Meat Quality: Tenderness
Meat Tenderness

• #1 Quality Concern
• #1 Palatability Concern for Consumers
• Costs the Beef Industry over $253 million annually
• Guaranteed Tender Product
Measuring Tenderness

• Objectively
  – Warner-Bratzler Shear Force Machine
  – ½” meat core; parallel to fiber orientation

• Subjectively
  – Sensory Panel
  – Human perspective
What is tenderness

• Proteases enzymes
• Calcium activated
• Calpains, calpastatin
• Degrade Z-disk
• Myofibril fragmentation
• Occurs pre- and postmortem
• 5 – 6% protein degradation/ d in humans
Make things more tender

• People will spend their lives and careers searching for ways to improve tenderness and understand the factors involved

• Ways to improve tenderness
  – Make the Sarcomeres longer
  – Disrupt the integrity of the myofibrils
  – Disrupt the integrity of the connective tissue matrix
What affects Tenderness

- Diet
- Implants/ Growth Promotants
- Cooler Affects
- Contractile State
- Age of Animal
- Muscle Function
- Cooking Methods
- Aging
Diet

- Vitamin D$_3$
- Hypothesis: Vitamin D$_3$ will raise the level of circulating calcium, thus activating more calcium dependent proteases
- Calpains = activated by calcium
- Fed the last 6 to 10 d before slaughter
Vitamin D3

• Increased plasma Ca concentrations (Swanek et al., 1999; Karges et al., 1999)
• Increased tenderness (WBSF) by 0.58 kg and sensory panel tenderness by 0.6 units (Swanek et al., 1999; Karges et al., 1999; Montgomery et al., 2000)
• No improvements in tenderness (Scanga et al., 1999; Rentfrow et al., 2000; Wertz et al., 2001)
• Under 4.5-kg WBSF confidence level
Growth Promotants/Implants

- Beef Implants
- Increase Testosterone
- Increase Calpastatin
- Implanted steers had higher WBSF values that non-implanted counterparts (Roeber et al., 2000; Platter et al., 2003)
Growth Promotants/ Implants

- Increased WBSF values in implanted Bos indicus cattle (Barham et al., 2003)
- However, under 4.5-kg
- Ractopamine (Paylean or Optaflexx) does not affect tenderness; sensory or WBSF (McKeith et al., 1988; Stoller et al., 2003; Schroeder, 2005)
Cooler Affects

- Talked about this in the conversion of muscle to meat
- Cold Shortening
- Thaw Rigor
- Problem in beef and lamb
- Electrical Stimulation
Contractile State

- Myosin – Actin cross-bridging
- Rigor mortis
- Achilles Tendon
- Pelvic hung
  - Tenderstretch
  - Lessens the affects of rigor
  - Not done in US
Muscle Function

- Support vs. Locomotion
- Amount of connective tissue
- Extent of rigor
- Can get tenderness differences within a given muscle or steak
- Double muscled cattle
- Callipyge Lamb
Post-mortem Aging

- **Dry vs. Wet Aging**
- **Dry** = meat lab & small meat processors
- **Wet** = majority of meat in the US
- **Dry** = considerable shrink
- **Wet** ≈ 20d from packing plant to grocery store
Age of Animal

- As age increases, meat becomes less tender (Miller and Montgomery, no date)
- Insoluble collagen
- Cross-links are heat stable
- Larger fiber diameters
Degree of Doneness

• Composition of meat: 70% water, 20% protein, 8% fat, 2% ash
• Higher degree of doneness = less water and fat
• Toughening of contractile proteins
• Problem with consumers
• Beef, Pork, and Chicken
Physical Changes during Cooking

- Upon cooking myofibrillar protein structure changes
- Disintegration of filaments as temperature increases
  - Protein hardening
  - Appears over 147° F
- Connective tissue
  - 1/3 original length
  - Collagen shrinkage
  - More soluble
Cooking the Tender cuts

- Dry Heat Cookery
- Broil
- Grill
- Pan – Fry
- Stir – Fry
- Roast
  - Be careful of degree of heat
High Heat

Low Heat
Cooking the Tough Cuts

- Moist Heat Cookery
- Low heat, long time
  - Prevent protein hardening
- Braise
  - Steam type heat
- Stewing
  - Cover with liquid
Rentfrow’s Recommendations

• Just to the point where a good vet can’t save it!!
• Beef = Medium Rare
• Pork = Medium
• Chicken = Fried or BBQ
Other things to think about!

- Genetics = 45% heritable
  - GeneSTAR, Igenity, EPD’s?
- Mechanical Tenderizers
  - Cubers or Jaccard
- Chemical Tenderizers
  - Papain (papya), Bromelin (pineapple), Ficin (fig)
- Marinating for Tenderness
  - Softens connective tissue, & increases H2O intake
See ya at lab