**Introduction**

For optimum health and performance, the animal’s diet must contain adequate quantities of all nutrients required, including amino acids. The limiting amino acid is that present the greatest deficiency relative to its requirement. A shortage of the limiting amino acid will constrain animal growth and reduce feed efficiency [10]. Moreover, there is evidence suggesting that a severe amino acid imbalance has a primary effect on feed consumption which, in turn, can affect growth rate and carcass composition [21, 25]. Amino acid excesses can also result in impaired growth performance [5-7, 12].

Methionine (Met) is considered to be the first limiting amino acid. This study was conducted to evaluate growth performance, carcass traits, relative weights of some organs and some blood parameters of broilers fed diets containing excess dietary lysine (Lys) and/or methionine (Met) levels during the starter period (0 to 21 d). A total of 304 day-old male broiler chicks were equally allocated into four experimental groups (n=76) each comprising four replicates of 19 birds. Broiler chicks were fed four starter diets including different Lys and Met levels: (I) 13.67 g/kg Lys (124% of NRC) and 6.28 g/kg Met (126% of NRC); (II) 22.07 g/kg Lys (200% of NRC) and 6.28 g/kg Met (126% of NRC); (III) 13.67 g/kg Lys (124% of NRC) and 10.08 g/kg Met (200% of NRC); (IV) 22.07 g/kg Lys (200% of NRC) and 10.08 g/kg Met (200% of NRC).

The results indicated that body weights (BW) and BW gains in groups receiving excessive supplemental Lys (Diets II and IV) were significantly lower than other experimental groups. Feed consumption, feed conversion ratio (FCR), carcass, leg quarter, breast with bone yields and relative weights of heart, spleen, bursa of Fabricius were not affected from Lys and/or Met supplementation. Nevertheless, leg quarter yield was enhanced in groups fed high Lys levels (Diets II and IV), and among the groups Diet IV presented the highest value. The data indicated that chicks are in amino acid imbalance. An excessive addition of Lys depressed BW and BW gain from 0 to 21 d of age, independently of Met addition. On the other hand, excess level of Lys in diet singly or in combination with excess Met, increased leg quarter yield.

**Key-words:** Broiler, lysine, methionine, growth, carcass traits, amino acid balance.

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**RéSUMÉ**

Influence d’un apport excessif en lysine et/ou en méthionine sur les performances de croissance et de carcasse des poulets de chair.  

Cette étude a été réalisée sur des poulets de chair qui ont reçu une ration comportant de la lysine (Lys) et/ou de la méthionine (Met) en excès, pendant la période de démarrage (0 à 21 j) afin d’évaluer leurs performances de croissance, les caractéristiques de leur carcasse, le poids relatif de certains de leurs organes et de doser certains paramètres sanguins. Un total de 304 poulets mâles âgés de 1 jour ont été aléatoirement répartis en 4 groupes (n=76) chacun comportant 4 lots de 19 oiseaux. Les poulets ont reçu 4 régimes "démarrage" contenant différents niveaux de Lys et Met: (I) 13.67 g/kg Lys (124% de CNR) et 6.28 g/kg Met (126% de CNR); (II) 22.07 g/kg Lys (200% de CNR) et 6.28 g/kg Met (126% de CNR); (III) 13.67 g/kg Lys (124% de CNR) et 10.08 g/kg Met (200% de CNR); (IV) 22.07 g/kg Lys (200% de CNR) et 10.08 g/kg Met (200% de CNR).

Les résultats indiquèrent que le poids vif (PV) et le gain de PV des groupes recevant plus de Lys (Rations II et IV) étaient significativement plus faibles que ceux des poussins appartenant aux deux autres groupes expérimentaux. La quantité d’aliments ingérés, l’indice de conversion alimentaire, les rendements de carcasse, de cuisse, de brêchet et les poids relatifs du cœur, de la rate, de la bourse de Fabricius n’ont pas été affectés par un apport excessif en Lys et/ou en Met. Néanmoins, le développement de la cuisse a été significativement plus important dans les groupes recevant les rations contenant de la Lys en excès (ration II et IV), et parmi les tous les groupes expérimentaux, la ration IV présentait la valeur la plus élevée. Les données ont montré que la ration de base des poulets était déséquilibrée en acides aminés. Une addition excessive de Lys dans la ration a diminué le PV et le gain de PV entre 0 et 21 j d’âge, indépendamment de l’addition de Met. D’autre part, l’apport en excès de Lys, séparément ou combiné avec un apport excessif de Met, a augmenté le rendement de la cuisse.

**Mots-clés :** Poulet de chair, lysine, méthionine, croissance, carcasse, équilibre en acides aminés.
Excess Met in a diet may cause deficiencies in other amino acids and induce toxicity [10]. Methionine, while it is often one of the most limiting amino acids, is also one that readily goes to toxic excess when it is found in large quantities in diets. Errors in feed preparation or excess supplemental Met can actually depress growth at level of 40 g/kg [11, 19] and even small excesses of Met can be deleterious [4]. However, NRC [19] acknowledges that such toxicities are unlikely in practical circumstances for poultry, in that toxicity requires a particularly high level of an amino acid relative to all others. Supplemental levels of Met used in poultry are usually fed at lower levels, ranging from 3.00-5.00 g/kg of the diet.

Increasing Lys level in the diet without consideration of other amino acids may limit performance if other essential amino acids are inadequate. It is crucial, therefore, to estimate whether essential amino acids may be formulated in an ideal ratio with Lys in broilers [15]. Formulating maize and soybean meal diets for broiler, which are adequate in Lys, is important because Lys is the second limiting amino acid and is one of the reference amino acids for the protein concept [2].

Small surplus of certain amino acids can sometimes increase the requirement for others. High dietary additions of these essential amino acids can cause severe growth depressions according to incomplete mixture of amino acids in diet [10]. For example, supplementing Arg to a high Lys diet [1, 20] and adding Met to high Arg diet [6] in chicks improves growth due to amino acid interactions. In addition to the requirement for growth, some of essential amino acids like Arg have been shown recently in several studies to have beneficial effects on the immune status of animals. However, the exact mechanism of Arg effects needs more investigation. To understand the effects of Arg and other limiting amino acids, one of the basic kinds of information needed is its effects on each lymphoid organ. Furthermore, the sensitivity of lymphoid organ to essential amino acid concentrations is not clear [18].

There is a large body of data available on the responses to different dietary Lys and Met concentrations under varying conditions. For many years there has been ongoing research on optimal amino acid ratios for broiler chicks. However, most of the work has been done with sufficient or deficient levels of essential amino acids, whereas the database for broilers fed excessive levels of amino acids which is supplemented to diets including optimum amino acid ratios is still rather limited. The present study was conducted to determine the effects of supplementation of excess Lys alone or in combination with excess Met to diet had optimum Arg:Lys and Arg:Met ratios on live performance, carcass traits, relative weights of organs, serum total protein and creatinine levels in broiler chicks between 0 and 21 d of age.

Material and Methods

1. ANIMALS AND EXPERIMENTAL PROTOCOL

Three hundred and four one-day-old male broiler chicks (ROSS 308) were randomly assigned to one control and three experimental groups (n=76) based on their initial weight, comprising four replicates of 19 birds each. Male broiler chicks were equally allocated into four dietary treatments in a 2x2 factorial experimental design. The study was ended at day 21. Broiler chicks were randomly placed in litter pens in a broiler house with concrete floors and wood shavings as litter. Chicks were housed in environmentally controlled litter pens (0.09 m2 per bird) and fed a starter diet for 3 weeks. Each pen used litter and was equipped with a nipple drinker line (3 nipples per pen) and a hanging feeder (15 kg capacity). Temperature was maintained at 34°C for the first 5 days and then gradually reduced according to normal management practices until a temperature of 23°C. Fluorescent lighting provided continuous daylight.

The basal diet was formulated to meet minimum NRC [19] recommendations for broiler chicks. Chicks were fed a non-medicated, maize and soybean meal diet (23.00 g/kg CP, 12.55 MJ/kg ME) with no added antibiotics, coccidiostats or growth promoters, up to 21 days (Table I). Composition of diets was calculated according to Feedstuffs Reference Issue and Buyers Guide, 2005. Crude protein (CP) of diets has estimated considering CP content of feed ingredients and CP equivalents of crystalline amino acids. Four dietary treatments were used: (I) basal diet with 13.67 g/kg Lys (124% of NRC) and 6.28 g/kg Met (126% of NRC); (II) basal diet with 22.07 g/kg Lys (200% of NRC) and 6.28 g/kg Met (126% of NRC); (III) basal diet with 13.67 g/kg Lys (124% of NRC) and 10.08 g/kg Met (200% of NRC); (IV) basal diet with 22.07 g/kg Lys (200% of NRC) and 10.08 g/kg Met (200% of NRC). Arg:Lys (1.14) and Arg:Met (2.50) ratios in group received Diet I were formulated to meet NRC [19] recommendations. DL-Met (99% purity) and L-Lys HCl (78% purity) were used as a feed additive in the present study (BASF Company Ltd, Gunsan, Korea). Water and feed were provided for ad libitum consumption.

2. PARAMETERS OF GROWTH PERFORMANCE AND BIOCHEMICAL ANALYSES

Group feeding was applied in all replications. Birds were randomly selected, weighed and banded at day one. They were weighed individually once a week. Feed was weighed weekly to evaluate consumption and FCR per pen. Feed conversion ratio was calculated by dividing pen feed consumption by pen weight gain. Dead birds were recorded daily to correct feed consumption data for mortality. Each bird was weighed just prior to slaughter. The yield was obtained for the entire carcass ([carcass weight/slaughter weight] x 100), breast with bone ([breast with bone weight/slaughter weight] x 100) and leg quarter ([leg quarter weight/slaughter weight] x 100). At 3 weeks of age, 12 birds per group (3 birds were selectively removed from each replicate according to average pen weight) were slaughtered by severing the jugular vein and breast with bone, leg quarter, liver, spleen and bursa.
of Fabricius were removed manually and weighed. Yields were calculated relative to live body weights. The mean values were calculated per pen and analyzed statistically.

In the present study blood samples for biochemical parameters were taken from V. subcutanea ulnaris of broiler chicks. Blood samples of 5 ml was obtained from 48 randomly selected birds (12 birds per group) and centrifuged at 3000G for 10 minutes after stored in room temperature for 6 hours. Serum samples were stored at -20°C until analysis. Total protein and creatinine levels in serum were analyzed by the photometer (Merck Microlab 200, Netherlands, serial no: 6-0722), using the commercial kits (Randox, United Kingdom).

3. STATISTICAL ANALYSIS

Data were analyzed using the General Linear Models procedure of the SAS (version 6.03, SAS Institute Inc., Cary, NC, 1988) by the following model:

\[
Y_{ijk} = \mu + L_i + M_j + LM_{ij} + e_{ijk}
\]

where \(\mu\) is the common mean; \(L_i\) is the effect of the \(i^{th}\) lysine; \(M_j\) is the effect of the \(j^{th}\) methionine; \(LM_{ij}\) is the effect of the interaction of the \(i^{th}\) lysine with the \(j^{th}\) methionine; and \(e_{ijk}\) is random error. A floor pen was the experimental unit for BW, BW gain, feed consumption and FCR analysis. Individual birds randomly selected from each floor pens were the experimental units for carcass characteristics, liver, spleen, bursa Fabricius and total protein and creatinine.

Results

1. GROWTH PERFORMANCE OF BROILER CHICKENS

All performance data are given in Table II. No significant differences were observed for BW gain at the start (1 to 7 days) of the trial. Body weight gain from day 8 to 21 were affected by addition of excess Lys to diet, whereas corresponding feed consumption and FCR were not influenced by amino acid supplementation. Feeding excess Lys singly (Diet II) and in combination with excess Met (Diet IV) caused a significant decrease in BW gain (p<0.001). High Met supplementation (10.08 g/kg of diet) to diet contained optimum Arg:Lys and Arg:Met ratios did not cause a significant change in performance parameters. No interaction of Lys and Met found in growth parameters.

2. CARCASS, PARTS YIELD, RELATIVE WEIGHTS OF ORGANS AND SOME BLOOD PARAMETERS

With respect to the carcass parameters, the nature of the effects on slaughter weight was similar to that observed for BW gain (Table III). Feeding excess Lys alone (Diet II) caused a significant (p<0.001) decrease in carcass weight. On the other hand, it appeared that the leg quarter yield increased (p<0.001) with high Lys addition to diet (Diet II and IV). Moreover, Lys and Met interacted to affect carcass weight (p<0.05). No apparent effect on carcass traits was observed in broiler chicks associated with excessive Met supplementation. For the remaining parameters, such as carcass yield and breast with bone yield the effects were inconsistent and not significant.

Data in Table IV show the effects of dietary treatments on relative organ weights and some blood variables. Interactions of lysine and methionine occurred in relative weight of liver (p<0.001), but not other relative organ weights and blood parameters (Table IV). With the exception of relative weight of liver, birds fed the supplemental Lys and/or Met (Diet II, III, IV) had similar relative organ weights to those of chicks received diets containing ideal Arg:Lys and Arg:Met ratios (Diet I). No signs of excess amino acid feeding were found in any of the organs examined macroscopically. Serum total protein and creatinine levels were not significantly different between dietary treatments (Table IV).

A total of 8 birds (three in group received Diet I, three in group received Diet II and one in group had Diet III and one in group fed Diet IV) died during the course of study. No significant difference was determined for mortality among experimental groups. Death mostly occurred during the first period (0 to 7 days) of the experiment and did not appear related to treatments.

Discussion

In the present study Diet I had adequate Lys and Met and was formulated to have optimal Arg:Met and Arg:Lys ratio according to NRC [19] recommendations. The supplementation with excess of Lys (22.07 g/kg diet) alone and with Met (10.08 g/kg diet) resulted in significant depression in BW gain, while feed consumption and FCR remained unchanged. Lysine has been reported to be among the more toxic of the amino acids [5, 11, 12, 22], and our growth performance results agree with those reported. CAREW et al. [5] fed excess level of Lys [2.84 x above the NRC requirement] to chicks and found significant differences in performance parameters. These workers pointed out that excess Lys in broiler diet causes severe reduction in BW gain (-25%) compared to the control group. This observation in BW gain was consistent with this study, birds receiving the diets with excess of Lys (Diet II) alone and excess Met (Diet IV) demonstrated a -8.04% and -8.91% lower BW gain compared to birds receiving the diet contained optimum Arg:Lys and Arg:Met ratios respectively. In another study, REZAEI et al. [23] fed male broilers with graded levels (0, 1.5, 3 g/kg) of Lys from 0 to 6 weeks of age. In their study, BW gain did not change significantly due to Lys addition at 0-3 weeks of age. Beside this they reported increased BW gain by increasing Lys level in grower and total period of the experiment. The reason of growth performance differences among this data and those reported before might be attributable to factors such as Lys levels, time period of experiment and consideration of Arg:Lys ratios in the diets.

In the present study, there was no difference in feed consumption and FCR between the treatments with excess level of Lys and/or Met (Diet II, III, IV) and the treatment between the treatments with excess level of Lys and/or Met (Diet II, III, IV) and the treatment
INFLUENCE OF EXCESSIVE LYSINE AND METHIONINE SUPPLEMENTATION IN BROILERS

**TABLE 1: Chemical composition of experimental diets given to broiler chicks (g/kg diet).**

<table>
<thead>
<tr>
<th>Ingredients (g/kg diet)</th>
<th>Diet I</th>
<th>Diet II</th>
<th>Diet III</th>
<th>Diet IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn</td>
<td>500</td>
<td>500</td>
<td>500</td>
<td>500</td>
</tr>
<tr>
<td>Soybean meal</td>
<td>394.2</td>
<td>394.2</td>
<td>394.2</td>
<td>394.2</td>
</tr>
<tr>
<td>Sunflower oil</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>Calcium carbonate</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>Dicalcium phosphate</td>
<td>17</td>
<td>17</td>
<td>17</td>
<td>17</td>
</tr>
<tr>
<td>Salt</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Vitamin-mineral premix</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Methionine (990 g/kg of CP)</td>
<td>2.7</td>
<td>2.7</td>
<td>6.5</td>
<td>6.5</td>
</tr>
<tr>
<td>Lysine (750 g/kg of CP)</td>
<td>1.1</td>
<td>12.3</td>
<td>1.1</td>
<td>12.3</td>
</tr>
<tr>
<td>Silica</td>
<td>15</td>
<td>3.8</td>
<td>11.2</td>
<td>-</td>
</tr>
</tbody>
</table>

**Calculated Analysis**

<table>
<thead>
<tr>
<th></th>
<th>ME (Mj/kg)</th>
<th>Crude protein</th>
<th>Calcium</th>
<th>Phosphorus (available)</th>
<th>Methionine (Met)</th>
<th>Lysine (Lys)</th>
<th>Threonine (Thr)</th>
<th>Arginine (Arg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diet I</td>
<td>12.63</td>
<td>226.2</td>
<td>10.4</td>
<td>4.5</td>
<td>6.28</td>
<td>13.67</td>
<td>9.10</td>
<td>15.75</td>
</tr>
<tr>
<td>Diet II</td>
<td>12.63</td>
<td>237.4</td>
<td>10.4</td>
<td>4.5</td>
<td>6.28</td>
<td>13.67</td>
<td>9.10</td>
<td>15.75</td>
</tr>
<tr>
<td>Diet III</td>
<td>12.63</td>
<td>230.0</td>
<td>10.4</td>
<td>4.5</td>
<td>10.08</td>
<td>13.67</td>
<td>9.10</td>
<td>15.75</td>
</tr>
<tr>
<td>Diet IV</td>
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<td>241.2</td>
<td>10.4</td>
<td>4.5</td>
<td>10.08</td>
<td>13.67</td>
<td>9.10</td>
<td>15.75</td>
</tr>
</tbody>
</table>

1 Each 2 kilograms of vitamin and mineral premix contained: 15 000 000 IU vit. A, 5 000 000 IU vit.D3, 100 000 mg vit. E, 5 000 mg vit. K3, 3 000 mg vit. B1, 6 000 mg vit B2, 5 000 mg vit. B6, 30 mg vit. B12, 25 000 mg niacin, 12 000 mg calcium-d-pantothenate, 1 000 mg folic acid, 200 mg d-biotin, 100 000 mg vit. C, 105 000 mg Mn, 84 000 mg Fe, 84 000 mg Zn, 9 000 mg Cu, 1 000 mg I, 200 mg Co, 180 mg Se, 1040 mg Mo.

**TABLE 2: Body weight gain (BW gain), feed consumption and FCR in broiler chicks receiving diets supplemented with Lys and/or Met in excess.**

<table>
<thead>
<tr>
<th>Dietary treatments</th>
<th>Initial BW g</th>
<th>Weight gain, g</th>
<th>Feed consumption, g/bird</th>
<th>Feed conversion ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lysine g/kg feed</td>
<td>1-7 days</td>
<td>8-14 days</td>
<td>15-21 days</td>
<td>Overall</td>
</tr>
<tr>
<td>Methionine g/kg feed</td>
<td>1-7 days</td>
<td>8-14 days</td>
<td>15-21 days</td>
<td>Overall</td>
</tr>
<tr>
<td>Pooled SEM</td>
<td>1-7 days</td>
<td>8-14 days</td>
<td>15-21 days</td>
<td>Overall</td>
</tr>
<tr>
<td>LysineNS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
</tr>
<tr>
<td>MethionineNS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
</tr>
<tr>
<td>Lysine x Methionine</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
</tr>
</tbody>
</table>

a, b: Means within a column with no common superscript differ significantly NS: P>0.05, ***: P<0.001.

**Table 2:** Body weight gain (BW gain), feed consumption and FCR in broiler chicks receiving diets supplemented with Lys and/or Met in excess.
### Table 3: Carcass traits of broiler chicks receiving diets supplemented with Lys and/or Met in excess.

<table>
<thead>
<tr>
<th>Dietary treatments</th>
<th>Lysine g/kg feed</th>
<th>Methionine g/kg feed</th>
<th>Slaughter weight, g</th>
<th>Carcass weight, g</th>
<th>Dressing percentage</th>
<th>Breast yield, Breast yield / Leg quarter yield, g</th>
<th>Leg quarter BW ratio, %</th>
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<tr>
<td></td>
<td>13.67</td>
<td>6.28</td>
<td>775.83</td>
<td>505.37a</td>
<td>65.12</td>
<td>146.92</td>
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<td></td>
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<td>10.08</td>
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<td>496.32a</td>
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<td>144.65</td>
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<td></td>
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<td>6.28</td>
<td>712.83</td>
<td>463.01b</td>
<td>64.94</td>
<td>125.88</td>
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<td></td>
<td>22.07</td>
<td>10.08</td>
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<td>485.68ab</td>
<td>66.20</td>
<td>135.66</td>
<td>18.48</td>
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<tr>
<td>Pooled SEM</td>
<td>9.202</td>
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<td>7.345</td>
<td>0.543</td>
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<td>0.402</td>
<td>0.884</td>
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<table>
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<th>Dietary treatments</th>
<th>Lysine g/kg feed</th>
<th>Methionine g/kg feed</th>
<th>Lysine, g/kg feed</th>
<th>MSE</th>
<th>Leg quarter BW ratio, %</th>
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<th>Dietary treatments</th>
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<table>
<thead>
<tr>
<th>Dietary treatments</th>
<th>Lysine g/kg feed</th>
<th>Methionine g/kg feed</th>
<th>Liver</th>
<th>Heart</th>
<th>Spleen</th>
<th>Bursa Fabricius</th>
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<td></td>
<td>13.67</td>
<td>2.75a</td>
<td>0.72</td>
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<td>0.020</td>
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<table>
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<th>Dietary treatments</th>
<th>Lysine g/kg feed</th>
<th>Methionine g/kg feed</th>
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<th>Methionine, g/kg feed</th>
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<td>NS</td>
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</tbody>
</table>

### Table 4: Organ weights and some blood parameters of broiler chicks receiving diets supplemented with Lys and/or Met in excess.

<table>
<thead>
<tr>
<th>Dietary treatments</th>
<th>Lysine g/kg feed</th>
<th>Methionine g/kg feed</th>
<th>Liver</th>
<th>Heart</th>
<th>Spleen</th>
<th>Bursa Fabricius</th>
<th>Total protein, g/dl</th>
<th>Creatinine, mg/dl</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>13.67</td>
<td>2.75a</td>
<td>0.72</td>
<td>0.07</td>
<td>0.33</td>
<td>3.627</td>
<td>0.344</td>
<td></td>
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<tr>
<td></td>
<td>13.67</td>
<td>2.55b</td>
<td>0.72</td>
<td>0.07</td>
<td>0.30</td>
<td>3.180</td>
<td>0.334</td>
<td></td>
</tr>
<tr>
<td></td>
<td>22.07</td>
<td>2.67ab</td>
<td>0.71</td>
<td>0.08</td>
<td>0.30</td>
<td>2.892</td>
<td>0.339</td>
<td></td>
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<tr>
<td></td>
<td>22.07</td>
<td>2.80a</td>
<td>0.71</td>
<td>0.07</td>
<td>0.28</td>
<td>3.200</td>
<td>0.351</td>
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<tr>
<td>Pooled SEM</td>
<td>0.058</td>
<td></td>
<td>0.022</td>
<td>0.005</td>
<td>0.020</td>
<td>0.196</td>
<td>0.013</td>
<td></td>
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<table>
<thead>
<tr>
<th>Dietary treatments</th>
<th>Lysine g/kg feed</th>
<th>Methionine g/kg feed</th>
<th>Metabolism</th>
<th>Protein, g/kg feed</th>
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<td></td>
<td>13.67</td>
<td>2.65</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>22.07</td>
<td>2.73</td>
<td></td>
<td></td>
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</table>

<table>
<thead>
<tr>
<th>Dietary treatments</th>
<th>Lysine g/kg feed</th>
<th>Methionine g/kg feed</th>
<th>Lysine, g/kg feed</th>
<th>Methionine, g/kg feed</th>
<th>ANOVA</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>13.67</td>
<td>2.65</td>
<td>13.67</td>
<td>6.28</td>
<td>NS</td>
</tr>
<tr>
<td></td>
<td>22.07</td>
<td>2.73</td>
<td>22.07</td>
<td>6.28</td>
<td>NS</td>
</tr>
<tr>
<td></td>
<td>0.108</td>
<td>2.65</td>
<td>22.07</td>
<td>2.67</td>
<td>NS</td>
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</table>
contained balanced and adequate amino acids (Diet I) at any
time period. As discussed by CAREW et al. [5] growth
depressions in chicks fed high levels of essential amino acids
may not always accompanied by reductions in feed
consumption. Furthermore, it was obvious that newly de-veloped
broiler hybrids had much more demand for feed
consumption. Thus, the demand for consumption might
reduce the feed consumption depression caused by addition
of excess amino acids. However, different results [1, 23]
associated with the effects of excess Lys on feed consumption
and FCR had been also reported by others.

In this study Met excess had little or no effect on
growth, and that Lys had major effects. This result was
in agreement with those of HAN and BAKER [12], who
expressed that 5.0 g/kg added Met does not change BW gain,
feed consumption and FCR. These workers suggested that
5.0 g/kg excesses of either Met or Lys were not harmful to
young broiler chicks fed corn-soybean meal diets. In previous
reports, chicks responded negatively to increasing Met level
to 3.00 g/kg [22], 4.00 g/kg [11] and 19.2 g/kg [5] in BW,
feed consumption and FCR.

The results of carcass traits in the present experiment suggest
that excess Lys (Diet II) lowered the slaughter weight and
carcass weight but did not affect dressing percentage in broiler
chicks (Table III). However, leg quarter / BW ratio was
improved by excess Lys alone (Diet II) and in addition with
excess Met (Diet IV) to diet. This finding associated with
dressing percentage was in agreement with other study [23].
Beside this, increasing Lys level decrease breast yield
(p<0.001) and also tend to decrease breast yield / BW ratio
(p= 0.061). This result was in contrast with some previous
literatures [3, 14]. KERR et al. [14] reported that increasing
Lys level up to 121 % of the NRC recommendation had
increased breast meat weight and proportional yield, with no
improvement at higher levels. Authors did not encounter any
previous discussion associated with the influence of excess
Lys and Met supplementation on leg quarter yield in broilers.

The effect of essential amino acids on immune organs is of
great interest because effective developments of these organs
are crucial for optimal immune responses. At present, limited
information is available on how excess essential amino acids
influence the development of lymphoid organs or
immune function. This research indicated that broilers fed
dietary Lys singly or in combination with Met level of 200%
of NRC, [19] recommendations did not significantly alter
relative weights of immune organs (spleen and bursa of
Fabricius). However, in some studies, researchers [8, 9, 18]
have found that deficiency of essential amino acids (especial-
ly Arg) can impair lymphoid organ weight and functions.
In this study we assumed that excesses of Met and Lys might
have caused a dose-dependent Arg deficiency. The effect of
dietary amino acid concentrations on immune organ weight
is highly variable. In addition, some studies have reported no
effect of dietary amino acid concentration on immune organs
[16, 17, 27]. In the present experiment, results obtained from
immune organs might depended to such factors as the absent
of any essential amino acid deficiency, time period of the
study and the composition of diets. Beside this, decrease
observed in relative weight of liver in birds fed diet with
excess Met was inconsistent. The authors had no biological
explanation for this finding.

Concerning serum biochemical parameters, excesses of Lys
and Met had no individual or combined effect on total protein
and creatinine levels. This result showed that amino acid excesses
had no significant effects on total protein and creatinine
levels in broiler chicks. A similar result was already
described in literature. SRINONGKOTE et al. [24] evaluated
effects of excess Lys and Arg (200% of NRC) in chicks and
did not observe significant differences in serum protein levels.

It would appear from the results of the present study that
excessive levels for Lys (22.07 g/kg) alone or in combination
with Met (10.08 g/kg) had depressive affect on BW gain, when
compared to optimum Arg:Lys and Arg:Met ratios. However,
supplementation of excess Lys alone or in combination with
excess Met to broiler diets increased leg quarter yield. Any
differences between these findings and those notified
previously might be attributable to such factors as the different
levels of Lys and Met used [5, 6, 11, 12, 13] and composition
of diets [22, 26]. Future research on excessive amino acids
including optimum essential amino acid ratios (Arg:Lys and
Arg:Met) in broiler starter diets may reveal optimum carcass
traits in associated with optimum growth parameters.

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