Evaluation of a Mixture of Corn Steep Liquor and Distillers Solubles as a Replacement for Corn and Supplement in Cattle Finishing Diets

A.S. Leaflet R1630

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Summary

Finishing yearling steers fed a corn-based diet containing steep liquor had statistically similar live performance as steers fed the control diet. Numerically steers fed the steep containing diet were 6% more efficient. Steers fed steep liquor tended to contain less carcass fat (as measured by intramuscular marbling) less kidney, heart and pelvic fat, and less backfat thickness. When priced at $50/ton adding steep liquor at 10% of diet dry matter reduced feed cost for gain 9%.

Introduction

Previous studies have indicated that coproducts of the corn processing industry have high value as feeds for growing and finishing cattle. Corn steep liquor is a liquid coproduct of the corn wet milling industry and is added with corn bran at the corn processing plants to generate corn gluten feed. Corn gluten feed has an energy value similar to corn grain when fed to cattle. Distillers solubles, the liquid coproduct of the dry milling of corn to produce fuel ethanol, has an energy value greater than corn grain when fed to cattle. The purpose of this experiment was to evaluate a combination of corn steep liquor and distillers solubles in a finishing diet for yearling steers.

Materials and Methods

Thirty-six crossbred yearling steers with an average weight of 840 lb were allotted at random to six pens with six steers per pen. Three pens were allotted at random to each of two diets shown in Table 1. The steers were started on test in mid December and fed for 145 days. The steers were implanted with Component® TE-S after having been on feed 28 days. The steers were weighed individually in the mornings before feeding, on two consecutive days at the start as well as when the cattle were sold, and at several intervals during the trial. The steers were started on the diets shown in Table 1, but intake was limited for the first four weeks while they adjusted to the higher levels of grain.

Adjustments were made in the amounts of molasses, protein and sulfur added to the diet containing steep liquor to equalize concentration of nutrients in the two diets. The steep liquor fed in this experiment was produced in a wet milling corn processing plant that also produces ethanol. Some stillage from the ethanol plant was included with the steep. The steep liquor contained, on the average, 48% dry matter and 33.5% crude protein on a dry basis. All ingredients were mixed and fed as total mixed diets.

All steers were sold as one group at a commercial beef packing plant. Weights of hot carcasses were taken after slaughter, and measurements on the carcasses were obtained after 24 hours in the cooler. Ribeye area and fat thickness of each carcass were traced on sheets of acetate paper and measured later. Marbling and percentage of kidney, pelvic and heart (KPH) fat were estimated by the USDA grader. Yield grades from individual carcasses were calculated from measurements on the carcasses using the standard yield grade equation.

Pen means were used as the experimental unit in the statistical analysis. Data were analyzed by one-way analysis of variance. Standard error of the means and least significant differences ($P < .05$) between means also were calculated.

Results and Discussion

The performance of the steers in the feedlot is summarized in Table 2. There were no significant differences observed between the response to the diet containing steep liquor and the control diet on final gain, feed intake or feed efficiency. Feeding steep improved feed efficiency 6%, but the difference was not statistically significant ($P > .1$). Steers fed steep did gain faster during the period from 28 to 68 days and during the final 41 days of the experiment (Figure 1). Overall gains of steers fed both diets declined with time on feed. Feed intake when averaged by period increased up to 104 days and then declined for the control steers and continued to increase for the steers fed steep liquor (Figure 2). Feed was utilized less efficiently with time on feed (Figure 3), however steers fed steep liquor maintained their feed efficiency during the final period.

The only carcass measurements affected by diet were decreases (P < .05) in marbling and percentage of KPH in steers fed steep liquor (Table 3). There was a numerical decrease in backfat, but the decrease was not statistically significant (P > .1). The decrease in overall carcass fatness of steers fed steep liquor was also reflected in a decrease in percentage of Choice carcasses from 78% to 65%.

In this experiment the economic value of steep liquor was not so much the result of improved performance, but of replacement of a portion of the corn and supplement in the diet. The steep-fed steers consumed less corn, soybean meal and urea and consumed no molasses. Using feed costs of $2.40/bu for corn (88% DM), $170/ton for soybean meal (92% DM), $130/ton for alfalfa pellets (90% DM), $80/ton for molasses (75% DM), $250/ton for urea and $17.50/cwt. for other supplemental ingredients, feed costs were $5.60/cwt for the control diet and $5.42/cwt for the diet with steep liquor (steep liquor priced at $50/ton at 48% DM). Feed costs per cwt would have been $5.31, $5.42, $5.52, $5.62 and $5.73 for the diet containing steep liquor if it cost $40, $50, $60, $70 and $80/ton, respectively. Feed costs were $37.05/cwt gain for the control steers and $33.75/cwt gain ($50/ton for steep) for steers fed the diet containing steep liquor.

Another way of evaluating alternative feeds in a finishing diet is to calculate their replacement value. This was done by calculating how much of each dietary ingredient was needed for 500 lbs of gain using the composition of the diets listed in Table 1 and the measured feed conversions for each diet given in Table 2. Giving value to the differences between the two diets in amounts of corn, soybean meal, molasses, etc., required for 500 lbs of gain by using the feed costs given above, indicated that adding steep liquor ($50/ton) to the diet reduced feed cost for 500 lbs of gain by $16.52. No costs were added for transportation or storage of steep liquor in this analysis.

Based on the results of this study, steep liquor seems to have value as an ingredient in finishing cattle diets. Most of the value is from the nutrients contained in steep liquor. The 6%, improvement in feed efficiency, though statistically nonsignificant, might have resulted from increased moisture content of the total mixed diet or from beneficial effects on fermentation and digestion of feed in the rumen and digestive tract.

Table 1. Composition of diets (dry basis).

	Diets	
	Control	Steep liquor
Whole corn	79.04	75.41
Alfalfa pellets	12.00	12.00
Soybean meal	5.00	1.00
Steep liquor		10.00
Molasses	2.00	
Urea	0.70	0.33
Limestone	0.78	0.84
NaCl	0.30	0.30
Trace mineral premix	0.024	0.024
Vitamin A premix[a]	0.08	0.08
Rumensin premix[b]	0.0195	0.0195
Elemental sulfur	0.0224	

[a]Provided 1,400 IU of vitamin A activity per pound of dry matter.
[b]Provided 15.6 mg sodium monensin per pound of dry matter.

Table 2. Feedlot performance.

	Diet			
	Control	Steep liquor	SE[a]	LSD[b]
No. steers	18	17		
Starting wt, lb.	847	832	9.6	37.6
Ending wt, lb.	1291	1308	22.0	86.3
Daily gain, lb.	3.11	3.33	0.11	0.45
Feed, lb. DM/d	20.6	20.8	1.12	4.39
Feed/gain	6.62	6.23	0.23	0.89
No. abscessed livers	8	8		

[a]Standard error of the mean.
[b]Least significant difference.

Implications

Steep liquor from a wet corn milling and ethanol plant has significant value as an ingredient in a cattle finishing diet. It can be added at levels up to 10% of the dry matter of the total diet and can be used to replace a portion of the corn and supplemental protein in a corn-based finishing diet for yearling steers.

Acknowledgments

This experiment was partially funded by a grant from the USDA to the Iowa Biotechnology Byproducts Consortium. Materials were supplied as follows: Steep liquor, Sioux Center Coop, Sioux Center, Ia., and Minnesota Corn Processors, Marshall, Min.; Rumensin, Elanco Products, Indianapolis, Ind.; trace mineral premix, Calcium Carbonate Division of J.M. Huber Corporation, Quincy, Ill; vitamin A, Hoffmann-LaRoche, Inc., Nutley, N.J. and component implants, VetLife, Winterset, Ia. The assistance of Rod Berryman, research farm superintendent; Julie Roberts, secretary; Deborah Bleile, laboratory technician; and the animal caretakers at the ISU Beef Nutrition and Management Research Center is appreciated.

Table 3. Carcass data.

	Diet			
	Control	Steep liquor	SE[a]	LSD[b]
Carcass wt, lb.	798	798	13.1	51.3
Dressing %	61.8	60.9	0.61	2.38
Ribeye area, in^2	14.6	14.8	0.34	1.34
Fat cover, in.	0.27	0.22	0.02	0.08
KPH fat, %	2.1	1.8	0.09	0.37
Marbling score[c]	431	369	11.9	46.7
% Choice	77.8	64.7	10.51	41.27
No. Choice	14	11		
No. Select	3	6		
No. Standard	1			
Yield grades				
1	11	13		
2	5	4		
3	2			
Avg. yield grade	1.98	1.66	0.11	0.44

[a]Standard error of the mean.
[b]Least significant difference.

Figure 1. Average daily gain of control and steep-fed steers by period.

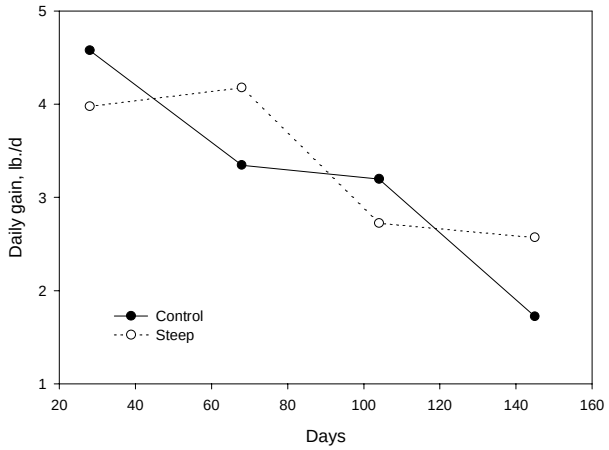

Figure 2. Average daily feed consumed by control and steep-fed steers by period.

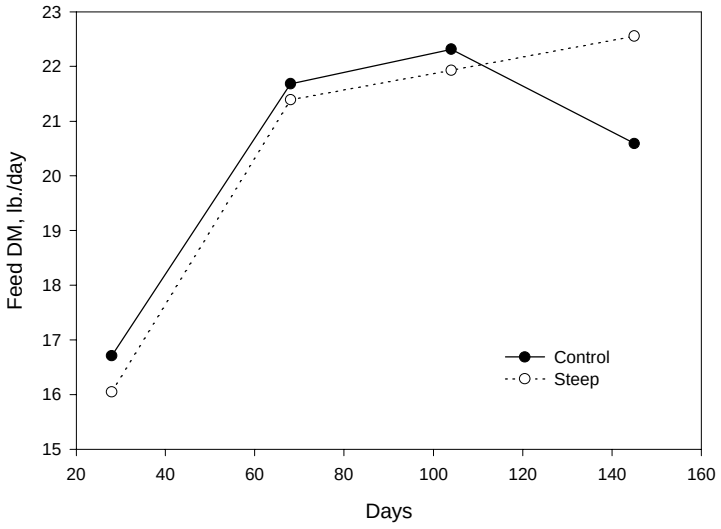

Figure 3. Average feed conversion by control and steep-fed steers by period.