Producer Perceptions and Observations

- Perception
  - DDGS is a risky ingredient because of mycotoxin concerns
    - Has limited DDGS use compared to potential

- Observations
  - Increased lactation feed intake
  - Sows are more content
  - Fewer constipation problems
Feeding DDGS to Sows
Adding high fiber ingredients (e.g. alfalfa, wheat straw) to gestation diets has been shown to:

- Increased litter size
  - (Munchow et al., 1982; Carter et al., 1987; Hagen et al., 1987; Everts, 1991; Ewan et al., 1996)
- Increased sow feed intake during lactation
  - (Farmer et al., 1996; Vestergaard and Danielson, 1998).
- Decrease expression of stereotypic behaviors
  - (Robert et al., 1993)
Fiber composition of DDGS and alfalfa are similar
- Soluble fiber = 4.3%
- Insoluble fiber = 52.4%

Feeding high amounts of DDGS in sow diets may increase litter size
Previously published recommendations for maximum use of DDGS in sow diets:

- Feed Co-Products Handbook (1997)
  - up to 50% in gestation diets
  - up to 20% in lactation diets
- Pork Industry Handbook
  - up to 40% in gestation diets
  - up to 10% in lactation diets
Methodology – Wilson et al., 2003

- Trial was conducted at SROC (Waseca, MN)

- Used 93 sows divided among 5 breeding groups
  - blocked by initial BW and parity and randomly assigned to one of four dietary treatment combinations
  - sows remained on dietary treatments through 2 reproductive cycles

- Each dietary treatment combination consisted of both a gestation and lactation diet
  - Corn-SBM Gestation and Corn-SBM Lactation
  - Corn-SBM Gestation and 20% DDGS Lactation
  - 50% DDGS Gestation and Corn-SBM Lactation
  - 50% DDGS Gestation and 20% DDGS Lactation
Methodology – Wilson et al., 2003

- Gestation diets were limit fed and feed intake was adjusted according to sow body weight on days 30, 60, and 90 of gestation
  - day 30 (1% BW + 100g)
  - day 60 (1% BW + 300g)
  - day 90 (1% BW + 500g)
- Lactation diets were limit fed until farrowing and then provided *ad libitum* post-farrowing
Methodology – Wilson et al., 2003

- Weight and backfat measurements taken at:
  - Breeding
  - After farrowing
  - Weaning
  - Days 30, 60, and 90 during gestation

- At farrowing, total pigs born, total pigs born alive, and individual pig birth weights were recorded.

- Pigs were cross-fostered among litters within dietary treatment within 24-48 hrs after birth to equalize litter size

- Pigs were weighed at weaning (18 ± 1 d of age)
Effect of Feeding a 50% DDGS Diet on Sow Weight Gain During Gestation – Wilson et al., 2003

Different superscripts indicate significant difference (P < .10).

**Gestation Dietary Treatment**

- **Control**
  - Cycle 1: a
  - Cycle 2: x

- **DDGS**
  - Cycle 1: a
  - Cycle 2: x
Effect of Feeding 0 or 50% DDGS Gestation Diets and 0 or 20% DDGS Lactation Diets on Pigs Weaned/Litter – Wilson et al., 2003

Dietary treatment

Number of Pigs

Control/Control  |  Control/DDGS  |  DDGS/Control  |  DDGS/DDGS

a, b, x, y Different superscripts indicate significant difference (P < .10).
Effect of Dietary Treatment Combination on Sow Lactation ADFI – Wilson et al., 2003

Dietary Treatment

Feed Intake, kg/day

Control/Control, Control/DDGS, DDGS/Control, DDGS/DDGS

a, b, x, y Different superscripts indicate significant difference (P < .10).
Objectives - Hill et al., 2005

- To determine if DDGS can be used in sow lactation diets
  - to minimize P excretion
  - to support sow performance
Materials and Methods – Hill et al., 2005

- Two dietary treatments
  - 5% Beet pulp (BP)
  - 15% DDGS

- Diets formulated to meet or exceed NRC
  - 1.2% Lysine
  - 0.9% Ca
  - 0.84% P
  - 3320 kcal/kg

- P supplied by
  - BP - 100% of P from mono-calcium phosphate
  - DDGS - 17% of P from DDGS and 83% from mono-calcium phosphate
Materials and Methods – Hill et al., 2005

- Sows allotted based on parity
  - Beet pulp
    - 9 primiparous
    - 21 multiparous
  - DDGS
    - 9 primiparous
    - 22 multiparous
- Common gestation diet
  - gradual adaptation to treatment diets
Litters balanced to 11 pigs by 2 d of age

Feed increased according to genetics, appetite, and body condition

Sow and litter weighed
- d 2
- d 18
Materials and Methods- Hill et al. 2005

- Fecal grab samples from sows
  - d 7
  - d 14
  - d 18

- Fecal samples analyzed for total P
Influence of beet pulp and DDGS on sow weights – Hill et al. 2005

<table>
<thead>
<tr>
<th></th>
<th>Beet Pulp</th>
<th>DDGS</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sow wt d2, kg</td>
<td>205.6</td>
<td>211.1</td>
<td>0.34</td>
</tr>
<tr>
<td>Sow wt d 18, kg</td>
<td>201.7</td>
<td>204.2</td>
<td>0.62</td>
</tr>
<tr>
<td>Sow wt change, kg</td>
<td>-6.2</td>
<td>-8.0</td>
<td>0.42</td>
</tr>
</tbody>
</table>
Influence of beet pulp and DDGS on litter weights – Hill et al. 2005

<table>
<thead>
<tr>
<th></th>
<th>Beet Pulp</th>
<th>DDGS</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Litter wt. d 2, kg</td>
<td>21.1</td>
<td>19.5</td>
<td>0.12</td>
</tr>
<tr>
<td>Litter wt. d 18, kg</td>
<td>62.9</td>
<td>62.3</td>
<td>0.83</td>
</tr>
<tr>
<td>Litter gain, kg</td>
<td>41.7</td>
<td>43.4</td>
<td>0.50</td>
</tr>
<tr>
<td>No. pigs weaned</td>
<td>10.9</td>
<td>10.8</td>
<td>0.82</td>
</tr>
<tr>
<td>Gain/pig, kg</td>
<td>3.82</td>
<td>3.91</td>
<td>0.61</td>
</tr>
</tbody>
</table>
Phosphorus concentration in fecal grab samples of sows fed beet pulp vs. DDGS during lactation – Hill et al. 2005

<table>
<thead>
<tr>
<th>Day</th>
<th>BP vs. DDGS</th>
<th>Linear effect</th>
<th>Quadratic effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>d 7</td>
<td>P = 0.71</td>
<td></td>
<td></td>
</tr>
<tr>
<td>d 14</td>
<td>P = 0.02</td>
<td></td>
<td></td>
</tr>
<tr>
<td>d 18</td>
<td>P = 0.22</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

BP vs. DDGS

Linear effect: P = 0.38  P = 0.05
Quadratic effect: P = 0.08  P = 0.39
Conclusion

- Inclusion of 15% DDGS in sow lactation diets
  - Supports sow lactation performance
  - May reduce fecal P excretion
Objectives - Song et al. (2006)

To determine the effects of increasing levels of DDGS in lactation diets on:

- Sow and litter performance
- Energy and nitrogen balance in sows
- Blood urea nitrogen
- Milk fat and protein concentrations
- Economics
# Experimental Diets

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Control</th>
<th>10% DDGS</th>
<th>20% DDGS</th>
<th>30% DDGS</th>
<th>30% DDGS High Protein</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn</td>
<td>66.20</td>
<td>62.34</td>
<td>58.81</td>
<td>54.92</td>
<td>47.70</td>
</tr>
<tr>
<td>SBM,47.5%</td>
<td>27.40</td>
<td>21.75</td>
<td>15.87</td>
<td>10.33</td>
<td>18.14</td>
</tr>
<tr>
<td>DDGS</td>
<td>0</td>
<td>10.00</td>
<td>20.00</td>
<td>30.00</td>
<td>30.00</td>
</tr>
<tr>
<td>Tallow</td>
<td>2.50</td>
<td>1.92</td>
<td>1.25</td>
<td>0.62</td>
<td>0.41</td>
</tr>
<tr>
<td>Dical. phos.</td>
<td>2.38</td>
<td>2.14</td>
<td>1.87</td>
<td>1.59</td>
<td>1.52</td>
</tr>
<tr>
<td>Limestone</td>
<td>0.47</td>
<td>0.65</td>
<td>0.83</td>
<td>1.01</td>
<td>1.00</td>
</tr>
<tr>
<td>Salt</td>
<td>0.35</td>
<td>0.35</td>
<td>0.35</td>
<td>0.35</td>
<td>0.35</td>
</tr>
<tr>
<td>VTM premix</td>
<td>0.50</td>
<td>0.50</td>
<td>0.50</td>
<td>0.50</td>
<td>0.50</td>
</tr>
<tr>
<td>Biotin</td>
<td>0.20</td>
<td>0.20</td>
<td>0.20</td>
<td>0.20</td>
<td>0.20</td>
</tr>
<tr>
<td>Lysine-HCl</td>
<td>0</td>
<td>0.15</td>
<td>0.32</td>
<td>0.48</td>
<td>0.18</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

Song et al. (2006)
## Calculated Nutrient Composition of Experimental Diets

<table>
<thead>
<tr>
<th></th>
<th>NRC 1998</th>
<th>0% DDGS</th>
<th>10% DDGS</th>
<th>20% DDGS</th>
<th>30% DDGS</th>
<th>30% DDGS High Protein</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crude Protein, %</td>
<td>18.50</td>
<td>18.80</td>
<td>18.80</td>
<td>18.80</td>
<td>18.80</td>
<td>22.00</td>
</tr>
<tr>
<td>Total calcium, %</td>
<td>0.75</td>
<td>0.80</td>
<td>0.80</td>
<td>0.80</td>
<td>0.80</td>
<td>0.80</td>
</tr>
<tr>
<td>Total phos., %</td>
<td>0.60</td>
<td>0.80</td>
<td>0.79</td>
<td>0.77</td>
<td>0.74</td>
<td>0.76</td>
</tr>
<tr>
<td>Available phos., %</td>
<td>0.35</td>
<td>0.51</td>
<td>0.51</td>
<td>0.51</td>
<td>0.51</td>
<td>0.51</td>
</tr>
<tr>
<td>Total lysine, %</td>
<td>0.97</td>
<td>1.04</td>
<td>1.06</td>
<td>1.07</td>
<td>1.09</td>
<td>1.12</td>
</tr>
<tr>
<td>TID lysine, %</td>
<td>0.85</td>
<td>0.98</td>
<td>0.98</td>
<td>0.98</td>
<td>0.98</td>
<td>0.98</td>
</tr>
<tr>
<td>TID met+cys, %</td>
<td>0.42</td>
<td>0.59</td>
<td>0.60</td>
<td>0.62</td>
<td>0.63</td>
<td>0.71</td>
</tr>
<tr>
<td>TID threonine, %</td>
<td>0.53</td>
<td>0.68</td>
<td>0.65</td>
<td>0.61</td>
<td>0.58</td>
<td>0.72</td>
</tr>
<tr>
<td>TID tryptophan, %</td>
<td>0.16</td>
<td>0.22</td>
<td>0.20</td>
<td>0.17</td>
<td>0.16</td>
<td>0.20</td>
</tr>
</tbody>
</table>

Song et al. (2006)
Analyzed Nutrient Composition of Experimental Diets

<table>
<thead>
<tr>
<th></th>
<th>Control</th>
<th>10% DDGS</th>
<th>20% DDGS</th>
<th>30% DDGS</th>
<th>30% DDGS HP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crude protein, %</td>
<td>17.81</td>
<td>18.00</td>
<td>17.33</td>
<td>16.99</td>
<td>20.27</td>
</tr>
<tr>
<td>ADF, %</td>
<td>8.94</td>
<td>4.37</td>
<td>5.29</td>
<td>6.98</td>
<td>8.48</td>
</tr>
<tr>
<td>Total calcium, %</td>
<td>0.88</td>
<td>0.88</td>
<td>0.84</td>
<td>0.82</td>
<td>0.76</td>
</tr>
<tr>
<td>Total phosphorus, %</td>
<td>0.81</td>
<td>0.78</td>
<td>0.75</td>
<td>0.74</td>
<td>0.73</td>
</tr>
<tr>
<td>Gross energy, Mcal/kg</td>
<td>3.95</td>
<td>4.03</td>
<td>4.10</td>
<td>4.18</td>
<td>4.02</td>
</tr>
<tr>
<td>Metabolizable energy, Mcal/kg</td>
<td>3.34</td>
<td>3.37</td>
<td>3.51</td>
<td>3.57</td>
<td>3.42</td>
</tr>
</tbody>
</table>

Song et al. (2006)
Lactating Sows - Song et al. (2006)

- 307 mixed parity sows
  - Group housed = 147 sows
  - Individual crates = 160 sows

- English Belle, GAP genetics, Winnipeg, MB, Canada
- Average initial weight of about 222 ± 15 kg
Animal Management - Song et al. (2006)

- Individually fully slatted farrowing crates
- Fed twice daily (07:00 AM and 02:30 PM)
- Ad-libitum access to water from nipple drinker
- Room temperature was set at 18-20°C
- Heat mat and lamp were provided for piglets
Effect of Increasing Dietary DDGS Level on Sow ADFI in Lactation

No significant difference (P = 0.10)
Effect of Increasing Dietary DDGS Level on Sow Body Weight Change

a,b Means with different superscripts are significantly different (P < 0.05)
Effect of Increasing Dietary DDGS Level on Sow Backfat Depth Change During Lactation

No significant difference (P = 0.21)
Effect of Increasing Dietary DDGS Level on Litter Size at Weaning

No significant difference (P = 0.31)
Effect of Increasing Dietary DDGS Level on Litter Weight Gain

No significant difference (P = 0.67)
Effect of Increasing Dietary DDGS Level on Average Daily Piglet Weight Gain

10, 20, and 30% DDGS vs. 30% DDGS HP (P < 0.1)
10, 20, and 30% DDGS vs. Control (P < 0.1)
Effect of Increasing Dietary DDGS Level on Wean to Estrus Interval

No significant difference (P = 0.35)
Effect of Increasing Dietary DDGS Level on Pre-Weaning Mortality

No significant difference (P = 0.71)
Effect of Increasing Dietary DDGS Level on Coefficient of Variation of Individual Pig Weight within Litters

No significant difference on Day 0 (P = 0.85) and Day 19 (P = 0.53)
Effect of Increasing Dietary DDGS Level on Gross Energy Intake

No significant difference (P = 0.23)
Effect of Increasing Dietary DDGS Level on Digestible Energy

No significant difference (P = 0.66)
Effect of Increasing Dietary DDGS Level on Metabolizable Energy

No significant difference (P = 0.37)
Effect of Increasing Dietary DDGS Level on Nitrogen Intake

No significant difference (P = 0.52)
Effect of Increasing Dietary DDGS Level on Nitrogen Retention

No significant difference (P = 0.91)
Effect of Increasing Dietary DDGS Level on Nitrogen Digestibility

No significant difference (P = 0.29)
Effect of Increasing Dietary DDGS Level on Nitrogen Content of Sow Milk

No significant difference at Day 0 ($P = 0.73$) and Day 19 ($P = 0.41$)
Effect of Increasing Dietary DDGS Level on Fat Concentration in Sow Milk

No significant difference on Day 0 (P = 0.99) and Day 19 (P = 0.59)
Effect of Increasing Dietary DDGS Level on Blood Urea Nitrogen

Means with different superscripts are different (P < 0.05)
Conclusion

Inclusion of up to 30% DDGS in sow lactation diets did not affect:

- Sow and litter performance
- Digestible and metabolizable energy
- Nitrogen retention and digestibility
- Milk nitrogen and fat concentration

Blood urea nitrogen was lower for sows fed the 20 and 30% DDGS diets compared to the corn-soybean meal diet and the high protein 30% DDGS diet.
Research Questions

- Litter size response
  - Is it repeatable?
  - Minimum dietary levels of DDGS?
  - Feeding strategy (when and how long)?

- Pig weight gain response
  - Is it repeatable?

- Can levels greater than 30% be fed to lactating sows without negative effects?

- Is high protein (BUN) a concern at high dietary inclusion rates?

- Can long-term feeding of DDGS
  - Reduce stereotypic behaviors?
  - Improve satiety?
  - Improve longevity?