Why is there so much interest in feeding DDGS to swine?

- "New Generation" DDGS is high in digestible nutrients
- Economical partial replacement for:
  - corn
  - soybean meal
  - dicalcium phosphate
- Increasing production and supply
- Unique properties
  - reduce P excretion in manure
  - increase litter size weaned/sow
  - gut health benefits?
Maximum Inclusion Rates of “New Generation” DDGS in Swine Diets
(Based Upon University of Minnesota Performance Trials)

- Nursery pigs (> 7 kg)
  - Up to 25%
- Grow-finish pigs
  - Up to 20% (higher levels may reduce pork fat quality)
- Gestating sows
  - Up to 50%
- Lactating sows
  - Up to 20%

Assumptions: no mycotoxins
formulate on a digestible amino acid and available phosphorus basis

Feeding “New Generation” DDGS to Weaned Pigs
Materials and Methods – Nursery Experiments

- Experiment 1
  - Pigs weaned at 19.0 ± 0.3 d of age
  - Weighed 7.10 ± 0.07 kg
- Experiment 2
  - Pigs weaned at 16.9 ± 0.4 d of age
  - Weighed 5.26 ± 0.07 kg
- Pigs were fed a commercial pelleted diet (d 0 to 3 postweaning)
  - Phase II (d 4-17) and Phase III (d 18 – 35) diets were formulated on a digestible amino acid basis.
    - Diets contained 0, 5, 10, 15, 20, or 25% DDGS

Effect of DDGS Level on Growth Rate (Experiment 1)

![Graph showing ADG (g/d) for different DDGS levels in Phase II and Phase III with SE values for each phase]

Means not sharing a common superscript letter are significantly different (P < .05)
Effect of DDGS Level on ADFI (Experiment 1)

![Graph showing ADFI (g/d) for different DDGS levels in Phase 2 and Phase 3. The graphs show different levels of DDGS (0%, 5%, 10%, 15%, 20%, 25%) and their standard errors (SE). The SE values are 46.9 for Phase 2 and 82.6 for Phase 3.](image)

Effect of DDGS Level on Gain/Feed (Experiment 1)

![Graph showing Gain/Feed (G/F) for different DDGS levels in Phase 2 and Phase 3. The graphs show different levels of DDGS (0%, 5%, 10%, 15%, 20%, 25%) and their standard errors (SE). The SE values are 0.06 for Phase 2 and 0.11 for Phase 3.](image)
Effect of DDGS Level on Growth Rate (Experiment 2)

Effect of DDGS Level on Feed Intake (Experiment 2)
Effect of DDGS Level on Gain/Feed (Experiment 2)

Effect of DDGS Level on Final BW (Experiment 2)
Feeding “New Generation” DDGS to Grow-Finish Pigs

Materials and Methods

- 240 crossbred pigs (approx. 28.3 kg BW)
  - Grow-finish facilities at WCROC – Morris, MN
  - Blocked by weight, gender and litter
  - Blocks randomly assigned to 1 of 4 diet sequences
    - 5-phase feeding program
  - 0, 10, 20, or 30% DDGS diets formulated on total lysine basis
  - 24 pens, 10 pigs/pen, 6 replications/trt
Effect of Dietary DDGS Level on Overall ADG of Grow-finish Pigs

0 % and 10 % DDGS > 20% and 30% DDGS (P < .10)

Effect of Dietary DDGS Level on Overall ADFI of Grow-finish Pigs

No significant differences among dietary treatments
Effect of Dietary DDGS Level on Overall G/F of Grow-finish Pigs

[Graph showing G/F ratio across different DDGS levels (0%, 10%, 20%, 30%)]

0% and 10% DDGS > 20% and 30% DDGS (P < .10)

Effect of Dietary DDGS Level on Carcass Weight

[Graph showing carcass weight across different DDGS levels (0%, 10%, 20%, 30%)]

0% and 10% DDGS > 20% and 30% DDGS (P < .01)
Effect of Dietary DDGS Level on % Carcass Lean

No significant differences among dietary treatments

Effect of Dietary DDGS Level on Carcass Loin Depth

Linear decrease with increasing dietary level of DDGS (P < .02)
Effect of Dietary DDGS Level on Carcass Backfat Depth

No significant differences among dietary treatments

Muscle Quality Characteristics from G-F Pigs Fed Diets Containing 0, 10, 20, and 30% DDGS

<table>
<thead>
<tr>
<th>Trait</th>
<th>0 %</th>
<th>10 %</th>
<th>20 %</th>
<th>30 %</th>
<th>RMSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>L&lt;sup&gt;a&lt;/sup&gt;</td>
<td>54.3</td>
<td>55.1</td>
<td>55.8</td>
<td>55.5</td>
<td>2.9</td>
</tr>
<tr>
<td>Color score&lt;sup&gt;b&lt;/sup&gt;</td>
<td>3.2</td>
<td>3.2</td>
<td>3.1</td>
<td>3.1</td>
<td>0.8</td>
</tr>
<tr>
<td>Firmness score&lt;sup&gt;c&lt;/sup&gt;</td>
<td>2.2</td>
<td>2.0</td>
<td>2.1</td>
<td>2.1</td>
<td>0.5</td>
</tr>
<tr>
<td>Marbling score&lt;sup&gt;d&lt;/sup&gt;</td>
<td>1.9</td>
<td>1.9</td>
<td>1.7</td>
<td>1.9</td>
<td>0.6</td>
</tr>
<tr>
<td>Ultimate pH</td>
<td>5.6</td>
<td>5.6</td>
<td>5.6</td>
<td>5.6</td>
<td>0.2</td>
</tr>
<tr>
<td>11-d purge loss, %</td>
<td>2.1&lt;sup&gt;f&lt;/sup&gt;</td>
<td>2.4&lt;sup&gt;g&lt;/sup&gt;</td>
<td>2.8&lt;sup&gt;h&lt;/sup&gt;</td>
<td>2.5&lt;sup&gt;g&lt;/sup&gt;</td>
<td>1.2</td>
</tr>
<tr>
<td>24-h drip loss</td>
<td>0.7</td>
<td>0.7</td>
<td>0.7</td>
<td>0.7</td>
<td>0.2</td>
</tr>
<tr>
<td>Cooking loss, %</td>
<td>18.7</td>
<td>18.5</td>
<td>18.3</td>
<td>18.8</td>
<td>2.6</td>
</tr>
<tr>
<td>Total moisture loss&lt;sup&gt;e&lt;/sup&gt;, %</td>
<td>21.4</td>
<td>21.5</td>
<td>21.8</td>
<td>22.1</td>
<td>3.1</td>
</tr>
<tr>
<td>Warner-Bratzler sheer force, kg</td>
<td>3.4</td>
<td>3.4</td>
<td>3.3</td>
<td>3.3</td>
<td>0.5</td>
</tr>
</tbody>
</table>

<sup>a</sup> 0 = black, 100 = white  
<sup>b</sup> 1 = pale pinkish gray/white; 2 = grayish pink; 3 = reddish pink; 4 = dark reddish pink; 5 = purplish red; 6 = dark purplish red  
<sup>c</sup> 1 = soft, 2 = firm, 3 = very firm  
<sup>d</sup> Visual scale approximates % intramuscular fat content (NPPC, 1999)  
<sup>e</sup> Total moisture loss = 11-d purge loss + 24-h drip loss + cooking loss
## Fat Quality Characteristics of Market Pigs Fed Corn-Soy Diets Containing 0 to 30% DDGS

<table>
<thead>
<tr>
<th></th>
<th>0 %</th>
<th>10%</th>
<th>20%</th>
<th>30%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Belly thickness, cm</td>
<td>3.15</td>
<td>3.00</td>
<td>2.84</td>
<td>2.71</td>
</tr>
<tr>
<td>Belly firmness score, degrees</td>
<td>27.3</td>
<td>24.4</td>
<td>25.1</td>
<td>21.3</td>
</tr>
<tr>
<td>Adjusted belly firmness score, degrees</td>
<td>25.9</td>
<td>23.8</td>
<td>25.4</td>
<td>22.4</td>
</tr>
<tr>
<td>Iodine number</td>
<td>66.8</td>
<td>68.6</td>
<td>70.6</td>
<td>72.0</td>
</tr>
</tbody>
</table>

Means within a row lacking common superscripts differ (P < .05).

## Feeding “New Generation DDGS to Sows”
Effect of Feeding a 50% DDGS Diet on Sow Weight Gain During Gestation (Reproductive Cycle 1)

Weight gain (kg)

0.0  20.0  40.0  60.0

Control  DDGS

Dietary treatment

(P > .22)
MSE 10.12

Effect of Feeding 0 or 50% DDGS Gestation Diets and 0 or 20% DDGS Lactation Diets on Pigs Weaned/Litter

Number of Pigs

0.0  2.0  4.0  6.0  8.0  10.0  12.0

Control/Control  Control/DDGS  DDGS/Control  DDGS/DDGS

Dietary treatment

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

Does Feeding DDGS Improve Gut Health?
What is Ileitis?

- Porcine Proliferative Enteropathy
- Caused by *Lawsonia intracellularis*
  - Present in 96% of U.S. swine herds (Bane et al., 1997)
  - 28% of pigs affected (NAHMS, 2000)
  - Can be shed in infected pigs for up to 10 weeks
- Animals are infected by oral contact with feces from animals shedding the bacteria
- 7-10 days after infection:
  - Lesions of the intestinal wall begin to form
  - Lesions maximized around 21 days post-infection

Clinical Forms of Ileitis

- Porcine Intestinal Adenomatosis (PIA)
  - Chronic form
  - Seen in growing pigs (6 - 20 weeks of age)
  - Decreased feed intake, lethargic
- Porcine Hemorrhagic Enteropathy (PHE)
  - Acute form, affects heavier pigs
    - Greatest frequency appears to be from 65 – 110 kg pigs
  - Massive intestinal hemorrhaging, bloody diarrhea, increase in mortality
Effect of Dietary Treatment on Lesion Length (21 d Post-Challenge) 
Experiment 2

**Effect of Dietary Treatment on Lesion Severity (21 d Post-Challenge) 
Experiment 2**

* Effect of disease challenge ($P < .01$).
Effect of Dietary Treatment on Lesion Prevalence (21 d Post-Challenge) Experiment 2

![Effect of Dietary Treatment on Lesion Prevalence Graph](image)

* Effect of disease challenge ($P < .01$).

Effect of Dietary Treatment on Fecal Shedding (PCR Analysis) Experiment 2

![Effect of Dietary Treatment on Fecal Shedding Graph](image)

* Effect of disease challenge ($P < .01$).
Effect of Treatment on *L. intracellularis* Infection (IHC Analysis) Experiment 2

**IHC Score**

<table>
<thead>
<tr>
<th>Score</th>
<th>SE = 0.12</th>
<th>D10 ($P = .05$)</th>
<th>AR ($P = .10$)</th>
</tr>
</thead>
</table>

**IHC Prevalence**

<table>
<thead>
<tr>
<th>% of pigs positive</th>
<th>SE = 2.8</th>
</tr>
</thead>
</table>

* Effect of disease challenge ($P < .01$).

Summary of Results, Experiment 2

- Inoculation level was close to goal
- DDGS inclusion (10%) or antimicrobial regimen had a positive effect on the pig’s ability to resist an ileitis challenge
- No beneficial additive effects of combining DDGS and BMD®/Aureomycin® regimen
DDGS and Phytase are a Key Part of Manure Phosphorus Management

- Adding 20% DDGS to a corn-soy diet and formulating on an available P basis
  - can reduce manure P by > 12%
- Adding phytase to a corn-soy diet
  - increases P bioavailability from 15% to > 45%
- Lowering dietary P, adding 20% DDGS & phytase
  - can reduce manure P excretion by 40 to 50%

Diet Composition When 18.8% DDGS and Phytase are Added to the Diet

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Corn-SBM-1.5 kg Lysine</th>
<th>18.8% DDGS + Phytase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn, kg</td>
<td>798.3</td>
<td>636.3</td>
</tr>
<tr>
<td>Soybean meal 44%, kg</td>
<td>176.9</td>
<td>159.4</td>
</tr>
<tr>
<td>DDGS, kg</td>
<td>0.0</td>
<td>188</td>
</tr>
<tr>
<td>Dicalcium phosphate, kg</td>
<td>11.6</td>
<td>0.0</td>
</tr>
<tr>
<td>Limestone, kg</td>
<td>7.2</td>
<td>9.8</td>
</tr>
<tr>
<td>Salt, kg</td>
<td>3.0</td>
<td>3.0</td>
</tr>
<tr>
<td>L-lysine HCl, kg</td>
<td>1.5</td>
<td>1.5</td>
</tr>
<tr>
<td>VTM premix, kg</td>
<td>1.5</td>
<td>1.5</td>
</tr>
<tr>
<td>Phytase, 500 FTU/kg</td>
<td>0.0</td>
<td>0.5</td>
</tr>
<tr>
<td>TOTAL, kg</td>
<td>1000.0</td>
<td>1000.0</td>
</tr>
</tbody>
</table>
We have developed a DDGS web site featuring:

* research summaries
  - swine, poultry, dairy, & beef
  - DDGS quality
* presentations given
* links to other DDGS related web sites
* international audiences