Colorado State University

Final Report

2011 National Beef Quality Audit
Phase I: Face-to-Face Interviews

**Submitted to National Cattlemen's Beef Association,
Centennial, CO**

April 2012

BEEF
Funded by
The Beef Checkoff

Center for Meat Safety and Quality, Department of Animal Sciences, Colorado State University, Fort Collins, CO 80523-1171
Phone: (970) 491-5826, Fax: (970) 491-0278

J. L. Igo
D. L. VanOverbeke
G. G. Mafi
D. L. Pendell
D. S. Hale
J. W. Savell
D. R. Woerner
J. D. Tatum
K. E. Belk

RESEARCH PROJECT SUMMARY OUTLINE – FINAL REPORT 4/1/2012

I. **Principal Investigator(s):**

J. L. Igo[1], D. L. VanOverbeke[2], G. G. Mafi[2], D. L. Pendell[1], D. S. Hale[3], J. W. Savell[3], D. R. Woerner[1], J.D. Tatum[1], and K.E. Belk[1].

[1]Center for Meat Safety & Quality, Department of Animal Sciences, Colorado State University, Fort Collins, CO 80523-1171. Phone: 970-491-5826. Fax: 970-491-0278. Email: Keith.Belk@colostate.edu

[2]Meat Science, Department of Animal Science, Oklahoma State University, Stillwater, OK 74078-0425.

[3]Texas Agriculture Experiment Station, Department of Animal Science, Texas A&M University, College Station, TX 77843-2471.

II. **Project Title:**

National Beef Quality Audit – 2011 (Phase I: Face-to-Face Interviews)

III. **Project Objectives:**

(1) To identify how customers of feeder calves, fed cattle, beef carcasses, beef whole muscle cuts, and beef variety meats and offal products describe seven specified quality attributes of: (1) How and where the cattle were raised, (2) Lean, fat, and bone, (3) Weight and size, (4) Cattle genetics, (5) Visual characteristics, (6) Food safety, and (7) Eating satisfaction and quantify quality-related details/practices that are important to each customer-sector within each attribute.

(2) To estimate the Contingent Valuation willingness-to-pay (WTP) of the identified sectors for the seven specified quality attributes.

(3) To establish a Best/Worst (BW) ranking of the importance of the specified quality attributes for each sector, as well as an overall ranking of importance for the entire industry.

(4) To document any additional quality-related or financial items of concern to each customer-sector of the industry and quantify their importance.

* In the context in which it will be used in this document, "quality" includes all factors affecting value/desirability of fed slaughter cattle, of their carcasses, products from those carcasses, and of their dress-off/offal items.

IV. **Abstract:**

The National Beef Quality Audit - 2011 evaluated the current status and progress being made towards quality and consistency of cattle, carcasses, and beef products produced by the U.S. fed beef population since the introduction of the National Beef Quality Audit in 1991. The objectives of this research were to determine how each beef market sector defines seven identified quality categories, estimates willingness to pay (WTP) for specified quality categories within each beef market sector, and establishes a best-worst (BW) scaling for the identified quality attributes. Face-to-face interviews were conducted using a modern, dynamic routing instrument over an 11-mo period (February to December 2011) with representatives of the following beef market sectors: Government and Allied Industries (n = 47); Feeders (n = 59); Packers (n = 26); Food Service, Distribution, and Further Processors (n = 48); and Retailers (n = 30). To accomplish the objectives, all responses were characterized using seven pre-established quality categories as the basis for asking interviewees the WTP and BW scaling questions. To determine WTP of the beef market sectors for U.S. fed beef, it was first important to understand what "quality" meant to each sector as it related to the U.S. fed beef products they purchase. To achieve this, "quality" was divided into seven pre-established categories: (1) How and where the cattle were raised, (2) Lean, fat, and bone, (3) Weight and size, (4) Cattle genetics, (5) Visual characteristics, (6) Food safety, and (7) Eating satisfaction, and interviewees in each beef market sector were asked to explain exactly which quality-related details/practices were important within each category. Overall, "Food safety" was the attribute of greatest importance to all beef market sectors except Feeders, who ranked "How and where the cattle were raised" as the most important. "Eating satisfaction" was the attribute of second most importance to all beef

market sectors, except Feeders. Feeders ranked "Weight and size" as the second most important. Overall, "How and where the cattle were raised" had the greatest odds (0.25) of being considered a "non-negotiable requirement" before the raw material for each sector would be considered at all for purchase, and differed ($P < 0.05$) from "Visual characteristics" (0.14), "Lean, fat, and bone" (0.12), "Eating satisfaction" (0.12), "Cattle genetics" (0.10), and "Weight and size" (0.06).   Of all market sectors combined, "Eating satisfaction" calculated the highest average percentage premium (11.1%), but only differed ($P < 0.05$) from "Weight and size" (8.8%). Most notably, when a sector said that "Food safety" was a "non-negotiable requirement," no sector was willing to purchase the product at a discounted price if the "Food safety" of the product could not be assured.

Key words: beef, beef quality, market survey, best-worst scaling, willingness to pay

V. **Background Information:**

Research to identify quality challenges, shortfalls, and targets of desired quality levels for the beef industry has been heavily funded during the past two decades. The research occurs in five year increments in order to give the industry time to adjust practices to overcome shortfalls, as well as time to meet the quality challenges identified. The rationale that prompted the research and continual study of beef industry practices was simply that the U.S. beef industry could not expect increases in prices for its products/byproducts when "quality" did not warrant such increases. Additional prompting of the monitoring system came from the philosophy of W. Edwards Deming, a statistician, who once said, "The industry cannot manage its quality problems until it can measure them (Deming, 1986)." The beef industry needed to identify product quality shortfalls and their root causes, because failure to inhibit or improve beef quality

problems could result in opportunity losses and continued decline in beef demand. Dr. W. Edwards Deming introduced his philosophy to the manufacturing industry of Japan in the post-World War II era and assisted the conquered country in adopting a new philosophy and new management principles. Dr. Deming's work was overlooked in the U.S. until the late 1970s and early 1980s when the Japanese manufacturing industry began dominating U.S. markets. Deming's System of Profound Knowledge was the basis for application of his famous "Deming Method" of Total Quality Management that consists of 14 Points for management and has been adopted throughout the U.S. industry in an attempt to simulate the business success that Japan experienced. Deming explained to the Japanese that, when manufacturing parts for cars or other items, if people and companies focus primarily on quality, quality tends to increase and costs decrease over time. In contrast, when people and companies focus primarily on costs, costs tend to increase and quality decreases over time. Keeping this in mind, the beef industry was challenged to seek out those "quality" suppliers that are reliable and dependable instead of reduced cost suppliers. Differences between the Japanese manufacturing industry and the beef industry presented additional challenges for the US beef industry. The Japanese manufacturing industry was simply focused on bringing in the highest quality pieces and parts to make a high quality end product. In contrast, the beef industry has to focus on building a high quality product, but also goes on to break the product down with the goal of selling high quality pieces and parts. These challenges helped mold the outline for the initial National Beef Quality Audit in 1991.

The first assessment of slaughter cattle quality was performed by Rod Bowling with Monfort Inc., in 1987, who also determined estimates of quality shortfalls in

economic terms. Results of that initial quality assessment showed that, when comparing 1,200 pound "thickly muscled" Hereford steers to "thinly muscled" Holstein steers, the difference in muscle-to-bone ratio was worth $99.96 per head (Smith et al., 1992). In a N.C.A./Texas A&M University/Swift and Company study in 1988, it was concluded that increased value for a carcass grading U.S. Select rather than U.S. Standard (holding carcass weight constant) was $40; for U.S. Choice rather than U.S. Select was $70; for upper two-thirds U.S. Choice versus lower one-third U.S. Choice was $50; and for grading U.S. Prime rather than qualifying for a premium upper two-thirds U.S. Choice program was $25 (Smith et al., 1992). As a result, across all quality grades, there was a difference in value of $185 per head from U.S. Prime to U.S. Standard.

Furthermore, Rod Bowling with Monfort, Inc., in 1989, reported a "Production-Potential Shortfall" of $107.32 per slaughter steer/heifer allocating: $10.57 of the total shortfall to Management Defects (condemnations, bruises, insect damage, dark cutters, injection-site lesions, hot-iron brands, etc.); $19.95 to Quality Deficiencies (too few U.S. Prime and U.S. Choice carcasses; too many U.S. Select and No Roll carcasses); and $76.80 to Yield Problems (too few Yield Grade 1 and Yield Grade 2 carcasses; too many carcasses in Yield Grade 3 and Yield Grade 4) (Smith et al., 1992).

The Value-Based Marketing Task Force of the National Cattlemen's Association, in their report entitled "War On Fat" in August 1990, defined "excess fat" as any fat in excess of what consumers will eat or any fat in excess of 0.6 cm at the 12th - 13th rib interface, the amount necessary to prevent cold-shortening and toughening of muscle fibers. The report estimated that the average amount of excess fat from fed cattle was 39.9 kg per head; the total weight, annually, of excess fat from fed cattle was 0.9 billion

kg, and the total cost, annually, of excess fat from fed cattle was $1.99 billion dollars (Value Based Marketing Task Force, 1990).

Dr. Chuck Lambert, in a report entitled "Lost Opportunities in Beef Production," stated that "U.S. beef producers must compete on a relative price and quality basis with U.S. producers of other meat, as well as with foreign producers of beef (Lambert, 1990)." The report continued with discussion comparing and contrasting the differences of the beef industry with other competitive protein sources and identifying alternative opportunities to reduce the cost of production without having to reduce costs by creating a functionally integrated production system. Lambert estimated that losses of $5.037 billion or $192.36 per head were incurred annually due to quality defects in slaughter steers/heifers, where $0.180 billion was due to hot-iron branding, $0.304 billion was due to outlier cattle, $4.410 billion was due to excess fat, and $0.143 billion was due to management losses (Lambert, 1990). In conclusion, Lambert (1990) stated that "there will always be some lost opportunities or slack in the beef production system; however, if even one-half the total lost opportunities in the beef industry could be addressed, gross industry returns would increase by over $229 per fed steer/heifer."

The aforementioned studies tried to assess the cost or value of beef quality defects in slaughter cattle that was being left on the table, and provided a model to more accurately estimate and verify losses, per slaughter steer/heifer, incurred by the U.S. beef industry due to various quality problems. These previous estimates of "quality defects, shortfalls, or inadequacies" were, at best, educated guesses; none had been verified, authenticated or tested (Smith et al., 1992). With this in mind, the National Cattlemen's Association agreed that the beef industry needed to organize a "National Beef Quality

Audit (NBQA)" to look at quality and to see how beef meets the specifications set by end-users of the product, to measure the industry's performance, and to pinpoint goals for enhancing the identified measures of beef quality by 2001.

Results of the National Beef Quality Audit - 1991

The initial NBQA in 1991 was conducted in three parts, including Face-to-Face Interviews, Harvest Floor and Cooler Assessments, and a Strategy Workshop. In Phase I (Face-to-Face Interviews), those questioned by the interview team found greatest fault with beef's inconsistency, excessive fatness, unreliable palatability, and high price (Smith et al., 1992). The "Top Ten Producer-Controllable Concerns About the 'Quality' of Beef for Retailers" in 1991 were: (1) Excess External Fat, (2) Excessive Weights/Box, (3) Too High Incidence of Injection-Site Blemishes, (4) Excess Seam Fat, (5) Low Overall Cutability, (6) Low Overall Uniformity, (7) Inadequate Tenderness, (8) Too Frequent Bruise Damage, (9) Too Many Dark Cutters, and (10) Too Large Ribeyes/Loineyes (Smith et al., 1992). The "Top Ten Producer-Controllable Concerns About the 'Quality' of Beef for Purveyors" in 1991 were: (1) Excessive External Fat, (2) Too High Incidence of Injection-Site Blemishes, (3) Too Large Ribeyes/Loineyes, (4) Too Frequent Bruise Damage, (5) Excessive Seam Fat, (6) Low Overall Uniformity, (7) Too Many Dark Cutters, (8) Low Overall Cutability, (9) Low Overall Palatability, and (10) Low Overall Appearance (Smith et al., 1992). The "Top Ten Producer-Controllable Concerns About the 'Quality' of Beef for Restaurateurs" in 1991 were: (1) Excessive External Fat, (2) Too High Incidence of Injection-Site Blemishes, (3) Excessive Seam Fat, (4) Too Large Ribeyes/Loineyes, (5) Insufficient Marbling, (6) Low Overall Cutability, (7) Too Many Dark Cutters, (8) Inadequate Tenderness, (9) Inadequate Flavor, and (10) Low Overall

Uniformity (Smith et al., 1992). The "Top Ten Producer-Controllable Concerns About the 'Quality' of Beef for Packers" in 1991 were: (1) Too Frequent Hide Problems, Caused by Brands, Insects, Parasites, and Mud/Feces/Urine, (2) Too High Incidence of Injection-Site Blemishes, (3) Excessive Carcass Weights, (4) Too Many Bruises, (5) Reduced Quality: Lower Marbling Scores, More Ossification of the Skeletal System, Elevated Incidence of Dark Cutters, and Decreased Tenderness (Due to Use of Implants), (6) Too Many Liver Condemnations, (7) Too Few U.S. Choice Carcasses, (8) Too Many Yield Grade 4 and 5 Carcasses, (9) Lack of Uniformity of Live Cattle and Carcasses, and (10) Too Many Dark Cutters (Smith et al., 1992).

In Phase II (Packing Plant Audits), Lorenzen et al. (1993) reported that slaughter floor data revealed: (1) Brand Incidence was 45%, (2) Presence of Horns was 31.1%, (3) Excessive Mud Incidence was 6.8%, (4) Liver, Lungs, Tripe and Entire-Viscera Condemnations were 19.2%, 5.1%, 3.50% and 0.1%, respectively, (5) Head and Tongue Condemnations were 1.1% and 2.7%, respectively, (6) Pregnancy was 2.7% of heifers, and (7) Bruise Incidence was 16.7%, 14.4%, 23.4% and 2.7%, respectively, on chucks, ribs, loins and rounds (Lorenzen et al., 1993). Cooler data revealed: (1) Bullock Incidence was 1.1%, (2) Carcass Maturity was 93% A-maturity, 6.7% B-maturity, and 0.3% C-maturity, (3) Marbling Score Incidence included 0.3% Practically Devoid and 5.8% Traces, (4) Dark Cutter Discount Incidence included 3.4% one-third grade, 1.2% two-thirds grade and 0.5% one full grade, (5) Blood Splash Incidence was 0.7%, (6) USDA Quality Grade Incidence included 7.6% Standard and 0.5% Commercial/Utility/Cutter/Canner, (7) Carcass Weight Incidence included 3.9% less than 272.2 kg and 6.9% more than 408.2 kg, (8) Fat Thickness Incidence included 2.2% less

than 0.5 cm and 19.6% greater than 2.0 cm, (9) Ribeye Area Incidence included 9.9% less than 27.9 square cm and 10.3% greater than 37.8 square cm, and (10) USDA Yield Grade Incidence included 10.0% Yield Grade 1, 13.6% Yield Grade 4 and 2.9% Yield Grade 5 (Smith et al., 1992).

In Phase III (Strategy Workshop), using the knowledge gained during Phase I and II, the benefit and ultimate objective was characterized as "Improving the Consistency and Competitiveness of Fed-Beef." Economic assessment of quality losses per slaughter steer/heifer was made and an agreement was reached that established, the beef industry was losing $279.82 for every slaughter steer/heifer in the U.S. during 1991 through "Quality Problems, Defects, Shortcomings/ Shortfalls." Lorenzen et al. (1993) reported that the amounts lost were $219.25 due to Waste, $28.81 because of Taste, $27.26 due to Management, and $4.50 because of Weight. Industry leaders were invited to the Strategy Workshop where they participated in various sessions and also determined that the ten best strategies for "Improving the Consistency and Competitiveness of Fed-Beef" were: (1) encourage quarter-inch fat trim as the new "commodity" fat trim specification for beef primals/subprimals; (2) change live-to-carcass price logic from dressing percentage to red meat yield; (3) keep the "heat" on communicating cutability to retailers and packers by improving understanding of the value of closer-trimmed beef; (4) go after, and correct, management practices that create non-conformity; (5) eliminate biological types of cattle (not breeds per se) that fail to conform; (6) institute quality-based marketing; (7) identify outlier-values for specific carcass traits; (8) design and conduct the strategic alliance field-studies; (9) use the national beef carcass data collection program to identify superior seedstock; and (10) repeat the NBQA at periodic intervals to assess progress and

identify new opportunities for improvements in consistency and competitiveness of fed-beef (Smith et al., 1992). Subsequent similar audits in 1995 and 2000 evaluated the degree of modifications that occurred relative to correcting the quality deficiencies and concerns compared to the initial benchmark NBQA in 1991.

Results of the National Beef Quality Audit - 1995

The NBQA 1995 was conducted as the sequel to the 1991 Audit to determine the degree of changes made by the beef industry in a short time frame. This NBQA allowed the beef industry to make mid-course corrections with regard to what could be accomplished, in light of what was known, to improve the quality, consistency, competitiveness and market-share of beef (Smith et al., 1995). In Phase I, those questioned established that the industry had focused on and made improvements in many of the top-of-mind areas of concern since the 1991 NBQA, but with these improvements, many new challenges surfaced. The "Top Ten Producer-Controllable Concerns About the 'Quality' of Beef for Purveyors" in 1995 were: (1) Excessive External Fat, (2) Too Large Ribeyes/Loineyes, (3) Low Overall Uniformity and Consistency, (4) Insufficient Flavor, (5) Inappropriate USDA Quality Grade Mix, (6) Low Overall Palatability, (7) Low Overall Cutability, (8) Inadequate Tenderness, (9) Beef's Price is Too High for the Value Received, and (10) Too High Incidence of Injection-Site Lesions (Smith et al., 1995). Improvements made between the 1991 and 1995 NBQAs for purveyors included Too High Incidence of Injection-Site Lesions moving from second in 1991 to tenth in 1995, Too Much Bruise Damage moving from fourth to out of the top ten concerns, and the emerging concern of Insufficient Flavor that was not in the top ten in 1991 moved to fourth in 1995. The "Top Ten Producer-Controllable Concerns About the 'Quality' of

Beef for Retailers" in 1995 were: (1) Low Overall Uniformity and Consistency, (2) Inadequate Tenderness, (3) Excessive Weights of Cuts and Boxes of Cuts, (4) Low Overall Palatability, (5) Beef's Price is Too High for the Value Received, (6) Inappropriate USDA Quality Grade Mix, (7) Insufficient Flavor, (8) Excessive Seam Fat, (9) Excessive External Fat, and (10) Too High Incidence of Injection-Site Lesions (Smith et al., 1995). Adjustments in concerns between 1991 and 1995 for retailers included Excessive External Fat ranking first in 1991 to ninth in 1995, Too High Incidence of Injection-Site Lesions moving from third in 1991 to tenth in 1995, and Low Overall Palatability increasing as a concern from not in the top ten in 1991 to fourth in 1995. The "Top Ten Producer-Controllable Concerns About the 'Quality' of Beef for Restaurateurs" in 1995 were: (1) Excessive External Fat, (2) Low Overall Uniformity and Consistency of Beef, (3) Inadequate Tenderness, (4) Beef's Price is Too High for the Value Received, (5) Low Overall Palatability, (6) Excessive Weights of Cuts and Boxes of Cuts, (7) Low Overall Cutability, (8) Too High Incidence of Injection-Site Lesions, (9) Too High Occurrence of Dark and Unattractive Lean, and (10) Insufficient Flavor (Smith et al., 1995). Consensus shifted between 1991 and 1995 for restaurateurs which included Excessive Seam Fat and Too Large Ribeyes/Loineyes moving from third and fourth, respectively, in 1991 to not in the top ten as concerns in 1995, and Beef's Price is Too High for the Value Received going from not being a top ten concern in 1991 to fourth in the 1995 NBQA. The "Top Ten Producer-Controllable Concerns About the 'Quality' of Beef for Packers" in 1995 were: (1) Lack of Uniformity and Predictability of Live Cattle, (2) Too High Rate of Liver Condemnations, (3) Too Frequent Hide Damage Due to Mud/Manure, (4 tie) Too Frequent Bruise Damage, (4 tie) Too Many Dark Cutters, (4 tie)

Excessive External Fat, (7) Cattle of Too Heavy Weight, (8) Inadequate Marbling, (9 tie) Too Frequent Hide Damage Due to Hot-Iron Brands, and (9 tie) Beef's Price is Too High for the Value Received (Smith et al., 1995). Packer concerns of Lack of Uniformity and Predictability of Live Cattle and Hide Damage Due to Mud/Manure both shifted from not being a top ten concern in 1991 to being ranked first and third, respectively, in 1995. In 1991, packers ranked Too High Incidence of Injection-Site Lesions as the second greatest concern and it was not considered a top ten concern by 1995 (Smith et al., 1995).

In Phase II, Boleman et al. (1998) reported that slaughter floor data revealed: (1) Brand Incidence was higher (52.3%) in 1995 than in 1991 (45.0%), (2) Presence of Horns (32.2%) was about the same as in 1991 (31.1%), (3) Excessive Mud Incidence, in 1995, was lower (5.1%) than in 1991 (6.8%), (4) Liver, Lungs and Tripe Condemnations were 22.2%, 5.0% and 11.0% in 1995 and were higher, the same and dramatically higher, respectively, than in 1991, at 19.2%, 5.1% and 3.5%, (5) Head and Tongue Condemnations, at 0.9% and 3.8%, respectively, in 1995 were not substantially different from those (1.1% and 2.7%) in 1991, and (6) Bruises (1 or more) were much higher (48.4%) in 1995 than in 1991 (39.2%; Boleman et al., 1998).

Cooler data revealed: (1) Percentages of carcasses in Yield Grades 1 and 2 increased in percentages from 1991 to 1995, from 44% to 58%, respectively; (2) percentages of slaughter steers/heifers that graded USDA Prime and Choice decreased from 1991 (55%) to 1995 (48%); (3) from 1991 to 1995, Carcass Weight decreased 5.4 kg, Fat Thickness decreased 0.3 cm, Ribeye Area decreased 0.3 square cm, Kidney/Pelvic/Heart fat percentage decreased 0.1 percentage point and USDA Yield Grade improved by 0.34 YG units (Boleman et al., 1998). Additionally, (4) percentage

of Dark Cutting beef carcasses decreased from 1991 (5.0%) to 1995 (2.7%), (5) percentage of carcasses that graded USDA Prime decreased from 1991 (2.3%) to 1995 (1.3%), percentage of carcasses that graded upper two-thirds USDA Choice decreased from 1991 (17.1%) to 1995 (11.4), percentage of carcasses that graded lower one-third USDA Choice decreased from 1991 (37.1%) to 1995 (36.6%), percentage of carcasses that graded USDA Select increased from 1991 (36.9%) to 1995 (46.7%), percentage of carcasses that graded USDA Standard decreased from 1991 (7.6%) to 1995 (4.6%), and (6) Carcass Weight decreased from 1991 (344.7 kg) to 1995 (339.2 kg), Fat Thickness decreased from 1991 (1.5 cm) to 1995 (1.2 cm), Ribeye Area remained constant from 1991 (32.8 square cm) to 1995 (32.5 square cm), and Yield Grade decreased from 1991 (3.16) to 1995 (2.82; Smith et al., 1995).

In Phase III, the vital objective, in getting the most knowledge gained from this effort, was described as "Improving the Quality, Consistency, Competitiveness and Market-Share of Beef: A Blueprint for Total Quality Management in the Beef Industry." Economic assessment of quality losses per slaughter steer/heifer harvested was made and consensus was achieved differing mechanics and assumptions from those used in 1991, called a "mid-course correction." It was agreed-upon that the beef industry was losing - through Quality Problems/Defects/Shortcomings/Shortfalls - $137.82 for every slaughter steer/heifer harvested in the U.S. during 1995 (Smith et al., 1995). The amount of dollars lost attributed to Waste were $47.76, $38.30 due to Taste, $47.10 because of Management, and $4.66 attributable to Weight.

Participants, guests, and industry leaders that attended the Strategy Workshop worked to determine the ten best strategies for "Improving the Quality, Consistency,

Competitiveness and Market-Share of Beef" which were: (1) assist producers to use selection and management techniques to produce cattle that fit customer expectations for marbling, red meat yield and weight; (2) establish close-trimmed beef (one-quarter inch or less) as the industry standard; (3) develop a cattle identification system that facilitates data collection and information feedback, and that reduces reliance on hot-iron branding; (4) encourage development of cattle-pricing systems that accurately identify and reward production of cattle with zero defects; (5) encourage development of cattle-pricing systems that identify, categorize and price product attributes that affect consumer satisfaction; (6) continue to discover, develop and apply technology to enhance the quality of beef; (7) identify breeding systems that optimize production, palatability and profitability; (8) identify procedures to facilitate improved customer satisfaction and loyalty to the beef eating experience (Smith et al., 1995). Subsequent audits followed the NBQA 1991 and 1995 in order to continually monitor the beef industry and identify which areas of quality concerns needed to be addressed.

Results of the National Beef Quality Audit - 2000

In Phase I, the "Top Ten Greatest Quality Challenges By Those in the Seedstock Generator, Cow-Calf Producer, Stocker/Backgrounder and Feedlot Operator Sectors" by 2000 were: (1) Inadequate Tenderness, (2) Lack of Uniformity in Live Cattle, (3) Insufficient Marbling/USDA Quality Grades Too Low, (4) Too Frequent Injection-Site Lesions, (5) Inadequate Flavor, (6) Low Cutability, (7) Excess Fat Cover, (8) Carcass Weights Too Heavy, (9) Inadequate Muscling, and (10) Presence of Bruises on Carcasses (Smith et al., 2000). The "Top Ten Changes Made By Feedlot Operators" since 1995 were: (1) Changed Injection-Site Location, (2) Changed the Genetic Type(s) of Cattle, (3)

Collected and Used Carcass Data, (4) Improved Handling Practices, (5) Increased Record Keeping, (6) Increased Worker/Employee Awareness, (7) Changed Implant Strategy, (8) Provided Incentive for Preconditioning, (9) Maintained Health/Management Data, and (10) Increased Individual Animal Identification (Smith et al., 2000). The "Top Ten Greatest Quality Challenges Identified by Packers" by 2000 were: (1) Lack of Uniformity in Live Cattle, (2) Carcass Weights Too Heavy, (3) Excess Fat Cover, (4) Inadequate Tenderness, (5) Insufficient Marbling/USDA Quality Grades Too Low, (6) Reduced Quality Grade/Tenderness Due to Implants, (7) Assuring Food Safety, (8) Low Cutability, (9) Presence of Bruises on Carcasses, and (10) Too High (numerically) USDA Yield Grades (Smith et al., 2000). The "Top Ten Greatest Quality Challenges According to Responses of Purveyors, Retailers and Restaurateurs" in 2000 were: (1) Insufficient Marbling, (2 tie) Lack of Uniformity in Cuts, (2 tie) Inadequate Tenderness, (4) Excess Fat Cover, (5) Inadequate Flavor, (6) Too Heavy Cut Weights, (7) Too Large Ribeyes, (8) Low Cutability, (9) Inadequate Juiciness, and (10) Inadequate Overall Palatability (Smith et al., 2000).

The "Top Ten Greatest Quality Improvements" by 2000, according to packers were associated with a reduction in incidence of some quality defects or nonconformities, including: (1) Presence of Injection-Site Lesions, (2) Carcass Weights Too Light, (3) Reduced Quality Grade/Tenderness Due to Implants, (4) Inadequate Muscling, (5) Too Small Ribeyes, (6) Hide Damage Due to Parasites, (7) Carcass Condemnations, (8) Excess Fat Cover, (9) Presence of Bruises on Carcasses, and (10) Hide Damage Due to Brands (Smith et al., 2000). The "Top Ten Greatest Quality Improvements" by 2000, according to purveyors were associated with a reduction in incidence of some quality

defects or nonconformities, including: (1) Presence of Bruises on Cuts, (2) Injection-Site Lesions, (3) Excess Fat Cover, (4) Inadequate Overall Palatability, (5) Low Cutability, (6) Inadequate Flavor, (7) Lack of Uniformity in Cuts, (8) Inadequate Tenderness, (9) Insufficient Marbling, and (10) Inadequate Juiciness (Smith et al., 2000). The "Top Ten Greatest Quality Improvements" according to retailers by 2000 were associated with a reduction in incidence of some quality defects or nonconformities, including: (1) Excess Fat Cover, (2) Presence of Bruises on Cuts, (3) Injection-Site Lesions, (4) Low Cutability, (5) Lack of Uniformity of Cuts, (6) Inadequate Muscling, (7) Excess Seam Fat, (8) Inadequate Overall Palatability, (9 tie) Cut Weights Too Light, and (9 tie) Inadequate Tenderness (Smith et al., 2000). Finally, the "Top Ten Greatest Quality Improvements" according to restaurateurs in 2000 were associated with a reduction in incidence of some quality defects or nonconformities, including: (1 tie) Presence of Bruises on Cuts, (1 tie) Injection-Site Lesions, (3) Excess Fat Cover, (4 tie) Inadequate Overall Palatability, (4 tie) Inadequate Flavor, (4 tie) Inadequate Tenderness, (7) Lack of Uniformity in Cuts, (8) Inadequate Juiciness, (9) Inadequate Muscling, (10 tie) Cut Weights Too Light, and (10 tie) Insufficient Marbling (Smith et al., 2000).

In Phase II, McKenna et al. (2002) reported slaughter floor data revealed a frequency of: (1) Brand Incidence (50.7%) was about the same in 2000 and 1995 (52.3%), but still higher than in 1991 (45%), (2) Presence of Horns was lower (22.7%) than both previous audits in 1995 and 1991 (32.2% and 31.1%, respectively), (3) Cattle With Excessive Mud/Manure Incidence was lower (3.8%) in 2000 than both previous audits in 1995 and 1991 (5.1% and 6.8%, respectively), (4) Cattle With Bruises (46.7%) in 2000 was about the same as in 1995 (48.4%) and higher than in 1991 (39.2%), (5)

Liver, Lungs, and Tripe Condemnations were 30.3%, 13.8%, and 11.6%, respectively, in 2000 and Liver and Lungs were higher than both the 1995 (22.2% and 5.0%) and the 1991 Audit (19.2% and 5.1%), and (6) Head and Tongue Condemnations increased drastically in 2000 (6.2% and 7.0%, respectively), when compared to the 1995 audit (0.9% and 3.8%) and the 1991 audit (1.1% and 2.7%; McKenna et al., 2002).

Cooler data revealed that the frequency for: (1) slaughter steers/heifers that graded USDA Prime and USDA Choice (51.0%) in 2000 was increased from (48.0%) 1995 and decreased from (55.0%) 1991, (2) A-maturity carcasses (96.6%) 2000, was slightly increased in percentage compared to both the 1995 and 1991 audits (95.1% and 93.0%, respectively), (3) B-maturity and Hardbone carcasses (3.4%) 2000 was slightly decreased compared to both the 1995 and 1991 audits (4.9% and 7.0%, respectively), (4) USDA Standard carcasses (5.6%) 2000 was slightly increased from 1995 (4.6%), but still decreased from 1991 (7.6%), (5) Carcass Fat Thickness averaged 1.2 cm in 2000 which was similar to 1.2 cm in 1995 and decreased from 1.5 cm in 1991, (6) Carcass Weight averaged 357.0 kg, and was increased from both the 1995 and 1991 Audits (339.2 and 344.7 kg, respectively), (7) Ribeye Area averaged 33.3 square cm and was similar to both the 1995 and 1991 average Ribeye Area (32.5 and 32.7 cm, respectively), and (8) Yield Grade averaged 3.0 and was similar to both the 1995 and 1991 audits (2.8 and 3.2, respectively).

In Phase III, it was agreed upon that, using a "new 2000 Logic/Prices," the beef industry was losing through Quality Problems/Defects/ Shortcomings/ Shortfalls, (1) $42.80 due to Excess External Fat/Excess Seam Fat per fed steer and heifer, (2) $8.16 allocated to Inappropriate Muscling per fed steer and heifer, (3) $2.39 due to Palatability,

(4) $20.96 for Insufficient Marbling per fed steer and heifer, (5) $0.63 due to Hardbone carcasses per fed steer and heifer, (6) $0.47 partitioned for Bullock carcasses per fed steer and heifer, (7) $1.70 due to Hide Defects Due to Branding per fed steer and heifer, (8) $0.96 for Carcass Pathology per fed steer and heifer, (9) $4.54 due to Offal Condemnations per fed steer and heifer, (10) $3.59 partitioned for Injection-Site Lesions per fed steer and heifer, (11) $0.75 due to Bruise Trim per fed steer and heifer, (12) $5.43 allocated for Dark Cutters per fed steer and heifer, (13) $1.26 for Blood Splash, Callused Ribeyes, Yellow Fat per fed steer and heifer, and (14) $6.46 due to Light and Heavy Weight Carcasses per fed steer and heifer, totaling $100.10 of value losses for quality challenges per fed steer and heifer (Smith et al., 2000). Using the 1991 Logic/Prices, Smith et al. (2000) found that in the NBQA-2000, the total value losses for quality challenges identified in Phase II of the Audits was $271.27 which had decreased by $6.54 or 2.35% from 1991, and was $277.81 per slaughter steer/heifer; when compared to the 1995 NBQA using the 1995 Logic/Prices, the total value losses in 2000 were $114.92 versus $135.88 in 1995 down $20.96 or 15.43% per slaughter steer/heifer.

Participants/guests at the Strategy Workshop determined that the nine best "Strategies for Improving the Consistency and Competitiveness of Fed-Beef" were: (1) assist producers with use of selection and management techniques to produce cattle that fit customer expectations for marbling, red meat yield, weight and other value-determining attributes; (2) assist producers with the process of collecting and analyzing data and sharing and utilizing information; (3) enhance an already commendable record in regards to the production of safe, nutritious and wholesome beef; (4) assure delivery of predictable and uniform lots of cattle by more correctly managing implants, nutrition,

horns, castration, sorting and health programs while refining selection strategies to meet specific market windows; (5) assure that the needs of case-ready product marketing efforts can be met by improving the yield, consistency and palatability characteristics of beef; (6) implement new production technologies only after carefully considering the consumer demand-perception, economic, environment and animal welfare consequences; (7) encourage continued use of cattle-marketing systems that identify, categorize and assign prices to product attributes that affect consumer satisfaction by appropriately rewarding and discounting performance; (8) identify breeding, management and sorting systems that optimize production, palatability, cutability and profitability; and (9) encourage post-harvest product enhancement technologies to assure the delivery of suitably tender and flavorful products to consumers while simultaneously managing the pre-harvest production process to achieve the same objectives (Smith et al., 2000).

Results of the National Beef Quality Audit - 2005

The most recent benchmark evaluation of the beef industry was conducted in 2005 and 2006. In Phase I, Smith et al. (2005a) reported those questioned confirmed that the industry had continued to address many of the top-of-mind concerns since the 1991, 1995 and 2000 NBQAs, but many new challenges had also surfaced. The "Top Ten Changes Made by Seedstock Producers" in 2005 were: (1) Improved Genetics (Using Performance), (2) Improved Genetics (Using Physical Traits), (3) Improved Genetics (Using Ultrasound), (4) Increased Record Keeping, (5) Changed Injection-Site Location, (6) Changed Vaccination Program, (7) Improved Genetics (Using Carcass Traits), (8) Joined Alliance/Supply Chain, (9) Increased Individual Animal Identification, and (10) Improved Handling Practices (Smith et al., 2005a).

The "Top Five Greatest Improvements Identified by Packers" in 2005 were: (1 tie) Presence of Injection-Site Lesions, (1 tie) Food Safety, (3) Carcass Weights Too Light, (4 tie) Presence of Bruises on Carcasses, and (4 tie) Liver Condemnations (Smith et al., 2005a). The "Top Six Greatest Quality Challenges Identified by Packers" were: (1) Reduced Grade/Tenderness Due to Implants, (2) Lack of Uniformity in Live Cattle, (3 tie) Carcass Weights Too Heavy, (3 tie) Yield Grades Too High, (5 tie) Presence of Bruises on Carcasses, and (5 tie) Hide Damage Due to Brands. Positive advances made in regards to quality challenges from the NBQA 2000 were that Excess Fat Cover, Inadequate Tenderness, Insufficient Marbling/Quality Grades Too Low, Food Safety, and Low Cutability were not identified as a "Top Five" Challenge by the NBQA 2005. Additionally, Hide Damage Due to Brands was not a "Top Ten" Challenge in 2000, and was tied for fifth in 2005. Presence of Bruises, Yield Grades Too High, and Reduced Grade/Tenderness Due to Implants all entered the "Top Five" Challenges in the NBQA 2005 compared to the results of the NBQA 2000. The "Top Ten Greatest Quality Challenges According to Responses of Purveyors" in 2005 were: (1) Cut Weights Too Heavy, (2 tie) Insufficient Marbling, (2 tie) Lack of Uniformity in Cuts, (2 tie) Too Large Ribeyes, (5 tie) Low Cutability, (5 tie) Inadequate Overall Palatability, (7) Excess Fat Cover, (8) Inadequate Tenderness, (9) Excess Seam Fat, and (10) Presence of Bruises on Cuts (Smith et al., 2005b). When compared to the NBQA 2000, Cut Weights Too Heavy went from fourth in 2000 to first in 2005, Too Large Ribeyes went from fifth in 2000, tied for second in 2005, and Excess Fat Cover moved down from third in 2000 to seventh in 2005. The "Top Eight Greatest Quality Challenges According to Responses of Retailers" in 2005 were: (1) Insufficient Marbling, (2) Lack of Uniformity in Cuts, (3 tie)

Inadequate Tenderness, (3 tie) Inadequate Flavor, (3 tie) Cut Weights Too Heavy, (3 tie) Excess Fat Cover, (3 tie) Inadequate Overall Palatability, and (3 tie) Inadequate Juiciness (Smith et al., 2005b). The positives from the NBQA 2005 according to retailers were that Inadequate Tenderness moved from first in 2000 to tied for third in 2005, and Too Large Ribeyes and Presence of Bruises on Cuts were ninth and tenth, respectively, in 2000 and were not a "Top Eight Challenge" by 2005. The "Top Eleven Greatest Quality Challenges According to Restaurateurs" in 2005 were: (1) Insufficient Marbling, (2) Excess Fat Cover, (3) Inadequate Juiciness, (4 tie) Inadequate Tenderness, (4 tie) Inadequate Flavor, (4 tie) Cut Weights Too Heavy, (4 tie) Low Cutability, (8 tie) Lack of Uniformity in Cuts, (8 tie) Too Large Ribeyes, (10 tie) Excess Seam Fat, and (10 tie) Cut Weights Too Light (Smith et al., 2005b). Inadequate Tenderness moved from first in the NBQA 2000 to tied for fourth in the NBQA 2005, Inadequate Flavor went from being tied for third in the NBQA 2000, to tied for fourth in the NBQA 2005, and Excessive Seam Fat went from being eighth in the NBQA 2000 to being tied for tenth in the NBQA 2005.

In Phase II, Garcia et al. (2008) reported harvest floor data revealed that the frequency of: (1) Brand Incidence was about the same in 2005, 2000 and 1995 (50.5%, 50.7%, 52.3%, respectively), and higher than in 1991 (45%), (2) Presence of Horns was similar in 2005 and 2000 (23.7%, 22.7%, respectively), and still much lower than the 1995 and 1991 audits (32.2%, 31.1%, respectively), (3) Cattle With Excessive Mud/Manure Incidence was the lowest in 2005 (2.8%) of all the audits when compared to 2000, 1995, and 1991 (3.8%, 5.1%, and 6.8%, respectively), (4) Cattle With Bruises was also the lowest value seen in 2005 (35.8%) compared to all of the previous audits in

2000, 1995, and 1991 (46.7%, 48.4%, and 39.2%, respectively), (5) Liver, Lungs, and Tripe Condemnations were reduced (24.7%, 10.56, and 7.76, respectively), in 2005 compared to 2000 (30.3%, 13.8%, and 11.6%, respectively), and (6) Head and Tongue Condemnations in 2005 (4.81%, 8.85%, respectively), were similar to those in 2000 (6.2%, 7.0%, respectively), and higher than 1995 (0.9%, 3.8%, respectively), and 1991 (1.1%, 2.7%, respectively; Garcia et al., 2008).

Cooler audit data revealed that: (1) percentages of slaughter steers/heifers that graded USDA Prime and Choice in 2005 (56.0%) increased from 2000 and 1995 (51.0% and 48.0%, respectively), and was similar to that in 1991 (55.0%), (2) A-maturity carcasses in 2005 (97%) was similar to 2000 (96.6%) and increased compared to the percentages in 1995 and 1991 (95.1% and 93.0%, respectively), (3) B-maturity and Hardbone carcasses in 2005 (2.9%) decreased from all previous audits (3.4%, 4.9%, and 7.0%, respectively), (4) USDA Standard carcasses in 2005 (4.1%) decreased compared to all previous audits (5.6%, 4.6%, and 7.6%, respectively), (5) Carcass Fat Thickness in 2005 (1.3 cm) increased from 2000 and 1995 (1.2 cm and 1.2 cm, respectively), but still was decreased compared to those in 1991 (1.5 cm), (6) Carcass Weight averaged 361.5 kg, increased from 2000, 1995, and 1991 (357.0, 338.8, and 344.7 kg, respectively), (7) Ribeye Area averaged 34.0 square cm in 2005 and was increased from 2000, 1995 and 1991 (33.3, 32.5, and 32.8 square cm, respectively), and (8) Yield Grade in 2005 (2.9) was comparable to those in 2000, 1995, and 1991 (3.0, 2.8, and 3.2, respectively).

In Phase III, it was agreed upon that, using a "new 2005 Logic/Prices," the beef industry was losing through Quality Problems/Defects/ Shortcomings/ Shortfalls, (1) $20.92 due to Yield Grade per fed steer and heifer, (2) $26.81 due to Quality Grade per

fed steer and heifer, (3) $4.94 due to Weight, and (4) $3.01 for Hide and Offal per fed steer and heifer, totaling $55.68 of value losses for quality challenges per fed steer and heifer (Smith et al., 2005b). Using the 2005 Logic/Prices, Smith et al. (2005b) found that in the NBQA-2005, the total value losses for quality challenges identified in Phase II of the Audits was $55.68 which had decreased by $14.52 from 1991 ($70.20) per fed steer/heifer; when compared to the NBQA-2000, the total value losses for quality challenges identified in Phase II of the Audits was $63.71 which had decreased by $6.49 from 1991; when compared to the 1995 NBQA using the 2005 Logic/Prices, the total value losses in 1995 were $58.01 down $12.19 from 1991 per fed steer/heifer.

In Phase III (Strategy Workshop), it was agreed that the "Top-18 Greatest Quality Challenges Developed by Participants at the Strategy Workshop" in 2005 were: (1) lack of traceability/individual animal ID/source and age verification/chronological age, (2) low overall uniformity of cattle, carcasses and cuts, (3) need for implementation of instrument grading, (4) inappropriate market signals, (5) segmentation between groups, (6) carcass and cut weights too heavy, (7) yield grades too high/low cutability, (8) inappropriate ribeye size (too small or too large), (9) reduced grade/tenderness due to implants, (10) excessive condition/fat cover/seam fat, (11) insufficient marbling, (12) lack of individualized management/management plans, (13) genetics to produce optimum carcass traits, (14) insufficient system for data capture, (15) multiple drug resistant *Salmonella*, (16) too frequent and severe bruises, (17) too frequent liver condemnations, and (18) feed ban compliance (Smith et al., 2005b).

Participants and guests at the Strategy Workshop determined that the best "Strategies for Improving the Consistency and Competitiveness of Fed-Beef" in 2005

were: (1) deliver product attributes that meet consumer needs/expectations for safety, taste, color and convenience; (2) improve the cattle supply by implementing instrument grading, reduce the number of Yield Grade 4 and 5 carcasses and control carcass weight, increase marbling, decrease variation, and maximize profitability; (3) expand marketing opportunities (in domestic and global markets) by developing traceability systems, verify source and age, reduce costs and waste in the beef value chain, and continue new product development; and (4) strengthen the connection among segments of the beef chain via communication and targeted educational programs (Smith et al., 2005a). Results from the 2005 audit were used to establish a new benchmark to help the U.S. beef industry improve the consistency and competitiveness of fed beef.

Willingness-to-Pay

The increased importance of benchmarking "quality" as it is related to the challenges, shortfalls and targets of the U.S. beef industry has been a continual process since 1991. However, a common restriction of previous NBQAs was the limited amount of importance placed on using objective measures to establish the value of specified quality attributes when deciding to purchase cattle and/or beef products. To do this, it is necessary to understand how each beef market sector defines "quality" as it is related to the specified quality categories of beef products in order to determine what exactly is important and what exactly within each category each sector is willing to pay a premium.

A number of methods have been employed as objective measures in economic studies, and in recent years, estimates of consumer willingness-to-pay (WTP) for new value-added traits are becoming important determinants of new product adoption (Lusk,

2003). The WTP concept was derived from welfare economics and defined as the marginal rate of substitution of particular attributes/levels for money (Louviere and Islam, 2008). Contingent Valuation (CV) procedures establish a hypothetical market in which a good that is usually unpriced can be bought or sold, and where participants are asked to state either their monetary valuation of a proposed change in the amount or availability of the good, or whether they would pay a specified sum for the good (Gregory and Furby, 1987). Willingness-to-pay studies are a structured survey technique within the CV method of economic analysis (Loomis et al., 1997). Initially, literature on WTP estimation was in the context of CV, where the primary focus was on environmental issues and on the measurement of aggregate welfare (Hanemann, 1984). More recently, the CV method has become more popular in valuing food quality attributes (Lusk, 2003).

Contingent Valuation studies can be administered to consumers in different question formats. The question format utilized in the current study is referred to as dichotomous choice. In dichotomous choice experiments, respondents are asked whether or not they would pay a given dollar amount, which varies randomly from respondent to respondent, for a good or service, and then from this, the maximum WTP value that the population would pay determined (Hanemann, 1984). Another example of question format utilized in CV studies is an auction bidding method. The auction bidding experimental valuation method described by Davis and Holt (1993) is designed to reveal the consumers' "true preferences" and provides a more reliable estimate of consumers' WTP than hypothetical WTP survey methods.

According to Gregory and Furby (1987), the CV methodology has some advantages over other valuation methods, primarily that there is no requirement to obtain a supply of the experimental product. This is simply due to the fact that the process is entirely hypothetical, thus only the need for information regarding the product is necessary. Because of this, another advantage to the CV method is that the context of the valuation question, such as benefits received from consumption of the product, can easily be given to the participants (Gregory and Furby, 1987). Disadvantages in WTP estimates according to Cummings et al. (1995) include hypothetical bias in WTP estimates where individuals often overstate their WTP in hypothetical CV situations. Feldkamp et al. (2005) stated that another disadvantage is the hypothetical nature of the question, it may cause participants to view their responses as inconsequential, and as a result, there is no incentive to truthfully report private values in hypothetical exercises. Because of this, Murphy et al., (2010) stated that several research reviews have found that when using a "hypothetical" WTP method instead of requiring "actual" expenditure, "actual" WTP estimates can be overestimated by 2 to 3-times, while others suggest 4 to 6-times times greater than "actual" WTP values.

Best-Worst Scaling

Before the Best-Worst (BW) scaling technique was available, Uusitalo (1990) demonstrated that one could use the analytical hierarchy process to derive a collective preference ranking of eight objectives using consumers' rating of the relative importance of one goal versus another for all possible pairs of eight social objectives. This test had inherent limitations requiring the need to assess all possible pairs, and to be effective, having to limit the number of objectives to ten or less total items. To overcome these

limitations, Louviere and Woodworth (1990) proposed a more stringent data collection procedure known as "BW" scaling that requires consumers to choose the two items having, respectively, the most and least of a characteristic from repeatedly presented subsets of items, to be able to scale the entire set of items on the characteristic. Finn and Louviere (1992) formally introduced the BW scaling procedure, describing it to model the cognitive process by which respondents repeatedly choose the two objects in varying sets of three or more objects that they feel exhibit the largest perceptual difference on an underlying continuum of interest. Thus, the BW model allows the researcher to utilize a general measurement model to identify the most important and least important issues on a common scale in any situation. BW scaling has been used to evaluate preferences for complex attitudinal dimensions, as well as more recent studies that have applied the method to measuring food- and meal- related properties and liking (Jaeger and Cardello, 2008).

Best-Worst scaling methodology holds several benefits over other currently used acceptance and preference methods. Most importantly, when comparing the 9-point hedonic scale, the unstructured line scale, the labeled affective magnitude (LAM) scale, or preference ranking and BW scaling, consumers identified the BW scaling method as the easiest to use (least difficult), and best in terms of providing accurate information (Hein et al., 2008). The BW scaling task improved the detection of differences in sample preferences without being a more challenging test. Secondly, Finn and Louviere (1992) described how the shortcomings of survey research can be avoided by using BW scaling and conjoint methods developed for more conventional marketing applications. Third, by requiring that participants select the best and worst, smallest and largest, most and least

liked, etc., objects in a set of three or more items, BW scaling provides more information than paired comparisons and requires less input from respondents (Jaeger et al., 2008). For instance, using the BW scaling, we are not only able to calculate the number of times an attribute was chosen as the "most important," but are also able to calculate the number of times the attribute was selected as the "least important." BW scaling also allows the design of individual-level scales, which can be used to provide a measurement of the original design on a ratio scale. By having people choose the best and worst options, people are forced to decide which issues are more or less important, and unlike rating scales, there is only one way for people to respond to the question (with a choice) (Lusk and Briggeman, 2009). Lastly, BW scaling allows us to compare issues and people across countries in a way that minimizes differences due to scale use and/or cultural response orientations and produces a unidimensional interval-level scale that reduces the problem of scalar inequivalence and greatly facilitates comparisons across countries (Auger et al., 2007). Thus, in the current study, BW scaling was used to reduce scalar differences across the identified beef marketing sectors, in order to allow direct comparisons without the interpretational issues found when using the 9-point hedonic scale or the unstructured line scale.

VI. **Materials and Methods:**

Face-to-face interviews were conducted across five beef market sectors: Government and Allied Industries (from here on referred to as Allied Industries; n = 47), Feeders (n = 59), Packers (n = 26), Food Service, Distribution, and Further Processors (from here on referred to as Food Service; n = 48), and Retailers (n = 30). Only U.S.

companies that purchased feeder calves, fed cattle, fed beef carcasses, fed beef

subprimals or whole muscle cuts, trimmings, or variety meats and offal were included in

this study, with the exception of the Allied Industries sector who work hand-in-hand with

individuals in the U.S. fed beef industry. All interviews with beef market sectors,

excluding Allied Industries, were conducted with those individuals who actually made

purchasing decisions of U.S. fed beef, or had a working knowledge of purchasing in

order to ensure the most accurate WTP responses.

Interview Instrument

A dynamic-routing, standardized, electronic interview instrument was developed

using commercial survey software (Survey Crafter Professional 4.0.9, Survey Crafter,

Inc., Acton, MA). The computer-assisted interview instrument had to be able to manage

both the dynamic routing structure of the interview for the varying beef market sectors, as

well as administer both WTP and BW scaling methods.

Demographic Questions

At the beginning of each interview, all participants were asked a series of

questions to better understand which beef market sector they represented, what types of

U.S. fed beef products they purchased, and from which countries they imported beef.

Additional questions were asked to establish demographic criteria allowing further

characterization of the interviewee's company.

Quality Categories

To determine WTP probabilities of U.S. fed beef customers for the identified quality categories, it was essential to first determine how each beef market customer defined "quality" as it relates to U.S. fed cattle and beef products. To complete this task, "quality" was divided into seven pre-determined categories: (1) How and where the cattle were raised, (2) Lean, fat, and bone, (3) Weight and size, (4) Cattle genetics, (5) Visual characteristics, (6) Food safety, and (7) Eating satisfaction. At no time were companies provided with the questions in advance of the face-to-face interview, nor were they given a definition of what the interviewer thought that each category meant. This was done to ensure that the definition provided was truly what that beef market customer thought, as well as to obtain the respondent's "top of mind" answer to reflect an initial response for each specified quality category.

Economic Factors

All interviewees, excluding those in the "Allied Industries" beef market sector, were asked to list any economic factors or conditions that were considered prior to purchasing any U.S. fed beef products. The purpose of this question was to allow all respondents to provide their input on economic considerations so that all subsequent responses would solely reflect perceptions regarding the "quality" categories of the products.

Willingness-to-Pay (WTP) Estimates

The WTP series of questions began with the initial question asking "What specific characteristics or attributes are considered 'non-negotiable requirements' in order for your company to purchase U.S. fed beef products?" Each respondent would give their

answer and the interviewer categorized the responses into one of the seven identified

quality categories. For instance, if a company responded that "where the product came

from" was a requirement before they would purchase the product, the response was

recorded under the quality category "How and where the cattle were raised." If the

company responded broadly and just said "quality," then the interviewer prompted the

respondent to be more specific to more accurately establish under which specified quality

category the answer best fit. All individuals conducting the face-to-face interviews were

trained in a correlation meeting with the lists of responses that fit each category. If a

response was given that was not on the list, the interviewer used their best judgment and

placed the response in the category deemed the "best fit."

Once the categories that were considered a "non-negotiable requirement" for

purchase were established, then the interviewees were asked a series of questions which

ascertained whether or not they would be willing to purchase cattle/beef products that did

not reflect the "non-negotiable requirements" at a discounted price. The series of

questions asked the respondent if the quality category that was a requirement could not be

assured, would they be willing to purchase the U.S. fed beef product if the product was

discounted (X%). The discount value (i.e., X) was randomly generated by the electronic

interview instrument software as a value between 10 and 20% and the value was recorded

by the interview software for each question asked. The discount question was then asked

a second time with a new (X%) value depending on how the first discount question was

answered. The software generated an (X% change) value between 1 and 9%, and by

specifically programming discounts and discount percent changes for each category,

random numbers were generated for each category. If the respondent accepted the

discount, then the (X%) discount decreased; whereas, if the respondent did not accept the discount, then the (X%) value increased. For example, if the respondent said "no" to a 15% discount for livestock or beef products they had previously stipulated as a "non-negotiable requirement," then the second question discount was between 16 and 24%; however if the respondent said "yes" to a 15% discount, then the second question discount was a number between 6 and 14%. If the interviewee responded "no" to the first discount question, and then "no" to the second discount question, they were asked if there was any discount that they would be willing to purchase the product that was deficient in the previously stated "non-negotiable requirement" characteristic for and, if so, what was the percent discount. The discount questions were repeated only for those specified quality categories that were deemed a "non-negotiable requirement." The reasoning behind asking the discount questions was to assess whether the attribute the respondent answered as a "non-negotiable requirement" was truly "non-negotiable" or if it was just simply a preference that was modified by price.

Once the discount questions had been asked for those categories deemed as "non-negotiable requirements," then a series of questions were asked for all remaining categories to ascertain their WTP a premium for a trait. Thus, if a company's "non-negotiable requirement" responses fit under the categories "How and where the cattle were raised" and "Weight and size," then the premium questions that they were asked were for the categories "Lean, fat, and bone," "Cattle genetics," "Visual characteristics," "Food safety," and "Eating satisfaction." Questions to ascertain WTP premiums for traits were asked to determine if they would pay a (Y%) premium if the category could be "guaranteed." The premium value (i.e., Y%) also was randomly generated by the

interview instrument software as a value between 10 and 20%; the value was recorded by the interview software for each question asked. The premium question was then asked a second time with a new (Y%) value dependent on how the first question was answered. The software generated a (Y% change) value between 1 and 9%, and by specifically programming premiums and premium percent changes for each category, random numbers were generated for each category. If the respondent was willing to pay the premium, then the (Y%) premium increased for the second question; whereas, if the respondent was not willing to pay the premium, then the (Y%) value decreased for the second question. For example, if the respondent said "no" to a 15% premium, then the second question premium was between 6 and 14%; however, if the respondent said "yes" to a 15% premium, then the second question premium was a number between 16 and 24%. If the interviewee responded "no" to the first premium question, and then "no" to the second premium question, they were asked if there was any premium that they would be WTP to purchase the product for the "guaranteed" category and if so, what percent premium were they WTP.

For any discount questions where the respondent accepted any discount for the category they initially considered a "non-negotiable requirement," the respondent was asked if they would be WTP a premium value for that category as if they had never called it a "non-negotiable requirement."

Best-Worst (BW) Scaling

The BW scaling was designed to quantify the importance of the seven pre-identified quality categories. As described by Louviere and Islam (2008), Lusk and

Briggeman (2009), and Murphy et al., 2010, an orthogonal fraction of 2^7 was used to create eight sets of questions, and each respondent was asked to choose one category as most important and one as least important for all eight questions. For example, one can treat each attribute as having two levels (present/absent), and use a fraction of a 2^k design to construct sets (k = number of categories; Louviere and Islam, 2008). As such, there was significantly reduced likelihood that we would encounter bias in the use of a rating scale since there is only one way to choose something as most (or least) important (Cohen and Neira, 2003). The respondent was presented with seven triads containing the seven different quality categories for which the most important and the least important categories were identified. The triads were composed in accordance with the block design for seven samples provided by Cochran and Cox (1957). The eighth question contained all seven quality categories and asked the respondent to identify only the most important and least important out of all seven quality categories.

Data Collection

Research institutions involved in conducting the face-to-face interviews were Colorado State University, Oklahoma State University, and Texas A&M University. Each interview was conducted in teams of two, where one researcher asked the questions based on the computer generated interview instrument and clicked/typed the respondent's answers to be saved in an electronic file, while the other individual wrote down the responses of the interviewee (for later use in quality control). Interviews were conducted to gather the greatest amount of information across the beef industry involving customers of U.S. fed cattle and/or beef products. Interviews were conducted at the 2011 National Cattlemen's Beef Association's Annual Convention in Denver, Colorado, at the 2011

American Meat Institute's International Meat, Poultry, and Seafood Industry Convention and Exposition held in Chicago, Illinois, and across the U.S. at many company headquarters. The individuals and companies who participated in the face-to-face interviews were representatives of the following sectors: Feeders, Packers, Food Service, Retailers and Allied Industries. Numbers of interviews conducted by market sector were: Allied Industries interviews (n = 47); Feeders (n = 59) which represented 36.4% of cattle in feed yards, based on the number of cattle each feed yard was feeding per turn and the number of turns per year as provided in the interview (data not shown) divided by the total number of cattle marketed in 2011 (USDA, 2011); Packers (n = 26) corresponding to over 90% of the market share of cattle harvested in the U.S. (Lowe and Gereffi, 2009); Food Service (n = 48) with $224.9 billion in estimated sales in 2008 (NRN, 2009); Retailers (n = 30) corresponding to $347.6 billion in estimated sales in 2010 (Supermarket News, 2011).

Response Analysis

The analyses of how each beef market sector defined the seven "quality" categories used a check box for each attribute that described each category during the interview. If the respondent mentioned any of the attributes on the list, then only those boxes were checked; however, if the respondent gave an answer that was not one of the attributes in the list, then the interviewer selected "Other" and typed in the response. When analyzing the "Other" responses, if the response was actually one of the attributes with a check box, then it was identified and counted towards the specific pre-identified attribute. Otherwise, the attribute was added to the list of responses for that beef market sector. Additionally, during the response analysis, if there were two or more attributes

within a single category that had similar meanings, then the attributes were grouped together and reported as a single category. When two or more attributes within a single category were grouped together, then each response was reanalyzed and, if the same respondent identified both attributes, then the response was counted as a single response for the new combined category.

Statistical Analysis

The PROC GLIMMIX procedure of SAS (SAS Institute Inc., Cary, NC) was used to estimate the probability that a respondent would identify each attribute as a "non-negotiable requirement," and given that the attribute was not a "non-negotiable requirement," the probability that the respondent would be WTP a "premium. Also estimated was the probability, given that an attribute was identified as a "non-negotiable requirement," that the respondent would be willing to purchase the product at a "discounted" price. The latter estimate was a check of whether the respondent's "non-negotiable requirements" were truly "non-negotiable," or if they were actually preferences for which price would dictate their purchase. The model was a logistic regression with sector × attribute interaction as the predictor. Individual comparisons of sectors within attributes were performed in the logit scale using least squares means (PDIFF; $\alpha = 0.05$) and back-transformed to probabilities.

The GLIMMIX procedure was used to estimate the average "percent premium" that respondents would be willing to pay for each attribute, given that the attribute had not been identified as a "non-negotiable requirement." Similarly, the average "percent discount" was estimated when attributes were identified as "non-negotiable

requirements." The responses were modeled as normally distributed with sector $\times$ attribute interaction as the predictor. Individual comparisons of sectors within attributes were performed using least squares means (PDIFF; $\alpha = 0.05$).

The FREQ procedure of SAS was used to determine the shares of preference for the BW scaling task using PROC SORT by sector and attribute. The procedure also was used to identify the types of beef products purchased, countries-of-origin of imported beef products, economic or financial concerns, and branded beef program specifications.

The MEANS procedure of SAS was used to calculate the mean number of months or years of employment for the individuals interviewed for each sector. The procedure was used to identify the mean number of branded beef programs that each sector participated in through purchasing or selling their beef cattle/products.

VII. **Summary of Results and Discussion:**

Allied Industries

The tables referenced in the following discussion of the BW scaling, description of each quality category, and the additional responses to open ended questions by representatives of the Allied Industry sector are Tables 3.4 - 3.10, 3.13, and 3.15 - 3.22. The relative importance of the seven pre-identified quality categories was estimated by shares of preference for each quality category. "Food safety" (82 shares of preference) was preferred slightly more often for the Allied Industry sector than was "Eating satisfaction" (79; Table 3.13). Representatives of the Allied Industry beef market sector

most frequently defined the category "Food safety" as *everything* (34%; the percent of responses for that attribute over the total number of respondents; Table 3.9). When asked to elaborate on their definition, interviewees explained that the response *everything* indicated that "everything about food safety is important; all of food safety is important to ensure a safe, wholesome product." *Consumer confidence and education* (27.7%) was only mentioned in connection with "Food safety" by the Allied Industries sector (Table 3.9). This was not surprising as groups and organizations within this sector are the ones who are charged with finding ways to educate consumers and to increase consumer confidence in the beef industry and their beef products. *Testing for pathogens* (17.0%) and *no residues* (14.9%) were also frequent responses from the Allied Industry sector with regard to "Food safety" (Table 3.9). Another response that has more recently been associated with "Food safety" was a*nimal welfare* (10.6%; Table 3.9). The humane treatment of animals has been widely publicized in recent years, causing many in the beef industry to change and document their practices and educate employees and the public with regard to *Animal welfare*. Third party auditing has also been employed as a "Food safety" initiative to monitor *Animal welfare* of those animals that will enter the food supply chain.

Tenderness (63.8%) and *flavor* (57.5%) were the top two most frequent descriptions of what the Allied Industries thought "Eating satisfaction" meant (Table 3.10). Consumers of beef want a tender product with good beef flavor to savor and enjoy at each experience. If the beef industry can improve both the *tenderness* and *flavor* of the product, *customer satisfaction* will increase. *Customer satisfaction* was mentioned in connection with "Eating satisfaction" by 34.0% of respondents in the Allied Industries

sector, who indicated that providing beef that meets consumers' expectations would increase demand for beef (Table 3.10).

When ranking the categories based on importance, "Cattle genetics" (45) was the third most important category for the Allied Industry sector (Table 3.13). *Quality genetics* was mentioned by more than half (51.1%) of the respondents, followed by *genetic potential for marbling* (23.4%; Table 3.7). Many studies have reported a direct correlation between marbling and tenderness (Emerson et al., 2011; Smith et al., 1987). By selecting for *genetic potential for marbling*, producers have the ability to positively affect the "Eating satisfaction" of beef. *Cloning* (4.3%) was only mentioned by the Allied Industry sector as a description of what "Cattle Genetics" meant (Table 3.7).

"Weight and Size" (32) was identified as the fourth most important quality category by the Allied Industry sector (Table 3.13). The most frequent descriptor of "Weight and size" by the Allied Industry sector was *carcass weights* (59.6%; Table 3.6). Representatives of the Allied Industry sector were very specific when describing *carcass weights* saying "less than 1,000 pounds" and "not too heavy, even though we are in a pounds driven market." Other descriptors of "Weight and size" by the Allied Industry sector included *frame score* (42.6%), specifically a moderate frame score, and *appropriate ribeye size* (21.3%), specifically stating a ribeye size "between 10 in^2 and 16 in^2" (Table 3.6).

"How and where the cattle were raised" (31) and "Visual characteristics" (31) tied in the number of times each category was preferred by the Allied Industry sector (Table 3.13). When describing the quality category "How and where the cattle were raised," the

Allied Industry sector most frequently mentioned *practices* (29.8%) and the *origin/adaptability* (29.8%) of the cattle (Table 3.4). *Practices* included branding using hot-iron brands, use of antibiotics, weaning time, and the use of marketing claims. The Allied Industry sector expanded on the *origin/adaptability* of the cattle to mean "what part of the U.S. the cattle came from," and "if the cattle had the ability to adapt to the environment they were selected for." *Genetics* (23.4%), *traceability* (17.0%), and *maintaining health/management records* (17.0%) were frequent responses by the Allied Industry sector describing "How and where the cattle were raised" (Table 3.4). *Animal well-being* (17.0%) also was used to describe "How and where the cattle were raised" and included responses about the animals being "humanely handled," receiving "humane transportation," being "humanely raised," and that the "chutes and pens were humanely designed" (Table 3.4).

"Visual characteristics" were described by the Allied Industry sector most frequently as p*henotypic attributes* (83.0%; Table 3.8). *Phenotypic attributes* included the "amount of muscle and fat," "balance," and "volume" estimated in the live beef cattle. In reference to beef products, the Allied Industry sector discussed the p*henotypic attributes* to be the "amount of muscle and fat" found in the product, and that the product appears "fresh." In reference to live beef cattle, the Allied Industry sector also mentioned *Structural soundness* (31.9%) of the animals, and that the animals had *predominantly black hides* (19.1%; Table 3.8). In regard to actual beef products, the Allied Industry sector responses included the *appropriate product color* (36.2%) wanting a "bright red colored product," and the *amount of marbling* (19.1%), desiring a "highly marbled product" (Table 3.8). Representatives of the Allied Industry sector also mentioned that

the *product MAP packaged* (2.1%) and the *product vacuum packaged* (2.1%) were important to the "Visual characteristics" of the product Table 3.8). Interestingly, the Allied Industry sector was one of only two beef market sectors that identified the types of product packaging under the category "Visual characteristics."

The attribute of least importance to the Allied Industry sector was "Lean, fat, and bone" (28; Table 3.13). The Allied Industry sector most frequently used the *lean to fat ratio* (61.7%) of the product to describe the category "Lean, fat, and bone" (Table 3.5). *Quality grade* (42.6%), or wanting a "highly marbled product" also was used to describe the category "Lean, fat, and bone" (Table 3.5). The Allied Industry sector also used *carcass weight and size* (21.3%) to describe "Lean, fat, and bone," specifically discussing "end point management" of live cattle and, in turn, "not getting the carcasses too big" (Table 3.5).

New to the 2011 NBQA was additional information collected from the beef market sectors regarding their views on "Sustainability," "Animal Well-being," "Traceability," the "Image of the beef industry," "Strengths," "Weaknesses," "Potential Threats" to the beef industry, and "Changes or modifications made since the 2005 NBQA." The Allied Industry sector representatives were asked specifically what "Sustainability" meant to their organizations. Their most frequent response was about the environment, specifically *reducing environmental impact* (21.3%; Table 3.15). *Economic sustainability* (14.9%), and *educating the public* (4.3%) about how sustainable the beef industry can be were also frequent responses given by the Allied Industry sector (Table 3.15). "Animal Well-being" responses from the Allied Industry sector were based on humane handling practices with the most frequent response being *care of the animal*

(29.8%; Table 3.16). Other top-of-mind responses in Table 3.16 that were not directly

associated with animal welfare or humane practices included *being transparent to the*

public (2.1%), *education of good management practices* (2.1%), and *regulations and*

food safety issues (2.1%) that have been introduced because of "Animal Well-being."

When representatives of the Allied Industry sector were asked what "Traceability" meant

to their organization, the most frequent response was the *ability to go back and*

investigate a potential issue; not COOL (23.4%; Table 3.17). "Traceability" was

identified in the 2005 NBQA during the Strategy Workshop as a top ten quality challenge

due to a "Lack of traceability/individual animal ID/source and age

verification/chronological age" (Smith et al., 2005b). *Age and source verified* (10.6%)

also was a frequent response in the 2011 NBQA that was previously identified in list of

traceability challenges during the 2005 NBQA Strategy Workshop.

When asked about the "Image" of the beef industry, respondents in the Allied

Industry sector most frequently said that the beef industry as a whole had *a positive*

image (29.8%; Table 3.18), whereas some said that the image was *not a good image;*

struggling (8.5%). Other frequent responses about the "Image" of the beef industry that

were more focused on consumer perception were *need to educate consumers about*

production and health of beef (4.3%), *consumer driven* (4.3%), and *a safe, quality eating*

experience at a reasonable price (4.3%; Table 3.18). The Allied Industry sector also

gave responses in regard to the "Strengths" of the beef industry. The "Strength" that was

identified most frequently within the Allied Industry sector was that beef offered the

consumer a *safe eating experience,* which in turn increased *consumer demand* (29.8%;

Table 3.19). Another "strength" that was identified by the Allied Industry sector was

food safety (17.0%; Table 3.19). *Food safety* has been a hot topic in the media and in research regarding beef products, and the fact that the Allied Industries frequently identified *food safety* as a top-of-mind response for "Strengths" of the beef industry was indicative of progress in the area of beef safety. *Research, technology, and innovation* was also identified as a "strength" of the beef industry, and because of continued progress in these areas, the efficiency of the beef industry showed consistent improvement (Table 3.19). In contrast to the "strengths" identified by the Allied Industries, one of the most frequent responses for "weaknesses" of the beef industry was that the industry as a whole was *too fragmented* (23.4%; Table 3.20). A similar response was identified as a top ten greatest quality challenge in the 2005 NBQA Strategy Workshop as "segmentation between groups" (Smith et al., 2005b). Other frequently mentioned "weaknesses" included *not telling our story to improve image* (23.4%) and *lack of education and knowledge about our industry* (21.3%; Table 3.20). Both responses were weaknesses in areas where consumer confidence in beef products was important. If the beef industry and the Allied Industry sector would improve on those two weaknesses, the image of beef would improve in consumers' eyes. The top three "Potential threats" identified by the Allied Industry sector were *Activist groups* (23.4%), *public perception* (23.4%), and *cost* (23.4%; Table 3.21). All three of these "threats" have the potential to drive the beef industry out of business, or make it extremely difficult to stay in business. When asked about any "Changes or modifications the Allied Industry had made since the 2005 NBQA," the most frequent response was *nothing* (31.9%; Table 3.22). Others in the Allied Industry sector *increased food safety initiatives* (10.6%), which were identified as top ten greatest quality challenges in the 2005 NBQA Strategy Workshop (Table 3.22).

Food safety initiatives identified in 2005 were overcoming multiple drug resistant *Salmonella*, and Feed ban compliance (Smith et al., 2005b). Also, became *more consumer focused* (6.4%) and *increased education to farmers and ranchers* (6.4%) were important changes that need to continually happen to increase both the demand for beef and improve the consumer perception of the beef industry (Table 3.22).

Retailers

The tables referenced in the following discussion of BW scaling, the description of each quality category, WTP, demographic information, and additional responses to open ended questions by the Retailer sector are Tables 3.1 - 3.22. The relative importance of the seven pre-identified quality categories for Retailers began with "Food safety" (93) as the most important category (Table 3.13). Retailers most frequently described "Food safety" as meaning that the *products/materials were produced in effective food safety environments* (40.0%; Table 3.9). "Food Safety" was also frequently described as *require implementation of HACCP* (33.3%) and that the product be *USDA inspected and verified* (23.3%). *Traceability* (26.7%) was a frequent response by Retailers, wanting to have the ability to trace a product back to the point of origin in case of an outbreak or a recall. *Traceability* was identified as a "top ten greatest quality challenge" in the 2005 NBQA Strategy Workshop. Interestingly, in all previous NBQAs, "Food safety" was not a Retailer "top ten concern of beef quality" or identified as a "greatest quality challenge" by Retailers. When Retailers were asked a series of WTP questions for "Food safety," eight respondents identified "Food safety" as a "non-negotiable requirement" for purchase, and not a single company was willing to purchase the product for a discounted price if the "Food safety" of the product could not be assured

(Table 3.11). Also, when Retailers said a category was a "non-negotiable requirement," Retailers meant that it was "non-negotiable" and were the least likely to purchase product at a discounted price if the "non-negotiable" category could not be assured. The category with the highest odds that Retailers were WTP a premium for was "Food safety" (0.50), but the odds of paying a premium were only statistically different ($P < 0.05$) from "Lean, fat, and bone" (0.20; Table 3.12).

"Eating satisfaction" (70) was identified as the second most important category by Retailers (Table 3.13). Retailers most consistently described "Eating satisfaction" as *flavor* (70.0%) and t*enderness* (66.7%; Table 3.10). *Flavor* and *tenderness* have a huge impact on *customer satisfaction* (36.7%), and without *customer satisfaction* and repeat customers, a Retailer cannot stay in business. *Consistency* was also important to Retailers who elaborated they wanted a "consistent eating experience" for their customers. "Eating satisfaction" was also an attribute with high odds (0.47) of Retailers being WTP a premium, but also only statistically different ($P < 0.05$) than "Lean, fat, and bone" (0.20; Table 3.12). "Eating satisfaction" grouped several attributes together from previous audits. "Inadequate tenderness" was the greatest concern by Retailers in 2000, and was tied for third in 2005; "Inadequate flavor" was tied for second for Retailers in 2000 and tied for third in 2005; "Inadequate overall palatability" was tied for sixth in 2000 and tied for third in 2005 for Retailers; and "Inadequate juiciness" was eighth in 2000 for Retailers and tied for third in 2005 (Smith et al., 2005b).

"How and where the cattle were raised" (24) and "Visual characteristics" (23) were similar in shares of preference by Retailers (Table 3.13). Retailers most frequently mentioned *origin of product* (60.0%) and *animal well-being* (50.0%) to describe "How

and where the cattle were raised" (Table 3.6). Other interesting descriptions of "How and where the cattle were raised" by Retailers included knowing the *feed ingredients* (30.0%), *never received an antibiotic* (20.0%), and *never receiving a hormonal implant* (16.7%; Table 3.6). In no previous NBQAs did Retailers mention any quality concerns or challenges in regards to "How and where the cattle were raised." "Visual characteristics" was most frequently described by Retailers as the *amount of marbling* (100.0%) and an *appropriate product color* (86.7%; Table 3.10). Interestingly, there was not a single attribute in any category for any other sector, other than *amount of marbling* under "Visual characteristics" for Retailers, which was mentioned in every interview for a given sector. Retailers elaborated when they mentioned *amount of marbling* to mean "USDA Select or higher," and *appropriate product color* to mean "a bright cherry-red color." Retailers were very specific when they said *no defects* (16.7%), wanting the beef product they purchase to "not have any dark cutters, no blood clots, no foreign materials, and for the pH of the product to be appropriate" (Table 3.10). In comparison to previous NBQAs, Retailer concerns with "too many dark cutters" was ninth in 1991, and was not a top ten concern or challenge to Retailers in 1995, 2000, or 2005 (Smith et al., 1995; Smith et al., 2005b).

"Weight and size" (11) and "Lean, fat, and bone" (11) tied in shares of preference by Retailers (Table 3.13). "Weight and size" was most frequently described by Retailers to mean *uniformity in cuts* (63.3%), *appropriate ribeye size* (30.0%), and *carcass weights* (23.3%; Table 3.6). Retailers mentioned "not wanting ribeyes that were too big," and wanting carcass weights to be "below 950 pounds." In comparison to previous audits, "lack of uniformity and consistency" ranked sixth for Retailers in 1991 as a quality

concern and first in 1995 (Smith et al., 1995), whereas in 2000 "lack of uniformity in cuts" was tied for second and remained second in 2005 (Smith et al., 2005b). "Too large ribeyes" was tenth for Retailers in 1991, not recorded as a top ten concern in 1995, was ninth in 2000, and not recorded as a top ten challenge for Retailers in 2005 (Smith et al., 1995; Smith et al., 2005b). "Lean, fat, and bone" was most frequently defined by Retailers as the *lean to fat ratio* (83.3%), which also included responses of "not too fat" (Table 3.5).   Interestingly, Retailers included the responses *cut to specification* (23.3%) and amount of *marbling* (20.0%) under the category "Lean, fat, and bone" (Table 3.5). Retailers under the "Lean, fat, and bone" category for amount of *marbling* were consistent with their responses only wanting "USDA Select or higher" product, the same as their response for "Visual characteristics." Previously, "excessive seam fat" ranked fourth in 1991 for Retailers and eighth in 1995 (Smith et al., 1995); however, "excessive seam fat" was not recorded as a top ten challenge in 2000 or 2005 (Smith et al., 2005b). "Excessive external fat" ranked first in 1991, ninth in 1995, tied for sixth in 2000 and tied for third in 2005 (Smith et al., 1995; Smith et al., 2005b). "Excessive external fat" has increased over the years of conducting the NBQAs and is a major factor in why *lean to fat ratio* was a top-of-mind response for Retailers in 2011.

"Cattle genetics" (8) was the least important category to Retailers, as they have little control over the influence of "Cattle genetics" on the products they purchase (Table 3.13). *Predominantly black hide* (50.0%) was the single most frequent response by Retailers to describe "Cattle genetics (Table 3.7). *Genetic potential for marbling* (23.3%) and *not Bos indicus* (13.3%) were also frequent responses. When Retailers elaborated on *not Bos indicus*, they mentioned "toughness associated with *Bos indicus*" beef, which is

why the *origin* of the product is so important to them. To avoid *Bos indicus* influenced beef, they chose to purchase from plants located in the Midwest U.S. and not from Texas. Interestingly, *EPDs* (13.3%) was a frequent response by Retailers who discussed in detail "marbling, ribeye area, and tenderness *EPDs"* associated with cattle that produce the beef they sell. When analyzing these responses in more detail, they derived from specific Retailers who are part of a vertically integrated beef system and truly use EPDs for selection, whereas most commercial Retailers would not have access to that type of information.

Types of beef products purchased by Retailers most frequently included *whole muscle or subprimal cuts* (96.7%), *beef offal and variety meats* (63.3%), and *preparation/restaurant/case ready cuts* (60.0%; Table 3.1). Products that Retailers purchased were from both domestic and international suppliers. Prior to implementation of mandatory COOL, 18 of the Retailers interviewed imported some type of beef product, whereas after COOL, only 13 of the Retailers interviewed imported some type of beef product. Five years ago, only 3 Retailers interviewed imported product from *Mexico,* which increased to 4 Retailers interviewed that imported beef in the last three years from *Mexico* (Table 3.2). *New Zealand* also saw an increase in the number of Retailers that imported beef from five years ago (2) to the last three year period (3; Table 3.2). Imported beef from *Australia* decreased from the last five years (9) to in the last three years (8), and imported beef from *Uruguay* also decreased from those Retailers that imported in the last five years (5) to in the last three years (4; Table 3.2). In order to purchase beef products, economic considerations identified by Retailers included *none* (40.0%), *purchase price* (26.7%), and *consumer demand* (26.7%; Table 3.3). Retailers

that said *none*, expanded on their response saying "no economic condition, not even price will keep me from putting beef in the meat counter." They said that "price may dictate what types and cuts of beef fill the meat case, but people want beef, and so I have to put it in the meat case." Interestingly, 80.0% of the Retailers interviewed participate in branded beef programs. The most frequent specifications mentioned by Retailers who purchase and sell those branded beef programs included *marbling* (79.2%), *hide color* (70.8%), *carcass weight* (58.3%), *ribeye area* (58.3%), and *yield grade* (50.0%; Table 3.14). Some Retailers included their store brand specifications in the list, while others only included specifications of USDA certified branded beef programs.

Additional questions collected from Retailers included their views on "Sustainability," "Animal Well-being," "Traceability," the "Image of the Beef Industry," "Strengths," "Weaknesses," "Potential Threats" to the beef industry, and "Changes or Modifications made since the 2005 NBQA." Retailers were asked specifically what "Sustainability" meant to their companies. Their most frequent response was being *environmentally friendly* (36.7%; Table 3.15). Interesting responses from Retailers with regard to "Sustainability" included *Supply and demand - making sure there is enough supply to meet the demand* (10.0%), and either mentioning that they *have an organized sustainability program within their company* (10.0%), or that they *purchase from suppliers with a sustainability program in place* (10.0%; Table 3.15). "Animal Well-being" responses from Retailers included responses about animal health, animal handling and education concerning "Animal Well-being." Most frequently, Retailers described "Animal Well-being" to be *animals that are healthy and provided adequate nutrition* (36.7%; Table 3.16). *Temple Grandin designed facilities and practices* (13.3%) were

mentioned by Retailers, who were only one of two sectors to mention Temple Grandin specifically (Table 3.16).   Another interesting response was Retailers wanting *suppliers to educate them about the programs they use* (6.7%; Table 3.16). Retailers specifically said "they wanted knowledge about the animal handling and well-being practices that their suppliers use, in order to best answer questions by consumers at the meat counter, and to be aware of the practices their suppliers use." "Traceability" was very important to Retailers and most frequently was described as the *ability to trace an outbreak or recall back to a point of origin quickly* (Table 3.17). *COOL* was also mentioned by Retailers as it was a top-of-mind issue they battle daily, making sure the paper work is correct, the product is correctly identified, and that the consumer can find the information on the product label (Table 3.17). Retailers also wanted to know *the birth to box story* (16.7%), *knowing every step of the process and where the product has been* (6.7%; Table 3.17). Consumers are becoming more educated and aware of how their food was produced, which has raised questions, and Retailers prefer to be able to answer their questions and give their customers the best experience possible when determining which species of protein to purchase.

When asked about the "Image" of the beef industry, Retailers most frequently responded with *very good, reputable* (63.3%), followed by a *safe product* (13.3%), and a *quality product* (10.0%; Table 3.18). Retailers were the only sector to mention *innovative* (6.7%) as a descriptor of the "Image" of the beef industry (Table 3.18). When discussing the "Strengths" of the beef industry, the most frequent response from Retailers was *food safety* (26.7%; Table 3.19). The fact that Retailers most frequently identified *food safety* as the greatest strength is an accomplishment for the beef industry because

this sector sells beef directly to consumers. Another strength identified by Retailers was *the marketing and promoting of the industry and the image of the industry* (23.3%; Table 3.19). Although, some sectors view the image and promoting of the industry as a weakness and an area that could use major improvement, Retailers view it as an industry strength In contrast, "Weakness" most frequently identified by Retailers was *not telling our story* (26.7%; Table 3.20). Although *food safety* was the most frequently identified strength, *food safety* (16.7%) was also identified as a frequent weakness response (Table 3.20). Other interesting "weaknesses" identified by Retailers included *resistant to change* (10.0%) and *government regulation* (10.0%: Table 3.20). "Potential threats" most frequently identified by Retailers was *food safety* (50.0%), followed by *cost* (26.7%), and a *shortage of supply* (23.3%; Table 3.21). *Food safety* was viewed as a "potential threat" to Retailers because if the food safety of beef products was compromised or an outbreak occurred, consumers would quickly substitute another protein for beef, and not only would consumer demand for beef decrease, but consumer confidence would also be compromised. *Cost* again was a "potential threat" due to the price of beef, and the cost of production that is accumulated at every step of the process. A *shortage of beef supply* was a "potential threat," because not only would prices increase even more than they already have, but again, people would substitute protein sources and choose to trade out of a species of protein, thus decreasing the market share. "Changes or modifications since the 2005 NBQA" for Retailers included *nothing* (33.3%), *purchasing only upper 2/3 USDA Choice programs* (16.7%), and *only carrying product of USA because of COOL* (13.3%; Table 3.22). Those Retailers that switched to *purchasing only upper 2/3 USDA Choice programs* said they did so because "the

consumers' demanded that we keep stocking the product and were willing to pay an additional price for it."

Food Service

The tables referenced in the following discussion of BW scaling, the description of each quality category, WTP, demographic information, and additional responses to open ended questions by the Food Service sector were Tables 3.1 - 3.22. The relative importance of the seven pre-identified categories for Food Service began with "Food safety" (157), as the most important category (Table 3.13). Food Service respondents most frequently described "Food safety" to mean that the product was *tested for pathogens* (50.0%; Table 3.9). "Food safety" was also described as *no detectable E. coli O157:H7* (37.5%), and as the product was *USDA Inspected and Verified* (22.9%). Unique to the Food Service sector, was the comment that "Food safety" meant that the *cooked product was certified to be cooked to proper endpoint temperature* (18.8%; Table 3.9). "Food safety" was not a "top ten quality concern or challenge" for Restaurateurs in any of the previous NBQAs (Smith et al., 1995; Smith et al., 2005b). The response by Food Service representatives in previous audits that most closely matched the "Food safety" category was "high incidence or presence of injection-site lesions." That response ranked second in 1991 and eighth in 1995 (Smith et al., 1995), was not a concern for Food Service in 2000 (Roeber et al., 2002) and increased to fourth for Food Service concerns in 2005 (Shook et al., 2008). When Food Service representatives were asked a series of WTP questions for "Food safety," 16 respondents identified "Food safety" as a "non-negotiable requirement" for purchase, and not a single company was willing to purchase the product for a discounted price if the "Food safety" of the product

could not be assured (Table 3.11). The category with the highest percent premium that Food Service respondents were WTP was "Food safety" (13.6%), but that premium only differed ($P < 0.05$) from the percent premiums that Food Service respondents were WTP for "Lean, fat, and bone" (7.7%), "Weight and size" (8.5%), and "Eating satisfaction" (9.4%; Table 3.12).

"Eating satisfaction" (89) was identified as the second most important category by interviewees in the Food Service sector (Table 3.13). Food Service representatives most frequently described "Eating satisfaction" as *flavor* (62.5%) and *tenderness* (52.1%; Table 3.10). *Flavor* and *tenderness* have an impact on *customer satisfaction* (29.2%) and it was stated in the interviews that "*customer satisfaction* and attracting repeat customers were the only ways Food Service operators could continue to operate their business" (Table 3.10). Unique to the Food Service sector was the frequent "Eating satisfaction" response *mouthfeel* (18.8%), which was used specifically in reference to steaks and the "springiness and texture of the steak when customers chewed it" (Table 3.10). "Eating satisfaction" was the category with the highest odds (0.38) of Food Service being WTP a premium, but was only statistically different ($P < 0.05$) from "Visual characteristics" (0.17; Table 3.12). The current study used the broad category "Eating satisfaction" to include several attributes that were identified in previous audits. In past audits, Food Service representatives identified "Inadequate tenderness" as a "top ten greatest quality concern or challenge," which ranked eighth in 1991 and third in 1995 (Smith et al., 1995), and increased in ranking to first in 2000 and tied for fourth in 2005 (Smith et al., 2005b). "Inadequate flavor" was also identified by previous Food Service survey participants as a "top ten greatest quality challenge or concern" ranking ninth in

1991 and tenth in 1995 (Smith et al., 1995), tying for second in 2000 and tying for fourth in 2005 (Smith et al., 2005b). "Inadequate overall palatability" was also identified as a challenge for Food Service beginning in 1995 (ranking 5th; Smith et al., 1995). "Inadequate overall palatability" decreased to tenth in 2000 and was not recorded as a "top ten greatest quality challenge" in the 2005 NBQA by Food Service (Smith et al., 2005b).

"Lean, fat, and bone" (37) and "How and where the cattle were raised" (36) were similar in shares of preference by Food Service (Table 3.13). Food Service respondents most frequently defined "Lean, fat, and bone" to mean the *lean to fat ratio* (68.8%) of the product, which also included responses of "not too fat" (Table 3.5). *Boneless* (29.2%) was a frequent response by Food Service representatives when describing the "Lean, fat, and bone" category (Table 3.5), and, even though Food Service operators may prefer to purchase boneless beef products, this is something that cannot be controlled by producers. *Quality grade* (16.7%) was another frequent response by Food Service respondents as a description of "Lean, fat, and bone", specifically stating "wanting USDA Select and higher product" (Table 3.5). In previous studies, "excess external fat" was identified by Food Service survey participants as a "top ten greatest quality challenge or concern" in 1991 (1), 1995 (1; Smith et al., 1995), and 2000 (3 tie) and 2005 (2; Smith et al., 2005b). Food Service representatives most frequently mentioned animal well-being (43.8%) to describe "How and where the cattle were raised," followed by *origin of the product* (31.3%; Table 3.4). The Food Service sector has started to implement third-party supply chain audits to ensure the beef they serve was treated humanely as a live animal. *Origin of the product* appears to be used as an indicator of quality in the Food

Service sector. Some respondents stated that they wanted the beef products they purchase to come from a certain region of the U.S. Similar to Retailers, Food Service representatives also mentioned wanting to know the *feed ingredients* (22.9%), wanting products from cattle that had *never received a hormonal implant* (14.6%), and desiring *traceability* (12.5%) of the product back through the supply chain to the packer (Table 3.4). Food Service interviewees did not mention any attributes relating to "How and where the cattle were raised" as a "top ten greatest quality challenge or concern" in any previous NBQAs.

"Visual characteristics" (27) and "Weight and size" (25) were also similar in shares of preference by Food Service (Table 3.13). The "Visual characteristics" category was most frequently described by those in the Food Service sector as having an *appropriate product color* (64.6%), with respondents specifically stating that they wanted "product with a bright red color, and white fat" (Table 3.8). Other frequent responses by Food Service representatives for "Visual characteristics" included the *amount of marbling* (29.2%) wanting "USDA Select or higher product," and *appropriate ribeye size* (18.8%). With respect to ribeye size, it was stated that because of "portion size and menu offerings, large ribeyes have to be cut really thin and are easy to overcook." In previous beef quality audits, Food Service participants identified "Insufficient marbling" as a "top ten greatest quality challenge or concern" in 1991 (5), but not in 1995 (Smith et al., 1995); "Insufficient marbling" increased as a concern for Food Service in 2000 (2) and 2005 (1; Smith et al., 2005b). Like Retailers, Food Service representatives mentioned *no defects* (18.8%) within the "Visual characteristics" category, specifically stating that they did not want "blood clots, off odors, bruises, dark cutters, or foreign materials in the

product they purchase." "Weight and size" was most frequently described by Food Service respondents to mean *appropriate ribeye size* (35.4%) and *uniformity in cuts* (35.4%; Table 3.6). "Low overall uniformity" was mentioned as a Food Service "top ten greatest quality challenge or concern" in 1991 (10), 1995 (2; Smith et al., 1995), 2000 (5 tie) and 2005 (8 tie; Smith et al., 2005b). *Box weight* (12.5%; Table 3.6) was a frequent response describing "Weight and size" by Food Service interviewees. Box weight also was identified as a "top ten greatest quality challenge" for Food Service in the 1995 (6), 2000 (9), and 2005 beef quality audits (4 tie; Smith et al., 1995; Smith et al., 2005b). Within the Food Service sector, "Weight and size" had the lowest odds (0.06) of being considered a "non-negotiable requirement" prior to purchase, which differed ($P < 0.05$) from "Food safety" (0.34), "How and where the cattle were raised" (0.32), "Lean, fat, and bone" (0.23), and "Eating satisfaction" (0.21; Table 3.12). Although Food Service operators were not likely to "require" the category "Weight and size" prior to purchase, the odds that they would pay a premium for "Weight and size" was relatively high (0.36), differing ($P < 0.05$) from "Visual characteristics" (0.17; Table 3.12).

Similar to responses from Retailers, "Cattle genetics" (5) was the least important category to those in the Food Service sector. *Predominantly black hide* (29.2%) was the most frequent response by Food Service representatives to describe "Cattle genetics" (Table 3.7). Interestingly, Food Service also said *not dairy type* (10.4%), and referenced the "size and shape of the ribeye when plated for customers is not ideal or appealing when cooked" (Table 3.7). A unique response by Food Service respondents in regard to "Cattle genetics" was *not genetically altered* (2.1%; data not shown). In no previous NBQAs did Food Service mention any quality concerns or challenges in reference to

"Cattle genetics."

Types of beef products purchased by the Food Service sector most frequently included *whole muscle or subprimal cuts* (89.6%), *preparation/ restaurant/case ready cuts* (39.6%), and *beef trimmings for further processing* (39.6%; Table 3.1). The beef trimmings purchased by the Food Service sector included those trimmings that first went to a further processor prior to arriving at the restaurant. Most interestingly, Food Service interviewees responded that they also purchased *feeder steers and heifers* (2.1%) and *fed steers and heifers* (4.2%; Table 3.1). Upon further analysis, these responses were from interviewees that were part of the restaurant end of a vertically integrated business and considered the business as a whole in their responses. These interviews were categorized as Food Service because it was the sector closest to the consumer. Food Service purchased beef products from all of the countries listed in Table 3.2. The number of Food Service companies that imported beef in the last 5 years and the last 3 years remained unchanged (28; Table 3.2). Although the number of Food Service companies that imported beef products did not change, the number of Food Service companies that imported beef from *Mexico, New Zealand, Nicaragua,* and *Uruguay* in the last five years (19, 17, 2, and 7, respectively) decreased in the last three years (18, 16, 1, and 5, respectively; Table 3.2). Imported product from *Canada* by Food Service in the last five years (8) increased in the last three years (9) and Canada was the only country for which the number of importing companies increased (Table 3.2). In order to purchase beef products, economic considerations identified by Food Service interviewees included *purchase price* (60.4%), *none* (31.3%), and *futures* (18.8%; Table 3.3). Food Service respondents that mentioned *purchase price* were very conscious of their bottom line and

said that "*purchase price* determined what types of products go on their menu because they need to make a profit." Similar to Retailers, those Food Service companies that said *none* were adamant that "no matter what, they had to put beef on the menu as an offering and would buy the product at any cost." Food Service companies that said *futures* determined if they purchased the product "watched the markets closely, but more recently shortened their contracts due to the rising price of beef." Responses from interviews revealed that 54.2% of Food Service companies that were interviewed purchased or sold product that fit into branded beef programs (Table 3.14). The most frequent branded beef specifications identified by Food Service representatives included *marbling* (69.2%), *hide color* (61.5%), *carcass weight* (53.9%), and *ribeye area* (53.9%; Table 3.14).

Additional information collected from Food Service interviewees included their views on "Sustainability," "Animal well-being," "Traceability," the "Image of the beef industry," "Strengths," "Weaknesses," "Potential threats" to the beef industry, and "Changes or modifications made since the 2005 NBQA." Respondents were asked specifically what "Sustainability" meant to their company. The most frequent responses were *environmentally friendly* (25.0%) and *economically, environmentally, and socially responsible* (25.0%; Table 3.15). Similar to Retailers, Food Service respondents also said *products received are produced from sustainable processors* (6.3%; Table 3.15). "Animal well-being" responses from Food Service representatives were also about animal health, animal handling, and practices used throughout the entire production process. Food Service respondents frequently mentioned *humane handling and treatment* (58.3%), *animals experience minimal stress* (10.4%), and the *use of industry standards and practices promoted by Temple Grandin* (8.3%; Table 3.20). Unique to Food Service

responses, was the response *use third party audits for the entire process* (12.5%; Table 3.20). "Traceability" was very important in the Food Service sector as reflected by the response *ability to trace an outbreak or recall back to a point of origin quickly* (56.3%; Table 3.17). "Traceability" was paramount to Food Service operators because they not only have to employ proper handling of raw product, but wanted to avoid serving a product that caused foodborne illness. An interesting "Traceability" response from Food Service respondents was the *ability to trace the product from farm to fork* (22.9%), specifically stating that "customers at our restaurant want to know the whole story, where their dinner came from, and we want to know as well to provide them with the correct information."

When asked about the "image" of the beef industry, Food Service most frequently responded with *very good, much more favorable than it was 10 to 15 years ago* (56.3%; Table 3.18). Other responses unique to the Food Service sector in regard to the "Image" of the beef industry included that we *need to become better advocates* (6.3%), and the beef industry had a *diverse product offering* (6.3%; Table 3.18). When discussing the "Strengths" of the beef industry, Food Service responded with *product quality* (37.5%), *food safety* (31.3%), and the *marketing program for beef* (31.3%; Table 3.19). Food Service specifically stated that the "*marketing program* for the beef industry was very good and caused their customers to want additional beef products on their menus." Other Food Service companies elaborated on *food safety* stating "*food safety* in the beef industry had shown continual improvement over the past decade and was a strength compared to other proteins." In contrast, "Weaknesses" frequently identified by Food Service were the *cost* of production (25.0%), and the industry was *too fragmented*

(18.8%; Table 3.20). The *cost* of beef production and beef products has continued to rise and is passed on to customers at the Food Service level, and when compared to other proteins, beef is one of the most expensive menu items. *Too fragmented* was identified as an industry weakness by Food Service representatives, because "the industry does not have total control of the process from farm to fork." At every step, someone could cause the product quality to decrease, and it would just take one person to ruin the product that took almost two years to create.   "Potential threats" viewed by the Food Service sector included *cost* (50.0%) and *activist groups* (20.8%; Table 3.21). *Bioterrorism* (16.7%) was a frequent response by Food Service who voiced their concern for the safety of the entire live cattle population and beef supply. "Changes or modifications made since the 2005 NBQA" for Food Service most frequently included *nothing* (41.7%), *food safety expectations and protocols have increased* (12.5%), and *shortened contracts* (8.3%; Table 3.22). Those Food Service companies that mentioned *shortening their contracts* said "the decision was based on beef prices and the market, and it made more sense to shorten their contracts and not be locked in at a higher price than necessary."

Packers

The tables referenced in the following discussion of the BW scaling, description of each quality category, WTP, demographic information, and the additional responses to open ended questions by the Packer sector are Tables 3.1 - 3.10 and 3.12 - 3.22. Of the seven pre-identified quality categories, Packers identified "Food safety" (73) as the most important quality category (Table 3.13).   Packers described "Food safety" most frequently as *no detectable E. coli O157:H7* (50.0%; Table 3.9).   Other frequent descriptions of "Food safety" among Packers were *products/materials come from cattle*

where pre-harvest interventions are in place (26.9%), *everything* (23.1%) about food

safety was important, and *no detectable Salmonella spp.* (19.2%; Table 3.9). The most

interesting response in reference to "Food safety" by Packers, and only given by two

sectors, was *no detectable non-O157 STECs* (19.2%; Table 3.9).   The sectors that

mentioned the non-O157 STECs (namely Packers and Allied Industry) were those that

the most recent, September 2011, ruling was being directly imposed upon or those that

were indirectly affected by the USDA Food Safety and Inspection Service's new rule for

detection and zero tolerance of "the big six" in addition to *E. coli* O157:H7.   In previous

audits, the only time "Food safety" specifically was mentioned by Packers, or any sector,

was in the NBQA 2000 and, then, it ranked seventh among the "greatest quality

challenges identified by Packers" (Smith et al., 2005b). Other quality challenges or

concerns identified by Packers in previous audits that potentially could fit under the

category "Food safety" include "too high incidence of injection-site blemishes," "too

frequent bruise damage," and "too many liver condemnations." "Too high incidence of

injection-site blemishes" was identified as a "top ten greatest quality challenge or

concern" in 1991 (2; Smith et al., 1991), but was not recorded as a concern in any of the

more recent NBQAs. The trait "too frequent bruise damage" was identified as a concern

in 1991 (4; Smith et al., 1991), 1995 (4 tie; Smith et al., 1995), 2000 (9) and 2005 (5 tie;

Smith et al., 2005b).   The last trait that fit in the "Food safety" category from previous

audits was "too many liver condemnations" which was identified as a concern in 1991 (6;

Smith et al., 1991), increased in level of concern in 1995 (2; Smith et al., 1995), and was

not recorded as a "top ten greatest quality challenge or concern" in the 2000 or 2005

NBQA.

"Eating satisfaction" (42) was identified as the second most important category by Packers (Table 3.13). Packers most frequently described "Eating satisfaction" as *tenderness* (65.4%) and *flavor* (53.8%: Table 3.10). *Marbling* was used more frequently to denote "Eating satisfaction" within the Packing sector (30.8%) than within the Food Service (8.3%) or Retail (13.3%) sectors, which sell beef directly to consumers (Table 3.12). Previous audits showed that "Too few U.S. Choice carcasses" or "Inadequate marbling" was a "top ten greatest quality challenge or concern for Packers" in 1991 (7; Smith et al., 1991) and 1995 (8; Smith et al., 1995), becoming increasingly important in 2000 (4; Roeber et al., 2002) and again in 2005 (3; Shook et al., 2008). Unique to the Packing sector, was a single response under the category "Eating satisfaction" of *no Zilmax* (3.8%) fed to the cattle (Table 3.10). When asked the series of WTP questions for "Eating satisfaction," Packers had the greatest odds of paying a premium for "Eating satisfaction" (0.54), but was only statistically different ($P < 0.05$) from "Visual characteristics" (0.19; Table 3.12).

"Lean, fat, and bone" (28) and "How and where the cattle were raised" (24) were similar in shares of preference by Packers (Table 3.13). Packers most frequently mentioned *lean to fat ratio* (69.2%), which also included responses "not too fat" and "body condition." Interestingly, Packers frequently mentioned wanting *yield grade 2s and 3s* (38.5%) and *prefer yield grade 1s* (19.2%) to describe "Lean, fat, and bone" content (Table 3.5). Unique to Packers was the response *not a lot of bone* (15.4%) meaning they did not want to purchase animals with excessive bone weight due to decreased cutout value. "Too many yield grade 4 and 5 carcasses" was cited as a "top ten greatest quality challenge or concern by Packers" in 1991 (8; Smith et al., 1991).

"Excess external fat" was listed by Packers as a "top ten concern" in 1995 (4 tie; Smith et al., 1995), and 2000 (3; Roeber et al., 2002), but was not recorded as a "greatest quality challenge by Packers" in 2005 (Shook et al., 2008). Packers most frequently described "How and where the cattle were raised" as *animal well-being* (38.5%), followed by *maintaining health/management records* (30.8%) and *age and source verified* (30.8%; Table 3.4). *Animal well-being* responses by Packers included descriptions of "humanely handled," cattle received "humane transportation" and "humane living conditions," and that the "chutes and pens were humanely designed." The reasoning behind the Packers response of *maintaining health/management records* was because Packers wanted to know that the cattle they received would not test positive for drug residues because the required withdrawal time had not been met. Also, for export purposes, *age and source verified* cattle were important to Packers because they could be used in certain export programs, whereas cattle without the paper trail, could not be utilized for those programs. Although not listed as a description of "How and where the cattle were raised," "too frequent hide problems" was a trait considered by Packers as a "greatest quality challenge or concern" in 1991 (1; Smith et al., 1991), in 1995 "due to mud/manure" or "due to hot-iron brands" (3 or 9 tie; Smith et al., 1995), was not recorded as a "greatest quality challenge" in 2000 and reappeared in 2005 "due to brands" (5 tie; Smith et.al., 2005b). When asked the series of WTP questions, Packers had the highest odds (0.31) of "requiring" the category "How and where the cattle were raised" prior to purchase, which differed ($P < 0.05$) from "Weight and size" (0.08), "Visual characteristics" (0.08), "Lean, fat, and bone" (0.04), "Cattle genetics" (0.04), and "Eating satisfaction" (0.04; Table 3.12).

"Cattle genetics" (15), "Weight and size" (14), and "Visual characteristics" (12) were similar in shares of preference by Packers (Table 3.13). Packers most frequently described "Cattle genetics" to mean *predominantly black hide* (50.0%; Table 3.7). In combination with *predominantly black hide*, Packers also frequently responded *genetic potential for marbling* (26.9%) and *quality grade* (26.9%; Table 3.7). Based on these frequently mentioned attributes by Packers, it could be concluded that Packers prefer black-hided cattle that grade USDA Choice or better. "Weight and size" was most frequently described by Packers as *carcass weights* (96.2%), specifically wanting "*carcass weights* in the range of 600 to 1,000 pounds" (Table 3.6). Other frequent responses by Packers were *appropriate ribeye size* (38.5%) and *appropriate live sell weight* (15.4%; Table 3.6). Packers elaborated on *appropriate ribeye size* to mean "between 10 in^2 and 16 in^2" and an *appropriate live sell weight* to be "less than 1,500 pounds." In previous audits, "excessive carcass weights" were identified by Packers as "top ten greatest quality challenges or concerns" in 1991 (3; Smith et al., 1991) and 1995 (7; Smith et al., 1995), but became a greater concern in 2000 (2) and 2005 (3 tie; Smith et al., 2005b). "Lack of uniformity" was also identified by Packers as a "top ten greatest quality challenge or concern" in 1991 (9; Smith et al., 1991), 1995 (1; Smith et al., 1995), 2000 (1) and 2005 (2; Smith et al., 2005b). Frequent responses by Packers describing "Visual characteristics" included *structural soundness/conformation* (38.5%), *predominantly black hide* (34.6%), and *no defects* (30.8%; Table 3.8). Packers specified that "*structural soundness* was extremely important because they did not want to purchase cattle with signs of lameness that could lead to downer cattle." Packers also elaborated on their response *no defects* to mean "no bruises, blood splash, injection-site

lesions, dark cutters, buck shot, hide damage, lesions or abscesses." Another interesting response in the category "Visual characteristics" by Packers was *breed type* (23.1%; Table 3.8). Packers "preferred cattle breeds with the potential to grade USDA Choice or better, and little to no hump height."

Types of beef products purchased by Packers most frequently included *fed steers and heifers* (80.8%), *whole muscle cuts or subprimals* (34.6%), and *beef trimmings for further processing* (26.9%; Table 3.1). Products Packers purchased were from both domestic and international suppliers. The number of Packers interviewed that imported beef products did not change from importing beef in the last five years (15) to the last three years (15; Table 3.2). The number of Packers interviewed that imported live beef cattle or beef products from *Argentina* increased from the last five years (1) to the last three years (2; Table 3.2). The number of Packers that imported beef from *Mexico*, *Canada, Australia, Uruguay, New Zealand*, and *Brazil* remained the same (13, 11, 3, 3, 2, and 1, respectively) from the last five years to the last three years (Table 3.2). The Packing sector imported live cattle from *Mexico* and *Canada*, and beef products from other countries that were used, in combination with domestic beef, to produce a variety of further processed products at the Packer level. In order to purchase live beef cattle or beef products, economic considerations identified by Packers included *purchase price* (26.9%), *futures* (19.2%), *none* (19.2%), and *inventory* (15.4%; Table 3.3). Packer responses of *purchase price, futures*, and *none* were similar to those given by Food Service and Retailers. *Inventory* was a unique frequent response by Packers and was elaborated to mean "the *inventory* available to purchase." Interestingly, 88.5% of Packers interviewed participated in branded beef programs (Table 3.14). When asked to

list any specifications or requirements to enter those programs, top-of-mind responses by Packers were *marbling* (73.9%), *hide color* (56.5%), *hump height* (52.2%), and *yield grade* (52.2%; Table 3.14). Packer responses concerning branded beef program specifications included a variety of "in-house" programs.

Additional responses collected from Packers included their views on "Sustainability," "Animal well-being," "Traceability," the "Image of the beef industry," "Strengths," "Weaknesses," "Potential Threats" to the beef industry, and "Changes or modifications made since the 2005 NBQA." Packers were asked specifically what "Sustainability" meant to their companies. Their most frequent response was *environmentally friendly* (30.8%; Table 3.15). Other interesting responses regarding "Sustainability" by Packers were *enough supply of cattle to run plants efficiently* (11.5%) and *innovation and continuing to evolve the company* (3.9%; Table 3.15). Most frequently, Packers described "Animal well-being" to include *humane handling and practices* (42.3%), *the supplier had to meet animal welfare standards* (11.5%), *animal comfort* (7.7%), and *animal welfare* (3.9%; Table 3.16). Packers were the third sector to mention Temple Grandin in their most frequent responses as *use Temple Grandin as a consultant* (3.9%; Table 3.16). "Traceability" was very important to Packers and the Packing sector was identified as the source to which all products could be traced. When defining "Traceability," *ability to trace an outbreak or recall back to a point of origin quickly* (19.2%) was the most frequent response by Packers, followed by *age and source verified* (15.4%; Table 3.17). An interesting response given by Packers in reference to "Traceability" was *control from farm to fork* (11.8%; Table 3.17).

When asked about the "Image of the beef industry," Packers most frequently responded with *a good, favorable image* (42.3%), although some thought the image was middle of the road with the response *okay, not favorable, but not undesirable* (7.7%), whereas others said it was *not good, using less than 50% of the available technologies* (3.9%; Table 3.18). Packers explained the "Strengths" of the beef industry to be the industry produces a *premium product* (26.9%) that has a desirable *taste* (23.1%) and the *diversity of production* (11.5%) methods available (Table 3.19). Some Packers discussed the *diversity of production* methods to include "never-ever programs, natural, organic, and other niche markets that the beef industry participates, in addition to conventionally raised product." *Food safety* was identified by Packers as a "Strength" (15.4%; Table 3.19) and also as a "Weakness" (19.2%; Table 3.20). Other "Weaknesses" identified by Packers included the *variability* (23.1%) of beef products, and that the industry was *too fragmented* (15.4%; Table 3.20). *Variability* was a major "Weakness" to Packers because the beef cattle that come into the plant lack consistency and uniformity and produce beef products that are extremely variable and inconsistent in size, trim level, and quality; it was mentioned that excessive variability is a result of the beef industry being *too fragmented*. "Potential threats" to Packers included *food safety* (46.2%), and *government regulations* (26.9%; Table 3.21). *Food safety* was considered the largest potential threat, because if the *food safety* of the product produced was compromised and a large outbreak occurred, the product would be traced to that Packer and they would likely go out of business. Packers also expressed that they represent the beef sector that that is most heavily burdened by *government regulations*, such as zero tolerance for *E. coli* O157:H7 and the recent regulation requiring zero tolerance for non-O157 STECs.

Interestingly, Packers identified the *supply* (15.4%) of beef cattle as a "Potential threat" to the industry, as well as *commodity prices* (19.2%), specifically corn (Table 3.21). Packers reported the "Changes or modifications made since the 2005 NBQA" were *nothing* (30.8%) that they *started purchasing cattle that fit branded beef programs* (15.4%), and *COOL* (15.4%) went into effect, which added additional paperwork and tracking (Table 3.22). Most notably, Packers mentioned that they were *killing larger, heavier cattle* (11.5%; Table 3.22). Carcass weights have steadily increased over the past 20 years as indicated by the 1991, 1995, 2000, and 2005 NBQAs and Packers are still seeing a trend of increasing cattle weights at the time of harvest.

Feeders

The tables referenced in the following discussion of BW scaling, the description of each quality category, WTP, demographic information, and additional responses to open ended questions by the Feeder sector were Tables 3.1 - 3.10 and 3.12 - 3.22. Feeders identified "How and where the cattle were raised" (103) being the most important category (Table 3.13). Feeders most frequently described "How and where the cattle were raised" to mean that the cattle *received a vaccination program* (44.1%; Table 3.4). Other descriptions of "How and where the cattle were raised" included the *origin/adaptability* (32.2%) of the cattle, the cattle were *healthy* (27.1%), and *feed ingredients* (27.1%) that the cattle received (Table 3.4). Feeders were all very specific with regard to the *origin/adaptability* of the cattle they purchased for their feedlots, and they specified many different locations across the U.S. as preferred sources of feeder calves for a variety of reasons. The *feed ingredients* that Feeders mentioned when describing "How and where the cattle were fed," included "grain fed/finished," "grass

fed/finished," background on high concentrate diet," "background on wheat," and "vegetarian diet only." No responses for "How and where the cattle were raised" were identified by Feeders in the 2000 or 2005 NBQA; feeders were interviewed starting in the 2000 NBQA. When asked the series of WTP questions, Feeders had the greatest odds (0.19) of considering "How and where the cattle were raised a "non-negotiable requirement" prior to purchase, which was different ($P < 0.05$) from "Lean, fat, and bone" (0.02), "Weight and size" (0.03), and "Eating satisfaction" (0.02; Table 3.12).

"Weight and size" (91) was identified as the second most important category by Feeders (Table 3.13). Feeders described "Weight and size" most frequently as *appropriate live purchase weight* (69.5%; Table 3.6). The *live purchase weight* range given by Feeders was "400 to 900 pounds, but most frequently wanted 500-700 pound calves" in order to have calves that returned the greatest amount of gain per dollar. Other responses describing "Weight and size" by Feeders were a "moderate" *frame score* (27.1%), *appropriate live sell weight* (25.4%) of "approximately 1,300 pounds," and *carcass weights* (11.9%) described as "not finishing the cattle too heavy" (Table 3.6). Previous audits showed that the "top ten greatest quality challenges identified by Feedlot Operators" included "carcass weights too heavy" in 2000 (4) and 2005 (5), and "lack of uniformity in live cattle" in 2000 (1) and 2005 (2; Smith et al., 2005b).

"Cattle genetics" (72) and "Lean, fat, and bone" (72) tied in the number of shares of preference by Feeders (Table 3.13). "Cattle genetics" was most frequently described by Feeders as *predominantly black hide* (37.3%), followed by *genetic potential for marbling* (16.9%), and *genetic potential to gain* (15.3%; Table 3.7). Feeders have options when selling their cattle to Packers, one being on a grid-based pricing system,

rewarding the Feeder for cattle that are trim and high quality grading, and the other

system being on pounds of product, either live weight or hot carcass weight. Because of

these systems of payment, it was not surprising that Feeders identified *predominantly*

black hide, genetic potential for marbling, and *genetic potential to gain* as their most

frequent responses. "Lean, fat, and bone" was frequently described by Feeders as the

lean to fat ratio (32.2%) of the cattle (Table 3.5). *Lean to fat ratio* of the cattle Feeders

purchase was important because Feeders wanted the cattle to put on the greatest number

of pounds per dollar. If the cattle were heavy conditioned when the Feeder purchased

them, the pounds of gain per dollar spent would be much lower than if the cattle were

under conditioned when the Feeder purchased them. Due to this,   Feeders provided the

unique response *rate of gain* (6.8%) when asked to describe "Lean, fat, and bone" (Table

3.5). In previous audits, "excess fat cover" was not identified as a "greatest quality

challenge" by Feedlot Operators in 2000, but was a "greatest quality challenge" in 2005

(10; Smith et al., 2005b). "Inadequate muscling" was identified by Feedlot Operators as

a "greatest quality challenge in 2000 (9), and 2005 (8 tie), and "yield grades too high"

was not recorded in 2000, but in 2005 was fifth (Smith et al., 2005b). When asked the

series of WTP questions, Feeders had the greatest odds (0.58) of WTP a premium for

"Lean, fat, and bone," which differed ($P < 0.05$) from odds of being WTP premium for

"Food safety" (0.37) or "Visual characteristics" (0.32; Table 3.12).

"Food safety" (52) was the fifth most important category for Feeders based on

shares of preference (Table 3.13). Feeders most frequently described "Food safety" as

the ability to produce *a safe and wholesome product* (25.4%) and that the animals

received a vaccination program and it was administered in the appropriate location

(18.6%; Table 3.9). Feeders also frequently mentioned *documented conformance to withdrawal* (10.2%) and *no antibiotic residues* (3.4%) in reference to the category "Food safety." "Injection-site lesions" and "presence of bruises on carcasses" were mentioned in previous audits as "greatest quality challenges for Feeders" in 2000 (6 and 10, respectively), and both were not recorded as a "greatest quality challenges" in 2005 (Smith et al., 2005b).

"Eating satisfaction" (41) and "Visual characteristics" (41) were the least important categories based on shares of preference by Feeders (Table 3.13). "Eating satisfaction" was most frequently described by Feeders as *tenderness* (44.1%), *marbling* (25.4%), and *customer satisfaction* (25.4%; Table 3.10). Feeders specifically addressed *tenderness* and *marbling*, "wanting a tender steak that was highly marbled." *Flavor* (20.3%) also was mentioned by Feeders as a description of "Eating satisfaction" (Table 3.10). Previous research showed "insufficient marbling," "inadequate tenderness," and "inadequate flavor" were all "greatest quality challenges identified by Feedlot Operators" in 2000 (3, 2, and 5, respectively), and again in 2005 (1, 3, and 8 tie, respectively; Smith et al., 2005b). When asked the series of WTP questions, Feeders were WTP the highest percent premium (11.4%) for "Eating satisfaction," and which differed different ($P <$ 0.05) from premiums offered for "Lean, fat, and bone" (8.9%), "Weight and size" (7.2%), and "Visual characteristics" (6.8%; Table 3.12). "Visual characteristics" was frequently described by Feeders as *uniformity and consistency* (30.5%), "moderate" *frame score* (30.5%), and *predominantly black hide* (28.8%; Table 3.8). Unique to Feeders, was the response *no eared cattle* (11.9%) for the category "Visual characteristics." No responses

in previous audits were identified as "greatest quality challenges" that fit the category "Visual characteristics."

Types of beef products purchased by Feeders most frequently included *feeder steers and heifers* (86.4%) and *feeder bulls and cows* (11.9%; Table 3.1). Cattle that Feeders purchased originated both domestically and internationally. The number of Feeders interviewed that imported cattle decreased from five years ago (18) to the last three years (16). The only two countries that Feeders imported cattle from were *Mexico* and *Canada* in the last five years (13 and 12, respectively) and the number of interviewed Feeders importing cattle from these two countries decreased in the last three years (12 and 9, respectively; Table 3.2). Economic considerations when purchasing cattle that were identified by Feeders included *purchase price* (42.4%), *futures* (27.1%), and *breakeven* (23.4%; Table 3.3). Feeders were sensitive to the *purchase price* of the cattle they buy because they wanted to be able to pencil in a profit and at the very least, *breakeven*. Of the Feeders interviewed, 42.4% participated in branded beef programs (Table 3.14). The most frequent top-of-mind specifications for those programs cited by the Feeders interviewed were *age and source verified* (64.0%), *marbling* (44.0%), *hide color* (36.0%), and *ribeye area* (32.0%; Table 3.14).

Additional responses collected from Feeders included their views on "Sustainability," "Animal well-being," "Traceability," the "Image of the beef industry," "Strengths," "Weaknesses," "Potential threats" to the beef industry, and "Changes or modifications made since the 2005 NBQA." Feeders were asked specifically what "Sustainability meant to their companies. Their most frequent response was *ensuring our company is around for future generations* (20.3%; Table 3.19). Other responses

regarding their bottom line were *economics - positive cash flow* (15.3%) and *profits - nothing is sustainable without profit* (11.9%; Table 3.15). "Animal well-being" was described by Feeders as *humane handling and humane practices* (30.5%) and *animal comfort* (30.5%; Table 3.16). Responses about "Animal well-being" that were unique to Feeders included *employees participate in part of a quality assurance program* (3.4%) and *beef quality assurance and cattle handling* (3.4%; Table 3.16). Feeders described "Traceability" to mean the *ability to trace an animal entirely from farm to fork* (28.8%), and *age and source verified* (25.4%: Table 3.17). Specific to Feeders, when asked to describe "Traceability" was the response *ear tags, brands, and knowing the back history from previous owners* (5.1%; Table 3.17).

When asked about the "Image of the beef industry," a majority of Feeders thought the image was *very good, favorable image* (57.6%), versus a few that said *not favorable because of negative media* (5.1%; Table 3.18). Specific to Feeders was the response *very conscientious cattle buyers* (8.5%; Table 3.18). "Strengths" of the beef industry identified by Feeders included that the industry produced a *quality product that was wholesome* (37.3%), and provided a product with desirable *taste and eating satisfaction* (25.4%; Table 3.19). Feeders identified *food safety* (20.3%) and the *nutrition and health of beef* (15.3%) as "Strengths" of the beef industry (Table 3.19). "Weaknesses" identified by Feeders included *not telling our story* (22.0%), *consumer perception* (18.6%), and *activist groups* (6.8%; Table 3.20). The three "Weaknesses" identified by Feeders go hand-in-hand with each other, as *activist groups* continued to proceed with negative campaigns and media ads to end animal agriculture, *consumer perception* of the beef industry has decreased. In addition, because the beef industry struggles to *tell their*

story, consumer perception of the industry has not improved. "Potential threats" identified by Feeders included *activist groups* (32.2%), *cost* (22.0%), and *food safety* (20.3%; Table 3.21). Feeder responses and elaboration of these three "Potential threats" were similar to those given by Packers, Food Service, Retailers, and Allied Industries. A "Potential threat" unique to Feeders was *environmental pressures* (17.0%), specifically being the amount of land available for animal agriculture was shrinking and government regulations about the land, runoff, gas emissions, etc. (Table 3.21). "Changes or modifications made since the 2005 NBQA" for Feeders included *nothing* (35.6%), improved the *quality of genetics in the cattle purchased* (20.3%) and participated in *age and source verified programs* (15.3%; Table 3.22). Another positive change identified by Feeders was implemented *low stress handling practices and changed the injection-site location* (10.2%; Table 3.22).

Conclusions

Based on the extensive amount of information collected during the 2011 NBQA face-to-face interviews, there were several areas of opportunity for the beef industry to grow and improve upon. An area that the beef industry could capture added value was "How and where the cattle were raised." The category of *"How and where the cattle were raised"* had the greatest odds of considered a "non-negotiable requirement" by all sectors. Also, because "How and where the cattle were raised" was most likely to be considered a "non-negotiable requirement," beef market sectors also were WTP a premium for attributes that were considered a part of the category "How and where the cattle were raised." Although the percent premium sectors were WTP was not the highest for "How and where the cattle are raised," it was not the lowest percent premium either.

Specifically within the category "How and where the cattle were raised," a trait that could warrant a premium value would be documentation of all practices, vaccinations, and health records. Traceability was another trait under the category "How and where the cattle were raised" that could warrant additional premiums by tracking the age and source of the animals, or the origin of the animals and product. Lastly, an area that could be determined through the use of third party audits would be documenting animal welfare, and humane handling and practices.

Another opportunity for the beef industry was in the category "Food safety." The sectors that sell beef directly to consumers as well as Packers identified "Food safety" as the most important quality attribute. The message from the 2011 NBQA was that although "Food safety" could never be guaranteed, producers of live cattle had the opportunity to implement pre-harvest interventions at the Feeder level to provide the industry with "niche" product that would warrant a premium value. Based on scientific research, Packers could discover the most cost efficient method of pre-harvest intervention to use, and request that their suppliers provide them with cattle that had undergone the pre-harvest intervention(s) and monetarily reward those that participated using a market signal.

Lastly, an area of opportunity that came to light was "Eating satisfaction." All sectors except Feeders had the greatest odds of WTP a premium for "Eating satisfaction," and Feeders were WTP the highest percent premium for "Eating satisfaction." Government, Feeders and Packers all most frequently described "Eating Satisfaction" to mean *tenderness*, whereas Food Service and Retailers described "Eating satisfaction" as *flavor*. *Tenderness* and *flavor* were two very important characteristics in terms of "Eating

satisfaction" and if the product could contain both of characteristics, a premium value could be captured.

Other areas for improvement in order to add value to the beef industry and its products could include producing cattle and products with an ideal lean to fat ratio and not being too fat. Additionally, to manage cattle and carcass weights in order to create a more uniform product and to improve consistency. The most common response for "Cattle genetics" was *predominantly black hide*. Producing cattle with *predominantly black hides* would allow producers to qualify for premium programs, and would also be used as a quality and marbling score indicator. Visually, the primary opportunities for improvement were *appropriate product color*, *appropriate amount of marbling*, and *structural soundness, and consistency*. Overall, many opportunities exist for the beef industry to capture added value for their products. The opportunities range from being relatively small and trivial that producers did not realize could warrant an opportunity for capturing a premium, to more significant changes, that in some cases, would require a market signal for the change to occur at the producer level.

IIX. **Publications, abstracts, manuscripts in progress, thesis or presentations that resulted from this research.**

A manuscript will be prepared for submission to a referred scientific journal. This research will be included as part of a thesis.

IX. **Additional funding secured as a result of beef industry support of this project.**

No additional funding has been secured at this time.

References

Auger, P., T. M. Devinney, and J. J. Louviere. 2007. Using Best-Worst Scaling Methodology to Investigate Consumer Ethical Beliefs Across Countries. J. Bus. Ethics 70: 299-326.

Boleman, S. L., S. J. Boleman, W. W. Morgan, D. S. Hale, D. B. Griffin, J. W. Savell, R. P. Ames, M.T. Smith, J. D. Tatum, T. G. Field, G. C. Smith, B. A. Gardner, J. B. Morgan, S. L. Northcutt, H. G. Dolezal, D. R. Gill, and F. K. Ray. 1998. National Beef Quality Audit - 1995: Survey of Producer-Related Defects and Carcass Quality and Quality Attributes. J. Anim. Sci. 76:96-103.

Cochran, W. G., and G. M. Cox. 1957. Balanced and partially balanced incomplete block designs. *Experimental Designs*. New York: John Wiley & Sons, Inc..

Cohen, S. H., and L. Neira. 2003. Measuring Preference for Product Benefits Across Countries: Overcoming Scale Usage Bias with Maximum Difference Scaling. Paper presented at the ESOMAR 2003 Latin America Conference, Punta del Este, Uruguay.

Cummings, R. G., G. W. Harrison, and E. E. Rutstrom. 1995. Homegrown values and hypothetical surveys: Is the dichotomous choice approach incentive-compatible? Am. Econ. Rev. 85: 260-266.

Davis, D. D., and C. A. Holt. 1993. *Experimental Economics*. Princeton Univ. Press, Princeton, NJ.

Deming, W. E. *Out of the Crisis*. Cambridge: MIT Press. 1986. Print.

Emerson, M. R., J. D. Tatum, D. R. Woerner, K. E. Belk, and G. C. Smith. 2011. Relationships of USDA Camera-Based Quality Grades to Beef Palatability Attributes. Final Report prepared for the National Cattlemen's Beef Association, Centennial, CO by the Center for Meat Safety and Quality, Department of Animal Sciences, Colorado State University, Fort Collins, CO.

Feldkamp, T. J., T. C. Schroeder, and J. L. Lusk. 2005. Determining consumer valuation of differentiated beef steak quality attributes. J. Muscle Foods. 16: 1-15.

Finn, A. and J. J. Louviere. 1992. Determining the Appropriate Response to Evidence of Public Concern: The Case of Food Safety. J. Public Pol. & Mar. 11: 12-25.

Garcia, L. G., K. L. Nicholson, T. W. Hoffman, T. E. Lawrence, D. S. Hale, D. B. Griffin, J. W. Savell, D. L. VanOverbeke, J. B. Morgan, K. E. Belk, T. G. Field, J. A. Scanga, J. D. Tatum, G. C. Smith. 2008. National Beef Quality Audit – 2005: Survey of targeted cattle and carcass characteristics related to quality, quantity, and value of fed steers and heifers. J. Anim. Sci. 86:3533-3543.

Gregory, R. and L. Furby. 1987. Auctions, experiments and contingent valuation. Public Choice. 55: 273-289.

Hanemann, W. M. 1984. Welfare Evaluations in Contingent Valuation Experiments with Discrete Responses. Amer. J. Agr. Econ. 66: 332-341.

Hein, K. A., S. R. Jaeger, B. T. Carr, and C. M. Delahunty. 2008. Comparison of five common acceptance and preference methods. Food Quality and Preference. 19: 651-661.

Jaeger, S. R. and A. V. Cardello. 2008. Direct and indirect hedonic scaling methods: A comparison of the labeled affective magnitude (LAM) scale and best-worst scaling. Food Quality and Preference. 20: 249-258.

Jaeger, S. R., A. S. Jorgensen, M. D. Aaslyng, and W. L. P. Bredie. 2008. Best-worst scaling: An introduction and initial comparison with monadic rating for preference elicitation with food products. Food Quality and Preference. 19: 579-588.

Lambert, C. D. 1990. Lost opportunities in beef production. National Cattlemen's Association. Englewood, Colorado.

Lorenzen, C. L., D. S. Hale, D. B. Griffin, J. W. Savell, K. E. Belk, T. L Frederick, M. F. Miller, T. H. Montgomery, and G. C. Smith. 1993. National Beef Quality Audit: Survey of Producer-Related Defects and Carcass Quality and Quantity Attributes. J. Anim. Sci. 71: 1495-1502.

Loomis, J., T. Brown, B. Lucero, and G. Peterson. 1997. Evaluating the validity of dichotomous choice question format in contingent valuation. Environ. Resource Econ. 10:109-123.

Louviere, J. J., and T. Islam. 2008. A comparison of importance weights and willingness-to-pay measures derived from choice-based conjoint, constant sum scales and best-worst scaling. Journal of Business Research. 61: 903-911.

Louviere, J. J., and G. G. Woodworth. 1990. Best-Worst Scaling: A Model for Largest Difference Judgments. Working Paper. Faculty of Business, University of Alberta, Edmonton, Alberta, Canada.

Lowe, M., and G. Gereffi. 2009. A Value Chain Analysis of the U.S. Beef and Dairy Industries. A report prepared for the Environmental Defense Fund. Social Science Research Institute, Duke University, Durham, North Carolina.

Lusk, J. L. 2003. Effects of cheap talk on consumer willingness-to-pay for golden rice. Amer. J. Agr. Econ. 85(4): 840-856.

Lusk, J. L., and B. C. Briggeman. 2009. Food values. Amer. J. Agr. Econ. 91(1): 184-196.

McKenna, D. R., D. L. Roeber, P. K. Bates, T. B. Schmidt, D. S. Hale, D. B. Griffin, J. W. Savell, J. C. Brooks, J. B. Morgan, T. H. Montgomery, K. E. Belk, and G. C. Smith. 2002. National Beef Quality Audit – 2000: Survey of targeted cattle and carcass characteristics related to quality, quantity, and value of fed steers and heifers. J. Anim. Sci. 80:1212-1222.

Murphy, R. G. L., M. B. Bowling, D. L. Pendell, D. R. Woerner, J. D. Tatum, and K. E. Belk. 2010. What is Quality? The Propensity of Foreign Customers of U.S. Pork to Pay for Pork Quality Attributes in Select Export Markets. Final Report prepared for the National Pork Board, Des Moines, IA by the Center for Meat Safety and Quality, Department of Animal Sciences, Colorado State University, Fort Collins, CO. pp. 1-193.

NRN. 2009. Top 100 chains ranked by U.S. systemwide foodservice sales. Nation's Restaurant News, June 29, 2009. Accessed Oct. 19, 2010. http://findarticles.com/p/articles/mi_m3190/is_24_43/ai_n32169259/?tag=content;col1.

Roeber, D. L., D. R. McKenna, P. K. Bates, T. B. Schmidt, K. E. Belk, T. G. Field, Pas, J. A. Scanga, J. W. Savell, J. B. Morgan, T. H. Montgomery, and G. C. Smith. 2002. The 2000 National Beef Quality Audits: Views of Producers, Packers, and merchandisers on Current Quality Characteristics of Beef. Prof. Anim. Scientist. 18:112-119.

Shook, J. N., D. L. VanOverbeke, J. A. Scanga, K. E. Belk, J. W. Savell, T. E. Lawrence, J. B. Morgan, D. B. Griffin, D. S. Hale, and G. C. Smith. 2008. The National Beef Quality Audit - 2005, Phase I: Views of Producers, Packers, and Merchandisers on Current Quality Characteristics of the Beef Industry. Prof. Anim. Scientist. 24:189-197.

Smith, G. C., J. W. Savell, H. R. Cross, Z. L. Carpenter, C. E. Murphey, G. W. Davis, H. C. Abraham, F. C. Parrish, Jr., and B. W. Berry. 1987. Relationship of USDA Quality Grades to Palatability of Cooked Beef. J. Food Qual. 10:269-286.

Smith, G. C., J. W. Savell, R. P. Clayton, T. G. Field, D. B. Griffin, D. S. Hale, M. F. Miller, T. H. Montgomery, J. B. Morgan, J. D. Tatum, and J. W. Wise. 1992. Improving the consistency and competitiveness of beef - A blueprint for total quality management in the fed-beef industry. The final report of the National Beef Quality Audit - 1991, conducted by Colorado State University and Texas A&M University, for the National Cattlemen's Association on behalf of the Cattlemen's Beef Promotion and Research Board.

Smith, G. C., J. W. Savell, H. G. Dolezal, T. G. Field, D. R. Gill, D. B. Griffin, D. S. Hale, J. B. Morgan, S. L. Northcutt, and J. D. Tatum. 1995. Improving the quality, consistency, competitiveness and market-share of beef - the final report of the second blueprint for total quality management in the fed-beef (slaughter steer/heifer) industry. The final report of the National Beef Quality Audit - 1995, conducted by Colorado State University, Texas A&M University, and Oklahoma State University, for the National Cattlemen's Association on behalf of the Cattlemen's Beef Promotion and Research Board.

Smith, G. C., J. W. Savell, J. B. Morgan, T. H. Montgomery, K. E. Belk, J. C. Brooks, Z. L. Carpenter, T. G. Field, D. B. Griffin, D. S. Hale, F. K. Ray, and J. A. Scanga. 2000. Improving quality, consistency, competitiveness, and market share of fed-beef – the final report of the third blueprint for total quality management in the fed-beef (slaughter steer/heifer) industry. The final report of the National Beef Quality Audit - 2000, conducted by Colorado State University, Texas A&M University, Oklahoma State University, and West Texas A&M University, for the National Cattlemen's Beef Association on behalf of the Cattlemen's Beef Promotion and Research Board.

Smith, G. C., J. W. Savell, J. B. Morgan, T. E. Lawrence, K. E. Belk, T. G. Field, L. G. Garcia, D. B. Griffin, D. S. Hale, T. W. Hoffman, J. A. Scanga, J. D. Tatum, D. L. VanOverbeke, and K. L. Nicholson. 2005a. Staying On Track: Executive Summary of the 2005 National Beef Quality Audit. National Cattlemen's Beef Association, Centennial, Colorado.

Smith, G. C., J. W. Savell, J. B. Morgan, T. E. Lawrence, K. E. Belk, T. G. Field, L. G. Garcia, D. B. Griffin, D. S. Hale, T. W. Hoffman, J. A. Scanga, J. D. Tatum, D. L. VanOverbeke, and K. L. Nicholson. 2005b. National Beef Quality Audit - 2005: A new benchmark for the U. S. Beef Industry. The preliminary report of the National Beef Quality Audit - 2005, conducted by Colorado State University, Texas A&M University, Oklahoma State University, and West Texas A&M University, for the National Cattlemen's Beef Association on behalf of the Cattlemen's Beef Promotion and Research Board.

Supermarket News. 2011. 2011 North American Food Retailers SN Top 75. January 24, 2011. Accessed Jan. 26, 2011. http://supermarketnews.com/top-75-retailers-wholesalers-2011.

USDA. 2011. Cattle on Feed. Released by the National Agricultural Statistics Service (NASS), Agricultural Statistics Board, United States Department of Agriculture (USDA). Accessed Jan. 24, 2012. http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1020.

Uusitalo, Liisa. 1990. Consumer Preferences for Environmental Quality and Other Social Goals. J. Cons. Policy. 13 (September): 231-251.

Value Based Marketing Task Force. 1990. The war on fat! A report from the Value Based Marketing Task Force, Beef Industry Council of the National Live Stock and Meat Board, Chicago, Illinois, and National Cattlemen's Association, Englewood, Colorado.