Comparison of tenderness, palatability, and retail caselife of enhanced cow subprimals to non-enhanced cow and USDA Select subprimals

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STORY IN BRIEF

The objective of this study was to determine the effects of enhancing cow subprimals on tenderness, palatability, and retail case life compared to non-enhanced cow and USDA Select subprimals. Strip loin, top sirloin butt, and ribeye subprimals were selected (n = 20 per treatment). Steaks were cut and aged for 14, 21, or 28 d. Non-enhanced cow ribeye steaks were tougher than enhanced cow or USDA Select ribeyes according to Warner-Bratzler shear force values. Furthermore, top sirloin butts from non-enhanced cow were tougher at 14 and 28 d compared to other treatments. Non-enhanced cow strip loin steaks had higher shear force values than enhanced cow and USDA Select steaks. Sensory data revealed that enhanced cow steaks from all subprimals were higher for initial juiciness for both aging periods, compared to non-enhanced cow and USDA Select. Sensory tenderness ratings for enhanced cow and USDA Select subprimals were significantly higher than non-enhanced subprimals; however, enhanced cow steaks from all three subprimals had a greater intensity for salty flavor. In ribeye and top sirloin butt steaks, grassy/cowy off flavor was more intense in non-enhanced cow steaks compared to enhanced and Select. Non-enhanced cow steaks from all three subprimals had the greatest amount of surface discoloration during display. It was concluded that enhanced cow steaks were comparable to USDA Select steaks relative to tenderness and juiciness. However, additional research needs to be conducted to further improve the effects of enhancement solutions on color stability.

Keywords: Caselife, Cow, Enhanced, Palatability, Tenderness

INTRODUCTION

Cow-calf producers cull cows when overall performance declines. Cull cows are segregated into different groups based on body condition scores (BCS). Breakers, which have a BCS of seven, eight, or nine, can be sold as boneless, wholesale cuts, whereas intermediate and poorly conditioned cows, known as boners, are typically utilized for ground beef. In the National Market Cow and Bull Beef Quality Audit-1999, researchers reported that 2.3% of the cows audited received a BCS of 1 or 2, while 4.5% of beef cows received a BCS of 8 or 9 (Roeber et al., 2001). The beef industry may be able to capitalize on whole muscle cuts from those cows to recoup more value than from simply producing ground beef.

In 2008, mature cattle accounted for 17.8% of the total number of cattle harvested in the United States (USDA, 2008), thus representing an important source of meat for the beef industry. However, cow meat is often less tender due to increased collagen cross-linking associated with age of the animal (Cross et al., 1973; Berry et al., 1974; Bouton et al., 1978) and tends to be darker in lean color (Boccard et al., 1979). The use of growth promotants, such as implants or β-agonists, can be used to increase red meat yield from cull cows (Neill et al., 2009), while lean

color and tenderness can potentially be improved with short-term concentrate feeding prior to harvest (Cranwell et al., 1996). Postmortem practices, such as aging and enhancement solutions, can be utilized to further improve tenderness and overall palatability of cow meat products (Hoffman, 2006; Hutchison, 2007).

Research is needed to compare overall palatability of mature cow meat products to young animals. Therefore, the objective of this study was to determine the impact of enhancement of cow subprimals on tenderness, palatability, and retail caselife as compared to non-enhanced cow subprimals and USDA Select subprimals.

MATERIALS AND METHODS

Subprimals. Two sources of subprimals were used in this study. Subprimals (strip loins, top sirloin butts, and ribeyes) were selected (n = 20 subprimals per treatment). The subprimals were aged for 14, 21, or 28-d time periods. The cow product (n = 40 per subprimal) was received from a Texas processor, and randomly divided into two different treatment groups, non-enhanced cow product (n = 20 per subprimal) and enhanced cow product (n = 20 per subprimal). The USDA Select product (n = 20 per subprimal) was purchased from a local purveyor in Perkins, Oklahoma.

After subprimals were aged for 14 d, the cow product selected for enhancement (n = 20 per subprimal) was injected with an enhancement solution, up to 10% of the initial weight. A total of ten, 1 in. steaks were cut from each subprimal for Warner-Bratzler shear force (WBSF), sensory evaluation, and simulated retail display. Each steak selected for WBSF analysis and simulated retail display was randomly assigned one of three aging periods: 14, 21, or 28 d. Steaks used for sensory evaluations were randomly assigned to one of two aging periods: 14 or 28 d.

Simulated Retail Display. The steaks were placed on a white styrofoam tray with a white soaker pad and were over-wrapped with a polyvinyl chloride film (PVC). Trays were placed into the coffin style display case. Each steak was subjectively evaluated for color attributes at 12-h intervals during the retail display until the steaks were deemed to be ~80% undesirable.

Color Evaluation. Subjective color was evaluated by a six-person, trained panel of Oklahoma State University personnel. Panelists assigned scores to each steak for muscle color, surface discoloration, and overall appearance at each evaluation time. Muscle color was characterized on an 8-point scale (8 = extremely bright cherry-red; 1= extremely dark red) as outlined in the Guidelines for Meat Color Evaluation (AMSA, 1991). The amount of surface discoloration was determined by a 7-point scale [7= total discoloration (100%); 1 = no discoloration (0%)]. Overall appearance was depicted by an 8-point scale (8 = extremely desirable, 1 = extremely undesirable).

Warner-Bratzler Shear Force. Following cooking, steaks were allowed to cool before determining shear force values. Six cores were obtained from each steak; cores were 1.27 cm in diameter and removed parallel to the muscle fiber orientation from each steak. The cores were sheared once by a Warner-Bratzler head attached to an Instron Universal Testing Machine

(model 4502; Instron Corp., Canton, MA). Mean peak WBSF was then calculated by averaging the six cores.

Sensory. Steaks were cooked and samples were uniformly cut from each steak and placed in a cup with the corresponding identification number. Samples were served warm to panelists. Sensory attributes were evaluated by an eight member, trained panel consisting of Oklahoma State personnel. Samples were evaluated using a standard ballot from the American Meat Science Association (AMSA, 1995), consisting of the evaluation of initial and sustained juiciness, tenderness and connective tissue amount on eight point scales (8 = extremely juicy, tender, none, 1= extremely dry, tough, abundant). Five flavor attributes were evaluated and included beef flavor, salty, soapy, painty/fishy, and grassy/cowy. Flavor intensity was scored on a 3-point scale [not detectable (1) to strongly detectable (3)].

Statistical Analysis. Data were analyzed, by subprimal, using the mixed procedure of SAS. The analysis of variance model for WBSF and cook loss included treatment and age as the fixed effects and identification number as the random effect. The analysis of variance model for sensory traits included treatment and age as the fixed main effects, and panelist and identification number as the random effects. The analysis of variance model for color attributes were analyzed using a repeated measures model with time as the repeated measure, identification number as the subject, and treatment and age as the fixed effects. All models also included primary and secondary interaction effects. The least squares means were separated using a pairwise t-test when the model displayed a treatment effect ($\alpha = 0.05$).

RESULTS AND DISCUSSION

Color Evaluation. The treatment by age interaction was significant ($P < 0.05$) for muscle color, surface discoloration, and overall appearance for ribeye and strip loin steaks. Select ribeye and strip loin steaks had brighter red color (4.09 ± 0.11 and 4.23 ± 0.15; $P < 0.05$) at 14 d when compared to all other treatment by age interaction groups. Enhanced and non-enhanced cow ribeye steaks at 21 and 28 d were classified as dark red according to panelists, giving them the darkest red muscle color and therefore the lowest overall appearance. Enhanced cow ribeye steaks at 21 d of age had the least amount of surface discoloration (2.16 ± 0.12; $P < 0.05$) as compared to non-enhanced cow ribeye steaks aged for 21 and 28 d and USDA Select ribeye steaks aged for 14 d, which had the most surface discoloration.

Muscle color was significantly different due to treatment over all aging periods (14, 21, and 28 d) for top sirloin butt steaks. Select top sirloin butt steaks had the brightest cherry-red muscle color (3.63 ± 0.06) as compared to non-enhanced cow steaks (2.45 ± 0.06) and enhanced cow steaks (1.84 ± 0.06). Top sirloin steaks at 21 d had a brighter ($P < 0.05$) red color than 14-d steaks (2.95 ± 0.07 vs. 2.64 ± 0.06), while top sirloin steaks at 28 d had the darkest red color (2.34 ± 0.07). Furthermore, these data aligned with results reported by Hutchison (2007), who revealed that the cow steaks aged for 28 d were less color stable than steaks aged for 7 d. Treatment played a significant ($P < 0.05$) role in surface discoloration for top sirloin butts. Non-enhanced cow top sirloin butts (3.22 ± 0.08) displayed the highest percentage surface discoloration, while enhanced displayed the lowest percentage (2.71 ± 0.08), and Select top sirloin butt steaks were intermediate (3.14 ± 0.08).

Warner-Bratzler Shear Force. The treatment by aging interaction was significant for WBSF for ribeyes and top sirloin butts. Non-enhanced cow ribeyes, over all aging periods (14, 21, 28 d), were significantly tougher ($P < 0.05$) than the enhanced cow and USDA Select steaks. Shear force values for non-enhanced cow top sirloin butt steaks aged for 14 and 28 d were significantly higher ($P < 0.05$) than enhanced cow and USDA Select steaks. Non-enhanced cow strip loin steaks (4.58 ± 0.15) were significantly tougher than the enhanced cow (3.90 ± 0.14) and USDA Select steaks (3.09 ± 0.14) over all aging periods (averaged for 14, 21, and 28 d). These results were supported by a study conducted by Hunsley et al. (1971), who indicated WBSF values from LM were higher for bulls across all age groups when compared to steers.

Sensory. Enhanced cow steaks were ranked higher for both initial and sustained juiciness ($P < 0.05$) over both aging periods (14 and 28 d) when compared to non-enhanced cow and Select ribeye, strip loin, and top sirloin butt steaks. These results were supported by a previous study that suggests enhanced steaks were significantly more tender and juicier than non-enhanced beef (Robbins et al., 2003). Non-enhanced cow and Select ribeye and top sirloin butt steaks were similar in initial juiciness and sustained juiciness. However, non-enhanced cow strip loin steaks were juicier than Select steaks when rated for initial and sustained juiciness over both aging periods.

Enhanced cow ribeye steaks were more tender when rated for first impression tenderness ($P < 0.05$) than USDA Select and non-enhanced and ribeye steaks (5.98 ± 0.14 vs. 5.66 ± 0.14 vs. 4.30 ± 0.14). However, enhanced cow ribeye steaks performed similar to Select ribeye steaks on overall impression of tenderness and connective tissue amount ($P > 0.05$). Non-enhanced cow subprimals were significantly less tender overall ($P < 0.05$) and had more ($P < 0.05$) connective tissue when compared to enhanced cow and Select steaks.

Sensory determination of flavor intensity for ribeyes revealed panelists found significant differences ($P < 0.05$) in the intensity of beef, salty, and soapy flavors. Enhanced cow steaks had the lowest beef intensity (1.98 ± 0.09), non-enhanced ribeyes were intermediate (2.19 ± 0.09), and USDA Select steaks had the highest beef flavor intensity (2.35 ± 0.09). Enhanced cow ribeyes exhibited higher salty (1.82 ± 0.06 vs. 1.02 ± 0.06 and 1.04 ± 0.06) and soapy flavors (1.14 ± 0.02 vs. 1.04 ± 0.02 and 1.02 ± 0.02) when compared to non-enhanced cow and USDA Select steaks, respectively. Robbins et al. (2003) found similar results in terms of higher salt intensity of enhanced beef.

Analysis of strip loin steak sensory data revealed treatment played a significant role ($P < 0.05$) for flavor intensity of beef flavor, salty flavor, and painty/fishy flavor over both aging periods (14 and 28 d). Beef flavor intensity was significantly different ($P < 0.05$) between all treatment groups with USDA Select having the most intense beef flavor (2.43 ± 0.11) followed by non-enhanced cow strip loin steaks (2.23 ± 0.11) and enhanced cow strip loin steaks (1.86 ± 0.11). Strip loin steaks were rated similarly to ribeye steaks for intensity of salty flavor, with enhanced cow strip loin steaks (1.89 ± 0.05) being more salty ($P < 0.05$) than USDA Select (1.03 ± 0.05) or non-enhanced cow steaks (1.01 ± 0.05). Non-enhanced cow strip loin steaks (1.14 ± 0.04) had a more intense ($P < 0.05$) painty/fishy flavor as compared to enhanced cow (1.08 ± 0.04) and USDA Select strip loin steaks (1.08 ± 0.04). The treatment by age interaction was significant (*P*

< 0.05) for the intensity of grassy/cowy flavor in strip loin steaks. Enhanced cow steaks aged for 28 d had the most intense (1.42 ± 0.08) grassy/cowy flavor. Enhanced cow steaks aged 14 d (1.41 ± 0.08) and 28 d non-enhanced cow steaks (1.39 ± 0.08) were intermediate in flavor intensity. All USDA Select strip steaks (1.11 ± 0.08) and 14 d non-enhanced cow steaks (1.13 ± 0.08) had the lowest grassy/cowy flavor.

Enhanced cow top sirloin butt steaks were significantly lower ($P < 0.05$) in beef flavor (1.54 ± 0.11) than non-enhanced cow and USDA Select top sirloin butt steaks. Grassy/cowy flavor intensity means were also significantly higher ($P < 0.05$) for top sirloin steaks at 28 d (1.89 ± 0.08 vs. 1.23 ± 0.07). The intensity of salt flavor in enhanced cow top sirloin butt steaks was higher ($P < 0.05$) at 14 d of age and at 28 d of age as compared to all other treatment by age groups. These results were supported by a previous study that found that enhanced beef had significantly higher salty flavor due to the salt/phosphate enhancement solution (Robbins et al., 2003). There was no significant difference in salt intensity ($P > 0.05$) when comparing non-enhanced cow and USDA Select top sirloin butt steaks at either aging period. There was no significant difference ($P > 0.05$) in soapy intensity between treatments at any aging period for top sirloin butt steaks.

This study showed that enhancing cow subprimals improved tenderness when compared to non-enhanced cow and some USDA Select subprimals. Enhanced cow subprimals were juicier than the non-enhanced cow and USDA Select subprimals but had undesirable off flavor characteristics. Mature cow meat could be competitive with USDA Select subprimals but improvements need to be made to mask off flavors and the negative effects on color associated with the enhancement process.

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ACKNOWLEDGEMENTS

This project was funded by beef and veal producers and importers through their $1-per-head checkoff and was produced for the Cattlemen's Beef Board and state beef councils by the National Cattlemen's Beef Association.