Conversion of Muscle to Meat
“A death with purpose gives meaning to life”

Trent Loos; Rural Route Radio
Maintaining Homeostasis

- The need to maintain the physiological state of the body
- Homeostasis
- What is death?
- Metabolism continues
- What happens before, during, and after death will greatly affect meat quality
Conversion of Muscle to Meat

- Two major changes occur:
  - Physical
    - Structural changes to the meat
  - Biochemical
    - Cessation of blood flow
    - Metabolism
What Happens!?

• Stunned and Bled
• Removal of blood
• Drop in blood pressure
• Increased heart rate
• Vasoconstriction
• Anaerobic Metabolism
Anaerobic Metabolism

- Creatine Phosphate
- ATP decreases
- Glycolysis will run wide open
- Lactic Acid production
- pH drops
- 7.1 to 5.6 normal
- Will continue to drop until runs out of energy or pH too low for enzymatic activity

Aerobic metabolism

TCA Cycle

Anaerobic metabolism
Dark, Firm, and Dry (DFD)

- Severe prolonged stress (>12h)
- Fight or flight
- No glucose or glycogen
- pH 7.1 to 6.8
- Dark cutters (Beef)
- Bacterial growth
- Looks old
- Works well for further processing
Pale, Soft, Exudative (PSE)

- Severe short term stress
- Pork
- Fight or Flight
- Glycolysis geared up
- Combination of high muscle temp + glycolysis
- 7.1 to 5.4 or lower
- Denatures proteins
- Cannot hold onto water
- Cannot be used in processed meats
Development of Rigor

• During the conversion of muscle to meat
• Ca^{2+} is released into the muscle cell
• Muscles contract
• ATP Depleted, cannot relax
• Myosin stays attached to actin
• Rigor Mortis – stiffness of death
• Nerves stay active for 6 to 10 min., but can maintain minor activity for over 15 minutes
Development of Rigor

- Three phases of rigor
  1.) Onset
    - Gradual loss of plasticity
  2.) Completion
    - Complete loss of plasticity
  3.) Resolution
    - Gradual loss of tension
    - Protease activity at the Z-lines
    - Not a loss of actomysin bonds
Delay time before onset of Rigor

<table>
<thead>
<tr>
<th>Species</th>
<th>Hours</th>
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<tbody>
<tr>
<td>Beef</td>
<td>6-12</td>
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<tr>
<td>Lamb</td>
<td>6-12</td>
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<tr>
<td>Pork</td>
<td>$\frac{1}{4}$ -3</td>
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<tr>
<td>Turkey</td>
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<tr>
<td>Chicken</td>
<td>&lt; $\frac{1}{2}$</td>
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<td>Fish</td>
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Influencing Factors

• Factors influencing the Physical and Biochemical changes
  – Handling
  – Environment
  – Transportation
  – Nutrition/ Growth Promotants
  – Genetics
  – Immobilization (Stunning)
  – Chilling
Handling

- Stress
- Cattle – head to tail
- Pigs – eye to eye
- Sheep – Judas Goat
- Redesign facilities
- Re-train employees
- Hot Shots
- Bruises
Environment

- More quality problems during drastic weather changes
- Hot vs Cold
- Co-mingling with unfamiliar animals
- Stress
Transportation

- Very Stressful
- Trucker Quality Assurance (TQA)
- Keep warm or cool (sprinklers)
- Co-mingling with unfamiliar animals
- Over crowding
- 30 minutes to load 180 pigs
Transportation

- Slip resistant floor
- Gentle acceleration and stopping
- Clean
- Eliminate the use of hot shots!
- Eliminate downers; non-injured and injured
- Rest (2 to 4 h) for pigs; cattle not normally rested for set period of time
Nutrition/ Growth Promotants

- Time off Feed
- Creatine Phosphate
- Growth Promotants:
  - Type IIb fibers
  - Leaner, heavier muscled carcasses
  - Tougher Meat
  - Lower quality grades in beef
Genetics (Pigs)

• Napole gene
  – AKA:
    • Acid Meat Gene
    • Hampshire Gene
  – More Glycogen (higher Glycolytic Potential)

• Halothane Gene
  – Rapid onset of rigor
  – Open mouthed breathing
  – Blotchiness of skin

• PSS (Porcine Stress Syndrome)
  – Nervous twitch
  – Leaky Ryanodine Receptor

• Heavy muscled; High lean to fat
• PSE
Immobilization

- Pigs
  - CO₂, Electricity
- Cattle
  - Captive bolt
- Sheep
  - Captive bolt, electricity
- Stun to stick
  - Blood splashing
  - Fiery Fat
- Blown out joints, backbones, etc
Chilling

- Remove heat as quickly as possible
- Pork
- Blast chill
- Thickness of Muscle
- Air flow
- Good cooler will forgive a lot of sins
- We need to be careful!!
Chilling

- Cold Shortening – too cold before it goes into rigor (<15° C or 59° F)
  - Muscle Fiber Type
  - Problem in Beef and Lamb
  - Electrical stimulation or 48 hour chill
- Thaw Rigor – muscle frozen before it goes into rigor
  - At thawing muscle tries to complete the process
  - Decrease in size
- Tough, moisture loss
Feel the wind in your face