Developing a Checklist for Pork Quality

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Presentation Overview
- Define Quality
- Describe Key Indicators of Pork Quality
- Outline Factors Influencing Variation in Pork Quality
- Identify Steps Producers Can Take to Improve Pork Quality

‘Quality’ can mean many different things
- Wholesomeness
- Nutritional value
- Tenderness
- Visual appearance
- Flavor & Juiciness
- Lean (% muscle)

What is Pork Quality
- “Functionality” is a common term used to describe pork quality
  - Factors that affect consumer acceptance or demand for pork and pork products
  - Factors that affect the processing and value-added opportunities for pork and pork products

Fresh Pork Quality Indicators
- Color
- Intramuscular Fat / Marbling
- Tenderness
- Taste
- Firmness/Wetness
- Water Holding Capacity
- pH

Color is dependent on the ratio of red to white muscle cells in a muscle
- Type I (Red)
  - Slow twitch
  - Aerobic
  - Higher myoglobin content
  - Myoglobin gives meat its red color
- Type II (White)
  - Fast twitch
  - Anaerobic
  - Lower myoglobin

Globular structure of Myoglobin
Pork Color - Consumer Perception at Point of Purchase

- Industry Standards - National Pork Board
  - Subjective Assessment
  - 1 to 6 scoring system

- NPB Standard
  1 = Pale, pinkish gray to white
  2 = Grayish pink
  3 = Reddish pink
  4 = Dark reddish pink
  5 = Purplish red
  6 = Dark, purplish red

"Ideal" Color

- At Purchase
  - Initial indicator of wholesomeness
  - Uniformity within packaging

- Eating Quality
  - Pork that is very pale (Score of 1) in various studies results in diminished eating quality
  - May be due to other, associated properties that go along with pale color including lower pH, and a tougher product

- Industry Target – Reddish-Pink – Purplish Red

Pale and Dark Pork

- Abnormally pale pork
  - Generally lower in pH
  - Inability to maintain shape
  - Surface and package fluid accumulation
  - Poor yield (excess shrink)
  - Poor overall palatability

- Extremely dark pork
  - Generally greater pH
  - Reduction in shelf-life
  - Increased risk of Off-flavors

Fat / Lipid

- Marbling
  - To some consumers this is a very desirable trait while to others it indicates too many calories.
  - "Fat = Flavor"
  - We know that flavor is one of the primary reasons a consumer will buy a product.

Visual Marbling Scores

- Standard industry scoring system
  - Assessed effectively using 1 to 6 scale
  - Increments correspond to chemical measurement of percent intramuscular fat

IMF (Marbling) and Eating Quality

- Findings dependent on the study evaluated
    - No impact of intramuscular fat on eating quality of loins
  - Recent NPB data
    - Major effect is found comparing the extremes, with small effects with 1% incremental increases from a minimum of 1% IMF
    - Desired within International Markets
Pork Firmness
- Surface texture, feel, appearance
- Assessed using a three-point scale:
  - 1 = Soft – Cut surfaces distort easily and are visibly soft
  - 2 = Firm – Cut surfaces tend to hold their shape
  - 3 = Very Firm – Cut surfaces tend to be very smooth with no distortion of shape

Pork Wetness
- Appearance of free-water on the pork surface
- Assessed on a three-point scale:
  - 1 = Exudative – Excessive fluid pooling on cut surfaces or in packages
  - 2 = Moist – Cut surfaces appear moist, with little or no free water
  - 3 = Dry – Cut surfaces exhibit no evidence of free water

Muscle Composition
- Water 75% (65 to 80)
- Protein 18.5% (16 to 22)
- Lipid 3.0% (1.5 to 13)
- Non-protein nitrogenous substances 1.5%
- Carbohydrates 1.0%
- Inorganic 1.0%

Water Holding Capacity (WHC)
- Ability to Bind the Water within the Muscle

A greater pH leads to more water holding capacity

Ultimate pH
- Measure of the acid-base relationship of pork
- Valuable association with pork color, wetness, firmness, water-holding capacity, and tenderness
- Typically measured 24 hours after harvest
- Higher pH = darker color, low drip loss, more firmness, increased tenderness
Poor water holding capacity and or low pH can negatively impact:

- Appearance
- Excessive purge
- Palatability
- Dry after cooking
- Value
- Loss in weight
- Discounted or discarded product

Pork Tenderness

- Clearly influences the quality of the eating experience
- Often found to be the most important consumer characteristic
- Of particular concern with whole muscle fresh products
  - Loin chops, Shoulder muscles, Ham muscles
- Related to muscle function
- Related to muscle size and dimension

Collagen & Degree of Doneness

Critical Control Points for Quality

- Farm Level ~ 50% of variation
- Genetics
- Nutrition
- Facilities & Handling
- Transportation
- Post Farm Gate ~50% of Variation
- Packing Plant
  - Pre-Harvest
  - Harvest
  - Chilling
- Post Harvest

Status of U.S. Genetic Pool

- 90 to 95% of U.S. Production is Commercial
- Efficiency Focus - Reproduction and Production
- Relatively few Genetic Suppliers –
  - Standard Genetic Improvement Principles
    - Similarity in Breeds & Mating Systems

Genetic Challenges: Antagonistic Relationships between Lean Production and Pork Quality

<table>
<thead>
<tr>
<th>Sign</th>
<th>Effect</th>
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</thead>
<tbody>
<tr>
<td>+</td>
<td>Unfavorable</td>
</tr>
<tr>
<td>-</td>
<td>Unfavorable</td>
</tr>
<tr>
<td>-</td>
<td>Unfavorable</td>
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</table>

- Backfat and Intramuscular fat
- % Lean and Intramuscular fat
- Loin muscle area & Loin Color
- Loin area & Loin Firmness/Wetness
Genetic Implications

- Genes are the backbone of pork quality
- Genes set the upper limit
- DNA technology and gene discovery will enhance the rate of progress

Nutrition and Pork Quality

Fat Quality Issues

- Soft can be a problem within the industry
  - Odor-flavors and shelf-life implications associated with feeding certain fats (oxidative rancidity, graying of the product)
- Feeds containing highly-unsaturated fats
  - Change in pig fat saturated:unsaturated ratio
- Vegetables oils (canola, soybean, corn, sunflower) are very high in unsaturated fats
- Animal fat sources (tallow, choice white grease, lard) are much more saturated

Effects of Feeding DDGS to Grow-Finish Pigs on Carcass, and Pork Quality

<table>
<thead>
<tr>
<th>Trait</th>
<th>0%</th>
<th>10%</th>
<th>20%</th>
<th>30%</th>
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</thead>
<tbody>
<tr>
<td>Belly thickness, cm</td>
<td>3.15</td>
<td>3.00</td>
<td>2.54</td>
<td>2.74</td>
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<tr>
<td>Belly firmness score, degrees</td>
<td>27.3</td>
<td>24.4</td>
<td>25.1</td>
<td>21.3</td>
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<tr>
<td>Adjusted belly firmness score, degrees</td>
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<td>23.0</td>
<td>25.4</td>
<td>22.2</td>
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<tr>
<td>Iodine number</td>
<td>66.9</td>
<td>68.6</td>
<td>70.9</td>
<td>72.9</td>
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Means within a row lacking common superscripts differ (P < .05).

Muscle Quality Characteristics from Grow-Finish Pigs Fed Diets Containing 0, 10, 20, and 30% DDGS

<table>
<thead>
<tr>
<th>Trait</th>
<th>0%</th>
<th>10%</th>
<th>20%</th>
<th>30%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bratzler sheer force, kg</td>
<td>21.4</td>
<td>21.5</td>
<td>21.8</td>
<td>22.1</td>
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<tr>
<td>Warner-Bruini shear force, kg</td>
<td>2.4</td>
<td>2.4</td>
<td>2.5</td>
<td>2.5</td>
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</tbody>
</table>

* 0% = basal, 100% = whole
* 1= rib, 2= loin; 1a=loin, 2a= rib, 1b=loin, 2b=rib, 3=very lean
* 1= rib, 2= loin, 3= very lean
* RMSE = root mean square error
Feed Withdrawal Prior to Slaughter
- 12 to 18 hours prior to stun and stick is recommended
- Benefits include improved dressing percentage, fewer problems with evisceration, reduced glycogen stores in the muscle
- Concerns occur when feed removal is > 18 hours
- Carcass shrink occurs
- Muscle quality may decline

Handling and Transport
- Major factors in Pork Quality Determination
  - IT IS THE PEOPLE
    - Who design the facilities (correct or incorrect)
    - Who do not know how to properly handle animals
  - STRESS on the Pig will increase the:
    - % Downers in the finisher, truck, or packing plant
    - % Dead on Arrival
    - % PSE and or DFD pork

Fatigued Pig Symptoms
- Normal Pig
  - Open-Mouth Breathing
  - Skin Discoloration
  - Refuse to move
  - Abnormal Vocalization
  - Muscle Tremors
  - Collapse = Fatigued
  - Death

Minimizing Incidence of Fatigued Pigs
ANIMAL HANDLING IS CRITICAL!

Handling Intensity

On-farm Handling
- Health/Stress Management
  - Well-lit buildings reduce excitability
  - Human-pig interaction on a regular basis (1 to 2 minutes in the pen daily) improves pig response and reduces fear of humans
  - Workers need training in pig handling and they need to held responsible for their actions when handling pigs
  - Some people simply should not move pigs
  - Be PREPARED PRIOR to LOADOUT
Handling in Pens and Alleys

- In pens
  - Mark animals prior to sorting not as you go
  - Never use Hot-shots in pens
  - Utilize sorting boards
  - You are not stronger than pigs and solid partitions aid sorting
  - Don’t SHOUT or YELL and make unusual noises
  - Move slowly and deliberately

- In alleys
  - Move pigs in small groups of 4 to 6 pigs
  - Allow pigs to follow the leader
  - Avoid 90° turns or manage accordingly
  - Avoid Electrical Prod use in Alley

Loading Ramps

- Dual ramp design with open panels between and solid outside walls increase loading efficiency
- Loading Ramps should have a maximum 20° slope, but 10° is better
- Use hot-shots only as a last resort and then only on the pig that needs it
- Certainly not every pig
- Certainly only for a short duration
- Never in sensitive areas, eyes, face, ears, vulva, rectum
- DO NOT SHOUT OR YELL
  - The people who do things the best don’t need to yell.

Loading Decisions

- Do not load pigs that are fatigued or cannot walk
- Do not allow individuals who are not following appropriate handling procedures to continue interacting with the pigs
  - Take a Stand and Stop if things are not right!

What can be done to minimize Transport and Marketing Stressors?

- Trucker
  - Take Responsibility for the pigs well-being
- Transporting
  - Flat deck trucks are preferred
  - Pots have too many steep, internal ramps
  - Do not overload
  - Load based on weight of pigs not just number
  - Leave immediately following loading to avoid temperature rise in loaded, stationary trucks

Transport Floor Space

- Utilized 42 loads in spring and fall to determine the effects of transport floor space on losses at the plant

<table>
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<th>Transport Floor Space</th>
<th>1.0</th>
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<th>2.5</th>
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<tr>
<td>Pig/pig/ft</td>
<td>P</td>
<td>P</td>
<td>P</td>
<td>P</td>
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<tr>
<td></td>
<td>4.28</td>
<td>4.47</td>
<td>4.70</td>
<td>4.97</td>
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<td></td>
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P < 0.001, SEM = 0.43, n = 252

NIAA
250 lbs = 4.26 ft/pig
300 lbs = 4.79 ft/pig
Transportation between the farm and plant

- Adjust for Weather Extremes
  - Fewer pigs/load in hot weather
  - Use wet sand or wet shavings (> 60 F)
  - Use straw ONLY in Cold weather
  - Install water drips or wet animals once loaded
  - Open sides of trailer to allow air-flow in summer and close sides in winter to prevent frost-bite
  - Unload immediately upon arrival to the plant

Final Thoughts

- Pork Quality is Important
  - Consumers are more demanding
- Genetics and Nutrition play a role
  - Economics primarily dictates these outcomes
  - Producers will work with what is offered
- On-farm Handling is Critical to Quality and Well-being
  - Directly under Producer Control
  - Producer Responsibility
  - Require National Pork Board Transporter Quality Assurance and PQA PLUS for all Animal Handlers

The End!