

Project Summary

Impact of Vitamin E and Wet Distiller's Grains plus Solubles on Shelf-life of Beef under Different Packaging Systems

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Background

Feeding wet distiller's grains plus solubles (WDGS) leads to high concentration of polyunsaturated fatty acids (PUFAs) in beef and results in higher lipid oxidation and lower color stability. Consumers consider beef color a decisive factor when selecting beef products in the retail case. Thus, detrimental effects on color may lead to consumers' rejection. Estimated retail case-life is between 1 and 3 days for high-value cuts. When discoloration happens before the end of case-life, beef is typically marked down in price or discarded, leading to potential economic losses. Modified-atmosphere packaging is used to extend the shelf-life of beef through color preservation and deterioration suppression. Feeding vitamin E (α -tocopherol) is also practiced to extend beef shelf-life. This vitamin is incorporated into membranes protecting PUFAs against oxidation. Previous research demonstrated that feeding vitamin E at 500 I.U./head/day during the finishing period could mitigate negative effects of feeding WDGS. The aim of this project was to determine the ideal levels of vitamin E when feeding WDGS at 35% and displaying the beef under different packaging systems. The objective of this project was to identify the impact of vitamin E and WDGS on shelf-life (color and oxidation) of beef under different packaging systems.

Methodology

Ninety steers were randomized in five dietary treatments (n=15 per treatment) containing 35% WDGS (DM-basis) plus different levels of vitamin E (0E, 100E, 300E, 500E or 1000E I.U. daily) or a control corn-based (CORN) dietary treatment with no vitamin E and fed for 128 days. *Longissimus dorsi* (LD) muscles (n=2) were aged for seven and 21 days. Steaks were displayed in O₂-permeable film, low O₂ modified atmosphere packaging (MAP) or high O₂ MAP. Objective color measurement was recorded for L^* , a^* and b^* . Subjective color was assessed using a four-member panel that scored visual discoloration over four days. Regarding sensorial tenderness, a nine-member beef attributes panel was screened, selected and trained to evaluate tenderness. For WBSF, at least six cores from each steak were sheared on an Instron Universal Testing Machine. Lipid oxidation was measured by the thiobarbituric acid assay (TBA). Data of this experiment were analyzed as a split-split plot design and color data were designed as repeated measures. Data were analyzed using the GLIMMIX procedure of SAS and means separations were performed using the LSMEANS and DIFF functions of SAS.

Findings

Feeding WDGS elevated PUFAs and lowered color stability of beef displayed under O₂-permeable film packaging. Regarding color, low O₂ MAP had the highest levels of discoloration when compared to other MAP methods (Figure 1). In this study, supplementing 1000 I.U. of vitamin E improved color stability after four days of display. The effects of WDGS on color were higher when beef was aged for 21 days. However, 1000 I.U. vitamin E supplementation also increased the stability of redness (a^*) of steaks packaged under O₂-permeable film atmosphere. The combination of any level of vitamin E and high O₂ atmosphere improved color stability of 21 day-aged steaks. High O₂ MAP resulted in greater shear force values and lower trained panel tenderness ratings compared to the other two packaging systems (Table 1). In this experiment, 300 and 1000 I.U. daily supplementation mitigated lipid oxidation in steaks packaged under high O₂ and O₂-permeable film, respectively.

Table 1. Tenderness of steaks displayed under different packaging systems

| Trait ^a | Packaging System | | | Standard Error |
|---------------------|-------------------------|------------------------|---------------------------|----------------|
| | High O ₂ MAP | Low O ₂ MAP | O ₂ -Permeable | |
| WBSF, kg | 3.63 ^c | 3.39 ^b | 3.37 ^b | 0.03 |
| Δ WBSF, kg | -0.19 ^c | 0.04 ^b | 0.05 ^b | 0.05 |
| Tenderness rating | 5.87 ^c | 6.16 ^b | 6.16 ^b | 0.04 |
| Δ tenderness rating | -0.13 ^c | 0.17 ^b | 0.08 ^b | 0.04 |

^aWBSF = Warner-Bratzler shear force; Tenderness rated on an 8-point hedonic scale where 1 = extremely tough and 8 = extremely tender.

^{b, c}Means in the same row with different superscripts are significantly different ($P < 0.05$).

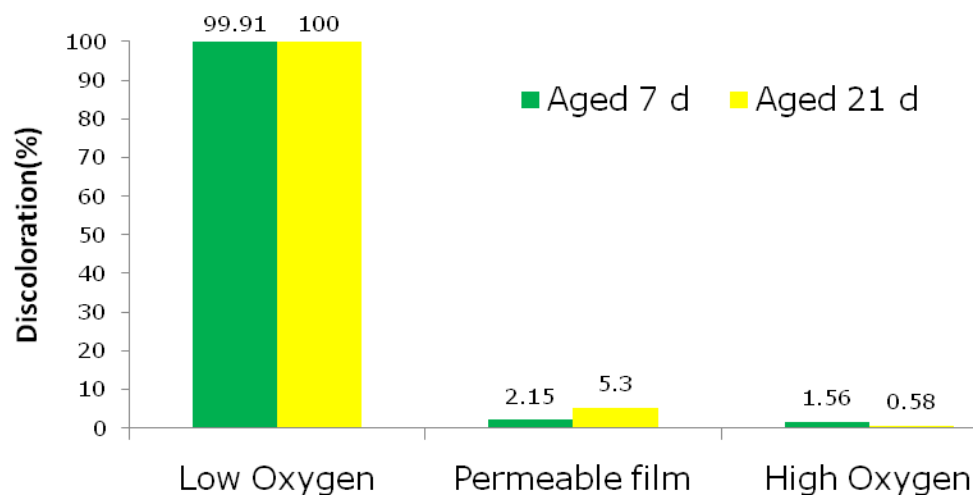
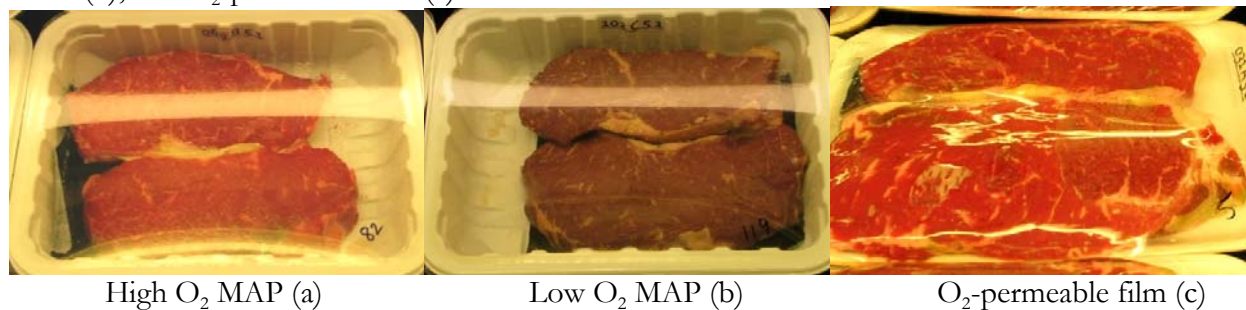


Figure 1. Discoloration of steaks displayed under three different atmospheres

Implications

Vitamin E supplementation and high O₂ MAP may be used to guarantee visual quality of moderately aged beef from animals fed WDGS. Vitamin E alone decreased oxidation of beef when steaks were displayed for four days under retail conditions. It appears that 1000 I.U. of vitamin E/head/day would protect against reduced color stability that occurs with 35% WDGS in the diet.

Visual discoloration of strip loin steaks (*longissimus dorsi*) packaged under high O₂ MAP (a), low O₂ MAP (b), and O₂-permeable film (c)



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