BROILER CHARACTERISTICS OF JAPANESE QUAILS (COTURNIX COTURNIX JAPONICA) AT DIFFERENT LEVELS OF DIET SUBSTITUTION WITH AZOLLA PINNATA

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ABSTRACT

The shrinking resources of world grain production and its escalating cost has triggered search for cheap unconventional feeds for poultry production. The present study aims to explore *Azolla pinnata*, a water fern, abundantly available in stagnant water in tropic and sub-tropic regions in world, but has been sparsely studied, as a potential feed resource in quails. This experiment was conducted for six weeks (42 days) on 192 day-old Japanese quails (*Coturnix coturnix japonica)* randomly allotted to four treatments, with different levels of *Azolla pinnata* (A) in the diet, *viz*., T_1 (0% A), T_2 (2.5% A), T_3 (5% A), and T_4 (7.5% A) with four replicates of twelve chicks in each group to evaluate its effect on important broiler characteristics like growth, feed utilization, and cost efficiency. The chicks were fed on isonitrogenous and isocaloric starter-cum-grower rations with 26% crude protein (CP) and 2700 Kcal / kg metabolic energy (ME). The study revealed that the broiler characteristics of T_3 chicks (5% A) with respect to body weight (g) at 6th week (169.81 ± 2.27), cumulative gain in body weight (g) in 6 weeks (162.40 ± 2.05), cumulative feed conversion efficiency (g) in 6 weeks (4.58 ± 0.05) were significantly ($P \leq 0.05$) superior to T_4 (7.5% A), but did not differ ($P \geq 0.05$) from T_1 (control) and T_2 (0.25% A) chicks, and was more economical owing to less expenditure on feed per chick (₹ 8.13) than T_1 (₹ 8.27), T_2 (₹ 8.18), and T_4 (₹ 8.16) chicks in six weeks, resulting in higher savings (1.69%) over the control (T_1), compared to T_2 (1.08%) and T_4 (1.33%) chicks. The livability in Azolla fed groups (T_2, T_3, T_4) was very high (99.3%) indicating the potential of *Azolla pinnata* as a cheap, safe and high density nutrient-rich feed resource for quails. The displacement level of 5% Azolla in diet was considered optimum in quails, as there was depression in broiler characteristics beyond this level.

KEY WORDS

Azolla, Cost efficiency, Feed efficiency, Growth, Quail

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INTRODUCTION

In poultry production, feed cost accounts for nearly 60 per cent of the total cost of production (Shaikh and Zala, 2011), of which the principal ingredients are cereals. The increasing cost of cereal grains increases the feed cost, and consequently the cost of poultry production. There is a conscientious effort to switch on to non-conventional feed items to slash feed cost in poultry production.

The planktonic algae of both marine and fresh water origin are considered to be potential sources of alternate feed items as a substitute for cereal grains in poultry ration. Azolla (*Azolla pinnata*), an aquatic fern, abundantly available in stagnant water in tropical and subtropical regions of the world, can be used as a suitable feed substitute, as it is very rich in proteins, essential amino acids, vitamins, growth promoter intermediaries, and minerals (Pillai *et al*., 2002), particularly so in small avian species like quails, which need high density nutrient rich feed.

Azolla has been recommended for feeding broiler and layer chickens (Parthasarathy *et al*., 2001; Basak *et al*., 2002), but studies on the feeding value of Azolla in Japanese quails are very limited. Hence in this study, an attempt was made to investigate the effect of feeding Azolla (*Azolla pinnata*) on broiler characteristic like growth and feed conversion efficiency in Japanese quails (*Coturnix coturnix japonica*) and to determine the optimum level to be incorporated in feed for superior performance.

MATERIALS AND METHODS

The experiment was conducted at the University Poultry Farm attached with College of Veterinary and Animal Sciences, Mannuthy to study the effect of dried Azolla (*Azolla pinnata*) as a feed ingredient in Japanese quail ration. Azolla was collected from the ponds maintained at the farm, sun dried, ground, and stored in plastic bags, until used for feeding.

The proximate analysis of dried Azolla showed that it contained 88.80% dry matter (DM), 25.46% crude protein (CP), 2.66% ether extract (EE), 14.80% crude fiber (CF), 41.58% nitrogen free extract (NFE), and 15.5% total ash. The dried Azolla also contained 2.25% calcium and 0.40% phosphorus. The calculated metabolic energy value of dried Azolla was found to be 1807 kcal / kg.

The experiment started with 192 day-old Japanese quail chicks, belonging to single hatch, were weighed individually, and were allotted randomly to four treatment groups (T_1, T_2, T_3, T_4) with four replicates of twelve quails each. The chicks of four treatment groups were fed on four isonitrogenous and isocaloric starter-cum-grower rations with 26% crude protein (CP) and 2700 Kcal / kg metabolic energy (ME). The diets for T_1, T_2, T_3, and T_4 chicks contained 0%, 2.5%, 5% and 7.5% dried Azolla respectively. The compositions and cost of the rations are given in Table-1.

The quails were housed replicate wise in separate cages with dimension of 76 x 63 x 26 cm, and were maintained under uniformly standard management conditions. The birds were reared up to 6 weeks (42 days) of age, and various broiler parameters *viz*., body weight, gain in body weight, feed consumption, and feed conversion efficiency and livability were evaluated on weekly basis. The data were analysed by standard statistical procedures.

Table-1. The composition and cost of the rations at different levels of Azolla (A).

S. No.	Ingredient	T_1 (0%A)	T_2 (2.5% A)	T_3 (5% A)	T_4 (7.5% A)
1.	Yellow maize (kg)	47.98	47.78	47.59	47.4
2.	Wheat bran (kg)	3.73	2.50	1.25	-
3.	Soya bean meal (kg)	33.23	32.75	32.28	31.8
4.	Unsalted dried fish (kg)	10.68	10.45	10.23	10.0
5.	Deoiled rice bran (kg)	3.35	3.10	2.84	2.6
6.	Calcite (kg)	0.83	0.72	0.61	0.5
7.	Salt (kg)	0.20	0.20	0.20	0.2
8.	Azolla (kg)	Nil	2.50	5.00	7.5
9.	Total (kg)	100	100	100	100
10.	C.P. (kg)	26	26	26	26
11.	ME (Kcal / kg)	2700	2700	2700	2700
12.	Feed cost (Rs / kg)	11.11	11.03	10.95	10.87

RESULTS

The broiler parameters like, growth, feed efficiency, and cost efficiency in quails are depicted below.

Body weight: The weekly mean body weight (g) of birds in different treatment groups up to 6 weeks are presented in Table-2. There was increase in the body weight of the chicks in all the groups (T_1, T_2, T_3, T_4) up to 6th week. The chicks on Azolla supplemented diets (T_2, T_3, T_4) showed significant ($P \leq 0.05$) depression in body weight than the control (T_1) up to the third week. From 4th to 6th week, the body weights of T_4 group was significantly ($P \leq 0.05$) lower than the weights of the other three groups (T_1, T_2, T_3), while the differences among T_1, T_2, and T_3 were non-significant ($P \geq 0.05$).

Body weight gain: The weekly mean body weight gain (g) in birds in different treatment groups up to 6 weeks are presented in Table-3. The weekly gain in body weight (g) increased up to 4th week, and declined there after. The weekly gain in body weights of T_4 chicks in 1st and 2nd weeks were significantly ($P \leq 0.05$) lower than the other three groups (T_2, T_3, T_4). On 3rd and 4th weeks, body weight gains in T_2, T_3, T_4 groups were significantly ($P \leq 0.05$) lower than T_1 chicks. The differences between the groups were non-significant ($P \geq 0.05$) on 5th and 6th weeks. The cumulative gain in body weight of T_4 chicks was significantly ($P \leq 0.05$) lower than the other three groups (T_1, T_2, T_3) in 5th and 6th weeks of age.

Feed consumption: There were significant ($P \leq 0.05$) differences between groups with respect to daily feed consumption (Table-4) in 3rd, 4th, and 5th weeks, but not in 6th week ($P \geq 0.05$). However, the differences between groups with respect to cumulative feed consumption up to 5th and 6th weeks were non-significant ($P \geq 0.05$).

Table-2. Weekly mean body weight (g) of quails at different levels of Azolla (A).

Age	T_1 (0% A)	T_2 (2.5% A)	T_3 (5.0% A)	T_4 (7.5% A)	Overall
Day old	7.53 ± 0.04	7.59 ± 0.06	7.41 ± 0.06	7.50 ± 0.06	7.53 ± 0.03
Week 1	26.30^{a} ± 0.54	24.52^{b} ± 0.47	24.53^{b} ± 0.57	23.32^{b} ± 0.57	24.67 ± 0.28
Week 2	63.46^{a} ± 1.08	59.49^{b} ± 0.96	58.88^{b} ± 0.99	56.02^{c} ± 1.00	59.46 ± 0.54
Week 3	98.99^{a} ± 1.47	89.94^{b} ± 1.34	88.68^{b} ± 1.39	86.50^{b} ± 1.52	91.03 ± 0.79
Week 4	138.96^{a} ± 1.82	137.09^{a} ± 1.66	135.25^{a} ± 1.77	133.50^{b} ± 1.56	136.19 ± 0.86
Week 5	162.40^{a} ± 2.26	159.47^{a} ± 1.83	155.61^{a} ± 1.82	151.73^{b} ± 1.57	157.28 ± 0.98
Week 6	177.16^{a} ± 3.17	175.42^{a} ± 2.66	169.81^{a} ± 2.27	164.07^{b} ± 1.76	171.61 ± 1.30

Note: (1) The figures are presented as Mean ± SEM. (2) Means bearing different superscripts within a row differed significantly ($P \leq 0.05$).

Table-3. Weekly mean body weight gain (g) of quails at different levels of Azolla (A).

Age	T_1 (0% A)	T_2 (2.5%A)	T_3 (5.0%A)	T_4 (7.5%A)	Overall
Week 1	18.78^{a} ± 1.06	17.03^{a} ± 0.64	16.98^{a} ± 0.73	15.83^{b} ± 1.01	17.15 ± 0.48
Week 2	37.18^{a} ± 0.41	34.95^{a} ± 1.37	34.38^{a} ± 1.16	32.73^{b} ± 0.88	34.81 ± 0.61
Week 3	35.53^{a} ± 0.67	30.43^{b} ± 0.75	29.83^{b} ± 0.77	30.50^{b} ± 0.83	31.57 ± 0.68
Week 4	39.90^{a} ± 0.61	47.15^{b} ± 2.22	46.58^{b} ± 1.58	46.98^{b} ± 1.14	45.16 ± 1.03
Week 5	23.50 ± 3.19	22.40 ± 1.01	20.40 ± 0.36	18.25 ± 0.71	21.14 ± 0.93
Week 6	14.75 ± 1.58	15.88 ± 3.00	14.23 ± 2.57	12.28 ± 0.66	14.28 ± 1.02
5^{th} week cumulative	154.87^{a} ± 2.22	151.88^{a} ± 3.39	148.20^{a} ± 1.70	144.23^{b} ± 1.95	149.79 ± 1.49
6^{th} week cumulative	169.63^{a} ± 0.97	167.84^{a} ± 3.10	162.40^{a} ± 2.05	156.57^{b} ± 2.57	164.11 ± 1.68

Note: As in Table 2

Table-4. Average daily feed consumption (g) of quails at different levels of Azolla (A).

Age	T_1 (0% A)	T_2 (2.5% A)	T_3 (5.0% A)	T_4 (7.5% A)	Overall
Week 1	2.15 ± 0.17	2.27 ± 0.06	2.34 ± 0.10	2.37 ± 0.12	2.28 ± 0.06
Week 2	2.33 ± 0.08	2.43 ± 0.11	2.43 ± 0.07	2.51 ± 0.05	2.43 ± 0.04
Week 3	2.70 ± 0.08	2.83 ± 0.06	2.89 ± 0.06	2.75 ± 0.07	2.79 ± 0.04
Week 4	3.69 ± 0.08	3.67 ± 0.14	3.64 ± 0.08	3.70 ± 0.13	3.67 ± 0.05
Week 5	8.24^{a} ± 1.16	7.69^{b} ± 0.39	8.94^{a} ± 0.11	10.12^{a} ± 0.30	8.75 ± 0.37
Week 6	13.67 ± 1.80	13.78 ± 3.33	13.96 ± 1.93	15.70 ± 0.89	14.28 ± 0.99
5^{th} week cumulative	3.56^{a} ± 0.07	3.63^{a} ± 0.09	3.77^{a} ± 0.02	3.88^{b} ± 0.04	3.71 ± 0.04
6^{th} week cumulative	4.40^{a} ± 0.05*	4.43^{a} ± 0.07*	4.58^{a} ± 0.05*	4.80^{b} ± 0.07*	4.55 ± 0.05*

Note: As in Table 2

Table-5. Average daily feed conversion efficiency (g) of quails at different levels of Azolla (A).

Age	T_1 (0% A)	T_2 (2.5%A)	T_3 (5.0%A)	T_4 (7.5%A)	Overall
Week 1	2.15 ± 0.17	2.27 ± 0.06	2.34 ± 0.10	2.37 ± 0.12	2.28 ± 0.06
Week 2	2.33 ± 0.08	2.43 ± 0.11	2.43 ± 0.07	2.51 ± 0.05	2.43 ± 0.04
Week 3	2.70 ± 0.08	2.83 ± 0.06	2.89 ± 0.06	2.75 ± 0.07	2.79 ± 0.04
Week 4	3.69 ± 0.08	3.67 ± 0.14	3.64 ± 0.08	3.70 ± 0.13	3.67 ± 0.05
Week 5	8.24^a ± 1.16	7.69^b ± 0.39	8.94^a ± 0.11	10.12^a ± 0.30	8.75 ± 0.37
Week 6	13.67 ± 1.80	13.78 ± 3.33	13.96 ± 1.93	15.70 ± 0.89	14.28 ± 0.99
5th week cumulative	3.56^a ± 0.07	3.63^a ± 0.09	3.77^a ± 0.02	3.88^b ± 0.04	3.71 ± 0.04
6th week cumulative	4.40^a ± 0.05*	4.43^a ± 0.07*	4.58^a ± 0.05*	4.80^b ± 0.07*	4.55 ± 0.05*

Note: (1) The figures are presented as Mean ± SEM. (2) Means bearing different superscripts within a row differed significantly ($P \leq 0.05$). (3) *The differences between 5th and 6th week cumulative feed conversion ratio in different groups were significant ($P \leq 0.01$).

Table-6. Feed consumption and cost-efficiency per chick in six weeks at different levels of Azolla (A).

S. No.	Item	T_1 (0% A)	T_2 (2.5%A)	T_3 (5.0%A)	T_4 (7.5%A)
1	Total feed (kg) / group	35.78	35.64	35.67	36.04
2	Total feed (kg) / chick	0.745	0.742	0.743	0.751
2	Total feed cost (₹) / chick	8.27	8.18	8.13	8.16
3	Saving (₹) / chick	—	0.09	0.14	0.11
4	Saving (%) / chick	—	1.08	1.69	1.33

Feed conversion ratio: The cumulative feed conversion ratios (Table-5) of chicks of T_4 group in 5th and 6th weeks were significantly lower ($P \leq 0.05$) than the other three groups. The differences between T_1, T_2, and T_3 were non-significant ($P \geq 0.05$). The differences between 5th and 6th week cumulative feed conversion ratio in different groups were highly significant ($P \leq 0.01$).

Cost efficiency: The chicks in T_3 (5% A) diet were found to be most economical with respect to the cost of feed (Rs), savings (Rs), and savings (%) per chick (Table-6).

Livability: The mean livability percentage of Japanese quails during the experimental period was excellent with one mortality each in T_1 and T_4 group of chicks.

DISCUSSION

Our study revealed that the broiler characteristics of chicks of T_3 group with 5% Azolla in diet did not differ significantly ($P \geq 0.05$) from the normal control chicks (T_1), with respect to body weight (g) at 6th week (169.81 ± 2.27), cumulative gain in body weight (g) in 6 weeks (162.40 ± 2.05), cumulative feed conversion efficiency (g) in 6 weeks (4.58 ± 0.05), and had lower feed cost per chick (₹ 8.13) over the chicks on normal diet. The broiler performance was depressed beyond 5% substitution of Azolla.

Our findings are consistent with the observations of Parthasarathy *et al.* (2001) and Basak *et al.* (2002), who have indicated that the optimum level of Azolla in the diet of broilers should be limited to 5% for superior performance and better economic returns ($P \leq 0.01$). Higher levels (10%, 15%, and 20%) hamper nutrient utilization (Basak *et al.*, 2002) due to high levels of NDF, ADF, and lignin (Alalade and Iyayi, 2006). Azolla is a potential feed resource for chicks, as it is rich in protein, essential amino acids, vitamins, growth promoter intermediaries, and minerals (Pillai *et al.*, 2002).

CONCLUSION

The finding of the study indicated that dietary supplementation of dried Azolla @ 5% was optimum in Japanese quails used for broiler purpose. Dietary inclusion at this level has no deleterious effect, and did not affect livability.

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