

Live Animal Measures of Tenderness – It's History, Current Status and Future



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Introduction

- Beef Quality
 - Marbling
 - Tenderness
- Quality beef consistently satisfies customer expectations for eating and preparation characteristics.
 - Expectations may include:
 - Tenderness
 - Flavor, Juiciness and color
 - Leanness
 - Packaging
 - Ease of preparation
 - Price

Introduction

- Beef Quality Grade
 - Composite evaluation of factors that affect palatability of meat
 - Tenderness
 - Juiciness
 - Flavor
 - These factors include carcass maturity, firmness, texture and color of lean, and the amount and distribution of marbling with the lean.

Introduction

- Beef Carcass Quality Grading based:
 - Degree of Marbling
 - Degree of Maturity
- USDA Beef Quality Grades
 - Prime
 - Choice
 - Select
 - Standard
 - Commercial
 - Utility
 - Cutter
 - Canner



Introduction

- Many factors influence beef quality
 - Pre-Harvest Management
 - Post-harvest Management
- Pre-Harvest Management
 - Control of breed/genetic inputs
 - Use of feeding systems that enhance product quality
 - Judicious application of growth enhancement technologies; and
 - Adherence to best management practices to avoid quality and tenderness problems associated with effects of morbidity, pre-harvest stress, administration of animal health products, and hormonal status of animal.

Pre-Harvest Management

- Heritability estimates from several studies indicate that tenderness is moderately heritable ($h^2 = 0.24$ to 0.53) in *Bos taurus*, and *Bos taurus* x *Bos indicus* cattle populations (Koch et al., 1982; O'Conner et al., 1997; Wheeler et al., 1996 and 2001; Wulf et al., 1996).
- Seedstock and commercial producers have relied upon traditional methods, such as progeny testing to obtain beef tenderness information.

Pre-Harvest Management

- Collection of carcass measures of tenderness is a long and expensive process for producers.
- Development of Expected Progeny Differences (EPD's) for tenderness are on the rise in many breed associations.
- Increased number of commercially available DNA markers of genes associated with differences in beef tenderness.

Pre-Harvest Management

- Feeding Systems
 - Grain Feeding
 - Produce carcasses with brighter-colored, finer-textured lean, whiter fat, and more marbling, all which enhances acceptability of retail beef (Schaake et al., 1993; Schroeder et al., 1980; Bowling et al., 1977).
 - Days on Feed
 - Young stocker cattle backgrounded on forages and then transitioned to high-concentrate, finishing diets prior to harvest to assist in developing carcass quality and palatability attributes normally associated with grain-fed beef (Klopfenstein et al., 2000).
 - Most improvements occur in early portion of feeding period (before 112 days and finishing diets longer than 180 days are detrimental to tenderness due to increased maturity; May et al., 1992; McKeith et al., 1985; Miller et al., 1987; Larick et al., 1987; Zinn et al., 1970).

Pre-Harvest Management

- Use of Growth Enhancement Technologies
 - Beneficial in enhancing growth performance
 - Some evidence suggests low-potency implants do not adversely affect tenderness; however, repetitive uses of estrogenic implants can increase carcass maturity and multiple lifetime implants may reduce marbling scores (Hardt et al., 1995; Paisley et al., 1999; Platter et al., 2003; Pritchard, 2000).

Pre-Harvest Management

- Health Management and Husbandry
 - Morbidity associated with BRD depresses growth performance of finishing cattle, resulting in lighter carcass weights and lower marbling scores (Gardner et al., 1999; Roeber et al., 2001).
 - Minimizing intramuscular (IM) injections and adherence of Beef Quality Assurance Guidelines for all animal health products helps avoid tenderness problems.
 - Timely application of routine management practices such as castration of male calves (NCBA, 1996; recommends castrate bull calves prior to 7 months of age or prior to develop of secondary sex characteristics).

Pre-Harvest Management

- Avoid Pre-Harvest Stress
 - Pre-harvest stress, either acute or prolonged, depletes muscle glycogen stores, resulting in production of beef with an abnormally high final muscle pH and a characteristically dark lean color (i.e. dark cutting beef) (Ashmore et al., 1973; McVeigh and Tarrant, 1981).
 - Any form of physical or psychological stress among cattle can result in muscle glycogen depletion.

Pre-Harvest Stressors

- Aggressive handling, excitement, or physical exertion of cattle before, during or following transport to the processing plant
- Long transit periods and(or) schedule delays preventing prompt unloading of cattle transported to processing plants
- Mixing of cattle from different sources before harvest, prompting physical activity as animals re-establish and an order of social dominance within the mixed group

Pre-Harvest Stressors

- Extremes in climatic conditions, including both extremely hot or cold, wet weather
- Extended fasting periods or extended periods of low energy diets prior to harvest
- Females exhibiting behavioral estrus near the time of harvest
- Cattle differ in behavior and temperament and respond dramatically different when subjected to various pre-harvest stressors.

NCBA, 2006 Pre-harvest cattle management practices for enhancing beef tenderness



History

- National Beef Quality Audit, 1991
 - Top ten producer controllable concerns
 - Excess external fat
 - Excessive weights/box
 - Too high incidence of injection site blemishes
 - Excess seam fat
 - Low overall cutability
 - Low overall uniformity
 - Inadequate tenderness
 - Too frequent bruise damage
 - Too many dark cutters
 - Too many large ribeyes/loineyes

History

- By 2000, Top ten greatest quality concerns according to responses of purveyors and retailers;
 - Insufficient marbling
 - Lack of uniformity in cuts
 - Inadequate tenderness
 - Excess fat cover
 - Inadequate flavor
 - Too heavy cut weights
 - Too Large Ribeyes
 - Low Cutability
 - Inadequate juiciness
 - Inadequate overall palatability

History

- New challenges emerged by 2005, Top ten changes made by seedstock producers:
 - Improved genetics (using performance)
 - Improved genetics (using physical traits)
 - Improved genetics (using ultrasound)
 - Increased record keeping
 - Changed injection site location
 - Changed vaccination program
 - Improved genetics (using carcass traits)
 - Joined alliance/supply chain
 - Increased individual identification
 - Improved handling practices

National Beef Quality Audit, 2011

- Top three challenges identified
 - Food Safety
 - Eating Satisfaction
 - How and where the cattle were raised
- Top three responses from pre-harvest segments:
 - Animal handling
 - Preventative health programs
 - Nutritional management

National Beef Quality Audit, 2011

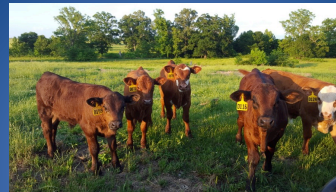
- No two market sectors define “Quality” the same way
- Increased transparency is a must
- Increased importance of food safety and eating satisfaction across all sectors
- Additional opportunities
 - Produce beef with more ideal lean:fat ratios
 - Managing cattle and carcass weights for more uniform, consistent products

National Beef Quality Audit, 2011

- Packer sector findings:
 - Improved individual animal id
 - Increased awareness of the importance of animal handling
 - Increased hot carcass weights
 - Increased availability of Prime and Choice
 - Increased percentage of conforming carcasses
 - Human and instrument grading are aligned

National Beef Quality Audit, 2011

- Producer sector findings:
 - Healthy cattle equal quality
 - Injection site improvements
 - Low-stress handling is a priority
 - BQA is becoming widespread
 - Identification and traceability



Value of marbling and tenderness in the marketplace

National Beef Quality Audit, 2011 estimated that lost economic opportunities were over \$40/head, primarily because of not meeting targets for both quality and yield grade. However, this is about a \$12/head improvement than the 2005 audit.

Tools for selection for marbling and tenderness

- Carcass EPD’s
- Ultrasound EPD’s
- Genomics
 - Genomic enhanced EPD’s
- New Tools with existing technology



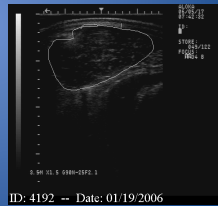
Carcass EPD’s

- Carcass Weight
- Marbling
- Fat thickness
- Ribeye Area
- Yield Grade
- Percent Retail Products
- Days to Finish
- Tenderness



Ultrasound EPD's

- Intramuscular Fat
- Ribeye Area
- Fat Thickness
- Percent Retail Product



Genomic Enhanced EPD's

- Enhance predictability of current selection tools
- Achieve more accuracy on EPD's for younger animals
- Characterize genetics for traits that are difficult or expensive to measure (i.e. feed efficiency, carcass traits in breeding stock or maternal traits in bulls).

Ultrasound Tenderness

Prediction of tenderness utilizing ultrasound images for carcass traits, (Designer Genes Technologies, Rethel King, Harrison, AR).



Currently, working with University of Georgia, Dr. T. D. Pringle, on validation of this procedure with carcass data utilizing slice shear tenderness data.



Summary

- Beef Quality Audits
 - External fat, Seam fat, Overall beef palatability, (1991)
 - Overall uniformity, tenderness, carcass weights (1995, 2000, and 2005)
 - Food safety, eating satisfaction, how and where cattle are raised (2011)

Summary

- Selection for marbling and tenderness
 - EPD's
 - Carcass
 - Ultrasound
 - Genomics
 - New tools
 - More information forthcoming in the near future as currently in validation process

Questions

