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Summary

Twelve steers (body weight 955 lb ± 37) were allotted to a 4 x 4 Latin square design digestion trial to examine the effects of corn processing on feed utilization. The grain component of the diet was either dry whole corn (WC), dry rolled corn (RC), corn reconstituted 12 hours before rolling (RRC), or corn reconstituted with a commercial surfactant[3] 12 hours before rolling (CRC). Dry matter content of the WC, RC, RRC, and CRC diets were 87.91, 87.30, 82.19, and 82.14%, respectively. Treatment had no effect on the digestibilities of dry matter (71.00% ± 1.57), organic matter (72.22% ± 1.53), crude protein (57.54% ± 1.66), neutral detergent fiber (52.68% ± 3.07), or starch (85.67% ± .98). Neutral detergent fiber digestion was affected by period, but this was not related to bulk density of the corn which ranged from 43 to 56 lb/bu over periods. Processing did not affect dry matter intake (21.76 lb/day ± .41), although reconstitution depressed ($P<.01$) dry matter intake as a percentage of body weight (2.19, 2.24, 2.11, and 2.14%, respectively). To quantify differences in particle size, processed grain samples were separated with #5, 7, 10, and 18 mesh sieves. Mean percentages retained on a #5 mesh sieve were 85.26, 58.74, 84.27, and 83.57% for WC, RC, RRC, and CRC, respectively. Subsequent separated fractions of WC and the reconstituted treatments were similar.

Key Words: Beef, Grain Processing, Digestibility

Introduction

There is a wealth of data that indicates no improvement in corn grain utilization due to dry rolling in high grain diets. Much of the digestion data were collected at intakes of 1 to 1.5% of body weight (BW). Digestibilities would be higher at reduced intakes and may not be applicable to intense production situations.

Many feedlots reconstitute their corn grain to a moisture content of 18 to 20% before rolling. The use of a surfactant is often employed to speed the reconstitution process. Although reconstituting may decrease shrinkage losses of processed grain, it has also been suggested that reconstitution or the surfactant itself may improve grain utilization. Increases in feed efficiency have been reported for ensiled high moisture (HM) corn and grain sorghum when compared to dry corn and grain sorghum. Reconstituting could prove beneficial if some of the advantages of ensiled HM grain could be realized, as reconstituting would be cheaper than storing ensiled grains.

The objective of this research was to determine if rolling of dry or reconstituted corn (with or without a surfactant) would increase corn utilization in high grain diets at intakes common to industry production levels.

Materials and Methods

To examine the effects of corn processing on feed utilization, twelve crossbred steers (initial BW 955 lb ± 37) of British and continental ancestry were used to conduct a

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4 x 4 Latin square design digestion trial. Steers were previously adapted to a 10% ground grass hay, 90% concentrate finishing diet. Experimental diets were 84.5% corn, 7.0% ground grass hay, 4.9% soybean meal, and 3.6% liquid supplement (Table 1). The grain component of the experimental diets was either dry whole corn (WC), dry rolled corn (RC), corn reconstituted with water and allowed to soak at least 12 hours before rolling (RRC), or corn reconstituted with a commercial surfactant at least 12 hours before rolling (CRC). A single lot of corn was used to prepare processed grains throughout each 14-day period. Water was added at 7% of corn weight to the WC in a horizontal ribbon-type mixer to raise the moisture content of the reconstituted grains approximately 6%.

Table 1. Diet composition

Ingredient	Dry matter basis
Corn, %	84.50
Grass hay, %	7.00
Soybean meal, %	4.90
Liquid supplement, %	3.60
Crude protein, %	12.03
Calcium, %	.532
Phosphorus, %	.317
Potassium, %	.894
NE_m (Mcal/cwt)	95.66
NE_g (Mcal/cwt)	65.54
Monensin (g/ton)	26.78
Tylosin (g/ton)	11.0

Chromic oxide was used as an external marker and was incorporated into the diet on days 7 through 14 of each period as a soybean meal based premix (10% Cr_2O_3, 90% SBM). A single batch of premix was used for all periods. This premix replaced soybean meal at 1% of the diet dry matter (DM). Steers were fed twice daily at 10:00 a.m. and 5:00 p.m. Dry matter intake (DMI) was allowed to increase to the point of feed refusal. At this point, intake was managed to reduce weigh backs. Fecal grab samples were collected before feeding on days 10 through 14. Fecal samples were composited within steer and period for analyses.

Diet composition was calculated from composite ingredient samples taken on period days 9 to 13. Diet ingredients, feces, and weigh backs were analyzed for DM, crude protein (CP), neutral detergent fiber (NDF), starch, ash, and chromic oxide.

Differences in particle size due to treatment were obtained by sieving triplicate grain samples (2.2 lb) through #5, 7, 10, and 18 mesh sieves (.157, .111, .080, and .039 in., respectively). Replicate means determined for periods 2 to 4 are reported.

Data were analyzed with the GLM procedure of SAS as appropriate for a Latin square design. Separation of least squares means were conducted with the PDIFF option at the .05 level. Dry matter intake was used as a covariate in the digestibility analyses.

Results and Discussion

Dry matter content of the diets was reduced ($P<.01$) five percentage points by reconstitution (Table 2). Processing did not affect DMI during the digestion trial (21.76 lb/day ± .41). However, reconstitution did depress ($P<.01$) dry matter intake as a percentage of body weight for the RRC and CRC vs the RC diet (2.11, 2.14, and 2.24%, respectively). Treatment had no effect on the digestibilities of DM (71.00% ± 1.57), organic matter [OM] (72.22% ± 1.53), CP (57.54% ± 1.66) NDF (52.68% ± 3.07), or starch (85.67 ± .98) [Table 2]. The least significant difference necessary to detect a difference in DM digestibility was 4.25%. The low apparent CP digestibility may be due to the high DMI of the steers which averaged 2.17% of BW. Correcting fecal CP values for contributions from metabolic fecal N (DMI x .0334) increased CP digestibility to 88.17% ± 1.54.

Diet CP level dropped to 10.1% in period 3 due to lower CP concentrations in the ground grass hay and low bulk density corn (Table 3). Starch and NDF digestibility were affected by period, but this was not related to bulk density of the corn or diet CP level (Table 3).

Orthogonal contrasts showed a decrease ($P<.05$) in diet refusal with the reconstituted corn treatments in the digestion trial (Table 2).

Table 2. Diet analysis, digestibilities, dry matter intake, and diet refusals by treatment

Variable	Treatment				SE
	WC	RC	RRC	CRC	
Diet, %					
Dry matter	87.91[a]	87.30[b]	82.19[c]	82.14[c]	.28
Crude protein	11.17	11.10	11.09	11.08	.04
Neutral detergent fiber	20.10	20.04	19.94	19.74	.23
Starch	61.63	62.06	61.68	61.20	.55
Ash	3.93	3.86	3.93	3.88	.04
Digestibility, %					
Dry matter	70.56	73.09	69.13	71.23	1.57
Organic matter	71.84	74.19	70.33	72.53	1.53
Crude protein	56.85	60.64	56.14	57.33	1.66
Adjusted crude protein[d]	87.32	91.16	86.57	87.63	1.54
Neutral detergent fiber	51.76	56.41	51.09	51.48	3.07
Starch	85.29	86.38	84.21	86.78	.98
Dry matter intake, lb/day	22.08[a,b]	22.30[a]	21.29[b]	21.37[b]	.30
Dry matter intake/body wt, %	2.19[a,b]	2.24[a]	2.11[b]	2.14[b]	.03
Diet refusals, lb/day	.87[a]	.73[a]	.47[a,b]	.19[b]	.17

[a,b,c]Unlike superscripts differ (P<.05).
[d]Crude protein digestibility adjusted for contributions from metabolism.

Table 3. Corn bulk density, diet crude protein level, neutral detergent fiber and starch digestibility by period

Variable	Period				SE
	1	2	3	4	
Bushel wt, lb	56.0	53.5	43.0	52.0	
Diet crude protein, %	11.42[b]	11.69[a]	10.10[d]	11.23[c]	.04
Starch digestibility, %	80.73[b]	86.36[a]	87.28[a]	88.29[a]	.98
Diet starch, %	61.82	61.28	62.14	61.34	.55
Neutral detergent fiber digestibility, %	47.07[c]	59.96[a,b]	48.19[c]	55.52[b,c]	3.07
Diet neutral detergent fiber, %	19.50[c]	20.02[b]	19.66[b,c]	20.55[a]	.23
Dry matter intake, lb/head/day	20.40[c]	21.41[b]	22.42[a]	22.82[a]	.30

[a,b,c,d]Unlike superscripts differ (P<.05).

Mean percentage of corn retained on a #5 mesh (4 mm) sieve was lowest for RC (85.26, 58.74, 84.27, and 83.57% for WC, RC, RRC, and CRC respectively). All separated fractions of WC, RRC, and CRC were similar (Figure 1).

Conclusions

No differences in diet component digestibilities among corn processing treatments were detected. Reconstitution reduced fines and feed refusal but highest dry matter intake as a percentage of body weight was achieved with the RC diet which had the highest proportion of fines in the grain.

Reconstitution reduces the proportion of fines associated with dry rolling and this may be an effective tool in reducing the shrink associated with processed grains. RRC corn absorbed as much water as the CRC corn. Dry matter values of the RRC and CRC corn may have been different if the corn was reconstituted in a different manner or rolled soon after reconstitution. With no significant increase in any of the digestibilities measured, the RC, RRC, and CRC treatments may not warrant the cost of processing.

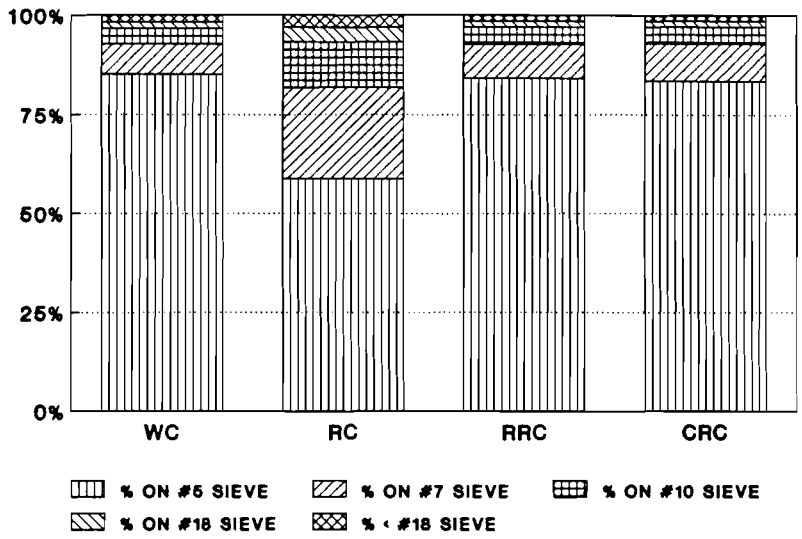

Figure 1. Separated corn particle size fractions (mean of periods 2 to 4).