Quality Parameters of Wet and Dry Aged Beef Loins from Cattle Fed High Doses of Vitamin E

David M. Velazco
Joe A. Sonderman
Nicolas J. Herrera
Chris R. Calkins

Summary with Implications

The objective of this experiment was to determine if dietary supplementation of high doses of vitamin E (alpha-tocopherol; 2,200 IU per day for 100 days) can impact quality attributes of wet and dry-aged beef strip loins. Steaks from beef cattle supplemented with high doses of vitamin E exhibited less lipid oxidation after wet or dry aging, took longer time to discolor during retail display, and sustained redder color for a longer period under retail display conditions compared to controls. Free amino acids related to positive beef flavor attributes were higher for dry-aged loins compared to traditional wet aged samples loins. In dry-aged beef, trained sensory panelists found fewer negative flavors in beef from cattle fed high doses of vitamin E compared to controls. Dietary supplementation of high vitamin E levels can reduce lipid oxidation during wet or dry aging, improve color stability during retail display, reduce off flavors and maintain red color for a longer period under retail display conditions compared to controls.

Introduction

There has been an increase in interest in dry aging of beef which can provide enhanced textures and flavors when compared to traditional wet-aged beef. Dry aging can be considered an art and a science, and because multiple factors play prominent roles in this process, there is limited objective research that can be used by processors for guidance. Dry-aged beef is recognized for its unique flavor notes; however, the prolonged exposure to oxygen can create notable limitations. The oxidation of lipids can create negative flavors. Since oxidation is an autocatalytic process, delaying its initiation and propagation can reduce overall lipid peroxidation. The hypothesis for this experiment was that using high supplementation levels of vitamin E would result in high vitamin E content after prolonged aging, thus suppressing lipid and pigment oxidation in dry-aged beef. Vitamin E is a lipo-soluble antioxidant that has shown efficacy in delaying lipid oxidation in meat products when fed to beef cattle. For this experiment, high doses of vitamin E were fed to beef cattle to mitigate oxidation of meat during and after prolonged exposure to oxidative environments. Research suggests that lipid oxidation and pigment oxidation are closely related. Thus, suppressing lipid oxidation could result in extended color stability. Flavor is the main reason for dry aging; therefore, an extensive analysis was needed to evaluate flavor of dry-aged beef from cattle fed high doses of vitamin E.

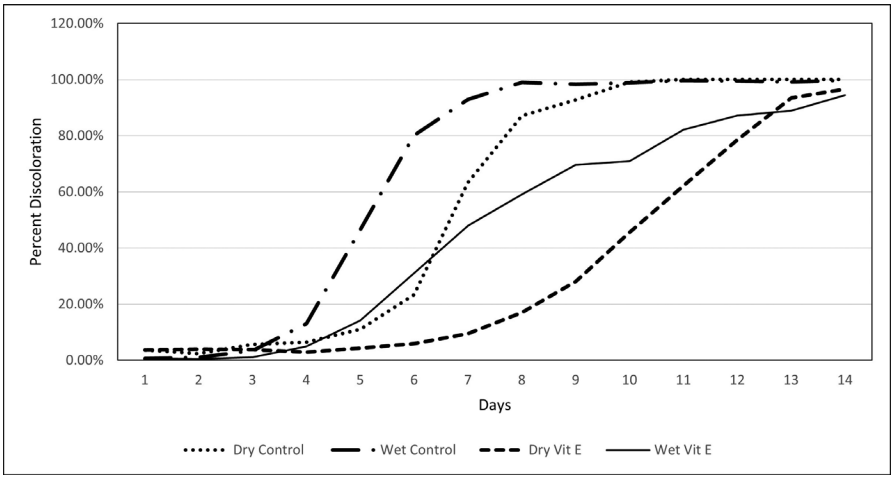

Figure 1. Subjective percent discoloration of all treatments (wet or dry aged) during 14 d of simulated retail display.

Procedure

Cattle (n = 150; 10/pen) were grain-finished with the dietary addition of 2,200 IU of vitamin E (α-tocopherol) per day for the last 100 days of feeding. One Low Choice carcass was selected per pen (n = 12). Low Choice carcasses (n = 12) were randomly selected from commercial production and were used as controls. Strip loins from cattle fed vitamin E and controls were randomly assigned to wet or dry aging for 42 days at 50% relative humidity. After aging, the longissimus lumborum muscle of a 0.5-inch steak from each loin was isolated and cut into equal one inch by two-inch pieces. One half was vacuum packaged and immediately frozen at -112 F and the other was subjected to retail display conditions for 8 days on Styrofoam® trays covered with an oxygen permeable polystyrene film. Lipid oxidation was measured using thiobarbituric acid reactive substances (TBARS) on days 0 (24 h post-harvest) and 42 of aging and after 8 days of retail display (after aging). Free amino acids were measured on days 0 (24 h post-harvest) and day 42 of aging. For subjective and objective color measurements, day 42 steaks were placed on Styrofoam® trays wrapped in an oxygen permeable polystyrene film and subjected to retail conditions for 14 days at 37 F. Graduate student panelists rated the percent discoloration for all steaks every day at the same time. Reference images of percent discoloration ranging from 5 % to

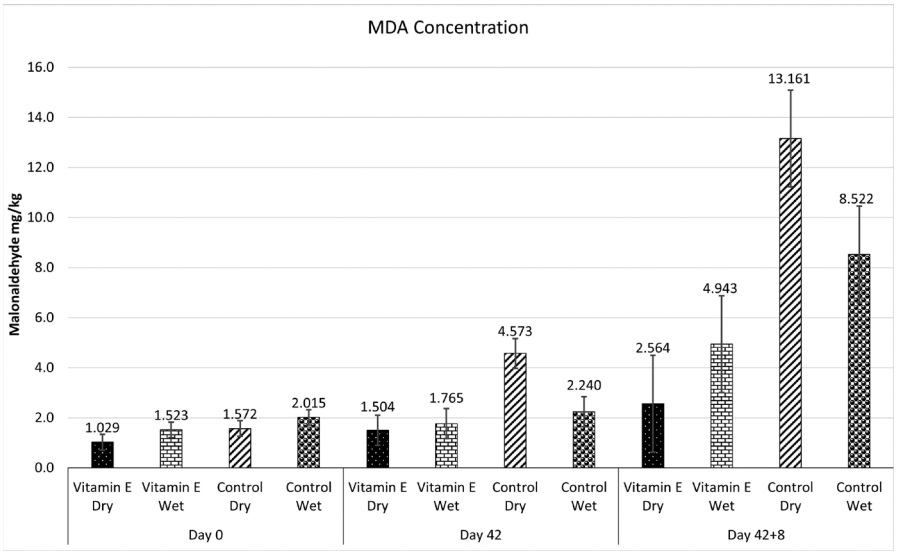

Figure 2. Oxidative rancidity measured with thiobarbituric acid reactive substances for all treatments (wet or dry aged) on day 0, 42, and 42+8 days of simulated retail display.

Table 1. Trained sensory analysis results based on a 0-to-15-point scale (zero lowest and 15 highest intensity)

	Positive Flavors			Negative Flavors		
Treatment	Umami	Roasted	Buttery	Rancid	Putrid	Sour
Vitamin E dry aged	4.889	8.750	0.667	0.000	0.000[b]	1.778
Control dry aged	4.361	8.639	0.661	0.056	0.167[a]	2.056

[a, b] Means with different superscripts differ. *P*-value = 0.0369, SEM = 0.0372.

100 % were available every day. Objective color measurements were taken with a Minolta Chromameter measuring a* values which represent redness. The measurement diameter was 0.31-inch with an 0.43-inch illumination diameter. The assigned illuminant was D65 and the standard observer was 2 degrees. Trained sensory analysis was done at Texas A & M University. A group of 6 panelists analyzed a steak from all loin samples and did descriptive sensory analysis.

Results

Subjective and Objective Color

There was a three-way interaction for discoloration between vitamin E inclusion (control vs high vitamin E), aging type (dry vs wet aging), and retail display day (P < 0.0001) for the last 10 days of retail display (Figure 1). Wet-aged controls discolored fastest, followed by dry-aged controls and wet-aged vitamin E samples. Dry-aged vitamin E samples had the lowest amount of discoloration.

There were aging type-by-day and aging-by-vitamin E inclusion interactions for a* values (P < .0001 and P = 0.0104, respectively). Generally, vitamin E-treated samples sustained higher redness values for longer times and dry-aged samples took longer to discolor compared to wet-aged samples.

Lipid Oxidation

On day 0, control and vitamin E inclusion loins did not differ (Figure 2) in lipid oxidation (*P* = 0.936). On day 42, control dry-aged and control wet-aged loins had the highest TBARS values and vitamin E wet and dry-aged loins had lower TBARS values (*P* = 0.043). Similarly, after 8 days of retail display post-aging, control dry-aged and control-wet aged steaks had the highest TBARS values and vitamin E wet and dry-aged steaks tended to have lower TBARS values (*P* = 0.085).

Free Amino Acids and Sensory Analysis

Free amino acids related to positive beef flavor attributes such as glycine (P = 0.0001), isoleucine (P = 0.0461), valine (P = 0.0147), and glutamate (P < 0.0001) were greater for samples dry-aged for 42 days compared to wet-aged samples. Trained sensory panelists generally noted slightly more positive flavor notes such as umami, roasted, and buttery on steaks from dry-aged beef fed vitamin E. More negative flavor notes such as rancid, putrid, and sour were noted in dry-aged control loins compared to loins from dry-aged beef fed vitamin E.

Conclusion

Dietary supplementation of high levels of vitamin E reduced discoloration and maintained redness during retail display of dry-aged beef steaks. Additionally, vitamin E reduced lipid oxidation in dry-aged beef and free amino acids related to positive beef attributes were higher in dry aged beef compared to wet aged beef. Supplementing high levels of vitamin E to beef cattle reduced lipid and pigment oxidation after prolonged aging. The beef from vitamin E supplemented cattle had fewer negative flavors produced by oxidation while maintaining the unique flavor characteristics of dry-aged beef.

David M. Velazco, graduate student

Joe A. Sonderman, graduate student

Nicolas J. Herrera, graduate student

Chris R. Calkins, professor, Animal Science, University of Nebraska–Lincoln