

High Oxygen Packaging System Negatively Affects Color Stability and Sensory Attributes of Beef Cuts

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Summary and Implications

Beef steaks stored in high-oxygen modified atmosphere packaging (HiOx-MAP) had more discoloration, lipid oxidation, and lower tenderness, juiciness, and flavor during 9 days display compared to the steaks packaged in vacuum (VAC). Therefore, MAP systems with lower oxygen mixture or incorporation of antioxidants through injection enhancement to meat in HiOx-MAP are recommended to minimize oxidation-induced quality deteriorations of beef round muscles.

Introduction

Modified atmosphere packaging (MAP) systems with a high oxygen (80%) level are widely used in retail meat markets because the bright red color of meat in this packaging system attracts consumers. However, high oxygen levels are likely to increase the incidence of oxidative changes in the meat, thus negatively affecting meat quality characteristics. Further, it may cause more quality problems for some beef round muscles, which have traditionally been underutilized because of commonly noted tenderness and discoloration defects. The objectives of this study were to determine effect of different packaging systems (HiOx-MAP and VAC) on color stability, and lipid oxidation, and sensory attributes of beef round cuts.

Materials and Methods

Ten market weight beef cattle (A-maturity) were slaughtered at the Iowa State University Meat Laboratory. The *longissimus lumborum* (LL; control muscle), *semimembranosus* (SM), and *adductor* (AD) muscles were removed from each carcass at 24 hours after slaughter. Steaks (2.54-cm thick) were cut from each muscle and randomly assigned to either HiOx-MAP (80% O₂, 20% CO₂) or VAC for packaging. Steaks were displayed for 9 days at 1°C under 2150 lux of fluorescent light. Surface color (Hunter), pH, thiobarbituric acid reactive substance (TBARS) values, star probe, and sensory analysis were

measured on steaks at the beginning and at the end of display. Results were analyzed using the Mixed procedure of SAS.

Results and Discussion

HiOx-MAP packaged beef steaks had significantly lower tenderness and juiciness scores compared to steaks in VAC. HiOx-MAP packaged beef steaks had an increase ($P < 0.05$) in lipid oxidation during display, and also increased off-flavor development. The AD in HiOx-MAP had the greatest increase of lipid oxidation during display followed by SM and LL suggesting that these beef round muscles are more susceptible to oxidation than LL. In contrast, the steaks packaged in VAC did not develop lipid oxidation during display time. The surface redness values of steaks packaged in HiOx-MAP rapidly decreased during display, and AD had the greatest decrease ($P < 0.05$) in surface redness (indicating more myoglobin oxidation) followed by SM and LL. However, VAC steaks had no significant change in redness during display. These data suggest that HiOx-MAP can create more oxidative conditions, which negatively affects myoglobin and lipid oxidation stability, meat juiciness and flavor. Further, the results support the hypothesis that conditions that promote oxidation are detrimental to improvement in tenderness with postmortem aging.

Table 1. Least squares means for sensory attributes¹ of beef steaks packaged in either HiOx-MAP or VAC, and displayed for 9 days at 1°C.

	Tenderness	Juiciness	Off-flavor
MAP	6.3 ^a	7.8 ^a	0.4 ^a
VAC	7.7 ^b	8.8 ^b	0.2 ^b
LL	10.0 ^a	8.8 ^a	0.3
SM	5.6 ^b	8.8 ^a	0.2
AD	5.4 ^b	7.4 ^b	0.3
S.E.M.	0.7	0.4	0.07

¹Sensory attributes were evaluated using a 15-cm line scale (1 = not tender, juicy; 0 = no off-flavor; 15 = very tender, juicy, high off-flavor).

^{ab} Within a column of each sensory trait, different superscripts indicate difference between packaging types, or between muscles ($P < 0.05$).