UTILIZATION OF RAW AZOLLA AS A NATURAL FEED ADDITIVE FOR SUSTAINABLE PRODUCTION IN NICOBARI FOWL*

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ABSTRACT

Back yard poultry, a common livelihood for poor farmers in Andaman & Nicobar Islands is facing recession due to prohibitive feed cost. This paper has examined the prospects of supplementing commercial feed with raw Azolla (*Azolla pinnata*), a nutrient-rich water fern, originally imported from mainland India, but adapted well to the local ecosystem, on the production performance of Nicobari fowl. There has been no such study earlier. Forty-week old, 72 chicks were divided into two groups of 36 birds for the study. The control group was given commercial feed (basal diet) at the rate of 120 g per chick per day, while the experimental group was given raw Azolla, at the rate of 200 g per chick per day in separate feeder, in addition to 120 g of basal diet, from 45-60 weeks. The growth, feed conversion efficiency, hen housed egg production, immunocompetence, and economic impact of supplementation were assessed. The final body weight of the birds (1560.0±26.8 g), and gain in body weight / day (2.77±1.78 g) were higher, and the feed conversion ratio (36.10 ± 1.19 g) was better in Azolla supplemented group than the birds in control group, during the experimental period ($P \geq 0.05$). The mean hen housed egg production / week between 45-60 weeks in Azolla fed group (64.76±1.57) was not different ($P \geq 0.05$) from the control (65.25±1.51), so also weekly egg production in different weeks, e.g. 45-48, 49-52, 53-56, and 57-60 weeks. There was no difference ($P \geq 0.05$) between the two groups with respect to immunocompetence, measured in terms of HI titre, MER titre, Foot-Index, and total serum protein concentration. There was 30.73% reduction ($P \leq 0.01$) in feed consumption in Azolla supplemented group that culminated in ₹ 0.76 savings on feed cost per egg per day over the control. The study tends to conclude that *Azolla* is a good feed additive for sustainable egg production in Nicobari fowl with no reconciliation in immunocompetence, but profitable due to savings on feed cost. The role of *Azolla* as a feed additive for economising poultry production was not reported earlier.

KEY WORDS

Azolla, Feed additive Immunocompetence, Nicobari fowl, Production sustainability

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INTRODUCTION

Back yard poultry is common in Andaman & Nicobar group of Islands. But, high feed cost is a major deterrent to poultry farming in this island state (Kumar *et al*., 2006). Studies have indicated that feed cost alone accounts for 70% of the total cost of production in poultry (Parthasarathy *et al*., 2002). There is always a craving for alternate indigenous feed resources to replace commercial as well as compounded poultry feed to curtail the cost of production. Azolla, an abundantly available aquatic fern in ponds, ditches, and paddy fields in tropical and subtropical regions of the world was grown at this institute (CARI) confirming the adaptability of this algae (*Azolla pinnata*) to A&N island's ecosystem (Figure-1), and has been recommended as a good feed resource, due to its high nutrient contents (Pillai *et al*., 2002; Alalade and Iyayi, 2006).

Incorporation of Azolla as a feed ingredient in poultry ration up to 5% has shown growth, feed conversion, protein efficiency and energy efficiency, comparable to the birds on normal ration, and had no deleterious health effect (Basak *et al*., 2002), along with promising economic returns (Parthasarathy *et al*., 2001). It is supported by the findings of Shamna *et al*. (2013), who have reported that growth and feed conversion efficiency in quails on *Azolla pinnata* at 5% displacement level of the basal ration was as good as the basal diet, besides it was more economical due to less expenditure on feed.

There has been no study on the performance of Nicobari fowl on raw Azolla supplemented feed. This study was carried out to evaluate the broiler performance, hen housed egg production, innate immune status, and economic viability of fresh Azolla supplemented feed in Nicobari fowl.

Figure-1. Azolla cultivation in CARI farm.

MATERIALS AND METHODS

This study was conducted at the Division of Animal Science, Central Agricultural Research Institute, Port Blair, Andaman & Nicobar Islands, on 40 weeks old, 72 Nicobari chicken, divided into two groups of 36 birds, with six birds in each of six replicates.

Harvest and Feeding of Azolla: Azolla, introduced from Tamilnadu Agricultural University (TNAU), Coimbatore, and cultivated at our Institute was harvested, and was thoroughly washed to get rid of cow dung smell. Harvested Azolla contained 8% dry matter, rest (92%) was moisture. The control group was given

commercial feed (basal diet) at the rate of 120 g per chick per day, while the experimental group was given the basal diet at the same rate given to the control group, along with raw azolla (*Azolla Pinnata*) at the rate of 200 gm per chick per day in separate feeder. Both the groups were maintained under similar management conditions. Water was provided *ad libitum* and 16-hour photoperiod was provided. The trial was conducted for 16 weeks (45-60).

Estimation of Production parameters: The data on body weight, feed consumption, and egg production were recorded. Feed conversion ratio was estimated as the amount (gm) of feed consumed per gram gain in body weight. The cost: benefit was estimated in terms of feed cost saved per egg per day over the control group. The data were statistically analysed as per Snedecor and Cochran (1994).

Immunocompetence analysis: Ten millilitre (10 ml) of blood was drawn from the jugular vein of two healthy goats in Alseveir's solution and goat red blood cell (GRBC) suspension (2%, v / v) was prepared in phosphate buffer solution (PBS) by mixing at the ratio of 1:1.

GRBC suspension (0.25ml) was injected intravenously in the wing vein, in both the groups of birds (Control and Azolla). About 1ml of blood was collected from the group of birds on 0, 7^{th,} 14th and 21st day, post-immunization with GRBC.

The innate immunocompetency status was measured (Gross and Seigel, 1988) against GRBC immunisation by means of anti-GRBC antibody response *viz.*, haemagglutination inhitbition (HI) titre and mercaptoethanol Resistant (MER) antibody titre at days 0, 7th, 14th, 21st post-immunization with GRBC.

Cell mediated immune (CMI) response was measured (Miggiano *et al*., 1976) by injecting 0.1ml of Concanavalin –A (con A) after mixing with 0.1ml of PBS interdigitally between the 3rd and 4th toe of left foot in both the groups, and 0.1ml PBS in the right foot (control).

The skin index (Foot index) was calculated as the difference in the diameters of the swelling both in the left foot and the right foot, by a vernier caliper between pre-immunization, and 24 hours post-immunization. Foot index was calculated in the following manner: Foot index (mm) = (Post immunization **–** Pre immunization) – (Post PBS **–** Pre PBS). Total serum protein was estimated by Folin's Lowry method.

RESULTS AND DISCUSSION

Growth and Feed intake: Our study revealed that the final body weight of the birds (1560.0 ± 26.8 g), and gain in body weight / day (2.77±1.78 g) were higher, and the feed conversion ratio (36.10 ± 1.19 g) between 45-60 weeks was better in Azolla fed group than the birds in control group (Table-1), but the differences were statistically non-significant (P≥0.05).

Parthasarathy *et al*. (2001) had observed that broilers on a diet supplemented with Azolla

at 5% level, as a replacement of protein mix (wheat bran-53% & groundnut cake-47% or wheat bran-52% & fish meal-48%), performed well with promising economic returns. Basak *et al*. (2002) had observed that substitution of sesame meal by Azolla meal (5%) in the ration did not affect the body weight, feed conversion ratio, protein efficiency, and energy efficiency in broiler chicks.

Balaji *et al*. (2009) had observed that the production performance of broiler chicken pertaining to body weight, feed intake, and feed efficiency was as good as the birds in control diet at 4.5% inclusion level of Sun dried and ground Azolla (*Azolla pinnata*) in diet. Our study revealed that supplementation of the diet with raw Azolla did no affect the growth and feed conversion efficiency in birds.

The feed intake in the Azolla supplemented group (Table-1a, Figure-2) was lower (P≤0.01) than the normal (control) group, probably due to its high fibre content. But, there was no retardation in growth due to its rich nutrient contents, particularly protein, vitamins, and minerals (Pillai *et al*., 2002; Alalade and Iyayi, 2006; Shamna *et al*., 2013). However, our results differed from the findings of Shamna *et al*. (2013), who did not find significant differences in feed intake in quails on normal ration from the quails on ration supplemented with 5% Azolla, as they used Sun dried Azolla powder in the ration. In contrast, we had used raw Azolla.

Table-1. Growth and feed conversion ratio.

Parameter	Control	Azolla
Initial Body weight (gm)	1294.0 ±25.7	1269.0 ± 27.84
Final Body weight (gm)	1546.0 ± 27.2	1560.0 ± 26.80
Gain in body weight (g)/day	2.40±1.36	2.77±1.78
Feed conversion ratio (gm)	41.66 ± 1.25	36.10 ± 1.19

Note: The figures are presented as Mean±SEM.

Table-1a. Feed intake (gm/day/bird).

Age in weeks	Control	Azolla	Savings (%)
45-48*	113.25±2.35	74.75±1.88	34.01
49-52*	102.00±1.47	74.25±0.85	27.16
53-56*	108.50±0.64	75.24±0.41	30.87
57-60*	107.50±2.53	74.25±0.75	30.86
over all mean*	107.81±0.95	74.62±0.55	30.73

Note: The figures are presented as Mean±SEM. (2) *Significant at P≤0.01.

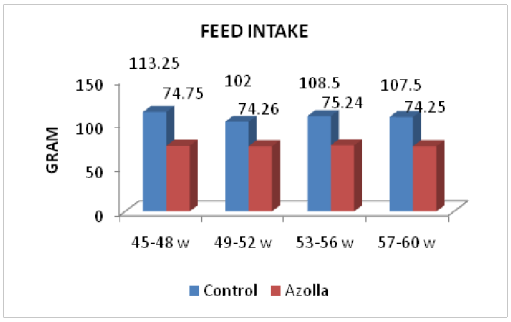

Figure-2. Feed intake (gm/day/bird)

Egg production: The hen housed egg production in different weeks (Table-2, Figure-3) revealed that the mean egg production of Azolla fed group (64.76±1.57) was not different (P≥0.05) from the control (65.25±1.51), so also weekly egg production

in different weeks, e.g. 45-48, 49-52, 53-56, and 57-60 weeks.

Khatunn *et al*. (1999) had assessed the nutrient content and feeding effect of Azolla at different levels *viz*., 50, 100, 150 and 200 g kg^{-1} at the expense of sesame meal in laying hen diets, and observed that replacement of sesame meal up to 200g kg^{-1} in diet resulted in better egg mass output and feed conversion ratio (FCR) at a level of 200g kg^{1}.

Our study revealed that supplementation of the diet with raw Azolla did no affect hen housed egg production in Nicobari fowl.

Table-2. Egg production performance.

Age (Wk)	Control	Azolla
45-48	74.7±0.48	74.5±0.63
49-52	69.5±0.65	68.6±0.47
53-56	62.3±1.42	61.9±1.60
57-60	54.3±0.66	53.8±0.88
Average	65.25±1.51	64.76±1.57

Note: The figures are presented as Mean±SEM.

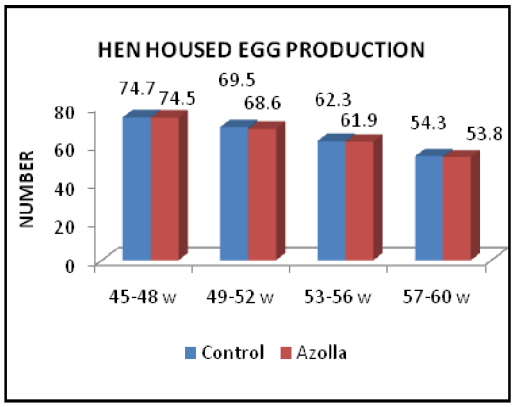

Figure-3. Hen housed egg production in different weeks.

Immunocompetence: The immunomodulatory effect of azolla feeding, determined in terms of humoral immune response, (Haemagglutination inhibition (HI) titre and Mercaptoethanol resistant (MER) antibody (IgG) titre), cell mediated immune response to Con-A, and total serum protein are presented in Table-3.

Humoral immune response: The mean HI titre in Azolla group (1.20±0.22) was higher ($P \geq 0.05$) than the control group (0.96±0.15). The mean MER titre in Azolla group (0.48±0.18) was also higher ($P \geq 0.05$) than the control (0.15± 0.15). There is little evidence in the available literature about humoral response in chicken to Azolla in diet.

Cell mediated immune response: The cell mediated immune (CMI) response expressed as Foot index (FI) in the Azolla group (0.60±1.52) was not different ($P \geq 0.05$) from the control (0.63±0.67). There is little evidence in the available literature on cell mediated response in chicken to Azolla in diet.

Serum protein concentration: The mean serum protein concentration (SPC) in Azolla group (56.63±0.89) was lower than the control group (57.54±0.53), but the difference was non-significant ($P \geq 0.05$). There is little evidence in the available literature about humoral response in chicken to Azolla in diet.

Table-3. Immunomodulatory effect of feeding Azolla.

Day	HI titre		MER titre		Total Serum Protein (mg/ ml)	
	Control	Azolla	Control	Azolla	Control	Azolla
0	0.83±0.14	0.45±0.15	0	0	60.75±0.61	60.45±0.82
7	1.05±0.21	1.45± 0.28	0.15± 0.15	0.80± 0.28	49.67±0.30	48.6±0.47
14	0.83±0.08	0.95 ±0.24	0	0.2 ±0.1	78.5±0.23	77.25±0.38
21	1.13±0.08	0.95 ±0.2	0	0.2± 0.1	41.25±0.58	40.23±0.76
Mean	0.96±0.15	1.20±0.22	0.15± 0.15	0.48±0.18	57.54±0.53	56.63±0.89

Benefit-cost analysis: The result of cost-benefit per egg per day is given in Table-4. By considering the average cost of the commercial feed as ₹ 15 per kg, saving in the consumption of commercial feed due to Azolla supplementation ultimately lead to a feed cost savings of ₹ 0.76 per egg per day over control.

Table-4. Benefit-cost analysis (₹).

Age in weeks	Feed cost / egg / day	
	Control	Azolla
45-48	2.27	1.49
49-52	2.20	1.62
53-56	2.60	1.82
57-60	2.95	2.06
Average	2.51	1.75
Savings (₹)	—-	0.76

CONCLUSION

It is concluded that fresh *Azolla* is a good feed - aditive for economising feed cost in fowl.

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