Use of “New Generation” Corn DDGS in Feeds for Swine, Poultry, and Aquaculture

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Overview – Part 3
- Feeding value and considerations of feeding DDGS to poultry
- Energy, digestible amino acids, and available phosphorus values of “new generation” DDGS for poultry
- Effect of DDGS color on amino acid digestibility and broiler growth performance
- University and field trial results from feeding “new generation” DDGS to laying hens
- University and field trial results from feeding “new generation” DDGS to broilers
- Maximum recommended dietary inclusion rates for “new generation” DDGS
- Use of DDGS in aquaculture

Use of Corn DDGS in Poultry Diets

Historical Use of DDGS in Poultry Diets in the U.S.
- Fed at low inclusion rates in U.S. poultry industry for many years
  - High B vitamin content (solubles)
  - Source of unidentified growth/reproduction factors?
  - Positive effect on palatability
  - Protein source when fed at higher dietary inclusion levels

Unidentified Growth or Hatchability Factors
- Growth response (Couch et al., 1957)
  - 5% DDGS in turkey diets
  - 17-32% improvement in gain
- Feed preference (Alenier & Combs, 1981)
  - 10% DDGS in chicken layer diets
- Reproduction improvement (Manley, 1978)
  - 3% DDGS in turkey breeder hen diets
  - Improvement in egg numbers and hatch (late lay)

Use of DDGS in Poultry Diets
- High inclusion rates have also provided good results
  - Favorable results with 25% DDGS in broiler diets
    - Waldroup et al., 1981
  - 15% DDGS in layer diets reduces fatty liver incidence
    - Jensen et al., 1974; Jensen, 1987; Akiba et al., 1983
  - 12% DDGS turkey diets gave similar performance to corn-soybean meal diets
    - Noll, 2002
Nutritional Value of DDGS for Poultry

- Must use high quality DDGS
  - Golden color = high amino acid digestibility
- Excellent energy and available phosphorus source
- Nutritional value higher than previously thought
- Unidentified growth factors?
- Source of xanthophyll
- Effective partial replacement for corn, soybean meal, and dicalcium phosphate

Considerations in Feeding DDGS to Poultry

- Product quality and variability
- Metabolizable energy content
- Amino acid digestibility
- Amino acid balance
- Phosphorus availability
- Diet levels
- Source of xanthophyll
- Cost in relation to other ingredients

DDGS As Protein Supplement

- Limiting amino acids (Parsons et al., 1983)
  - Lysine
  - Tryptophan
  - Arginine (perhaps equally limiting with trp)
- Dietary lysine and energy adjustments are needed with high inclusion rates (>10%) of DDGS
  - growth
  - feed conversion

Comparison of Energy Values of DDGS for Poultry (88% DM Basis)

<table>
<thead>
<tr>
<th></th>
<th>“New Generation” DDGS</th>
<th>NRC (1994)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AME, kcal/kg</td>
<td>2260</td>
<td>2480</td>
</tr>
<tr>
<td>Range</td>
<td>2090-2418</td>
<td></td>
</tr>
<tr>
<td>TME, kcal/kg</td>
<td>2850</td>
<td>3097</td>
</tr>
<tr>
<td>Range</td>
<td>2650 - 3082</td>
<td></td>
</tr>
</tbody>
</table>


Amino Acid Content of Corn DDGS (5 Sources)

<table>
<thead>
<tr>
<th>Amino acid</th>
<th>Range</th>
<th>Average</th>
<th>NRC, 1994</th>
</tr>
</thead>
<tbody>
<tr>
<td>Methionine</td>
<td>0.44 – 0.56</td>
<td>0.49</td>
<td>0.60</td>
</tr>
<tr>
<td>Cystine</td>
<td>0.45 – 0.60</td>
<td>0.52</td>
<td>0.40</td>
</tr>
<tr>
<td>Lysine</td>
<td>0.64 – 0.83</td>
<td>0.74</td>
<td>0.75</td>
</tr>
<tr>
<td>Arginine</td>
<td>1.02 – 1.23</td>
<td>1.08</td>
<td>0.98</td>
</tr>
<tr>
<td>Tryptophan</td>
<td>0.19 – 0.23</td>
<td>0.22</td>
<td>0.19</td>
</tr>
<tr>
<td>Threonine</td>
<td>0.94 – 1.05</td>
<td>0.98</td>
<td>0.92</td>
</tr>
</tbody>
</table>


True Digestible Amino Acid Levels of Corn DDGS for Poultry (5 Sources)

<table>
<thead>
<tr>
<th>Amino acid</th>
<th>True Dig. Amino Acid, %</th>
<th>Average</th>
<th>Digestibility Coefficient, %</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Methionine</td>
<td>0.35 – 0.53</td>
<td>0.43</td>
<td>86 - 90</td>
<td>88</td>
</tr>
<tr>
<td>Cystine</td>
<td>0.28 – 0.57</td>
<td>0.40</td>
<td>66 - 85</td>
<td>76</td>
</tr>
<tr>
<td>Lysine</td>
<td>0.37 – 0.74</td>
<td>0.53</td>
<td>59 - 83</td>
<td>71</td>
</tr>
<tr>
<td>Arginine</td>
<td>0.73 – 1.18</td>
<td>0.93</td>
<td>80 - 90</td>
<td>86</td>
</tr>
<tr>
<td>Tryptophan</td>
<td>0.14 – 0.21</td>
<td>0.18</td>
<td>76 - 87</td>
<td>82</td>
</tr>
<tr>
<td>Threonine</td>
<td>0.61 – 0.92</td>
<td>0.74</td>
<td>67 - 81</td>
<td>75</td>
</tr>
</tbody>
</table>

Correlation Between DDGS Color and Amino Acid Digestibility ($r^2$)

<table>
<thead>
<tr>
<th>Amino acid</th>
<th>L*</th>
<th>a*</th>
<th>b*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lysine</td>
<td>.67</td>
<td>NS</td>
<td>.77</td>
</tr>
<tr>
<td>Cystine</td>
<td>.67</td>
<td>NS</td>
<td>.74</td>
</tr>
<tr>
<td>Threonine</td>
<td>.51</td>
<td>NS</td>
<td>.58</td>
</tr>
</tbody>
</table>

Growth of Chicks Fed Nine Sources of DDGS

Feed Conversion of Chicks Fed Nine Sources of DDGS

Comparison of Phosphorus Level and Relative Availability of DDGS for Poultry (88% dry matter basis)

| Source: 2003 Lumpkins, Dale, and Batal, University of Georgia. Abstract. |

Results from Recent Layer Trials Feeding “New Generation” DDGS (University of Georgia)

- Hy-line W35 laying hens (21 to 43 weeks of age) fed diets containing:
  - 0% DDGS – 2800 kcal ME/kg
  - 15% DDGS – 2800 kcal ME/kg
  - 0% DDGS – 2870 kcal ME/kg
  - 15% DDGS – 2870 kcal ME/kg
- No differences in egg production except when low energy, 15% DDGS diet was fed (reduction)
- No differences in egg weight, specific gravity, Haugh units, yolk color, or shell breaking strength


Effect of Dietary DDGS Level and Energy Density of Layer Diets on % Egg Production 22-42 wks

<table>
<thead>
<tr>
<th>Energy Density</th>
<th>DDGSs Level (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>15</td>
</tr>
<tr>
<td>High (2870 Kcal/kg)</td>
<td>90.2</td>
</tr>
<tr>
<td>Low (2800 Kcal/kg)</td>
<td>89.2</td>
</tr>
</tbody>
</table>

Source: Lumpkins et al., 2003.
Xanthophyll Content of Control and DDGS Diets During a 12-Wk Layer Trial - Jalisco Mexico

Differences in Yolk Color (Roche Units) in Eggs Produced by Layers Fed Control and DDGS Diets – Jalisco Mexico

Average Percentage of Production by Week for Layers Fed Control and DDGS Diets – Jalisco Mexico

Egg Production and Quality When Laying Hens Were Fed Diets Containing 10% DDGS (Jalisco, Mexico Field Trial)

Performance Control DDGS P value
% Egg Production 68.7 72.4 .02
% First Class Eggs 66.2 68.9 .10
Egg Wt./Hen/Wk, kg .31 .32 .11
% Dirty Eggs 1.4 2.2 .002
Egg Yolk Color 10.6 10.8 .02

Results from Recent Broiler DDGS Trials

- Broiler chicks (0 to 18 days) fed diets containing:
  - 0% DDGS - 3000 kcal ME/kg
  - 15% DDGS – 3000 kcal ME/kg
  - 0% DDGS – 3200 kcal ME/kg
  - 15% DDGS – 3200 kcal ME/kg
- ADG and G/F higher for 3200 kcal ME diets
- No difference in performance between 0% or 15% DDGS within dietary energy level


Results from Recent Broiler DDGS Trials

- Broiler chicks (0 to 42 days) fed isocaloric and isonitrogenous diets containing:
  - 0% DDGS
  - 6% DDGS
  - 12% DDGS
  - 18% DDGS
- No difference in ADG and G/F when 0, 6, or 12% DDGS diets were fed
- ADG was reduced for chicks fed 18% DDGS
- No difference in carcass yields

Effect of Feeding Increasing Levels of DDGs to Broilers on Body Weight and Feed/Gain after a 6-Week Feeding Period

<table>
<thead>
<tr>
<th>Dietary Level of DDGS</th>
<th>Body Wt. 42d. Kg</th>
<th>Feed/Gain</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1.47</td>
<td>1.57</td>
</tr>
<tr>
<td>6</td>
<td>1.47</td>
<td>1.56</td>
</tr>
<tr>
<td>12</td>
<td>1.45</td>
<td>1.57</td>
</tr>
<tr>
<td>18</td>
<td>1.43</td>
<td>1.59</td>
</tr>
</tbody>
</table>

Lumpkins et al., 2003

DDGS Broiler Trial – CP Taiwan

Growth Performance of Broilers Fed 0 or 10% DDGS (day 15-39) at CP-Taiwan

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Control</th>
<th>10% DDGS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial Number of Birds</td>
<td>450</td>
<td>450</td>
</tr>
<tr>
<td>Final Number of Birds</td>
<td>441</td>
<td>439</td>
</tr>
<tr>
<td>% Livability</td>
<td>98.0</td>
<td>97.6</td>
</tr>
<tr>
<td>Day 15 Body Wt., g/bird</td>
<td>392</td>
<td>395</td>
</tr>
<tr>
<td>Day 28 Body Wt., g/bird</td>
<td>1246</td>
<td>1232</td>
</tr>
<tr>
<td>Day 39 Body Wt., g/bird</td>
<td>1988</td>
<td>1981</td>
</tr>
<tr>
<td>Day 15-28 ADFI, g/bird</td>
<td>986</td>
<td>978</td>
</tr>
<tr>
<td>Day 28-39 ADFI, g/bird</td>
<td>1860</td>
<td>1865</td>
</tr>
<tr>
<td>Day 15-39 ADFI, g/bird</td>
<td>2846</td>
<td>2843</td>
</tr>
<tr>
<td>Feed/Gain, Day 15-39</td>
<td>1.78</td>
<td>1.79</td>
</tr>
</tbody>
</table>

Recommended Inclusion Rates of DDGS for Poultry

- Broilers
  - 10% inclusion rates (Starter/Finisher)
    - Without energy adjustments
  - > 10%
    - With adjustments for lys, met, thr, trp, and energy

- Chicken Egg Layers
  - 10% inclusion rate
  - > 10%
    - With adjustments for lys, met, thr, trp, and energy

DDGS Use in Aquaculture

- Very little research has been conducted on feeding DDGS to fish.
  - University of Kentucky (1992)
    - A diet containing all plant protein sources (DDGS and soybean meal) can completely replace all of the fish meal in catfish diets.
  - D’Abramo (1993)
    - Up to 4% DDGS can be used effectively in freshwater prawn feeds
DDGS Use in Aquaculture

- Hughes Tunison Laboratory of Fish Nutrition (1986)
  - Up to 8% DDGS can be used effectively in lake trout diets.
- Feeding DDGS has no effect on organoleptic properties of meat quality in all of the studies conducted.

Recommendations for DDGS Use in Aquaculture

<table>
<thead>
<tr>
<th>Species/type</th>
<th>DDGS Inclusion Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Catfish</td>
<td>Up to 20%</td>
</tr>
<tr>
<td>Trout</td>
<td>Up to 8%</td>
</tr>
<tr>
<td>Salmon</td>
<td>Up to 8%</td>
</tr>
<tr>
<td>Freshwater prawns</td>
<td>Up to 6%</td>
</tr>
<tr>
<td>Shrimp</td>
<td>Up to 5%</td>
</tr>
<tr>
<td>Tilapia</td>
<td>Up to 10%</td>
</tr>
</tbody>
</table>

Source: Feed Co-products Handbook

U of M DDGS Web Site
www.ddgs.umn.edu

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