

2015

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Cleveland, Brandy D.; Redfield, Amy L.; MacDonald, James C. Donald; Jones, Tommi F.; and Sullivan, Gary A., "Effect of Feeding Distillers Grains in Different Phases of Production on the Fatty Acid Profile and Oxidation of Frozen, Cooked Beef Links" (2015). *Nebraska Beef Cattle Reports*. 845.  
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# Effect of Feeding Distillers Grains in Different Phases of Production on the Fatty Acid Profile and Oxidation of Frozen, Cooked Beef Links

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## Summary

*Lipid oxidation of cooked ground beef links made from cattle fed different diets and with different concentrations of added natural antioxidants was compared to evaluate product shelf life. Fatty acid composition was analyzed on raw lean, composite, and fat portions from each shoulder clod. Samples without antioxidants were the most oxidized, with no differences between other antioxidant concentrations throughout frozen storage. An increase in polyunsaturated fatty acids was found in beef when finished on modified distillers grains but did not result in increased oxidation. Therefore, the addition of natural antioxidants was effective at reducing oxidative rancidity regardless of animal diet.*

## Introduction

As a result of the rapid growth of the ethanol industry, ethanol byproducts have become imperative in cattle diets. Previous research results suggest that cattle fed wet distillers grains (WDGS) have an increase in polyunsaturated fatty acids, which may decrease oxidative stability (2009 *Nebraska Beef Cattle Report*, pp. 107-109 and 110-112). Polyunsaturated fatty acids are fatty acids that contain more than one double bond in their carbon chain. The polyunsaturated fatty acids will more readily undergo free-radical chain reactions resulting in deterioration of the lipid quality. Lipid oxidation and off-flavor development after cooking is accelerated due to the

release of iron, free and heme-bound, from myoglobin during cooking (2014 *Nebraska Beef Cattle Report*, pp. 103-104). Lipid oxidation reduces shelf life and decreases overall consumer acceptability of the product by increasing the evidence of “warmed over” or “rancid” flavors. The use of plant extracts, such as rosemary or green tea, is becoming increasingly popular in meat processing as a natural antioxidant to increase shelf life of cooked meat products. This becomes particularly beneficial for companies seeking to clean up labels or use “natural” labeling claims for their product. Therefore, the objective of this study was to evaluate the impact of feeding modified wet distillers grains during different production phases on the fatty acid profiles of beef and on the oxidation of cooked beef links during frozen storage.

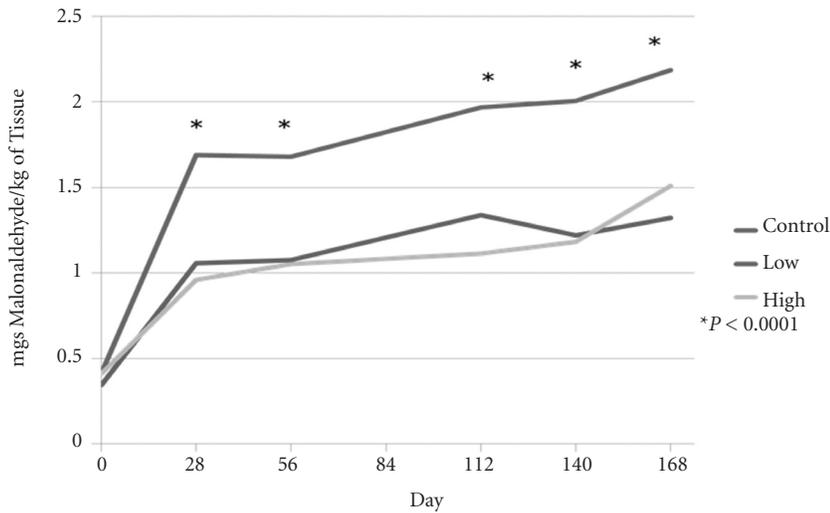
## Procedure

Cattle were randomly assigned to one of four dietary treatments that included either 2 or 5 lb/head/day (DM basis) of wet distillers grains during the winter backgrounding phase and either Sweet Bran<sup>®</sup> or modified wet distillers grains (MDGS) during the finishing phase (40% dietary inclusion, DM basis). All cattle were supplemented with MDGS at a rate of 0.6% of BW during the summer months. A total of 16 USDA Choice clods from four carcasses from each dietary treatment group were collected. Composite, subcutaneous fat, and lean sample were collected for fatty acid analysis. Each clod was independently ground and divided into three 5 lb batches. All treatments contained 0.75% salt, 0.25% phosphate and either 0%, 0.13% or 0.20% rosemary plus green tea extract (FORTIUM RGT12 Plus Dry Natural Plant

Extract; Kemin, Des Moines, Iowa). Beef and non-meat ingredients were mixed for 1 minute and the mixture was stuffed into skinless links using a piston stuffer. Links were placed in individual foil trays for each clod and cooked in a smokehouse to an internal temperature of 160°F. Links were placed in zip-top bags with the presence of oxygen and placed in dark, frozen storage. Lipid oxidation was evaluated on 0, 28, 56, 84, 112, 140 and 168 days using the thiobarbituric acid reactive substances (TBARS) analysis. Data were analyzed as a 2 X 2 X 3 factorial with repeated measures (day) using the PROC MIXED procedure of SAS for TBARS and a 2 X 2 factorial using the PROC GLIMMIX procedure of SAS for fatty acid analysis.

## Results

No significant dietary treatment effects or interactions were observed ( $P \geq 0.18$ ). However, an antioxidant concentration  $\times$  day interaction ( $P < 0.041$ ) was observed for oxidation (Figure 1). Both 0.13% and 0.20% concentrations of antioxidant were less oxidized than the control for all time periods except day 0 ( $P > 0.05$ ), where the means ranged from 0.34 to 0.41 of mg of malonaldehyde/kg of product. The threshold for when lipid oxidation becomes evident to consumers is 1 mg of malonaldehyde/kg of product. As expected, all samples exceeded this threshold by day 28, although the control exceeded the threshold by a larger margin ( $P < 0.0001$ ) than the samples with an antioxidant addition which were near 1 mg through day 56. There were no differences ( $P > 0.64$ ) in lipid oxidation between samples with 0.13 or 0.20% added antioxidants on any day of evaluation. These results sug-



**Figure 1.** Effect of adding no, low, or high concentrations (0%, 0.13%, 0.2%) natural plant extract on the lipid oxidation (mg of malonaldehyde/kg of product) in ready-to-eat beef links.

**Table 1.** Effect of finishing diet on fatty acid composition (g/100g raw sample) of shoulder clod composite sample.

| Fatty Acids                | Finishing Diet   |                            | P-value |
|----------------------------|------------------|----------------------------|---------|
|                            | Sweet Bran       | Modified Distillers Grains |         |
| C16:0 (g/100g)             | 5372             | 4770                       | 0.104   |
| C16:1 (g/100g)             | 598 <sup>b</sup> | 738 <sup>a</sup>           | 0.043   |
| C17:0 (g/100g)             | 373 <sup>a</sup> | 276 <sup>b</sup>           | 0.002   |
| C17:1 (g/100g)             | 341 <sup>b</sup> | 236 <sup>a</sup>           | 0.006   |
| C18:0 (g/100g)             | 3476             | 3222                       | 0.375   |
| C18:1 (g/100g)             | 11170            | 10163                      | 0.183   |
| C18:2 (g/100g)             | 524 <sup>b</sup> | 747 <sup>a</sup>           | 0.005   |
| SFA <sup>1</sup> (g/100g)  | 9894             | 8914                       | 0.137   |
| PUFA <sup>2</sup> (g/100g) | 592 <sup>b</sup> | 843 <sup>a</sup>           | 0.002   |
| MUFA <sup>3</sup> (g/100g) | 12893            | 11506                      | 0.093   |

<sup>ab</sup>Means in the same row with different superscripts are significantly different ( $P \leq 0.05$ ).

<sup>1</sup> Saturated Fatty Acids: C14:0, C15:0, C16:0, C17:0, C18:0.

<sup>2</sup> Polyunsaturated Fatty Acids: C18:2, C20:4.

<sup>3</sup> Monounsaturated Fatty Acids: C14:1, C16:1, C17:1, C18:1T, C18:1, C18:1V, C20:1.

gest that the addition of rosemary and green tea extract can suppress lipid oxidation in frozen, cooked beef products.

For the lean, fat, and composite portion fatty acid analysis, a finishing effect was observed where beef from cattle finished on MDGS had greater amounts of C18:2 ( $P \leq 0.022$ ) and total PUFA ( $P \leq 0.028$ ). The composite sample also had a finishing effect where cattle finished on MDGS had greater amounts of C16:1 ( $P = 0.043$ ) and lesser amounts of C17:0 and C17:1 ( $P = 0.002$  and  $0.006$ , respectively; Table 1). The fat portion had a background effect where supplementing with greater amounts of WDGS resulted in a greater amount of UFA, less C18:0, and a lower UFA:SFA ( $P = 0.005$ ,  $0.006$ , and  $0.014$ , respectively) in comparison to lesser amounts of WDGS supplementation. Therefore, feeding MDGS in the finishing phase increases PUFAs in fat, lean, and composite portions of beef.

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<sup>2</sup>This project was funded in part by the Beef Checkoff and the University of Nebraska Agricultural Research Division.