an air-tight storage structure and the consideration of an appropriate preservative. Organic

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[a] Animal and Range Sciences Baccalaureate.

[b] Biomax SI, Charles Hansen's Laboratory, Milwaukee, WI.

acids such as propionic and chemical mixtures containing propionic, acetic, benzoic and formaldehyde have been used primarily as agents to inhibit mold growth. Ammoniation and the use of biological additions such as viable microorganisms and enzyme products also appear to have potential in improving preservation of ensiled wet grain. Recent research (SHEEP 83-2) showed that treatment of high-moisture ground ear corn with Lactobacillus acidophilus improved crude protein digestibility and nitrogen retention by lambs. The inoculant also resulted in a 4% saving in dry matter stored.

The purpose of this experiment was to determine the feeding value of high-moisture, shelled corn inoculated with Lactobacillus plantarum[c] in diets fed to growing and fattening lambs. Various chemical determinations were made to evaluate the preservation effects of the inoculant.

Procedures

Shelled corn grain with 24.6% moisture was purchased locally for the experiment. The corn was passed through a roller mill prior to ensiling to give a cracked corn product with few whole kernels. Each of four experimental concrete silos was filled with approximately 5,000 lb. (wet) of corn. The silo structures were reinforced concrete culverts 6 feet high, 5 feet inside diameter, with a 4-inch wall. Each silo was situated on end and was equipped with a 14-inch door opening the height of the silo. The silos were placed on a concrete floor over a "U" shaped trough installed for the collection of seepage liquids. The rolled corn was weighed into a feed mixing wagon[d] equipped with a scale, allowed to mix for 10 minutes and elevated into the silo. Two silos were filled with untreated high-moisture corn. Two silos were filled with corn inoculated with a water suspension of Lactobacillus plantarum fermentation product. The water was treated with a dried milk product to neutralize the chlorine in the water. The final suspension provided 45 million colony forming units of L. plantarum per pound of ensilage. The ensilage was leveled and packed by three people walking on the surface during filling. The silos were covered with a plastic (6 mil) cover and a wooden lid placed on the plastic such that the lid fit inside the silo. Cement blocks were placed on the lid to provide 1,200 pounds weight. All silos were indoors.

Samples of approximately 600 grams were collected at ensiling and as the corn was removed for feeding. The samples were placed in double plastic bags, evacuated and immediately frozen.

The silos were opened 181 days after ensiling and manually unloaded from the top. The fermented corn was packed into identified steel barrels, transported to the Animal Science Complex, weighed and stored under refrigeration for feeding.

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[c] Biomax SI, Charles Hansen's Laboratory, Inc., Milwaukee, WI.
[d] Blair Manufacturing Company, Blair, NE.

TABLE 1. DAILY GAIN FOR GROWING AND FINISHING LAMBS FED UNTREATED AND INOCULATED HIGH-MOISTURE CORN

	Untreated corn		Inoculated corn[a]	
	Silo A	Silo B	Silo C	Silo D
No. of lambs[b]	10	10	10	8
Initial wt., lb.	60.7	61.2	61.2	61.1
Final wt., lb.	111.9	112.2	112.6	111.9
Average daily gain by period, lb.				
Period I, 46 days	.330	.307	.309	.307
Period II, 43 days	.520	.516	.498	.539
Period III, 34 days	.394	.438	.462	.397
Average daily gain, lb.				
Overall, 123 days	.414	.416	.417	.413

[a] Inoculated with Biomax SI, Charles Hansen's Laboratory, Inc., Milwaukee, WI.

[b] Initially 10 lambs in each group. Deaths were due to causes unrelated to treatment. Feed consumption values are for 8 head.

TABLE 2. DAILY DRY FEED FOR GROWING AND FINISHING LAMBS FED UNTREATED AND INOCULATED HIGH-MOISTURE CORN

	Untreated corn		Inoculated corn[a]	
	Silo A	Silo B	Silo C	Silo D
Average daily feed intake by period, lb.				
Period I, 46 days	2.01	2.01	2.01	2.00
Period II, 43 days	2.33	2.29	2.32	2.31
Period III, 34 days	2.42	2.43	2.43	2.41
Average daily feed intake, lb.				
Overall, 123 days	2.24	2.22	2.23	2.22

[a] Inoculated with Biomax SI, Charles Hansen's Laboratory, Inc., Milwaukee, WI.

Forty crossbred wether lambs averaging 62 lb. were purchased through an order buyer for use in this trial. The lambs were ear tagged, implanted with 12 mg of zeranol, vaccinated against enterotoxemia, dewormed and sheared prior to the start of the experiment. The lambs were housed indoors in individual pens equipped with a feed box and water container. The feeding period was 123 days.

The diet consisted of 60% high-moisture corn (75.7% dry matter) and 24% alfalfa-bromegrass haylage (41.5% dry matter) and 16% protein supplement. The supplement contained soybean meal (50% protein), 85.9%; ground limestone, 7.1%; dicalcium phosphate, 2.0%; and trace mineral salt, 5.0%. Vitamin A was included in the supplement to provide approximately 1,500 IU of the vitamin per lamb daily. The B-vitamin niacin was included (100 ppm) in the diets of half the lambs used in the experiment. Results of that phase of the study are presented in SHEEP 85-2.

Results

Lamb Feeding Trial

Statistical analyses of the data showed that there was no interaction between the corn treatments and niacin treatments. Therefore, the data were pooled for discussion here.

Weight Gain

Initial and final weights and average daily gains for each of three periods are presented in table 1. The data are presented for each experimental silo to study any effect of storage on feeding value of the corn. Weight gain data for the short intervals were variable with only small differences between silos. Overall, weight gains ranged from .413 to .417 lb. per day. Statistical treatment of the data indicate no significant period or overall differences ($P<.05$) for lambs fed untreated corn and corn inoculated with L. plantarum.

The diets fed in this experiment contained adequate amounts of concentrate for growth and fattening, i.e., 76% concentrate with approximately 24% roughage as alfalfa-brome haylage. More rapid growth and fattening can be accomplished with lambs fed diets containing less roughage. This ratio of concentrate to roughage was selected to minimize digestion disturbances while maintaining an adequate level of corn in the diet.

Feed Intake

Average daily dry feed intakes for each period and over the full term of the experiment are shown in table 2. Level of feed intake generally increased with time on experiment with only small differences between silos or between high-moisture corn treatments. Intake in general was somewhat lower than experienced in previous trials with lambs of this weight and potential for growth.

Spoiled and moldy corn was separated from good corn as the silos were emptied. Occasionally mold growth occurred in the barrels used for feed storage due to exposure to air. However, untreated and inoculated corn from the silo exhibited a fruity fermented aroma and was generally free from mold growth. No attempt was made to separate any moldy corn from good corn at time of feeding.

Feed Efficiency

The data for efficiency of conversion of feed to body weight gains for each period and over the trial are presented in table 3. Feed requirements were calculated in comparisons between silos and for each period. Over the entire experiment, feed efficiency ranged from 5.34 to 5.40 lb. of dry feed per pound of gain and would be considered to be typical for this type of diet. There were no important differences between untreated and inoculated high-moisture corn.

Chemical Characteristics

A complete profile of chemical characteristics for the untreated and inoculated corn is not available at this time. Limited analyses performed on samples collected as the experimental corn was removed from the silos are presented in table 4. Most important of the chemical characteristics was the lowering of pH (silo A, 4.69, vs. silo C, 4.54, and silo B, 4.81, vs silo D, 4.70) with the inoculation treatment.

Acid content was lower than that observed with corn silage, but there is an indication that fermentation did occur. A measure of this is titratable acidity. Titratable acidity was higher for the inoculated corn than for the untreated corn (silo C, 3.26, vs silo A, 2.52, for a 29% increase; silo D, 3.12, vs silo B, 2.35, for a 33% increase). Analyses are in progress to determine the quantity of lactic and other volatile fatty acids in the fermented corn.

TABLE 3. FEED EFFICIENCY FOR GROWING AND FINISHING LAMBS FED UNTREATED AND INOCULATED HIGH-MOISTURE CORN

	Untreated corn		Inoculated corn[a]	
	Silo A	Silo B	Silo C	Silo D
Feed per lb. gain by period, lb.				
Period I, 46 days	6.88	6.69	6.72	7.32
Period II, 43 days	4.56	4.50	4.71	4.32
Period III, 34 days	6.66	5.64	5.31	6.30
Feed per lb. gain, lb.				
Overall, 123 days	5.40	5.34	5.34	5.37

[a] Inoculated with Biomax SI, Charles Hansen's Laboratory, Inc., Milwaukee, WI.

TABLE 4. CHEMICAL PROFILES OF HIGH-MOISTURE CORN AT TIME OF FEEDING

	Untreated corn		Inoculated corn[a]	
	Silo A	Silo B	Silo C	Silo D
Dry matter, %[b]	75.81	75.95	75.59	75.29
pH	4.69	4.81	4.54	4.70
Titratable acidity[c]	2.52	2.35	3.26	3.12
Crude protein[d]	11.62	11.59	11.72	11.71

[a] Inoculated with Biomax SI, Charles Hansen's Laboratory, Inc., Milwaukee, WI.
[b] Toluene distillation with acid correction.
[c] Milliliters .1N KOH to raise pH to 7.
[d] Dry matter basis.