PRINCIPAL COMPONENT ANALYSIS OF THE MULTIVARIATE RELATIONSHIP BETWEEN OXIDATION PRODUCTS AND COLOR ATTRIBUTES IN BISON *LONGISSIMUS LUMBORUM* AND *PSOAS MAJOR* MUSCLES

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I. OBJECTIVES

Fresh bison meat color deteriorates promptly under retail aerobic packaging conditions and oxidation products are originated; however, the role of different oxidation products in bison meat color stability has not yet been evaluated. A principal component analysis was used to examine the multivariate relationship between lipid (malondialdehyde [MDA], 4-hydroxy-2-nonenal [HNE]), and protein (carbonyl content [CAR]) oxidation products and color attributes (objective and subjective) in bison *longissimus lumborum* (LL) and *psoas major* (PM) muscles.

II. MATERIALS AND METHODS

A total of 10 LL and 10 PM from 5 A1-grade bison carcasses were obtained from a commercial plant within 48 h postmortem. The muscles were cut into 2 equal portions, vacuum-packaged, and randomly assigned to an aging period of 7 and 14 d at 2°C. At the end of each aging period, muscle portions were removed from the packages, pH was measured, and 2.5-cm-thick steaks were obtained for sensory (muscle color and discoloration scores), instrumental (L^*, a^*, and b^*) color measurements, and protein and lipid oxidation analyses. After 5 d in retail display, color and pH were measured, and the steaks were removed for subsequent protein and lipid oxidation determination. Principal component analysis was performed on oxidation compounds and color traits to identify the influence of the measured attributes.

III. RESULTS

Correlation coefficients revealed strong relationship of MDA with a^*, color and discoloration scores (r or rs > 70; $P < 0.01$), followed by a moderate correlation between HNE and CAR (r or rs < 0.70; $P < 0.01$). The factor analysis showed that the first 2 principal components (PC) with eigenvalues greater than 1 explained 73.09% of the standardized variance (PC1 explained 58.48%, and PC2 14.61%). While the set of variables for the first PC included mainly MDA, HNE, CAR, a^*, b^*, and color and discoloration scores (based on the largest loading values), the PC2 was related to pH, L^*, and b^*. Results showed clear segregation between steaks displayed day 0 and day 4 (regardless of the muscle and aging time), where PM and LL steaks aged for 7 and 14 d at day 0 of retail display were closely associated with redness and yellowness traits, and located far away of oxidation compounds and scores, indicating more red color stability and less oxidation. In contrast, steaks at day 4 of the retail display were closely associated with oxidation compounds and scores. Noticeably, 3 distinct

groups within steaks displayed at day 4 were identified according to the muscle and aging time. A first group was represented by PM steaks aged for 7 and 14 d with more oxidation compounds and high scores (representing high oxidation level and less red color). The second (close to the central axis) and third group (negative side of PC2) of steaks displayed at day 4 were represented by LL steaks aged for 7 and 14 d, respectively, showing different levels of color deterioration on LL muscle based on aging period.

IV. CONCLUSION

These results indicate that color attributes are moderate to strongly influenced by the lipid and protein oxidation compounds in bison meat. Content of individual lipids and protein oxidation compounds were positively associated with color and discoloration scores but negatively associated with *a** and *b**.

Keywords: bison, carbonyl content, color stability, discoloration mechanism, malondialdehyde