OXIDATIVE STRESS AS A MEASURE OF POSTMORTEM MEAT QUALITY IN CROSSBRED LAMBS

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I. OBJECTIVES

The objective of this study was to evaluate the effects of different levels of lipopolysaccharide (LPS)-mediated oxidative stress on fresh meat quality in *Longissimus lumborum* of crossbred lambs.

II. MATERIALS AND METHODS

Crossbred lambs ($n = 29$) were blocked by weight and fed a standard finishing ration for the duration of the study. Lambs were individually housed, and treatment groups were administered one of 3 injections every 72 h across a 3-injection (9-d) cycle: a saline control (Control), 50 ng LPS/kg body weight (LPS50), or 100 ng LPS/kg body weight (LPS100). Rectal temperatures were measured to indicate inflammatory response. Lambs were harvested at the Loeffel Meat Laboratory, and 80 mg of pre-rigor *Longissimus lumborum* were collected in Control and LPS100 treatments within 30 min postmortem for RNA analysis. Loins were split and randomly assigned for 1 or 14 d of aging. Chops were fabricated after aging and placed under retail display (RD) conditions for 0 or 7 d. Using SAS (version 9.4, SAS Institute Inc., Cary, NC), objective and subjective color data were analyzed as a split-plot repeated measures design with treatment as the whole-plot, aging period as the split-plot, and days of RD for repeated measures. Tenderness, troponin-T, desmin, calcium, and pH were analyzed as a split-plot design with treatment as the whole-plot and aging period for split-plot. Lipid oxidation was a split-split-plot design with treatment as the whole-plot, aging period as the split-plot, and RD time as the split-split-plot. Transcriptomics, sarcomere length, fatty acids, and isoprostanes were analyzed as a completely randomized design. Data were analyzed using the PROC GLIMMIX procedure of SAS using animal as the experimental unit. All means were separated with the LSMEANS statement with an α level of 0.05 for significance. Tendencies were considered at an α level of 0.10.

III. RESULTS

LPS-treated lambs had increased ($P < 0.05$) rectal temperatures at 1, 2, 4, and 24 h post-injection. Transcriptomics exhibited significant ($P_{raw} < 0.05$) upregulation in RNA pathways related to generation of oxidative stress in LPS100 compared to Control. A trend was found for tenderness (Warner-Bratzler shear) ($P = 0.10$), with chops from LPS50 having a lower shear force compared with Control at 1 d postmortem. Additionally, the LPS50 treatment exhibited greater troponin-T degradation ($P = 0.02$) compared to all treatments at 1 d. No statistical differences were found at 14 d postmortem for shear force or troponin-T ($P > 0.05$). Aging decreased WBSF ($P < 0.0001$) and increased free calcium concentration ($P < 0.0001$), pH ($P < 0.0001$), and proteolytic degradation ($P < 0.0001$) across all treatments. After 7 d of RD, following aging periods, chops increased discoloration as RD increased ($P < 0.0001$), with Control chops aged for 14 d being the most discolored. Chops from lambs given LPS had higher ($P < 0.05$) a^* values compared to Control at 14 d of aging. The L^* values were greater ($P < 0.05$) in LPS100 compared to both LPS50 and Control. Aging tended ($P = 0.0608$) to increased lipid oxidation (thiobarbituric acid reactive substances) during RD across either aging period. There were no significant differences ($P > 0.05$) in sarcomere length, proximate composition, fatty acid composition, or isoprostane content.

IV. CONCLUSION

These results suggest that defined upregulation of oxidative stress has no detriment on fresh meat color but may alter biological pathways responsible for muscle composition and enzymatic processes, resulting in changes in tenderness early postmortem.

Keywords: apoptosis, color stability, lamb, meat quality, oxidative stress