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gain predicted a breakpoint at 1.6% urea (95% confidence interval was 1.55 to 1.66%). This level of urea suggests that dietary DIP requirement for SFC-based diet is approximately 9.5% of dietary DM.

Degradable intake protein requirement for DRC-based diets could not be determined by nonlinear analysis because the first increment of urea provided the best feed/gain. This suggests that the DIP requirement for the DRC-based diet was met at 6.3% of dietary DM. Degradable intake protein requirement for HMC was consistent between Trials 1 and 3 (approximately 10% of dietary DM) and considerably higher than predicted level (7.1% of DM). The greater DIP requirement for HMC is most likely due to greater rate and extent of starch fermentation with HMC compared to DRC. Degradable intake protein requirement for SFC was the same as predicted in Trial 2 (7.1% of DM), but higher in Trial 3 (9.5% of DM). Reasons for differences in estimated DIP requirement for a SFC-based diet are not clear, but may be due to differences in initial weight, intake, and/or method of grain adaptation.

Our results suggest that the average dietary DIP requirements for DRC, HMC, and SFC-based diets are 6.3, 10.0, and 8.3% of DM, respectively. These dietary DIP requirements are highly related to ruminal starch digestibilities reported in literature (78, 89, and 83% for DRC, HMC, and SFC, respectively). Level 1 of the NRC (1996) accurately predicts the DIP requirement for a DRC-based diet. However, DIP requirements for HMC and SFC-based diets are underestimated because Level 1 of the NRC does not account for differences in ruminal starch digestion. Level 2 of the NRC (1996) accounts for differences in ruminal starch digestion, and therefore, may more accurately predict DIP requirements for HMC and SFC-based diets.

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# High Moisture and Dry-Rolled High-Oil Corn for Finishing Feedlot Steers

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Terry Mader  
Fred Owens<sup>1</sup>

When fed in the dry rolled form, high-oil corn improved feed efficiency over normal corn. However, high-oil corn did not improve efficiency over normal corn when fed in the high moisture form.

## Summary

*Finishing steers fed diets containing dry-rolled high-oil corn had a 2.5% reduction in dry matter intake and 4.2% better feed efficiency than steers fed diets containing dry-rolled normal corn. Hot carcass weight, dressing percent, liver abscess score, rib fat thickness, marbling score and yield grade did not differ among treatments. Steers fed high-moisture high-oil corn had larger ribeye area and greater percent kidney, pelvic and heart fat than steers fed high moisture normal corn. No differences in performance or efficiency were detected from substituting high-oil high moisture corn for normal high moisture corn.*

## Introduction

Nutritionally modified grain varieties, such as "high-oil" (HO) corn, have been developed that may improve efficiency of livestock production. Higher oil content of grain increases energy density of the diet and aids in dust control. However, the ideal management systems (processing method; fat, ionophore, mineral supplementation) for nutritionally modified grains may differ from those ideal for normal grain. For example, South Dakota State University researchers detected a processing by corn

type interaction between normal and high-oil corn. Dry matter intakes and gains were 5 to 10% greater for steers fed rolled HO corn than steers fed whole HO corn. These results indicate that HO corn may need to be processed prior to feeding to finishing beef cattle. To date, no information has been published on HO corn harvested, stored and fed as high moisture grain to feedlot cattle. The objective of this study was to evaluate high-oil corn versus normal corn when fed as dry-rolled or high moisture grain to finishing feedlot steers.

## Procedure

In separate locations, normal (N) and high-oil (HO) corn varieties were planted at the University of Nebraska, Northeast Research and Extension Center in Concord, Neb. Varieties were harvested as both high-moisture (HM) and as dry corn. At harvest each load of corn was sampled and analyzed for DM content. High-oil and normal high moisture corn were harvested at 28 % DM. Corn harvested as HM grain was rolled and stored in two separate bunker silos. Dry corn (D) was coarsely rolled prior to feeding.

Three hundred eighty British x continental crossbred steers were purchased in early November 1998 and were processed in mid- to late November. Processing included: weighing, implanting, tagging, vaccinating, and deworming. Weights at processing were used to divide the steers into light (LWG) and heavy (HWG) weight groups. On Dec. 7, the LWG again was weighed and sorted by weight into additional groups and placed into their respective trial pens on Dec. 8. Initial weight for the LWG was an average of full live weights taken on Dec. 7 and Dec. 8. The HWG was treated the same as the LWG, with full live weights taken

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**Table 1. Percentage of grain from each grain type and form in each diet.**

Grain type	Treatment			
	1	2	3	4
Normal				
Dry-rolled	50	0	0	50
High moisture	50	0	50	0
High-oil				
Dry-rolled	0	50	50	0
High moisture	0	50	0	50

on Dec. 9 and Dec. 10. Fifteen steers were excluded from the research pool for the following reasons: too heavy, too light, or lame.

The LWG included 200 steers with 10 steers/pen in 20 pens (five weight groups with four treatments in each weight group). The HWG included 160 steers with 10 steers/pen (four weight groups with four treatments in each weight group). Pens were assigned randomly within each weight group to one of four treatments. Each diet contained equal amounts of DM corn from D and HM. This made the four different combinations of N and HO corn in the D and HM form: (1) ND plus NHM, (2) HOD plus HOHM, (3) HOD plus NHM, and (4) ND plus HOHM as shown in Table 1.

On a DM basis, the finishing diets contained 84% corn, 7.5% alfalfa hay, 4.5% liquid supplement, 2.0% soybean meal, and 2.0% Rumensin®, Tylan®, thiamine supplement. Diet ingredients and feedbunk samples were obtained every second week and analyzed for DM content. Corn samples were also analyzed for CP, pepsin insoluble nitrogen and crude fat. High-moisture corn was also analyzed for pH, ethanol and selected volatile fatty acids. Feedbunk samples were analyzed for nitrogen, calcium and phosphorus. Fecal samples were collected from two steers/pen and four pens/treatment and analyzed for pH, crude fat, and starch content.

The LWG and HWG were harvested after 92 and 81 days on feed, respectively. On day of harvest, liver abscess scores and hot carcass weights were recorded. After a 24-hour chill, rib eye area (REA), rib fat thickness (RF), USDA quality grade, USDA yield grade and percent kidney, pelvic and heart fat (% KPH) were recorded. Tissue samples

**Table 2. Corn analysis, Dry Matter Basis.**

	Normal	High-oil	P < .10
<b>High Moisture Corn</b>			
Dry matter at harvest, %	71.6	71.8	
Dry matter at feeding, %	66.8	68.8	.028
Crude fat, %	5.00	8.12	.0001
pH	4.04	4.14	
Crude protein, %	8.45	8.87	.045
Pepsin insoluble nitrogen, %	10.43	10.72	NS
Ethanol, %	1.97	1.88	NS
Lactate, %	3.97	4.18	.063
Acetate, %	1.40	1.25	NS
Propionate, %	.20	.17	NS
<b>Dry-Rolled Corn</b>			
Dry matter, %	86.4	86.4	NS
Crude fat, %	4.48	6.98	.0001
Pepsin insoluble nitrogen, %	26.77	26.30	NS

**Table 3. Summary of steer performance, intake and efficiency comparing high moisture and dry-rolled high-oil corn over approximately 90 day feeding period.**

Item	Treatment			
	1	2	3	4
No. head	90	90	90	90
No. pens	9	9	9	9
Initial weight, lb	900	898	900	900
Average daily gain, lb/day <sup>a</sup>	4.16	4.18	4.18	4.07
DM intake (DMI), lb/day <sup>b</sup>	26.07	25.50	25.28	25.98
Feed efficiency, DMI/gain <sup>c</sup>	6.28	6.09	6.07	6.38
Final weight, lb	1261	1263	1261	1254

<sup>a</sup>Adjusted to a common dress of 63%.

<sup>b</sup>Treatments 1 plus 4 vs 2 plus 3 differ ( $P < .10$ ).

<sup>c</sup>Treatments 1 plus 4 vs 2 plus 3 differ ( $P < .05$ ).

**Table 4. Summary of steer carcass data comparing high moisture and dry-rolled high-oil corn in feedlot diets.**

Item	Treatment			
	1	2	3	4
Hot carcass weight, lb	794	795	794	790
Actual dress, %	62.6	62.5	63.1	62.7
KPH fat, % of carcass <sup>a</sup>	2.29	2.36	2.30	2.34
Ribeye area, sq in	13.73	13.91	13.65	13.94
Estimated fat, in	.42	.43	.42	.43
Marbling score <sup>b</sup>	537	531	504	530
USDA yield grade	2.51	2.43	2.48	2.39
Final yield grade <sup>c</sup>	2.64	2.62	2.66	2.58
Liver abscesses, %	3.33	5.56	7.78	10.00

<sup>a</sup>Treatments 1 plus 3 vs 2 plus 4 differ ( $P < .05$ ).

<sup>b</sup>Marbling score of 400 = Traces, 500 = Small, 600 = Modest, 700 = Moderate.

<sup>c</sup>Final yield grade =  $2.50 + (2.50 \times \text{estimated fat thickness}) + (.20 \times \text{percent KPH}) + (.0038 \times \text{hot carcass weight}) - (.32 \times \text{ribeye area})$ .

were removed from the neck region of a sub-sample of carcasses (mean of 20 carcasses/treatment) of the HWG on the day carcass data was collected. Lipid extracted from both the lean and fat tissue were analyzed for following fatty acids: myristic, myristoleic, palmitic, palmitoleic, stearic, oleic, linoleic, linolenic, arachidic, eicosenoic, and summed

to calculate total saturated, and mono-, di-, and tri-unsaturated.

## Results

Even though HOHM corn and NHM corn were harvested at the same moisture content, HOHM corn had a higher ( $P < .05$ ) DM content (based on oven

DM determinations) than NHM corn after fermentation (Table 2). The CP content was greater ( $P < .10$ ) for HO corn than N corn as is typical for high-oil corn (Table 2).

Based on analysis of feces from these steers, no differences ( $P > .05$ ) in fecal starch content were detected among treatments. However, crude fat content of feces was 5.04%, 7.96%, 6.85%, and 6.31% for treatments 1, 2, 3 and 4 respectively. Thus steers fed HODR corn (treatments 2 and 3) had more ( $P < .05$ ) of their fecal DM as crude fat than steers fed NDR corn (treatments 1 and 4).

When compared with steers fed diets containing dry-rolled normal corn, (mean of treatments 1 and 4) steers fed diets containing HODR corn (mean of treatments 2 and 3) tended to have lower ( $P < .10$ ) dry matter intakes but had

improved ( $P < .05$ ) feed conversions. No differences ( $P > .10$ ) were detected in feed intake, gain and efficiency between steer groups fed high-moisture normal corn (mean of treatments 1 and 3) vs high-moisture high-oil corn (mean of treatments 2 and 4; Table 3).

No differences ( $P > .05$ ) in saturation of fatty acid from lean or fat tissue among treatments were detected. However, steers fed high-oil corn tended to have greater ( $P < .10$ ) percentages of arachidic acid (C20:0) in both meat (.66 vs .59) and fat (.92 vs .86) samples. Steers fed high-oil high-moisture grain had greater ( $P < .05$ ) internal (KPH) fat than steers fed normal high moisture grain (2.35 vs 2.30). Feeding a mixture of high-oil grain with normal corn grain (mean of treatments 3 and 4) tended to slightly increase ( $P < .10$ ) the incidence of liver

abscesses when compared to steers fed either grain form alone (average of treatments 1 and 2; Table 4).

Results from this study indicate that substituting dry high-oil corn for a portion of the dry corn with normal oil content in diets for feedlot steers can decrease dry matter intake and improve feed conversion. Although no problems with fermentation of high-moisture high-oil corn were encountered, no performance advantage from substituting high-moisture high-oil corn for high-moisture corn with normal oil content was detected.

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## Corn Processing Method in Finishing Diets Containing Wet Corn Gluten Feed

**Tony Scott**  
**Todd Milton**  
**Terry Klopfenstein**  
**Rick Stock<sup>1</sup>**

Feed efficiency and dietary net energy available for gain tended to be improved by more intensively processing corn in finishing diets containing wet corn gluten feed.

### Summary

*Two trials were conducted to determine the effects on performance and carcass characteristics of corn grain diets differing in degree of processing and containing wet corn gluten feed. Generally, more intensive processing methods such as fine-grinding, high moisture ensiling, and steam-flaking*

*resulted in lower daily feed consumption compared to feeding rolled or whole corn. Feed efficiency and dietary net energy concentration tended to be improved by more intensive processing methods in finishing diets containing wet corn gluten feed.*

### Introduction

Inclusion of wet corn gluten feed in place of corn grain replaces dietary starch with highly digestible fiber. The resultant effect can be increased feed intake and daily gain as well as decreased incidence and severity of acidosis in finishing cattle. While feeding wet corn gluten feed is a widely accepted practice, limited information is available about the effects different grain processing methods may have in diets containing wet corn gluten feed.

The objectives of this research were to evaluate the effects of corn processing method in finishing diets containing wet corn gluten feed and to evaluate the value of feeding wet corn gluten feed in minimal (dry-rolled) and intensive (steam-flaked) processed corn-based finishing diets on performance and carcass characteristics of finishing calves.

### Procedure

#### Trial 1

Four hundred eighty crossbred steer calves (667 lb) were stratified by weight and randomly assigned to one of 32 pens (15 head/pen). Each pen was randomly assigned to one of eight treatments. Four treatments were designed based on dry-rolled corn

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