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Measures of Oxidation in Beef Following Retail Display in Various Package Types

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Objectives

This study aimed to investigate the influence of package type and muscle on thiobarbituric reactive substances, non-heme iron, and carbonyls in raw *Longissimus lumborum* (LL) and *Gluteus medius* (GM) muscles.

Materials and Methods

Thiobarbituric reactive substances (TBARS), non-heme iron (NHI), and carbonyls (C) were measured in raw *Longissimus lumborum* (LL) and *Gluteus medius* (GM) muscles packaged in 1 of 5 package types: high-oxygen modified atmosphere lidded trays (80% O₂/20% CO₂, HIOX), carbon monoxide modified atmosphere lidded trays (0.4% CO/30% CO₂/69.6% N₂, CO), rollstock (forming/non-forming films, ROLL), vacuum packaging (VAC), and traditional overwrap (remained under vacuum prior to being placed on foam trays and sealed with polyvinyl chloride film, OW) in a 2 × 5 factorial arrangement. Paired strip loins and top sirloin butts ($n = 10$ paired subprimals from USDA Choice, “A” maturity beef carcasses) were vacuum packaged, stored in darkness (4°C) and aged for 14 d; prior to fabrication into 2.54 cm steaks. Steaks were kept in darkness (4°C) in their respective packaging for an additional 7 d until retail display for 48 h under continuous fluorescent lighting (4°C); while VAC steaks remained in darkness. Malonaldehyde was measured in steaks using the TBARS method. Carbonyl content

was evaluated as a measure of protein oxidation by derivatization with 2,4 dinitrophenylhydrazine (DNPH). Non-heme iron (NHI) concentration was measured using a ferrozine method. All data were analyzed utilizing statistical procedures in SAS (9.4; SAS Inst. Inc., Cary, NC). Significance was determined at $\alpha = 0.05$.

Results

No muscle × package type interactions ($P > 0.05$) occurred for TBARS, C, or NHI. Package type ($P < 0.001$) and muscle ($P < 0.004$) had an impact on TBARS. The HIOX treatment had the greatest ($P < 0.05$) TBARS values compared to all other package types. Additionally, samples packaged in CO had greater ($P < 0.05$) TBARS than VAC. Moreover, the GM possessed greater ($P < 0.05$) TBARS values than the LL. Package type had no effect ($P > 0.05$) on carbonyls or NHI content. However, C and NHI differed among muscles ($P < 0.05$). The GM possessed greater ($P < 0.05$) C and NHI content compared to the LL.

Conclusion

These results indicate high oxygen packaging environments are detrimental to the chemical stability of raw beef as measured by TBARS. Furthermore, the GM is more susceptible to oxidation than the LL; possibly because of increased NHI.