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R. H. Pritchard
South Dakota State University

M. A. Robbins
South Dakota State University

SUBSTITUTION OF ROLLED BARLEY FOR WHOLE SHELLED CORN IN FINISHING DIETS FOR STEERS

R. H. Pritchard[1] and M. A. Robbins[2]
Department of Animal and Range Sciences

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Summary

Rolled barley was substituted for 0, 25, 50, 75 or 100% of the whole shelled corn in finishing diets fed to steers for 84 days. Increasing barley substitution resulted in a linear (P=.12) decrease in ADG and a quadratic (P<.05) decrease in DMI with no effect on feed conversion. At the termination of the study, barley substitution caused a linear reduction in carcass weight (P<.01) and dressing percent (P<.01). The 100% substitution of barley for corn reduced (P<.05) the percentage of carcasses grading choice. Dietary net energy values calculated from steer weights, gain and feed intake increased linearly (P<.10) as barley content of the diets increased, possibly reflecting positive associative effects. Published energy values for barley may not be suitable for least cost pricing in all feeding situations.

(Key Words: Cattle, Barley, Corn, Energy, Associative Effects.)

Introduction

Barley is often competitively priced compared to corn for many South Dakota cattle feeders. Rolled barley is a rapidly fermented grain which limits its use in high concentrate finishing diets.

The rate of fermentation of grain sources used in finishing diets affects feed intake, starch digestion and frequency and severity of acidosis. There is evidence that using combinations of grains of differing fermentation rates can improve feed efficiency. Whole shelled corn is one of the more slowly fermented feedstuffs used in finishing diets.

This feeding trial was designed to determine if specific blends of rolled barley and whole shelled corn would enhance efficiency of feed utilization in feeder cattle fed finishing diets.

Materials and Methods

In mid-March, Angus and Limousin x Angus steers (159 head; initial weight, 794 ± 2.4 lb) were stratified by weight and origin to 20 pens of seven or eight head. These steers had been in the research feedlot since early November. The diets fed included the following corn:barley ratios: 100:0, 75:25, 50:50, 25:75 and 0:100 (Table 1). The steers had been limit fed high grain diets during backgrounding and were abruptly switched to the finishing diets at the start of this experiment. Initial feed delivery was restricted to 15 lb DM per head and was increased gradually over the first 14 days. Peak DMI was reached by 28 days on feed. Diet composition (Table 2) is based on analysis of weekly samples of diet ingredients.

Steers were implanted with Ralgro on the second of two consecutive day weights used as the initial weight. Feed and water were withheld for 12 hours before weighing. Similar weighing procedures were followed after 84 days on feed.

Carcass weight and federally assigned yield and quality grades were obtained from IBP (Luverne, MN).

Tabular NE values (Table 2) were based on typical composition of feeds for cattle previously published. Calculated NE values (Table 3) were derived using NRC relationships of energy requirements

[1]Associate Professor.
[2]Manager, Beef Cattle and Sheep Nutrition Unit.

TABLE 1. CORN-BARLEY DIET FORMULATIONS[a,b]

	Diet				
Item	100:00	75:25	50:50	25:75	0:100
Ground hay	10.000	10.000	10.000	10.000	10.000
Whole shelled corn	80.654	61.538	41.433	20.988	
Rolled barley		20.406	41.432	63.005	80.655
Molasses	2.500	2.500	2.500	2.500	2.500
Soybean meal, 44%	4.600	3.540	2.500	1.423	.520
Calcium carbonate	1.081	1.126	1.180	1.233	4.290
Dicalcium phosphate	.391	.300	.191	.091	1.279
Potassium chloride	.354	.350	.344	.340	.336
Trace mineralized salt[c]	.300	.300	.300	.300	.300
Fat	.120	.120	.120	.120	.120

[a]All values dry matter basis.
[b]All diets provide 26 g/T monensin and 1000 IU/lb supplemental vitamin A.
[c]Contains NaCl 93 to 98%, Zn ≥ .35%, Mn ≥ .28%, Fe ≥ .175%, Cu ≥ .035%, I ≥ .007%, Co ≥ .007%.

TABLE 2. DIET COMPOSITION[a,b]

	Diet					
Item	100:00	75:25	50:50	25:75	0:100	SEM
Dry matter, %[b]	86.7	86.8	87.0	87.1	87.2	.271
Crude protein, %[bd]	11.1	11.37	12.13	12.47	12.99	.100
ADF, %[bd]	6.63	7.50	8.39	9.30	10.03	.110
NDF, %[bd]	14.46	18.24	22.13	26.13	29.33	.367
NE_m, Mcal/cwt[c]	93.0	90.9	89.0	86.9	85.1	
NE_g, Mcal/cwt[c]	61.5	60.0	58.4	56.8	55.5	
Ca, %[c]	.639	.639	.647	.640	.640	
P, %[c]	.364	.363	.363	.363	.363	
K, %[c]	.900	.899	.899	.900	.899	

[a]All values except DM on DM basis.
[b]Determined by laboratory analysis.
[c]Estimated from tabular values.
[d] Diet effect ($P<.01$).

for maintenance and gain based on mean body weight and ADG observed in this study.

Data were analyzed by procedures appropriate for a completely randomized design experiment. Pen was considered the experimental unit for feedlot performance data while steer was considered the experimental unit for analyzing carcass data. Linear and quadratic responses to diet were tested using the CONTRAST option in the GLM procedure of SAS. Frequency data for carcass traits were tested by the Chi square procedure.

Results and Discussion

Presumably barley has lower energy values than corn because of the relatively higher fiber content. This resulted in a linear decline in the tabular NE_m and NE_g values as barley content of the diets increased (Table 3). As a rule of thumb, we expect DMI of high grain diets to increase as energy density decreases. This is based on the assumption steers will consume feed to an energy intake maximum. In this experiment, DMI began to decline ($P<.05$) when diets contained 50% barley and continued to decline for the 25:75 and 0:100 diets. This may be due to the higher amounts of rapidly fermentable carbohydrate in these diets. It could also be related to the undesirable texture of the dry rolled barley.

Daily gains tended to decline linearly ($P=.12$) as the dietary proportion of barley increased. This response is expected when DMI declines. We would expect feed/gain to increase under these conditions because intake became a smaller multiple of maintenance, but no differences ($P>.15$) were observed in this experiment.

The NE values of diets can be calculated based on average weight and rate of gain of cattle. Dietary NE_m and NE_g both tended to increase ($P<.10$) as dietary barley increased. This is a reversal from the expected response and is not easily explained. Intake patterns did not differ during the feeding period. There is the possibility that the lower feed intake when the grain mix was ≥50% barley worked to improve feed efficiency as has been noted for restricted feeding programs.

Quality of barley grain is variable and tabular feed compositions represent the average of this variation which could lead to over or under estimation of dietary energy. This grain was 88% DM, 13.7% CP, 7% ADF and 29% NDF. Tabular values are 89% DM, 12% CP, 7% ADF and 24% NDF. The similarity of fiber content between tabular values and actual values for this lot of barley cannot help to explain the differences in NE observed. The higher than expected CP content of the barley resulted in higher ($P<.001$) CP content of the barley containing diets (Table 2). All diets should have contained sufficient CP to meet requirements for growth for this set of steers.

There was a linear decline in carcass weight ($P<.01$) and dressing percent ($P<.05$) as dietary barley increased (Table 4). Based on these conditions, we could assume that the steers fed higher barley diets were not as fat as the steers on the 100:0 diet. Federally assigned yield grades tended to decrease ($P<.10$) as diet barley content increased. The NE equations would be more accurate when cattle are fed to a similar body fat endpoint. If the barley-fed cattle were leaner, it may have favorably biased the NE estimates.

The data reported indicate barley has 5% higher NE_m and 3% higher NE_g content than corn. If body fat differences were accounted for, barley energy content may still be equal to the dry whole shelled corn used.

From an economic standpoint, several factors should be considered when considering barley feeding. Most obvious is the relative cost of the rolled barley. In this experiment, another 6 days would have been required to have the 0:100 steers weighing as much as the 100:0 steers. At trial termination, the 0:100 steers had consumed 201 lb per head less feed than the 100:0 steers. After an additional 6 days, the total feed savings per head would have been 78 lb. The feed savings would more than offset the additional 6-day yardage charge. There is also a significant savings in supplemental crude protein to consider. The supplement for the 100:0 diet was 34.7% CP, while the supplement for the 0:100 diet was 10.3% crude protein to produce 12.0% CP diets.

TABLE 3. FEEDLOT PERFORMANCE OF STEERS FED CORN-BARLEY DIETS

Item	Diet					SEM
	100:00	75:25	50:50	25:75	0:100	
Initial wt, lb	793	796	797	792	795	2.4
Final wt, lb[a]	1072	1064	1071	1057	1054	8.2
ADG, lb[b]	3.32	3.19	3.26	3.15	3.08	.095
DMI, lb/head[c]	22.89	22.81	22.20	21.77	20.50	.215
Feed/gain	6.92	7.16	6.81	6.91	6.67	.194
Calculated						
NE_m, Mcal/cwt[d]	89.7	86.9	91.3	90.1	94.5	2.11
NE_g, Mcal/cwt[d]	59.6	57.9	60.7	59.9	62.4	1.35

[a] P=.13.
[b] Linear P=.12.
[c] Quadratic P<.05.
[d] Linear P<.10.

TABLE 4. CORN-BARLEY DIET EFFECTS ON CARCASS TRAITS

Item	Diet					SEM
	100:00	75:25	50:50	25:75	0:100	
Carcass wt, lb[a]	646	651	648	621	623	8.5
Dressing percent[b]	60.4	61.3	60.6	58.9	59.2	.65
Yield grade[c]	2.45	2.34	2.36	2.31	2.19	.096
Choice, %[d]	73.3	81.3	77.4	76.7	48.4	

[a] Linear P<.01.
[b] Linear P<.05.
[c] Linear P<.10.
[d] P<.05.