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Vitamin E Mitigates the Boost in Lipid Oxidation of Beef Due to Wet Distillers Grains Feeding

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Summary

Beef tenderloin and strip loin steaks were obtained from yearlings ($n = 90$) fed 0%, 20% and 40% wet distillers grains (DM basis) with or without distillers solubles and vitamin E supplementation. Our aim was to increase the shelf life of case-ready beef by vitamin E supplementation to minimize the potential of lipid oxidation due to wet distiller grains feeding. Data from this study indicate that vitamin E supplementation significantly mitigates the increased oxidation potential of tenderloin and strip loin steaks during retail display due to WDG feeding.

Introduction

The major issue of meat at retail display is the alteration of freshness due to oxidation. Meat containing more polyunsaturated fatty acids (PUFA) is prone to oxidize, producing many secondary byproducts, which subsequently deteriorate the color and flavor of meat. Godsey et al. (2009 *Nebraska Beef Report*, pp. 66-69) have shown that feeding efficiency and average daily gain increase linearly as inclusion levels of wet distillers grains increase. However, many studies have shown that feeding wet distillers grains (WDG) to cattle increases the PUFA content of beef, which reduces the shelf life of meat due to rapid oxidation (Senaratne et al., 2009 *Nebraska Beef Report*, pp. 110-112, and de Mello et al., 2008 *Nebraska Beef Report*, pp. 108-109).

Studies have shown that animal diets supplemented with antioxidants can increase the level of antioxidant

incorporation in meat, thereby suppressing lipid oxidation. Vitamin E (E) or α -tocopherol is one of the most promising antioxidants used in animal feeding. Although an abundance of feeding trials with E supplementation have been conducted to minimize oxidation of fresh meat, no work has been carried out on the effect of WDG diets supplemented with E on fresh beef. Therefore, this study was conducted to determine the effects of WDG feeding on maintaining quality of beef by E supplementation.

Procedure

Ninety crossbred steers were randomly assigned to ten diets containing 0%, 20% or 40% WDG (DM basis) with or without E supplementation and distillers solubles. All the conditions at feeding, slaughter and meat fabrication were similar to procedures described by Senaratne et al. (2009 *Nebraska Beef Report*, pp. 116-117). Strip loin (m. *Longissimus lumborum*) and tenderloin (m. *Psoas major*) steaks were cut one-inch thick after 7 and 28 days of aging at $32 \pm 36^\circ\text{F}$. One steak of each sample was immediately vacuum-packaged and stored at -4°F to avoid oxidation until tested for thiobarbituric acid reactive substances (TBARS). Other steaks of each muscle were split in half and packaged aerobically on Styrofoam trays. They then were placed on a table in a cooler maintained at $32\text{-}36^\circ\text{F}$ under continuous 1000-1800 lux warm white fluorescence lighting for seven days to simulate retail display conditions. A piece of each steak was collected at day 4 and day 7 of retail display, vacuum packaged and stored at -4°F . Finally, frozen steaks were macerated after dipping in liquid nitrogen and stored under -112°F until they were tested for TBARS.

Table 1. Main effects and their interactions on percentage discoloration of strip loin (m. *Longissimus lumborum*) steaks during retail display.

Effects	P-value
WDG	< .0001*
SOL	0.0003*
WDG \times SOL	0.5787
E	0.0002*
E \times WDG	0.0711
E \times SOL	0.5236
E \times WDG \times SOL	0.0836
Aging	< .0001*
WDG \times aging	0.1596
SOL \times aging	0.4532
WDG \times SOL \times aging	0.3058
E \times aging	0.1128
E \times WDG \times aging	0.9251
E \times SOL \times aging	0.3841
E \times WDG \times SOL \times aging	0.6322
D	< .0001*
WDG \times D	0.0002*
SOL \times D	0.1283
WDG \times SOL \times D	0.1346
E \times D	< .0001*
E \times WDG \times D	0.4206
E \times SOL \times D	0.6120
E \times WDG \times SOL \times D	0.9974
Aging \times D	< .0001*
WDG \times aging \times D	0.0965
SOL \times aging \times D	0.0001*
WDG \times SOL \times aging \times D	0.5016
E \times aging \times D	0.4454
E \times WDG \times aging \times D	0.0311*
E \times SOL \times aging \times D	0.2351
E \times WDG \times SOL \times aging \times D	0.4154

*Main or interaction effects are significant at $P < 0.05$.

SOL = distillers solubles (L and H).

D = retail display day (0, 4 and 7 days).

Results were subjected to the GLIMMIX procedure of SAS (version 9.1, Cary, N.C., 2002) as split plot design with repeated measures. Levels of WDG (0%, 20% and 40%), vitamin E (with or without), distillers solubles (low and high) and their interactions were considered as the main plot variables, while aging periods and day of retail display and their interactions were analyzed as subplot variables. Significant main effects and their interactions were identified at $P < 0.05$.

(Continued on next page)

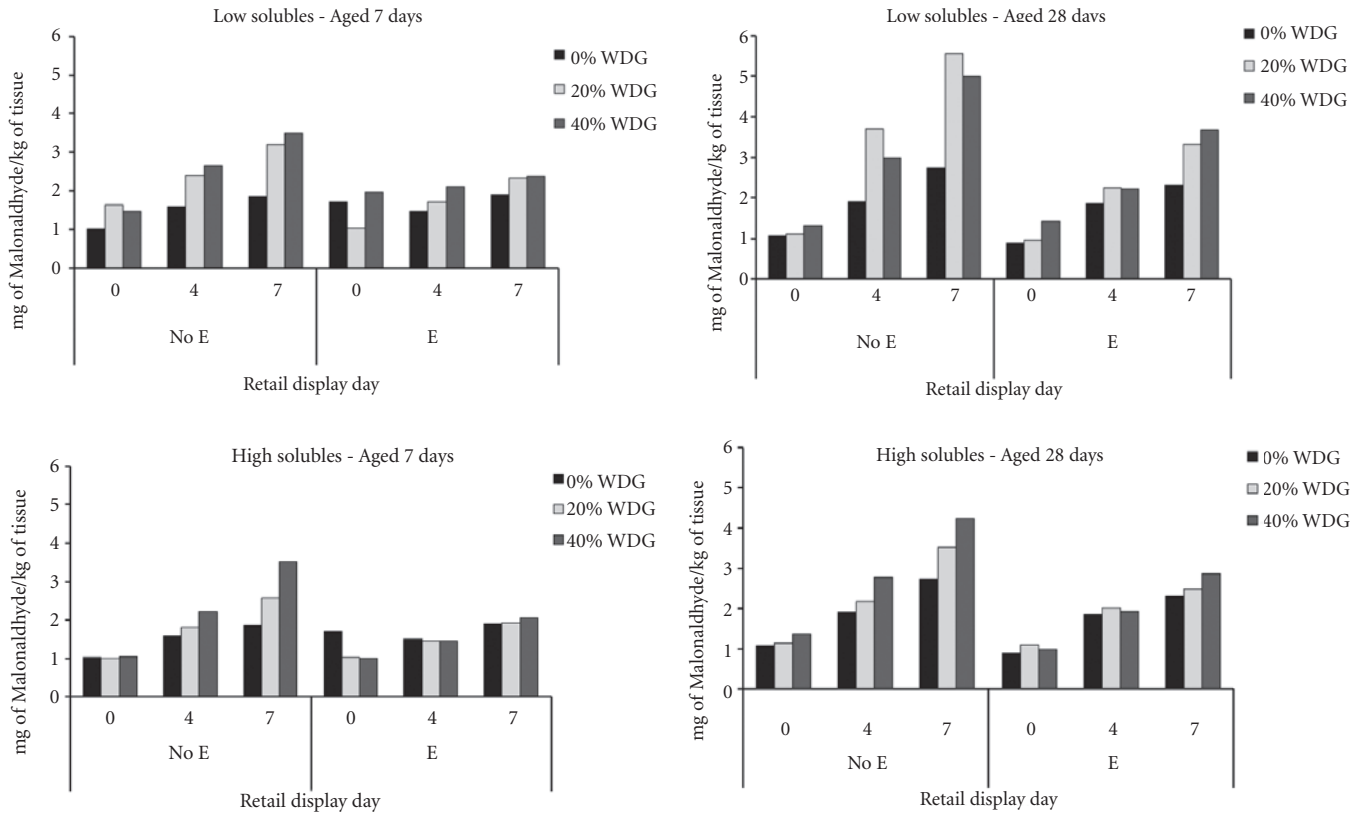


Figure 1. TBARS of 7- and 28-day aged strip loin (*M. longissimus lumborum*) steaks from animals fed diets containing 0%, 20% or 40% WDG with or without E supplementation and distillers solubles.

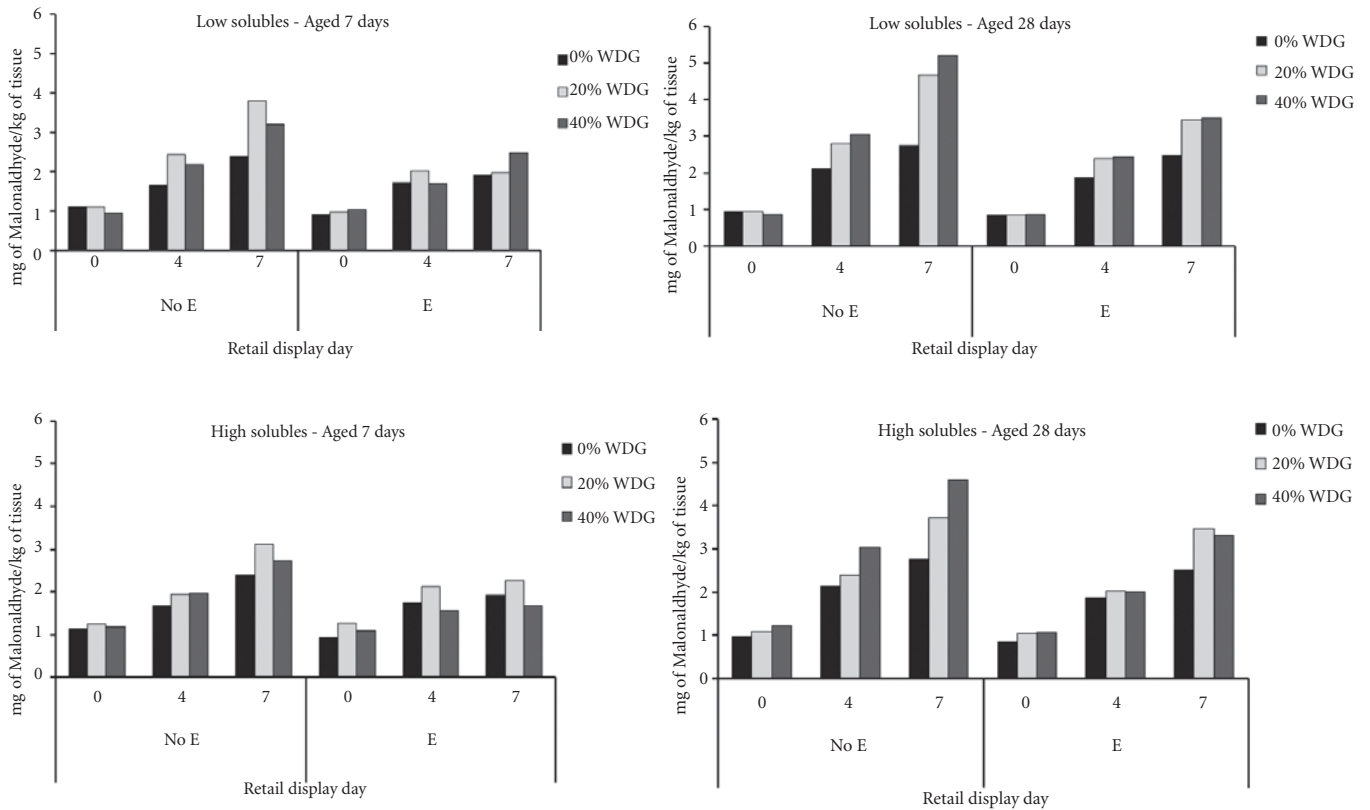


Figure 2. TBARS of 7- and 28-day aged strip loin (*M. psoas major*) steaks from animals fed diets containing 0%, 20% or 40% WDG with or without E supplementation and distillers solubles.

Table 2. Main effects and their interactions on percentage discoloration of strip loin (m. Psoas major) steaks during retail display.

Effects	P-value
WDG	0.0010*
SOL	0.1692
WDG × SOL	0.8923
E	0.0001*
E × WDG	0.3033
E × SOL	0.4756
E × WDG × SOL	0.2613
Aging	< .0001*
WDG × aging	< .0001*
SOL × aging	0.7562
WDG × SOL × aging	0.1731
E × aging	0.2955
E × WDG × aging	0.0811
E × SOL × aging	0.7701
E × WDG × SOL × aging	0.4429
D	< .0001*
WDG × D	0.0402*
SOL × D	0.1008
WDG × SOL × D	0.8997
E × D	0.0132*
E × WDG × D	0.5946
E × SOL × D	0.6181
E × WDG × SOL × D	0.8590
Aging × D	< .0001*
WDG × aging × D	0.0168*
SOL × aging × D	0.8461
WDG × SOL × aging × D	0.6782
E × aging × D	0.1214
E × WDG × aging × D	0.1180
E × SOL × aging × D	0.2257
E × WDG × SOL × aging × D	0.7717

*Main or interaction effects are significant at $P < 0.05$.

SOL = distillers solubles (L and H).

D = retail display day (0, 4 and 7 days).

Results

The significance of main effects and their interactions on oxidation of strip loin and tenderloin steaks are shown in Tables 1 and 2. Since there were significant interactions of E x WDG x aging period x retail display day ($P = 0.0311$) and of solubles x aging period x retail display day ($P = 0.0001$) on TBARS values on oxidation of strip loin steaks, significant main effects were not considered (Table 1). In addition, there were also significant interactions of WDG x aging period x retail display day ($P = 0.0168$) and of E x retail display day ($P = 0.0132$) on oxidation of tenderloin steaks (Table 2); therefore, the main effects were not considered.

Aging increased oxidation; therefore, the TBARS of day 28 aged strip loin and tenderloin steaks from cattle fed rations containing high and low solubles were greater than those aged seven days (Figure 1 and 2). As time of retail display increased, the oxidation or TBARS values of strip and tenderloin steaks significantly increased from day 0 to day 7 of retail display (Figures 1 and 2).

Steaks from cattle fed E supplemented diets showed significantly lower TBARS values compared to steaks from animals fed non-supplemented diets (Figures 1 and 2). That was likely due to impediment of oxidation by the antioxidant, vitamin E.

It appears that greater oxidation occurred in steaks from animals fed diets lower in distillers solubles. The hypothesis was that higher levels of solubles would contribute to greater oxidation. We have no explanation for these contrary results.

As a whole, results of this study indicate that vitamin E supplementation is able to minimize the increased oxidation during retail display of tenderloin and strip loin steaks due to WDG feeding.

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