Broiler Nutrition

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Broiler Genetics is Constantly Changing

What about the response to nutrient density?
Response of the Ross 308 Broiler to Balanced Protein Density – Liveweight and $2\text{kg FCR}_{\text{adj}}$
Response of the Ross 308 Broiler to Balanced Protein Density – 2kg Breast Meat%
Effect of Feeding High, Medium or Low AA Density on Body Weight Uniformity

(Corzo et al., 2004)
Conclusion

• The modern broiler is very responsive to a RANGE of balanced protein densities

• The OPTIMUM ECONOMIC response is close to standards and higher for meat portions and FCR

• What about Energy?
• Good physical feed quality
• Bell drinkers
• 20 L: 4 D
• Enough feeder space

Feed Intake
34 days
Brooding

- Most important phase
  - Temperature regulation is not complete in first 7 days
  - Feed conversion is most efficient
- Growth and Conversion is most economical during this phase
- Any damage done in the first 2 weeks may not appear until later in life
  - eg., chilled chicks = ascites later
Spot Brooding
Whole House Brooding
Responsibility for Feed Quality

- Purchasing Department
- Nutritionist
- Feed Mill Mgr.
Ingredient Evaluation

New Crop Year

Corn

Crude Protein, %

Date

N = 255
Mean = 6.94
SD = 0.67
CV = 9.59
Min = 5.16
Max = 8.69
Corn Protein, Fat and Fiber

- Protein
- Fat
- Fiber

Poly. (Protein)
Poly. (Fat)
Linear (Fat)
Linear (Fiber)
Alternative Ingredients

- Ingredient Specification Sheet
  - Product Description
  - Expected Nutrient Content
  - Analytical Methods
  - Physical Characteristics
  - Rejection Criteria
Alternative Ingredients

• Ingredients with high variation will have a lower value in the least cost formulation program

• DDGS
  – Fermentation batches within a plant have a greater effect on variation than did sampling or between plant variation (Belyea et al., 2010)
It's Just Chicken Feed!
Mixing

• Adding too little of an ingredient reduces animal performance
• Adding too much can significantly affect the cost of the feed
  – Adding 1 kg too much fat adds $.96 per batch
• Make sure scale resolutions are figured into the rounding factor on ingredients
  – eg. Adding 2.2 lb of Lysine on scale with 1 lb resolution
Mixer Profile: Amino Acids/Protein

![Graph showing Mix Time (minutes) vs % CV for DL-Methionine, Lysine-HCl, and Crude Protein]
Effect of worn outer ribbon in a horizontal ribbon mixer
Segregation of Mash Feed During Handling (Starting with low or high CV Feed)

Beyer, et al., 2000
Effect of Protein CV on Chick Growth Rate

Body weight gain, grams

21 day old

Control  10% CV  20% CV

773  716  703
Effect Protein CV on Feed Conversion

Feed/Gain

21 day old

Control  10% CV  20% CV

1.74  1.82  1.86
What Impacts Pellet Quality?

• Conditioning Parameters
  – Time, Moisture, Die

• Milling equipment
  – Grinding, Elevating, Cooling

• Feed ingredients, Formulation

• Storage and Delivery to Farm
  – Load out, Truck equipment

• On Farm Equipment
  – Feeders, Augers
Factors Influencing Pellet Quality

- Formulation: 40%
- Conditioning: 15%
- Particle Size: 20%
- Cooling: 20%
- Die Specifications: 5%
Finished Feed Quality

• Protein Analysis - ± 1% of target is acceptable
  – ± .5% results in improved performance
  – Protein mixer profile should be ± .25%
• Calcium Analysis – typical CV’s and SD’s
  – Broilers – CV of 7% and SD of .09%
  – Breeders – CV of 17-19% and SD of .6%
• Phosphorus Analysis, CV of 6% is normal
• Sodium Analysis, SD of .02% is typical, don’t use for mixer profiles, mixes too well!
• Fat Analysis, SD of .57% for 6.75% fat level
  – CV of 8.5% is normal
How important is the physical form during Pre-Starter and Starter phases?
PARTICLE SIZE PREFERENCE IN CHICKS

SUMMARY

ALBERTVILLE

2007
**Particle Size**

- Starter and Grower diets separated into 4 fractions

<table>
<thead>
<tr>
<th>Starter</th>
<th>Fractions (mm)</th>
</tr>
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<tbody>
<tr>
<td>&lt;0.82</td>
<td>0.82-2.00</td>
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<tr>
<td>2.00-3.18</td>
<td>&gt;3.18</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Grower</th>
<th>Fractions (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;2.00</td>
<td>2.00-3.18</td>
</tr>
<tr>
<td>3.18-4.76</td>
<td>&gt;4.76</td>
</tr>
</tbody>
</table>
Feed Intake Results

Intake Day 1-10

- 3.18 mm +
- 2 to 3.18 mm
- 0.816 to 2 mm
- Fines (<0.816 mm)
Effect of Feed Form and Particle Size on Feed Conversion at 44 days
**FEED FORM CHOICE by HEAVY BROILERS**

<table>
<thead>
<tr>
<th>Pellets in Feed (%)</th>
<th>Feed Form Consumed (g)</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pellets</td>
<td>Fines</td>
<td>Pellets Consumed (%)</td>
</tr>
<tr>
<td>0</td>
<td>----</td>
<td>204</td>
<td>----</td>
</tr>
<tr>
<td>25</td>
<td>155</td>
<td>104</td>
<td>60</td>
</tr>
<tr>
<td>50</td>
<td>323</td>
<td>57</td>
<td>85</td>
</tr>
<tr>
<td>75</td>
<td>459</td>
<td>10</td>
<td>98</td>
</tr>
</tbody>
</table>
## Effects of Pelleting on Broiler Performance

*Feed Form (21-49 days)*

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Mash</th>
<th>Pellets</th>
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<tbody>
<tr>
<td>BW, 49 days, kg</td>
<td>2.00 a</td>
<td>2.13 b</td>
</tr>
<tr>
<td>FCR</td>
<td>1.85 a</td>
<td>1.79 b</td>
</tr>
<tr>
<td>Adj. FCR</td>
<td>1.91 a</td>
<td>1.79 b</td>
</tr>
</tbody>
</table>

Pfaff, 1985
Delayed Feed Intake in Chicks

Juul-Madsen H.R., et al., 2004

Three Treatments:
- Treatment 1 - fed 6 hours post hatch
- Treatment 2 - fed 30 hours post hatch
- Treatment 3 - fed 54 hours post hatch

42 days Results:
- Treatment 2: 2g lower daily weight gain, compared to Trt. 1
- Treatment 3: 5g lower daily weight gain, compared to Trt. 1
Effect of Early Access to Feed on Bodyweights at 40 Days

Noy and Sklan, 2005
The Effect of Particle Size on Gizzard Development

- Coarse feed stimulates gizzard action
  – Normalizes feed passage rate.
  – More complete protein digestion?
- Processed feed requires less gizzard action
  – Swollen proventriculus and thin Gizzard
  – Inadequate protein digestion?
The effect of whole and ground wheat on gizzard development in broilers

Hetland et al., 2003

Whole Wheat

Ground Wheat
When highly processed diets are fed to poultry the gizzard atrophies and functions as a transit rather than a grinding organ (Cummings, 1994).
Feed Form and Particle Size

• Pelleted feed improves FCR compared to mash. Negative effect of increased fines from poor pellet quality

• Coarse grain mash diets improves broiler performance. Gut Integrity in improved
<table>
<thead>
<tr>
<th>Form</th>
<th>Starter</th>
<th>Grower</th>
<th>Finisher</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;3mm</td>
<td>15%</td>
<td>&gt; 70%</td>
<td>&gt; 70%</td>
</tr>
<tr>
<td>2 to 3mm</td>
<td>40%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 to 2mm</td>
<td>35%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;1.0mm</td>
<td>&lt;10%</td>
<td>&lt;10%</td>
<td>&lt;10%</td>
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FEED FORM

Effect on Feeding Behavior
THE EFFECT OF FEED FORM ON FEEDING BEHAVIOR

Feed Intake (g/bird/day)

Age in Days

Feed Intake (g)

Pellet Fed
Crumb Fed
THE EFFECT OF FEED FORM ON FEEDING BEHAVIOR

% Occupancy of Feed Places

Age (days)

% Occupancy

Pellet Fed
Crumb Fed
IDEAL AMINO ACID PROFILE

<table>
<thead>
<tr>
<th>DIGESTIBLE AMINO ACID</th>
<th>STARTER FEED</th>
<th>GROWER FEED</th>
<th>FINISHER FEED</th>
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<tbody>
<tr>
<td>LYSINE</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>METHIONINE &amp; CYST(e)INE</td>
<td>74</td>
<td>76</td>
<td>78</td>
</tr>
<tr>
<td>METHIONINE</td>
<td>37</td>
<td>38</td>
<td>39</td>
</tr>
<tr>
<td>THREONINE</td>
<td>65</td>
<td>66</td>
<td>67</td>
</tr>
<tr>
<td>VALINE</td>
<td>75</td>
<td>76</td>
<td>77</td>
</tr>
<tr>
<td>ISO-LEUCINE</td>
<td>67</td>
<td>68</td>
<td>69</td>
</tr>
<tr>
<td>ARGinine</td>
<td>103</td>
<td>104</td>
<td>105</td>
</tr>
<tr>
<td>TRYPTOPHAN</td>
<td>16</td>
<td>16</td>
<td>16</td>
</tr>
</tbody>
</table>

SLIGHT CHANGES TO AMINO ACID RATIOS BASED ON FIELD STUDIES AND REVISION OF LITERATURE.
Estimated Digestible Lysine (g/kg) of male broilers as function of body weight

Body Weight, kg

Dig. Lysine for Gain, g/kg
Summary

Response to Balanced Protein is positive for Modern Breeds
- 100, 110,105,110
- Ideal amino acid profile

Energy levels in Pre-starter and Starter phases
- 0-10 D – 3025 kcal/kg
- 10-21 D – 3150 kcal/kg
- FCR is defined in these phases

Energy levels in Grower Phase
- Manual (3200-3225 kcal/kg)
  - Controlled Environment
- Plus 50-100 kcal/kg
  - Open Side Houses and/or poor pellet quality or mash diets
- Corn Energy Adjustments
- Introduce high energy diets earlier for females
Questions?
Where is the Best Broiler Performance in the World?
Live Performance

• Average 1.50 FCR at 5.86 lb
• One of the best results last year:
  – 1.405 FCR at 6.06 lb., 37 days of age!
    • .164 lb. (74.4 g/d) average daily gain
  – Excellent brooding, management
  – Low disease challenge
    • Mortalities are less than 3%
Thank You!