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Effect of Dietary Inclusion of Azolla (*Azolla pinnata*) in Raw and Meal Forms on the Production Performance, Immunocompetence, Development of Digestive Organs and Carcass Quality Traits of Coloured Chicken

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ABSTRACT

One hundred and twenty day old straight run coloured chicken (Chabro) were distributed into four treatments: T1-basal diet, T2-5% of basal diet replaced with Azolla meal on dry matter basis, T3- Basal diet+Raw *azolla* after 4 weeks, T4- T2+Raw *azolla* after 4 weeks. Average weekly weight gain of T1, T2 and T3 were significantly higher (P<0.01) than T4 birds at 2nd week. There was no significant difference in the weekly FCR among the treatment groups during the experiment. Humoral immune response to 1% SRBC (log_2 titre) and cell mediated immune response to PHA-P was comparatively better in T2 group. Per cent gizzard weight was significantly higher (P<0.05) in T2 than other groups. There was no significant difference among the treatment groups in the carcass quality traits. It may be concluded that *azolla* meal can replace poultry feed up to 5% level with higher humoral and cell mediated immune responses.

Keywords: growth, immunity, *azolla*, coloured chicken

Poultry feed industry needs an integrated nutrient supply system. This can be achieved by effective use of non conventional feed resources and green feeding. *Azolla pinnata* is a good source of protein and minerals (Pillai *et al*., 2002). Feeding trials carried out with different combinations of commercial feed and fresh *Azolla* showed that 20-25% level of commercial poultry feed could be replaced by supplementing it with fresh *Azolla* in diet. Birds receiving normal feed with 5% extra in the form of *Azolla*, grew faster than the bird fed with 100% feed alone (Pillai *et al*. 2002). Feeding *azolla* to poultry did not have any adverse effect on the weight of broiler chickens and increased the egg production in layers (Bhattacharyya et al., 2016; Alalade *et al*. 2007). However, detail studies in coloured chicken are necessary to tap the beneficial effects of *azolla* in rural poultry production. Thus, a study was conducted to assess the effect of dietary inclusion of *azolla* (*Azolla pinnata*) in raw and meal forms on the in coloured chicken.

MATERIALS AND METHODS

Birds and experimental design

Raw *Azolla pinnata* was procured from '*Azolla* Demonstration Unit' of the University. Raw *azolla* was sundried in a clean and dust free environment to obtain fine powder. The powder formed was packed in an airtight container. A total of 120, day old straight run coloured chicken (Chabro) were distributed into four treatments: T1-basal diet, T2-5% of basal diet replaced with Azolla meal on dry matter basis, T3- Basal diet for 4 weeks, thereafter the chicks got the access to *ad lib* raw *azolla* along with basal diet, T4- T2+ after four weeks the chicks got t access to *ad lib* raw *azolla* along with basal diet.

Experimental procedure and analyses

Weekly body weight gain was recorded and weekly feed conversion ratio determined till 8th week of age.

After 6 weeks of age, general immune response was studied by taking 9 birds from each treatment group and measuring important immunocompetence traits such as antibody response (log_2 titer) to 1% sheep red blood cells (SRBC) (Siegel and Gross, 1980; Van der Zijpp, 1983), 2-mercaptoethanol resistant antibodies (MER or IgG) and mercaptoethanol sensitive antibodies (MES or IgM) against SRBC (Martin *et al*., 1989) and Cell mediated immune response to PHA-P (Corrier and DeLoach, 1990). After 8 weeks of age, six representative birds from each treatment group was randomly selected and slaughtered to study the gastrointestinal tract development (proventriculus, gizzard, small intestine, large intestine and caeca) and various slaughter traits *viz.* pre slaughter fasting shrinkage in live weight, dressing yield, eviscerated yield, ready to cook yield, giblet yield (heart, liver and gizzard), yield of individual cut-up parts (thighs, drumsticks, breast, back, neck, wings) as a percentage of live weight.

Statistical analyses

Data were subjected to one-way analysis of variance in a completely randomized design (Snedecor and Cochran, 1980) using Statistical Package for the Social Sciences. Significant differences among treatment means were calculated as per Duncan's multiple range test (Duncan, 1955).

RESULTS AND DISCUSSION

Production performance

There was no significant difference in the weekly body weight gain among the treatment groups except in 2nd week (Table 1). Average weekly weight gain of T1, T2 and T3 were significantly higher (P<0.01) than T4 birds at 2nd week. Our results are in accordance with Parthasarathy *et al.* (2002), who reported no effect on body weight gain of broilers on 5 per cent *azolla* diets whereas Alalade and Iyayi (2006) could not observe any significant difference in weight gain of chicks fed with *azolla* meal at the levels of 0, 5, 10 and 15% in diet. Similarly, Balaji *et al.* (2009) reported that the cumulative body weight gain of broilers at sixth week of age in groups fed 0, 1.5, 3.0 and 4.5 per cent *azolla* incorporated diets were statistically similar indicating that inclusion of *azolla* up to 4.5 per cent in rations did not have any influence on body weight gain in broiler chicken. Bhattacharyya *et al.* (2016) found similar growth performance in control and *azolla* based diets where basal diet was replaced with 4.5 and 5.5 per cent *azolla* meal.

Weekly FCR showed no significant differences among the treatment groups during the experiment (Table 2). Our findings are in agreement with Basak *et al.* (2002), who observed no significant difference in feed conversion ratio among the broilers fed with 0, 5, 10 and 15 per cent *azolla* meal during 5-6 weeks and 2-6 weeks periods. Similar results were also reported by Querubin *et al.* (1986). Similarly, Parthasarathy *et al.* (2002) reported that the feed and protein efficiency ratios were similar in basal and 5 per cent *azolla* diets whereas, Balaji *et al.* (2009) also reported that there was no significant difference in mean cumulative feed efficiency among treatment groups fed 0, 1.5, 3.0 and 4.5 per cent *azolla* incorporated diets. Similarly, Dhumal *et al.* (2009) reported no significant difference in feed conversion ratio among the control,

Table 1: Effect of feeding *azolla* (*Azolla pinnata*) on average weekly body weight gain (g) of coloured chicken

Treatment	1st wk	2nd wk	3rd wk	4th wk	5th wk	6th wk	7th wk	8th wk
T1	68.06	124.00^{b}	171.06	204.90	208.97	211.13	252.40	199.87
T2	70.40	123.26^{b}	168.73	221.37	205.23	241.40	227.60	191.47
T3	70.80	131.73^{b}	170.86	220.03	232.43	224.07	197.00	174.00
T4	68.80	107.86^{a}	159.40	201.53	205.13	220.00	139.17	243.23
Pooled SEM	0.78	3.09	2.81	5.037	7.41	7.40	16.81	12.57
Sig Level	NS	P<0.01	NS	NS	NS	NS	NS	NS

Means bearing different superscripts within a column differ significantly (P<0.01); NS: Non significant (P>0.05) SEM: Standard error of means

Table 2: Effect of feeding azolla (*Azolla pinnata*) on weekly feed conversion ratio (FCR) of coloured chicken

Treatment	1st wk	2nd wk	3rd wk	4th wk	5th wk	6th wk	7th wk	8th wk
T1	2.40	2.30	2.27	2.47	2.44	2.92	2.28	2.40
T2	2.23	2.31	2.31	2.08	2.55	2.24	2.76	2.62
T3	2.31	2.29	2.27	2.25	2.41	2.55	2.53	2.55
T4	2.34	2.32	2.31	2.28	2.45	2.51	2.65	2.52
Pooled SEM	0.03	0.01	0.02	0.07	0.13	0.13	0.07	0.04
Sig Level	NS	NS	NS	NS	NS	NS	NS	NS

NS: Non significant (P>0.05) SEM: Standard error of means.

Table 3: Effect of feeding azolla (*Azolla pinnata*) on the humoral immune responses [antibody titer (log 2) values] to 1% SRBC cell mediated immune response (response to PHA-P) (Foot web index) of coloured chicken at 6 weeks of age

Treatment	HA	IgG	IgM	Foot web index
T1	6.88	2.38	4.50	0.40
T2	8.57	3.29	5.29	0.50
T3	7.00	2.38	4.63	0.35
T4	7.50	2.75	4.75	0.38
Pooled SEM	0.30	0.19	0.21	0.03
Sig Level	NS	NS	NS	NS

NS: Non significant (P>0.05) SEM: Standard error of means.

2.5 and 5 per cent *azolla* dietary treatment groups, thus inferring that 5 per cent level of incorporation of *azolla* in broiler diets may not adversely affect FCR.

Immuno competence traits

Though there was no significant difference existed among the treatment groups but the response to 1% SRBC (log_2 titre) was apparently better in 5 percent *azolla* group as compared to the other treatment groups (Table 3). This finding may be supported by almost similar heretophil: lymphocyte ratio (H: L) in control and *azolla* fed birds representing similar immune response. The H: L ratio quantifies the balance between the non-specific, fast acting defenses of heterophils and the antigen specific, slower-acting defenses of lymphocytes (Shaniko, 2003) thus acting as an indicator of stress response among chickens' populations (Graczyk *et al*., 2003) and as a general biomarker relevant to immune function (Shaniko, 2003) in poultry. On contrary, Prabina and Kumar (2010) reported higher antibody tire value against Ranikhet virus in birds that were administered with dried *azolla* at 10% level in comparison to the birds which took dried Azolla at 7.5% level. Similarly, Dhumal *et al*. (2009) reported feeding *azolla* meal in broiler improved the anti-body titre values as compared to control group at 35 days of age in commercial broilers.

No significant difference was found in the response to PHA-P among the treatment groups (Table 3). However, cell mediated immune response to PHA-P was apparently better in *azolla* fed groups and was found highest with 5 percent *azolla* meal as compared to the other treatment groups. Our findings are in accordance with Sujatha *et al.* (2013), who reported that there was no significant difference in the cell mediated immune (CMI) response expressed as Foot web index (FI) between the control group and fresh *azolla* fed @ 200g per chick per day from 45-60 weeks in Nicobari fowls. However, similar trend but with significant differences was observed by Bhattacharyya *et al.* (2016) and Mishra *et al.* (2016), who reported that Foot web index was significantly (P<0.05) higher in the basal diet replaced with dry *Azolla pinnata* powder than the control group commercial birds and chabro birds.

Table 4: Effect of feeding azolla (*Azolla pinnata*) on the development of digestive organs of coloured chicken at 8 weeks of age

Treatment	Proventricular weight (g)	Small intestine length (cm/100 g)	Small intestine weight (g/100 g)	Large intestine length (cm/100g)	Large intestine weight (g/100 g)	Average caecal length (cm/100g)	Caecal weight (g/ 100 g)
T1	0.48	9.27	3.00	0.54	0.25	0.93	0.59
T2	0.41	8.00	3.20	0.55	0.21	0.99	0.53
T3	0.48	8.64	3.18	0.53	0.22	0.91	0.51
T4	0.43	9.05	2.85	0.63	0.22	0.96	0.49
Pooled SEM	0.02	0.22	0.10	0.03	0.02	0.03	0.02
Sig Level	NS	NS	NS	NS	NS	NS	NS

NS: Non significant (P>0.05) SEM: Standard error of means.

Table 5: Effect of feeding azolla (*Azolla pinnata*) on carcass quality characteristics of coloured chicken at 8 weeks of age

Treatment	Shrinkage (%)	Dressing (%)	Eviscerated wt (%)	Heart wt (%)	Liver wt (%)	Gizzard (%)
T1	3.47	72.04	62.40	0.51	1.95	1.65^{a}
T2	4.33	74.12	61.42	0.43	2.03	2.39^{b}
T3	3.70	74.26	59.57	0.39	1.84	2.05^{ab}
T4	3.67	71.43	61.19	0.57	1.78	2.11^{ab}
Pooled SEM	0.19	0.73	0.86	0.03	0.07	0.10
Sig Level	NS	NS	NS	NS	NS	P<0.05

NS: Non significant (P>0.05) SEM: Standard error of means.

Development of digestive organs, carcass characteristics and yield of cut up parts

There was no significant difference in gastrointestinal tract development traits among the treatment groups except percent gizzard weight (Table 4). A significant increase (P<0.05) was observed in the per cent gizzard weight over the control group only.

There was no significant difference in carcass quality characteristics *viz*. percent processing shrinkage, dressing percentage, per cent eviscerated weight, per cent heart weight, per cent liver weight and percent gizzard weight (Table 5). Results pertaining to yield of cut-up-parts of the carcass at eight weeks of age have been expressed as percent yield of eviscerated weight of the carcass (Table 6). Statistical analysis revealed no significant difference in the cut-up-parts such as thigh, drumstick, breast, back, neck and wings among the treatment groups. Our results are in accordance with Dhumal *et al.* (2009), who reported that there were no significant difference in carcass yield percentage among the control, 2.5 and 5 per cent *azolla* dietary treatment groups signifying the non-influence of *azolla* meal on carcass quality. Similarly, Bhattacharyya *et al*. (2016) noted that replacement of basal diet with 5.5% dry *Azolla pinnata* powder on dry matter basis did not significantly affect the carcass quality characteristics and cut up parts of commercial broilers. Balaji *et al*. (2009) also reported that the per cent dressed yield, eviscerated yield and ready-to-cook yield in broilers were not influenced by dietary supplementation of dried *azolla*. The per cent giblet yield of birds fed with 4.5% *azolla* was significantly higher (P<0.05) than control and other treatments, concluded that dietary inclusion of dried *azolla* up to 4.5% levels did not have any adverse effect on production performance of broiler chicken. In the present study, the gizzard weight in the *azolla* feed groups was significantly higher compared to the control group. The high crude fibre content (17.29%) of the *azolla* might have elicited the weight of gizzard. This is in concurrence

Table 6: Effect of feeding azolla (*Azolla pinnata*) on the cut up-parts (% of live weight) of coloured chicken at 8 weeks of age

Treatment	Thighs (%)	Drumstick (%)	Breast (%)	Back (%)	Neck (%)	Wings (%)
T1	17.48	15.78	27.03	24.80	4.42	10.48
T2	16.44	16.14	25.80	25.50	4.49	11.63
T3	17.02	15.70	27.15	24.60	4.17	11.36
T4	17.40	15.94	26.39	24.00	4.22	12.03
Pooled SEM	0.25	0.20	0.44	0.32	0.18	0.25
Sig Level	NS	NS	NS	NS	NS	NS

NS: Non significant (P>0.05) SEM: Standard error of means.

with Mateos *et al*. (2012) who noted that increasing the insoluble fiber content of the diet resulted in a increased gizzard weight and gizzard contents which, in general, is indicative of improved functioning of the GIT.

CONCLUSION

It may be concluded that *azolla* meal can replace poultry feed up to 5% level with higher humoral and cell mediated immune responses without causing any adverse effect on the production performance, development of digestive organs and slaughter traits in coloured chicken.

REFERENCES

Alalade, O.A. and Iyayi, E.A. 2006. Chemical composition and the feeding value of *Azolla* (*Azolla pinnata*) meal for egg-type chicks. *Int. J. Poult. Sci.*, **5**: 137-141.

Alalade, O.A., Iyayi, E.A. and Alalade, T.O. 2007. The nutritive value of Azolla (*Azolla pinnata*) meal in diets for growing pullets and subsequent effect on laying performance. *J. Poult. Sci*., **44:** 273-277.

Balaji, K., Jalaludeen, A., Churchil, R.R., Peethambaran, P.A. and Senthilkumar, S. 2009. Effect of dietary inclusion of Azolla (*Azolla pinnata*) on production performance of broiler chicken. *Indian J. Poult. Sci.*, **44**: 195-198.

Basak, B., Pramanik, A.H., Rahmnan, M.S., Taradar, S.U. and Roy, B.C. 2002. Azolla (*Azolla pinnata*) as a feed ingredient in broiler ration. *Int. J. Poult. Sci.*, **1**: 29-32.

Bhattacharyya, A., Shukla, P.K., Roy, D. and Shukla, M. 2016. Effect of *azolla* supplementation on growth, immunocompetence and carcass characteristics of commercial broilers. *J. Anim. Res*., **6:** 941-945.

Corrier, D.E. and Deloach, J.R. 1990. Evaluation of cell mediated, cutaneous basophil hypersensitivity in young chickens by interdigital skin test. *Poult. Sci.*, **69:** 403-408.

Dhumal, M.V., Siddiqui, M.V., Siddiqui, M.B.A. and Avai, P.E. 2009. Performance of broilers fed on different levels of *Azolla* meal. *Indian J. Poult. Sci.,* **44:** 65-68.

Duncan D.B. 1955. Multiple range and multiple F tests. *Biometrics,* **11:** 1-42.

Graczyk, S., Pliszczak-Krol, A., Kotonski, B., Wilczek, J. and Chmielak, Z. 2003. Examinations of haematological and metabolic changes mechanisms of acute stress in turkeys. *Electronic J. Polish Agri. Univ., Vet. Med*., **6:** 1-10.

Martin, A., Gross, W.B. and Siegel, P.B. 1989. IgG and IgM responses in high and low antibody selected lines of chickens. *J. Hered*., **80:** 249-252.

Mateos, G.G., Jiménez-Moreno, E., Serrano, M.P. and Lazaro, R.P. 2012. Poultry response to high levels of dietary fiber sources varying in physical and chemical characteristics. *J. Applied Poult. Res.* **21:** 156-174.

Mishra, D.B., Roy, D., Kumar, V., Bhattacharyya, A., Kumar, M., Kushwaha, R. and Vaswani, S. 2016. Effect of feeding different levels of *Azolla pinnata* on blood biochemicals, hematology and immunocompetence traits of Chabro chicken. *Vet. World,* **9:** 192-198.

Parthasarathy, R; Kadrivel, R and Kathaperumal, V. 2002. Azolla as a partial replacement for fishmeal in broiler rations. *Indian Vet. J*., **79:** 144-146.

Pillai, P.K., Premalatha, S. and Rajamony, S. 2002. Azolla: A sustainable feed for livestock. *Leisa Magazine,* **4:** 15-17.

Prabina, B.J. and Kumar, K. 2010. Dried Azolla as a nutritionally rich cost effective and immune-modulatory feed supplement for broilers. *Asian J. Anim. Sci.*, **1:** 20-22.

Querubin, L.J., Aloantara, P.F., Luis, E.S. and Princesa, A.O. 1986. Chemical composition and feeding value of *azolla* in broiler ration. *Philippine J. Vet. Anim. Sci.*, **12:** 65.

Shaniko, S. 2003. Physiological responses of laying hens to the alternative housing systems. *Int. J. Poult. Sci.,* **2:** 357-360.

Siegel, P.B. and Gross W.B. 1980. Production and persistency of antibodies in chickens to sheep erythrocytes. 1.Directional selection. *Poult. Sci*., **59:** 1-5.

Snedecor G W and Cochran W G. 1980. Statistical Methods. 6th ed. Iowa State University Press, Ames, Iowa.

Sujatha, T., Udhayakumari, D., Kundu, A., Jeyakumar, S., Sundar, J., and Kundu, M.S. 2013. Utilization of raw *azolla* as a natural feed additive for sustainable production in Nicobari fowl. *Anim. Sci. Rep*., **7:** 146-152.

Van der zijpp A.J. 1983. The effect of genetic origin, source of antigen and dose of antigen on the immune response of cockerels. *Poult. Sci.,* **62**: 205-11.