RESEARCH ARTICLE

Effect of Dietary Supplementation of Arginine on Performance of Commercial Broiler Chicken

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Abstract

The experiment was conducted to evaluate the effect of dietary arginine supplementation on the performance of commercial broiler chickens. A total of 144 straight run day old commercial broiler chicks were randomly allotted to six treatment groups with four replicates per treatment. Each replicate was having six chicks, resulting in 24 chicks per treatment group. Six experimental diets (T_1, T_2, T_3, T_4, T_5 and T_6) were formulated and fed as starter (0-10 days), grower (11-21 days) and finisher (22-42 days) diets. The basal diet formulated according to BIS (2024) specifications was considered as the control (T_1) without arginine supplementation, while diets T_2, T_3, T_4, T_5 and T_6 were prepared by supplementing arginine at 0.1%, 0.2%, 0.3%, 0.4%, and 0.5%, respectively. The parameters studied included body weight, body weight gain, feed consumption, feed conversion ratio (FCR), livability, and return over feed cost. During the early growth phase, higher levels of arginine supplementation (0.4% and 0.5%) significantly ($p<0.05$) increased body weight and body weight gain and improved FCR, while at 42 days of age, an apparent improvement in body weight, body weight gain and FCR was observed in the arginine supplemented groups. Economically, diets containing 0.4% and 0.5% arginine were more beneficial compared to the control diet.

Key words: Arginine supplementation, Commercial broilers, Economics. Feed efficiency, Growth performance.

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Introduction

The poultry industry is a major contributor to global and national food security, providing an efficient and affordable source of high-quality animal protein; however, sustaining productivity in modern broilers requires precise nutritional interventions. Among essential nutrients, arginine has gained considerable importance due to its central role in growth, immunity, energy metabolism and stress adaptation. Genetic advancement has markedly increased growth rate and feed efficiency in broilers, rendering the NRC (1994)'s arginine recommendations inadequate, particularly under Indian production conditions characterized by high ambient temperature and environmental stress. Poultry are unable to synthesize arginine endogenously due to the absence of key urea cycle enzymes, making dietary supply critical for protein synthesis, nitric oxide production, creatine biosynthesis and polyamine formation (Wu *et al.,* 2009; Brugaletta *et al.,* 2023).

Arginine enhances vascular function and cardiovascular efficiency through nitric oxide synthesis, reduces ascites and regulates lipid metabolism by promoting lipolysis while suppressing lipogenesis, thereby lowering abdominal fat deposition and improving carcass quality (Miri *et al*., 2022). It also stimulates skeletal muscle growth via the mTOR signaling pathway, supports cellular energy homeostasis through creatine formation and improves immune competence by enhancing T-cell proliferation, antioxidant defense and intestinal barrier integrity (Tong and Barbul, 2004; Beski *et al*., 2015; Wang *et al*., 2022). Arginine deficiency has been associated with poor livability and higher mortality, whereas supplementation above conventional levels improves survivability and performance (Corzo and Kidd, 2003; Verhelle and Saremi, 2024). Under heat stress conditions, arginine requirements further increase due to reduced feed intake and impaired protein synthesis, and supplementation during the finisher phase has been shown to improve body weight gain, feed conversion efficiency and blood lipid profiles irrespective of dietary energy level (Khajali and Wideman, 2010; Fouad *et al.,* 2013; Oliveira *et al*., 2024). Overall, arginine functions as a critical functional amino acid for enhancing productivity, health and sustainability in modern broiler

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production systems. Hence, the present study was planned to evaluate the effect of dietary supplementation of arginine on growth performance and feed efficiency of commercial broiler chicken.

Materials and Methods

The experiment was conducted at the Poultry Research Station, College of Veterinary Science and Animal Husbandry, Kamdhenu University, Anand, Gujarat, using one hundred and forty four (144) straight run, day-old commercial broiler chicks of a single hatch from a private hatchery. The duration of the experiment was six weeks (42 days, 15th August to 25th September, 2025). The average ambient temperature and relative humidity during the experiment were 28.5 °C and 82.6%, respectively. After arrival, all chicks were wing banded and individually weighed. The birds were then randomly allotted to six treatment groups, each comprising four replicates, with six chicks per replicate, resulting in 24 chicks per treatment.

Six experimental diets (T_1, T_2, T_3, T_4, T_5 and T_6) were formulated and offered *ad libitum* to the respective treatment groups as starter (0-10 days), grower (11-21 days) and finisher (22-42 days) diets. The basal diet was formulated according to BIS (2024) specifications and considered as the control diet (T1) without arginine supplementation. The experimental diets T_2, T_3, T_4, T_5 and T_6 were prepared by supplementing the basal diet with arginine at levels of 0.1%, 0.2%, 0.3%, 0.4% and 0.5%, respectively. All necessary management and biosecurity precautions were strictly followed. Birds were vaccinated against Ranikhet disease (RD) and Infectious Bursal Disease (IBD) as per the standard vaccination schedule. Body weight, body weight gain, feed consumption and feed conversion ratio were recorded weekly.

The experiment was conducted under a Completely Randomized Design (CRD) following Snedecor and Cochran (2014) and the mean values of replicates under each treatment were used for statistical analysis using one-way analysis of variance and Duncan's multiple range test for significance at $p<0.05$.

Results and Discussion

Body Weight

The mean body weight (BW) of day-old chicks did not differ significantly among the treatment groups. At the end of the 10th and 14th day of age, birds fed diets supplemented with 0.4% and 0.5% arginine showed significantly ($p < 0.05$) higher body weight compared to those fed the control and 0.2% arginine diets. However, the body weight of birds receiving 0.1% and 0.3% arginine diets remained statistically at par with each other. At the end of the experiment (42 days), no significant differences in mean body weight were observed among the treatment groups. However, numerically higher body weight was recorded in birds fed 0.5% and 0.4%

Table 1: Effect of dietary supplementation of arginine on body weight (g) of broiler chicken

Treatments	Weekly body weight (g)							
	BW_0	BW_1	BW_{10d}	BW_2	BW_3	BW_4	BW_5	BW_6
T1	43.50 ±0.57	180.89 ±4.14	266.76^{bc} ±6.75	414.88^{bc} ±11.72	653.08 ±22.15	1086.33 ±32.68	1627.08±47.02	2217.33 ±63.94
T2	44.49 ±0.49	188.52 ±3.31	277.25^{abc} ±5.23	441.67^{abc} ±9.43	749.41 ±23.42	1154.58 ±37.36	1654.08 ±51.82	2211.75 ±65.15
T3	43.86 ±0.54	181.11 ±0.54	262.34^{c} ±6.90	410.5^{c} ±11.59	657.92 ±25.79	1102.83 ±36.02	1626.67 ±45.42	2201.5 ±55.21
T4	44.21 ±0.80	188.56 ±3.11	283.40^{ab} ±5.10	437.92^{abc} ±7.69	746.42 ±16.88	1136.17 ±26.88	1631.88 ±34.56	2159.88 ±45.58
T5	42.87 ±0.51	193.81 ±3.41	286.08^{a} ±5.25	446.08^{ab} ±9.86	757.83 ±25.80	1202.08 ±35.92	1725.75 ±50.05	2298.17 ±71.51
T6	44.65 ±0.54	197.08 ±3.81	293.66^{a} ±5.15	458.92^{a} ±7.92	729.92 ±24.35	1221.83 ±37.70	1776.92 ±53.95	2359.21 ±75.40
CV%	2.53	4.84	4.39	4.89	9.54	7.32	6.74	6.16
SEm	0.56	4.56	6.11	10.64	34.13	42.12	56.43	69.08
CD at 5%	NS	NS	18.16	31.61	NS	NS	NS	NS

Means bearing different superscripts within same column differ significantly ($p<0.05$). NS=Non-significant

arginine diets (Table 1). The findings of the present study were in agreement with those of Khajili *et al.* (2013) and Liu *et al.* (2019), who reported significantly ($p < 0.05$) higher body weight in arginine supplemented groups during the early growth phase. Similarly, Fouad *et al.* (2013), Bulbul *et al.* (2013) and Khaleel and Saed (2023) also reported no significant differences in body weight among treatment groups at later stages.

Body Weight Gain

During the starter phase ($BWG_{0\text{-}10d}$), the mean body weight gain of birds fed the 0.5% arginine diet was significantly ($p < 0.05$) higher than that of birds fed the T_1 (Control diet) and 0.2% arginine diets, but it did not differ significantly from those fed the 0.1%, 0.3% and 0.4% arginine diets. However, no significant differences in body weight gain were observed among the dietary treatment groups during the grower ($BWG_{11\text{-}21d}$) and finisher phase ($BWG_{22\text{-}42d}$) (Table 2). Overall body weight gain ($BWG_{0\text{-}6wk}$) also did not differ significantly among the treatments. However, numerically the highest body weight gain was recorded in birds fed the 0.5% arginine diet. The results of the present study were in partial agreement with the findings of Murakami *et al.* (2012). Khajali *et al.* (2013) and Liu *et al.* (2019) also reported significantly ($p< 0.05$) higher body weight gain in the arginine supplemented groups during the early phase. However, by 42 days of age, Murakami *et al.* (2012) observed non-significant differences among all treatment groups. Similarly, Fouad *et al.* (2013), Castro *et al.* (2019) and Khaleel and Saed (2023) also observed non-significant differences in body weight gain at the end of the experimental period (42 days), indicated that dietary arginine supplementation enhance early growth stage.

Feed Consumption

Dietary supplementation of arginine had no significant effect on feed consumption. No significant differences were observed among the treatment groups during the starter, grower, finisher and overall experimental periods. However, numerically higher feed consumption was recorded in the T_6 (0.5% arginine) treatment group throughout the experimental period (Table 3). The findings of the present study were in agreement with the earlier reports (Murakami *et al.,* 2012; Fouad *et al.,* 2013; Khaleel and Saed 2023; Khyber *et al.,* 2024), wherein it is also reported that dietary arginine supplementation did not exert a significant influence on feed intake. In contrast, Al-Daraji and Salih (2012), Khajali *et al.* (2013), Castro *et al.* (2019), Liu *et al.* (2019), Yazdanabadi *et al.* (2020), Hameed *et al.* (2021) and Brugaletta *et al.* (2023) reported significantly ($p<0.05$) higher feed intake in birds fed higher levels of dietary arginine compared to the control

Table 2: Effect of dietary supplementation of arginine on body weight gain (g) of broiler chicken

Treatments	Body weight gain (g)			
	$BWG_{0\text{-}10d}$ (Starter)	$BWG_{11\text{-}21d}$ (Grower)	$BWG_{22\text{-}42d}$ (Finisher)	$BWG_{0\text{-}6wk}$ (Overall)
T1	$223.25^{bc} \pm 6.58$	386.32 ± 18.96	1564.25 ± 51.75	2173.82 ± 63.92
T2	$232.76^{abc} \pm 5.14$	472.17 ± 20.25	1462 ± 58.23	2167.27 ± 65.07
T3	$218.47^{c} \pm 6.92$	395.57 ± 20.95	1543.60 ± 41.40	2157.64 ± 55.23
T4	$238.78^{ab} \pm 5.14$	463.01 ± 15.45	1413.51 ± 59.74	2115.30 ± 70.11
T5	$243.22^{a} \pm 4.98$	471.75 ± 22.48	1540.46 ± 60.79	2255.43 ± 71.38
T6	$249.01^{a} \pm 5.05$	436.25 ± 21.98	1629.43 ± 57.11	2314.70 ± 75.18
CV%	5.30	14.07	7.40	6.28
SEm	6.22	30.79	56.48	68.28
CD at 5%	18.47	NS	NS	NS

Means bearing different superscripts within same column differ significantly ($p<0.05$). NS=Non-significant.

Table 3: Effect of dietary supplementation of arginine on feed consumption (g/bird) of broiler chicken

Treatments	Feed consumption (g/bird)			
	$TFC_{0\text{-}10d}$ (Starter)	$TFC_{11\text{-}21d}$ (Grower)	$TFC_{22\text{-}42d}$ (Finisher)	$TFC_{0\text{-}6wk}$ (Overall)
T1	328.63 ±1.39	802.54 ±9.42	3099.83 ±23.47	4231.00 ±15.07
T2	319.33 ±3.21	836.33 ±5.94	3071.42 ±38.20	4227.08 ±36.78
T3	318.00 ±4.01	789.88 ±10.83	3061.67±20.40	4169.54 ±30.03
T4	325.00 ±3.87	827.58 ±4.29	2912.58 ±26.70	4257.54 ±49.75
T5	323.00 ±1.82	843.00 ±11.82	3054.75 ±21.61	4220.75 ±32.43
T6	326.04 ±0.62	840.29 ±11.32	3131.92 ±43.52	4298.25 ±54.77
CV%	4.17	5.57	4.85	4.48
SEm	6.73	22.94	74.16	94.91
CD at 5%	NS	NS	NS	NS

NS=Non-significant

group. Conversely, Bulbul *et al.* (2013) and Abdelmaged and Desoky (2023) observed an opposite trend, wherein birds receiving higher arginine supplementation exhibited significantly lower feed intake than the control group.

Feed Conversion Ratio

The feed conversion ratio (FCR) of birds fed the control diet (T_1) was significantly ($p < 0.05$) higher than that of birds fed the 0.4% and 0.5% arginine diets up to the second week of age and higher than those fed the 0.1%, 0.3% and 0.4% arginine diets up to the third week, indicating improved feed efficiency in the arginine supplemented groups. However, the FCR of T_1 remained statistically at par with 0.2% and 0.3% arginine up to the second week and with 0.2% and 0.5% arginine up to the third week, while 0.4% and 0.5% arginine during the second week and 0.1%, 0.3% and 0.4% arginine during the third week were at par among themselves. At the end of the experimental period (0-6_{wks}), birds fed diets supplemented with 0.5% arginine (T_6) and 0.4% arginine (T_5) exhibited numerically improved FCR (Table 4). Murakami *et al.* (2012) similarly reported no significant differences in FCR at 42 days of age, suggesting that the beneficial effects of arginine supplementation are more pronounced during the early growth phase. In contrast, the present findings differ from those of Al-Daraji and Salih (2012), Bulbul *et al.* (2013), Yazdanabadi *et al.* (2020), Hameed *et al.* (2021), Nassar *et al.* (2022), Abdelmaged and Desoky (2023), Brugaletta *et al.* (2023) and Khyber *et al.* (2024), who reported significantly ($p < 0.05$) improved FCR in broilers fed arginine supplemented diets compared to control groups.

Livability (%)

Livability of birds in all the groups was 100.00%, except T_4 group, which recorded one mortality, resulting in a livability of 95.83% during the entire experimental period. Similar observations were reported by Hameed *et al.* (2021), where higher dietary arginine levels resulted in improved livability. Al-Daraji and Salih (2012) also found increased survival rates in arginine supplemented groups (up to 90.6%) as compared to the control group. In contrast**,** Nassar *et al.* (2022) and Brugaletta *et al.* (2023) recorded near perfect livability (above 99%) in both control and arginine supplemented groups, indicated that arginine inclusion did not negatively affect survival.

Economics: Return over Feed Cost (ROFC)

The Return Over Feed Cost (ROFC) (Rs./bird) for birds fed the T_1, T_2, T_3, T_4, T_5 and T_6 diets was 39.89, 38.01, 37.85, 36.43, 41.64 and 42.60, respectively. The highest ROFC was recorded in birds fed the T_6 diet, followed by those fed T_5,

Table 4: Effect of dietary supplementation of arginine on feed conversion ratio of broiler chicken

Treatments	Feed Conversion Ratio					
	FCR_{0-1}	FCR_{0-2}	FCR_{0-3}	FCR_{0-4}	FCR_{0-5}	FCR_{0-6}
T1	1.02±0.01	1.41^{a}±0.02	1.74^{a}±0.02	1.80±0.02	1.85±0.01	1.91±0.01
T2	0.96±0.01	1.32^{bc}±0.01	1.55^{b}±0.02	1.73±0.02	1.84±0.01	1.91±0.01
T3	0.99±0.00	1.39^{ab}±0.01	1.69^{ab}±0.02	1.77±0.01	1.84±0.01	1.89±0.01
T4	1.00±0.01	1.33^{abc}±0.01	1.55^{b}±0.02	1.72±0.01	1.82±0.01	1.88±0.01
T5	0.97±0.00	1.31^{c}±0.00	1.55^{b}±0.02	1.66±0.02	1.78±0.02	1.84±0.01
T6	0.98±0.01	1.29^{c}±0.00	1.60^{ab}±0.02	1.68±0.02	1.78±0.01	1.83±0.02
CV%	3.86	3.70	5.87	4.41	3.19	2.94
SEm	0.02	0.02	0.05	0.04	0.03	0.03
CD at 5%	NS	0.07	0.14	NS	NS	NS

Means bearing different superscripts within same column differ significantly ($p<0.05$). NS=Non-significant.

Table 5: The Return Over Feed Cost (ROFC) (Rs./bird) of birds fed with different diets

Particulars	Treatments					
	T_1	T_2	T_3	T_4	T_5	T_6
Total feed consumption (g)	4231.00	4227.08	4169.54	4257.54	4220.75	4298.25
Total cost of feed consumed including cost of Arginine (Rs./bird)	159.64	161.15	160.54	158.13	165.77	170.48
Cost of feed (Rs./kg broiler bird)	72.01	72.89	72.94	73.24	72.14	72.27
Average body weight (kg)	2.217	2.211	2.201	2.159	2.298	2.359
Income from selling of birds (@ 90 Rs./ kg live bodyweight)	199.53	199.00	198.09	194.31	206.82	212.31
ROFC (Rs./ bird)	**39.89**	**37.85**	**37.55**	**36.18**	**41.05**	**41.83**

*The price of Arginine was taken @ Rs.350/- per kg

T_1, T_2, T_3 and T_4 diets (Table 5). The findings of the present study were in agreement with Al-Daraji and Salih (2012), who reported significantly higher economic returns in arginine supplemented groups, particularly at higher inclusion levels, indicating improved profitability through enhanced overall performance. Similarly, Nassar *et al.* (2022) observed higher net revenue in birds supplemented with arginine (0.5 g/kg feed) compared to the control and other treatment groups. Overall, the results suggest that dietary arginine supplementation is an effective strategy for improving productive performance and economic efficiency in broiler production.

Conclusions

Dietary supplementation of arginine enhanced growth performance and feed efficiency during early phase of life in broiler birds fed with 0.5% arginine and 0.4% arginine treatment diets. Throughout the entire experimental period, the best performance was observed in terms of body weight, body weight gain, feed efficiency and Return over Feed Cost in the birds fed diet with 0.5% arginine, followed by the birds fed diet with 0.4% arginine. Hence, on the basis of research findings of present study, it can be concluded that arginine (@ 0.4% and 0.5%) can be used as an efficient feed supplement for improving growth performance, feed efficiency and economic return in commercial broilers.

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