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## Research Article

# Growth Performance of Native Chickens in the Grower Phase Fed Methionine and Lysine-Supplemented Cafeteria Standard Feed

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## Abstract

**Objective:** This study was conducted to determine the effect of cafeteria standard feed supplemented with methionine and lysine on the growth performance of native chickens during the grower phase (6-14 weeks). **Methodology:** A total of 240 six week-old native chickens were randomly divided into 4 treatments and 4 replications, with 15 birds in each replicate. The dietary treatments were: T<sub>0</sub> (feed based on cafeteria standard), T<sub>1</sub> (feed based on protein standard of NRC), T<sub>2</sub> (cafeteria feed+0.10% methionine+0.25% lysine), T<sub>3</sub> (cafeteria feed+0.23% methionine+0.55% lysine). Feed consumption, body weight gain and feed conversion ratio were measured over the 8 week growing period. At the end of the feeding trial, 32 birds were slaughtered and carcass percentages were determined. **Results:** Feed consumption of T<sub>0</sub>, T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub> were 2,671, 2,628, 2,722 and 2,805 g/bird/8 weeks, respectively. The body weight gain for the respective treatments was 692, 677, 747 and 780 g/bird/8 weeks whereas the feed conversion ratio was 3.86, 3.70, 3.65 and 3.60. The percentage of carcass for the four treatments was 59.50, 59.66, 61.36 and 61.55%, respectively. **Conclusion:** Treatment T<sub>3</sub> that had supplementation with 0.23% methionine and 0.55% lysine produced the best growth performance.

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

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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

A balanced diet plays an important role in the performance of native chickens in all phases of growth. Free choice feeding is an appropriate method to determine the nutrient requirements of native chickens. For native chickens in the grower phase (6-14 weeks) the established nutrient requirements are 15.34% crude protein, 2,993.29 kcal kg<sup>-1</sup> metabolized energy, 1.47% calcium and 0.60% phosphorus<sup>1</sup>. However, the growth of native chickens can be increased by adjusting the amounts of essential amino acids in the diet. Studies by Schutte *et al.*<sup>2</sup> and Gill<sup>3</sup> showed that methionine and lysine are essential amino acids that are critical for tissue growth in chickens. As such, the availability of dietary methionine and lysine affects the composition of amino acid protein in the body<sup>4,5</sup>. Trisiwi<sup>6</sup> reported that feeds containing 16% crude protein adjusted with methionine, lysine and threonine compared to feed with 18% crude protein produced growth and feed efficiency similar to that of 10 week-old native chickens. Prawirokusumo<sup>7</sup> showed that broiler chickens given feed supplemented with 1.30% lysine and 1.10% methionine achieved maximum growth. The addition of 0.86% lysine to feed given to 12 week-old native chickens also increased growth and feed efficiency<sup>8</sup>. The aim of this study was to determine the amount of methionine and lysine supplementation of cafeteria standard feed needed to optimize the performance of native chickens during the grower phase (6-14 weeks).

## MATERIALS AND METHODS

This study was conducted at the Poultry Laboratory of the Faculty of Animal Science University of Gadjah Mada, Yogyakarta. A total of 240 six week-old native chickens obtained from the Animal Husbandry Department, Sukoharjo Regency Central Java were randomly divided into 4 treatment groups with 4 replications, with 15 birds in each replicate. The chickens were reared in wire cages measuring 2 × 1 × 0.5 m. The treatment groups were: T<sub>0</sub> (feed based on cafeteria standard containing 15.34% crude protein), T<sub>1</sub> (feed based on protein standard of NRC (16%) for laying chickens), T<sub>2</sub> (cafeteria feed+0.10% methionine+0.25% lysine) and T<sub>3</sub> (cafeteria feed+0.23% methionine+0.55% lysine). The feeding trial lasted for eight weeks.

The composition and nutrient contents of the experimental diets are shown in Table 1. The feed ingredients used were: Yellow corn, rice bran, soybean meal, fish meal, CaCO<sub>3</sub>, vitamin premix, commercial DL-methionine and L-lysine HCl. Feed consumption, body weight gain and feed

Table 1: Composition (%) and nutrient content (% DM) of experimental diets during the growth phase (6-14 weeks)

Ingredients	Treatments (%)			
	T <sub>0</sub>	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>
Yellow corn	50.88	50.70	50.70	50.50
Rice bran	36.87	35.61	36.74	36.48
Soybean meal	5.18	6.00	5.17	5.18
Fish meal	6.48	7.10	6.46	6.48
Limestone	0.30	0.30	0.30	0.30
Vitamin premix	0.29	0.29	0.29	0.29
DL-methionine			0.10	0.23
L-lysine HCL			0.25	0.55
Total	100.00	100.00	100.00	100.00
<b>Calculated nutrients</b>				
Metabolized energy (kcal kg <sup>-1</sup> )	2,993	2,991	2,983	2,971
Crude protein (%)	15.34	16.00	15.29	15.26
Ether extract (%)	6.23	6.18	6.21	6.18
Ash (%)	7.69	7.91	7.67	7.64
Crude fiber (%)	7.30	7.22	7.28	7.24
Methionine (%)	0.02	0.03	0.12	0.25
Lysine (%)	0.05	0.05	0.30	0.60
Calcium (%)	1.47	1.55	1.47	1.47
Phosphorus (%)	0.60	0.59	0.60	0.59

conversion ratio were measured weekly and the final body weight was measured at the end of the 8 week trial. At the end of the feeding trial, 8 birds were randomly selected from each replicate and slaughtered to determine the carcass percentage. The data were analyzed using one-way analysis of variation. Means were compared by Duncan's test at 5% probability level<sup>9</sup>.

## RESULTS

**Feed consumption:** The effect of the different dietary treatments on growth rates, final body weights, feed consumption and carcass percentage of finisher birds was assessed (Table 2). There were significant differences ( $p < 0.01$ ) in feed consumption among the treatments, wherein birds fed diet T<sub>3</sub> had the highest feed consumption (2,805 g/bird). Diet T<sub>2</sub> had the second highest feed consumption (2,722 g/bird), followed by T<sub>0</sub> (2,671 g/bird) and T<sub>1</sub> (2,628 g/bird) (Table 2, Fig. 1).

**Body weight gain:** The live weight and body weight gain were significantly different among the dietary treatments ( $p < 0.01$ ). Chickens fed the diet T<sub>3</sub> had the highest live weight and most body weight gain (1,064.31 and 779.70 g/bird/8 weeks), followed by T<sub>2</sub> (1,014.21 and 747.05 g/bird/8 weeks) and T<sub>1</sub> (909.69 and 521.91 g/bird/8 weeks). The diet T<sub>0</sub> had the lowest live weight and weight gain (911.25 and 507.35 g/bird/8 weeks) (Table 2, Fig. 2).

Table 2: Growth performance of native chickens (6-14 weeks) given feed with different methionine and lysine levels

Item	Treatment			
	T <sub>0</sub>	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>
Feed consumption (g/bird/8 weeks)	2671.00 ± 48.00 <sup>bc</sup>	2628.00 ± 39.68 <sup>c</sup>	2722.00 ± 49.75 <sup>ab</sup>	2805.00 ± 75.15 <sup>a</sup>
Body weight (g/bird/8 weeks)	911.00 ± 19.95 <sup>c</sup>	910.00 ± 33.37 <sup>c</sup>	1014.00 ± 37.99 <sup>b</sup>	1064.00 ± 24.99 <sup>a</sup>
Body weight gain (g/bird/8 weeks)	692.00 ± 15.75 <sup>c</sup>	677.00 ± 28.63 <sup>c</sup>	747.00 ± 35.65 <sup>b</sup>	780.00 ± 15.54 <sup>a</sup>
Feed conversion ratio	3.86 ± 0.09 <sup>a</sup>	3.70 ± 0.15 <sup>a</sup>	3.65 ± 0.16 <sup>b</sup>	3.60 ± 0.11 <sup>b</sup>
Carcass weight (g/bird)	504.00 ± 16.25 <sup>c</sup>	499.00 ± 30.92 <sup>c</sup>	580.00 ± 48.81 <sup>b</sup>	663.00 ± 44.33 <sup>a</sup>
Carcass percentage (%)	59.50 ± 0.82	59.66 ± 1.21	61.36 ± 2.72	61.55 ± 0.72

<sup>a,b,c</sup>superscript on the same line indicates significant difference (p<0.05)

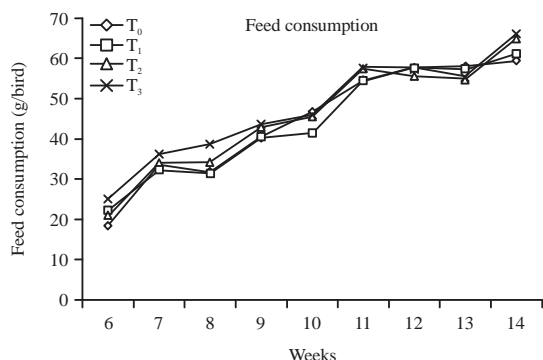


Fig. 1: Relationship between diet treatment and feed intake of native chickens aged 6-14 weeks

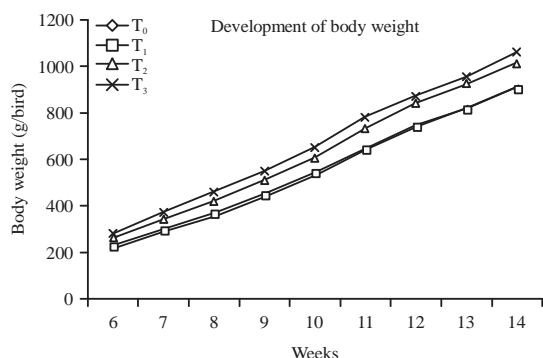


Fig. 2: Relationship between diet treatment and body weight of native chickens aged 6-14 weeks

**Feed conversion ratio:** The feed conversion ratio of birds fed the various treatments also differed significantly (p<0.01). Birds fed diet T<sub>3</sub> had the best feed conversion ratio (3.60), followed by T<sub>2</sub> (3.65), T<sub>1</sub> (3.70) and T<sub>0</sub> (3.86) (Table 2).

**Carcass weight and carcass percentage:** The carcass weight during the grower phase was significantly different among the diets (p<0.01) but there were no significant differences in carcass percentage. Chicken fed the diet T<sub>3</sub> showed the highest carcass weight (663.13 g/bird), followed by T<sub>2</sub> (579.88 g/bird), T<sub>0</sub> (504.38 g/bird) and the lowest was T<sub>1</sub> (498.63 g/bird) (Table 2).

## DISCUSSION

Supplementation with amino acids can affect the growth of native chickens during different growth stages. Here we examined the effect of lysine and methionine supplementation on the growth characteristics of native chickens. The addition of 0.23% methionine and 0.55% lysine (T<sub>3</sub>) to grower feed increased feed consumption by 5.04% compared to feed based on a cafeteria standard (T<sub>0</sub>). On the other hand, the addition 0.10% methionine and 0.25% lysine (T<sub>2</sub>) increased feed consumption by 3.59% compared to feed based on the NRC standard (T<sub>1</sub>).

The addition of methionine and lysine produced the highest feed consumption (Fig. 1). Methionine and lysine are critical amino acids for chickens. Growth rates can be increased rapidly by adding these amino acids to the diet because they are immediately absorbed into the body and in contrast to amino acids consumed as part of total protein, individual amino acids require no prior digestion. Swennen *et al.*<sup>10</sup> reported that when optimal amounts of amino acids are present in feed, chickens will increase feed consumption to meet their requirements. Meanwhile, diets that have inadequate amounts of amino acids result in decreased levels of plasma amino acids and reduced feed intake that can affect chicken growth<sup>11</sup>. Si *et al.*<sup>12</sup> reported that not only is crude protein important to meet nutrient requirements but the presence of balanced amount of amino acids in the feed is also required. This finding is consistent with the results of the current study showing that addition of methionine and lysine (T<sub>2</sub> and T<sub>3</sub>) increased body weight gain and live weight to higher levels compared to T<sub>0</sub> and T<sub>1</sub> that lacked supplementation. The body weight was also higher for birds that consumed diets containing lysine and methionine supplements.

Here the addition of the amino acids methionine and lysine to feed given to chickens in the grower phase (6-14 weeks) increased body weight by 17% compared to cafeteria standard feed and protein standard of NRC feed over the 8 week trial period (Fig. 2). The administration of methionine and lysine (T<sub>2</sub> and T<sub>3</sub>) also accelerated the growth

of chickens relative to cafeteria standard feed and protein standard of NRC feed. This result could be due to the increased absorption of methionine and lysine to produce the higher weight gain at 14 weeks of age seen for birds fed diets T<sub>2</sub> and T<sub>3</sub>. This result is consistent with the results of a previous study by Cafe and Waldroup<sup>13</sup> showing that chicken weight is affected by the availability and balance of amino acids in feed they consume and also supports results of Domingues *et al.*<sup>14</sup>, who found that the most important nutrients in the growth phase are the essential amino acids methionine and lysine.

The addition of 0.23% methionine and 0.55% lysine in feed improved feed conversion ratio by 6.74% compared to cafeteria standard feed and 2.70% compared to protein standard of NRC feed. Feed conversion ratio in T<sub>2</sub> and T<sub>3</sub> were also improved as reflected by the faster growth rate (Fig. 2) seen upon administration of methionine and lysine.

Maynard *et al.*<sup>15</sup> reported that protein synthesis on ribosomes is highly dependent on the presence of amino acids required by tissues. Thus, the efficiency and rate of protein synthesis in tissue cells is strongly influenced by amino acid completeness and balance. As such, the increased weight gain seen for birds fed diet T<sub>2</sub> and T<sub>3</sub> could be attributed to a higher rate of protein synthesis in tissues. The higher weight gains were also associated with increased feed conversion ratio, which is consistent with previous studies showing that a complete and well-balanced diet containing needed micronutrients promotes the growth of chicken tissue and improves feed efficiency<sup>8,16,17</sup>.

The addition of 0.23% methionine and 0.55% lysine in feed at the grower phase (6-14 weeks) increased carcass weight by 31.47% compared to cafeteria standard feed and by 33.00% compared to NRC feed with standard protein concentrations. The administration of methionine and lysine at 0.10 and 0.25% increased the carcass weight over that for standard feed and NRC feed by only 15.00 and 16.29%, respectively. A study by Prawirokusumo<sup>7</sup> showed that the addition of methionine and lysine increases the weight of breasts and drumsticks, which are the main components of chicken carcasses. The increment of muscle mass addition depends on the rate of protein synthesis of body tissues relative to protein degradation<sup>18</sup>. Si *et al.*<sup>12</sup> and Zhai *et al.*<sup>19</sup> reported that the addition of lysine to the diet increased the amount of dissolved protein, water holding capacity and pH of breast meat, as well reduced the amount of denatured protein. This result suggests that lysine plays an important role in the formation of breast tissue as the main component of the carcass<sup>12,20</sup>. These results, together with our findings, indicate that methionine and lysine are critical amino acids for use in

native chicken nutrition. Thus, one method to improve the growth performance of native chickens is to add critical amino acids such as methionine and lysine to the feed.

## CONCLUSION

The results of this study showed that:

- The addition of methionine and lysine to 0.23 and 0.55%, respectively, in the feed provided better growth than cafeteria standard feed and feed with standard protein as recommended by the NRC for laying hens
- Higher feed consumption was seen for birds fed diets supplemented with methionine and lysine, resulting in better feed conversion ratio

## SIGNIFICANCE STATEMENT

This study examined whether supplementation of cafeteria feed with methionine and lysine was beneficial for increasing growth performance of native chickens during the grower phase. Results from this study provided insights into the true nutrient requirements of native chickens and indicated that methionine and lysine supplementation is an effective strategy for increasing growth of native chickens and further suggests that other micronutrients could have similar growth-promoting effects.

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