Dark storage of enhanced dark-cutting beef in nitrite-embedded packaging increased metmyoglobin formation upon repackaging

M. Denzer, G. G. Mafi, D. L. VanOverbeke, and R. Ramanathan

1Department of Animal and Food Sciences, Oklahoma State University, Stillwater, OK 74078, USA

Introduction: Consumers prefer a bright-cherry red appearance of steaks in the grocery store. This appearance is achieved by the binding of oxygen to myoglobin when the steaks are in polyvinyl chloride (PVC) overwrap. Dark-cutting beef deviates from the bright cherry-red appearance resulting in a darker color and negative perception from consumers. Nitrite-embedded packaging (NEP) has been shown to improve redness and color stability of dark-cutting beef; however, there is limited understanding of color stability after using NEP and repackaging into PVC for retail.

Purpose: The objective was to evaluate novel NEP and enhancement effects on the color of dark-cutting beef after repackaging into PVC for display.

Methods: From a commercial packing plant, dark-cutting beef strip loins (n = 8; pH = 6.39) and USDA Low Choice beef strip loins (normal-pH, n = 6) were collected. Bisected dark-cutting loins were randomly assigned to nonenhanced dark-cutting (DCN) and enhanced dark-cutting (DCE) with glucono delta-lactone and rosemary. Steaks (1.91 cm) sliced from nonenhanced normal-pH, DCN, and DCE loins were randomly assigned to 3, 6, or 9 d in dark storage, and DCE steaks were packaged in nitrite-embedded packaging (NEP) with normal-pH and DCN steaks packaged in vacuum packaging. At dark storage d of 3, 6, or 9, steaks were repackaged in PVC and displayed for 6 d. Upon repackaging, the instrumental color was evaluated every 12 h, and metmyoglobin formation was calculated using the ratio of reflectance of 572 nm and 525 nm. Delta E was calculated to determine the change in color over time using the change in L*, a*, and b* values from h 0 to h 12 of display. Data were analyzed using the Mixed Procedure of SAS, and least square means were considered significant at $P < 0.05$ and separated using the PDIFF option.

Results: Metmyoglobin formation increased ($P < 0.05$) within 12 h of repackaging DCE steaks held for 3 d and 6 d of dark storage. At h 12 of display, DCE steaks had significantly more metmyoglobin formation than DCN and normal-pH steaks. The $\Delta E$ of DCE steaks was negative, indicating a decline in color after 12 h of display, while the normal-pH and DCN steaks had a positive $\Delta E$ value indicating improved surface color.

Significance: The repackaging DCE steaks resulted in decreased color stability and increased metmyoglobin formation. However, NEP can improve color stability of dark-cutting beef when not removed from the NEP system.

Keywords: Meat color, dark-cutting beef, nitrite-embedded packaging