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Wet Distillers Grains Plus Solubles Affect Lipid Oxidation and Objective Color of Beef Steaks

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Summary

Strip loins (M. Longissimus lumborum), tenderloins (M. Psoas major) and top blades (M. Infraspinatus) from 48 calf-fed, crossbred steer carcasses, were used to test the effects of wet distillers grains plus solubles finishing diets on beef shelf life. After 7-day display, inclusion of wet distillers grains plus solubles in the diet caused higher levels of oxidation on top blades and strip loins and negative effects on color of top blade and tenderloin steaks after 3 days of retail display.

Introduction

Deviation in muscle color can determine economic losses due product rejection by the consumer. A bright-red color is considered an indicator of freshness as compared to brown color which is not. Feeding regimen, fatty acid profile, fat content and packaging systems can affect not only meat color, but also flavor and lipid oxidation.

Diet formulation may affect beef quality, composition and ultimately shelf life due to increases in polyunsaturated fat acids (PUFA). Finishing diets with wet distillers grains plus solubles (WDGS) may negatively impact color stability during retail display through an increase in PUFA. Therefore, the focus of this research was to study the effects of WDGS finishing diets on color and oxidation of strip loins, tenderloins and top blades.

Procedure

Ninety-four calf-fed, crossbred steers were allocated to three different finishing diets (0%, 15% or 30%

- WDGS - DM basis) (Luebbe et al., 2008 *Nebraska Beef Report*, pp. 60-62) and fed for 133 days. Forty-eight carcasses, 16 from each treatment, were randomly selected from the 94 and their respective short loins (IMPS #174) and shoulder clods (IMPS #114) were removed, vacuum packaged and shipped to the Loeffel Meat Laboratory at the University of Nebraska-Lincoln. After 7 days aging at 39°F, the strip loins (*M. Longissimus lumborum*) and tenderloins (*M. Psoas major*) were excised from the short loins and the top blades (*M. Infraspinatus*) from the shoulder clods. After fabrication, two 1-inch thick steaks were cut from each strip loin, tenderloin and top blade. One steak was vacuum packaged and frozen (3.2°F) immediately until the lipid oxidation analysis could be made (thiobarbituric acid assay - TBA). The other steak was divided in two and the halves were placed on a Styrofoam tray and wrapped in oxygen-permeable film. Two display retail cases maintained at $35.6 \pm 2^\circ\text{F}$ were used to simulate retail display conditions. Samples were randomly placed in the cases and exposed to continuous 2850 Lm fluorescent lighting with intensity of 1614 lux.

Objective color measurement was recorded for L* (psychometric lightness; black = 0, white = 100), a* (red = positive values; green = negative values) and b* (yellow = positive values; blue = negative values) using a HunterLab chromameter with a 1-inch diameter measurement area using a D65 illuminant. The chromameter was calibrated using the ceramic disk provided by the manufacturer everyday before measuring. Color measures were obtained at 1, 3, 4, 5, 6 and 7 days of display and the values were recorded from three different locations of each steak. Lipid stability was evaluated in the same steaks that were kept under retail conditions. The

steaks were submerged in liquid N₂, pulverized and stored at -112°F. Lipid oxidation was measured by the thiobarbituric acid assay at 0, 3 and 7 days of retail display.

Results

Objective color

Significant color values are shown on Tables 1 and 2 (top blades and tenderloins respectively). Increasing levels of WDGS resulted in lower L* values (darker) for top blade steaks when compared to controls ($P = 0.03$). The a* (redness) values were significantly lower ($P = 0.01$) for top blades from cattle fed 30% WDGS after 7 day display when compared to 0% and 15%.

Tenderloins from cattle fed 15% and 30% WDGS had lower a* values after 3 days of retail display ($P = 0.05$) when compared to 0% (Table 2). Conversely, dietary treatment did not significantly influence any objective color parameter (L*, a* or b*) of strip loin steaks.

Roeber and others (*Journal of Animal Science*, 2005, 83: 2455-2460) reported that finishing diets including distillers grains at high rates (40% to 50% - DM basis) may negatively affect color stability of strip loin steaks although low to moderate levels (10% to 25%) could be included with no negative effects. Conversely, data from this study indicate that levels up to 30% did not affect shelf life of strip loin steaks. However, top blade and tenderloin steaks had compromised shelf life as WDGS increased and when moderate levels were used (30%), respectively.

Lipid Oxidation Analysis

Top blade steaks from cattle fed 30% had higher levels of oxidation

Table 1. Least square means of L* and a* for top blade steaks from WDGS treatments.

Parameter	Display time	Dietary treatments ¹			P-value
		0%	15%	30%	
L*		37.81 ^A	36.07 ^B	36.56 ^{AB}	0.03
a*					0.02
	Day 1	22.50 ^a	22.78 ^a	22.13 ^a	
	Day 3	21.91 ^{Aa}	21.62 ^{Ab}	19.24 ^{Bb}	
	Day 4	22.28 ^{Aa}	22.52 ^{Aab}	19.29 ^{Bb}	
	Day 5	21.23 ^{Aab}	21.80 ^{Aab}	18.89 ^{Bb}	
	Day 6	19.80 ^{Abc}	21.67 ^{Aab}	15.77 ^{Bc}	
	Day 7	18.66 ^{Ac}	19.52 ^{Ac}	14.61 ^{Bc}	

¹Wet distillers grains plus solubles (% DM basis).^{A,B}Means in the same row having different superscripts are significant at $P \leq 0.05$ level.^{a,b,c}Means in the same column having different superscripts are significant at $P \leq 0.05$ level.**Table 2. Least square means of a* for tenderloin steaks from WDGS treatments.**

Parameter	Display time	Dietary treatments ¹			P-value
		0%	15%	30%	
a*					0.05
	Day 1	25.36 ^a	24.27 ^a	25.49 ^a	
	Day 3	22.86 ^{ab}	20.68 ^{Bb}	20.71 ^{Bb}	
	Day 4	21.67 ^c	21.05 ^b	20.00 ^b	
	Day 5	19.70 ^d	17.14 ^c	17.77 ^c	
	Day 6	15.57 ^{Ac}	14.19 ^{ABd}	13.32 ^{Bd}	
	Day 7	15.76 ^c	15.67 ^c	13.77 ^d	

¹Wet distillers grains plus solubles (% DM basis).^{A,B}Means in the same row having different superscripts are significant at $P \leq 0.05$ level.^{a,b,c,d}Means in the same column having different superscripts are significant at $P \leq 0.05$ level.**Table 3. Least square means of TBA values (mg malonaldehyde/kg) for top blade and strip loin steaks from WDGS treatments.**

Muscle	Display time	Dietary treatments ¹			P-value
		0%	15%	30%	
Top blade					<0.01
	Day 1	0.68 ^a	0.53 ^a	0.59 ^a	
	Day 3	1.43 ^{Aa}	2.37 ^{ABb}	3.42 ^{Bb}	
	Day 7	3.84 ^{Ab}	5.04 ^{Ac}	8.42 ^{Bc}	
Striploin					<0.01
	Day 1	0.58 ^a	0.52 ^a	0.45 ^a	
	Day 3	0.65 ^a	1.74 ^a	1.45 ^a	
	Day 7	2.02 ^{Ab}	3.77 ^{Bb}	4.80 ^{Bb}	

¹Wet distillers grains plus solubles (% DM basis).^{A,B}Means in the same row having different superscripts are significant at $P \leq 0.05$ level.^{a,b,c}Means in the same column having different superscripts are significant at $P \leq 0.05$ level.

(higher TBA values) ($P < 0.01$) after 7 days of display when compared to 0% and 15% WDGS (Table 4). This demonstrates the relationship between oxidation and color due the negative effect found also on top blade color. Conversely, no WDGS effects were identified on TBA values of tenderloin steaks ($P = 0.19$). However, 15% and 30% did significantly increase TBA values of strip loin steaks ($P < 0.01$). These observations suggest that individual cuts respond differently to WDGS finishing diets.

Mello Jr. et al. (2008 *Nebraska Beef Report*, pp. 120-121) reported increased PUFA in beef from steers fed WDGS. Based in this information we hypothesize that high levels of PUFA led more oxidation and detrimental effects on color. However, future studies are needed to clarify these effects.

Conclusion

The data of this study indicate that including WDGS in finishing diets can compromise the color and oxidation capacity of beef steaks resulting in lower shelf life.

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