Interactive effects of digestible valine and isoleucine to lysine ratios provided to male broilers from 4 to 6 weeks of age.

Introduction

Supplementing commercial broiler diets with feed amino acids (AA) lowers diet costs without compromising broiler performance. Typically diets are supplemented with L-Lys, DL-Met, and L-Thr. In diets containing meat and bone meal (MBM), Ile and Val have been reported as co-limiting for the 4\textsuperscript{th} limiting AA [1,2]. Corzo et al. (2008) reported digestible Val-to-Lys (dVal:dLys) ratios of 75 to 78 were required to maximize growth performance, feed conversion, and lean tissue accretion [3]. Both growth performance and breast meat yield were optimized when broilers were fed diets with a digestible Ile-to-Lys (dIle:dLys) ratio of 67 [4,5]. However, data are limited which evaluate the interaction effects of varying dVal:dLys and dIle:dLys on broiler growth and lean tissue accretion.

Objective

Two experiments were conducted to determine the potential interaction effects of feeding diets that varied in dVal:dLys and dIle:dVal ratios on growth performance and meat yields with diets containing MBM in the finisher feeding phase.

Materials and Methods

Diets: Broilers received 1 of 10 experimental diets (experiment 1) consisting of 9 diets arranged in a 3 (74, 78, 82 dVal:dLys) x 3 (63, 68, 73 dIle:dLys) factorial with a positive control diet (1.00% digestible Lys). In experiment 2, broilers were fed 1 of 11 experimental diets. Diets included a similar 3 (74, 78, 82 dVal:dLys) x 3 (62, 67, 72 dIle:dLys) factorial arrangement with moderate Lys (0.92% dLys) and requirement Lys (1.05% dLys) control diets. The moderate Lys control was used as a comparison to the experimental diet with similar concentrations of Ile and Val. The requirement Lys control was utilized to verify that the Lys concentration used in the factorial diets was limiting. As dietary Lys was the reference AA, it must be deficient to ensure broilers do not consume excess Lys. To create the 9 factorial diets, the 4 basal diets (Table 1) with either high or low concentrations of digestible Val or Ile, were blended in pre-planned proportions.

All diets were corn-soybean meal based and contained 2% (experiment 1) or 3% (experiment 2) MBM (57% CP). Additionally, diets in experiment 2 were formulated with 5% distillers dried grains with solubles (DDGS). All diets were formulated to exceed the requirement for TSAA, Thr, Arg, and Trp with respect to digestible Lys. Experimental diets were provided in pelleted form.

Bird Husbandry: A total of 2,880 (experiment 1) or 2,944 (experiment 2) Ross x Ross 708 male broilers were obtained from a commercial hatchery. At 1 d of age, chicks were randomly distributed to 120 (experiment 1, 24 birds per pen) or 128 (experiment 2, 23 birds per pen) floor pens and fed common diets in crumble or pellet form until 28 d of age. Each pen was equipped with a hanging feeder, a nipple drinker line, and used litter. Birds consumed feed and water on an ad libitum basis. Housing, temperature, and lighting protocols followed commercially recommended practices.

Birds and feed were weighed on d 28 and d 42 (d 26 and 40, experiment 2) to calculate BW gain, feed intake, and feed conversion. Mortality was recorded daily. On d 43 (experiment 1) or d 41 (experiment 2), 6 birds per pen were randomly selected for processing, weighed, and transported to the processing plant. Whole carcass (without abdominal fat) and abdominal fat were weighed. Carcass were split into front and back halves and placed on ice for 18 h. Then, the front halves were deboned to obtain weights of pectoralis major and minor muscles. Carcass, abdominal fat, and total...
breast meat yields were calculated using final live BW of the broilers selected for processing.

**Statistics:** Both experiments were arranged as a 3 x 3 factorial in a randomized complete block design with either 1 or 2 positive control diets for experiments 1 or 2, respectively. Main and interaction effects were determined. Preplanned orthogonal contrasts were conducted between each control and the dose-response treatment with the same dVal:dLys and dlle:dLys ratios. Differences between treatments were considered statistical significance at \( P \leq 0.05 \).

**Table 1: Composition of experimental diets (% as fed)**

<table>
<thead>
<tr>
<th>Ingredients (%)</th>
<th>Low Val Low Ile</th>
<th>Low Val High Ile</th>
<th>High Val Low Ile</th>
<th>High Val High Ile</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn</td>
<td>1.425</td>
<td>1.425</td>
<td>1.425</td>
<td>1.425</td>
<td>1.425</td>
</tr>
<tr>
<td>Poultry oil</td>
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<td>1.425</td>
<td>1.425</td>
<td>1.425</td>
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<tr>
<td>DL-Methionine</td>
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<td>0.30</td>
<td>0.30</td>
<td>0.30</td>
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<tr>
<td>L-Threonine</td>
<td>0.17</td>
<td>0.17</td>
<td>0.17</td>
<td>0.17</td>
<td>0.17</td>
</tr>
<tr>
<td>L-Valine</td>
<td>0.02</td>
<td>0.02</td>
<td>0.02</td>
<td>0.02</td>
<td>0.02</td>
</tr>
<tr>
<td>L-Isoleucine</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>L-Arginine</td>
<td>0.10</td>
<td>0.10</td>
<td>0.10</td>
<td>0.10</td>
<td>0.10</td>
</tr>
<tr>
<td>Others (^1)</td>
<td>to 100</td>
<td>to 100</td>
<td>to 100</td>
<td>to 100</td>
<td>to 100</td>
</tr>
</tbody>
</table>

\(^1\) Others include: defluorinated phosphate, calcium carbonate, sodium bicarbonate, sodium chloride. Vitamin and Mineral premix. Vitamin and mineral premixes were formulated to meet all vitamin and trace mineral requirements of the bird.

**Results**

**Experiment 1:** Feed conversion was improved \((P < 0.05)\) with increasing concentrations of dVal when the dlle:dLys was 68. Higher concentrations of dlle did not reduce feed conversion when dVal concentrations were 74 and 78. Feed conversion was optimized at dVal:dLys and dlle:dLys ratios of 74 and 63, 78 and 63, and 82 and 68 (Figure 1). Mortality was higher \((P < 0.05)\) for birds consuming diets with dVal:dLys and dlle:dLys ratios of 78 and 82 and 63 had 0% mortality. From these data, a dVal:dLys ratio of 74 appeared sufficient for normal growth. Progressive increases in dietary concentrations of dlle did not improve growth performance.

Broilers fed increasing concentrations of dlle had increased \((P = 0.02)\) breast meat yield and reduced \((P < 0.02)\) fat pad yield. Broilers consuming the control diet had higher breast meat yield and lower abdominal fat pad yield than the dose response diets with identical dVal:dLys and dlle:dLys ratios. This effect is likely attributed to higher dietary dLys concentrations of the control \((1.00 \text{ vs 0.95%})\).

**Experiment 2:** No interactions were observed between birds fed diets varying in dietary dVal:dLys and dlle:dLys \((P > 0.05)\). Broilers fed diets with progressive increases in dVal:dLys had lower feed conversion, increased BW and abdominal fat weight, and lower breast meat yield than broilers fed diets with the lowest dVal:dLys ratio. Breast meat yield increased \((P < 0.002)\) for broilers fed higher concentrations of dlle:dLys (67 and 72) compared with birds fed the diet with a dlle:dLys ratio of 62.

Broilers consuming the moderate control diet had similar growth performance and meat yields as the dose response treatment with the same concentration of dVal and dlle. However,
feed intake, feed conversion, and abdominal fat weight and yield were lower while breast tissue accretion was higher for broilers fed the requirement control compared with broilers fed the dose response diet with the same dVal and dIle:dLys ratio.

Increasing the dVal:dLys ratio improved growth and feed conversion in experiment 2 but similar results were not observed in experiment 1. This response may be attributed to lower analyzed dVal concentrations for diets formulated to dVal:dLys ratios of 74 and 78 in experiment 2. These data support previously determined dietary recommendations for dVal of 0.78% for adequate growth and meat yield.

In both experiments, broilers fed diets with increased dIle had greater breast meat yield. Data supporting higher dIle requirements for maximizing meat accretion have been previously reported [5]. Based on this research, a dIle:dLys ratio at or above 68 appears to be needed to ensure proper growth and meat yields.

Figure 1: Live performance and carcass characteristics (Experiment 1)

Figure 2: Live Performance and carcass characteristics (Experiment 2)
Two experiments were conducted to determine possible interaction effects between dietary valine and isoleucine when fed to Ross x Ross 708 male broilers during the finisher feeding phase.

Experimental diets were arranged as a 3 x 3 factorial.  

Increasing dIle:dLys ratio resulted in beneficial effects on feed conversion, abdominal fat pad percentage, and breast meat yield in experiment 1.

In experiment 2, broilers grew heavier and had lower feed conversion when consuming diets with a dVal:dLys of 82 compared with broilers consuming diets with a dVal:dLys of 74.

Greater breast meat yields were realized when feeding broilers diets formulated with a dIle:dLys of 72 compared with a dIle:dLys of 62.

In order to maximize growth performance and meat accretion of high yielding broilers, diets must be formulated with adequate concentrations of Val and Ile. Current recommendations for dVal:dLys and dIle:dLys ratios for broilers from 4 to 6 weeks of age are 78-82 and 68, respectively.

### References


**Key Points**

- Two experiments were conducted to determine possible interaction effects between dietary valine and isoleucine when fed to Ross x Ross 708 male broilers during the finisher feeding phase.

- Experimental diets were arranged as a 3 x 3 factorial.
  
  **Exp 1**: 74, 78, 82 dVal:dLys x 63, 68, 73 dIle:dLys.
  

- Increasing dIle:dLys ratio resulted in beneficial effects on feed conversion, abdominal fat pad percentage, and breast meat yield in experiment 1.

- In experiment 2, broilers grew heavier and had lower feed conversion when consuming diets with a dVal:dLys of 82 compared with broilers consuming diets with a dVal:dLys of 74.

- Greater breast meat yields were realized when feeding broilers diets formulated with a dIle:dLys of 72 compared with a dIle:dLys of 62.

- In order to maximize growth performance and meat accretion of high yielding broilers, diets must be formulated with adequate concentrations of Val and Ile. Current recommendations for dVal:dLys and dIle:dLys ratios for broilers from 4 to 6 weeks of age are 78-82 and 68, respectively.