JOURNAL OF POULTRY SCIENCE AND TECHNOLOGY
Journal homepage: www.jakraya.com/journal/jpst

ORIGINAL ARTICLE

Feeding Potential of Aquatic Fern-Azolla in Broiler Chicken Ration

Shoukat Ara[a], S Adil[b*], MT Banday[b] and Manzoor A Khan[c]

[a]Division of Environmental Sciences, [b]Division of Livestock Production and Management, [c]Division of Veterinary Pathology, Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir, Shalimar, Srinagar, India.

*Corresponding Author:

Dr. Sheikh Adil

Email: aadilsheikh5@gmail.com

Received: 02/03/2015

Revised: 22/03/2015

Accepted: 25/03/2015

Abstract

To determine the impact of dietary inclusion of aquatic fern Azolla on profitability of broiler production, a study was conducted with 240 Cobb broiler chicks which were randomly assigned into five groups having three replicates of 16 each. Birds in control (T_1) group were fed the basal diet, where as in other groups fish meal was replaced with 5 (T_2), 10 (T_3), 15 (T_4) and 20% (T_5) Azolla. Chemical analysis of Azolla revealed the presence of 22.06% crude protein, 3.62% ether extract, 14.3% crude fibre, 33.4 nitrogen free extract, 18.1 % total ash, 2.04% calcium and 0.65% phosphorus on dry matter basis. Highest final body weight ($p<0.05$) of 1231.9g was obtained in T_2 followed by 1207.9g in T_1. Lowest body weight of 1112.1g was recorded in T_5. Feed intake decreased in all the treatment groups with highest intake in the control group. Net profit per 100 birds was Rs. 954 in T_1, 1104 in T_2, 918 in T_3, 868 in T_4 and 825 in T_5. An additional profit of Rs. 150 and a loss of Rs 36, 86 and 129 per 100 birds were observed in T_2, T_3, T_4 and T_5 respectively when compared with the control. No significant ($p>0.05$) impact was recorded on carcass characteristics. The results indicated that Azolla at 5% inclusion level in broiler chicken ration is highly economical.

Keywords: Azolla, Broiler chicken, Carcass characteristics, Growth and Profitability.

1. Introduction

Although the poultry industry in India has made remarkable progress during last 3 decades, yet the escalating cost and unavailability of the feed ingredients are the major deterrent for target production. Feed is the most expensive of all inputs and about 70% of production cost is accounted for feed alone (Parthasarathy *et al*., 2001). As feed related improvement in the performance has a profound effect on profitably, the poultry nutritionists have been trying to find out alternative cost effective, non-conventional feed ingredients. Aquatic plant species, because of their growth habit, appear not to accumulate secondary plant compounds and therefore offer a greater potential than tree leaves as a source of protein for monogastric animals (Bacerra *et al*., 1995). Of late, there has been an increased emphasis in the use of aquatic plants in poultry ration because the protein and other nutrient content in them are comparable to certain leguminous plants. Of these, the water fern Azolla is perhaps the most promising, being free crop of high nutritive value (Lumpkin and Plucknett, 1982). Azolla is a free floating fresh water fern belonging to the family Azollaceae and order Pteridophyta. It is commonly found in tropics and sub-tropics and grows naturally in stagnant water of drains, canals, ponds, rivers, haors-baors, and marshy lands. With its sudden appearance since 2002, *Azolla* has now spread widely in aquatic ecosystems of Kashmir valley. Anabaena-azollae, living in the cavity of Azolla leaf, can fix high amount of atmospheric dinitrogen due to presence of symbolic algae in the leaves (Becking, 1979). Azolla is a potential feed ingredient for poultry and livestock (Singh and Subudhi, 1978; Pannerker, 1988). As it is rich in protein and other constituents viz. , amino acids, carotinoids, minerals,vitamins etc, the present study was undertaken to evaluate the impact of dietary inclusion of this fern on the performance and profitability of broiler chicken.

2. Materials and Methods

240 Cobb straight run commercial broiler chicks at 7 days of age were individually weighed and randomly assigned into 5 groups having 3 replicates of

16 chicks each. The birds were placed on deep litter up to six weeks of age. The chicks were maintained on a 24 hours consistent lighting schedule and proper ventilation was ensured. Fresh feed and water was provided daily *ad libitum.* The diets were formulated to meet the recommendations of Bureau of Indian Standards (BIS, 1992). The birds in the control group (T_1) were fed diet without Azolla while as in other groups fish meal was replaced by 5 (T_2), 10 (T_3), 15 (T_4) and 20% (T_5) Azolla.

Azolla was collected from local water bodies especially world famous Dal lake. It was then dried in the sunlight. After sun drying, it was ground and stored in the plastic bags until used for feeding. Chemical analysis of basal diet (Table 1) and Azolla (Table 2) was done as per AOAC (1996).

Table 1: Ingredient and chemical composition of experimental basal diet (% DM)

Ingredients (%)	Starter (up to 3 wks)	Grower (3-6 wks)
Yellow Maize	51.20	56.70
Soya bean meal	26.50	23.20
Rice polish	10.20	10.50
Fishmeal	9.00	6.40
Limestone	1.27	1.50
DCP	0.83	0.87
L-lysine	0.09	0.03
DL-methionine	0.19	0.08
Salt	0.30	0.30
Trace mineral mixture*	0.24	0.24
Vitamin premix**	0.18	0.18
Total	100.00	100.00
Crude Protein	21.7	20.5
Crude Fibre	4.16	4.62
Ether Extract	6.77	7.31
Total Ash	3.89	3.54
Metabolizable energy (Kcal/Kg diet)*	2812	2937

**Trace mineral premix provided the following mg per kg of diet: Manganese 80, , Iron 60, , Zinc 60, , Copper 5, , Cobalt 0.2, , Iodine 1, and Selenium 0.15*

***Vitamin premix provided the following per 2.5 kg of diet: Vitamin A 15.000 IU, Vitamin D_3 1.500 IU, Vitamin E 20 mg, Vitamin K 5 mg, Vitamin B_1 3 mg, Vitamin B_2 6 mg, Niacin 25 mg, Ca pantothenate 12 mg, Vitamin B_6 5 mg, Vitamin B_{12} 0.03 mg, Folic acid 1 mg, D-biotin 0.05 mg, Choline Chloride 400 mg and carophyll-yellow 25 mg*

The Azolla was mixed thoroughly in aforesaid quantities to a small amount of feed (1 kg) in a premixer. The resultant mixture was then mixed with the rest of the feed in a mechanical blender until a thorough and consistent mixture was obtained. Protection was given to birds against New castle and Gumboro's diseases at 6 and 15 days respectively. The body weight of birds per replicate was recorded on the individual basis at weekly intervals. The cumulative feed consumption per replicate was also recorded on weekly basis. The mortality, if any was recorded on daily basis.

Table 2: Chemical composition of Azolla

Constituent	% DM basis
Crude protein	22.06
Ether extract (EE)	3.62
Crude fibre (CF)	14.3
Nitrogen Free Extract (NFE)	33.4
Total ash	18.1
Calcium	2.04
Phosphorus	0.65

At six weeks of age, the influence of dietary inclusion of Azolla on profitability of broiler chicken was worked out by taking the feed cost, chick cost etc into consideration. Further, four birds per replicate were selected at random and studied for carcass attributes. Each bird was weighed immediately before severing the jugular vein at the atlanto-occipital joint and then allowed to bleed. The shanks were cut off at the hock joint, and carcass was subjected to the scalding process at 60°C for 30 seconds. The feathers were removed completely by hand picking leaving the skin intact. Thereafter, the abdominal cavity was opened to expose the visceral organs, and the carcass characteristics were evaluated.

The data obtained were statistically assessed by the Analysis of Variance (ANOVA) through SPSS (17.0) software considering replicates as experimental units. Duncan's multiple range test (Duncan 1955) was used to test the significance of difference between means by considering the differences significant at $p \leq 0.05$.

3. Result and Discussion

The results of chemical analysis of Azolla (Table 2) revealed presence of 22.06 % Crude protein (CP), 3.62% Ether extract (EE), 14.3% Crude fiber (CF), 33.4% Nitrogen free extract (NFE), 18.1% Total ash, 2.04% Calcium and 0.65% Phosphorus on dry matter basis. The values of CP content of Azolla estimated are in close concordance with the findings of

Table 3: Economics of dietary inclusion of Azolla per 100 birds in broiler chicken

Parameter	T_1	T_2	T_3	T_4	T_5	Sig.
Mortality	Nil	Nil	Nil	Nil	Nil	-
Final body weight (Kg)	1207.9^{ab}±31.22	1231.9^{a}±24.51	1159.3^{abc}±23.02	1136.7^{bc}±19.03	1112.1^{c}±21.63	0.031
Feed consumed (Kg/bird)	2219.3^{a}±9.52	2125.6^{b}±21.48	2088.3^{bc}±27.06	2044.6^{c}±36.79	2043^{c}±9.16	0.002
Feed cost (Rs.)	4395	4343	4095	3984	3952	-
Chick cost (Rs.)	3100	3100	3100	3100	3100	-
Total production cost* (Rs.)	7495	7443	7195	7084	7052	-
Income by sale of birds @ Rs 70/kg	8449	8547	8113	7952	7777	-
Net profit per bird (Rs.)	954	1104	918	868	825	-
Relative profit or loss per bird** (Rs.)	-	+ 150	- 36	- 86	- 129	-

Means within the same row with different superscripts are significantly different (P<0.05)
**Production cost = Feed cost + Chick cost; **Profit or loss in comparison to birds of control group*

Table 4: Carcass characteristics of broiler chicken fed diets supplemented with Azolla

Parameter (% Live wt.)	T_1	T_2	T_3	T_4	T_5	Sig.
Breast	19.81 ±0.53	19.14 ±0.48	18.86 ±0.61	18.99 ±0.80	18.77 ±0.53	NS
Drum-sticks	9.43 ±0.31	9.83 ±0.41	9.27 ±0.31	9.62 ±0.55	9.32 ±0.42	NS
Thighs	10.29 ±0.26	10.63 ±0.31	10.52 ±0.11	10.45 ±0.27	10.28 ±0.49	NS
Wings	7.45 ±0.12	7.63 ±0.24	8.11 ±0.13	7.53 ±0.02	8.31 ±0.23	NS
Back	13.55 ±0.41	12.84 ±1.32	12.22 ±0.28	12.43 ±0.33	12.34 ±0.37	NS
Neck	5.53 ±0.21	5.12 ±0.28	5.22 ±0.13	5.21 ±0.51	5.13 ±0.43	NS

NS= Means within the same row with no superscripts are significantly same (P<0.05)

Alalade and Iyayi (2006) and Raseena (2006). Further, Basak *et al*. (2002) reported that EE content of Azolla varied between 3.0 to 3.5%, in present study more or less similar value (3.62%) was obtained. The CF content of 14.3% is in agreement with the findings of Querubin *et al*. (1986). Parthasarathy *et al*. (2001) reported that NFE content of the fern varies between 38.85 to 44.06%, however, in our study NFE value of only 33.4% was recorded. The total ash content of 18.1% was recorded which corroborates with the findings of Basak *et al*. (2002) and Alalade and Iyayi (2006). Azolla contains a calcium content of 2.11% (Parthasarathy *et al*., 2001b) which is in close conformity with the value recorded in present study. Ali and Leeson (1995) found 0.31% phosphorus in Azolla but in our study a value of 0.65% phosphorus was recorded. The variations in the nutrient composition of Azolla as reported by researchers could be due to species difference and habitat variation of the taxon.

No bird died in any treatment group during the experimental period, indicating that inclusion of Azolla in feed had no deleterious effect on broiler chicken (Table 3). The final body weights were improved significantly ($p<0.05$) in birds fed 5% Azolla (T_2) when compared with the control group (Table 3), thus confirming the results of Querubin *et al*. (1986) and Basak *et al*. (2002) who observed improvement in live weight of broiler chicks fed 5% Azolla meal in the diet. However, as the level of Azolla was increased (T_3, T_4 and T_5), it resulted in decreased body weights as was reported by Parthasarthy *et al*. (2002). Reduction in the body weight due to higher Azolla levels (10, 15 and 20%) might be due to higher level of NDF (Buckingham *et al*., 1978) and lignin (Tamany *et al*., 1992) in Azolla meal which are the main limiting factors for its efficient utilization. There was a significant ($p>0.05$) decrease in feed consumption of all the groups fed Azolla in diet compared to control (Table 3). Lowest feed consumption was observed in the group fed 20% Azolla in the diet (T_5), confirming

the results of Alalade and Iyayi (2006) who reported decrease in feed consumption with increase in the level of Azolla up to 15% in the diet of poultry birds. The decrease in the feed consumption has been attributed by to reduced palatability (Bested and Morento, 1985) and increased bulkiness of Azolla (Bacerra *et al*., 1995) which reduces its utilization.

Replacement of 5% protein source by Azolla in diets of broiler chicken was found economically better than the control group (Table 3). The net profit per 100 birds was Rs. 954 in T_1, 1104 in T_2, 918 in T_3, 868 in T_4 and 825 in T_5. An additional profit of Rs. 150 per 100 birds was achieved in T_2 when compared with the control. These findings are in agreement with the results of Dhumal *et al*. (2009) who observed higher returns in chicken fed ration wherein 5% protein source was replaced by Azolla. Increased net returns in T_2 could be ascribed to the improvement in the body weights (Table 3). Similar results were observed by Querubin *et al*. (1986) and Basak *et al*. (2002). A loss of Rs 36, 86 and 129 per 100 birds was noticed in T_3, T_4 and T_5 respectively when compared with the control. Reduction in net profit per bird in these groups could be due to reduced body weights (Table 3). Reduction in the body weights due to increased levels of Azolla might be due to reduced palatability (Bested and Morento 1985) and higher level of NDF (Buckingham *et al*. 1978) especially lignin (Tamany *et al*. 1992) in the Azolla meal. As the replacement of protein source by Azolla is increased beyond 5%, net returns per bird get decreased indicating restriction of Azolla inclusion to a lower level in the ration of broiler chicken. Carcass characteristics of broiler chicken fed Azolla based diets showed non-significant difference ($p>0.05$) in the percentage of cut-up parts of birds between various treatments (Table 4) confirming the earlier findings of Dhumal *et al*. (2009).

4. Conclusion

Based on the results obtained, it may be concluded that dietary replacement of 5% protein source by Azolla has positive impact on improvement in terms of body weight and net returns per bird. Therefore, 5% Azolla may be incorporated in the diets of broiler chicken to make the broiler production more profitable.

Acknowledgement

The authors thankfully acknowledge the financial assistance from Department of Science and Technology, Ministry of Science and Technology, Government of India.

References

Alalade OA and Iyayi EA (2006). Chemical composition and feeding value of Azolla (*Azolla pinnata*) meal for egg type chicks. *International Journal of Poultry Science*, 5: 137-141.

Ali MA and Leeson S (1995). Azolla" Biology and agronomic significance. *Botanical Review*, 35: 17-35.

AOAC (1996). *Official Methods of Analysis*. 16th edition. Association of Official Analytical Chemists. Washington, USA.

Bacerra M, Preston TR and Ogle B (1995). Effect of replacing whole boiled soya beans with azolla in the diets of growing ducks. *Livestock Research for Rural Development*, 7: 1-11.

Basak B, Pramanik AH, Rahmnan MS, Taradar SU and Roy BC (2002). Azolla (*Azolla pinnata*) as a feed ingredient in broiler ration. *International Journal of Poultry Science*, 1: 29-24.

Becking JH (1979). Environmental requirements of Azolla for the use of tropical rice production. In: *Nitrogen and Rice*. International Rice Research Institute. Los Banos. Leguna. Phillipines. pp: 345-374.

Bested SB and Morento SE (1985). The effect of different percentage of Azolla on fattening pigs. *Journal of Mountain State Agricultural College*, 17: 31-40.

BIS (1992). Poultry Feeds Specification. 4th Revision. Bureau of Indian Standards. New Delhi, pp. 4.

Buckingham KW, Stephen WE, James GM and Goldman CR (1978). Nutritive value of the nitrogen fixing aquatic fern *Azolla filliculoides*. *Journal of Agriculture and Food Chemistry*, 26: 1230-34.

Dhumal MV, Siddiqui MF, Siddiqui MBA and Avari PE (2009). Performance of broilers fed on different levels of Azolla meal. *International Journal of Poultry Science*, 44: 65-68.

Duncan DB (1955). Multiple range and multiple F-test. *Biometrics*, 11: 1-42.

Lumpkin TA and Plucknett TL (1982). Azolla as a green manure: use and management in crop production. Westview Press Boulder, Colorado. *Westview Tropical Agriculture Series*, 15: 230.

Pannaerker S (1988). Azolla as a livestock and poultry feed. *Livestock Adviser*, 13: 22-26.

Parthasarathy R, Kadirvel R and Kathaperumal V (2001). Chemical evaluation of Azolla as poultry feed ingredient. *Cheiron*, 30: 24-26.

Parthasarathy R, Kadirvel R and Kathaperumal V (2001b). Chemical evaluation of azolla as poultry feed ingredient. *Cheiron*, 30: 35-37.

Parthasarathy R, Kadirvel R and Kathaperumal V (2002). Azolla as a partial replacement for fishmeal in broiler rations. *Indian Veterinary Journal*, 79: 144-46.

Querubin LJ, Alcantara PF and Luis ES (1986). Chemical composition and feeding value of Azolla in broiler ration. *Philippines Journal of Veterinary and Animal Science*, 13: 46.

Raseena (2006). Effect of dietary supplementation of Azolla

(*A. pinnata*) on production performance in Japanese quail (*Coturnix coturnix japonica*). *M.V.Sc. thesis submitted to Kerala Agricultural University, Thrissur, India*.

Singh PK and Subudhi BPR (1978). Utilization of Azolla in poultry feed. *Indian Farming*, 27: 37-39.

SPSS® 10.0. Computer Software, 1999. SPSS Inc., Headquarters, 233 p., Wacker Drive, Chicago, Illinois. 60606, USA.

Tamany Y, Samanta G, Chakraborty N and Mondal L (1992). Nutritive value of Azolla (*Azolla pinnata*) and its potentiality of feeding in goats. *Environmental Ecology*, 10: 755-756.