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Research Report

EFFECT OF SUPPLEMENTAL VITAMIN E ON THE COLOR AND CASE-LIFE OF TOP LOIN STEAKS AND GROUND CHUCK PATTIES IN MODIFIED ATMOSPHERE CASE-READY RETAIL PACKAGING SYSTEMS

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Story in Brief

Ground chuck and top loin steaks from cattle fed diets supplemented with either 0 or 500 IU/hd/day of vitamin E were packaged utilizing a modified atmosphere case-ready packaging system. Random samples were taken from the strip loins and bulk ground chuck of each treatment at fabrication to determine the vitamin E concentrations in the products. Cuts were stored in the dark at $39.2^{\circ}\text{F} \pm 1^{\circ}\text{F}$ for 0 to 14 d. Following storage, cuts were displayed in an open retail case at 35.6° to 42.8°F for 8 d. Twice daily, objective and subjective measures of display color properties were obtained. Lipid oxidation was measured on display days 0, 4, and 8 for each supplementation by storage group combination. Analysis of retail samples revealed a higher concentration of vitamin E in Vitamin E samples compared with control samples for both top loin steaks and ground chuck patties. Both Vitamin E top loin steaks and Vitamin E ground chuck patties maintained more acceptable visual scores for overall appearance for a greater portion of the display period than did their control counterparts. Maximum display life, when averaged across all storage days, was improved by 3 d and 0.9 d with vitamin E for top loin steaks and ground chuck patties, respectively. This study suggests that vitamin E would be beneficial in improving lipid and color stability of beef products stored in high oxygen modified atmosphere packaging systems.

Key Words: Color, Vitamin E, Case-Life

Introduction

Over the past several years, many changes in retail meat products have occurred. One such change has been the progressive movement toward the reduction of labor and enhanced food safety by utilizing "case-ready" fresh poultry, fish and pork products. Currently all poultry and most pork products arrive at retail stores as "case-ready" requiring minimal handling and processing prior to retail display. Fabrication of beef, on the other hand, requires the majority of time and labor in today's retail meat department.

It appears the main limiting factor in the production of "case-ready" beef products is unstable lean color (Effertz, 1997; Schut, 1998). Due to elevated myoglobin content associated with beef muscle, its relative color stability is much more of a concern than that of poultry products. Consumers associate

a bright, cherry red lean color with beef freshness (Kropf, 1980).

A successful case-ready beef packaging system must provide a bright red, display ready product with a long storage life (Down, 1997). Of all case-ready meat packaging systems, modified atmosphere packaging (MAP) utilizing an 80% O₂ and 20% CO₂ gas atmosphere is the most widely used. Enriched oxygen atmospheres are an adequate means of extending the color life of beef products during storage (Daun et al., 1971).

Addition of vitamin E to the diet of finishing steers improves the retail case-life of "normal" beef products as shown in the Domestic Shelf Life Alliance (Westcott et al., 1999). The use of vitamin E in MAP "case-ready" programs could potentially help the packer/processor provide a more consistent, made to order, longer-lasting product to the retailer and eventually to the ultimate consumer. This study was designed to investigate the additive ability of vitamin E supplementation to increase the performance of ground chuck patties and beef top loin steaks in MAP applications through reduction of lipid and muscle pigment oxidation.

Materials and Methods

Meat Samples. Boxed beef subprimals, strip loins (IMPS #180a) and neck-off chuck rolls (IMPS #116), were obtained from beef cattle that were fed diets supplemented with either 0 or 500 IU/hd/d vitamin E in the d form of α -tocopheryl acetate for a minimum of the last 100 d of the finishing period. Approximately ten top loin steaks were obtained from each of five strip loins for each treatment group (n=48 steaks/treatment). Whole neck-off chuck rolls were ground once through a 0.50 in plate and twice through a 0.13 in plate to ensure equal fat distribution. After grinding and mixing, patties were hand formed. Both steak and ground chuck patties were then packaged utilizing a MAP packaging system.

Packaging. Within 20 min of retail fabrication, meat samples were packaged. Individual trays containing either top loin steaks or ground beef patties were wrapped in MAPAC-M stretch packaging film. One Vitamin E and one Control package with matching storage and display times were placed into a 12 x 16 in barrier film packaging bag. A modified atmosphere package (MAP) was then created using a Corr-vac Mark IV flexible MAP system that contained 80% O₂ and 20% CO₂. Two MAP packages were then placed into cardboard boxes for storage.

Storage and Display. MAP packages were stored in cardboard boxes in the absence of light for 0 to 14 d at 35.6° F \pm 1° F. After their designated storage time was achieved, individual packages were removed from their MAP bags and placed in a commercial retail display case for 0, 4, or 8 d under cool-white florescent light (1600 to 1900 lux) at 35.6 to 39.2° F.

Packages were rotated randomly in the case once daily and new packages were added to random locations in the case.

Color Assessment. Twice daily retail display products were objectively evaluated for lean color using a Minolta CR-300 colorimeter. The a^* value was recorded for each sample until its designated removal day. The a^* value is an indicator of the intensity of red color. Measurements were taken at medial, central and lateral positions of each steak. These color measurements were of the lean color only, and precaution was taken to avoid any intramuscular fat. Four measurements were taken from each ground chuck patty at each observation time. A template was used to take these measures at each quarter section of the patty in approximately the same location for each observation. All samples, top loin steaks and ground chuck patties, were visually evaluated twice daily by a three member trained panel for lean color, fat color, percentage discoloration, and overall appearance (Sanders et al., 1997).

Statistical Analysis. The least squares means option of the General Linear Model procedure of SAS (1985) was used to compare means for treatment by storage group by display interactions. Objective color and visual panel data were analyzed with a split plot design. Trends in a^* values, lean color, fat color, percentage discoloration, and overall appearance over display period were fitted via regression.

Results and Discussion

Vitamin E Concentrations. Analysis of randomly selected samples from MAP top loin steaks revealed that tissue vitamin E concentrations of the Vitamin E samples were 92.9% higher than in the Control samples. Similarly it was found that vitamin E concentrations in Vitamin E ground chuck samples were 77.0% greater than Controls.

Lean Color. MAP packaging significantly increased the red color of both Vitamin E and Control steaks after 2 d of storage when compared with conventionally packaged steaks. Both Vitamin E and Control steaks maintained this increase over the 14-d storage in the dark. Vitamin E steaks exhibited significantly ($P < .05$) higher a^* values over the entire 8 d in the open display case when averaged across all storage days (Figure 1). Decrease in a^* value can be interpreted as a decrease in red color.

Storage in MAP packaging significantly decreased the Minolta a^* value of ground chuck patties stored for extended periods in the dark. Control patties displayed a steady decrease in a^* value between d 2 and 6 of storage, and a dramatic drop in a^* value between d 6 and 8 of storage. Vitamin E patties also exhibited a steady decline in a^* value over the 14-d storage period, but maintained a displayable red color through d 10 of storage. Vitamin E ground chuck patties had higher a^* values between d 1 and 5 of display than

did Control (Figure 2).

Subjective Color Analysis. Maximum display life of top loin steaks was calculated utilizing overall appearance scores (Figure 3). Days of display to reach unacceptable overall appearance decreased as the storage period increased for control steaks. Vitamin E was effective in increasing the display life of top loin steaks. Mean treatment overall appearance scores were significantly higher than control. Days of display to reach unacceptable overall appearance decreased as the storage period increased for both vitamin E and control patties (Figure 4). Control patties stored 0 d maintained extended display life when compared with Vitamin E patties. Vitamin E was effective in increasing the display life of ground chuck patties on all other storage days. This research indicates that vitamin E would be beneficial in extending the color stability and display life of ground chuck patties stored in MAP packaging.

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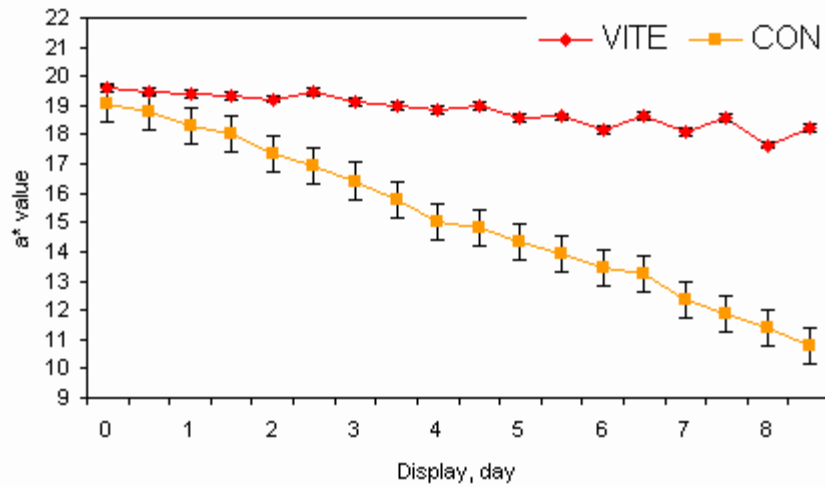


Figure 1. Effect of display on the Minolta a* (redness) value of MAP packaged top loin steaks averaged across all storage days. Standard error bars indicated (P<.05).

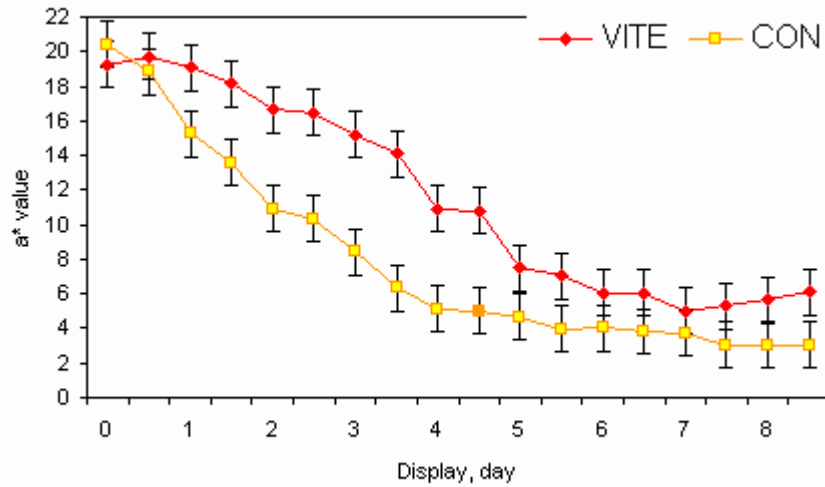


Figure 2. Effect of display on the Minolta a* value of MAP packaged ground chuck patties averaged across all storage days. Standard error bars indicated (P<.05).

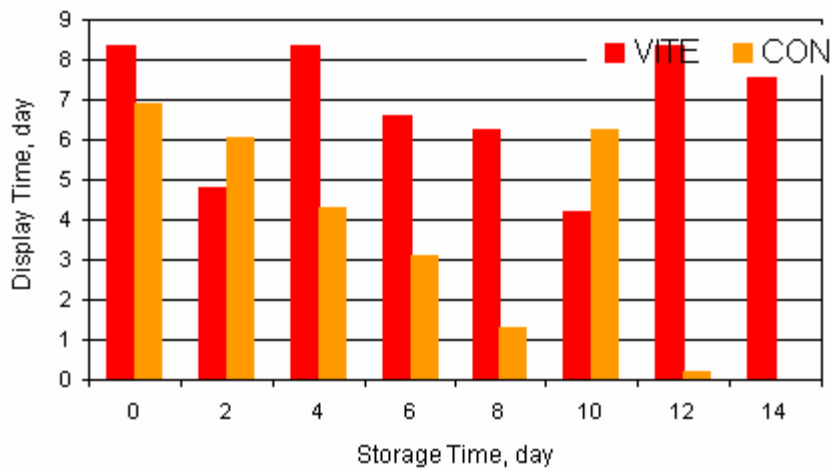


Figure 3. Comparison of overall acceptance scores for MAP packaged loin steaks represented as days of display to reach unacceptable score ($P < .05$).

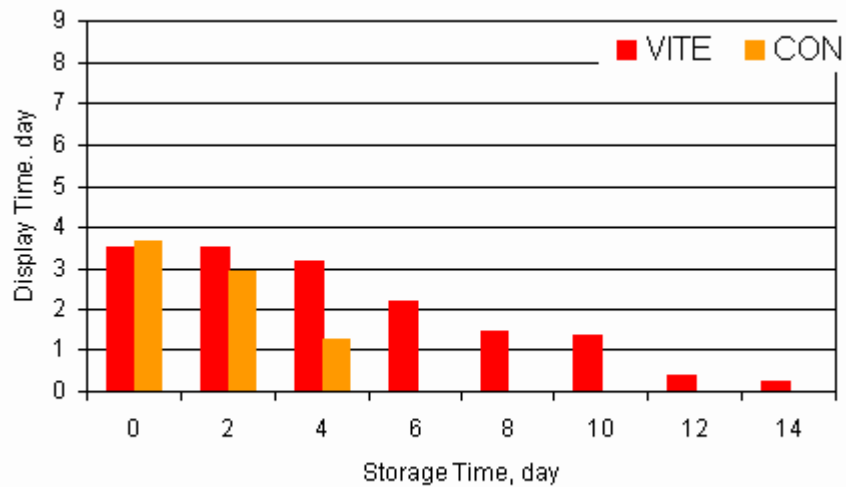


Figure 4. Comparison of overall acceptance scores for MAP packaged ground chuck patties represented as days of display to reach unacceptable score ($P < .05$).