Effect of protein content and digestibility on broiler performance

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## Background to the problem

### Historical changes in broiler efficiency

<table>
<thead>
<tr>
<th>Year</th>
<th>Weight</th>
<th>Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>1950</td>
<td>1.5 kg</td>
<td>68</td>
</tr>
<tr>
<td>1992</td>
<td>1.5 kg</td>
<td>32</td>
</tr>
<tr>
<td>2015</td>
<td>1.5 kg</td>
<td>26</td>
</tr>
</tbody>
</table>
The need for greater precision in diet formulation

Genetic potential

Diets
- Essential amino acids
- Right amount
- Accessible form
- Rapidly bioavailable

High quality meat
Protein feed research currently

Ideal protein concept

Protein ingredient

Ideal protein

Influence of excess digestible dietary protein

- Hyperaminoacidemia
  - Feed intake
  - Feed efficiency
  - Protein deposition
  - Energy utilization

Influence of excess indigestible dietary protein

- Protein fermentation
  - Feed intake
  - Feed efficiency
  - Bird health
  - Protein deposition

Indigestible CP
link between excess diet protein and necrotic enteritis

Damage small intestine

Clostridium perfringens

http://en.engormix.com/MA-poultry-industry/health/articles/managing-sub-clinical-necrotic-t1490/165-p0.htm
http://i.dailymail.co.uk/i/pix/2013/01/04/article-2256746-16C0207A00005DC-674_634x491.jpg
link between excess diet protein and necrotic enteritis

Wilkie et al. (2005)
Protein in a practical diet

Balance diet to meet birds amino acid requirement

Excess Protein

Diet
Feed formulation challenges

- Straight run or mixed sex flock
- No feed antibiotic usage
  - potential risk for disease challenge
- Most limiting amino acids in diet
  - variations in dietary protein levels
- Dietary protein ingredients may have high and low digestible amino acids compared to what is expected
Objectives

To identify the effects of dietary protein with high or low indigestible fraction on broiler performance.

Hypothesis

Dietary protein with high indigestible fraction will result in poor broiler performance.
Materials and methods

- **Experimental design**
  - CRD with a $2 \times 3 \times 2$ factorial arrangement: Gender($2$), CP levels ($3$) and indigestible CP levels($2$)
  - Ross 308 male (1944) and female (2232) were randomly allocated to 72 litter floor pens
Protein ingredients used in the diet formulation were digested in vitro.
Materials and methods

- In the lab
  - Ingredients CP
  - Rapidly digested CP
  - Slowly digested CP
  - Indigestible CP

- The indigestible fractions for all the ingredients were calculated and used as a criteria during diet formulation.
Materials and methods

Test diets

- All diets had the same level of digestible methionine and met Ross 308 grower nutrient specifications
- NO medication
Materials and methods

- Birds were fed the same six from 0-32 day of age.
- Birds were vaccinated with Coccivac-B52 on day 5
- Body weights and feed intake were measured on day 12, 22 and 32
- On day 32, 288 birds were processed for meat yield
Results

☑ Diet CP level + indigestible CP

Day 12 body weight

<table>
<thead>
<tr>
<th>Protein level : Indigestible protein</th>
<th>LIP 24</th>
<th>HIP 26</th>
<th>LIP 28</th>
<th>HIP Reference Guide</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body weight (grams/bird)</td>
<td>a</td>
<td>a</td>
<td>b</td>
<td>b</td>
</tr>
</tbody>
</table>
Results

Day 22 Body Weight

- Diet CP level

Body weight (grams/bird)

<table>
<thead>
<tr>
<th>Diets CP levels</th>
<th>24</th>
<th>26</th>
<th>28</th>
<th>Ross Guide</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body weight</td>
<td>a</td>
<td>a</td>
<td>b</td>
<td></td>
</tr>
</tbody>
</table>

Ross 308 As hatched
Results

Day 32 Body Weight

- Diet indigestible CP
- Diet CP level

Body weight (grams/bird)

LIP | HIP | Indigestible CP | Diets CP levels | 24 | 26 | 28 | Ross Guide
---|---|---|---|---|---|---|---
a | ab | a | b

Ross 308 Adjusted
Results

Total feed intake 0-32 days

Indigestible CP+ diet CP level

Feed intake (grams/bird)

LIP | HIP | LIP | HIP | LIP | HIP
--- | --- | --- | --- | --- | ---
24  | 26  | 28  | Ross Guide

Ross 880 As labeled

Indigestible CP : Diet CP levels

a | ab | ab | ab | c | bc

www.usask.ca
Results

Total feed to gain mortality corrected

- Indigestible CP
- Diet CP level

<table>
<thead>
<tr>
<th>Protein level</th>
<th>LIP</th>
<th>HIP</th>
<th>24</th>
<th>26</th>
<th>28</th>
<th>Ross 308 As hatched</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indigestible CP</td>
<td>b</td>
<td>a</td>
<td>a</td>
<td>b</td>
<td>b</td>
<td></td>
</tr>
</tbody>
</table>
Results

Protein efficiency ratio

- Indigestible CP
- Diet CP level

<table>
<thead>
<tr>
<th>Protein level</th>
<th>LIP</th>
<th>HIP</th>
<th>24</th>
<th>26</th>
<th>28</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ratio (g BW gain/g CP consumed)</td>
<td>a</td>
<td>b</td>
<td>a</td>
<td>b</td>
<td>c</td>
</tr>
</tbody>
</table>

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Results

✓ Gender + diet CP level + indigestible CP

Carcass yield

<table>
<thead>
<tr>
<th>Gender</th>
<th>LIP Indigestible CP</th>
<th>HIP Indigestible CP</th>
<th>Diets CP levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>a</td>
<td>b</td>
<td>24</td>
</tr>
<tr>
<td>Female</td>
<td>a</td>
<td>a</td>
<td>26</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>28</td>
</tr>
</tbody>
</table>
Results

Whole breast meat

✓ Indigestible CP + Diet CP level

CP levels: Indigestible CP
Results

Thigh meat

Gender

Thigh meat (%) of live weight

Male  Female

a  b
Results

✓ Gender + diet CP level + indigestible CP

Drum meat

Gender

<table>
<thead>
<tr>
<th>Gender</th>
<th>Drum meat (% of live weight)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>3.14</td>
</tr>
<tr>
<td>Female</td>
<td>3.12</td>
</tr>
</tbody>
</table>

Indigestible CP

<table>
<thead>
<tr>
<th>Indigestible CP</th>
<th>Drum meat (% of live weight)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LIP</td>
<td>3.07</td>
</tr>
<tr>
<td>HIP</td>
<td>3.04</td>
</tr>
</tbody>
</table>

Diets CP levels

<table>
<thead>
<tr>
<th>CP levels</th>
<th>Drum meat (% of live weight)</th>
</tr>
</thead>
<tbody>
<tr>
<td>24</td>
<td>3.12</td>
</tr>
<tr>
<td>26</td>
<td>3.12</td>
</tr>
<tr>
<td>28</td>
<td>3.11</td>
</tr>
</tbody>
</table>
Diets formulated to meet broiler nutrients requirement which have excess indigestible CP will have negative effects at 32 days on:

1. Body weight
2. Feed to gain
3. Protein efficiency ratio (gram BW gain per gram CP consumed)
4. Carcass yield
5. Whole breast yield if level of CP in the diet is greater than 24%
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Questions?