Maintaining Feed Quality

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West Virginia University Appointment

- FFA and 4H poultry events
- Small conference presentations
- VPGC research
- Applied Nutrition
- Poultry Production
- Companion Animal Science
- Poultry Judging (Fall and Spring)
- Guest lecture in approximately 9 additional courses

Research 45%
Teaching 30%
Extension 25%
WVU Graduate Students

- Feed Manufacture
- Enzyme efficacy
- Antibiotic alternatives
- Organic production

FFA and 4H poultry events
Small conference presentations
VPGC research
Applied Nutrition
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Companion Animal Science
Poultry Judging (Fall and Spring)
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Maintaining feed quality

Independent mills - perceptions

Integrated mills - economics

Pellet formation

Heat, moisture, and pressure

Causes starch to gelatinize and proteins to gel

Techniques exist to improve pellet quality

- These techniques are well documented in the literature

- However, legitimate concerns exist with past pelleting research
Concerns with past pelleting research

- Few studies adequately describe pelleting techniques
- Past pelleting/feeding research does utilize current genotypes
- Few studies differentiate between effects on feed form and nutrient availability (negative or positive)

Moritz’s opinion on pelleting

Various techniques used to pellet feed affect ingredient/nutrient conformation

- Feed form (pellet quality)
- Nutrient availability
- Bird Performance

Strategy 1. Slow down production rate

Strategy 2. Use a thicker pellet die


Strategy 3. Increase steam conditioning temperature


Strategy 3. Increase steam conditioning temperature

Every 30°F increase in temperature 1% moisture is added

If
Mash is 13% moisture

Mash temperature is 40°F

Then
Choke point of the die is 18% moisture

I should stay below 190°F
Strategy 4. Use a pellet binder


Strategy 5. Decrease corn particle size


Corn ground to 600 microns or less has been suggested to maximize pellet quality

Strategy 6. Manipulate diet formulation

Moritz’s opinion on pelleting

Various techniques used to pellet feed affect ingredient / nutrient conformation

Feed form (pellet quality)

Nutrient content

Nutrient availability

Bird Performance

Feed Form Study (broilers)

- Pellets were produced using 200°F conditioning temperature, 1.77x 3/16 in die, 80 psig steam, and a slow production rate

- Fines were produced by grinding pellets with a roller mill
  - 0:100 pellets to fines
  - 30:70 pellets to fines
  - 60:40 pellets to fines
  - 90:10 pellets to fines

3x4 factorial study

Feed Conversion Ratio (D21-38)

Feed Form P=0.0001 Sex P=0.0001

Feed Form Ratio

HPQ MPQ LPQ Ground Pellets

1.88 1.86 1.84 1.82 1.80 1.78 1.76 1.74 1.72 1.70 1.68

Male

Straightrun

Female
**Economic analysis using grower period feed intake and carcass gain**

<table>
<thead>
<tr>
<th>Feed form treatments (pellet: fine)</th>
<th>21d chick weight (lb)</th>
<th>38d carcass weight (lb)</th>
<th>21-38d feed intake/bird (lb)</th>
<th>$/lb of carcass weight</th>
<th>Relative difference between GP and pelleted treatments ($/lb)</th>
</tr>
</thead>
<tbody>
<tr>
<td>GP (0:100)</td>
<td>1.71</td>
<td>3.11</td>
<td>5.26</td>
<td>0.371</td>
<td>0.00</td>
</tr>
<tr>
<td>LPQ (30:70)</td>
<td>1.63</td>
<td>3.17</td>
<td>5.33</td>
<td>0.365</td>
<td>-0.006</td>
</tr>
<tr>
<td>MPQ (60:40)</td>
<td>1.64</td>
<td>3.23</td>
<td>5.49</td>
<td>0.366</td>
<td>-0.005</td>
</tr>
<tr>
<td>HPQ (90:10)</td>
<td>1.64</td>
<td>3.32</td>
<td>5.45</td>
<td>0.350</td>
<td>-0.021</td>
</tr>
</tbody>
</table>

\[
\text{$/lb of carcass weight} = \frac{300}{2000 \text{ lbs feed}} \times \frac{\text{feed intake}}{(\text{carcass weight} - \text{60% x 21d chick weight})^2}
\]

*60% of 21d chick weight is an estimated carcass weight of 21d chicks

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**Moritz’s opinion on pelleting**

Various techniques used to pellet feed affect ingredient / nutrient conformation

Feed form (pellet quality) → Nutrient availability → Bird Performance
Feed manufacture and lysine availability study (broilers)

- 2 x 2 x 2 Factorial Design
  - 2 Production Rate (0.6 or 0.9 ton/hr)
  - 2 Die Thickness (1.5 or 1.77 in)
  - 2 MAF level (0.5 or 3%)

- Three additional treatments
  - Lower lysine (80% of Cobb-Vantress recommendation)
  - Unprocessed Mash
  - Double-pelleted

Main Effects: Pellet Mill Energy Usage

<table>
<thead>
<tr>
<th>Rate P&lt;0.0001</th>
<th>Die P=0.0001</th>
<th>MAF P&lt;0.0001</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kilowatt-Hour/Tonne</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Slow</th>
<th>Fast</th>
<th>Thick</th>
<th>Thin</th>
<th>0.5%</th>
<th>3%</th>
<th>Double Pelleted</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>b</td>
<td>a</td>
<td>b</td>
<td>a</td>
<td>b</td>
<td>b</td>
</tr>
</tbody>
</table>

Main Effects: Pellet Durability Index

<table>
<thead>
<tr>
<th>Rate P&lt;0.0001</th>
<th>Die P=0.0001</th>
<th>MAF P&lt;0.0001</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pellet Durability Index (%)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
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<td>b</td>
</tr>
</tbody>
</table>


Feed Conversion Ratio (D23-42)

ANOVA: P=0.0006

Factorial Trts : Unprocessed Mash P=0.0106

Factorial Trts : Double Pelleted P=0.0059

Manufacture Considerations

• Create the best pellet possible; however, consider...
  – Feed Enzymes (if added at the mixer)
    • Enzyme companies can provide post pellet enzyme activity data
  – Amino acids
    • Universities can provide digestible amino acid data

Distillers Dried Grains w/ Solubles (DDGS)

• Broiler Finisher Diet Formulations

<table>
<thead>
<tr>
<th></th>
<th>No DDGS</th>
<th>Low DDGS</th>
<th>High DDGS</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Corn</td>
<td>75</td>
<td>68</td>
<td>60</td>
</tr>
<tr>
<td>% DDGS</td>
<td>0</td>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td>% Fat</td>
<td>1.6</td>
<td>2</td>
<td>2.4</td>
</tr>
</tbody>
</table>
Distillers Dried Grains w/ Solubles (DDGS)

Pellet Durability Index (%)

Production Rate (ton/hr)

Distillers Dried Grains w/ Solubles (DDGS)

• Broiler Grower Diet Formulations

<table>
<thead>
<tr>
<th></th>
<th>No DDGS</th>
<th>High DDGS</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Corn</td>
<td>64</td>
<td>39</td>
</tr>
<tr>
<td>% DDGS</td>
<td>0</td>
<td>30</td>
</tr>
<tr>
<td>% Fat</td>
<td>1.9</td>
<td>3.9</td>
</tr>
<tr>
<td>% Tri Cal Phos</td>
<td>1.4</td>
<td>0.7</td>
</tr>
</tbody>
</table>

Loar et. al., 2010
Distillers Dried Grains w/ Solubles (DDGS)

- If high pellet quality is not obtainable, then pellet quality considerations become less important.
- If throughput is a greater economical issue then remember all sand is not created equal and feed phosphate addition may be necessary.

Inorganic Feed Phosphates

- Monocalcium Phosphate
  - 21 P, 16 Ca
- Dicalcium Phosphate
  - 18.5 P, 20 Ca
- Tricalcium Phosphate (Defluorinated Phosphate)
  - 18 P, 28 Ca

Diets were formulated to Cobb 500 specifications

<table>
<thead>
<tr>
<th>Ingredients</th>
<th>Monocal P (%</th>
<th>Dical P (%</th>
<th>Trical P (%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn</td>
<td>57.89</td>
<td>58.00</td>
<td>59.08</td>
</tr>
<tr>
<td>Soybean meal (48%)</td>
<td>36.06</td>
<td>36.04</td>
<td>35.84</td>
</tr>
<tr>
<td>Soybean oil</td>
<td>1.89</td>
<td>1.86</td>
<td>1.57</td>
</tr>
<tr>
<td>Feed phosphate</td>
<td>1.66</td>
<td>1.89</td>
<td>1.54</td>
</tr>
<tr>
<td>Limestone</td>
<td>1.37</td>
<td>1.89</td>
<td>0.66</td>
</tr>
<tr>
<td>Salt</td>
<td>0.47</td>
<td>0.47</td>
<td>0.24</td>
</tr>
<tr>
<td>Vitamin mineral premix</td>
<td>0.25</td>
<td>0.25</td>
<td>0.25</td>
</tr>
<tr>
<td>DL—methionine</td>
<td>0.23</td>
<td>0.23</td>
<td>0.23</td>
</tr>
<tr>
<td>Colbax 68 (coccidiostat)</td>
<td>0.08</td>
<td>0.08</td>
<td>0.08</td>
</tr>
<tr>
<td>BMD (antibiotic)</td>
<td>0.05</td>
<td>0.05</td>
<td>0.05</td>
</tr>
<tr>
<td>Lysine</td>
<td>0.04</td>
<td>0.04</td>
<td>0.05</td>
</tr>
<tr>
<td>Threonine</td>
<td>0.003</td>
<td>0.003</td>
<td>0.004</td>
</tr>
</tbody>
</table>
**Take-home message**

- Pellet quality has economic importance as long as nutrition is not compromised.

- High DDGS inclusion can decrease pellet quality as well as throughput and these problems may be difficult to simultaneously alleviate through changes in manufacture strategy.

**Inorganic Feed Phosphates**

- MonoCal P
- DiCal P
- TriCal P

"Die scouring" may be associated with the smaller size, higher density, and rough shape of TriCal P.
Thank you