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Growth Performance of Commercial Broiler Chicken Fed Dried Azolla

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ABSTRACT

A study was undertaken to explore the nutritive value of *Azolla pinnat*a as a non-conventional feed ingredient in broiler chicken feeding. The study was conducted for a period of 42 days with 150-day old unsexed Vencobb chicks divided into 5 groups (1 control + 4 treatments) with 3 replicates having 10 chicks in each replicate. The groups were designated as T0, T1, T2, T3 and T4where in T0 served as standard control group. Group T1, T2, T3 and T4 were fed with dried Azolla at 2, 3, 4 and 5 per cent substitution level, respectively. During the starter phase, results of growth trial revealed significantly higher weight gain and feed conversion ratio in as compared to control and other treatments group. Finisher phase T4 group had 4.7% higher weight gain as compared to control. Overall growth performance (0-42 days) of broiler birds exhibited significantly highest weight gain in T4. Results for the feed intake, feed conversion ratio, proximate analysis of broiler meat, digestibility coefficients of different nutrients and serum mineral analysis exhibited non-significant (P>0.05) difference. Economics of broiler production by substitution of 5% Azolla exhibited higher gain as compared to control. It is thus concluded that 5% substitution of dried Azolla replacing soybean meal in broiler chicken commercial feed positively affects the growth performance and feed conversion. Dried Azolla as an unconventional feed ingredient can be included in the broiler ration at 5 per cent level increasing the gross profits by 10.60%.

KEY WORDS: Azolla, Broiler chicken, Economics, FCR, Nutrients.

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INTRODUCTION

Poultry farming is one of the most profitable businesses of agriculture and provides nutritious meat and eggs for human consumption within the shortest possible time. Feed alone incurs about 70 per cent of the total cost of poultry production and thus requires special attention in lowering feed cost to make it economically viable and profitable for the farmers. The shrinking resources of world grain production and its escalating cost have triggered the search for cheap unconventional feeds for poultry production and gaining attention of poultry nutritionists worldwide.

Among the feed proteins, plant originates are less costly than animal protein, but limited work has been done in our country on the use of unconventional feed ingredients in poultry diets which is quite inadequate. The need to identify and use unconventional feed ingredient has led the poultry nutritionists to explore the possibility for the use of a water fern Azolla (*Azolla pinnata*) as an unconventional feed ingredient in poultry feed owing to its immense potential as a source of high protein (25-30%), chlorophyll, carotenoids, essential amino acids, vitamins (vitamin A, vitamin B12, â-Carotene), growth promoter intermediaries and minerals (Lakshmanan et al., 2017; Samad et al., 2020). Thus, Azolla is a potential source of nutrients and has high feeding value. In view of above facts, the present study was designed to determine the effects of various levels of dried Azolla on the performance, meat quality and serum mineral level of broiler birds.

MATERIALS AND METHODS

Experimental Plan

The research work was carried out in the experimental poultry house of the Department of Animal Nutrition, DGCN College of Veterinary & Animal Sciences, Palampur, HP. In this 42-day study, 150-day-old unsexed Vencobb chicks were individually weighed on 0 day and assigned to five groups consisting of three replicates with ten chicks in each replicate, according to a completely randomized block design. Group T_0 did not contain the test ingredient, thereby serving as control group.

Cultivation of Azolla

Fresh green Azolla was cultivated, multiplied, and harvested in concrete (1 x 1 x .3 meters) and mud tanks (2 x 2 x.3 meters) constructed in the premises of Metabolic stall CSK HPKV Palampur, which was sun-dried immediately after harvesting. Dried Azolla was then ground and stored in airtight plastic bags until used for feeding.

Feed

Group T1, T2, T3 and T4 were offered dried Azolla in formulated feed at 2, 3, 4 and 5 per cent substitution level, respectively. Feed were formulated as per BIS (1992), for 0-21 days, broiler starter feed and for 22-42 days broiler finisher feed was offered to respective groups, presented in Table1.The metabolizable energy (ME) contents of different test diets used were calculated as per the equation proposed by Lodhi et al. (1976). The chicks were reared in battery cages with aluminum wire floor mesh. Standard management conditions like light, temperature, relative humidity, and ventilation were monitored and provided to each group. During the experimental period, birds were fed ad libitum on replicate basis and provided with clean, wholesome water.

Table 1. Ingredients and chemical composition (%) of broiler starter and finisher diet.

.	Starter					Finisher				
	T0	T1	T2	T3	T4	T0	T1	T2	T3	T4
Ingredient's composition (%)										
Yellow corn	47.01	47.01	47.01	47.01	47.01	51.23	50.23	50.23	50.23	50.23
Soybean meal	35.65	34.25	33.22	32.15	31.08	30	29.5	29	28.5	28
Fishmeal	8.00	7.90	7.90	7.90	7.90	4	4	4	4	4
Rice polish	3.72	3.72	3.72	3.72	3.72	7.07	6.77	6.07	5.57	5.07
De-oiled rice bran	5	5	5	5	5	7.2	7.2	7.2	7.2	7.2
Vegetable Oil	0.35	0.35	0.35	0.35	0.35	0.50	0.50	0.50	0.50	0.50
Dried Azolla	0.00	1.98	2.97	3.96	4.95	0.00	2	3	4	5
Premix#	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28
Chemical composition (%)										
CP (Crude Protein)	22.00	22.00	22.00	22.00	22.00	20.00	20.00	20.90	20.70	20.90
EE (Ether extract)	3.30	3.70	3.50	3.00	3.60	3.20	3.50	3.20	3.00	3.10
CF (Crude Fiber)	5.20	5.90	6.00	6.00	6.10	6.20	6.30	6.30	6.30	6.30
TA (Total Ash)	5.10	5.60	5.20	5.90	6.00	6.00	5.20	5.70	5.60	5.20
NFE (Nitrogen Free Extract)	64.50	62.60	63.20	62.90	62.10	64.50	64.70	63.80	64.40	64.30
AIA (Acid insoluble ash)	2.00	2.15	2.30	2.40	3.40	1.90	0.90	1.10	1.00	1.20
Ca (Calcium)	1.00	1.00	1.00	1.00	1.10	1.00	1.00	1.00	1.00	1.00
P (Phosphorus)	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
ME (Metabolizable Energy-Kcal/kg)	2800	2800	2800	2800	2800	2900	2900	2900	2900	2900

#Premix was prepared by mixing the following in 200 g maize flour:-
Ventrimix 10g (Vitamin- A- 82,500 I.U., B2- 50 mg, D3- 12,000 I.U., Vitamin K- 10mg/g),Ventribee Plus -20 g (Vitamin B1- 25mg, B6 -35mg, B12-250µg, E-225mg, Pantothenate-225mg, Niacinamide-300mg, Folic acid -20mg/5g) E care Se forte -25 mg (Vitamin E – 0.20g, Se- 0.04mg/g) Super DOT (Dinitro-O-TOULAMIDE – 250MG, Ethopabate-16mg/g)
Trace Minerals – 100g (Ferrous Oxide -2g, Di-calcium Phosphate -54g, Copper Sulphate -2g, Manganese Sulphate -3g, Zinc Sulphate -0.6g, Zinc oxide -1g, Ferrous Sulphate -10g, Potassium Iodide -2.5g, Magnesium Sulphate -25g)

Parameters Studied

Different growth parameters such as gain in body weight (GIW), feed intake (FI) and feed conversion ratio (FCR) were recorded weekly. Digestibility of nutrients, proximate composition of meat and cost benefit ratio were also calculated. The digestibility of various nutrients was carried out in caged battery brooders. For metabolism trial, five birds from each replicate with comparable body weight were selected and shifted to separate battery brooder on the 28th day of the experiment. An adaptation period of 3 days was given and the total fecal collection method for next 5 days was employed to estimate the apparent nutrient digestibility based on the total intake of feed and feces voided, recorded in each group. Feed and fecal samples drawn were later analyzed for proximate principles as proposed by AOAC (2005). Calcium and phosphorus in feed and fecal samples were estimated by atomic absorption spectrophotometer (AAS; USA, 1982).

At the end of the trial, six birds from each treatment were sacrificed by severing the jugular vein to study the proximate composition of meat. Thereafter, a portion of the breast muscle was harvested and sealed in sterile polythene bags. After weighing, the samples were allowed to dry in hot air oven and then crude protein (CP), crude fiber (CF), ether extract (EE), total ash (TA), acid insoluble ash (AIA), calcium and phosphorus contents were estimated by standard methods AOAC (2005). At 42 days of age, 3-5 mL of blood from randomly chosen 5 birds per replicate was collected from wing vein in heparinized centrifuge tubes, under aseptic conditions.

The plasma was separated through centrifugation of tubes at 5000 rpm for 15 minutes and stored at -20°C for later analysis of serum mineral content by using Agape kits.

Statistical analysis

The data collected during the conduct of above studies was statistically analyzed by the methods of Snedecor and Cochran, 1968 using complete randomized block design (CRD).

Results and Discussion

Growth performance of broiler birds for initial body weight, final body weight, gain in live body weight, feed intake and feed conversion ratio has been presented in Table 2.

Table 2. Growth performance of broiler birds.

Particulars	GIW (g/bird)	FI (g/bird)	FCR
Starter Phase (1-4 week)			
T0	674.71 ^{a} ±5.35	1669±15.96	2.41 ^{a} ±0.02
T1	659.43 ^{ac} ±4.55	1662±20.18	2.43 ^{a} ±0.03
T2	693.43 ^{ac} ±9.23	1632±17.81	2.30 ^{a} ±0.07
T3	709.64 ^{c} ±3.04	1679±21.12	2.32 ^{ab} ±0.03
T4	734.28 ^{c} ±5.07	1639±32.04	2.22 ^{b} ±0.02
p-Value	<0.0001		<0.01
Finisher phase (4-6 week)			
T0	760.66±13.04	1920±10.21	2.52±0.10
T1	804.13±10.2	1950±20.98	2.36±0.01
T2	778.20±19.7	1970±12.87	2.45±0.23
T3	789.04±12.7	1930±14.12	2.44±0.30
T4	796.71±14.6	1885±16.87	2.38±0.23
p-Value	0.2393		0.9832
Overall growth performance (1-6 weeks)			
T0	1479 ^{a} ±11.50	3725±24.92	2.43±0.01
T1	1533 ^{b} ±12.80	3568±21.85	2.37±0.12
T2	1497 ^{a} ±9.23	3600±14.46	2.32±0.04
T3	1531 ^{b} ±12.73	3640±16.35	2.38±0.05
T4	1562 ^{b} ±15.72	3505±20.34	2.24±0.23
p-Value	0.0001		0.8357

Figures with different super scripts in a column are significantly ($P<0.05$) different from each other
GIW: Gain in weight, FI: Feed intake, FCR: Feed conversion ratio

The results for growth performance (Table-2) during starter phase revealed significantly higher GIW and FCR in treatment T4 offered 5 per cent died azolla. Overall results (1-6week) revealed that the average GIW in control group T0 was lowest (1479 g), whereas corresponding gain in live weight in treatments T1, T2, T3, and T4 was 1532, 1497, 1531and 1562 g, respectively. The average final body weight of the birds exhibited a particular trend. There was a linear increase in weight gain with increasing level of dried azolla. The results are in accordance with the findings of Basak et al. (2002) who reported higher ($P<0.01$) gain in live body weight with 5 per cent azolla in test diet. Similarly, Dhumal et al. (2009) reported that the body weights of broiler birds offered azolla meal at 6th week in treatment group were numerically higher than the control. However, Parthasarthy et al. (2002) reported no significant difference in body weight gain of broilers on basal and 5 per cent azolla. Ashraf et al. (2015) also reported that there was no adverse effect on the performance of broilers when 5 per cent of mustard oil cake was replaced by azolla. In the previously published works, researchers also concluded that Azolla could be used in poultry feed over 5 per cent without any side effects on growth performance and productivity (Lakshmanan et al.,2017; Samad et al.,2020; Al-Shwilly,2022). Substitution of dried azolla did not affect feed intake (Table 2) amongst different treatment groups. Feed intake was optimal which led to improved FCR in treatment groups which was significantly better at 5 per cent substitution of dried azolla thus concluding that the substitution of azolla at 5 percent level did not affect the palatability of feed. Basak et al. (2002) also reported that use of azolla meal up to 5 per cent may be used in broiler diets at a safe level and had no deleterious effect on the palatability of broiler diets. Similar findings were reported by AL- AL-Shwilly (2022) that inclusion of azolla in broiler diet did not affect feed consumption up to 15 per cent level of inclusion. Perusal of the results for FCR exhibited significant ($P<0.05$) difference in treatment T4 compared to control T0 during starter phase but numerically higher FCR during finisher phase. Numerically treatment T2 and T4 exhibited 5 and 8 percent better FCR than control groupT0.The results obtained in the present study fall in line with the findings of Basaket al. (2002), Naghshi et al. (2014), Saikia et al. (2014) who recorded improvement in FCR with inclusion of Azolla as feed ingredient in poultry broiler birds. Ashraf et al. (2015) reported that replacement of mustard oil cake with dried azolla up to 5 per cent did not cause any significant effect on FCR.

Results regarding proximate analysis (Table 3) of broiler meat exhibited significantly ($p<0.001$) higher value of Dry Matter (DM) in T3 and T4 treatment whereas no significant difference for Crude Protein (CP), Crude Fibre (CF), Ether Extract (EE), total ash, acid insoluble ash, and Nitrogen Free Extract (NFE) was recorded. The results are in accordance with the findings of Balaji et al. (2009) who concluded that the proximate principles were not influenced by the dietary supplementation of dried azolla. Results of the digestibility trial (Table 3) revealed that the average value of digestibility coefficients of DM, CP, CF, EE and NFE, were non-significant between groups. However, a previous study by Parthasarathy et al. (2002) reported that birds fed on 5 per cent azolla significantly retained nitrogen (43.96 per cent). Results for serum mineral content (Table 3) revealed no significant difference for Ca, Mg, Cu, Zn, Fe and P in different treatment groups offered dried azolla and were well within the normal range.

Table 3. Proximate composition of broiler meat, digestibility coefficients of proximate principles during metabolic trial and serum mineral contents at the end of finisher phase of broilers.

Particulars	T0	T1	T2	T3	T4	p-Value
Proximate composition of broiler meat						
DM	70.03±0.13[a]	69.61±0.24[ac]	69.99±0.4[ac]	72.96±0.01[b]	72.90±0.32[b]	<0.001
TA	2.03±0.20	2.89±1.20	3.00±0.07	2.96±0.80	2.88±0.70	0.864
AIA	1.5±0.45	1.26±0.76	1.6±0.05	1.14±0.87	1.96±0.50	0.884
CP	61.65±2.33	63.03±4.65	58.88±3.22	71.16±6.34	67.09±5.43	0.386
EE	2.58±0.12	3.07±0.45	3.18±0.78	3.65±0.09	3.49±0.56	0.567
CF	3.14±1.13	3.73±2.32	3.83±0.97	3.72±1.21	3.83±0.78	0.996
NFE	27.49±1.78	21.80±2.76	22.37±2.11	21.59±1.12	22.55±2.34	0.273
Digestibility coefficients of proximate principles						
DM	65.47±0.12	63.45±1.56	62.21±0.09	63.98±0.98	64.46±0.54	0.1754
CP	51.27±4.53	52.78±3.22	51.65±4.33	51.34±2.32	54.43±7.89	0.9878
EE	72.23±1.21	75.61±2.45	74.56±4.67	76.31±3.41	74.23±4.32	0.9307
CF	47.34±1.43	48.19±0.98	52.09±2.31	47.76±1.87	51.06±1.98	0.2869
NFE	60.23±1.01	58.83±0.99	62.62±2.01	61.66±1.32	57.23±0.98	0.0946
DM: Dry matter, CP: Crude protein, CF: Crude fiber, EE: Ether extract, NFE: Nitrogen free extract, TA: Total ash, AIA: Acid insoluble ash						
Serum Mineral Content						
Calcium(mg/dL)	9.42±0.01	9.53±0.12	9.76±0.76	10.7±1.23	10.5±1.34	0.783
Magnesium(mg/dL)	1.20±1.01	1.12±1.04	1.06±1.11	1.72±0.23	1.42±0.08	0.979
Copper (ppm)	0.20±0.07	0.19±0.04	0.17±0.13	0.13±.01	0.16±0.09	0.975
Zinc (ppm)	2.11±0.65	2.33±1.05	2.23±0.04	2.12±0.33	2.18±0.33	0.998
Iron (ppm)	2.01±0.09	2.23±0.07	2.89±0.65	3.33±0.34	2.78±1.76	0.818
Phosphorus(mg/dL)	4.76±0.67	5.07±0.78	5.03±0.98	5.12±1.89	4.99±1.22	0.999

Figures with different super scripts in a column are significantly (P<0.05) different from each other

Economics of feeding

The cost of test diet prepared for broiler birds offered during present study was computed by considering the prevailing prices of the feed ingredients and feed additives and given in Table 4. The cost of production per kg live weight gain was lowest in T4 (Rs 21.31) group and highest in control T0 (Rs. 22.23). Similarly, the gross profit was lowest in control T0 (Rs. 56.5) and highest in the T4 (Rs 63.2). Economics of broiler birds' production by inclusion of 5% Azolla in broiler feed exhibited 10.60% higher gross profit compared to control T0. The results were also supported by other researchers finding that inclusion of azolla at 5% level gave better economic returns (Parthasarathy et al.,2002; Ashraf et al.,2015).

Table 4. Economics of feeding

Particulars	T0	T1	T2	T3	T4
Cost of feed/Kg	22.23	21.92	21.72	21.52	21.31
FCR per Kg gain in live weight	2.4	2.3	2.3	2.3	2.3
Cost of total feed (Rs.)	53.5	50.4	49.9	49.4	46.8
Sale price per kg live body weight (Rs.)	110	110	110	110	110
Gross profit /bird (Rs.)	56.5	59.6	60.1	60.6	63.2

CONCLUSION

It is thus concluded that 5% substitution of dried Azolla replacing soybean meal in broiler chicken commercial feed positively affects the growth performance and feed conversion. Dried Azolla as an unconventional feed ingredient can be included in the broiler ration at 5 per cent level increasing the gross profits by 10.60%.

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