Breeder Nutrition for Modern Broiler Breeders

John Halley, PhD
Aviagen Inc.
Broilers are capable of growing at 3 grams per hour

Meeting the needs of consumers for broiler products has changed the nutritional/management needs of the broiler breeder
• The *absolute* nutrient requirements of broiler breeders are influenced by both restricted feeding level and dietary nutrient concentration.

• So, we must **match** feed intake to nutrient requirements of the flock.
• There is no single requirement for amino acids (protein) or energy
• Requirements change according to changes in the components of the requirement
  • Maintenance
    • Temperature (energy)
  • Growth
  • Egg mass (% production x egg weight)
• Never forget, we are feeding a population of birds
• by definition uniformity of growth is critical to accurately feed the flock
• The more variable a flock is in bodyweight, the more variable will be their:
• Reproductive performance
• Mortality
• Individual nutrient requirements
Bodyweight distribution for flock of PS females at differing CV% mean bodyweight of 4.60 lb

- Counts at 10% CV
- Counts at 14% CV
- Counts at 16% CV

~90% of birds 15% of mean

~69% of birds 15% of mean

~75% of birds 15% of mean
• Most current publications will state that 12% CV is acceptable
• Leeson and Summers – 8% is standard
• How do we effect a significant change in our pullet uniformity?
  – Leeson and Summers, Broiler Breeder Production
    • Correct Feed Distribution
    • Correct Feeder Space
    • Feed Segregation Issues solved
    • Inadequate Water Access
    • Disease Challenges, esp. coccidiosis, worms
    • Flock sizes too large (smaller pens?)
    • Effective Environmental Control throughout house
    • Brooding Practices
• Grading?
  – Used in many locations around the world
  – Some companies do multiple gradings at various ages
  – Even one grading seems to be very beneficial
• How do we know if we have made progress?
  – Percent CV determinations
  – Handling of pullets
  – Calculating cumulative nutrients
  – Improvement in Fertility
  – Better Peak production
  – Better persistency
  – 1-5% production at 25 weeks of age
• Making informed decisions demands solid flock record keeping - *not opinions!*
• Monitor bodyweight and uniformity (CV%) weekly – *for the life of the flock*
• CV goal <12%?
Energy

- By definition – the first limiting “nutrient”
- Components
  - Maintenance
    - Temperature
  - Growth
  - Egg mass (% production x egg weight)
Total energy requirements for the Ross 708 to achieve performance objectives

68-70°F (20-21°C)
Energy

- Environmental temperature is a major factor influencing the bird’s energy requirement
  – Maintenance energy requirement is directly affected
<table>
<thead>
<tr>
<th>Temperature (°C Degrees)</th>
<th>Delta Energy by Phase (%)</th>
<th>Rearing</th>
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<td>5.79</td>
<td>1.73</td>
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Energy

• Focus on caloric intake
• Required feed allocation is derived from the energy level of the feed
Energy

• If bird weights exceed target weights, the energy requirements will be higher than expected
If negative energy balance occurs – reproduction is of lower priority to the bird than basic functions – egg output and growth will decline.
Feeding from Photo-Stimulation to Peak

- Keep Bodyweights on Target and Avoid Over-Feeding
- When pullets are exposed to circulating estrogen for the first time they are highly reactive to it
  - *Super-sensitized*
  - First 4 weeks after photo-stimulation is the most critical time in terms of over-feeding
Feeding from Photo-Stimulation to Peak

- Over-feeding results in excess production of Large Yellow Follicles
  - Primary influence on large yellow follicle number is bodyweight
    - Increased double-yolks
    - Increased internal ovulations
    - Increased risk of peritonitis and prolapse
Feeding from Photo-Stimulation to Peak

• Broiler breeder hens will divert excess nutrients into:
  – Liver lipids
  – Excess follicle development
  – Growth
    • Lean and fat tissue
Feeding from Photo-Stimulation to Peak

- On Peak Feed by 65-75% production
- Peak Feed depends on flock uniformity, performance trend, and house temperatures
Post-Peak Feed Reduction

- Peak egg production is usually achieved at 30-31 weeks of age
- Egg mass will peak ~ 3 weeks later
  – Thereafter – for best persistency feed allowances need to be reduced
Post-Peak Feed Reduction

• In most situations, total reduction needed from peak to depletion unlikely to be greater than 55-65 kcal/bird/day
• In high producing flocks (peak >85%) first feed reduction should not occur earlier than 4 weeks after peak
• Feed reductions should be gradual
  – Not greater than 6 kcal/bird/day in any given week
Post-Peak Feed Reduction

• Control of bodyweight and egg weight progression become priorities

• Protocol should be established to allow:
  – Weekly bodyweight gain of 0.03 lb/bird/week
  – Monitor egg weight trend relative to target
  – Monitor physical condition
  – Monitor changes in “clean-up” time
  – Monitor average daily temperature changes
Monitor Feed Clean-up Time

• Indication of adequacy of feed allocation
• Record feed clean-up time daily
• Key is to look for *change* in clean-up time
  – If change is >45 minutes, bird weight should be measured immediately
• Sudden feed clean-up time changes often precede changes in:
  – bodyweight by 2-3 days
  – egg production by 10-12 days
Amino Acids

• We must consider the requirements of all essential AA for:
  – Maintenance
  – Growth
  – Egg mass (% egg production x egg weight)

• Based on the AA profile required for maintenance, tissue growth and components of the egg
# Amino Acids for Maintenance

<table>
<thead>
<tr>
<th>Amino Acid</th>
<th>MAINTENANCE&lt;sup&gt;1&lt;/sup&gt; % of protein</th>
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* 1.75 g protein/kg/day

<sup>1</sup>Leveille and Fisher, 1958
# Amino Acids for Tissue and Feather Development

<table>
<thead>
<tr>
<th>Amino Acid</th>
<th>TISSUE&lt;sup&gt;1&lt;/sup&gt; % of protein</th>
<th>FEATHER&lt;sup&gt;1&lt;/sup&gt; % of protein</th>
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* Tissue 18% protein; Feather 93.9% protein

<sup>1</sup>Stilborn et al., 2010
<sup>2</sup>Stilborn et al., 1997
# Amino Acids for Egg Production

<table>
<thead>
<tr>
<th>Amino Acid</th>
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<th>OVALBUMIN</th>
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<td>5.98</td>
<td>7.50</td>
<td>8.50</td>
<td>7.30</td>
</tr>
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*Egg protein 12.1% of egg weight (44% yolk, 56% albumen and membranes)*

1 USDA, 2010

2 Romanoff and Romanoff, 1949
Amino Acids

Estimated methionine requirement to achieve Ross 708 performance objectives

- Maintenance
- Growth
- Egg mass
- Total
Amino Acids

• Compute the total AA requirement for each AA and compare to feed allocation to determine appropriate % of diet

  – Example: 580 mg/bird/day for Methionine at peak
    • If we were feeding a 1325 kcal/lb diet 33.4 lb/100 at peak to obtain 442 kcal/bird/day, then we must have a minimum of .385 of methionine in the diet to achieve 580 mg/bird/day
Comments

• Optimal breeder performance demands good bodyweight uniformity
• Routine measurements & good record keeping are critical
  – What you did...why you did it...what the results were
• We must focus on feeding nutrient intake and not units of weight
• Calcium metabolism is critical to Egg Quality
• Success with broiler breeders is a team effort!
Breeder Nutrition: Shell Quality
Introduction

• During the life of a flock egg weight increases due to bodyweight gain and reduced production after peak

• Larger eggs are beneficial to broiler performance (selection for heavier broilers)
  – Hatching heavier chicks will have:
    • More residual yolk
    • Lower susceptibility to dehydration and heat loss
However!

• Large increases in egg size during late production can affect egg quality and handling

• Large eggs tend to have
  – Poorer hatchability
  – Poorer shell quality
  – More cracks
• We are feeding a *population* of birds
• by definition uniformity of growth is critical to *accurately* feed the flock
• The more variable a flock is in bodyweight, the more variable will be their:
  • Reproductive performance
  • Mortality
  • Individual nutrient requirements
Hen Body Weight and Egg Weight

• Heavier hen weights are associated with larger eggs throughout laying cycle - early and late

• Good control of body weight in lay will help to control late egg weight

• Excessive increases in body weight may lead to poorer persistency, which will make the increase in late egg weight even worse

• Late light stimulation reduces the number of very small eggs produced, without increasing egg weights later in production
Higher bodyweights are generally associated with heavier eggs.
Maximizing Egg Production

• Birds need energy to meet the increasing demands of egg production & growth

• After peak is attained, manage for persistency
  – Adjust feed amounts by responding to changes in egg weight (weigh eggs daily, from the second collection), bodyweights, ambient temp., and production
Nutrition and Egg Weight

• Nutritional specification can help control late egg size
  – However, the feed must still have the correct nutrient concentration or egg production may suffer
    • Using multiple breeder diets to reduce protein (aa’s) later in lay can be helpful

• Important nutrients for control of late egg size may be; linoleic acid, protein and some specific amino acids (Methionine?)
Summary of Four Broiler Breeder Studies in Cages using Colostomized Hens
Large Particle Limestone

Improved Shell Quality

Increased Bone Ash

Total P Excretion Reduced (P=0.15 and P=0.086)

% P Retention increased (P=0.13)

% P Retention positive linear response (P= 0.01)

Increased Total Egg P (P=0.028)
P Retention affected by CaCO$_3$ Particle Size

- Large: 28.4%
- Small: 22.8%

$p=0.13$
- Hatching egg pack
  - Clean eggs
    - Manage for it
  - Cleaning?
Thank you!