An Evaluation of the Effects of Long-Term Industry Selection for Increased Carcass Leanness in Duroc Swine

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Outline

- Background
- Objectives of the Study
- Project Design
- Data Collection
- Results
- Implications
Initiation of grid-based marketing systems in 1985

Selection focus toward lean percentage

Impact on consumer acceptance/meat quality

Hayenga, 1985

Brorsen, 1998
Objectives

- Evaluate the effects of long-term selection for carcass leanness on deposition rates and growth patterns of LMA, BF, & IMF

- Quantify the effect that selection for increased percent lean has had on meat and eating quality since the mid to late 1980’s
Project Design

■ Old Time Period
  - Available boars from the mid to late 1980's
  - Frozen semen

■ Current Time Period
  - Boars currently available in 2002
  - Fresh semen
Project Design

- Two breeding seasons (Replications)
- Littermate and ½ sib pairs of females
  - Alternate sire time period mating between replications
- Expected conception rate difference
  - 6 frozen matings per boar
  - 5 fresh matings per boar
Progeny Test

- One or two boars kept intact from each litter
- Serial Scan
  - 6 bi-weekly scans beginning at 135 lbs.
  - Off-test scans collected at 240 lbs.
- Two pigs from each litter used in carcass evaluation
Objective 1

- Evaluate the effects of long-term selection for carcass leanness on deposition rates and growth patterns of LMA, BF, & IMF
**Data Collection**

- **Serial Ultrasonic Scans**
  - NSIF certified technician
  - Aloka 500

- **Tenth-rib LMA & BF**

- **Intramuscular Fat**
Data Analysis

**Growth Patterns**

- **Random Regression Model**
  - *Fixed Effects*: Cont. group, sex, time period, and the interaction of time period by first and second order polynomial terms of the appropriate covariate
  - *Random Curves*: First and second order polynomials of the covariate

- **Unstructured and auto-regressive covariance structures** were fit for random terms and residuals, respectively
Deposition rates are significantly different ($P < .05$)
Growth Patterns

Loin Muscle Area

Deposition rates are significantly different (P < .05)
Growth Patterns

Intramuscular Fat

Deposition rates are significantly different (P < .05)
## Off-Test Results

<table>
<thead>
<tr>
<th></th>
<th>Wt (lbs)</th>
<th>BF (in)</th>
<th>LMA (in²)</th>
<th>IMF (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CTP</td>
<td>232.4</td>
<td>0.75</td>
<td>6.33</td>
<td>4.10</td>
</tr>
<tr>
<td>OTP</td>
<td>235.3</td>
<td>0.97</td>
<td>5.63</td>
<td>4.53</td>
</tr>
</tbody>
</table>
Objective 2

- Quantify the effect that selection for increased percent lean has had on meat and eating quality since the mid to late 1980's
Data Collection

- **Composition Traits**
  - BF10, LRBF, LLBF, LMA

- **Quality Traits**
  - Min, Hunt, pH
  - Color, Firmness, Marbling, IMF, WHC
  - Cooking Loss, Instron Tenderness

- **Sensory Panel**
  - Tenderness, Juiciness, Chewiness, Flavor
# Data Description

<table>
<thead>
<tr>
<th></th>
<th>Progeny Test</th>
<th>Carcass &amp; Sensory Eval.</th>
<th>Number of Sires</th>
</tr>
</thead>
<tbody>
<tr>
<td>CTP</td>
<td>557</td>
<td>178</td>
<td>23</td>
</tr>
<tr>
<td>OTP</td>
<td>232</td>
<td>98</td>
<td>16</td>
</tr>
<tr>
<td>Total</td>
<td>789</td>
<td>276</td>
<td>39</td>
</tr>
</tbody>
</table>
Data Analysis

Time Period Differences

- Least Squares means procedure
- Mixed model
  - **Fixed Effects**
    - Sire time period, rep, cont. group, sex, interaction of sex by line
    - Covariates: off-test wgt., on-test wgt., carcass wgt.
  - **Random Effects**
    - Sire and Dam nested within time period
Results

Average Daily Gain

No Significant difference between lines (P>0.05)
## Results

### Carcass Characteristics

<table>
<thead>
<tr>
<th></th>
<th>BF10 (in)</th>
<th>LRBF (in)</th>
<th>LLBF (in)</th>
<th>LMA (in²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CTP</td>
<td>0.80</td>
<td>0.94</td>
<td>0.76</td>
<td>6.47</td>
</tr>
<tr>
<td>OTP</td>
<td>1.10</td>
<td>1.09</td>
<td>0.95</td>
<td>5.40</td>
</tr>
</tbody>
</table>

Lines significantly different for all four carcass traits (P<0.05)
Results

Intramuscular Fat Percentage

LS means are significantly different (P<0.05)
Results

Subjective Quality Scores

LS means with different letters are significantly different (P<0.05)
Results

Objective Color

Minolta

Hunter

No significant differences between LS means (P>0.05)
Results

\[ \text{pH} \]

No significant differences between LS means (P > 0.05)
Results

**Instron Tenderness**

Kilograms

<table>
<thead>
<tr>
<th>Kilograms</th>
<th>CTP</th>
<th>OTP</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.9</td>
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</tr>
<tr>
<td>5.1</td>
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<tr>
<td>5.3</td>
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<td>6.1</td>
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<td>6.3</td>
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<td></td>
</tr>
<tr>
<td>6.5</td>
<td></td>
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</tr>
</tbody>
</table>

LS means are significantly different (P<0.05)
Results

Water Holding Capacity
Milligrams of moisture lost

Percent Cooking Loss
Percentage of Raw Weight

No significant differences between LS means (P>0.05)
Results

Sensory Panel Evaluation

LS means with different letters are significantly different (P<0.05)
Conclusions

- Significant progress toward the enhancement of carcass composition has been realized within the Duroc breed since the mid 1980’s

- Growth patterns and deposition rates of LMA, BF, & IMF have been significantly altered by industry selection for carcass leanness

- Increased carcass leanness through time has been at the expense of meat quality traits such as IMF percentage, Instron tenderness, and color, as well as various eating quality traits
Applications

- Identification of genetic lines still available via frozen semen that have superior meat quality attributes

- Identified genetic lines with superior meat quality may be utilized to diversify pork products when pursuing niche markets involving enhanced meat quality
Applications

- Determine the feasibility and application of genetic archives developed by seedstock producers and boar studs
- Enable packers to further understand the ramifications of grid-based pricing of hogs without emphasis on meat quality
Acknowledgments