

PACKAGING TYPE IMPACTS PROTEIN DEGRADATION AND FREE AMINO ACID PRODUCTION DURING POSTMORTEM STORAGE IN BEEF STEAKS

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I. OBJECTIVES

The objective of this study was to determine the influence of packaging type on postmortem degradation and production of free amino acids in beef steaks.

II. MATERIALS AND METHODS

Beef strip loins and top sirloin butts were chosen from USDA Choice carcasses ($n = 40$, 20/subprimal). Subprimals were fabricated into 2.54-cm steaks 7 d postmortem and randomly assigned to packaging types: carbon monoxide motherbag (CO) (0.4% CO/30% CO₂/69.6% N₂), high-oxygen modified atmosphere packaging (HIOX) (80% O₂/20% CO₂), and rollstock (ROLL). Steaks designated for the polyvinyl chloride overwrap (OW) treatment were placed in ROLL treatment until retail display. A steak was also removed from each subprimal and immediately frozen at -20°C with no packaging or aging treatment applied. Steaks were aged in the dark for 14 d, then displayed in coffin-style cases for 48 h under continuous fluorescent lighting. Steaks were then vacuum packaged and frozen at -20°C . Prior to analysis, steaks were homogenized in liquid nitrogen. To quantify degradation of desmin and troponin-T (TnT), Western blot analysis was conducted using sodium dodecyl sulfate-polyacrylamide gel electrophoresis and immunofluorescence staining for imaging. Desmin was measured at bands located at 55 kDA, and TnT was measured at bands at 30 kDA. Free amino acid analysis was conducted using gas chromatography-mass spectrometry following derivatization and separation. Data were analyzed as a 2×4 factorial design with packaging, muscle, and their interaction serving as fixed effects, and gel was incorporated into the model as a random effect for Western blot analysis.

III. RESULTS

Desmin degradation was impacted by packaging type ($P < 0.001$). Initial samples taken at 7 d postmortem and HIOX samples possessed ($P < 0.05$) the greatest relative intensity of desmin compared to all other packaging types, which indicates a higher concentration of desmin and less degradation during postmortem aging. No differences were observed in TnT degradation for packaging type ($P = 0.442$). Six amino acids (alanine, cystine, glycine, proline, tyrosine, and valine) were impacted ($P \leq 0.01$) by both the main effects of packaging and muscle. For all 6 amino acids, *longissimus lumborum* steaks possessed a greater ($P < 0.05$) concentration of each respective amino acid compared to *gluteus medius* steaks. Tyrosine was present ($P < 0.05$) in the highest concentration in HIOX steaks compared to ROLL steaks. Additionally, 7 d initial samples possessed the lowest ($P < 0.05$) concentration of all free amino acids, likely the result of limited postmortem proteolysis during aging. The majority of free amino acids ($n = 12$) were impacted solely by the packaging main effect

($P < 0.04$). Initial samples exhibited the lowest concentration of amino acids compared to all other treatments, with the exception of histidine ($P < 0.05$). ROLL and OW steaks possessed ($P < 0.05$) the greatest concentration of the remaining free amino acids, followed by CO steaks ($P < 0.05$) and then HIOX steaks ($P < 0.05$). Histidine was present ($P < 0.05$) in greater concentrations in HIOX steaks in comparison to ROLL, CO, and initial steaks.

IV. CONCLUSION

These results indicate that packaging type has a strong influence over postmortem proteolysis and production of important flavor precursors, such as free amino acids. With retail transitioning to more case-ready products, processors should consider anaerobic packaging to optimize tenderness and flavor.

Keywords: aging, desmin, flavor, free amino acids, packaging