The Effects of Valine Supplementation in the Diet on Growth Performance and Giblet Weight of Native Chicken at the Starter Phase

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Abstract. The aim of this experiment was to determine the effect of Valine supplementation in the diet on the growth performance and giblet weight of Native chicken at the starter phase. This experiment was conducted in Kefamenanu, East Nusa Tenggara Province, Indonesia, from June to July 2022. A total of five hundred a-week-old Native chicken with average of initial weight 59.39 g were used in the experiment. The Chicken were divided into five treatments with five replications based on a completely randomized design. The diet treatments were: T_0 (control feed); T_1 (0.75% Valine); T_2 (1.00% Valine); T_3 (1.25% Valine); and T_4 (1.50% Valine). The parameters observed were body weight, body weight gain, feed intake, feed conversion ratio and giblet weight. The data obtained were analyzed by analysis of variance and Duncan test. The result showed that the body weight of T_0, T_1, T_2, T_3, and T_4 were 298.96, 314.68, 315.16, 309.48, and 305.74 g/bird, respectively. Body weight gain were 239.42, 255.38, 255.78, 250.08, and 246.40 g/bird/6 weeks, respectively. The feed intakes were 577.03, 526.16, 510.17, 568.70, and 579.0.2 g/bird/6 weeks. Feed conversion ratio were 2.41, 2.20, 1.99, 2.27, and 2.35, respectively. The giblet weights were 31.03, 31.55, 32.08, 31.38, and 31.02 g/bird, respectively. The result indicated that the body weight, body weight gain, and the feed conversion were affected by the level of Valine ($P < 0.05$), while the feed intake and the giblet weight were not significant. It was concluded that supplementation with 0.75 - 1.00% Valine to the diet of Native chicken resulted in optimal growth performance at the starter phase.

Keywords: Native chicken · growth performance · giblet weight · starter phase · Valine

1 Introduction

Fish flour- and soybean meal-based feed protein are exorbitant and this causes production cost of more than 70%. The use of feed protein from both ingredients also results in ammonia pollution in the hencoop due to the high content of uric acid in the excrete. One of the solutions is by using cheaper synthetic amino acid and reducing hencoop pollution effect.

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Several studies have modified the feed given with cafeteria feed standard as reported by Lisnahan et al.[1] i.e., by using methionine and lysine amino acid that have significant effects on native chicken growth. Similarly, with the use of threonine and tryptophan amino acid in the feed, it was reported by Lisnahan and Nahak [2] that the productivity of native chicken increased. According to NRC [3] on broilers and laying hens, the next limiting amino acid is Valine. Valine amino acid functions to increase muscle metabolism, fix damaged tissues and control body immune [4]. In addition, Valine is also a precursor in penicillin biosynthesis pathway and known for inhibiting tryptophan transport crossing blood-brain barrier [5]. Valine and Isoleucine simultaneously and synergically push growth and other metabolisms in livestock body [6]. The requirement standards of Valine amino acid in broilers and laying hens have existed as reported by NRC [3], while in Native chicken, there is none so far. Therefore, the amino acid need in Native Chicken at the starter phase is important to be studied.

2 Materials and Methods

2.1 Experimental Birds and Management of Experimental Diets

This study was conducted in Kefamenanu, East Nusa Tenggara from June to July 2022. A total of five hundred a-week-old Native chickens were used in this study. They were randomly assigned to the five treatments in a completely randomized design with five replicates. The five treatments were: (1) T_0 (control feed); (2) T_1 (control feed + 0.75% L-Valine); (3) T_2 (control feed + 1.00% L-Valine); (4) T_3 (control feed + 1.25% L-Valine) and (5) T_4 (control feed + 1.50% L-Valine). The feed ingredients and composition of nutrients of each treatment are presented in Table 1. In the study, feed and water were given ad libitum.

2.2 Data Collection and Analysis

Parameters observed were feed intake, body weight gain, feed conversion, and giblet weight. The data obtained were analyzed by the analysis of variance based on completely randomized design and Duncan's test (SPSS 25).

3 Results and Discussion

3.1 Result

The average weight of Native chicken administered with L-Valine with different levels is presented in Table 2. The statistical analysis showed that treatment significantly affects the weight of Native chicken at the starter phase ($P < 0.05$). The highest average of weight in T_1 and T_2 was different from the other treatments. A supplementation of 0.75% L-Valine in the feed increased the weight by 5.26% compared with the control feed (T_0). When the L-Valine level was increased to 1.00% (T_2), the weight was not significant compared with T_1 even though it was the highest response. When the L-Valine was increased to 1.25% (T_3), the weight started to decrease up to T_4 (1.50% L-Valine).

This weight decrease was 1.80% and 1.21%. The same applied to the weight gain (Table 1) that has the same response as the weight ($P < 0.05$). The weight gain went up in T_1 and T_2 by 6.67% and 6.83% compared with T0. Subsequently, the weight gain went down when the L-Valine levels were 1.25% and 1.50% (T_3 and T_4) as much as 2.23% and 3.67%.

The average consumption of Native chicken at the starter phase is presented in Table 2. The statistical analysis showed that treatment has no significant effect on the feed consumption. It indicates that the feed supplemented with L-Valine at different levels has no effect on the feed consumption.

The average conversion of Native chicken feed supplemented with L-Valine can be seen in Table 2. The statistical analysis showed that treatment has significant effects on the Native chicken at the starter phase ($P < 0.05$). The responses to T_0, T_3 and T_4 were not significant, but significant to 0.75% and 1.00% L-Valine levels, and it was the lowest feed conversion. The increase of 0.75% L-Valine (T_1) of the control feed (T_0), the feed conversion could be suppressed by 8.71%. When it was increased further to 1.00% (T_2), the feed conversion decreased by 17.43% compared with T_0. The feed conversion increased when the L-Valine was more than 1.00% in T_3 and T_4.

Giblet consists of heart, liver, and gizzard. The average giblet weight of Native chicken at the starter phase is presented in Table 2. The statistical analysis showed that treatment has no significant effect on giblet weight. This indicates that the feed supplemented with L-Valine with different levels has no effect on giblet organs.

3.2 Discussion

During the starter period, L-Valine supplementation increased the weight of Native chicken. However, when the number was too high in linear, it decreased the chicken weight. The decrease was shown in the L-Valine level above 1.00%. Presumably, this is because the use of Valine amino acid must be followed by Leucine and Isoleucine amino acids that are included in branched-chain amino acids (BCAA). These three BCAA amino acids are antagonistic to each other in nature if the administration is too excessive [7]. Valine is needed in the maintenance and growth of tissues. If the Leucine content in the feed is too high, it increases Valine and Isoleucine optimum content or vice versa [8], since these amino acids stimulate the branch chain of keto acid dehydrogenase, which is a complex enzyme involved in the oxidative deamination of three BCAA [9]. Thus, Valine increase causes the other 2 BCAA oxidation increase. BCAA contributes to 35% of the feed essential amino acid in the body protein [7] and is a vital controller of muscle protein synthesis [10]. This feed supplementation with amino acid may influence the chicken muscle fiber diameter. Berres et al. [11] and Tavernari et al. [12] determined the Valine levels of 0.81 and 0.80%, respectively, for broilers during growth phase. Valine plays a role in helping preventing muscle damage, since it supplies muscle with extra glucose in charge of energy production during physical activities [13]. Valine is also a precursor in penicillin biosynthesis pathway and known for inhibiting tryptophan transport crossing brain-blood barrier[14]. This indicates that Valine is an essential amino acid that is vital for smooth nervous system and cognitive function.

In natural diet, Valine is a limiting amino acid after methionine, lysine and threonine before arginine and isoleucine. L-Valine supplementation enables further reduction

Table 1. Composition (%) and nutrient content (% dry mater) of experiment diets.

Ingredients	Treatments				
	T_0	T_1	T_2	T_3	T_4
Corn	59.60	58.95	58.60	58.35	58.10
Rice brand	17.00	17.00	17.00	17.00	17.00
Soybean meal	14.00	14.00	14.00	14.00	14.00
Fish meal	5.00	5.00	5.00	5.00	5.00
Vitamin Premix	0.40	0.40	0.40	0.40	0.40
Mineral Premix	0.40	0.40	0.40	0.40	0.40
Dl-Methionine	0.50	0.50	0.50	0.50	0.50
L-Lysine HCl	1.00	1.00	1.00	1.00	1.00
L-Threonine	1.00	1.00	1.00	1.00	1.00
L-Arginine	0.60	0.60	0.60	0.60	0.60
L-Tryptophan	0.50	0.50	0.50	0.50	0.50
L-Valine	0.00	0.75	1.00	1.25	1.50
Dicalcium-phosphate	1.00	1.00	1.00	1.00	1.00
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Calculatet nutrients					
Metabolized energy (kcal/kg)*	3112.18	3088.14	3075.19	3065.95	3056.70
Crude protein (%)*	16.41	16.35	16.32	16.29	16.27
Ether extract (%)*	6.61	6.58	6.56	6.55	6.53
Ash (%)*	6.18	6.17	6.16	6.16	6.15
Crude fiber (%)*	4.79	4.78	4.77	4.77	4.76
Methionine	0.43	0.43	0.43	0.43	0.43
Lysine	1.10	1.10	1.10	1.10	1.10
Tryptophan	0.56	0.56	0.56	0.56	0.56
Threonine	1.06	1.06	1.06	1.06	1.06
Arginine	0.90	0.90	0.90	0.90	0.90
Valine	0.10	0.81	1.06	1.31	1.46
Calcium	1.63	1.62	1.61	1.61	1.61
Phosphorus	0.45	0.45	0.45	0.45	0.45

* Analysis result of Biochemical Laboratory of the Faculty of Animal Husbandry UGM Yogyakarta (Lisnahan, 2018)

of one point crude protein percentage. Feed consumption is likely affected by energy sufficiency. In Table 1, the metabolized energy for all treatments have been sufficient for starter phase chicken. If the feed energy is lacking, chicken will use energy sources

Table 2. Performance of Native chicken at the starter phase

Variable	Treatment				
	T_0	T_1	T_2	T_3	T_4
Final weight (g/bird)	298.96 ± 4.21^{d}	314.68 ± 0.72^{a}	315.16 ± 1.79^{a}	309.48 ± 2.00^{b}	305.74 ± 1.43^{c}
Body weight gain (g/bird/6 weeks)	239.42 ± 4.45^{d}	255.38 ± 1.07^{a}	255.78 ± 2.79^{a}	250.08 ± 2.56^{b}	246.40 ± 1.50^{c}
Feed intake (g/bird/6 weeks)	577.03 ± 15.85	526.16 ± 80.69	510.17 ± 18.63	568.70 ± 10.83	579.02 ± 6.70
FCR	2.41 ± 0.04^{a}	2.20 ± 0.03^{b}	1.99 ± 0.42^{b}	2.27 ± 0.03a	2.35 ± 0.03^{a}
Giblet weight (g/bird)	31.03 ± 1.66	31.55 ± 2.78	32.08 ± 1.49	31.38 ± 2.14	31.02 ± 1.74

Remarks: Superscript was different on the average row showing a significant difference ($p < 0.05$); T_0 (control feed); T_1 (T_0 + 0.75% L-Valine); T_2 (T_0 + 1.00% L-Valine); T_3 (T_0 + 1.25% L-Valine); T_4 (T_0 + 1.50% L-Valine).

from the body protein and fat. On the contrary, Agostini el al. [10] explained that Valine can suppress appetite but increase weight and feed efficiency. Nascimento et al. [15] have reported that there is no significance of feed consumption on broilers farming supplemented with 0.85% Valine.

Feed conversion is a ratio between feed consumption and weight gain. L-Valine supplementation decreased feed conversion at 0.75% and 1.00% levels. This is the result expected in chicken farming for the business success. As in weight, a negative correlation also applied to the feed conversion. If the L-Valine is excessive as in T_3 and T_4 (1.25% and 1.50%), the feed conversion is high or not efficient. Valine utilization in feed has to consider the ratio of other limiting amino acids such as lysine, and 2 other BCAA. Valine-lysine ratio in broilers as reported by Agostini et al. [10] was 0.88. In this study, the valine-lysine ratio was 0.75–1.00. Based on the ideal concept of amino acid, T_1 and T_2 approached this ratio. In T_3 and T_4, the Valine was excessive hence resulted in low weight and high feed conversion. It is similar with the ratio between Valine and leucine and isoleucine. These three essential amino acids must be in balance in the feed. If the Valine amount is increased but the leucine and isoleucine are low, then it will affect the growth even become antagonistic if one of these BCAAs is excessive. Tavernari et al. [12] elaborated that broilers age 30–43 days need Valine, Isoleucine and Leucine with the ratio of 0.80%: 72%: 142%.

In the starter phase, a difference in the giblet organs is invisible yet. Feed consumption is one of the factors affecting the giblet weight. If the feed consumption is high, then the giblet weight will also high. In this study, the feed consumption of Native chicken was not significant. Besides, the giblet weight is also affected by the nutrient content in the feed especially the crude fiber content. In this study, the feed crude fiber content used (Table 1) was 5.00%. This crude fiber content is still within the tolerance limit allowed for poultry, which is not more than 6% [3].

When ration enters the body, a metabolism process will occur. This metabolism process will affect the activity of gizzard, liver and heart. Poultry will increase their metabolism ability to digest crude fiber hence increasing the size of the gizzard, liver and heart [16]. The size of the gizzard is affected by its activity. Gizzard muscle activity will occur if food enters it. Liver plays a role in bile secretion, fat, protein, carbohydrate, iron and vitamin metabolisms, detoxification, red blood formation, as well as vitamin storage [17]. Eleroglu et al. [16] explained that the factors affecting the weight of liver are body weight, species, sex, age, and pathogenic bacteria. Liver weight increases along with age, but the percentage is constant to body weight.

According to Nurlia et al. [17], heart is a muscle organ having a vital role in blood circulation, divided into four chambers namely two ventricles (left and right ventricles) and two atriums (left and right atriums). Heart functions as a pump and driving motor in blood circulation and it works autonomously or controlled by central nervous system beyond willpower and consciousness. The size of heart depends on sex, age, body weight and activity of animal. This organ enables efficient blood circulation into lungs for O_2 and CO_2 exchange in supporting metabolic process. The size of heart depends on sex, age, body weight, and activity of animal.

4 Conclusions

Based on the result and discussion, it can be concluded that Native chicken farmed at the starter phase needs 0.75–1.00 Valine to reach optimum growth.

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