Protein and Amino Acid Requirements of Laying Hens

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Introduction

- Genetic improvement in the performance of laying hens
  - Increased egg performance, improved egg quality
  - Reduced body weight and feed intake

- Protein and essential amino acids are key components of laying hen diets (Bregendahl et al., 2008)
  - Most expensive part of the diet
Introduction

- Need to avoid deficiency or excess levels of CP and AA
  - Cost of lost production or extra protein
  - High CP and AA levels are stressful to hens
    - Metabolic cost of eliminating excess amino acids
  - High protein diets cause nitrogen pollution
    (Keshavarz and Austin, 2004)
Introduction

- Previous research
  - Early work failed to use digestible amino acids and an ideal amino acid ratio in diet formulation
  - Often research amino acid levels did not result in a maximum response
Daily egg mass and feed conversion of two layer strains fed graded levels of balanced protein (Bonekamp et al., 2007)
Introduction

- Previous research

- Early work failed to use digestible amino acids and an ideal amino acid ratio in diet formulation
- Often studied amino acid levels did not result in a proven maximum response
- Commercial recommendations are extrapolated from existing research
Research Objective

- To assess the digestible lysine amino acid requirement of laying hens (28-40 wk)
  - Ideal amino acid ratio
Experimental Design

- Treatments
  - 5 levels of digestible lysine: 550, 625, 700, 775 and 850 mg/hen/day
- Lohmann LSL Lite hens
- Complete randomized design (CRD)
- Ten replications of 12 hens per treatment
Preparation of Experimental Diets

- Two base diets were made with 500 and 850 mg/kg of digestible lysine
- Experimental diets were prepared by mixing these two base diets
- Average daily feed intake was considered to decide on the mixing of ratio of the basal diets
Data Collection

- Body weight and feather scoring
  - 0, 20 and 39 weeks of the experiment
- Hen-day egg production
- Feed intake – Every 3 weeks
- Egg weight and specific gravity – Every 3 weeks
- Egg composition (albumen, yolk and egg-shell wt) – 14, 25 and 38 weeks of the experiment
Data Collection

- Body composition and tissue weights
  - 0, 13 and 26 weeks of the experiment
- Manure collection for N and uric acid content
  - 20 and 33 weeks of the experiment
- Mortality
  - Collected daily and sent to PDS for necropsy
Table 1: Effect of daily D-Lys intake on egg production and egg weight (28 – 40 wks. of age)

<table>
<thead>
<tr>
<th>D-Lys Intake (mg/h/d)</th>
<th>Egg Production (% Hen-Day)</th>
<th>Av. Egg Weight (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Projected</td>
<td>Actual</td>
<td></td>
</tr>
<tr>
<td>550</td>
<td>553</td>
<td>88.4</td>
</tr>
<tr>
<td>625</td>
<td>647</td>
<td>94.4</td>
</tr>
<tr>
<td>700</td>
<td>719</td>
<td>96.7</td>
</tr>
<tr>
<td>775</td>
<td>804</td>
<td>97.2</td>
</tr>
<tr>
<td>850</td>
<td>856</td>
<td>97.0</td>
</tr>
</tbody>
</table>
Hen-day Egg Production

D-Lys intake (mg/h/d) vs. %

R² = 0.9973

www.usask.ca
Egg Weight

\[ R^2 = 0.9998 \]
Egg mass

![Graph showing the relationship between D-Lys intake (mg/h/d) and egg mass (g). The graph displays a linear relationship with an $R^2 = 1$. The axis for D-Lys intake ranges from 500 to 900 mg/h/d, and the egg mass ranges from 45 to 60 g.]
Feed efficiency

R² = 0.9962

kg feed/kg egg mass vs. D-Lys intake (mg/h/d)
Number of dead or culled hens

Number of hens

D-Lys intake (mg/h/d)

Number of dead or culled hens
Body weight

![Graph showing body weight changes over time on experimental diets. The x-axis represents time on experimental diets (wks) ranging from 0 to 20, while the y-axis represents body weight (kg) ranging from 1.4 to 1.8. Different lines indicate different diet groups: 550, 625, 700, 775, and 850.]
Additional Data

- Sorting eggs by egg weight classification
- Feather condition
- Egg components
- Body composition
- Manure nitrogen levels
- Economics
Preliminary Data Interpretation

- HD egg production, egg weight, egg mass and feed efficiency improved with increase in daily intake of D-Lys
- Hen body weight increased and mortality decreased with increasing level of D-Lys
- Data will provide egg and feed industries with an improved ability to reach production goals
Preliminary Take Home Message

- Amino acid requirements of hens are based on performance criteria (egg numbers, egg weight, egg mass, feed efficiency)

- Specific balanced amino acid requirements will be based on producer performance objectives and feed cost
Thank you

Questions?