

# Shelf Life of Ground Beef from Cattle Fed Distillers Grains Containing Different Amounts of Oil

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## Summary with Implications

*Beef shoulder clods were collected from steers fed one of four finishing diets: no distillers grains and three with distillers grains containing different amounts of oil. Raw ground beef patties were evaluated for changes in objective color, discoloration, and lipid oxidation during simulated retail display (7 days). Cooked beef links in refrigerated (18 days) and frozen storage (198 days) were analyzed for lipid oxidation throughout shelf life. Fatty acid profiles were evaluated in lean, subcutaneous fat, and ground composite samples. All distillers grain diets increased C18:2 and polyunsaturated fatty acids in beef. There were no dietary differences in lipid oxidation throughout shelf life of raw ground beef and cooked beef links and no differences in color characteristics of raw ground beef. Finishing cattle on distillers grains altered fatty acid composition but did not impact shelf life characteristics of raw or cooked ground beef. The amount of oil in the distillers grains did not result in any significant differences in fatty acid profile and shelf life measures.*

## Introduction

Due to the increased production of corn ethanol, most feedlot diets have incorporated the ethanol co-product distillers grains. Previous studies have indicated modified distillers grains, when fed in a finishing diet, have had an impact on the fatty acid profile of raw beef with a general increase in C18:2 and polyunsaturated fatty acid concentration (2009 Nebraska Beef Report, pp. 107–109 and 110–112; 2015 Nebraska Beef Report, pp. 122–123.) When observed in raw ground beef applications, changes in

lipid oxidation between a control corn diet and diets with dried distillers grains have been shown to occur during storage time. Increases in lipid oxidation can be related to increased concentration of polyunsaturated fatty acids.

Technology in ethanol production has evolved to remove a portion of free oil from distillers grain through centrifugation. Generally this process reduces the oil content from 11–13% to 7–8% in the final distillers grains. However, feeding “de-oiled” distillers grains still impacts the fatty acid composition and quality characteristics in ground beef (2016 Nebraska Beef Report, pp.158–160) The purpose of this study was to determine the effects of the oil removal process, and fat content of distillers grains on the quality and shelf life of raw and cooked ground beef products from cattle fed distillers grains.

## Procedure

Steers (n = 256; 32 pens with 8 pens per diet) were randomly assigned to one of four finishing diets for 134 days prior to harvest: corn (control), 40% full-fat modified distillers grains with solubles (MDGS; DM Basis), 40% de-oiled MDGS (DM Basis), 40% de-oiled MDGS with oil added back to have the same lipid content as full-fat MDGS (DM Basis). The right shoulder clod (IMPS# 114) from one USDA Choice carcass from each pen was collected for processing (n = 32). The untrimmed, vacuum packaged shoulder clods were held for 2 weeks at 34°F. On day 14 postmortem, a sample of lean, subcutaneous fat and ground composite (lean and fat) was removed from each clod. Each shoulder clod was independently ground to 3/16”, and 4 oz. patties were formed, placed on Styro-foam trays and overwrapped for storage in simulated retail display conditions. During simulated retail display, objective color (L\*, a\*, b\*), was evaluated and percentage discoloration was evaluated by panelists (n = 5) on days 0, 1, 2, 3, 4, 5, 6, and 7. Half

patty samples were collected on days 0, 1, 2, 3, 5, and 7 for analysis of lipid oxidation by the thiobarbituric acid reactive substances (TBARS) analysis.

Cooked beef links were produced from each shoulder clod by mixing 10 lbs of raw ground beef with non-meat ingredients (0.75% salt, 0.25% sodium phosphate on a meat block basis) for 1 minute then formed into skinless links using a piston stuffer with a Colisimo Press attachment. Links were placed in parchment-lined aluminum trays, covered with aluminum foil and cooked to an internal temperature of 160°F. Following cooking, links were placed in zip-lock bags in dark refrigerated (37°F) and frozen storage (-4°F). Lipid oxidation was evaluated on samples taken from refrigerated storage on days 0, 3, 6, 9, 12, and 18, and from frozen storage on days 28, 56, 84, 112, 140, 168, and 196.

Data were analyzed for main effects of diet, and when appropriate, main effects of diet, storage time, and their interaction using GLIMMIX procedure of SAS (v.9.4). Storage time was considered a repeated measure. When significant effects were identified ( $P \leq 0.05$ ), means were separated using LSMEANS with Tukey’s adjustment.

## Results

Finishing diets that included modified distillers grains increased the content of C18:2 in lean, subcutaneous fat, and ground composite samples, and the concentration of polyunsaturated fatty acids (PUFA) in subcutaneous fat and composite samples ( $P \leq 0.01$ ; Figure 1). Similar increases in C18:2 and PUFA in de-oiled distillers grains treatments were obtained in previous studies (2016 Nebraska Beef Report, pp.158–160; 2015 Nebraska Beef Report, pp. 122–123). There were no differences in fatty acid content, or quality between MDGS treatments despite differences in oil content. This result is likely due to the protection of the remaining oil in de-oiled distillers grains from biohydrogenation in the rumen, allowing

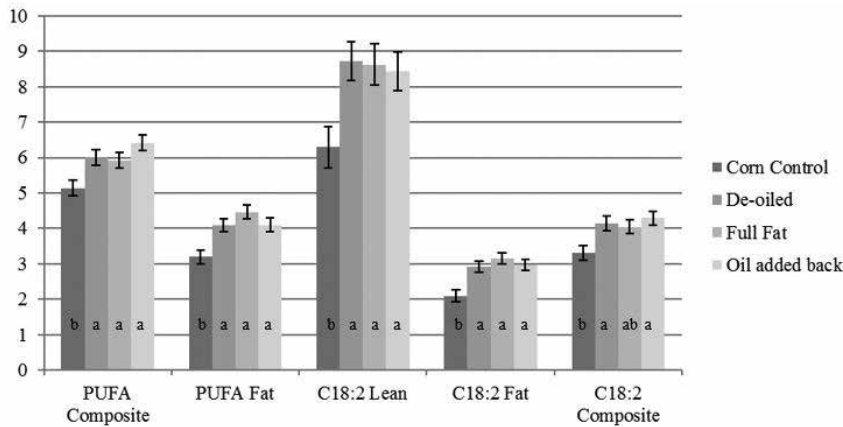


Figure 1: Polyunsaturated fatty acid (PUFA) and C18:2 content in different locations from steers finished on corn control, de-oiled modified distillers grains with solubles (MDGS), full fat MDGS or de-oiled MDGS plus corn oil diets. <sup>a,b</sup> means in the same trait with a common superscript are similar ( $P \leq 0.05$ ). Error bars  $\pm$  standard error.

Table 1: Lipid oxidation of raw ground beef patties held in simulated retail display and cooked beef links held in dark refrigerated storage from steers fed corn control, de-oiled modified distillers grains with solubles (MDGS), full fat MDGS or de-oiled MDGS plus corn oil diets. (SE = 0.28 and SE = 0.57 respectively)

Day of storage	Lipid oxidation (ppm of malonaldehyde/ kg of sample)				Day main effect
	Corn control	De-oiled MDGS	Full fat MDGS	Oil added MDGS	
Retail display of raw beef patties					
0	2.3	2.44	2.3	2.02	2.06 <sup>a</sup>
1	3.51	3.66	3.04	3.18	2.98 <sup>b</sup>
2	3.97	4.54	3.59	3.98	3.71 <sup>c</sup>
3	4.78	5.52	4.68	5.12	4.55 <sup>d</sup>
5	7.34	9.23	7.54	8.52	7.49 <sup>e</sup>
7	8.72	11.48	9.93	11.08	9.42 <sup>f</sup>
Refrigerated storage of cooked beef links					
0	0.99	1.03	1.14	0.99	1.04 <sup>a</sup>
3	3.21	2.67	3.03	2.81	2.93 <sup>b</sup>
6	4.02	3.83	3.52	3.54	3.73 <sup>b</sup>
9	5.29	4.24	3.52	4.44	4.37 <sup>b</sup>
12	4.92	3.84	4.75	5.01	4.63 <sup>b</sup>
15	6.59	5.4	5.62	6.6	6.05 <sup>c</sup>
18	6.62	5.79	8.59	6.01	6.75 <sup>c</sup>

<sup>a-f</sup> means in the day main effect column and within product type with a common superscript are similar ( $P \leq 0.05$ )

for greater deposition of C18:2 and other polyunsaturated fatty acids in the meat. Diet did not impact objective color measures ( $P = 0.83$ ), discoloration ( $P = 0.87$ ), or lipid oxidation in raw beef patties ( $P = 0.28$ ; Table 1). A previous study similarly did not see a diet effect for any color measurements (2015 Nebraska Beef Report, pp 124), however, Martin et. al. observed an increase in the amount of discoloration of de-oiled distillers grain treatments held in simulated retail display over time. (2016 Nebraska Beef Report, pp.158–160) Lipid oxidation and discoloration of raw patties increased throughout simulated retail display ( $P < 0.001$ ).

Finishing diet had no effect on lipid oxidation of cooked beef links in refrigerated ( $P = 0.34$ ; Table 1) or frozen storage ( $P = 0.94$ ). One previous finding reported no dietary differences from feeding distillers grain in lipid oxidation of cooked beef links (2015 Nebraska Beef Report, pp 122–123) and one study found an increase in lipid oxidation in cooked beef links (2016 Nebraska Beef Report, pp. 158–160). Lipid oxidation did increase throughout storage time in both refrigerated and frozen links ( $P < 0.001$ ), regardless of finishing diet. Therefore, it can be concluded that feeding modified distillers grains, regardless of the oil content, increased the amount of C18:2 and PUFA in beef but did not have negative effects on the quality and shelf life of raw ground beef patties or cooked ground beef links in this study.

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