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Summary

Waxy corn in rolled or whole shelled form was compared with rolled normal corn in finishing diets for cattle. Steers (n = 144; initial BW = 765 lb) were allocated to 18 pens and fed these three grain types in a 123 d experiment. The waxy corn was a sole source grain that tested >99% pure waxy endosperm. The normal rolled was acquired as needed through a commercial elevator. Diets contained 78% grain as NR) normal rolled; WR) waxy rolled; or WW) waxy whole grain. Diet had no effect on DMI and there were no differences for production variables between NR and WR treatments ($P > 0.10$). When waxy corn was fed in whole grain form there was a 7% reduction ($P < 0.05$) in ADG and a 5% increase ($P < 0.05$) in feed required per pound of gain. The reduced ADG caused by WW corresponded to lower carcass weight. The WR treatment caused an increase in KPH ($P < 0.05$). No other effects on carcass characteristics were observed. In rolled form waxy and normal corn have comparable feeding value in finishing diets. Rolling waxy corn will increase feed value by approximately 5%.

Introduction

The waxy endosperm mutation of corn was found in China in 1909. The starch in waxy corn is 100% amylopectin. In typical dent yellow corn the starch is 75% amylopectin, 25% amylose. Amylopectin is thought to be more digestible than amylose. Waxy corn has been evaluated as a grain source for cattle but results have been inconsistent.

There is a premium market for waxy corn because of its food processing characteristics. Those characteristics may be favorable in finishing diets of cattle. They may also diminish the need for grain processing. We chose to evaluate waxy corn in rolled or whole shelled form relative to rolled normal corn in high concentrate diets being fed to yearling steers.

Materials and Methods

A single diet formulation (Table 1) was used throughout this experiment. Within the constraints of the formulation, the three treatments involved use of either NR) normal (dent yellow) rolled corn; WR) waxy rolled corn; or WW) waxy whole shelled corn. Normal corn was purchased from commercial elevators periodically throughout the experiment. The waxy grain was all from a sole source and purchased in one lot. The waxy corn source was sampled three times, evaluating 800 seeds per sample. Waxy purity in these samples ranged from 99.3 to 99.5%. Diets were formulated to contain 12.75% Crude Protein, 93 Mcal NE_m/cwt and 62 Mcal NE_G/cwt.

The 144 steers used were selected from a population of 178 steers that had been part of a receiving-backgrounding experiment at the research feedlot. Allotment included stratification of the two previous treatments across current treatments.

Management at the ranch of origin affected body weights at allotment and was accommodated by nesting that prior management within replicate pens. After these allowances were made, steers were ranked by body weight (final weight from backgrounding experiment) and assigned a random sequence of treatment codes. Final assignment was for 18 pens (6 pens per corn source) of 8 steers. The feeding experiment began January, 2001.

A one diet step-up program was used. Initially, feed delivery was set at 12.5 lb. Feed delivery was then systematically increased until each pen achieved it's own plateau for voluntary intake. Feed was delivered once daily in the afternoon. The steers were implanted with Revalor-S after 28 d on feed.

Individual body weights were recorded initially and after 28, 56, 84, 112, and 123 d on feed.

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There was no restriction of feed or water prior to weighing the steers. Cumulative performance was based upon a final live weight calculated as hot carcass weight/0.625. Diet ingredients were sampled weekly as assayed for DM, CP, and ash. Fiber (NDF and ADF) was determined only for the oat silage. Dry matter intake was quantified by applying ingredient DM contents to feed batching records on a weekly basis. Two animals were removed from the experiment after 56 d as it became apparent that they were bulls. Their body weight records were deleted from the data set, and they were presumed to have consumed the average daily DMI of their respective pens prior to removal.

Steers were co-mingled and shipped to the packing plant (145 mi) 24 h after final body weight was measured. Individual identity of steers was tracked through the slaughter and grading processes. The hot carcass weight, ribeye area, and ribfat depth were measured. USDA graders assigned to the plant made visual appraisals of marbling (nearest 1/10) and KPH (nearest 0.5%). Complete carcass data were recovered on 134 of the 142 steers slaughtered.

Data were analyzed by procedures appropriate for a completely random design with main effects of diet (n = 3) and replicate (n = 6). Performance data (ADG, DMI, and feed/gain) were analyzed on a pen mean basis. Carcass data analyses were conducted by considering each steer to represent an experimental unit. Separation of least squares means were tested using Fishers test in the GLM package of SAS.

Results and Discussion

Normal corn tested higher in crude protein (CP) and ash than did the waxy corn (Table 2). It was also more variable. On average, the difference in CP in corn sources could have altered diet CP by < 0.5% points. Since all diets should have exceeded CP requirements of these steers, this difference probably had little influence on experimental outcomes.

Steers were marketed after 123 d on feed. We observed no grain effects on steer performance during the initial 84 d on feed. Gains were uniformly low during the period of 57 to 84 d. Because of harsh winter conditions, the cattle had gradually accumulated a substantial quantity of mud by March (56 d BW) but had almost completely shed out by the d-84 weight in April. The loss of 40 lb of mud in this 28 d period would affect apparent ADG by 1.43 lb/d. Intake and health records during this period and subsequent performance and carcass data are indications that there were no disease problems associated with the numerical slump in ADG. Because of the short time (11 d) between 112 d and 123 d weights, final period performance was evaluated from 85 to 123 d.

Although interim ADG had been similar ($P > 0.10$), after 123 d body weight was lower ($P < 0.05$) for the WW treatment (Table 3). Cumulative performance indicated the WW grain caused ($P < 0.05$) lower ADG and higher F/G than either rolled grain treatment. No differences in performance were evident among the two rolled grain sources. Feed intake was not affected by treatment.

The whole waxy corn caused ($P < 0.05$) lighter carcasses and a lower dressing percentage (Table 4). The only other carcass trait affected by grain source was KPH, which was higher ($P < 0.05$) for the WR than other treatments. The increase in KPH was not sufficient to affect Yield Grade. The distribution of Yield Grade and Quality Grade frequencies is indicative of quality cattle and was not affected by grain source (Table 5).

Results of this experiment indicate that when feeding rolled corn as the base diet ingredient for finishing cattle, there is no difference in energy value between normal and waxy corn. When evaluating only waxy corn sources, a 7% improvement in ADG and a 5% improvement in feed efficiency were achieved by rolling the grain.

Tables

Table 1. Test diet

	%, DMB
Oat silage	8.00
Corn[a]	78.73
Soybean meal, 44%	9.02
Liquid supplement[b]	4.25

[a] Either as normal-rolled, waxy-rolled or waxy-whole.
[b] Provided monensin and tylosin to make final diet 28 g/T and 11 g/T, respectively; provided vitamins and minerals to meet or exceed nutrient requirements (NRC, 1996).

Table 2. Corn sample analyses based upon weekly samples

	Normal-rolled	Waxy-rolled	Waxy-whole
Dry matter	85.28 ± 0.34	85.52 ± 0.21	86.72 ± 0.13
Crude protein[a]	9.60 ± 0.48	8.80 ± 0.09	8.63 ± 0.06
Ash[a]	1.70 ± 0.25	1.07 ± 0.02	1.04 ± 0.01

[a]DM basis.

Table 3. Interim period and cumulative performance of steers by treatment

	Treatment			
	Normal-rolled	Waxy-rolled	Waxy-whole	SEM
Initial BW, lb	763	768	765	3.0
1 to 28 d				
d-28 BW, lb	909	922	913	4.4
ADG, lb	5.21	5.48	5.24	0.184
DMI, lb	18.23	18.28	18.21	0.105
F/G	3.55	3.35	3.49	0.119
29 to 56 d				
d-56 BW, lb	1045	1052	1037	5.3
ADG, lb	4.88	4.65	4.48	0.137
DMI, lb	22.09	22.44	21.56	0.432
F/G	4.56	4.83	4.83	0.151
57 to 84 d				
d-84 BW, lb	1100	1111	1095	5.6
ADG, lb	1.95	2.10	2.07	0.110
DMI, lb	20.76	21.26	21.05	0.425
F/G	10.74	10.19	10.43	0.636
85 to 123 d				
d-123 BW, lb	1236[b]	1243[b]	1219[c]	3.1
ADG, lb	3.49	3.38	3.18	0.097
DMI, lb	20.60	21.04	20.60	0.323
F/G	6.02	6.37	6.64	0.220
Cumulative, carcass adjusted				
Final BW[a]	1219[b]	1229[b]	1195[c]	4.3
ADG, lb[a]	3.71[b]	3.74[b]	3.49[c]	0.041
DMI, lb	20.44	20.78	20.37	0.275
F/G	5.51[b]	5.55[b]	5.84[c]	0.059

[a] Least squares means.
[b,c]Means without common superscripts differ ($P < 0.05$).

Table 4. Carcass characteristics by treatment[a]

	Treatment			
	Normal-rolled	Waxy-rolled	Waxy-whole	SEM
Hot carcass weight, lb	766[d]	767[d]	748[e]	6.6
Dress, %[b]	64.25[d]	64.45[d]	63.84[e]	0.180
Ribeye area, in^2	12.43	12.24	12.18	0.156
Ribfat depth, in	0.45	0.46	0.46	0.016
KPH, %	2.00[d]	2.23[e]	1.94[d]	0.050
Marbling[c]	6.1	6.2	6.0	0.149
Yield grade	2.97	3.11	2.98	0.066

[a]Least squares means.
[b]Based upon 4% shrink of final live weight.
[c]$Small^0$ = 5.0; $Slight^0$ = 4.0.
[d,e]Means without common superscripts differ ($P < 0.05$).

Table 5. Carcass grading distributions by treatment

	Treatment		
	Normal-rolled	Waxy-rolled	Waxy-whole
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Yield Grades			
1 & 2	55	43	61
3	43	54	39
4	2	2	0
Quality Grades			
Prime	16	20	14
Avg. – High Choice	39	33	36
Low Choice	27	35	27
Select	18	13	23