



Modified Atmospheric Packaging and Antioxidant Enhancement Improves Redness of Atypical Dark-Cutting Beef

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Objectives

Dark-cutting carcasses occur when muscle pH does not decrease sufficiently during rigor mortis because of antemortem glycogen depletion. Typical dark-cutting beef have a pH > 6.0, however, atypical dark-cutting (ADC) beef have a pH around 5.7- 5.9 but have a darker lean color similar to dark-cutting beef. Previous studies noted that greater muscle pH in dark-cutting beef increase oxygen consumption and decrease myoglobin oxygenation. However, limited research has determined the biochemical basis of ADC. Therefore, the objectives of this study were to characterize the biochemical basis of ADC beef carcasses and to utilize modified atmosphere packaging (MAP) and rosemary enhancement to improve appearance during retail display.

Materials and Methods

Strip loins from ADC and USDA Low Choice (C) carcasses were selected from a commercial beef processing plant and transported to the Food and Agricultural Products Center in Stillwater, OK. Control (C) and ADC steaks (prior to enhancement and packaging) were utilized to measure pH, color, oxygen consumption, and proximate compositions. Loin sections were cut into halves and randomly assigned to combinations of packaging types and enhancement treatment. Packaging included high-oxygen MAP (HiOx-MAP; 80% oxygen and 20% carbon dioxide), carbon monoxide MAP (CO-MAP; 0.4% CO, 69.6% N, and 30% CO₂), and PVC. Enhancement includes 0.1% rosemary oleoresin pumped to 10% of loin green weights. Following enhancement and packaging, steaks were

displayed under retail conditions for 6 d to measure color changes using a HunterLab spectrophotometer. The data were analyzed using the Mixed Procedure of SAS, and the experiment was replicated 13 times ($n = 13$).

Results

There were no differences for initial pH or proximate compositions ($P < 0.05$) between C and ADC. However, ADC had lower initial lightness (L^* values), redness (a^* values), and red intensity (chroma) compared with C. Further, ADC had greater ($P < 0.05$) oxygen consumption than C. There was a significant packaging \times enhancement \times display time interaction resulted for L^* , a^* , and chroma. CO-MAP and HiOx-MAP in combination with rosemary enhancement improved ($P < 0.05$) redness of ADC by 61.7% and 42.3%, respectively, compared with ADC in PVC packaging. Similarly, MAP and enhancement improved lightness (L^* values) and chroma compared with ADC in PVC. By Day 6 of display, enhanced ADC steaks packaged in both HiOx-MAP and CO-MAP had similar color parameters to control choice steaks; however, non-enhanced ADC steaks had significantly lower a^* ($P < 0.0001$) and chroma ($P < 0.01$) values when packaged in HiOx-MAP when compared to both C and enhanced ADC.

Conclusion

The results suggest that ADC beef has greater oxygen consumption than C steaks even at similar muscle pH. Use of modified atmospheric packaging in combination with enhancement has the potential to improve surface color of ADC beef.