Effects of Season and Trailer Design on Transport Losses in Market Weight Pigs

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Areas to Discuss

• Define transport losses

• Background
  – Incidence of transport losses in U.S.
  – Seasonal variation in transport losses
  – Trailer design

• Controlled study on trailer design and season
Transport Losses: Definitions

• Dead on arrival (DOA):
  – A pig that died during transport

• Non-ambulatory pig:
  – A pig unable to move or keep up with contemporaries
  – Downers, subjects, slows, suspects, cripples, stressors, fatigued, injured

• Transport losses:
  – The sum of dead and non-ambulatory pigs at the plant
Classifying Non-ambulatory Pigs

Yearly Incidence of Dead Pigs at USDA Inspected Plants (1991-2006)

Non-ambulatory Pigs at the Plant

- National statistics are not available for non-ambulatory pigs

- A summary of 22 commercial field trials (2000-2007)
  - 4,607,567 market weight pigs
  - 27,240 trailer loads of pigs

<table>
<thead>
<tr>
<th>Plant Losses</th>
<th>Mean</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deads, %</td>
<td>0.25</td>
<td>0.00</td>
<td>0.77</td>
</tr>
<tr>
<td>Non-ambulatory, %</td>
<td>0.37</td>
<td>0.11</td>
<td>2.34</td>
</tr>
<tr>
<td>Total losses, %</td>
<td>0.62</td>
<td>0.14</td>
<td>2.39</td>
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</table>

~1 pig per load dies or becomes non-ambulatory at the plant

Seasonal Variation in the Midwest

Trailer Design

- Trailer design has important implications for:
  - Environmental conditions inside the trailer
  - Ease of pig handling
  - Injuries and bruising
  - Transport losses
Components of Trailer Design

• Trailer type
  – Drop center (pot-belly)
  – Straight deck

• Number of decks
  – 2 decks
  – 3 decks

• Nose vents
  (photos courtesy of Wilson Trailers)

• Side vents
  – Punched sided
  – Slat sided

• Internal ramps
  – Yes vs. no
  – Ramp angle
  – Ascend vs. descend

(photos courtesy of Wilson Trailers)
Pot-belly vs. Straight Deck Trailers

• **Pot-belly advantages**
  – Lower center of gravity
  – Can haul pigs and/or cattle

• **Straight deck advantages**
  – Fewer internal ramps (1 vs. 5)
  – Ramps are designed for pigs

(Kelly Weaver, personal communication)
Punched Sided vs. Slat Sided

- **Punched sided advantages**
  - Biosecurity
  - Lighter weight
  - More aerodynamic

- **Slat sided advantages**
  - More open surface area
  - More ventilation when stopped?

(photos courtesy of Wilson Trailers)

(Kelly Weaver, personal communication)
Recent Field Data

• Survey data suggests that pot-belly trailers have 5\% higher transport losses than straight decks (McGlone, 2006)

• However, trailer design may be confounded with:
  – Driver, farm, length of journey, transport floor space

• Farm and driver are the two largest sources of variation in transport losses (Ellis et al., 2003)


Controlled Field Study

- Objectives: to determine the effects of trailer design and season on physical indicators of stress (during loading and unloading), transport losses at the plant, and carcass trim loss.

*This study was funded by the National Pork Board Checkoff

Experimental Design

• 109 trailer loads of market weight pigs (n = 17,256; ~286 lbs) from one commercial farm were used in a randomized complete block design with a $2 \times 4$ factorial arrangement of treatments:

1). Trailer design (pot-belly vs. straight-deck)

2). Season (spring vs. summer vs. fall vs. winter)
**Trailer Designs Evaluated**

- Both trailer designs were double-deck, aluminum, punched sided trailers from the same manufacturer (Wilson Trailers, Sioux City, IA)

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**Pot-belly**

<table>
<thead>
<tr>
<th>Top 1</th>
<th>Top 2</th>
<th>Top 3</th>
<th>Top 4</th>
<th>Top 5</th>
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<tbody>
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<td>X</td>
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<table>
<thead>
<tr>
<th>Bottom 1</th>
<th>Bottom 2</th>
<th>Bottom 3</th>
<th>Bottom 4</th>
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</thead>
<tbody>
<tr>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
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</table>

**Straight Deck**

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<thead>
<tr>
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<th>Top 5</th>
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<table>
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<tr>
<th>Bottom 1</th>
<th>Bottom 2</th>
<th>Bottom 3</th>
<th>Bottom 4</th>
<th>Bottom 6</th>
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<tbody>
<tr>
<td>X</td>
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<td></td>
<td></td>
<td>Bottom 5</td>
</tr>
</tbody>
</table>

- Designates an internal loading ramp
- “X” Designates location of temperature and RH sensors
Seasons Evaluated

• Pigs were loaded on 28 days over all 4 seasons with pigs being transported on 7 days per season

• Seasons
  – Spring: April and May
  – Summer: August and September
  – Fall: September, October, and November
  – Winter: January and February
Handling at the Farm

• 2 pot-belly and 2 straight deck trailers were loaded in random order on each day

• Pigs were loaded by University of Illinois personnel
  – Sorting boards and electric prods, if necessary

• Pigs were mixed on the trailer and were provided with ~4.8 ft²/pig on the trailer

• One handler was used at the farm to load all 4 trailers
Handling at the Plant

• Pigs were transported ~4 hours to a commercial plant

• One handler was used at the plant to unload all 4 trailers

• Packing plant employees identified dead and non-ambulatory pigs up to the weigh scale
Measurements

• Trailer temperature and relative humidity by event
  – Loading, waiting at farm, transport, waiting at plant, and unloading

• Physical signs of stress (during loading and unloading)
  – Open-mouth breathing, skin discoloration, and muscle tremors

• Electric prod use during unloading
  – Recorded as “yes” or “no” by compartment

• Transport losses at the plant
  – Dead on arrival and non-ambulatory pigs

• Carcass trim loss
  – Percentage of carcasses requiring trim
## Event Times

<table>
<thead>
<tr>
<th>Event times, min</th>
<th>Trailer Design</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pot-belly</td>
</tr>
<tr>
<td>Loading</td>
<td>68.9</td>
</tr>
<tr>
<td>Waiting at farm</td>
<td>11.7</td>
</tr>
<tr>
<td>Transport</td>
<td>234.1</td>
</tr>
<tr>
<td>Waiting at plant</td>
<td>18.8</td>
</tr>
<tr>
<td>Unloading</td>
<td><strong>35.8</strong></td>
</tr>
<tr>
<td>Total time</td>
<td>364.6</td>
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</tbody>
</table>
Conditions Inside the Trailer

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Trailer Design</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average temperature, °C</td>
<td>Pot-belly 13.4</td>
</tr>
<tr>
<td>Average relative humidity, %</td>
<td>Straight Deck 15.2</td>
</tr>
<tr>
<td>Average relative humidity, %</td>
<td>Pot-belly 63.6</td>
</tr>
<tr>
<td>Average relative humidity, %</td>
<td>Straight Deck 59.8</td>
</tr>
</tbody>
</table>

- Note: effects of trailer design on temperature and relative humidity were dependent upon season

- More detailed information will be presented by season, deck, and compartment at the 2008 Midwest Animal Science Meetings (Murphy et al., 2008)
Electric Prod Use During Unloading

- Prods were used as a last resort by the plant truck monitor
- Prod use was recorded as “yes” or “no” by compartment

**Pot-belly**

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<th>Top 3</th>
<th>Top 4</th>
<th>Top 5</th>
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<tbody>
<tr>
<td>1.89%</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
</tbody>
</table>

- Bottom 1: 32.1% (7.3% of all compartments)

**Straight Deck**

<table>
<thead>
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<th>Top 3</th>
<th>Top 4</th>
<th>Top 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00%</td>
<td>x</td>
<td>x</td>
<td>x</td>
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</table>

- Bottom 1: 0.00% (0.0% of all compartments)

Designates an internal loading ramp
Effects of Trailer Design on Physical Signs of Stress During Unloading

*Indicates a trailer design × season interaction (P < 0.05)
Effects of Trailer Design on Transport Losses at the Plant

![Bar chart showing transport losses for different categories and trailer designs.]

- Deads on Arrival: Pot-belly 0.35, Straight deck 0.35
- Non-ambulatory: Pot-belly 0.57, Straight deck 0.46
- Total Losses: Pot-belly 0.96, Straight deck 0.85

Note: The significance levels for group differences are indicated as follows:

- Deads on Arrival: (P = 0.67)
- Non-ambulatory: (P = 0.61)
- Total Losses: (P = 0.82)
Effects of Trailer Design on Carcass Trim Loss at the Plant

(P = 0.43)

Carcasses Requiring Trim, %

<table>
<thead>
<tr>
<th></th>
<th>Carcasses Requiring Trim, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pot-belly</td>
<td>6.72</td>
</tr>
<tr>
<td>Straight deck</td>
<td>7.29</td>
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</tbody>
</table>

(Elanco)
Effects of Season on Transport Losses at the Plant

Transport Losses, %

- Spring
- Summer
- Fall
- Winter

<table>
<thead>
<tr>
<th>Season</th>
<th>Deads on Arrival</th>
<th>Non-ambulatory</th>
<th>Total Losses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spring</td>
<td>(P = 0.67)</td>
<td>(P = 0.03)</td>
<td>(P = 0.38)</td>
</tr>
<tr>
<td>Summer</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Fall</td>
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<tr>
<td>Winter</td>
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Summary of Controlled Study

• Trailer temperature and relative humidity
  – Straight decks had higher temperatures and lower RH than pot-belly trailers

• Handling characteristics
  – Pot-belly trailers required more time to unload and more electric prod use

• Physical signs of stress
  – Pot-belly trailers had more OMB and SD during unloading

• Transport losses and carcass trim loss
  – No effects of trailer design on transport losses or carcass trim loss
  – Non-ambulatory rate was higher in winter than spring and summer
Overall Summary

• Trailer design
  – No effects of trailer design on transport losses when handling and transport floor space were standardized across trailers
  – Driver effects > trailer effects ???

• Season
  – In the Midwest, the rate of non-ambulatory pigs increases during late fall and early winter time period
  – Additional research is necessary to understand why
Back-up Slides
Seasonal Variation in Non-ambulatory Pigs

• Rate of non-ambulatory pigs increases in the Midwest during late fall and early winter (Ellis & Ritter, 2006)

• Potential explanations proposed by Ellis & Ritter (2006):
  – Temperature stress
  – Heavier pigs
  – Increased number of pigs transported
  – Health status
  – Summer is over!