Management Practices and Pork Quality

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Areas Discussed

- What is “Management”? 
- What is “Pork Quality”? 
- Link between “Management” and “Quality” 
- Transport losses
Management?

“The organization and control of the way something operates”

Includes all aspects from “conception to consumption”

Focus of this presentation:
“Pre-harvest animal handling”
Pre-harvest Pig Handling

• Narrow definition
  – How pigs are moved at the farm and at the plant

• Broader definition
  – Involves all factors that can affect the animal from leaving the farm pen to arriving at the point of harvest
Pork Quality?

- Quality is complex
  - Multi-faceted and multi-factorial
- Components
  - Compositional
  - Nutritional
  - Technological
  - Toxicological
  - Sensorial
  - Hygienic
Link between Pre-harvest Pig Handling in Pork Quality

• The process of “handling” of pigs between the farm and the point of harvest results in “stress” on the animal and increased activity.

• “Stress” and activity change:
  – Muscle metabolism both pre- and post-harvest
  – Muscle energy levels
  – Muscle temperature

• Postmortem, result in changes in:
  – Muscle pH and temperature
  – Muscle color and water-holding capacity
Stress and Pork Quality

• Key issues are the intensity and timing of pre-slaughter stress

• Short-term “acute” stress
  • Close to harvest
  • Influences the incidence of PSE via rate of post-mortem glycolysis and muscle temperature

• Longer term “chronic” stress
  • 24 hours pre-harvest
  • Influences the incidence of DFD via muscle glycogen levels at harvest
Losses During Transport: Definitions

**Losses up to the scale in the slaughter plant**

- **INJURED (NAI)**
- **NON-INJURED (NANI)**
- Slows, Subjects, Suspects, Downers
- **FATIGUED**
- **Dead on Arrival**
- **Non-ambulatory**

**NON-INJURED (NANI)**
- Slows, Subjects, Suspects, Downers
- **FATIGUED**

Images of pigs illustrating the concepts.
Incidence of Dead Pigs Arriving at US Packing Plants (1990-2004)

Incidence of Fatigued Pigs at the Plant?

- No national statistics available
- Field studies = ~0.2% to 1.0%
- Total transport losses = ~0.5 to 1.3% of pigs transported
Fatigued Pigs - Symptoms

Symptoms characteristic of an extreme stress response

- Open-mouthed breathing
- Skin discoloration
- Muscle tremors
- Unresponsiveness to stimuli to move
- Characteristic vocalization
Metabolic Changes in Fatigued Pigs

- Metabolic acidosis:
  - Increase in blood lactate
  - Decrease in blood pH

- Elevated body temperature

Anderson et al., 2003
“Accumulation” of Stress

Normal Pig  ↓  Stress
Open-Mouth Breathing
Skin Discoloration
Refuses to move  ↓  Stress
Abnormal Vocalization
Muscle Tremors
Collapse = Fatigued  ↓  Stress
Death
Fatigued Pigs

- Fatigued pigs can occur at any stage from the farm to the point of slaughter

- Most (if not all) pigs will become fatigued if subjected to sufficient stress

- Individual stressors may be additive

- Most fatigued pigs will recover given sufficient time in a “minimum stress” environment
IS THERE A LINK BETWEEN TRANSPORT LOSSES & PORK QUALITY?
# Pork Quality of Fatigued Pigs

<table>
<thead>
<tr>
<th></th>
<th>Plant A</th>
<th>Plant B</th>
<th>Plant C</th>
<th>Plant D</th>
<th>Overall</th>
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</thead>
<tbody>
<tr>
<td>Ultimate pH</td>
<td>6.20</td>
<td>6.00</td>
<td>5.96</td>
<td>5.90</td>
<td>6.00</td>
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<tr>
<td>Subj. Color</td>
<td>3.8</td>
<td>4.0</td>
<td>3.6</td>
<td>3.7</td>
<td>3.8</td>
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<tr>
<td>Minolta L*</td>
<td>46.1</td>
<td>43.8</td>
<td>46.6</td>
<td>46.3</td>
<td>45.7</td>
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<tr>
<td>Drip loss, %</td>
<td>1.97</td>
<td>1.42</td>
<td>2.37</td>
<td>1.74</td>
<td>1.91</td>
</tr>
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</table>

*a NPPC, 1999 (1-6)
*Carr et al., (2005)*
Animal Handling Factors at the Farm Associated with Stress/Transport Losses

- Facility design
  - Aisle width
  - Length of building (distance from pen to truck)
  - Ramp height and angle
- Temperature & humidity (season, time of day)
- Handling intensity
- Pre-sorting of pigs prior to loading
- Fasting time
Non-ambulatory pigs at the Farm

**DISTANCE MOVED**
- **SHORT** = 0 to 30 meters
- **LONG** = 60 to 90 meters

Ritter, 2006
109 loads = ~17,000 pigs

Non-ambulatory, injured pigs at the plant

**Non-ambulatory at the farm, %**
- **P = 0.09**
- **SEM = 0.09**

**Non-ambulatory, injured, %**
- **P = 0.06**
- **SEM = 0.07**
Influence of fasting time on transportation losses

Ritter, 2006
72 loads = ~11,000 pigs

Probability:
Dead = 0.16
Total losses = 0.31
Transport
Transport Factors Associated with Stress/Transport Losses

- **Trailer design**
- “Environment” on the trailer:
  - Temperature and humidity
  - Air movement
  - Sprinkler cooling
  - Mixing of pigs on the truck
  - Floor space
- **Times for:**
  - Loading and unloading
  - Transport
  - Waiting at the farm and plant
- **Transport distance and driving conditions**
### Trailer Design

<table>
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<tr>
<th></th>
<th>Straight</th>
<th>Potbelly</th>
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</thead>
<tbody>
<tr>
<td><strong>Unloading time, min</strong></td>
<td>20</td>
<td>36</td>
</tr>
<tr>
<td><strong>Open-mouth breathing after unloading, % of pigs</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| Spring                             | 1.3      | 4.9      | **
| Summer                             | 2.1      | 6.2      | **
| Fall                               | 1.9      | 2.0      |
| Winter                             | 0.9      | 2.7      |
| **Total transport losses, %**      | 0.85     | 0.96     |

Ritter, 2006
109 loads = ~17,000 pigs

** = P < 0.01
Influence of mixing of pigs from different farm groups on the trailer on transportation losses

Ritter, 2006
72 loads = ~ 11,000 pigs

Probability:
Fatigued = 0.34
Total losses = 0.34
5.8 sq. ft./pig

5.0 sq. ft./pig

4.2 sq. ft./pig
Influence of floor space on the truck on transport losses

Mean pig weight = 288 lb
NIAA recommendations: 250 lb = 4.26 sq. ft./pig; 300 lb = 4.79 sq. ft./pig

Ritter, 2006
42 loads = ~6,000 pigs
Interaction between Floor Space on the Trailer and Season for Transport Losses

Ritter, 2006
72 loads = ~11,000 pigs
Relative humidity changes in the trailer
Winter Load

1: Loading (38 min)
2: Wait at the farm (7 min)
3: Transport (193 min)
4: Wait at Plant (17 min)
5: Unloading (30 min)
Conclusions

- This is not BIOTECHNOLOGY

- Pigs experience a wide range of potential stressors from the farm through to the point of harvest that can influence:
  - transport losses
  - pork color and water-holding capacity

- Our knowledge of the impact of many of these “management factors” is limited
Acknowledgement

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