Long postmortem aging effects on tenderness, flavor, lean color, and color stability of beef top loin and top sirloin steaks

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Background
Meeting consumer expectations for palatability continues to be a challenge for foodservice and retail operators. Extended postmortem aging has been widely used by the industry to ensure adequate tenderness of beef products. However, despite extensive research on the effects of aging on tenderness, relatively little work has been done examining aging effects on other important quality attributes, particularly flavor and lean color stability. The objectives of this research were to: (1) evaluate the effects of long aging times on tenderness, flavor, lean color, and color stability of top loin and top sirloin steaks from carcasses with marbling scores between Small00 and Small49 (Lower Small) or between Slight50 and Slight99 (Upper Slight); (2) evaluate VISNIR predictions for tenderness and lean color stability of beef longissimus lumborum, gluteus medius, and biceps femoris (sirloin cap) steaks aged for differing durations; and (3) evaluate the relationships between palatability and color traits in beef longissimus lumborum, gluteus medius, and biceps femoris (sirloin cap) steaks aged for differing durations.

Methodology
Carcasses (n = 100) were selected to have marbling scores between Small00 and Small49 (Lower Small) or between Slight50 and Slight99 (Upper Slight). Visible and Near-Infrared reflectance (VISNIR) spectra were collected on the ribeye of each carcass to predict lean color stability. Alternating carcass sides were assigned to be aged for 14, 21, 28, or 35 d, and then, top loin (longissimus lumborum) and top sirloin (gluteus medius and biceps femoris) muscles were cut into steaks. Color attributes were measured during 11 days of simulated retail display. Muscle pH and myoglobin concentration were measured on steaks from all muscles. Oxygen consumption, nitric oxide metmyoglobin reducing ability and initial metmyoglobin formation were measured on longissimus lumborum steaks to further understand the mechanisms associated with differences in color stability. Additionally, steaks were evaluated for tenderness, juiciness, and 32 flavor attributes by a highly trained sensory panel.

Findings
Overall tenderness ratings were increased in all three muscles by increased postmortem aging time (Figure 1). These increases were linear in longissimus lumborum and gluteus medius steaks, indicating that each incremental increase in aging time resulted in similar improvements in tenderness. In biceps femoris steaks, tenderness increased between steaks aged for 21 days compared to those aged for 14 days, but longer aging times than 21 days produced no further increases in tenderness. Overall color change during simulated retail display was increased by increased aging time (Figure 2). Moreover, the extent to which color change during simulated retail display was affected by aging time was muscle dependent. Longissimus lumborum steaks had the most stable lean color of the muscles evaluated in the present experiment, but were also the most affected by increased aging time with regard to color stability. Lean color stability of gluteus medius and biceps femoris steaks had smaller increases in color change during simulated retail display due to aging time than longissimus lumborum steaks. Increased aging time had only minimal effects on the beef flavor attributes evaluated in the present study.
The marbling classes evaluated in the present experiment had no effect on tenderness or juiciness in any of the three muscles evaluated and had only minimal impact on flavor in these muscles. Marbling class effects on color traits of longissimus lumborum, gluteus medius, and biceps femoris steaks were small and likely of little practical importance.

The greatest source of variation in beef flavor attributes appeared to be production lots. Moreover this variation was largely associated with undesirable or “off” flavors. Thus, it appears that certain production practices may be contributing to the incidence of beef flavor characteristics that may be undesirable to consumers.

The USMARC non-invasive prediction system for lean color stability was able to segregate carcasses into color stability groups based on VISNIR spectra collected on the ribeye at grading. Differences in lean color stability created by sorting carcasses based on VISNIR were larger in longissimus lumborum steaks than in gluteus medius or biceps femoris steaks.

Implications

These findings highlight the importance of postmortem aging in ensuring tenderness of beef products, particularly in muscles from the top sirloin. The minimal effects of aging time on beef flavor attributes in this study indicate that extended aging time can be used to improve tenderness without deleterious effects on other important palatability traits.

Improvements in tenderness associated with increased postmortem aging time could help retailers improve consumer satisfaction, particularly with gluteus medius steaks. However, the decreases in color stability associated with longer postmortem aging in this muscle may be problematic, given its relative labile color-life. Thus, retailers may need to include packaging technology such as mother-bag systems to capitalize on tenderness improvements with aging without increasing losses associated with discounting discolored product.

Pictures

Taking instrumental color readings on steaks during simulated retail display.

Longissimus lumborum (left) and biceps femoris (right) steaks during simulated retail display.

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Figure 1. Least-squares means for aging time main effects affecting overall tenderness ratings of longissimus lumborum, gluteus medius, and biceps femoris sirloin cap steaks aged for 14, 21, 28, or 35 d postmortem.

Figure 2. Least-squares means for muscle × aging time interaction affecting overall color change of longissimus lumborum, gluteus medius, and biceps femoris sirloin cap steaks aged for 14, 21, 28, or 35 d postmortem during simulated retail display.

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