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Supplementation of L-Arginine through the Parent Feed and in Ovo Feeding on Post-hatch Performances of Local Ducks

Syahruddin[a]*, Laily Agustina[b], Wempie Pakiding[c], Ratmawati Malaka[d]

[a]*Agriculture Science Study Program, Post Graduate School Hasanuddin University, Makassar 90245, Animal Science Study Program Gorontalo State University, Gorontalo 96128, Indonesia*

[b,c]*Department of Animal Nutrition, Faculty of Animal Science, Hasanuddin University, Makassar 90245, Indonesia*

[d]*Department of Technology of Animal Product, Faculty of Animal Science, Hasanuddin University, Makassar 90245, Indonesia*

[a]*Email: udin.aksal@yahoo.co.id*

[b]*Email: agustina.laily@yahoo.com*

[c]*Email: pwempie@yahoo.com*

[d]*Email: Ratihtamalag39@gmail.com*

Abstract

This study aims to determine the hatching weight, performance and growth rate of local ducks that are supplemented with L-Arginine (Arg) through the parent feed and through the in-ovo feeding. A total of 500 fertile eggs were obtained from the parent feed without supplementation of L-Arginine (digestible Arg = 1.04%) and as many as 500 other fertile eggs obtained from parent feed with 0.25% L-Arginine supplementation (digestible Arg = 1.29%). Eggs obtained from parent feed without supplementation of L-Arg and eggs from the parent feed with 0.25% L-Arg supplementation were into the semi-automatic incubator and divided into 4 treatments and 5 replications.

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* Corresponding author.

The treatments were: P0 (Parent feed + 0% L-Arg and injection of 0% L-Arg) (control), P1 (Parent feed + 0% L-Arg and injection of 1.5% L-Arg), P2 (Parent feed + 0.25% L-Arg and injection of 0% L-Arg), and P3 (Parent feed + 0.25% L-Arg and injection of 1.5% L-Arg).

In ovo feeding is done on day 8 incubation with injection into albumen using automatic syringe with depth of 10 mm. After hatching as much as 180 day old duck was moved into the pen according to the previous egg treatment and upgraded to 9 replicates, resulting in 36 experimental units. Each pen is filled with 5 ducklings with mixed gender. The results showed that the administration of L-Arginine through the parent feed and in ovo feeding can increase the hatching weight, hatching weight ratio with the egg weight, body weight gain and final body weight but no effect on feed intake and feed conversion ratio. Growth rates at week 1, 4, 5 and 8 significantly increased body weight by administering L-Arginine through the parent feed and ovo feeding. It can be concluded that L-Arginine supplementation through the parent feed and in ovo feeding can increase the hatching weight, body weight gain and the final body weight of local duck with the same feed intake and feed conversion ratio.

Keywords: in ovo feeding; L-Arginine; parent feed; performance; local duck.

1. Introduction

Local duck has its advantages compared to other poultry because local duck is relatively more resistant to disease. The mortality rate experienced by local duck farms is generally not as high as in chicken farms. However, on the other hand local duck has a lower performance compared to broiler ducks or originating duck from abroad (import) for example Peking duck. Peking duck has a fast growth rate, the weight and quality of carcass produced is also much heavier and better than the local ducks.

Efforts to improve the performance of local ducks have been done by researchers by trying to implement an intensive maintenance system like those done on commercial chicken. The results obtained can increase egg production and body weight gain. However, it is economically less profitable because feed conversion ratio is still high. Feed conversion ratio of 2-10 weeks of local duck by 6.59 [1] and 6.96 [2] when compared with the feed conversion ratio of Peking duck at 6 weeks by 4.49 [3].

Improved performance of local ducks can be done through improving the quality of hatching eggs. One of them through increased nutritional status for the parent. The increase is thought to contribute to increased deposition of nutrients into eggs for maximum growth and embryonic development. Other attempts to improve the performance of local ducks may also be done through the provision of exogenous nutrients into eggs to enhance hyperplasia of embryonic muscle cell ducks during organogenesis. So that gives an impact on performance improvement after hatching. One of the nutrients needed by ducks is the amino acids, especially the essential amino acids.

L-Arginine amino acids are reported to improve insulin release [4, 5], precursors of other amino acid formation [6], supports physiological activity in poultry and nitric oxide synthesis (NO) [7], stimulates growth hormone synthesis, IGF-1 and immune system activity [8] and has an important role in muscle cell hyperplasia [9]. L-

Arginine plays a role in the process of muscle cell hyperplasia to support an increase in the number of muscle cells. The number of muscle cells that formed during the incubation period is highly dependent on the ability of cell hyperplasia. Local ducks that have large numbers of muscle cells are believed to grow faster and have a higher body weight. Based on the above description it is necessary to evaluate the supplementation of L-Arginine through the parent feed and in ovo feeding to increase the performances of local ducks after hatching.

2. Material and Methods

A total of 500 fertile eggs were obtained from 42 to 45 weeks old breeder parent feed with no L-Arginine supplementation (parent feed + 0% L-Arg (digestible Arginine (dig. Arg) = 1.04%) and 500 other fertile eggs were obtained from the parent feed with supplementation 0.25% L-Arginine (parent feed + 0.25% L-Arg dig. Arg = 1.29%). The feed ingredients and nutritional value that given to no supplemented L-Arg the parent feed and parent feed with supplemented L-Arg has be seen in Table 1.

Table 1: Feed ingredients and nutritional value for parent feed duck production age 42 – 45 weeks

Feed ingredients	Parent feed + 0% L-Arg	Parent feed + 0.25% L-Arg	Nutritional value	Parent feed + 0% L-Arg	Parent feed + 0.25% L-Arg
Yellow corn	50	50	Dry Matter (%)	86.86	86.86
			Metabolizable		
Rice bran	13	13	Energy (kcal/kg)	2724	2724
Soybean meal	15	15	Crude Protein (%)	19.22	19.72
Meat bone meal	12	12	Crude Fat (%)	3.56	3.56
Coconut oil	1	1	Crude Fiber (%)	3.56	3.56
L-Lysine	0.4	0.4	Calcium (%)	2.92	2.92
DL-Methionine	0.3	0.3	Av. Phosphorus (%)	0.90	0.90
Limestone powder	4.5	4.5	Natrium (%)	0.32	0.32
Dicalcium Phosphate	1	1	Cloride (%)	0.28	0.28
Sodium	0.2	0.2	Lysine (%)	1.37	1.37
Sodium bicarbonat	0.5	0.5	Methionine (%)	0.63	0.63
Premix*	1	1	Dig. Lysine (%)	1.21	1.21
Grit	1	0.75	Dig. Methionine (%)	0.58	0.58
L-Arginine	**0**	**0.25**	Dig. Meth + Cys (%)	0.47	0.47
Cholin Chloride	0.1	0.1	Dig. Threonine (%)	0.60	0.60
Total (%)	100	100	**Dig. Arginine (%)**	**1.04**	**1.29**

Note: *The premix composition per kg contain 25% Calcium (Ca), 1.0% Phosphor (P), 6 g Iron (Fe), 4 g Mangan (Mn), 0.075 g Iodine (I), 0.3 g Copper (Cu), 3.75 g Zinc (Zn), 0.5 mg vitamin B12 and 50.000 IU vitamin D3. Calculation according to data of nutrient content [10, 11].

All eggs that used from the no L-Arg supplemented of parent diet and parent feed with L-Arg supplementation were fertile eggs weighing 61 - 63 g. The eggs are inserted into semi-automatic incubator with temperature 38.5 - 39.5^{o}C and relative humidity (RH) 65% (days 1 - 14), 75% (days 15 - 25) and 85% (26 - 28). The egg was rotated 3 times a day (07:00, 15:00 and 22:00). On the 7th day of the incubation, candling egg was handled to selecting the fertility. Infertile eggs replaced with fertile eggs that have been prepared as reserves. The experimental design used a completely randomized design (CRD) with 4 treatments and 5 replications. Thus, there were 20 units of experiment and each unit was filled with 50 eggs.

As for the treatments are: P0 = Parent feed + 0% L-Arg and injection of 0% L-Arg (control); P1 = Parent feed + 0% L-Arg and injection of 1.5% L-Arg (1.5 g/100 ml saline m/v); P2 = Parent feed + 0.25% L-Arg and injection of 0% L-Arg; and P3 = Parent feed + 0.25% L-Arg and injection of 1.5% L-Arg (1.5 g/100 ml saline m/v). Injection was performed on the 8th day of the incubation into the albumen of 0.5 ml/egg. Injection was used automatic syringe at a depth of 10 mm at the pointed egg. Furthermore, the injection site was cleaned with alcohol and covered with paraffin and smeared by nail polish.

After hatching, as much as 180 day old ducks (DODs) were moved into the pen (length x width x height/1 x 1 x 0.65 m) with litter base. DODs were divided into 4 treatments (according to previous egg treatment) and 9 replications, so there were 36 experimental units. Each pen was filled with 5 DODs with mixed gender (unsexed) and equipped with one feeding area and one drinking pot. Feed and drink were given ad-libitum. The feed of DODs was mixed from yellow corn, rice bran and CAB PARAMA Concentrate. Feed protein content 27.75% for ducks 0 - 2 weeks old and 18.30% for ducks aged 2 - 8 weeks. The ducks feed formulation has be seen in Table 2.

Table 2: Feed formulations of duck aged 0 - 2 weeks and 2 - 8 weeks

Feed ingredients (%)	Age 0 – 2 Weeks	Age 2 – 8 Weeks
Yellow Corn	30	60
Rice bran	10	10
CAB PARAMA Concentrate*	60	30
Total (%)	100	100

Note: *Nutrient composition of each kg CAB PARAMA concentrate contains 11.0% water content, crude protein 40.0%, 3.0% crude fat, crude fiber 7.0%, 15.0% ash, calcium 2.7 - 3.0 and phosphorus 0.6% (Analysis results of PT. Japfa Comfeed Indonesia, Tbk.)

Observation of the hatching weight was done on the 28th day after hatching. After the 8 weeks (56 days) ducks are all weighed to know the average body weight of each plot or experimental unit. Body weight gain is obtained by reducing the final body weight of 8 weeks with the body weight day old duck. Feed intake was obtained by measuring the amount of feed consumed by ducks for 8 weeks. The feed conversion ratio of 8 weeks of age is obtained by dividing the body weight gain by the amount of feed intake for 8 weeks. Growth rates were evaluated by measuring the body weight of ducks at age 1, 2, 3, 4, 5, 6, 7 and 8 weeks. The data

obtained were analyzed using analysis of variance. If the treatment showed a significant effect then continued to be tested with least significant difference test [12].

3. Result and Discussion

The results showed that the treatment (P3) had significant effect (P<0.05) on the hatch weight and the ratio of hatch weight to egg weight compared to P0 (control) and P2 (via parent feed only). Supplementation with L-Arginine through parent diet and in ovo feeding (embryo) can increase the hatch weight and the ratio of hatch weight with the egg weight (Table 3).

Table 3: Hatch weight and hatch weight ratio: egg weight of local duck with supplemented of L-Arginine through parent diet and in-ovo feeding

Variables	Treatment			
	P0	P1	P2	P3
Hatching weight (g/bird)	38.54 ± 1.04^{a}	39.84 ± 1.21^{a}	39.72 ± 1.07^{a}	41.48 ± 0.77^{b}
Hatching weight ratio: egg weight (%)	58.06 ± 1.77^{a}	60.20 ± 1.19^{b}	60.05 ± 1.33^{ab}	62.43 ± 1.68^{c}

Note: Means in the same rows with different superscripts differ significantly (P<0.05).

P0 = Parent feed + 0% L-Arg and injection of 0% L-Arg (control)

P1 = Parent feed + 0% L-Arg and injection of 1.5% L-Arg

P2 = Parent feed + 0.25% L-Arg and injection of 0% L-Arg

P3 = Parent feed + 0.25% L-Arg and injection of 1.5% L-Arg.

Supplementation of L-Arginine through the parent feed and in ovo feeding can increase the hatching weight of the local duck. The increased hatching weight because the increased the embryo weight produced by administration of L-Arginine. Reported [13] that in ovo feeding can increase the hatching weight, occurs due to increased muscle mass during the myogenesis process. The results study [14] also reported that the administration of L-Arginine in ovo feeding resulted in higher hatching weight. The increased hatching weight occurs due to the increased embryos weight produced by administration of L-Arginine. The result study [15] and [16] reported that heavier embryos will produce higher hatching weight than lighter embryos.

The increased hatching weight can also be caused by increased liver and muscle glycogen reserves with L-Arginine supplementation. Study [17] reported that in ovo feeding with carbohydrates and arginine may increase the glycogen reserves, which may provide the energy needed for duck growth before hatching. The greater amount of energy reserves (glycogen) needed to support hatching activities. When the status of low energy reserves during the hatching process, there will be a reshuffle of protein tissue, especially muscles [18, 19]. The reshuffle of muscle tissue causes a decrease in muscle mass, so it will have an impact on low hatching weight.

Study [20] showed that an increase in glycogen 1.5 mg / g organ will increase the weight of hatch 1.9 g.

The hatch weight ratio to egg weight was higher in treatment with L-Arginine supplementation through the parent feed and in ovo feeding compared with controls and other treatments. This occurs because the hatch weight obtained in the treatment of L-Arginine supplementation through the parent feed and ovo in ovo feeding is also higher. The results of the study [21] that in ovo feeding of arginine had significantly improved hatch weight, chick/egg weight ratio and placement weight and provides enough nutrition for the weight to be sustained up to at least 35 day. The higher the value of the hatch weight ratio with the egg weight, the higher the rate of embryo growth, although it comes from an egg of a smaller size.

The results showed that L-Arginine supplementation (P3 treatment) had significant effect ($P<0.05$) on body weight gain and final body weight compared with P0 (control), P1 (in ovo feeding only) and P2 (only through parent feed). However, L-Arginine supplementation had no significant effect ($P>0.05$) on feed intake and feed conversion ratio. Supplementation with L-Arginine through the parent diet and in ovo feeding (embryo) can increase body weight gain and final body weight. However, L-Arginine supplementation was not to able decrease feed intake and feed conversion ratio of local duck of 8 weeks old (Table 4).

Table 4: Post-hatch performances local ducks at the age of 56 days of supplementation L-Arginine through parent feed and in ovo feeding

Variables	Treatment			
	P0	P1	P2	P3
Feed intake (g/bird)	4915.50 ± 345.63	5029.00 ± 130.89	5038.90 ± 252.17	4934.00 ± 275.11
Body weight (g/bird)	1335.40 ± 55.11^{a}	1391.70 ± 54.59^{ab}	1348.10 ± 86,76^{a}	1439.50 ± 72.39^{b}
Body weight gain (g/bird)	1296.90 ± 55.06^{a}	1351.80 ± 54.22^{ab}	1308.30 ± 86.03^{a}	1398.00 ± 72.01^{b}
Feed conversion ratio	3.80 ± 0.30	3.72 ± 0.12	3.87 ± 0.33	3.54 ± 0.31

Note: Means in the same rows with different superscripts differ significantly ($P<0.05$).

P0 = Parent feed + 0% L-Arg and injection of 0% L-Arg (control)

P1 = Parent feed + 0% L-Arg and injection of 1.5% L-Arg

P2 = Parent feed + 0.25% L-Arg and injection of 0% L-Arg

P3 = Parent feed + 0.25% L-Arg and injection of 1.5% L-Arg.

Feed intake of all treatments showed no significant difference, either supplemented by L-Arginine through parent feed or injection or control. This happens because all treatments are fed the same feed and nutritional content. This causes the level of palatability of feed is the same, causing the feed intake for all treatments is not different.

Feed intake is also influenced by nutrient content, especially protein content and energy metabolism of feed. The amount of livestock consumption with high levels of protein and metabolic energy tends to decrease and vice versa increases if protein and energy levels of metabolism are low [22, 23]. The average duck feed intake over the age of 8 weeks ranged from 4915.50 ± 345.63 g/bird up to 5038.90 ± 252.17 g/bird (Table 4). The average of feed consumption obtained was lower than the result obtained by [24] at local ducks until 8 weeks old ranged from 7242.14 ± 260.03 g/bird to 7635.72 ± 275.37 g/bird.

Meaning of live duck weight with supplementation of L-Arginine through the parent feed continued in ovo feeding (P3) can increase body weight of duck. The mean body weight of duck at 8 weeks of mixed sex ranged from 1335.40 ± 55.11 g / bird (P0) to 1439.50 ± 72.39 g / bird (P3) (Table 4). The mean final weight of duck obtained is higher than that obtained by [25] showed that the final live weight of the Tegal duck 8 week old varied from 1184 ± 80.81 g/duck to 1238.5 ± 78.46 g/duck with daily weight 4.33 ± 2.30 g/duck up to 6.94 ± 1.68 g/duck. However, lower than the results obtained by [24] that the live body weight of local male duck at 8 weeks ranged between 1425.72 g / bird up to 1500.72 g / bird. The increase in final weight on treatment P1 and P3 occurs because injection of L-Arginine can increase muscle mass. Muscle mass reported by [26] as an important component in the body of the poultry that will determine the weight. In addition, increased body weight gain will have an impact on achieving a high of final body weight.

Body weight gain is an important indicator for measuring growth rates. The results showed that there was an increase in weight gain by L-Arginine supplementation through the parent feed and in ovo feeding (P3) compared with control (P0) and supplementation through the only feed (P2). However, in ovo feeding treatment also showed body weight gain. The same report was also reported by [15] on ducks. The results of [27] reported that administration of L-Arginine with in-ovo feeding resulted in higher weight gain and lower feed conversion compared to the control group. Increased weight gain was higher along with reduced feed conversion ratio. It shows that the amount of feed nutrients absorbed into the body of the ducks more. So as to increase the body weight gain of ducks also increased.

The value of feed conversion describes the level of efficiency of the use of feed consumed. The lower feed conversion value indicates more efficient use of feed and vice versa. Feed conversion as a measure to assess how much feed the duck consumes into body tissue, expressed by the magnitude of body weight is still the best way [28]. The lower value feed conversion then the duck are more efficient in changing the feed into body tissue [28].

Supplementation of L-Arginine through the parent feed and in ovo feeding does not affect the feed conversion value of duck. However, the feed conversion value obtained ranged from 3.54 ± 0.31 (P3) to 3.87 ± 0.33 (P2), the feed conversion value of local duck for 8 weeks obtained is still relatively low when compared with study [24] the feed conversion of local duck (Mojosari x Alabio) males for 8 weeks ranged from 5.03 ± 0.06 to 5.35 ± 0.25. Similarly, the results of research [29] reported that the average feed conversion of Mangelang duck 4.10, Tegal duck 4.49, Mojosari duck 4.45 and Manila duck 3.03. Low feed conversion values indicate the performance of the digestive tract [30] and [31] reported that feed conversion rates in poultry are largely determined by the performance of the digestive tract especially the small intestine (duodenum, jejunum, and

ileum).

The results showed that L-Arginine supplementation through the parent diet and in ovo feeding (P3) had significant (P<0.05) increased average body weight in weeks I, IV, V and VIII compared with control. However, the results showed that L-Arginine supplementation was inconsistent in increasing average body weight of duck each week (Table 5).

Table 5: The average weekly body weight of local ducks post of supplementation *L-Arginine* through parent feed and in ovo feeding (g/bird)

Week	Treatment			
	P0	P1	P2	P3
I	102.19 ± 7.61[a]	110.44 ± 3.24[b]	109.64 ± 5.78[b]	111.19 ± 8.27[b]
II	288.04 ± 28.34	304.16 ± 22.07	302.69 ± 28.66	312.92 ± 27.83
III	545.86 ± 39.20	555.03 ± 37.58	554.33 ± 55.73	567.80 ± 51.69
IV	729.33 ± 24.45[a]	786.64 ± 50.46[b]	778.49 ± 55.39[b]	787.27 ± 47.13[b]
V	954.73 ± 46.55[a]	986.54 ± 65.57[ab]	979.89 ± 60.47[ab]	1013.22 ± 36.03[b]
VI	1146.28 ± 52.60	1150.58 ± 58.85	1149.06 ± 55.12	1161.14 ± 43.00
VII	1256.70 ± 69.56	1299.07 ± 73.25	1274.98 ± 50.30	1306.82 ± 42.89
VIII	1335.44 ± 55.11[a]	1391.70 ± 54.59[ab]	1348.07 ± 86.76[a]	1439.48 ± 72.39[b]

Note: Means in the same rows with different superscripts differ significantly (P<0.05).

P0 = Parent feed + 0% L-Arg and injection of 0% L-Arg (control)

P1 = Parent feed + 0% L-Arg and injection of 1.5% L-Arg

P2 = Parent feed + 0.25% L-Arg and injection of 0% L-Arg

P3 = Parent feed + 0.25% L-Arg and injection of 1.5% L-Arg.

Supplementation of L-Arginine through the parent feed and in ovo feeding (P3) can increase body weight in weeks I, IV, V and VIII when compared with control (P0) (Table 5).

This may be due to the number of muscle cells that the ducks possess with L-Arginine supplementation more, since cell numbers are one of the determinants of muscle mass [26, 32, 33]. In the first week of maintenance of cell hypertrophy has not been maximal so it has not impact on weight. In the last week of cell maintenance is getting higher.

This causes ducks with many muscle cells will have high muscle mass and impact on the achievement of high end body weight. In addition to muscle growth the final body weight is also influenced by the growth of bone and digestive organs.

4. Conclusion and Recommendation

Supplementation L-Arginine through the parent feed and in ovo feeding can increase the hatching weight, body weight gain and the final body weight of local duck with the same feed consumption and feed conversion ratio. We recommend that to improve the performance of local ducks after hatching it is necessary to supplement 0.25% L-Arginine through its parent feed (1.29% digestible Arginine) and in ovo feeding with L-Arginine (1.5 g/100 ml saline m/v; injection to egg) as much as 0.5 ml/egg on the 8th day of the incubation period.

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