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Effect of Degree of Doneness, Quality Grade, and Time on Objective Color Readings from Longissimus Lumborum Steaks Cooked to 6 Degrees of Doneness

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Objectives

The objective of this study was to determine the effect of quality grade and time after cooking on the instrumental color of steaks cooked to varying degrees of doneness (DOD). An increase in internal temperature results in greater myoglobin denaturation and cooked color has a large impact on consumer perception.

Materials and Methods

Twenty-four beef strip loins (IMPS #180) from 12 animals representing 5 quality treatments [Prime, Top Choice (Modest^{00}– Moderate^{100} marbling), Low Choice, Select, Select Enhanced (108%)] were collected from a Midwest beef processor and transported to the Kansas State University Meat Laboratory. Sub-primals were divided and cut into 2.54 cm thick steaks and aged 21 d. Steaks were assigned to a DOD so that each animal would be represented by a single steak within each DOD. Steaks were stored frozen at –40°C and thawed at 2 to 4°C for 24 h prior to cooking. Each steak was cooked to peak at an internal temperature to either very rare (55°C), rare (60°C), medium-rare (63°C), medium (71°C), well done (77°C), or very well done (82°C) on electric clamshell grills (Cuisinart Griddler; Cuisinart, Stamford, CT). Steaks rested for 3 min before being cut for evaluation. Each cooked steak was cut in half, perpendicular to the long axis of the steak, and color was measured on the internal face of the medial side and was evaluated immediately for $L*$, $a*$, and $b*$ using a Hunter Lab Miniscan spectrophotometer (Illuminant A, 2.54-cm aperture, 10° observer; Hunter Associates Laboratory, Reston, VA) at 3 locations and averaged. $L*$, $a*$, and $b*$ were also evaluated at 1, 2, 3, 6, 9, and 12 min post-cutting.

Results

For $L*$, there was an interaction ($P < 0.05$) between quality treatment and time. There was no difference ($P > 0.05$) among quality treatments for $L*$ value at any time point, except at 12 min, in which Top Choice samples were lighter ($P < 0.05$) than Select Enhanced samples. Additionally, the interaction between time and DOD was significant ($P < 0.05$) for $L*$, $a*$, and $b*$. For $L*$, within very rare, rare, and medium-rare the color lightened ($P < 0.05$) as time progressed from 0 to 12 min. Whereas for well done and very well done, the color darkened ($P < 0.05$) over time. Across very rare, rare, medium-rare, and medium, $a*$ values increased ($P < 0.05$) over time. However, for well done and very well done, time had only a minimal impact on $a*$ values. For $b*$, values increased ($P < 0.05$) within each DOD; however, these changes were more prevalent at lower DOD, with increased ($P < 0.05$) $b*$ values at each successive time point within very rare samples, but similar ($P > 0.05$) across the final 3 time points for well done and very well done. For $a*$, quality treatment had an effect ($P < 0.05$), with Select Enhanced having a lower value than all treatments other than Prime. Select Enhanced had a lower ($P < 0.05$) $b*$ value than all other quality treatments.

Conclusion

The impact of time on cooked color was DOD dependent, with steaks cooked to lower DOD becoming lighter and more red in color with time and steaks cooked to higher DOD becoming darker. Additionally, quality treatment had no impact on cooked color measures of non-enhanced samples. These results provide insight into cooked beef color changes related to time and how this might impact DOD perceptions by consumers.