

Effect of Dietary Supplementation of Azolla Meal on Performance of Commercial Broiler Chicken

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ABSTRACT

An experiment was carried out to investigate the effect of dietary supplementation of Azolla meal on performance of commercial broiler chicken. A total of 144 straight-run day-old chicks were randomly assigned to six treatments, each consisting of 4 replicates with 6 chicks totalling 24 chicks per treatment. Birds in treatment T1 were fed with control basal diet, and those in T2, T3, T4, T5 and T6 received control basal diet supplemented with 5, 10, 15, 20 and 25% Azolla meal, respectively. Body weight (BW₆) and body weight gain (BW_{G0-6}) of birds fed with diet containing 5% Azolla meal (T2) up to 6th week of age were significantly ($p < 0.05$) higher as compared to birds fed with control diet and diet containing higher levels of Azolla meal. Total feed consumption (TFC₀₋₆) of broiler birds fed with diet containing 5% & 10% Azolla meal was at par and was significantly ($p < 0.05$) higher as compared to birds fed with control (T1) diet and diet containing 15, 20 & 25% Azolla meal. Feed conversion ratio (FCR₀₋₆) of control (T1) diet was improved significantly ($p < 0.05$) as compared to birds fed with diet containing higher levels of Azolla meal. No bird died during the experiment and ROFC was higher in control diet than other treatment diets. Based on the study it can be concluded that supplementation of Azolla meal up to 5% in diet has a good effect on body weight gain without any deleterious effect on chicken, but due to reduced ROFC for high cost of Azolla meal, it is not economically viable to use.

Key words: Alternative protein source, Azolla meal, Commercial broiler chicken, Growth performance

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INTRODUCTION

Poultry farming among Indian livestock vocations occupies a special position because of enormous potential of bringing rapid economic growth incurring low investment. The broiler chicken production has emerged as a rapidly growing venture for both rural and commercial poultry farmers, leading to the establishment of numerous farms across the country and creating job opportunities for young, unemployed individuals. However, farmers face challenges; including the availability and high cost of quality feed ingredients, as well as the need to produce high-quality products cost-effectively. The daily increase in feed costs remains a major obstacle for poultry farming in India (Kumar *et al.*, 2012; Pathak *et al.*, 2019; Zargar *et al.*, 2020). This wide gap between availability and requirement of feed material can be filled by effective use of some non-conventional feed resources like Azolla meal either by replacing a certain quantity of their diet or under choice feeding system.

Azolla is a floating fern belonging to the Salviniaceae family, characterized by a small branching stem and roots that hang in the water. Azolla is very rich in proteins, essential amino acids, β -carotene, vitamin B12, growth promoter and minerals including calcium, phosphorus, ferrous, and copper. This is essential for bone formation and supports optimal nerve and muscle function. Additionally, it contains magnesium, an important cofactor for various metabolic processes, and potassium, which plays a key role in maintaining osmotic balance between cells and the surrounding fluid (Kamalasanana *et al.*, 2002; Anuar *et al.*, 2022). So, this study was planned to evaluate the effect of

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dietary supplementation of different levels of Azolla meal on performance of commercial broiler chicken.

MATERIALS AND METHODS

The experiment was conducted at Poultry Research Station, Veterinary and Animal Science Research and Extension Unit, Kamdhenu University, Anand, Gujarat using 144 straight run day-old commercial broiler chicks of a single hatch from a private hatchery. The duration of experiment was six weeks (1st August to 11th September, 2024). The average temperature during the study was 28.9 °C and relative humidity 83.8%. After arrival, chicks were wing-banded and weighed individually.

The chicks were randomly distributed into six treatments (T_1 , T_2 , T_3 , T_4 , T_5 and T_6); each consisted of 4 replicates of six chicks each totaling to 24 chicks per treatment. Six experimental diets were formulated and provided *ad libitum* to the birds of respective treatments as pre-starter, starter, and finisher diets during 0-7 days, 8-21 days and 22-42 days of age, respectively. Control diet was formulated as per BIS-2007 specifications and it was considered as control diet (T_1) without Azolla meal. Within the remaining experimental diets, *i.e.*, T_2 to T_6 , control diet was supplemented with the Azolla meal @ 5, 10, 15, 20 and 25%, respectively. Standard medication protocols were followed. All essential biosecurity measures were implemented. The birds were immunized against Ranikhet Disease (RD) and Infectious Bursal Disease (IBD) according to the standard schedule. During the experiment, body weight, body weight gain, viability, feed consumption and feed conversion ratio (FCR) were recorded. The data were analyzed using Completely Randomized Design as per Snedecor and Cochran (1994). Means of replicates under each treatment were considered for analysis.

RESULTS AND DISCUSSION

Body Weight

The mean body weight (BW) at day old age did not differ significantly among treatment diets. At the end of 6th week, the body weight of birds fed with 5% Azolla meal was significantly ($p < 0.05$) higher than birds fed with 10%, 15%, 20% and 25% Azolla meal in diet, but was statistically at par with the birds fed with control diet (Table 1). The present findings were in accordance with Rawat *et al.* (2015), Joysowal *et al.* (2018), Kumar *et al.* (2018) and El-Aal *et al.* (2023), who found that broiler chicken fed diet inclusive of 5% Azolla meal had significantly ($p < 0.05$) higher body weight at 42 days of age as compared to birds fed with diet without Azolla meal. Similarly, Samad *et al.* (2020), Kamel and Hamed (2021), AL-Shwilly (2022) and Ibrahim *et al.* (2024) also found that broiler chicken fed diets supplemented with Azolla meal had significantly ($p < 0.05$) higher body weight as compared to birds fed with control diet. However, contrary to present findings, Paudel *et al.* (2015), Hassen *et al.* (2019) and Rengma

et al. (2019) reported that the birds fed diet without Azolla meal attained higher body weights than treatment diets.

Table 1: Body weight (BW) of broilers fed diet with different inclusion levels of Azolla meal

Treatments	BW ₀ (g)	BW ₆ (g)
T_1	45.32 ± 0.77	2369.63 ^{ab} ±58.66
T_2	44.61±0.79	2442.00 ^a ±47.35
T_3	45.83±0.66	2274.88 ^b ±50.34
T_4	44.01 ± 0.66	2078.46 ^c ±59.14
T_5	44.48 ± 0.50	1931.42 ^d ±41.75
T_6	46.20± 0.78	1792.33 ^e ±39.19

Means with different superscripts within a column differs significantly ($p < 0.05$).

Body Weight Gain

During the pre-starter phase (BWG₀₋₁), the body weight gain (BWG) of birds fed diet with control, 5% and 10% Azolla meal was at par and significantly ($p < 0.05$) higher as compared to the birds fed diet with 15%, 20% and 25% Azolla meal. In starter phase (BWG₂₋₃), the body weight gain of birds fed diet with 5% Azolla meal was significantly ($p < 0.05$) higher than the birds fed with control, 15%, 20% and 25% Azolla meal. However, no significant differences were observed between T_1 and T_3 , and T_1 and T_4 diets. During finisher phase (BWG₄₋₆), the body weight gain of birds fed diet with 5% Azolla meal was significantly ($p < 0.05$) higher than all other treatments, but statistically at par with control diet. The overall body weight gain (BWG₀₋₆) of birds fed diet with 5% Azolla meal was significantly ($p < 0.05$) higher than birds fed with higher levels of Azolla meal, although statistically it was at par with control diet. There was gradual and significant drop in overall BWG with increasing levels of Azolla meal in the diets from 5% to 25% (Table 2). Present results are similar to the findings reported by Kumar *et al.* (2018), Samad *et al.* (2020), Kamel and Hamed (2021), El-Aal *et al.* (2023) and Ibrahim *et al.* (2024), who observed that inclusion of Azolla meal in broiler diets resulted in significantly ($p < 0.05$) higher body weight gain as compared to control diet. However, the current results are in contrast to Paudel *et al.* (2015), Hassen *et al.* (2019) and Rengma *et al.* (2019), who reported lower body weight in birds fed with Azolla meal diets than the control diet.

Table 2: Body weight gain (BWG), Feed consumption (FC) and Feed conversion ratio (FCR) of broilers fed diet with different levels of Azolla meal at different stages of life

Parameter	Treatments	BWG ₀₋₁	BWG ₂₋₃	BWG ₄₋₆	BWG ₀₋₆
Body weight gain (g)	T_1	104.66 ^a ±3.85	622.85 ^{bc} ±19.20	1596.79 ^{ab} ±41.98	2324.30 ^{ab} ±51.22
	T_2	109.87 ^a ±2.65	675.71 ^a ±13.00	1611.88 ^a ±31.65	2397.40 ^a ±23.63
	T_3	102.61 ^a ±4.42	636.60 ^{ab} ±13.01	1489.83 ^b ±13.45	2229.04 ^b ±21.78
	T_4	92.20 ^b ±2.75	592.13 ^c ±22.53	1350.13 ^c ±22.65	2034.45 ^c ±20.12
	T_5	86.99 ^b ±2.94	447.57 ^d ±9.38	1352.38 ^c ±57.50	1886.93 ^d ±61.78
	T_6	89.64 ^b ±2.81	438.66 ^d ±5.56	1217.83 ^d ±49.23	1746.13 ^e ±48.32



	Treatments	FC ₀₋₁	FC ₂₋₃	FC ₄₋₆	FC ₀₋₆
Feed consumption (g)	T ₁	155.78 ^b ±4.36	885.29 ^a ±28.53	3052.88±82.28	4093.99 ^{bc} ±109.82
	T ₂	173.78 ^a ±5.11	942.33 ^a ±17.44	3222.17±47.78	4338.28 ^a ±65.08
	T ₃	166.89 ^{ab} ±5.10	929.58 ^a ±29.72	3106.58±61.86	4203.05 ^{ab} ±89.45
	T ₄	165.57 ^{ab} ±1.69	904.38 ^a ±25.91	3052.46±15.93	4122.41 ^{bc} ±34.83
	T ₅	162.72 ^{ab} ±1.36	769.50 ^b ±9.95	3150.79±46.01	4083.02 ^{bc} ±43.46
	T ₆	157.48 ^b ±4.27	790.79 ^b ±7.04	3027.79±27.23	3976.07 ^c ±30.06
	Treatments	FCR ₀₋₁	FCR ₂₋₃	FCR ₄₋₆	FCR ₀₋₆
Feed conversion ratio	T ₁	1.04 ^c ±0.01	1.42 ^{de} ±0.01	1.91 ^d ±0.06	1.73 ^d ±0.04
	T ₂	1.13 ^b ±0.02	1.39 ^e ±0.00	2.00 ^d ±0.05	1.78 ^{cd} ±0.03
	T ₃	1.13 ^b ±0.02	1.46 ^d ±0.02	2.08 ^{cd} ±0.03	1.85 ^c ±0.02
	T ₄	1.22 ^a ±0.02	1.53 ^c ±0.02	2.26 ^{bc} ±0.04	1.98 ^b ±0.02
	T ₅	1.24 ^a ±0.02	1.72 ^b ±0.02	2.34 ^{ab} ±0.10	2.12 ^a ±0.06
	T ₆	1.16 ^{ab} ±0.05	1.80 ^a ±0.02	2.50 ^a ±0.08	2.22 ^a ±0.05

Means with different superscripts within a column for a parameter differs significantly ($p < 0.05$).

Feed Consumption (FC)

The feed consumption in the pre-starter phase for birds fed with 5% Azolla meal was significantly ($p < 0.05$) higher as compared to birds fed with control and T₆ diets, and the values of T₂ to T₅ were statistically similar. In the starter phase, feed consumption of birds fed with T₁ was the highest yet statistically similar to T₁ to T₄ diets, and all these were significantly ($p < 0.05$) higher than T₅ and T₆ diets. During the finisher phase feed consumption of birds fed with different diets did not differ significantly, although it was highest in T₂ and lowest in T₆ diet. The overall feed consumption of birds fed with 5% Azolla meal was significantly ($p < 0.05$) higher than birds fed with control and other Azolla meal diets, except with 10%, which was at par with 5% level. The overall FC showed a decreasing trend with increase in the level of Azolla meal (Table 2). This decrease in feed consumption may be due to high fibre content and lower palatability of diets with increasing levels of Azolla meal. Present results are similar to the reports of Paudel *et al.* (2015), and Islam and Nishibori (2016), who showed significantly ($p < 0.05$) higher feed consumption in birds fed with Azolla meal as compared to control diet. Similarly, Rana *et al.* (2017), Kumar *et al.* (2018) and El-Aal *et al.* (2023) found significantly ($p < 0.05$) higher feed consumption of diet containing 5% and 10% Azolla meal as compared to control diet. However, Rawat *et al.* (2015), Hassen *et al.* (2019), Kamel and Hamed (2021) and Ibrahim *et al.* (2024) reported that the dietary treatments had no similar effect on the feed intake during the overall experimental period.

Feed Conversion Ratio (FCR)

The feed conversion ratio of birds during pre-starter phase (0-1 week of age) was significantly ($p < 0.05$) better in birds fed with control diet as compared to other treatment diets. During starter phase (2-3 week of age) the feed conversion ratio of birds was significantly ($p < 0.05$) improved in 5% Azolla

meal, at par with control, than the birds fed with higher levels of Azolla meal, while in the finisher phase (4-6 week of age), feed conversion ratio was found to be significantly similar and better in T₁, T₂ and T₃ than rest of the diets. The overall feed conversion ratio of birds was significantly better ($p < 0.05$) with control diet, at par with 5% Azolla, as compared to birds fed with higher levels of Azolla meal. Inclusion of Azolla meal at higher levels adversely affected the FCR of broiler birds at different stages (Table 2). Present results were contradictory with the findings of Rawat *et al.* (2015), Islam and Nishibori (2016), Rana *et al.* (2017), Kumar *et al.* (2018), Hassen *et al.* (2019), Rengma *et al.* (2019), Kamel and Hamed (2021), AL-Shwilly (2022), El-Aal *et al.* (2023) and Ibrahim *et al.* (2024), who reported better FCR at higher rates of Azolla meal inclusion. The higher concentrations of Azolla meal in the diet lower the palatability and increase the fibre content, which resulted on lower feed intake and thereby decrease in growth performance and increased FCR.

Economics: Return over Feed Cost (ROFC)

ROFC (Rs. /bird) from the birds fed with T₁, T₂, T₃, T₄, T₅ and T₆ diets was 51.53, 43.49, 36.82, 26.68, 17.58 and 11.70, respectively. The highest ROFC was obtained in the birds fed with T₁ diet followed by T₂, T₃, T₄, T₅ and T₆ diets, respectively (Table 3). ROFC was lower in treatment diets than the control diet due to high price of Azolla Meal. The findings of the present study were in agreement with Paudel *et al.* (2015) who found higher economical returns (*i.e.*, profit per bird) when the birds were fed with control diet as compared to birds fed with the treatment diets. The present results were in contrast to the results observed by Basak *et al.* (2002), Dhumal *et al.* (2009), Ara *et al.* (2015), Islam and Nishibori (2016), Mishra *et al.* (2016), Hassen *et al.* (2019) and Kamel and Hamed (2021), who observed that diets with Azolla meal resulted in considerably higher profit.

Table 3: Return Over Feed Cost (ROFC) of birds fed with different treatment diets

Particulars	Treatments					
	T ₁	T ₂	T ₃	T ₄	T ₅	T ₆
Total feed consumption (g)	4093.99	4338.28	4203.05	4122.41	4083.02	3976.07
*Actual feed cost (Rs./bird) (A)	171.16	175.21	156.03	137.65	122.93	107.25
Cost of Azolla meal powder (Rs. /bird) @ 50 Rs./kg (B)	0	10.85	21.00	31.00	41.00	49.50
Total feed cost/bird (A + B)	171.16	186.06	177.03	168.65	163.93	156.75
Cost of feed (Rs./kg broiler bird)	72.25	75.58	75.81	77.98	79.67	79.73
Average body weight (kg)	2.369	2.442	2.275	2.078	1.931	1.792
Income from selling of birds (@ 94 Rs./kg body weight)	222.69	229.55	213.85	195.33	181.51	168.45
ROFC (Rs./bird)	51.53	43.49	36.82	26.68	17.58	11.70

*Feed cost of pre-starter, starter and finisher mess was Rs. 40.19, 41.44 and 42.00 per kg, respectively, and in T₁ to T₆ diet it varied from Rs. 42.64 to 35.12 as per the levels of costly ingredients replaced with inclusion of Azolla meal.

CONCLUSIONS

Broiler birds fed with diet containing 5% Azolla meal performed equally well in terms of growth performance and feed efficiency with control diet as compared to birds fed with higher levels of Azolla meal from 15 to 25%, which showed reduced performance in broiler chicken. Higher inclusion level of Azolla meal increases the feed cost, which results into lower economic return. Thus, it is not recommended to use Azolla meal in the broiler diet.

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