

Effects of Dried Distillers Grains With Solubles on Growing and Finishing Steer Intake, Performance, Carcass Characteristics, Color and Sensory Attributes

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The objectives of this study were to determine the effects of dried distillers grains with solubles on growing and finishing performance, carcass characteristics and meat quality traits. These data suggest dried distillers grains with solubles (DDGS) can be included at 30 percent dietary dry matter (DM) in both the growing and finishing period, partially replacing dry-rolled corn, with no detrimental effects on performance, carcass characteristics or sensory attributes, although DDGS may affect color negatively.

Summary

Seventy-two crossbred and purebred beef steers (653 ± 20 pounds initial body weight [BW]) were used in a completely randomized design to determine effects of dried distillers grains with solubles (29.2% crude protein [CP], 9.7% fat, DM basis; DDGS) on growing and finishing steer intake, performance, carcass and meat quality traits. The study contained two feeding periods, growing and finishing, which resulted in four treatments: 0:0, 30:0, 0:30 and 30:30 (diet DDGS percentage fed during growing and finishing periods, respectively). Steers were fed individually a growing diet (65% concentrate) for 57 days then acclimated to and fed a finishing diet (90% concentrate) for 80 or 145 days. Dietary ingredients included dry-rolled corn, corn silage, grass hay, concentrated separator byproduct and supplement.

During the growing period, dry-matter intake (DMI) was not different ($P \geq 0.63$). Steer performance, including average daily gain (ADG) and gain:feed (G:F), were not affected ($P \geq 0.14$) by treatment during the growing period and final BW at the end of the growing period was not different ($P = 0.99$). During the finishing period, DMI, ADG and G:F were not different ($P \geq 0.22$). As a result, final BW was not different ($P \geq 0.28$). Carcass traits (ribeye area; 12th rib fat; kidney, pelvic and heart fat (KPH); yield grade; and marbling) were not different ($P \geq 0.16$).

Results from the trained panel indicated no differences ($P \geq 0.16$) in tenderness; however, steaks from steers fed 30% DDGS during the finishing period tended ($P = 0.10$) to be juicier and more flavorful than steaks from control steers. Inclusion of 30% DDGS in the growing period tended to lower L (muscle lightness) ($P = 0.08$) and lowered B (muscle yellowness) ($P = 0.01$) of steaks. Overall feeding of DDGS lowered B ($P = 0.02$) compared with feeding dry-rolled corn (0:0). Feeding DDGS during the finishing period lowered A (muscle redness) ($P < 0.001$) of steaks. Furthermore, overall feeding of DDGS lowered A ($P < 0.001$) compared with feeding dry-rolled corn (0:0). Feeding 30% DDGS did not impact any performance or carcass characteristics but did influence steak sensory attributes and color.

Introduction

Dried distillers grains with solubles can be used as a protein and energy source depending on the amount included in the diet (Ham et al., 1994). Feeding up to 40% wet or dry distillers grains in growing and finishing diets improves ADG and G:F in steers compared with feeding dry-rolled corn only (Ham et al., 1994).

Beef consumers want a high-quality product that is tender, juicy and flavorful. Research is limited in evaluating effects of feeding DDGS to growing and finishing steers on meat quality. Roeber et al. (2005) fed finishing Holstein steers up to 50% dried distillers grains (DDG) and reported no differences in tenderness or sensory traits compared with corn-based diets.

Little quantitative information is available on the effects of short- and long-term feeding of DDGS to steers on performance and carcass quality. Therefore, our objectives were to determine the effects of DDGS on growing and finishing steer intake, performance, carcass characteristics, color and sensory attributes.

Materials and Methods

Seventy-two crossbred and purebred beef steers were used in a completely randomized design. The study contained two feeding periods, growing and finishing, which resulted in four treatments: 0:0, 30:0, 0:30 and 30:30 (diet DDGS percentage fed during growing and finishing periods, respectively). Steers were fed individually a growing diet (65% concentrate) for 57 days then acclimated for 14 days to a finishing diet (90% concentrate) and fed for 80 or 145 days. Diets were based on dry-rolled corn, corn silage, grass hay, concentrated separator byproduct and supplement (Table 1). Diets included 27.5 parts per million (ppm) of Rumensin and 11 ppm of Tylan and were formulated to contain a minimum of 12.5 percent CP, 0.70 percent calcium (Ca) and 0.30 percent phosphorus (P).

Table 1. Formulated dietary composition of growing and finishing diets containing 0 or 30 percent corn dried distillers grains with solubles offered to beef steers (% dietary DM).

Item	Diet, % of dietary DM			
	Growing		Finishing	
	0% DDGS ¹	30% DDGS	0% DDGS ¹	30% DDGS
Dry-rolled corn	50	20	80	50
DDGS	—	30	—	30
Corn silage	20	20	5	5
Grass hay	20	20	5	5
CSB ²	5	5	5	5
Wheat middlings	2.18	2.53	1.00	2.18
Soybean meal	—	—	1.00	—
Limestone	1.40	2.10	1.58	2.45
Urea	0.75	—	0.75	—
Dicalcium phosphate	0.30	—	0.30	—
Salt	0.25	0.25	0.25	0.25
Trace mineral premix ³	0.05	0.05	0.05	0.05
Vitamin A, D premix ⁴	0.02	0.02	0.02	0.02
Vitamin E premix ⁵	0.02	0.02	0.02	0.02
Monensin premix ⁶	0.02	0.02	0.02	0.02
Tylosin premix ⁷	0.01	0.01	0.01	0.01
	-----Analyzed composition-----			
Crude Protein	12.80	17.90	16.10	22.70
Neutral Detergent Fiber	37.30	39.50	26.10	33.20
Acid Detergent Fiber	20.30	18.50	9.40	10.00
Calcium	1.23	1.23	1.87	2.13
Phosphorus	0.32	0.44	0.54	0.71

¹ Dried distillers grains with solubles; nutrient content of DDGS used averaged 29.2% CP, 34.7% NDF, 9.5% ADF, 9.7% crude fat, 0.03% Ca and 0.81% P.

² Concentrated separator byproduct (de-sugared molasses).

³ Contained 250 ppm Co, 25.6 ppt Cu, 1.05 ppt I, 6.50 ppt Fe, 40.0 ppt Mn and 160 ppt Zn.

⁴ Contained 22.0 kIU/pound vitamin A and 2.10 kIU/pound vitamin D.

⁵ Contained 20 IU/kg vitamin E.

⁶ Contained 176.4 ppt monensin (Elanco Animal Health, Indianapolis, Ind.) to provide 27.5 ppm of dietary DM.

⁷ Contained 88.2 ppt tylosin (Elanco Animal Health, Indianapolis, Ind.) to provide 11 ppm of dietary DM.

Steers were assigned to treatment and fed individually. Steers received a Ralgro implant on day 0 and Revalor IS on day 60. Final weights were calculated from hot carcass weight (HCW) using an average dressing percentage of 62.5 percent and a 4 percent shrink. Average daily gain and G:F were calculated based on this data. Cattle were sent to a commercial abattoir for slaughter on either March 24 or May 28. Steers marketed on March 24 were estimated to have at least 0.4 inch backfat as

measured by ultrasound. The remaining steers were marketed on May 28 when the majority of the steers had an estimated 0.4 inch backfat as measured by ultrasound.

One steak from each steer was used for simulated retail display shelf-life analysis. A colorimeter was used to measure longissimus lean L (muscle lightness), A (muscle redness) and B (muscle yellowness) color space values through the overwrap polyvinyl chloride (PVC) film for each postmortem display day at 9 a.m. each day.

One steak from each steer was used for evaluation of tenderness using the Warner-Bratzler shear force machine (WBSF). Steaks were thawed for 24 hours at 35° Fahrenheit, weighed and then cooked in clamshell-style grills at 350° F until the steaks reached an internal temperature of 158° F. Six 0.5-inch cores from each steak were removed parallel to the muscle fiber.

Sensory panel analysis was conducted with a trained panel. Steaks were thawed at 35° F for 24 hours and cooked as previously described for WBSF evaluation. Steaks then were cut into pieces of approximately 0.5 by 0.5 by 1 inch and served to panelists for evaluation. Panelists scored 10 samples each day using an 8-point scale where 1 equaled extremely tough, dry and bland and 8 equaled extremely tender, juicy and intense beef flavor.

Results

During the growing period, two steers from the 30% DDGS treatment were removed from the study due to conditions unrelated to treatment. One steer was removed prior to initiation of treatments and the other removed due to chronic bloat; therefore, 70 steers were used during the growing period. Steers were fed growing diets for 57 days. Initial BW of steers was not different ($P = 0.57$) and averaged 653 ± 20 pounds. Steer performance, including DMI (22.5 lbs./d), ADG (3.85 lbs./d) and G:F (0.17 lbs./lb.) were not affected ($P \geq 0.14$) by treatment during the growing period. Final BW at the end of the growing period also was not different ($P = 0.99$) and averaged 937 ± 13 pounds.

Three steers were removed from the data set due to low feed intakes during the finishing portion of the trial. Two of the steers removed were on the 30 percent DDGS treatment and one steer was from the 0 percent DDGS treatment. Days fed during the finishing period were not different ($P \geq 0.27$; Table 2) across treatments and averaged 102 ± 8 days. No treatment differences ($P \geq 0.22$) were observed for DMI, ADG or G:F. Ham et al. (1994) fed cattle 40 percent DDGS, which partially replaced dry-rolled corn in finishing diets, and observed improved ADG and G:F when compared with cattle consuming dry-rolled corn diets. In the current study, no differences ($P \geq 0.28$) in final BW were observed.

Similar to final BW, no differences were found in HCW ($P \geq 0.28$; 791 ± 22 lbs.; Table 2). Longissimus muscle area (12.1 ± 0.5 inch²), 12th rib fat thickness (0.50 ± 0.04 inch) and KPH ($2.48 \pm 0.16\%$) were not different ($P \geq 0.16$); therefore, no differences ($P \geq 0.35$; 3.33 ± 0.17) were observed for yield grade. No differences ($P \geq 0.43$) were observed for marbling, which averaged 431 (small⁰ = 400; Table 2).

Table 2. Performance and carcass characteristics of steers fed growing and finishing diets containing 0 or 30 percent corn dried distillers grains with solubles.

Item	Treatment ¹				SEM ²	Contrast ³		
	0:00	30:00:00	0:30	30:30:00		Growing	Finishing	Corn vs. DDGS ⁴
Steers, number	18	15	16	18	—	—	—	—
Days on Feed	99	106	97	106	8	0.27	0.87	0.61
Performance								
Final BW, lb.	1193	1226	1204	1239	33.00	0.28	0.73	0.41
DMI, lb./hd/d	18.40	18.80	19.90	17.60	1.50	0.51	0.92	0.80
ADG, lb./hd/d	3.46	3.22	3.51	3.40	0.15	0.22	0.48	0.58
G:F, lb./lb.	0.22	0.19	0.19	0.21	0.03	0.91	0.89	0.52
Carcass Characteristics								
HCW, lb.		798	783	807	22.00	0.28	0.73	0.41
LM area, in ²	12.10	12.50	11.80	11.80	0.50	0.60	0.34	0.95
12th rib fat, in	0.46	0.53	0.48	0.52	0.04	0.16	0.90	0.21
KPH, %	2.41	2.60	2.44	2.47	0.16	0.46	0.73	0.59
Marbling ⁵	430	448	440	407	21.00	0.71	0.43	0.96
Yield grade	3.20	3.33	3.44	3.33	0.17	0.95	0.45	0.35

¹Dietary dried distillers grains with solubles percentage fed during growing and finishing periods, respectively.

²n = 15.

³Growing = main effect of feeding dried distillers grains with solubles during the growing period; Finishing = main effect of feeding dried distillers grains with solubles during the finishing period; Corn vs. DDGS = feeding dry-rolled corn (0:0) vs. feeding dried distillers grains with solubles during the growing and finishing periods (30:0 + 0:30 + 30:30).

⁴Corn distillers dried grains with solubles.

⁵Marbling Score: Small⁰ = 400.

Warner-Bratzler shear force and cooking loss were not different ($P \geq 0.13$) across treatments (Table 3). Results from the trained panel indicated no differences ($P \geq 0.16$) in tenderness, which averaged 6.03 ± 0.16 (8-point hedonic scale; Table 3); however, steaks from steers fed 30% DDGS during the finishing period tended ($P = 0.10$) to be juicier and more flavorful than steaks from the control steers (6.01 vs. 5.83 ± 0.11 and 6.02 vs. 5.89 ± 0.08 , respectively).

Table 3. Shear force, color analysis and sensory characteristics of steaks from steers fed growing and finishing diets containing 0 or 30 percent corn dried distillers grains with solubles.

Item	Treatment ¹				SEM ²	Contrast ³		
	0:00	30:00:00	0:30	30:30:00		Growing	Finishing	Corn vs. DDGS ⁴
Steaks, number	17	15	16	18	—	—	—	—
Shear force, lb.	8.20	8.49	7.98	7.52	0.49	0.86	0.19	0.68
Cooking loss ⁵ , oz.	1.77	1.51	1.64	1.62	0.11	0.17	0.92	0.13
Color ⁶								
L	49.03	48.69	48.77	48.48	0.19	0.08	0.19	0.04
A	21.69	22.33	20.27	19.99	0.24	0.41	<0.001	<0.001
B	8.74	8.27	8.56	8.21	0.18	0.01	0.44	0.02
Sensory characteristics ⁷								
Tenderness	6.02	5.81	6.16	6.11	0.16	0.40	0.16	0.97
Juiciness	5.84	5.82	5.98	6.03	0.11	0.87	0.10	0.39
Flavor	6.04	5.74	5.99	6.05	0.08	0.13	0.10	0.23

¹Dietary dried distillers grains with solubles percentage fed during growing and finishing periods, respectively.

²n = 15.

³Growing = main effect of feeding dried distillers grains with solubles during the growing period; Finishing = main effect of feeding dried distillers grains with solubles during the finishing period; Corn vs. DDGS = feeding dry-rolled corn (0:0) vs. feeding dried distillers grains with solubles during the growing and finishing periods (30:0 + 0:30 + 30:30).

⁴Corn dried distillers grains with solubles.

⁵Initial weight used as a covariate.

⁶L = white to black (100 = white, 0 = black); A = red to green (35 = red, -35 = green); B = yellow to blue (35 = yellow, -35 = blue).

⁷Tenderness (8 = extremely tender, 1 = extremely tough); juiciness (8 = extremely juicy, 1 = extremely dry); flavor (8 = extremely flavorful, 1 = extremely bland).

Steaks from steers consuming 30 percent DDGS during the growing period tended to have lower L ($P = 0.08$) and lowered B ($P = 0.01$) color values when compared with steaks from steers consuming 0 percent DDGS during the growing period (Table 3). Feeding DDGS regardless of period resulted in lower L ($P = 0.04$) and B ($P = 0.02$) compared with feeding dry-rolled corn (0:0). Feeding DDGS during the finishing period lowered the A ($P < 0.001$) of steaks. Furthermore, feeding DDGS lowered the A ($P < 0.001$) compared with feeding dry-rolled corn (0:0). A finishing period x display day interaction ($P = 0.02$) was present for the A values in steaks from steers fed 30 percent DDGS and decreased the A at a faster rate than in steers fed 0 percent DDGS. Reasons for a faster decline in the A of steaks from steers fed DDGS may be attributed to increased oxidation of unsaturated fatty acids and enzymatic-reducing systems that control metmyoglobin levels in meat (Gray et al., 1996).

Literature Cited

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