Effects of differences in carcass maturity on eating quality of beef produced by grain-finished steers and heifers that have been classified as less than 30 months old using birth records or dentition

Principal Investigator: J. D. Tatum
Colorado State University

Study Completed
May 2013

Funded by the Beef Checkoff.
Effects of differences in carcass maturity on eating quality of beef produced by grain-finished steers and heifers that have been classified as less than 30 months old using birth records or dentition: Project Summary

Background
When beef carcasses are officially quality graded, USDA graders examine physiological maturity indicators (i.e., size and shape of the ribs and ossification of the bones and cartilages along the vertebral column of the split carcass, as well as the color and texture of the ribeye at the 12th rib) and classify each carcass into 1 of 5 maturity groups designated A through E (USDA, 1997). The A maturity group includes carcasses of cattle approximately 9 to 30 mo old (USDA, 1996). Occasionally, however, cattle less than 30 mo old exhibit premature skeletal ossification and produce B maturity (or older) carcasses, causing them to have lower final quality grades and less value in the U.S. beef trade.

An alternative method of aging cattle is to determine the animal’s dental age. Currently, dentition is not used for USDA grading; however, in an ongoing effort to prevent human exposure to tissues that might contain the agent that causes bovine spongiform encephalopathy, carcasses from all cattle processed in U.S. federally inspected beef plants must be segregated into 2 age groups using dentition. Carcasses from cattle with fewer than 3 permanent incisors (PI) are classified as less than 30 mo of age (MOA), whereas those produced by cattle with 3 or more PI are classified as 30 MOA or older. Carcasses in these 2 age groups subsequently are graded and fabricated separately. If fed steers and heifers with fewer than 3 PI consistently produce beef that provides the same eating experience as beef from carcasses classified by USDA graders as A maturity, then it could be argued that all carcasses from cattle aged as less than 30 MOA based on dentition should be considered A maturity for grading purposes, regardless of their carcass maturity characteristics. This study was conducted to compare sensory properties of beef from A maturity and B maturity or older carcasses produced by grain-finished steers and heifers classified as less than 30 MOA.

Methodology
Carcasses (N = 450) of cattle classified as less than 30 MOA using dentition were selected at commercial beef processing facilities to represent 2 USDA maturity groups (A00 to A99, A and B00 to C99, B-C) and 3 marbling categories (Slight, SL; Small, SM; and Modest or greater, MT+). Strip loin steaks were obtained from both sides of each carcass and aged for 14 d. One steak was used to obtain Warner-Bratzler shear force (WBSF) and slice shear force (SSF) measurements. The other steak was rated by a trained sensory panel for juiciness (0 = extremely dry, 15 = extremely juicy), tenderness (0 = extremely tough, 15 = extremely tender), and detectable levels of several flavors (0 = no presence, 15 = very strong presence): including meaty/brothy (basic flavor and aroma of grilled or roasted beef; simulated by the flavor of beef broth), buttery/beef fat (flavor and aroma associated with cooked fat from grain-finished beef; often described as a buttery flavor), bloody/serumy (flavor and aroma associated with blood in beef cooked to a rare degree of doneness; sometimes described as a metallic taste), livery/organy (flavor and aroma associated with cooked beef liver or kidney), grassy (flavor and aroma of beef produced by grass-finished or short-fed cattle; often described as green or hay-like), and gamey (flavor characteristic of wild game meat). Amount and solubility of collagen in the strip loin also were determined.
Findings

An important question that has not been addressed in the scientific literature is whether or not advanced carcass maturity characteristics are associated with reduced beef tenderness among cattle whose dental ages are less than 30 mo. We hypothesized that advanced carcass maturity characteristics (B maturity or older), occurring among fed steers and heifers whose dental ages have been determined to be less than 30 mo, would not adversely affect beef tenderness, juiciness, or flavor. Results showed that sensory panelists were unable (P > 0.05) to detect any differences in tenderness, juiciness, or flavor between LM steaks from carcasses classified as A maturity and steaks from B-C maturity carcasses (Figure 1). Moreover, no differences (P > 0.05) in shear force (Figure 2) were observed between maturity groups and B-C maturity carcasses had a greater percentage of heat-soluble collagen than did A maturity carcasses. These findings do not support the use of skeletal and lean maturity characteristics to determine USDA quality grades of beef carcasses originating from grain-finished cattle classified as less than 30 MOA.

Marbling categories, however, effectively stratified carcasses (MT+ > SM > SL) according to differences (P < 0.0001) in LM tenderness, juiciness, meaty/brothy flavor, and buttery/beef fat flavor (Figure 3). Results of this study suggest that, when applied to carcasses of fed steers and heifers whose dental ages are less than 30 MOA, USDA grades would be no less effective in identifying eating quality differences if the A and B-C maturity categories were combined and USDA grades were assigned using only marbling.

Implications

According to results of the 2011 National Beef Quality Audit, 7.2% of the U.S. fed steer and heifer population produced carcasses that were classified as B maturity or older (Moore et al., 2012). O’Connor et al. (2007) reported official USDA maturity scores for more than 4,300 beef carcasses produced by cattle of known ages (11 to 30 MOA) and found that cattle as young as 14 MOA produced carcasses classified as B maturity or older. Currently, prices of carcasses classified as B or older are discounted $18 to $55/cwt (USDA, 2013), yet if beef from these “more mature” carcasses has sensory attributes comparable to those of beef produced by A maturity carcasses with the same degree of marbling, then any price discount due to quality grade is unjustified. Results of the present study indicate that sensory attributes, shear force measurements, and collagen solubility do not differ for A and B-C maturity carcasses originating from grain-finished cattle classified as less than 30 MOA. These findings do not support the current grading concept of using skeletal and lean maturity characteristics to reflect differences in collagen maturity and associated tenderness differences for this sub-population of cattle.
Tables:

**Figure 1. Effect of maturity on sensory panel ratings for tenderness, juiciness, meaty/brothy flavor and buttery/beef fat flavor**

![Sensory Panel Ratings](image1)

**Figure 2. Effect of maturity on Warner-Bratzler shear force (WBSF) and slice shear force (SSF)**

![Shear force](image2)

**Figure 3. Effect of marbling on sensory panel ratings for tenderness, juiciness, meaty/brothy flavor and buttery/beef fat flavor**

![Sensory Panel Ratings](image3)
For more information contact:
National Cattlemen's Beef Association
A Contractor to the Beef Checkoff
9110 East Nichols Avenue
Centennial, Colorado 80112-3450
(303) 694-0305