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A Bacterial Preservative for Ensiled High-Moisture Corn

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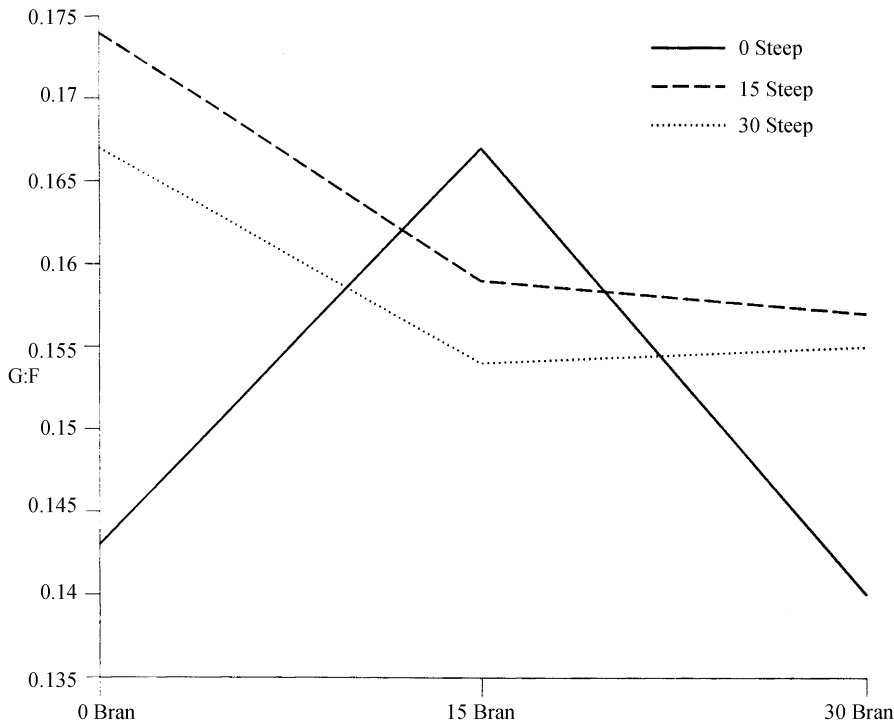


Figure 1. Interaction of level of bran and level of steep on feed efficiency.

(15%) gave as much response in efficiency and daily gain as 30% S, suggesting an effect other than energy content alone. Previous research at the University of Nebraska (1995 Nebraska Beef Report, pp 30-33) has shown increased lactate utilization by rumen microbes in steers fed distiller's solubles. The steep liquor used in this trial contained some distiller's solubles resulting from alcohol production. Thus, S would have reduced the starch content of the diet and may have enhanced lactate utilization by rumen microbes. The resulting net effect may have been reduced subacute acidosis.

Addition of B to diets containing both 15 and 30% S decreased efficiency suggesting lower energy content in B compared to S. The combinations of 15 or 30% S with 15 or 30 percent B resulted in diets similar to those containing 30-60% wet corn gluten feed. These ratios of S to B are probably representative of the range of values seen in the wet milling industry. Efficiencies were better than the control for all combinations of S and B. This is consistent with previous research with

wet corn gluten feed especially where subacute acidosis is a factor in the high grain control diet. It is of interest to note that addition of 15% S to 30% B increased efficiency 12% when compared to 30% B fed alone, suggesting an associative effect between the S and B.

Results of this research indicate that replacement of dry rolled corn with corn bran (15 percent of diet DM), corn steep liquor, and corn bran and corn steep liquor in combination improved daily gain. Addition of corn bran, corn steep liquor (15% of diet DM), or corn bran and corn steep liquor in combination also increased DM intake. It appears the greatest efficiency response occurs with the first increment of B or S included in the diet. There may be an associative effect between B and S when fed in combination. This research also suggests that S is higher in energy than the dry-rolled corn it replaced.

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A Bacterial Preservative for Ensiled High-Moisture Corn

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PRO-MAX bacterial inoculant added to ground high-moisture corn before ensiling can speed up fermentation, lower the pH faster, and increase propionic acid percentage enough to reduce spoilage organism counts.

Summary

High-moisture corn at 26 to 27 percent moisture was ground and ensiled, with or without inoculation with PRO-MAX², a bacterial preservative designed to stimulate production of lactic and propionic acids during

fermentation. Laboratory analyses showed lower pH and counts for spoilage organisms at 40 and 80 days after ensiling, along with higher propionic acid than in the control corn. A finishing trial with yearling steers showed similar overall performance and carcass means for the control and the treated corn.

Introduction

High-moisture corn ensiled at 24 to 30 percent moisture normally produces organic acids during fermentation. Preservation is achieved after sufficient acids are produced to lower pH enough to inhibit spoilage organisms. Bacterial inoculants are sometimes added to corn during ensiling to reduce nutrient losses by stimulating mainly lactic acid production to lower the pH rapidly. During feed-out of the ensiled corn, spoilage can occur at exposed surfaces of the ensiled product in storage or in the bunk if the corn remains very long under hot and wet environments. Therefore, one objective of this trial was to treat high-moisture ground corn with a bacterial inoculant that would not only stimulate production of lactic acid, but also propionic acid which would improve storage and bunk-life characteristics of high-moisture corn by reducing spoilage organism counts. Ultimately the objective was to compare yearling cattle performance and carcass characteristics when fed during summer on a finishing diet containing dry rolled corn and ground high-moisture corn that was treated with this preservative or left untreated at ensiling time during fall harvest.

Procedure

High-moisture harvested shelled corn was ground with a hammer mill before packing in two 12-foot-wide concrete bunkers, alternating every three to four loads between the bunkers. The corn averaged 26.4 and 27.4 percent moisture in the control and treatment bunkers, respectively. The inoculant treatment (PRO-MAX) contained *Propionibacterium spp.* fermentation product, *Pediococci acidilacteri* fer-

mentation product and maltodextrin. The treatment rate was 120 grams of inoculant in cold water per 12.5 tons of high-moisture corn, applying 500 thousand colony forming units (cfu) per gram of crop. The dissolved inoculant was sprayed on corn at the unloading auger of the hammer mill through use of a commercial spray tank.

The high-moisture corn ranged in depth from 3 to 4 feet after packing and was covered with black plastic and tires. Samples of both control and inoculated corn were taken at 40, 80, 120, and 180 days post ensiling for microbial (cfu/g) and organic acid (%) analyses.

Eighty Angus crossbred yearling steers averaging 928 pounds initially were randomly allotted by weight groups to eight pens and started on trial on July 11, 1995. After five to seven days on each of three step-up diets, the final diet was reached, which on a dry matter basis contained 45.5 percent dry rolled corn, 37.3 percent ground high-moisture corn, 10 percent corn silage, and 7.2 percent of a pelleted supplement that included 58 percent crude protein with 38 percentage units from NPN. The calculated nutrient contents were 12.5 percent crude protein, 64 Mcal of NEg, .76 percent calcium and .34 percent phosphorus. Rumensin and Tylan were included at 30 and 10 grams per ton of diet dry matter, respectively. The cattle were implanted with Synovex S initially and fed ad libitum once daily during the 105-day finishing trial. Carcass information was collected at slaughter. High-moisture corn was loaded at feeding with a payloader, and the small amounts removed daily from each bunker allowed considerable surface exposure.

Results

High-moisture harvested corn inoculated with the PRO-MAX bacterial preservative at ensiling time did not affect overall performance and carcass comparisons when fed to yearling finishing steers during the following summer and early fall (Table 1). While the cattle on treated high-moisture corn appeared to gain faster during the first and second periods of the 105-day feeding trial, a

Table 1. Treated vs untreated high-moisture ensiled corn for finishing yearling steers.

Corn	Control	Treated
No. of pens	4	4
No. of steers	40	40
Initial weight, lb	929	927
Final weight, lb	1320	1325
Daily gain, 28 days	4.21	4.56
Daily gain, 28-64 days	3.67	3.82
Daily gain, 64-105 days	3.84	3.72
Daily gain, 105 days	3.74	3.78
Feed DM intake, lb	24	23.6
Feed/gain ratio	6.41	6.24
Hot carcass weight, lb	788	791
Dressing percent	62.18	62.16
Marbling score ^a	5.54	5.75
Quality grade ^b	19.1	19.4
Fat cover, in	.42	.44
Rib eye area, sq in	13.1	13.8
Yield grade	2.8	2.6

^aMarbling score of 5.0 = Small.

^bQuality grade of 19.0 = Choice -.

slightly lower gain during the last period caused overall gains to be similar. There were no statistically significant differences in the comparisons. The slight improvement in feed per unit of gain for the treated high-moisture corn (6.24 vs 6.41) had a statistical P value of .17, which is somewhat weak as an indicator of repeatability.

The results from the laboratory analyses of the stored corn at several times after ensiling are shown in Table 2. Coliform counts were lower in the treated sample taken at 40 days and were low in both treated and untreated samples at later dates. Mold counts were lower in treated corn samples at 40 and 80 days compared to the control. Propionic acid was higher in treated corn samples taken at 40, 80 and 180 days. Differences in lactic and acetic acid were not consistent between treatments. Corn samples taken for the storage analyses were higher in moisture than those taken during ensiling, possibly due to condensation under the plastic cover during storage.

The inoculation of the high-moisture corn with the PRO-MAX preservative lowered pH and the counts of undesirable microorganisms at 40 and 80 days post ensiling. Propionic acid was increased in the treated corn which can be a benefit against spoilage at the

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Table 2. Microbial and organic acid analysis of treated and untreated stored high-moisture corn.

Treatment	Days ensiled	pH	Microbial Analysis (cfu/g)			Organic Acid Analysis (%)		
			Yeast	Mold	Coliforms	Lactic	Acetic	Propionic ^a
Control	40	5.0	5.5x10 ⁵	4.8x10 ⁵	4.9x10 ³	.9	.7	<.2
Treated	40	4.5	1.5x10 ⁴	1.0x10 ⁴	<10	.4	.5	.4
Control	80	3.63	1.5x10 ³	2.0x10 ²	<10	.4	.4	<.2
Treated	80	3.43	3.0x10 ⁴	<100	<10	.2	.5	.4
Control	120	3.6	1.5x10 ⁷	2.0x10 ²	<10	.1	.1	<.2
Treated	120	3.54	1.8x10 ⁷	3.0x10 ⁴	<10	.2	0	<.2
Control	180	3.3	2.8x10 ⁴	4.5x10 ²	<10	1.1	.3	<.2
Treated	180	3.45	7.5x10 ⁶	3.0x10 ²	<10	.2	.2	.3

^aMinimum level of propionic acid detectable is .2%.

exposed surface of the stored high-moisture corn as well as in the bunk. There was not enough effect on nutrient quality of the treated corn to affect cattle performance or carcass characteristics with a diet dry matter that contained about 37 percent of the treated corn.

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²PRO-MAXTM is a high-moisture corn inoculant from AgMasterTM Silage Inoculants and manufactured for Agtech Products, Inc., Waukesha, WI 53186.

A Low Roughage Diet Alternative for Finishing Cattle

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A low roughage diet containing Impact supplement can reduce feed to gain ratio while maintaining daily gain. A relatively high energy level in this diet results in lower ad libitum intake.

Summary

A finishing trial was conducted to compare a high concentrate ration supplemented with Impact (manufactured by Purina Mills Inc.) with a finishing ration containing 10 percent DM from corn silage and a urea containing protein supplement. Steers fed the low roughage diet containing Impact consumed slightly less feed and were 5.4 percent more efficient. Carcass traits were similar for the two treatments except the steers fed Impact had slightly less fat.

Introduction

Optimum levels and types of roughages in finishing cattle diets continue to

be questioned. Fiber in roughages adds a safety factor by diluting the energy concentration slightly which diminishes the incidence of acidosis. Roughages also add a "scratch factor" that may improve the motility of the rumen. Fiber is poorly digested in high concentrate rations, offers very little energy to promote gain, and can possibly lower the digestion of concentrates in the diets. Roughage sources are also bulky to handle, and add to manure build up in pens. Because of problems with roughages in finishing rations, many attempts have been made to eliminate roughages; yet it is felt by cattle feeders that with traditional all concentrate programs, the incidence of acidosis is often increased. The increase of acidosis in all concentrate diets is due to considerable variation in daily intake. Purina Mills Inc. has developed a protein supplement, Impact^{®2}, to aid in controlling the variation in daily feed intake with a high concentrate diet. As a result intake is lowered slightly.

Impact supplement used in this trial contained 58.2 percent crude protein with 36.8 percentage units from NPN. Fat content of the dry matter was 3.7 percent and fiber was 5.2 percent. This supplement contains a combination of

ingredients that alters intake patterns and avoids extremely high intakes at any single feeding.

The objective of this trial was to compare the performance and carcass characteristics of steers fed a high concentrate diet containing corn, pressed beet pulp and Impact supplement or corn, corn silage, pressed beet pulp and a urea containing protein supplement.

Procedure

A finishing trial was initiated with 88 Angus and Angus cross yearling steers that had previously grazed summer pasture together for a full grazing season. The average initial weight was 907 lb and they were allotted by weight groups to eight pens of nine and two pens of eight steers. Five pens were fed a control diet and five pens were fed a similar diet containing Purina Impact supplement. Four step-up diets were fed for five to seven days each to reach the final diet, which for the control on a dry matter basis contained 72.7 percent dry rolled corn, 10 percent corn silage, 10.1 percent pressed beet pulp, and 7.2 percent of a protein-mineral supplement. Calculated nutrient contents were 12.6 percent crude protein, 61.6 Mcal