Capturing Potential Through Nutrition: Group Housed Gestating Sows

L. Eastwood
R.Q. Buis
C.F.M de Lange

quincybuis@wfs.ca
laura.eastwood@ontario.ca
Goal: Increase Sow Lifetime Productivity

Optimize # of healthy pigs weaned per sow per lifetime

- Control feed costs
- Maintain good sow welfare
- Good sow health
- *Reduce nutrient losses into the environment*
Total Born per Litter: 2005 vs 2015

<table>
<thead>
<tr>
<th>Year</th>
<th>Lower 10 percentile</th>
<th>Mean</th>
<th>Upper 10 percentile</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>9.8</td>
<td>10.6</td>
<td>11.93</td>
</tr>
<tr>
<td>2015</td>
<td>11.3</td>
<td>12.4</td>
<td>13.5</td>
</tr>
<tr>
<td>Change, %</td>
<td>+ 15.3%</td>
<td>+ 17.0%</td>
<td>+ 13.2%</td>
</tr>
</tbody>
</table>

- Farms now approaching and surpassing 30 pigs weaned / sow / year
Influence of Birth Weight Category on Pig BW at d 156 of Age

Bergstrom et al., 2009
Key to Management of Sows

**MINIMIZE SOW BODY CONDITION AND WEIGHT CHANGES THROUGHOUT HER REPRODUCTIVE LIFE**

- **Gestation:**
  - ✔ Pregnancy related weight gain (~30kg)
  - ✔ Allow for maternal growth
    - ✔ Achieve maturity (~parity 3 or 4)
    - ✔ Recover losses of previous lactation
  - ✗ Excess gain of weight or condition

- **Lactation:**
  - ✗ Maternal weight loss
Desirable Body Weight Changes in Sows

NRC, 2012
Actual Changes in Body Fat Content

Effect of Increased Back Fat at Farrowing

1) Reduces lactation feed intake
2) Results in increased back fat loss during lactation
3) Severe back fat loss during lactation, reduces next litter

Bars with different letters within graphs represent $P < 0.05$

Young et al., 2004 J. Anim Sci. 82:3058
Gestation Nutrition

- **Two most important nutrients:**
  - Energy
  - Amino acids (protein, especially lysine)

- **Other nutrition issues:**
  - Sufficient intake of critical vitamins and minerals
  - Use fiber in diet to induce satiety and reduce abnormal (stereotypic) behavior of restricted fed gestating sows
Determinants of Nutrient Requirements in Gestating Sows (1/3)

Determinants of Nutrient Requirements in Gestating Sows (1/3)

Determined by:
- **Body weight**
  - $\uparrow$ BW = $\uparrow$ Requirements
- **Genetics**
- **Environment**
  - Below Lower Critical Temp = $\uparrow$ Requirements
- **Housing System**
  - Activity = $\uparrow$ Requirements

Maintain body mass, no net loss or gain
Determinants of Nutrient Requirements in Gestating Sows (2/3)

- **Day 12-14**: Implantation & placenta formation
- **Day 30**: Litter size largely determined
- **Day 20 to 70**: Rapid placental growth (& muscle fiber development in piglets)
- **Day 50**: Start exponential fetal growth, following placenta growth

Bazer et al. (2012); NRC (2012)
Determinants of Nutrient Requirements in Gestating Sows (3/3)

- Energy
- Amino Acids
- Maintenance
- Conceptus
- Protein Deposition
- Lipid Deposition

Maternal Body
- Maternal growth
  - Towards maturity
  - Recover losses
  - Total BW and BCS gain
NRC 2012 Gestating Sow Model

NRC Model

Energy (Feed) intake

+ Some measures of sow Performance

Response to energy intake

Requirements for AA, Ca, P

Energy

Amino Acids

Maintenance

Conceptus

Protein Deposition

Lipid Deposition

Maternal Body
Estimated Lysine Requirements of Gestating Sows

Move towards phase or blend feeding of individual gestating sows within and across parities.
Estimated Energy and Lysine Requirements of Gestating Gilt*

*Completed with a modified NRC (2012) from Q.Buis et al., 2016
Feeding Strategies in Group Housed Systems

• Multiple options:
  • Competitive
    • Floor feeding
    • Trough feeding
    • Trickle feeding
    • Half or shoulder stalls
  • Non-competitive
    • Free access stalls
    • Electronic sow feeders
Electronic Sow Feeders (ESF)

• Technology is developing quickly, in real-time, linking individual sow performance and state to feeding strategy
• Opportunity for (and value of) precision feeding is increasingly recognized (e.g., dairy industry)
  ➢ More closely meeting nutrient requirements of individual sows and over time:
    • Reduced feeding costs and nutrient losses into the environment (Clowes et al. 2002; Pomar et al., 2012) ✓
    • Improved long-term sow productivity and longevity ?
    • Improved sow welfare ?
‘Simple’ Group Housed Systems, Can Work!

- Respect amount and quality of space
- Plan or manage grouping (ex. large and small sows together)
- Expect slightly higher variability in sow body condition
  - May need some stalls (small pens / more aggressive culling) to isolate sows with extreme body condition
- Will lose opportunity to feed and manage each sow individually
Potential Gestation Feeding Strategies

- **Bump Feeding**
- **Top dressing**
  - Providing an additional supplemental diet during late gestation or for thin sows
- **Adjusting based on BCS**
  - Increasing or decreasing feed per sow on visual assessment
- **Phase feeding**
  - Different feeding levels at different periods of gestation and for each parity
- **Switch feeding**
  - Changing between diets at set points in gestation
- **Blend feeding**
Bump Feeding

- Increased amount of gestation feed starting day 85-90 of gestation
  - Increases intake of amino acids and energy, in same ratio
  - Scientific evidence of effectiveness is unclear*:
    - No effect: Miller et al. (2000), Hughes and van Wettere (2012), Eckhardt et al. (2013)
    - Shelton et al. (2009) in gilts no effect and added $5.00 per litter in cost
    - Cromwell et al. (1989) positive influence but controls under fed
    - Soto et al. (2011) did find a positive influence in gilts
  - Several of these studies reported increased sow weight gain

*Courtesy: S. Dritz Kansas State University
Precision Feeding Two Diets in Varying Amounts
(High vs Low protein; HP vs LP)

- Blended two feeds at ESF according to modified NRC 2012 for parity 1 sows
- Results: Compared to controls that received the same total amount feed and lysine, Sows on PF grew faster during late gestation, when needs of conceptus were highest
- Validation of effectiveness requires larger number of animals as well as a multi-parity approach to study effects on long term sow performance

Summary Thus Far

• Goal: Increase sow Lifetime Productivity
• Requirements of sows change with:
  - Size
  - Parity
  - Stage of gestation
• Consider variations in requirements between sows
  • Energy requirements can easily vary by more than 0.5 kg feed between sows
  • Increased amino acid requirements late gestation
  • Reduced amino acid requirement of parity 3+ sows
• Consider benefit of phase and parity segregated feeding
  • Electronic sow feeders (ESFs) will allow (dynamic) precision feeding of individual sows
Important Considerations for Group Feeding

- Consumer perspective: shift to groups will improve sow welfare
- Improved welfare from increased freedom of movement can be quickly erased by excessive and uncontrolled aggression
  - Aggression at/around feeding can lead to injury, lameness, low feed intake and poor performance (Kemp and Soede, 2012)
- Increased activity levels may alter the sows nutritional requirements

Key Nutritional Aspects to consider with Group Housing Systems
- Reduce aggression through nutrition (and management) – satiety!
- Feed allowance
- Bone development and strength
Satiety

• Over-feeding of gestating sows is still an issue
  – Reduces sow productivity and longevity

• Feed intake restriction can lead to abnormal (stereotypic) behaviour
  – Animal welfare concern

• How can we ↑ satiety and ↓ abnormal behaviour in sows?

FIBRE

Amount?

Type?

Physical Characteristics?
Satiety

• **European Union**
  
  – 9-12% Crude Fibre is common, some diets up to 20% CF
  
  OR
  
  – ‘regular’ gestation diets should be supplemented with additional fibre sources

• **More important than crude fibre concentration:**
  
  – Physical size - for gut fill
    
    • Coarsely ground material better at reducing hunger

  – Balance between fermentable fibre and crude fibre
    
    • Fermentable fibre provides a slow, consistent release of energy throughout the day, helping with longer-term satiation
    
    • Formulate diets based on NE to account for fermentable fibre
<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Crude Fiber</th>
<th>ADF</th>
<th>NDF</th>
<th>NSP*</th>
<th>Fermentability of NSP*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn</td>
<td>1.98</td>
<td>2.88</td>
<td>9.11</td>
<td>12.7</td>
<td>55</td>
</tr>
<tr>
<td>SBM, 47% CP</td>
<td>3.89</td>
<td>5.28</td>
<td>8.21</td>
<td>28.7</td>
<td>88</td>
</tr>
<tr>
<td>Barley</td>
<td>3.90</td>
<td>5.78</td>
<td>18.3</td>
<td>23.9</td>
<td>45</td>
</tr>
<tr>
<td>Wheat shorts</td>
<td>5.15</td>
<td>5.98</td>
<td>35.0</td>
<td>35.8</td>
<td>38</td>
</tr>
<tr>
<td>DDGS, 6-9% oil</td>
<td>8.92</td>
<td>12.0</td>
<td>30.5</td>
<td>39.4</td>
<td>70</td>
</tr>
<tr>
<td>Sugar beet pulp</td>
<td>18*</td>
<td>23.5</td>
<td>44.9</td>
<td>70.8</td>
<td>85</td>
</tr>
<tr>
<td>Soybean hulls</td>
<td>35.7</td>
<td>41.6</td>
<td>59.4</td>
<td>70.9</td>
<td>51</td>
</tr>
<tr>
<td>Alfalfa meal</td>
<td>24**</td>
<td>32.2</td>
<td>42.0</td>
<td>60.9</td>
<td>45</td>
</tr>
</tbody>
</table>

NRC, 2012; **Lewis and Southern 2000; *CVB, 2004
# Feeding Sugar Beet Pulp to Gestating Sows

<table>
<thead>
<tr>
<th></th>
<th>Control</th>
<th>+ SBP</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diet NE (Kcal/kg)</td>
<td>2036</td>
<td>2053</td>
<td>NS</td>
</tr>
<tr>
<td>Feed Intake (kg/d): gestation 1</td>
<td>2.61</td>
<td>2.58</td>
<td>NS</td>
</tr>
<tr>
<td></td>
<td>2.74</td>
<td>2.73</td>
<td>NS</td>
</tr>
<tr>
<td>Parity 2 Weaning Weight (kg)</td>
<td>185.6</td>
<td>176.6</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Change in Back Fat (mm): gestation 1</td>
<td>+7.0</td>
<td>+4.4</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td></td>
<td>+5.2</td>
<td>+4.4</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Piglets Born Alive: Parity 1</td>
<td>10.5</td>
<td>11.0</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td></td>
<td>11.5</td>
<td>12.2</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Non-feeding oral activities (% of obs.)</td>
<td>23.8</td>
<td>13.7</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Sham Chewing (% of obs.)</td>
<td>14.4</td>
<td>5.6</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

No effect on: # stillborn, litter birth weight, PWM, wean to estrus, farrowing rate

*38.3% sugar beet pulp in gestation; replacing tapioca, alfalfa meal and straw; initial body weight 124 kg; initial back fat 13.7 mm; >170 sows/treatment Van der Peet-Schwering et al. 2003a,b
Feeding Fibre
Feed Allowance

• ↑ energy requirement due to ↑ exercise/activity

• Difficult to predict because not every sow or system is the same
  – Body condition
  – Expected litter sizes
  – Animal temperament
  – Housing conditions (layout, thermal environment, etc.)
  – Overall management

• Additional feed energy required may be as high as 10-20%
  – If sows are over-conditioned, exercise will help and feed allowance should not be increased

• Daily feed allowance should be monitored closely and adjusted periodically to meet desired body condition score
Bone Development and Strength

- Do group housed sows require increased Calcium and Phosphorus for bone development and strength?

- NRC 2012 Ca and P values are adequate for group housed sows (Tan and Beaulieu, 2014)
  - 3 diets (NRC Ca & P, +15% Ca & P, -15% Ca & P
  - 2 housing systems (stalls or groups with non-competitive feeding)
    - -15%/group housed had low serum calcium, but NRC/group were fine
    - Increased piglets born alive in group vs. stall
      - 1 piglet more/litter in -15% and NRC groups
      - 2 piglets more/litter in +15% group

- Possible ↑ performance potential with ↑ Ca/P??

- Subsequent parities?
Capturing Potential Through Nutrition

- Remember the importance of body condition scoring in any system
- Consider feeding requirements to support optimal productivity and longevity, as well as welfare
  - Dietary fibre levels to reduce abnormal behaviour
  - Full feed for 24-48 hours after mixing to reduce aggression?

NFACC Code of Practice for the Care and Handling of Pigs, 2014
Capturing Potential Through Nutrition

- **Open Stall, Floor & Trough Feeding Systems:**
  - Reduce feeding competition as much as possible
    - Space feed drops or stations around pen
  - Sort pens to reduce competition
    - Eating speed
    - Body condition
    - Size
    - Parity
  - Sort pens to improve feeding accuracy
    - Gestation stage (phase feeding)
Capturing Potential Through Nutrition

• **ESF Feeding Systems:**
  
  – Reduce pre-feeding competition as much as possible
    • Well designed pens
  
  – Access to multiple feed lines for precision or phase feeding
  
  – Timely identification of sows needing special attention
    • Ability to notice reduced feed consumption rapidly
Additional Opportunities

- **Reduced Lower Critical Temperature?**
  - LCT for stall housed sows = ~16°C
  - Group housed sows given a choice preferred 9 to 12°C (Predicala, 2016)
    - Reduced heating costs in winter months?
      - 78% savings in natural gas consumption during 6-wk winter trial in Western Canada
    - Decreased feed requirements in winter months?
      - Modify diet to a high heat-increment (fibre) diet to maintain performance