

Project Summary

Relationships of USDA Camera-Based Quality Grades to Beef Palatability Attributes

**Principal Investigators: M. R. Emerson, J. D. Tatum, D. R. Woerner, K. E. Belk, & G. C. Smith,
Colorado State University**

**Study Completed
May 2010**



Funded by The Beef Checkoff

Relationships of USDA Camera-Based Quality Grades to Beef Palatability Attributes: Project Summary

Background

A 1978 U.S. Government Accountability Office investigative report to the U.S. Congress, concluded that USDA's subjective beef grading system lacked accuracy and consistency and that these issues would persist until objective grading instruments could be developed. Nevertheless, US beef quality grades continued to be based on subjective assessments of marbling until, in 2006, two camera-based grading systems, designed to objectively quantify marbling, were approved for use in determining official USDA quality grades.

To gain USDA approval, grading instruments met performance standards for prediction of marbling assessments of a five-member USDA expert grading panel when operated at commercial production speeds. However, instrument grading was not implemented immediately because post-approval testing revealed considerable disparity between grades assigned by instruments and grades assigned by USDA field graders. Instruments underestimated marbling scores assigned by field graders and the resulting differences in grade placement were great enough to prevent industry adoption of camera-assisted quality grading. After extensive evaluation involving grade comparisons among more than 400,000 carcasses, USDA officials eventually aligned camera-based quality grades with grades assigned by USDA field graders, leading to adoption of instrument-assisted quality grading by several beef processors.

Alignment of grading instruments with the marbling assessments of field graders, rather than those of the expert panel, while necessary to encourage industry adoption of instrument-assisted quality grading, was viewed by some as a reduction in U.S. beef quality standards. To address these concerns, this study was commissioned to quantify relationships of the recently adopted camera-based USDA quality grades to sensory attributes (tenderness, flavor, juiciness) of fed-steer and -heifer beef.

Methodology

Heifer and steer carcasses ($n = 718$, all A-maturity) were selected at beef processing plants in CO, KS, NE, and TX, using marbling scores determined by on-line camera grading systems, to represent 7 degrees of marbling: Traces (TR), Slight (SL), Small (SM), Modest (MT), Moderate (MD), Slightly Abundant (SA), and Moderately Abundant (MA). Strip loin steaks were obtained from both sides of each carcass and aged for 14 days. 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), and grassy (flavor and aroma of beef produced by grass-finished or short-fed cattle; often described as green or hay-like). Panelists also assigned each steak a composite sensory rating describing the overall sensory experience ($< 7.5 =$ negative, $\geq 7.5 =$ positive).

Findings

In the current study, camera-based marbling assessments explained 45, 40, 32, and 71% of the variation in panel ratings for juiciness, tenderness, meaty/brothy flavor intensity, and buttery/beef fat flavor intensity, respectively and 61% of the variation in ratings for overall sensory experience. In comparison, Smith et al. (1984) reported that differences in marbling explained 24, 27, 30, and 34% of the variation in sensory panel ratings for juiciness, tenderness, flavor, and overall palatability, respectively. The increased precision of instrument-based vs. subjective marbling assessment likely contributed to the greater magnitude of correlations between marbling and beef sensory attributes observed in the current study compared with those reported previously.

Increased degree of marbling resulted in steaks having greater juiciness, tenderness, meaty/brothy flavor intensity, and buttery/beef fat flavor intensity. As a result, the likelihood of a steak delivering a positive sensory experience became greater ($P < 0.001$) as degree of marbling increased (MA = SA > MD = MT > SM > SL > TR). Nearly all (98 to 99%) of the steaks with MA and SA marbling, and most (between 80 and 90%) of the steaks with MD and MT marbling provided a positive overall sensory experience compared with 62% of the SM steaks, 29% of the SL steaks and 15% of the TR steaks (Figure 1). Steaks produced by steers had lower WBSF and SSF values and were generally rated as more tender by sensory panelists than steaks produced by heifers, but the effect of sex on panel tenderness was significant only within the TR category.

Comparison of two methods for determining camera-based quality grades (i.e., use of original camera grade lines, based on marbling assessments of USDA grading experts vs. use of adopted camera grade lines, based on marbling assessments of field graders) showed that both methods of grade placement effectively stratified carcasses into grades that differed ($P < 0.05$) with respect to steak juiciness, tenderness, and flavor, with little discernible difference between methods (Figure 2).

Implications

For more than 8 decades, beef carcasses (and resulting primal and subprimal beef cuts) have been sorted into marketing categories that differ with respect to expected eating quality using USDA beef quality grades. Over the years, the subjectivity of USDA quality grading has been a subject of criticism and concern for the beef industry. The adoption of camera-based technology to assist in assignment of quality grades to beef carcasses significantly improves and modernizes the U.S. beef grading system. The new, objectively determined marbling standards theoretically should remain unchanged (within limits of instrument precision) from plant-to-plant, region-to-region, and year-to-year. Results of this study provide strong support for use of instrument-assisted quality grading as implemented in 2009.

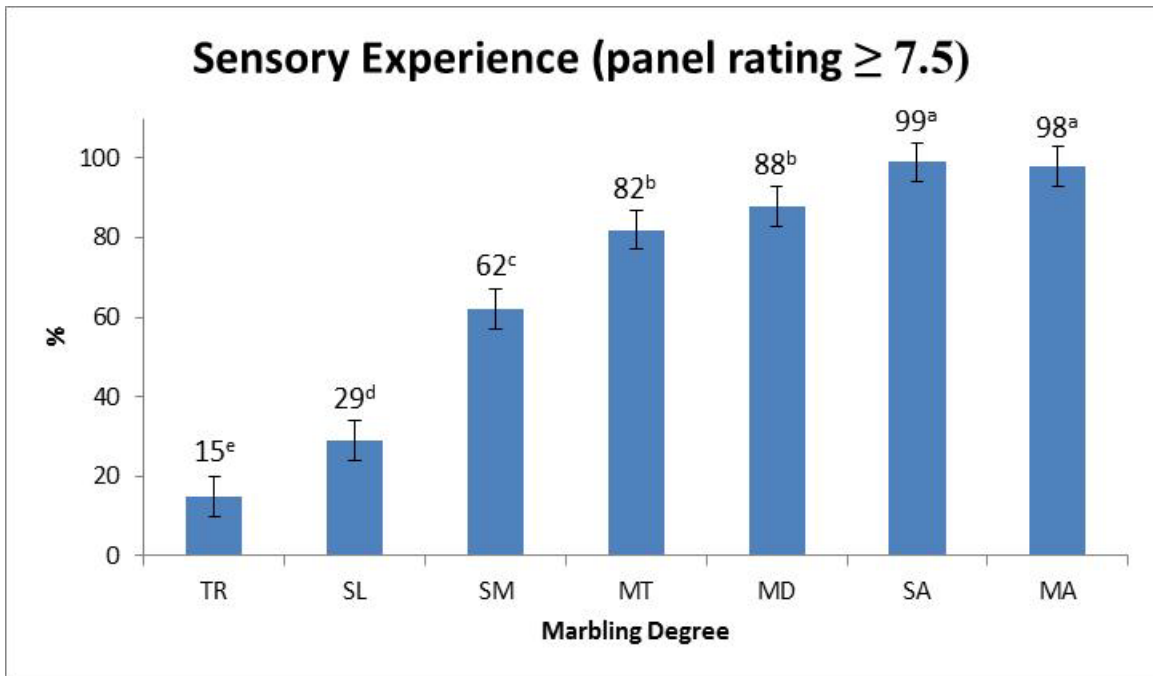


Figure 1. Frequency of steaks representing each marbling degree that received overall sensory experience ratings ≥ 7.5

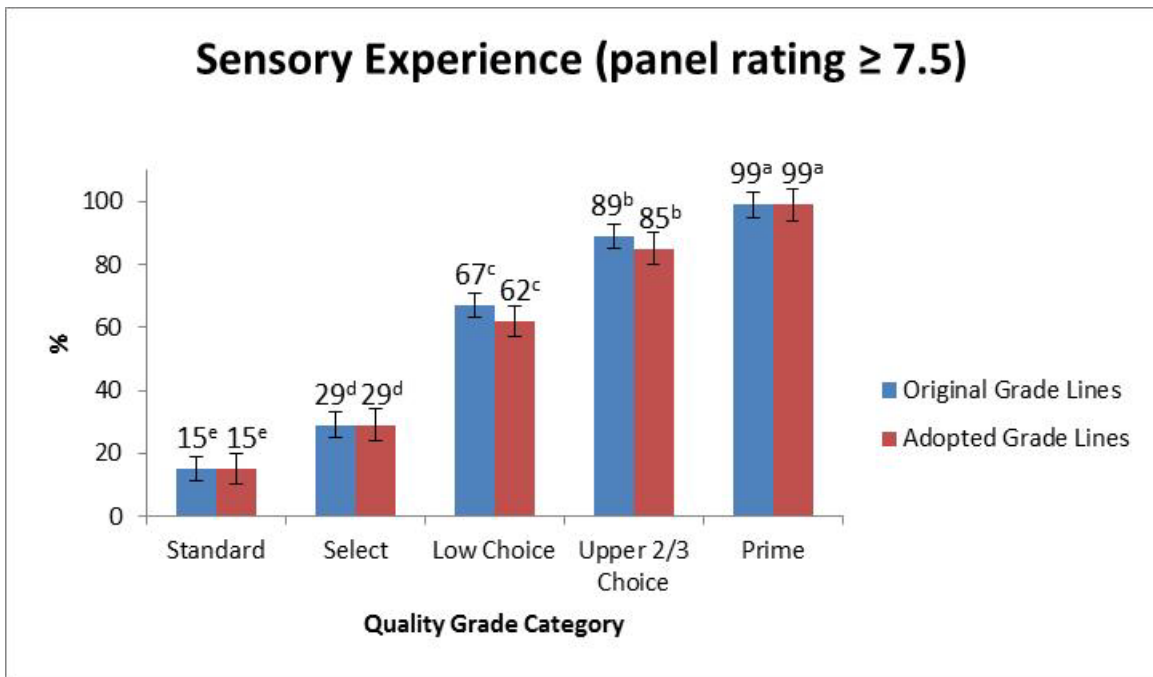
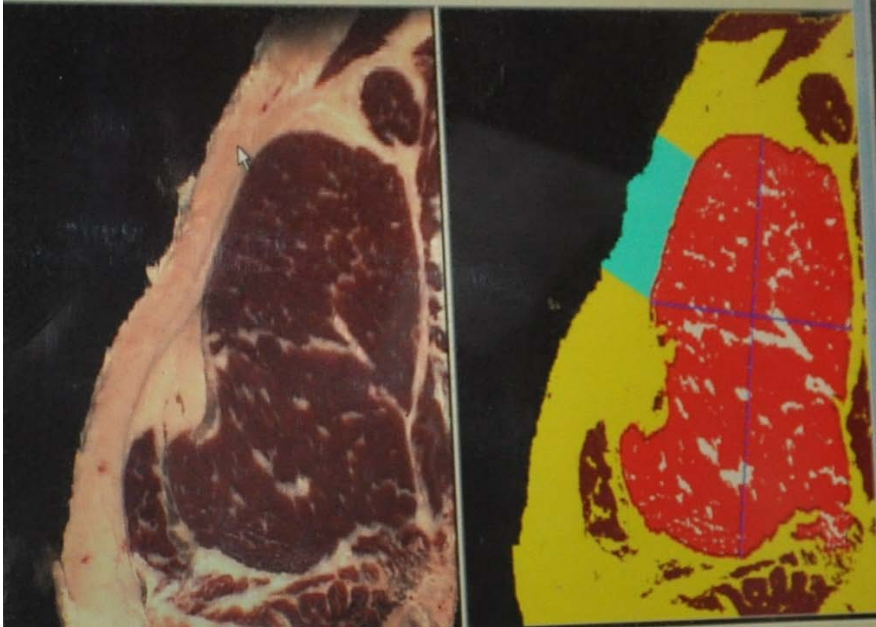


Figure 2. Effect of grade placement approach (original camera grade lines vs. adopted camera grade lines) on frequencies of steaks receiving overall sensory experience ratings ≥ 7.5



For more information contact:
National Cattlemen's Beef Association
9110 East Nichols Avenue
Centennial, Colorado 80112-3450
(303) 694-0305