2016

Effect of Feeding De-oiled Dry Distillers Grains Plus Solubles on Beef Oxidation, Color and Tenderness

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Summary

Cattle fed a de-oiled dry distillers grains plus solubles (DDGS) diet (50% DM basis) were compared to cattle fed a corn-based control diet to determine effects on discoloration, oxidation, color, and tenderness of beef aged for 2, 8, 14 and 21 days. Dietary treatment had no effect on tenderness. From the fourth day of retail display, beef from animals fed de-oiled DDGS had greater lipid oxidation and greater percentages of discoloration. The de-oiled DDGS treatment also showed greater discoloration after 21 days of aging. While feeding de-oiled DDGS did not impact lipid oxidation at 2, 8 and 14 days of aging, at 21 days of aging, meat from cattle fed de-oiled DDGS had greater oxidation in comparison to a corn-based diet.

Introduction

Color is the first aspect taken into consideration by consumers while purchasing meat. Lipid oxidation of meat causes unwanted off-flavors that are typically accompanied with brown discoloration, affecting the purchasing decision. Following the aging process, lipid oxidation occurs more readily, exacerbating potential issues to consumers.

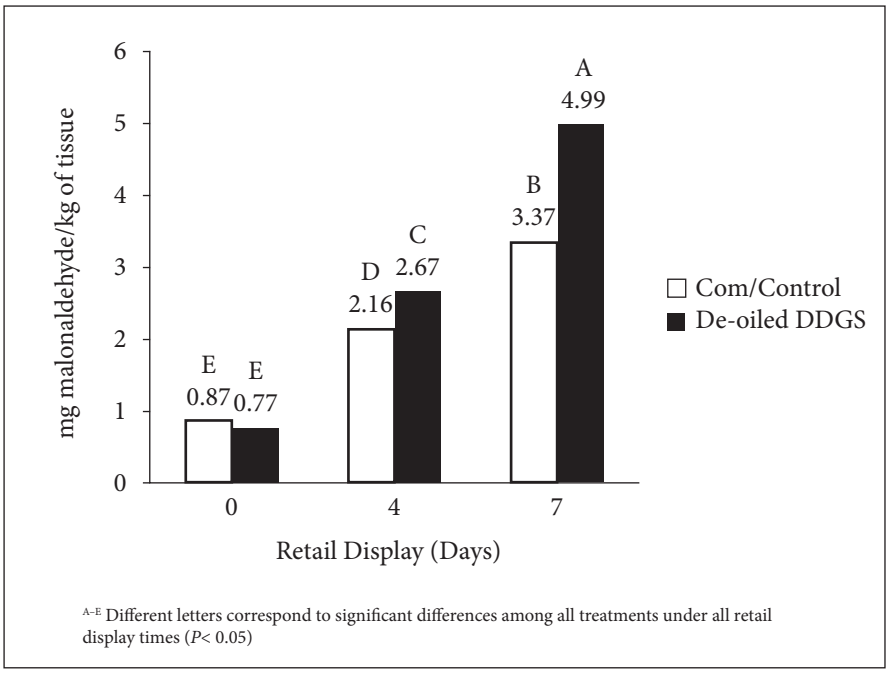
In an effort to maximize revenues of by-products, the ethanol industry is currently extracting a fraction of the oil found in distillers grains and has generated de-oiled distillers available for cattle feed. A previous study at the University of Nebraska-Lincoln evaluated the effects of de-oiled wet distillers grians plus solubles (WDGS) versus a traditional full-fat WDGS diet and a corn-based diet on lipid oxidation and beef shelf-life. With prolonged aging, de-oiled WDGS reduced lipid oxidation (2014 Nebraska Beef Cattle Report, pp. 114–115). It is unknown whether dry distillers grains plus solubles (DDGS) would also decrease lipid oxidation in comparison to a corn-based diet. Thus, the objective of this research was to determine the effect of feeding de-oiled DDGS on retail shelf-life, oxidation, color and tenderness after aging compared to a corn-based diet.

Procedure

Steers (n = 48) were fed one of two dietary treatments: a corn-based control diet (50% dry-rolled corn, DM basis) and a 50% dietary inclusion (DM basis) of de-oiled DDGS (dietary formulations can be found in the 2016 Nebraska Beef Cattle Report, pp. 128–31) After slaughter, the strip loins from the right and left sides of the carcasses were collected. Vacuum sealed loins were aged for 2, 8, 14 and 21 days (33°F). At two days of aging part of the loins were fabricated into 1-inch steaks for visual discoloration, color and tenderness and ½-inch steaks for thiobarbituric acid reactive substances (TBARS), a measure of lipid oxidation. The remaining portions of the loins were vacuum sealed and aged for to 8, 14 or 21 days at which point the fabrication process was repeated. At all aging periods, the steaks were placed in foam trays and overwrapped with oxygen permeable film and placed in retail display (37°F) for seven days. At the same time, objective color measurements were collected each day for all seven days. Steaks at day 0 of retail display were immediately vacuum packed and stored in an ultra-low freezer (−112°F) until analysis.

Visual Discoloration (discoloration score, %)

Visual discoloration was assessed daily for all samples placed in retail display. A trained panel of 6 people evaluated the percentage of discoloration, where 0% meant no discoloration and 100% meant complete discoloration.



A-E Different letters correspond to significant differences among all treatments under all retail display times ($P < 0.05$)

Figure 1. Lipid oxidation (TBARS) interaction of dietary treatment and retail display days from strip steaks placed under retail conditions (P < 0.0001).

Objective Color (L, a* and b*)*

Objective color measurements were collected each day for seven days with a Minolta Chromameter CR-400 (Minolta Camera Company, Osaka, Japan) with an 8 mm diameter illumination area, illuminant D65 and 2° standard observer, L* (brightness), a* (redness) and b* (blue to yellow).

Lipid Oxidation (TBARS)

Frozen samples were cut into small pieces, with no subcutaneous fat, and frozen in liquid nitrogen. Then, the pieces were powdered in a blender and 5 g of powdered sample was weighed to conduct the TBARS protocol.

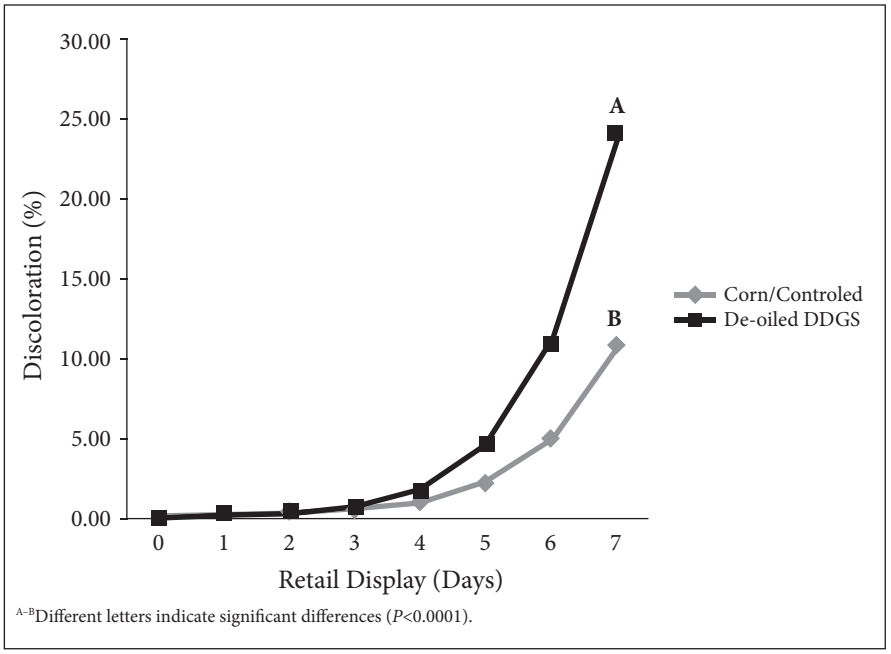
Tenderness (Warner-Bratzler Shear Force—WBSF)

The frozen steaks were defrosted for 24 hours (33°F) and a thermocouple was placed in the geometric center of each steak. The steaks were grilled on Hamilton Beach grills until they reached an internal temperature of 160°F (grilled on one side until 95°F and turned to finish grilling). The grilled steaks were placed on plastic trays and covered with plastic film and kept in a cooler for 24 hours (33°F). Then, six cores were taken on parallel direction to the muscle fiber of each steak and sheared to determine tenderness.

Statistical analysis was performed using the Proc Glimmix procedure in SAS (SAS Institute, Inc., Cary, N.C.) to test the effects of dietary treatment, aging period, and days of retail display and their interactions. Repeated measures were used to analyze the discoloration and color data and all means were separated with the LS MEANS statement and the TUKEY adjustment with an 0.05 alpha level.

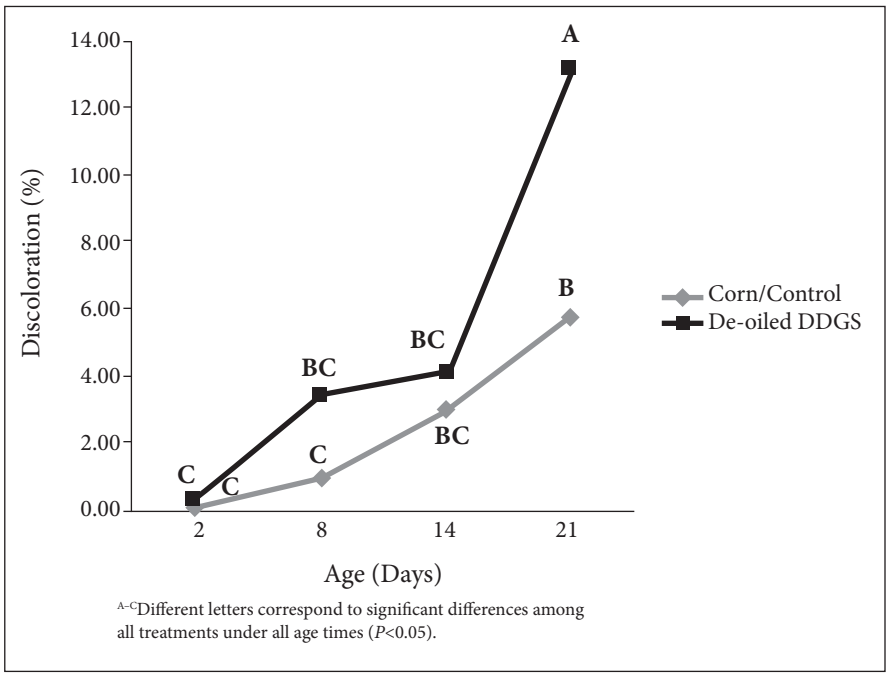
Results

For all variables analyzed, there were significant aging by retail display interactions ($P < 0.05$) meaning that as retail display time progressed at different aging time points, responses varied according to dietary treatments. A significant retail display by treatment interaction was found for TBARS, a*, b*, and discoloration. These interactions between retail display and



[A–B]Different letters indicate significant differences ($P<0.0001$).

Figure 2. Discoloration (%) of strip loin steaks (L. dorsi) placed under retail display according to dietary treatment and retail display days across all aging times.



[A–C]Different letters correspond to significant differences among all treatments under all age times ($P<0.05$).

Figure 3. Discoloration (%) of strip loin steaks (L. dorsi) placed under retail display according to dietary treatment and aging period.

dietary treatment indicate that samples did not have similar responses at different aging time points and the most relevant interactions are discussed below. Tenderness was not affected due to dietary treatment nor were there any interactions of treatment by aging or treatment by retail display affecting meat tenderness ($P > 0.05$).

On days 4 and 7 of retail display, meat from cattle finished with de-oiled DDGS showed greater oxidation, characterized by greater TBARS values (Figure 1). This difference in oxidation level was not observed at day 0 of retail display. In general, meat from animals fed with de-oiled DDGS showed higher concentrations of malonaldehyde mg / kg of tissue versus meat from cattle finished on the corn-based diet (2.81 vs. 2.14, respectively; $P < 0.0001$).

Similar to the increase in lipid oxidation, steaks from cattle fed de-oiled DDGS discolored at a greater rate and extent (Figure 2). In agreement with these results, samples from cattle fed de-oiled DDGS treatment also had steaks with greater visual discoloration and lower objective color scores (L *, a * and b *; data not shown).

There was a significant interaction between days of aging and dietary treatment, where at 2, 8, and 14 days of aging, discoloration was not different due to diet but at 21 days of aging steaks from cattle fed de-oiled DDGS presented greater discoloration than steaks from cattle fed the corn control treatment (Figure 3).

Feeding de-oiled DDGS resulted in increased oxidation and discoloration of strip steaks under prolonged aging when compared to steaks from cattle on a corn-based control diet. Removal of fat in DDGS does not appear to aleviate concerns over the retail shelf-life or lipid oxidation of beef.

Acknowledgement

This project was funded in part by The Beef Checkoff.

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