ISSN 1682-8356
ansinet.org/ijps

INTERNATIONAL JOURNAL OF

POULTRY SCIENCE

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308 Lasani Town, Sargodha Road, Faisalabad - Pakistan
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E-mail: editorijps@gmail.com

OPEN ACCESS International Journal of Poultry Science

ISSN 1682-8356
DOI: 10.3923/ijps.2017.506.510

Research Article

Effect of Addition of Methionine and Lysine into Diets Based on Cafeteria Standards on the Growth Performance of Native Chickens at Starter Phase

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Abstract

Objective: The aim of this study was to determine the effect of the addition of methionine and lysine to feed based on cafeteria standards of native chickens on their growth performance (0-6 weeks). **Materials and Methods:** A total of 288 days-old native chickens (DOC) were used in this study. The DOC were divided into 4 treatments groups with 4 replications. The treatment diets were T0 and T1 (according to cafeteria and NRC standards) and T2 and T3, which were based on cafeteria standards with the addition of 0.14% methionine and 0.40% lysine for T2 and 0.27% methionine and 0.79% lysine for T3. The data collected were feed intake, body weight, feed conversion ratio and carcass as a percentage of body weight. **Results:** The results showed that the feed intake of T0, T1, T2 and T3 were 516.97, 556.91, 621.79 and 654.30 g/bird/6 weeks, respectively. The body weights for each group were 219.09, 232.67, 267.16 and 284.61 g/bird/6 weeks, respectively. The feed conversion data were 2.79, 2.80, 2.66 and 2.61, respectively and the carcass percentages were 53.20, 52.75, 54.63 and 56.85%, respectively. **Conclusion:** Feed formulated to cafeteria standards with the addition of 0.27% methionine and 0.79% lysine (group T3) resulted in the best growth performance.

Key words: Native chicken, cafeteria, methionine, lysine, growth performance

Received: July 19, 2017 Accepted: November 10, 2017 Published: November 15, 2017

Citation: Charles V. Lisnahan, Wihandoyo, Zuprizal and Sri Harimurti, 2017. Effect of addition of methionine and lysine into diets based on cafeteria standards on the growth performance of native chickens at starter phase. Int. J. Poult. Sci., 16: 506-510.

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

The growth performance of chickens is not only determined by feed factors and protein-energy balance but also by the nutrient balance of feed. The nutrient balance required in the diets varies at different phases of growth and meeting the nutrient balance is essential to achieve optimal growth. In the previous study by cafeteria feeding system had been established nutrient requirement standards for native chickens at starter phase (0-6 weeks) such that crude protein, metabolizable energy, calcium and phosphorus were 16.95%, 2989.90 kcal kg^{-1}, 1.76 and 0.58%, respectively[1].

The growth performance of native chickens could be improved by correcting the critical essential amino acid levels in the diets. Methionine and lysine are essential amino acids that are critical for the growth of body tissues[2,3]. Bronstein and Lepstein[4] reported that feeds containing 19.1% crude protein, when supplemented with methionine, would produce similar growth and efficiency as feeds containing 23% crude protein. Waldroup *et al*.[5] stated that the maximum growth of young chicks can be obtained by feeding diets with crude protein of 19% and critical amino acids. Leeson and Summers[6] stated that giving 1.25% lysine to chickens until an age of 42 days and 1.06% methionine in the finisher period can increase the growth and development of chicken breast meat. Conde-Aguilera *et al*.[7] reported that the availability of methionine in the diet affects the amino acid composition of the body proteins. The addition of methionine and lysine to the cafeteria nutrient standard requirement would improve the performance of chicken growth, considering that these amino acids can modify muscle growth[8]. The purpose of this study was to determine the effect of the dietary addition of methionine and lysine to the feed based on cafeteria standards on the growth performance of starter phase native chickens (0-6 weeks).

MATERIALS AND METHODS

This research was conducted for a duration of 6 weeks at the Laboratory of Poultry Science, Faculty of Animal Science, Universitas Gadjah Mada, Yogyakarta, Indonesia. A total of 288 days-old native chickens (DOC) were obtained from the Animal Husbandry Department, Sukoharjo Regency, Central Java. The DOC were allocated to 16 units of wire cages, each of 2×1×0.50 m. Chicks were given Medivac ND Hitchner B1 and Medivac ND La Sota vaccines at ages 3 and 21 days. Feed was given *ad libitum* in the form of flour. Feed materials used were yellow corn, bran, soybean meal, fish meal, limestone, vitamin premix, amino acids methionine and lysine. The dietary composition and nutrient contents are shown in Table 1.

The chicks were randomly divided into 4 dietary treatment groups with 4 replications, each with 18 chicks. Treatment T0 and T1 were both based on cafeteria standards, with 16.95 and 18% CP based on NRC[9], respectively. Treatments T2 and T3 were based on cafeteria standards but with the addition of 0.14% methionine and 0.40% lysine and 0.27% methionine and 0.79% lysine, respectively. Feed intakes, body weight gains and feed conversion were determined on a weekly basis. At the end of 42 days, the chickens were

Table 1: Composition (%) and nutrient content (% DM) of experimental diets during the starter phase (0-6 weeks)

	Treatments			
Feed materials	T0	T1	T2	T3
Yellow corn (%)	50.64	50.28	50.37	50.11
Bran (%)	33.45	31.80	33.27	33.10
Fish meal (%)	7.06	8.30	7.02	6.99
Soybean meal (%)	8.10	9.10	8.05	8.01
Limestone (%)	0.33	0.10	0.33	0.32
Vitamin premix (%)	0.42	0.42	0.42	0.42
DL-methionine (%)	-	-	0.14	0.27
L-lysine HCL (%)	-	-	0.40	0.79
Total (%)	100.00	100.00	100.00	100.00
Nutrient contents				
Metabolized energy (kcal kg^{-1})	2989.90	2991.40	2973.87	2958.21
Crude protein (%)	16.95	18.00	16.85	16.76
Crude fat (%)	6.08	6.02	6.04	6.01
Ash (%)	8.17	8.53	8.12	8.08
Crude fiber (%)	7.05	6.96	7.01	6.97
Methionine (%)	0.03	0.03	0.16	0.30
Lysine (%)	0.06	0.07	0.46	0.85
Calcium (%)	1.65	1.76	1.64	1.63
Phosphorus (%)	0.58	0.58	0.58	0.58

slaughtered and the carcass percentage was determined. The data were analyzed with a one-way analysis of variance and the differences between the means were tested using Duncan's multiple range test with a 5% significance level[10].

RESULTS AND DISCUSSION

Feed intake: Table 2 shows the feed intake, body weight gain, feed conversion ratio and carcass percentage of native chickens fed the dietary treatments. The results showed that there were significant differences ($p<0.05$) in feed intakes among the treatment groups. The birds fed diet T3 showed the highest feed intake (654.30 g/bird/6 weeks), followed by T2 (621.79 g/bird/6 weeks), T1 (556.91 g/bird/6 weeks) and T0 showed the lowest feed intake (516.97 g/bird/6 weeks). In general, birds fed diet based on cafeteria standards showed significantly lower ($p<0.05$) feed intake than those fed diet based on NRC standards (T1), while birds fed diet based on cafeteria standards supplemented with lysine and methionine had higher feed intakes than those fed on NRC standards diet, suggesting that there were some deficiencies in amino acids when birds were fed the cafeteria system. Deficiency of essential amino acids, especially methionine and lysine, greatly affects feed intake[11]. Barboza *et al.*[12] suggested that the efficiency or imbalance of amino acids can cause changes in feed intake.

The addition of 0.25% methionine and 0.79% of lysine into diets at the starter phase increased feed intake up to 26.56% compared to T0 and the addition of 0.14% methionine and 0.40% lysine increased feed intake by 20.28%. Figure 1 shows that the feed intake was higher in the treatments with the addition of methionine and lysine. It was because methionine and lysine were the critical amino acids for the growth of the chickens. The addition of commercial methionine and lysine increased growth rate because both amino acids were immediately absorbed (ready to absorb) into the body, requiring no prior digestion unlike when whole proteins are consumed.

The methionine serves to form proteins in body tissues and promotes growth[6]. The addition of methionine and lysine in diets T2 and T3 resulted in higher body weight gain and final body weights than birds fed diets T0 and T1. These amino acids increased feed intake and subsequently methionine and lysine intake. Swennen *et al.*[13] reported that when amino acids in the feed are at optimal levels, chickens will increase feed intake in an effort to meet their needs. Imbalances of amino acids in the diet will lower the amino acid content in plasma, reduce feed intake and affect chicken growth[14]. Si *et al.*[15] stated that nutrient requirements include not just crude protein but also the correct balance of amino acids in the diet.

Body weight: The results showed that total body weights (g/bird/6 weeks) were significantly different ($p<0.05$) among birds fed the dietary treatments. The highest body weight was recorded for birds fed diet T3 (284.61 g/bird/6 weeks), followed by T2, T1 and T0, (267.16, 232.67 and 219.09 g/bird/6 weeks, respectively). The addition of dietary methionine and lysine during the starter phase (0-6 weeks) increased body weight by 29.90% when compared to cafeteria standard feed and 22.32% when compared to standard NRC requirements. Wang *et al.*[16] suggested that the addition of methionine and lysine increased protein synthesis, decreased protein decomposition in the body and improved overall chicken growth performance.

The development of the body weight of native chickens over 6 weeks is shown in Fig. 2. Supplementing methionine

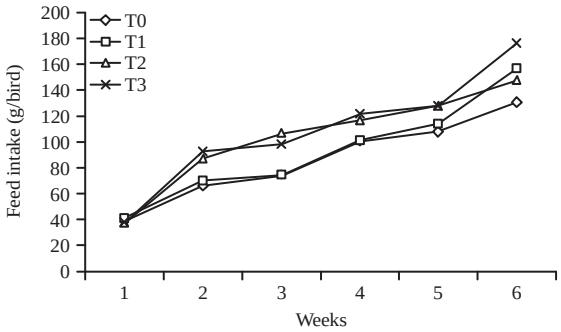

Fig. 1: Development of native chicken feed intake from ages 1-6 weeks

Table 2: Growth performance of native chickens (0-6 weeks) given feed with different methionine and lysine levels

	Treatments			
Description	T0	T1	T2	T3
Feed intake (g/bird/6 weeks)	516.97±19.46[d]	556.91±12.63[c]	621.79±17.03[b]	654.30±27.85[a]
Body weight gain (g/bird/6 weeks)	185.17±8.97[d]	199.00±8.99[c]	234.00±6.69[b]	250.40±11.56[a]
Feed conversion	2.79±0.41[a]	2.80±0.92[a]	2.66±0.05[b]	2.61±0.27[b]
Carcass (%)	53.20±2.11	52.75±1.47	54.63±0.65	56.85±0.82

[a,b,c,d]Superscript on the same line shows a significant difference ($p<0.05$)

and lysine (T2 and T3) in the diets increased the growth compared to the cafeteria and NRC protein standards. This was due to methionine and lysine being more digestible and quickly absorbed by the body such that birds fed diets T2 and T3 showed higher body weight at the age of 6 weeks. Methionine and lysine function form tissue protein[17]. Cafe and Waldroup[18] indicated that chicken weight is influenced by the availability and balance of amino acids in the feeds consumed. Domingues *et al.*[19] stated that the most important nutrient supply in the growth phase are the essential amino acids methionine and lysine. Grizard *et al.*[20] reported that amino acids stimulate synthesis proteins in the liver, spleen and lung pancreas, which subsequently act as mediators in the metabolic pathways for protein synthesis of the body.

Feed conversion ratio: The results showed that the feed conversions over 6 weeks were significantly different ($p<0.05$) among the treatments. Feed conversion ratio (FCR) of birds fed diets T0, T1, T2 and T3 were 2.79, 2.80, 2.66 and 2.61, respectively. Birds fed diets T3 (2.61) and T2 (2.66) showed significantly lower FCR than those fed on un-supplemented diets. The addition of 0.27% methionine and 0.79% lysine in feed decreased the feed conversion ratio by 6.45% compared to cafeteria standard feed and by 6.79% compared with standard NRC protein. Better FCR for T3 and T2 were caused by faster growth (Fig. 2) when diets were supplemented with methionine and lysine. Si *et al.*[15] suggested that the ideal levels of methionine and lysine for higher growth rates may be more than those recommended by NRC[9] for growth and conversion performance.

Maynard *et al.*[21] stated that the synthesis of protein that occurs within the ribosomes is highly dependent on the presence of the amino acids in the tissues. The efficiency and magnitude of protein synthesis in tissue cells is strongly influenced by the completeness and balance of amino acids which circulate and reach into the tissues. Hickling *et al.*[22] suggested that methionine and lysine increased chicken growth, thus increased the efficiency of feed used. Bronstein and Lepstein[4] reported feed containing 19.1% crude protein, when supplemented with methionine, increased the efficiency of feed used that is similar to a diet containing 23% protein.

Percentage of carcass: The results showed that carcass weight was not significantly different among the treatments at the starter phase. Tamzil[23] reported that the percentage of chicken carcass at the end of the starter phase (6 weeks) was 61.39 and 63.08% at the age of 10 weeks. The addition of lysine and methionine did not affect the deposition and

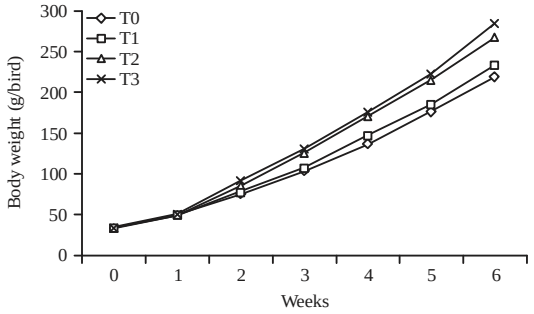

Fig. 2: Development of native chicken body weight from ages 0-6 weeks

proportion of muscle, fat and skeletal tissues in any bird, hence there were no significant differences in carcass percentage between the groups.

There were no significant differences in carcass percentages between T3 (56.85%), T2 (54.63%), T0 (53.20%) and T1 (52.75%). It may be due to the absence of large differences in carcass weights. Another possibility is that since the native chickens were still in the starter phase (6 weeks), the growth of body parts that make up the carcass component is ongoing and the carcass has not yet reached maximum weight. The increment of muscle mass depends on the rate of protein synthesis of body tissues more than the degradation[24].

CONCLUSION

It is concluded that the addition of 0.27% methionine and 0.79% lysine in the diets increased feed intake and growth and decreased FCR relative to the cafeteria feed and the NRC standard feed containing 18% crude protein.

SIGNIFICANCE STATEMENT

This study uncovers possible effects of methionine and lysine that can be beneficial for the growth performance of native chickens at the grower phase after supplementation with cafeteria feed. This study will help researchers to understand the true nutrient requirements of native chickens. Thus, these results inform a new standard of methionine and lysine requirements for native chicken diets.

ACKNOWLEDGEMENT

This study was funded by Direktorat Jenderal Penguatan Riset dan Pengembangan Kementerian Riset, Teknologi dan Pendidikan Tinggi through "Hibah Penelitian Disertasi Doktor". Authors would like to thank Prof. Abdul Razak Alimon for the contribution checklist and correction of this article.

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