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Comparison of Lipid and Protein Oxidation Products and their Impact on Colour Stability in Bison *Longissimus Lumborum* and *Psoas Major* Muscles

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Objectives

To compare lipid (malondialdehyde [MDA], 4-hydroxy-2-nonenal [HNE]) and protein (carbonyl content [CAR]) oxidation products and determine their influence on color stability in two bison muscles (*longissimus lumborum* [LL; color stable] and *psoas major* [PM; color labile]).

Materials and Methods

A total of 10 *longissimus lumborun* (LL) and 10 *psoas major* (PM) from five A1 grade bison carcasses were obtained from a commercial slaughter plant within 48 h post-mortem. From each muscle, a 10-cm thick piece was removed and subsampled for evaluation of pH, MDA (by thiobarbituric acid assay), HNE (by ELISA) and CAR (by 2,4-dinitrophenylhydrazine). These measurements allowed the establishment of a baseline for the different oxidation products. The remainder of the muscles were cut into two equal portions, and each portion was vacuum-packaged and assigned to an ageing period of 7 and 14 d at 2°C. At the end of each ageing period, each muscle portion was removed from their packages, pH measured, and steaks obtained for sensory (muscle and discoloration scores) and instrumental color measurements (L^*, a^* and b^*) over 5 d of retail display, and for estimation of MDA, HNE and CAR. After 5 d in retail display and following color and pH measurements the steaks were removed and collected for MDA, HNE and CAR determination. Data were analyzed as a completely randomized design with a split-split plot arrangement. Additionally, correlation and regression analysis were performed to identify the influence of the measured attributes on color.

Results

Regardless of the ageing time, LL showed greater redness and lower surface discoloration by instrumental (a* value; $P = 0.04$) and sensory ($P < 0.01$) color evaluation than PM at the end of the retail display. Furthermore, LL exhibited lower MDA, HNE and CAR content compared to PM ($P < 0.05$). A three-way interaction (muscle × ageing time × retail day display) was detected on MDA content, where PM presented a higher level of MDA with increasing ageing time and retail display than LL ($P = 0.02$). The pH was not different between LL and PM ($P > 0.05$) steaks.

In both muscles, Pearson (r) and Spearman (rs) correlation coefficients indicated that MDA was the oxidation compound showing the highest correlation to a* ($r = –0.78$; $P < 0.01$) and discoloration (rs = 0.81; $P < 0.01$) scores, followed by a moderate correlation with HNE and CAR (r or rs < 0.7; $P < 0.01$). The pH did not exhibit correlation with color traits, except for lightness, in both muscles. For the stepwise regression analysis, the main variable entered into the equation for predicting a*, color and discoloration score in PM muscle was MDA with an R^2 of 0.72, 0.75 and 0.78, respectively, while for LL muscle, MDA presented an R^2 of 0.62, 0.68 and 0.66;, respectively. The pH, HNE and CAR only explained an additional 2% of the variation in those attributes.

Conclusion

The results of color attributes corroborated that bison LL is a color-stable muscle due to the lower level of protein and lipid oxidation products developed during storage and retail display compared to PM muscle, which is considered color-labile muscle. The MDA seemed to have remarkable importance in the color deterioration than HNE and CAR, particularly in bison PM muscle.