Meat Quality; Fat/ Marbling
Levels of Fat

- **Subcutaneous Fat** = Directly under hide
- **Internal Fat** = KPH, visceral, mesenteric fat
- **Intermuscular Fat** = Seam fat
- **Intramuscular Fat** = w/in perimysium (marbling)
- **Brown Fat** = neonatal fat; more mitochondria, generates heat
Fat & Livestock

• Least fat to most fat
  – Beef = Bulls, Steers, Heifers
  – Sheep = Rams, Wethers, Ewes
  – Pork = Boars, Gilts, Barrows

• The bulk of pig fat is deposited in the subcutaneous layer

• Cattle and sheep tend to have more intermuscular than subcutaneous fat
Fat Quality

• Saturated vs Unsaturated Fat
  – Saturated = Single bonds (Trans fats)
  – Unsaturated = Double bonds

• Beef = Unsaturated fat
  – Difficult to alter
  – Grain-fed vs Grass/ Forage-fed

• Pork = Saturated fat
  – Can easily be altered through feeding
  – Create more heart healthy pork
  – Boar taint (Skatole and/or Androstenone)
Pork Fat

• 70 – 75% of the pork carcass is further processed (Cannon et al., 1995)
• Fat quality is very important
• Unsaturated fat = adverse affects on processing characteristics (St. John et al., 1987; Shackelford et al., 1990; Rentfrow et al., 2002)
• Belly/Bacon quality
• Shelf life problems
Belly Flop

Report both right and left edge numbers to the nearest half inch & report average vertical & lateral.
## Fatty Profile as altered through feeding

<table>
<thead>
<tr>
<th>FA</th>
<th>Con</th>
<th>CWG</th>
<th>HOC</th>
<th>HOHOC</th>
<th>SE</th>
<th>Sig*</th>
</tr>
</thead>
<tbody>
<tr>
<td>SFA</td>
<td>40.003&lt;sup&gt;b&lt;/sup&gt;</td>
<td>37.574&lt;sup&gt;a&lt;/sup&gt;</td>
<td>36.764&lt;sup&gt;a&lt;/sup&gt;</td>
<td>37.694&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.376</td>
<td>P &lt; 0.01</td>
</tr>
<tr>
<td>UFA</td>
<td>58.664&lt;sup&gt;a&lt;/sup&gt;</td>
<td>61.016&lt;sup&gt;bc&lt;/sup&gt;</td>
<td>62.018&lt;sup&gt;c&lt;/sup&gt;</td>
<td>60.975&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.368</td>
<td>P &lt; 0.05</td>
</tr>
<tr>
<td>MUFA</td>
<td>48.359&lt;sup&gt;a&lt;/sup&gt;</td>
<td>49.778&lt;sup&gt;b&lt;/sup&gt;</td>
<td>47.701&lt;sup&gt;a&lt;/sup&gt;</td>
<td>51.581&lt;sup&gt;c&lt;/sup&gt;</td>
<td>0.376</td>
<td>P &lt; 0.05</td>
</tr>
<tr>
<td>PUFA</td>
<td>10.306&lt;sup&gt;b&lt;/sup&gt;</td>
<td>11.238&lt;sup&gt;c&lt;/sup&gt;</td>
<td>14.317&lt;sup&gt;d&lt;/sup&gt;</td>
<td>9.395&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.300</td>
<td>P &lt; 0.05</td>
</tr>
</tbody>
</table>

*LSMEANS within a row with different superscripts differ significantly.

Con = Control, CWG = Choice white grease, HOC = High oil corn, HOHOC = High oil, high oleic corn
Measuring Fat or Body Composition

- Eyeball
- Carcass cutouts
- Ultrasound
- Fat-O-Meater
- Specific Gravity
- TOBEC (Total Body Electrical Conductivity)
- Bioelectrical Impedance
- $^{40}$K Body Counter
Marbling

- Beef industry – pays on marbling
- Pork industry – does not, but recognized as a problem
- Lamb – does not pay for marbling
What does marbling do?

- **Juiciness**
  - Saliva
  - Slight Forgiveness when over cooked
- **Flavor**
  - We like the flavor of fat
- **Tenderness**
  - Very, very low correlation
Development of Marbling

- Appears to be a linear deposition
- Excess energy in the diet
- Close to blood vessels
- Tends to increase with age
What influences Marbling?

- **Genetics**
- **Beef**
  - British vs Continental vs *Bos indicus*
- **Pork**
  - Duroc & Berkshire
- **Diet**
  - High concentrate
  - Grass/forage fed
- **“Time on Feed”**
  - Feedlot
  - Over 100 d; typically 150 d
Early Weaning

<table>
<thead>
<tr>
<th>Quality Grade</th>
<th>EW</th>
<th>NWC</th>
<th>NW</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥ Choice%</td>
<td>100</td>
<td>96</td>
<td>100</td>
</tr>
<tr>
<td>≥ Ave. Choice%</td>
<td>93</td>
<td>68</td>
<td>68</td>
</tr>
<tr>
<td>≥ Prime%</td>
<td>15</td>
<td>11</td>
<td>0</td>
</tr>
</tbody>
</table>

EW = Early weaned; NWC = Normal weaning + creep; NW = Normal Weaning

Myers et al., 1999
The Conundrum

• 20 years ago; Choice sold in meat case; Prime in Premium case
• Currently Select sold in meat case; Choice in Premium case
• “Why can’t I get the same flavor and quality of steak that I get in a restaurant?”
Window of acceptability
Certified Angus Beef

- Most successful branded beef program
- Promotion of Angus bulls
- Criteria
  - 51% Black
  - Ch° or higher
  - No dark cutters
  - YG 3.9 or lower
  - No dairy; hump height less than 2”
  - A maturity
- Quality Program, not a Genetic Program
Laura’s Lean

- Laura Freeman, Winchester, KY
- Mainly exotic bred cattle; Limousin, Charolais, Simmental, Gelbvieh, Piedmontese, Belgian Blue
- No antibiotics or implants
- USDA Select or Standard
Other Branded Beef Programs

- The success of CAB has led to other branded beef programs
- Certified Hereford
- Black Angus Beef (several of these)
- Excel’s Sterling Silver
- Tyson’s Chairman’s Reserve
- Nolan Ryan’s Tender Aged Beef
- Many, many, many more
Pork and Marbling

• Restaurant industry has voiced concerns over the lack of marbling in pork
• Movement toward higher marbling breeds
• Japanese market; dark colored loins, more marbling
• Berkshire and Durocs known for marbling
Meat Quality; Water Holding Capacity
Water Holding Capacity

• Which package would you buy?
Water Holding Capacity

- Important in both fresh meats and processed meats
- Flavor, juiciness, and consumer satisfaction
- $$$$$$$$$$$$$$$$$$$$$$$$

[Image of a packaged meat product]
Types of water in meat

- Water is polar; + & - charges
- **Bound Water**
  - Bound to proteins
  - 4 to 5%
- **Immobilized Water**
  - Next layer
  - Attracted to bound water
- **Free Water**
  - Held by capillary forces
Fresh Meats

- Isoelectric Point
- Proteins
- pH when the number of positively charged groups are equal
- Isoelectric Point = 5.1
- No space left over to attract water

![Graph showing the relationship between pH of Meat and Increasing water-holding capacity. The graph has a U-shape with the lowest point at pH 5.1.](image-url)
What happens?

• Pre-mortem effects
  – Stress

• Genetics
  – High glycolytic activity (Napole gene)
  – PSS or Halothane gene

• Rapid pH decline combined with high muscle temperature

• PSE & DFD
How do we fix this?

- Reduce stress
- Blast chill (pork)
  - Slow pH decline
- Electrical Stimulation
- Sodium phosphate
  - Increased pH
- Sodium chloride
  - Changes isoelectric point