Effects of fat level in distillers grain on feedlot finishing performance and carcass traits

V.L. Anderson[1] and C.L. Engel[1]

*The objective of this study was to evaluate the effects of different corn oil (fat) levels in distillers grains with solubles (DGS) on beef cattle performance during finishing and the effects on carcass traits. Three different distillers grains products were procured from three different sources, with differing amounts of corn oil removed. The products contained 5.47, 8.05 and 12.96 percent corn oil and were fed at 19.4 percent of diet dry matter (DM). Increasing fat levels had minimal impact on intake, gain and gain efficiency, with little effect on carcass traits except marbling scores increased (*P < *0.03) with corn oil level.*

Summary

Angus-sired steers (n = 174, 1,018.6 ± 9.66 pounds) were blocked by weight (fall calves and yearlings) and allocated to one of four treatments based on corn oil level in DGS: 1) control (CON) no DGS, 2) low corn oil (LOW, 5.47 percent), 3) medium corn oil (MED, 8.05 percent) and 4) high corn oil (HIGH, 12.96 percent). For DGS treatments, DGS was fed at 19.4 percent of diet DM. Eleven or 12 steers were assigned to each of 16 pens, with four replicates per treatment. Steers were fed a corn-based diet (62 megacalories per pound [Mcal/lb]) to appetite formulated to meet or exceed National Research Council (NRC) requirements. Steers were weighed at the start of the finishing phase, at day 28, and at the end of the study. Steers were marketed in two groups at Tyson Fresh Meats, Dakota City, Neb., with carcass traits evaluated by the same trained grader. Total dietary fat levels were 3.58, 4.02, 4.52 and 5.48, for CON, LOW, MED and HIGH treatments, respectively. DGS was included in respective treatments at 19.4 percent (DM basis) with sunflower meal included at 13.3 percent (2.44 percent oil) in the CON ration to provide similar protein level. Dry-matter intake (DMI) was affected minimally by fat

[1]Carrington Research Extension Center, NDSU

level ($P < 0.14$) throughout the entire feeding period. However, a numeric linear increase in DMI was observed during the first 28 days on feed for LOW, MED and HIGH treatments of 27.64, 28.19 and 28.90 pounds/head/ay, respectively. Throughout the entire feeding period, average daily gain (ADG) ($P > 0.54$) and gain efficiency (gain-to-feed; $P > 0.84$) were not affected by treatment. Ribeye area (REA) tended to decrease ($P < 0.07$) with increasing corn oil. Yield grade numerically increased with a linear trend ($P < 0.07$) from 2.98 to 3.27 for CON and HIGH, respectively. Marbling score increased linearly ($P < 0.02$) with increasing corn oil.

Introduction

Distillers grains with solubles (DGS) is a palatable, energy- and protein-dense feed for beef feedlot cattle. Corn oil makes up 12 to 15 percent of DGS DM if no oil is removed. Considering that corn oil has 2.25 times the energy value of starch, this lipid component of the diet is a significant energy source.

Corn oil has higher monetary value in markets other than feed. Partial removal of corn oil has become common in the ethanol industry, with levels in DGS reported at 3 to 9 percent, depending on the process. The effect of removing a portion of the corn oil on animal performance is not well-defined. A summer feedlot finishing study was conducted to compare effects of decreasing corn oil levels in the DGS.

Methods and Procedures

Fall-born calves (n = 92) and spring-born yearling Black Angus and Angus-cross steers (n = 90) were delivered to the NDSU Carrington Research Extension Center as part of the second annual North Dakota Angus University feedout program in late May 2013. Steers were blocked (four weight blocks) by weight and allotted to one of 16 pens (11 or 12 animals per pen), with four pens per treatment in a randomized complete block design.

The fall calves were fed growing diets for 42 days before transitioning to finishing treatments. Three different DGS products were sourced (Table 1) based on specific corn oil levels with no oil removal (HIGH; 12.96 percent corn oil), partial oil removal (MED; 8.05 percent corn oil) and reduced oil (LOW; 5.47 percent corn oil). The control diet (CON) included sunflower meal (2.44 percent oil).

Distillers grains were sourced from different plants to obtain the desired corn oil levels. HIGH corn oil DGS was purchased from Highwater Ethanol, Lamberton, Minn. MED corn oil DGS was sourced at Blue Flint Ethanol, Washburn, N.D., and LOW corn oil DGS came from POET, Groton, S.D. Dietary treatments (Table 2) were DGS with different oil content fed at 19.4 percent (DM) of the corn-based finishing diet.

Other ration ingredients included dry-rolled corn grain, chopped grass hay, corn silage, condensed separator byproduct and a supplement that contained vitamins, minerals and monensin sodium (Rumensin, Elanco, Greenfield, Ind.). The diets were formulated to meet or exceed NRC (1996) nutrient

Table 1. Nutrients in distillers grains with different fat levels.

Nutrient Composition	Low Fat[a]	Medium Fat[b]	High Fat[c]
	Percent, DM basis		
Dry matter	88.83	89.26	89.63
Crude protein	32.69	31.90	28.76
Fat	5.47	8.05	12.96
ADF	11.93	16.48	15.74
NEg, Mcal/lb	0.62	0.62	0.62
Calcium	0.12	0.11	0.13
Phosphorus	1.00	0.83	0.83
Sulfur	1.07	0.48	0.52

Source: [a]POET, Groton, SD; [b]Blue Flint Ethanol, Washburn, N.D.; [c]Highwater Ethanol, Lamberton, Minn.

Table 2. Finishing diets with increasing fat in distillers grain.

Finishing Diets	Diet Treatments			
	Control	Low Fat	Medium Fat	High Fat
	Percent, DM Basis			
Corn, dry rolled	66.68	60.96	60.95	61.02
Dry distillers grains and solubles	0.57	19.40	19.34	19.40
Sunflower meal	13.30	--	--	--
Grass hay, chopped	11.13	11.29	11.29	11.27
Condensed separator by-product	6.76	6.73	6.73	6.73
Ionophore, vitamin, mineral supplement	1.56	1.62	1.69	1.58
Nutrient Composition				
Crude protein, %	12.42	12.88	12.70	12.12
Fat, %	3.58	4.02	4.52	5.48
NEg, Mcal/lb	0.60	0.62	0.62	0.62

requirements for finishing steers.

The corn oil removal process is as follows: After ethanol is volatilized from the fermented ground corn mash, the remaining slurry consisting of protein, fiber and corn oil is centrifuged to separate the solids from the liquid. The liquid stream is centrifuged again to remove a portion of the corn oil, resulting in MED corn oil DGS.

Additional oil is removed to produce LOW corn oil DGS by a two-stage separation that includes centrifugation of thin stillage followed by emulsification and processing through a specialized centrifuge that removes additional oil. The remaining liquid is condensed distillers solubles [CDS] or "syrup," which is added back to the solids in the drying process to be included as part of the final DGS product.

Cattle were fed to appetite with rations mixed in a truck-mounted Knight "Little Augie" three-auger mixer wagon and delivered to fence-line bunks once each day. Ration adjustments were made daily according to morning bunk readings. All calves were implanted with a Revalor S (Merck Animal Health, Whitehouse Station, N.J.) anabolic implant at the start (day zero) of the finishing trial. Steers were fed until we determined that 80 percent of the respective block(s) would grade U.S. Department of Agriculture Choice or better.

Steers were marketed in two groups (days on feed were 105 and 69) at Tyson Fresh Meats, Dakota City, Neb., with carcass traits evaluated by the same trained grader. None of the cattle in this trial died. Statistical analysis was performed using PROC Mixed procedures of SAS. Pen was the experimental unit. This project was reviewed and approved by the NDSU Animal Care and Use Committee.

Results and Discussion

While some variation occurred in animal performance (Table 3), no significant overall effects for DMI ($P > 0.14$), gain ($P > 0.54$) and gain efficiency ($P > 0.26$) were observed due to fat level in DGS. A linear increase in DMI with increasing fat level was observed for the first 28 days on feed, however.

Most carcass traits were unaffected with carcass weight ($P > 0.18$); dressing percent ($P > 0.34$); fat thickness ($P > 0.30$); kidney, pelvic and heart (KPH) fat percentage ($P > 0.48$); and yield grade ($P > 0.27$; Table 4). However, we observed a trend ($P = 0.07$) toward higher marbling scores (linear $P = 0.02$) and increased percentage of USDA Choice with increased fat in DGS.

This project included distillers grains at 19.4 percent of the diet DM, while some other studies include higher levels of DGS in feeding trials to test effects of fat content. Gigax et al. (2011) observed improved gain and carcass weight but no differences in marbling scores when wet distillers grain with 6.7 and 12.9 percent fat was fed in finishing diets at 35 percent of DM.

Pritchard et al. (2012) also observed improved gain and feed efficiency but no difference in marbling score with diets that were 5.34 and 6.58 percent fat, respectively, with 40 percent DGS in the diet. Fat differences were created by including distillers grains with and without solubles in that study.

However, Jolley et al., (2013) reported no differences in steer performance with different fat levels from DGS (9.2 and 11.8 percent fat) fed at 40 percent of DM and no differences when CDS was included at 27 percent of DM (6 and 21.1 percent fat).

Implications

Corn oil will continue to be removed from DGS with new technology available to remove a greater proportion of the lipid fraction. Differing animal performance results from the few studies completed suggest reduced-fat distillers grains has minimal effect on feedlot performance and carcass traits and will continue to be useful in feedlot diets.

The economic effects of marbling vary with grid dynamics. Based on the observed differences in percentage of cattle grading USDA Choice and a $5 spread between USDA Choice and select carcasses, the advantages for the steers fed the MED or HIGH diets, compared with the steers on the LOW treatment, were approximately $4.50 and $6.50 per head, respectively. Livestock producers still need to know the nutrients in the feed to formulate the most economical ration. Additional work may be warranted on the effects of fat level in growing rations that contain higher forage levels.

Acknowledgments

The authors express their appreciation to the North Dakota Corn Utilization Council for partial funding for this study and to the technicians and administrative support personnel at the Carrington Research Extension Center for their contributions to this experiment. Appreciation is also expressed to the North Dakota Angus Association and individual producers who consigned steers to the Angus University.

References

NRC. 1996. Nutrient Requirements of Beef Cattle. 7th Revised Edition. National Academy of Science, Washington, D.C.

Gigax, J.A., BL. Nuttleman, W.A. Griffin, G.E. Ericson and T.J. Klopfenstein. 2011. Performance and carcass characteristics of finishing steers fed

low-fat and normal-fat wet distillers grains. Nebraska Beef Report. P 44-45.

Pritchard, R., E. Loe and T. Milton. 2012. Relationship between fat content and NE values for some ethanol byproducts. South Dakota Beef Report. P 29-34.

Jolly, M.J., B.L. Nuttleman, D. Burken, C.J. Schneider, T.J. Klopfenstein and G.E. Erickson. 2013.Effects of modified distillers grains plus solubles and condensed distillers solubles with and without oil extraction on finishing performance. Nebraska Beef Report. P 64-65.

Table 3. Finishing performance of steers fed rations with increasing fat in distillers grains.

	Treatments						Contrast	
	Control	Low Fat	Medium Fat	High Fat	Std Err	*P* Value	Linear	Quadratic
No. head	42	44	42	44				
Initial wt., lb.	1,017	1,017	1,014	1,026	9.96	0.28	0.23	0.18
Final wt., lb.	1,427	1,416	1,417	1,446	9.98	0.20	0.23	0.08
DMI, lb/hd/d								
d0-d28	27.78	27.64	28.19	28.90	0.43	0.23	0.07	0.39
d29-finish	31.82	30.49	30.87	32.39	0.53	0.11	0.40	0.03
Overall	30.48	29.57	30.07	31.29	0.47	0.14	0.20	0.05
ADG, lb.								
d0-d28	4.68	4.51	4.91	4.96	0.17	0.27	0.13	0.54
d29-finish	4.71	4.58	4.42	4.63	0.11	0.39	0.44	0.18
Overall	4.68	4.59	4.61	4.77	0.09	0.54	0.53	0.20
Gain efficiency (gain-to-feed)								
d 0- d 28	0.169	0.164	0.175	0.172	0.01	0.59	0.45	0.82
d 29 - finish	0.148	0.151	0.143	0.143	0.00	0.26	0.12	0.71
Overall	0.154	0.156	0.153	0.153	0.002	0.84	0.33	0.21

Table 4. Carcass traits of steers fed distillers grains with increasing fat levels.

	Treatments						Contrast	
	Control	Low Fat	Medium Fat	High Fat	Std Err	P Value	Linear	Quadratic
Hot carcass wt., lb.	850	846	850	866	6.05	0.18	0.09	0.15
Dressing percent	62.62	62.83	63.11	63.03	0.20	0.34	0.12	0.44
Rib eye area, sq. in.	13.89	14.00	13.89	13.55	0.13	0.14	0.07	0.11
Fat thickness, in	0.49	0.56	0.54	0.54	0.02	0.30	0.29	0.24
KPH, %	2.34	2.32	2.39	2.31	0.04	0.48	0.77	0.47
Yield grade[1]	2.98	3.11	3.10	3.27	0.10	0.27	0.07	0.81
Marbling sore[2]	444	442	482	493	14.24	0.07	0.02	0.64
Percent USDA Choice	67	72	82	89				

[1]Yield grade is numerical score relating to fat to lean proportions of a carcass with low score less fat
[2]Score used to determine quality grade with 300-399 = USDA Select; 400-499 = USDA Low Choice