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Retail Display Lighting and Packaging Type May Influence Beef Flavor and Oxidative Stability

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Objectives

This study aimed to evaluate the impact of retail display lighting and packaging type on beef flavor and lipid oxidation in five muscles.

Materials and Methods

Subprimals (n = 40 strip loins, 60 shoulder clods, 60 tenderloins, 24 inside rounds, 60 top butts) were randomly collected from separate carcasses. At 7d postmortem muscles (*Longissimus lumborum,* LL; *Triceps brachii*, TB; *Psoas major*, PM; *Semimembranosus*, SM; *Gluteus medius*, GM) were fabricated and sliced to 2.54cm steaks. Per muscle, 120 steaks were randomly assigned to packaging treatments: vacuum rollstock (ROLL); high-oxygen (80% O_2/20% CO_2; HIOX); overwrapped in a motherbag with carbon monoxide (0.4%CO/30%CO_2/69.6%N_2; CO); and traditional overwrap (OW), which was vacuum packaged until immediately prior to display. Packages were stored in the dark at 2°C an additional 13 d prior to retail display, then were displayed under fluorescent lights (FL) or light-emitting diodes (LED) with a third treatment in dark storage (DARK). All were held in their respective light treatments at 2°C for 72h, then assigned for trained panels or chemical analysis, vacuum packaged and frozen at –20°C. For sensory analysis steaks were thawed to 4°C and cooked to 71°C. Panelists (n = 8) were trained to evaluate twelve flavors, overall juiciness and tenderness, which were scored on a 100-point scale (0 = not present; 100 = extremely present). Lipid oxidation of raw steaks was quantified as 2-thiobarbituric acid reactive substances (TBARS; mg malondialdehyde (MDA)/kg beef).

Results

No three-way interaction ($P \geq 0.10$) or lighting effect ($P \geq 0.09$) was observed for trained panels or TBARS. Cardboard flavor had a muscle×lighting interaction (P = 0.02). In GM, FL had greater ($p < 0.05$) cardboard than other lighting; in other muscle types lighting was similar. Muscle×packaging influenced three attributes ($P \leq 0.02$). Steaks in ROLL were sweeter ($p < 0.05$) than other packaging in GM, PM and TB; ROLL was juicier ($p < 0.05$) than other packaging in GM, PM, and SM. Across all packaging types tenderness was greatest for PM, while SM was least tender ($p < 0.05$) in CO, HIOX and OW packaging. Packaging influenced nine flavors ($P \leq 0.01$); ROLL was greatest in beef ID, bloody/serumy, fat-like, umami, and salty, while HIOX scored greatest for oxidized, bitter, and sour. Brown/roasted was greatest ($p < 0.05$) in HIOX and CO. Muscle impacted liver-like flavor (P = 0.01), which was lower ($p < 0.05$) in SM than all other muscle types; LL, TB, PM and GM were similar ($p > 0.05$) for liver-like. Packaging influenced TBARS ($p < 0.01$); HIOX had the greatest concentration of MDA, followed by CO, OW and ROLL with the lowest ($p \leq 0.05$). Muscle influenced TBARS ($P < 0.01$), where TB was greatest ($p < 0.05$), followed by SM, PM, and GM, which were similar ($p > 0.05$); LL had the lowest MDA concentration. Oxidized ($P < 0.01$, r = 0.34), cardboard ($P < 0.01$, r = 0.30), bitterness ($P < 0.01$, r = 0.23), and sourness ($P < 0.01$; r = 0.22) were positively correlated with TBARS, while beef ID ($P < 0.01$, r = –0.23), umami ($P < 0.01$, r = –0.23), and tenderness ($P < 0.01$; r = –0.21) were negatively correlated.

Conclusion

Retail display lighting did not directly influence sensory characteristics or lipid oxidation; lighting only impacted cardboard flavor in an interaction with muscle type. These results suggest after 72h retail display, flavor differences between steaks of similar muscle and packaging displayed under LED or fluorescent lights may not be distinguishable.

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