Distillers Dried Grains with Solubles for Swine Diets

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Production of DDGS

- Co-product from the dry-milling of corn for production of ethanol
- 1 bu of corn yields:
  - 2.7 gallons of ethanol
  - 18 lbs of DDGS
  - 18 lbs of CO₂
- Other grains can be used
  - Sorghum
- Level of production has increased recently:
  - Increased number and capacity of ethanol plants
  - ↑ supply and ↓ cost of DDGS in Midwest

Historical Use of DDGS

- Used in ruminant diets primarily
- Not used in swine or poultry diets:
  - Lack of nutritional information
  - Variability of nutrient content
  - Viewed as having low energy density
  - Poor amino acid profile
  - Digestibility of amino acids
  - Cost and supply

DDGS Swine Research Conducted at Univ. of MN

- 12 experiments conducted so far:
  - DDGS Database
  - Determine DE and ME Values for DDGS (2)
  - Nutrient Balance and Gas/Odor Emission
  - Apparent Ileal Amino Acid Digestibility
  - P Availability Study
  - Grow-Finish Performance/Carcass Quality
  - Sow Reproductive Performance
  - Nursery Performance
  - Gut Health / Ileitis (3)
**DDGS Nutrient Database**

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>MN-SD*</th>
<th>OMP</th>
<th>NRC(1998)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DM</td>
<td>88.9</td>
<td>88.3</td>
<td>93.0</td>
</tr>
<tr>
<td>Crude fat</td>
<td>10.9</td>
<td>8.2</td>
<td>9.0</td>
</tr>
<tr>
<td>Crude fiber</td>
<td>8.8</td>
<td>7.1</td>
<td>4.6</td>
</tr>
<tr>
<td>ME*</td>
<td>3895</td>
<td>3874</td>
<td>3449</td>
</tr>
<tr>
<td>Crude protein</td>
<td>30.2</td>
<td>28.1</td>
<td>29.8</td>
</tr>
<tr>
<td>Try</td>
<td>0.64</td>
<td>0.53</td>
<td>0.67</td>
</tr>
<tr>
<td>Met</td>
<td>0.55</td>
<td>0.50</td>
<td>0.54</td>
</tr>
<tr>
<td>Thr</td>
<td>1.13</td>
<td>0.98</td>
<td>1.01</td>
</tr>
<tr>
<td>Trp</td>
<td>0.22</td>
<td>0.19</td>
<td>0.27</td>
</tr>
</tbody>
</table>

* Number of samples = 120 (10 plants, 12 samples each), DM basis

**Energy Balance Studies**

- ME and DE values obtained were significantly higher than NRC 1998 but were highly variable
  - 3380 to 5905 kcal DE/kg (3983 kcal DE/kg)
  - 3315 to 5930 kcal ME/kg (3917 kcal ME/kg)

- Calculated DE and ME values:
  - DE kcal/kg = 3965 (CV=2.2%) Range: 3883 to 4020 kcal/kg
  - ME kcal/kg = 3592 (CV=4.4%) Range: 3510 to 3654 kcal/kg

**DDGS Apparent Ileal Amino Acid Digestibility Comparison**

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Lys</td>
<td>0.83 (53) 0.44</td>
<td>0.68 (0 ) 0.00</td>
<td>0.67 (46) 0.31</td>
</tr>
<tr>
<td>Met</td>
<td>0.55 (58) 0.32</td>
<td>0.49 (49) 0.24</td>
<td>0.54 (72) 0.39</td>
</tr>
<tr>
<td>Thr</td>
<td>1.13 (55) 0.62</td>
<td>1.01 (36) 0.36</td>
<td>1.11 (50) 0.56</td>
</tr>
<tr>
<td>Trp</td>
<td>0.24 (63) 0.15</td>
<td>0.27 (56) 0.15</td>
<td>0.20 (70) 0.14</td>
</tr>
</tbody>
</table>

**DDGS P Availability Study**

- Phosphorus analysis of P excretion & retention
  - Relative to P intake for DDGS and Dical Phosphate
  - Excretion 27.5% availability of P (r^2 = .47)
  - Retention 92.2% availability of P (r^2 = .72)
  - DDGS 0.89% total P x 90% avail = 0.80% avail P
  - Corn 0.28% total P x 14% avail = 0.04% avail P
  - SBM (44% CP) 0.65% total P x 31% avail = 0.20% avail P

**DDGS Nursery Performance Studies**

- 2 experiments
  - 19 and 17 days of age (15.6 vs 11.6 lbs)
  - Commercial pelleted diet first 4 days
  - 0, 5, 10, 15, 20, or 25% DDGS
  - Formulated on App II Dig AA basis
  - Phase 2 (2 weeks), Phase 3 (3 weeks)

- Similar growth, feed intake, and G/F
  - Slight lag during Phase 2 for younger pigs, but they caught up by end of nursery period
### DDGS Nursery Performance Studies

- **Performance**
  - Growth rate similar at 0 and 10% DDGS levels
  - Drop at 20 & 30% levels
  - No difference in feed intakes
  - Decrease in G/F at 30% DDGS inclusion level

### DDGS Grow-Finish Performance and Carcass Composition Study

- **Performance**
  - Growth rate similar at 0 and 10% DDGS levels
  - Drop at 20 & 30% levels
  - No difference in feed intakes
  - Decrease in G/F at 30% DDGS inclusion level

- **Carcass composition**
  - % lean and backfat depth unaffected

- **Importance of using available vs. total amino acid levels when formulating and using DDGS**

### DDGS Sow Gestation/Lactation Study

- **Study just completed**
- **2 x 2 factorial arrangement of treatments:**
  - Gestation: 0 or 50% DDGS
  - Lactation: 0 or 20% DDGS
- **Followed through 2 parities (mixed parity sows)**
  - 93 sows initially, 49 sows second cycle
- **Initial results suggest an increase of ≅ 0.75 pig weaned for the 2nd litter with DDGS feeding**
  - Insoluble fiber effect?
Ileitis

DDGS Ileitis Challenge Studies

Field reports:
- Beneficial effect of adding 5 to 10% DDGS in grow-finish diets
- DDGS contains low levels of soluble (0.7%) and high levels of insoluble (42.2%) fiber (Shurson et al., 2000)
- Low soluble fiber diets may reduce the proliferation of pathogenic organisms in the GI tract (Hampson, 1999).
- DDGS contains yeast cells
  - May have nutraceutical properties

Experiment 1:
- NC: Negative control, corn-soybean meal diet
- PC: Positive control, corn-soybean meal diet
- D10: 10% DDGS diet
- D20: 20% DDGS diet

Experiment 2:
- NC, PC, and D10 same as Experiment 1
- PC+AR: Corn-soybean meal diet with antimicrobial regimen
- D10+AR: 10% DDGS diet with antimicrobial regimen

Experiment 3:
- NC, PC, and D10 same as Experiment 1
- SH: 5% Soy Hulls diet
- PA: Polyclonal antibody product with soy hulls

Just completed 3rd challenge study:
- Variable results with DDGS in diet
  - 1 study – positive effect on lesion prevalence, length, and severity in ileum and colon
  - 10% inclusion rate
  - Similar to effect of an antimicrobial/antibiotic treatment (BMD/CTC)
  - 2 studies – no beneficial effect of DDGS inclusion
- Dosage rate very high in one study
  - Probably higher in all studies than would occur in field
- Other potential nutritional strategies:
  - Soybean hulls, polyclonal antibody product

Quality Criteria

- Establish relationship with supplier
  - Quality control measures in place
    - Nutrient specs, mycotoxins, handling characteristics
  - Consistency of product
    - Proportion of solubles standardized
    - Grading system in place?
  - Color: generally, lighter is better
    - Indicates higher amino acid digestibility
  - Smell: shouldn’t have burnt smell
    - May affect palatability
    - Can indicate protein damage
Quality Criteria

Univ. of MN DDGS Web Site

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

www.ddgs.umn.edu