Effect of Feeding De-oiled Wet Distillers Grains Plus Solubles on Beef Oxidation and Tenderness

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Summary

Cattle fed a de-oiled wet distiller's grains plus solubles (WDGS) diet were compared to cattle fed corn or traditional (full-fat) WDGS diets to determine effects on discoloration, oxidation, and tenderness of beef aged for seven and 21 days. At seven days of aging, dietary treatment had no effect on discoloration. At 21 days of aging, beef from cattle fed de-oiled WDGS had less oxidation than the corn control and several of the full-fat WDGS treatments. Although tenderness increased with aging and retail display, dietary treatment had no effect on tenderness. These findings suggest that these dietary treatments, followed by a short aging period, don't have a large impact on shelf life stability and oxidation, but with prolonged aging periods and retail display, feeding de-oiled WDGS can reduce oxidation.

Introduction

Research done at the University of Nebraska–Lincoln has found that feeding wet distillers grains plus solubles (WDGS) increases the polyunsaturated fatty acid (PUFA) content in beef, which results in higher oxidation (2011 *Nebraska Beef Cattle Report*, pp. 96-99). Oxidation in beef is evidenced by visual discoloration and development of off-flavors and, consequently, has a negative effect on consumer purchasing decisions. Greater oxidation is seen with prolonged aging periods. With recent trends in the removal of the soluble oil fraction from WDGS used for ethanol production, de-oiled WDGS is more accessible than normal or full-fat WDGS. Therefore, this research was conducted to determine the effect of feeding de-oiled WDGS on retail shelf life, oxidation, and tenderness after aging compared to corn or full-fat WDGS diets.

Procedure

A total of 336 steers were fed one of seven dietary treatments: an all-corn control, and 35%, 50%, or 65% dietary inclusion of WDGS, either full-fat or de-oiled. After harvest, 15 low Choice carcasses were selected within each dietary treatment (n = 105) and strip loins were obtained. Vacuum sealed loins were aged seven and 21 days (33°F). At seven days of aging part of the loins were fabricated into 1-inch steaks for visual discoloration and tenderness and ½-inch steaks for Thiobarbituric acid reactive substances (TBARS), a measure of oxidation. The remaining portions of the loins were vacuum sealed and aged up to 21 days at which point the fabrication process was repeated. At both aging periods the steaks were placed in Styrofoam trays and overwrapped with oxygen-permeable film and placed in retail display conditions (37°F) for four and seven days. Steaks at day 0 of retail display were immediately vacuum packed and stored in an ultra-freezer (-112°F) until needed.

Visual Discoloration (discoloration score)

Visual discoloration was assessed daily for all samples placed in retail display. The steaks were evaluated on a percent scale where 0% meant no discoloration and 100% meant complete discoloration.

Oxidation (TBARS)

Frozen samples were diced into small pieces, with no subcutaneous fat, and flash frozen in liquid nitrogen. The nitrogen-frozen pieces were powdered in a metal cup blender and 5 g of powdered sample was weighed to conduct the TBARS protocol.

Tenderness (Warner-Bratzler Shear Force – WBSF)

The 1-inch frozen steaks were thawed 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 (cooked on one side until 95°F and flipped to finish cooking). The cooked steaks were placed on trays and covered with plastic film and kept in a cooler for 24 hours (33°F). Six cores were taken parallel to the muscle fiber of each steak and sheared to determine tenderness. The Proc Glimmix procedure in SAS (SAS Institute, Inc., Cary, N.C.) was used to test the effects of dietary treatment, aging period, and retail display and their interactions. Repeated measures were used to analyze the discoloration data and all means were separated with the LS MEANS statement and the TUKEY adjustment with an alpha level of 0.05.

Results

Treatment had no effect on discoloration in samples aged for seven days ($P > 0.05$). After 21 days of aging, discoloration was significant at five days of retail display ($P < 0.0001$; Table 1) and all treatments surpassed 50% discoloration by day seven. At day five, meat from the corn control had the most discoloration and was as equally discolored as 50% de-oiled WDGS

Table 1. Discoloration (%) of strip loin steaks (*L. dorsi*) aged 21 days.

	Days on retail display							
Treatment	0	1	2	3	4	5	6	7
35% De-oiled WDGS	0.12	0.32	0.33	0.88	1.53	4.35^{c}	17.75^{d}	52.98^{d}
50% De-oiled WDGS	0.50	0.88	1.07	1.73	3.10	15.42^{ab}	39.50^{b}	67.75^{b}
65% De-oiled WDGS	0.28	0.60	0.75	1.00	3.43	9.38^{bc}	40.20^{b}	69.88^{ab}
35% Full-fat WDGS	0.38	0.80	1.02	1.73	2.50	4.48^{c}	25.83^{c}	67.67^{b}
50% Full-fat WDGS	0.17	1.05	0.33	0.55	1.87	11.95^{bc}	31.30^{c}	57.30^{cd}
65% Full-fat WDGS	0.50	1.50	1.15	1.67	3.75	14.98^{ab}	50.30^{a}	76.72^{a}
Corn control	0.38	1.56	1.17	2.22	6.87	20.03^{a}	31.77^{c}	60.60^{c}

$^{a\text{-}d}$Means in the same column with different superscripts are significantly different ($P \leq 0.05$).

Table 2. TBA means according to dietary treatment.

Treatment	Mean
35% De-oiled WDGS	1.12^{c}
50% De-oiled WDGS	1.13^{c}
65% De-oiled WDGS	1.21^{bc}
35% Full-fat WDGS	1.78^{ab}
50% Full-fat WDGS	1.18^{c}
65% Full-fat WDGS	1.78^{ab}
Corn control	1.98^{a}
SEM	0.14
P-value	<0.0001

$^{a\text{-}c}$Means with different superscripts are significantly different ($P \leq 0.05$).

and 65% full-fat WDGS. Some of the corn control cattle had been exposed to WDGS prior to this finishing diet study, which could explain the higher-than-anticipated results for the corn control. At day six of retail display, 65% full-fat WDGS had the most discoloration followed by 65% and 50% de-oiled WDGS. By day seven, 65% full-fat and 65% de-oiled WDGS showed the most discoloration, while 35% de-oiled WDGS presented the least discoloration.

Treatment had a significant effect on oxidation ($P < 0.0001$; Table 2), as measured by the amount of thiobarbituric acid reactive substances. The corn control was found to have the highest amount of oxidation and was not statistically different from 35% full-fat WDGS and 65% full-fat WDGS. The oxidation measures suggest that beef from cattle finished on de-oiled WDGS and 50% full-fat WDGS had less oxidation, yet these data were not in full agreement with the discoloration data.

There was an increase in tenderness with aging from seven to 21 days ($P < 0.0001$) and as retail display progressed ($P < 0.0001$), where at seven days of aging the WBSF was 3.4 kg, at 21 day aging the WBSF was 2.9 kg, and at 0 day retail display the WBSF was 3.3 kg, and at seven day retail display the WBSF was 3.1 kg. Dietary treatment had no effect on WBSF ($P = 0.57$). At seven days of aging, dietary treatment had no effect on discoloration and all samples had an increase in oxidation regardless of the treatment. However, at 21 days of aging, feeding de-oiled WDGS resulted in less oxidation compared to the corn control and several of the full-fat WDGS treatments. These findings suggest that feeding WDGS doesn't have a large impact on shelf life stability and oxidation when the meat is aged for short periods, but with prolonged aging periods and retail display, feeding de-oiled WDGS can reduce oxidation.

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