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Effect on Growth and Economics of Vanaraja Poultry on Azolla Feed Supplementation

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Abstract

A study was conducted by Krishi Vigyan Kendra, West Siang, Indian Council of Agricultural Research, Arunachal Pradesh Centre, India for a period of 72 weeks, from January, 2021 to May, 2022 with 300 unsexed 4 weeks old brooded Vanaraja chicks which were provided to the farmers. The birds were randomly divided into five feeding trial groups (20 birds in each treatment group with 3 replications), namely TO_1 (birds were let out for foraging with no supplementation), TO_2 (basal diet), TO_3 (basal diet + 5% fresh Azolla), TO_4 (basal diet + 10% fresh Azolla) and TO_5 (basal diet + 15% fresh Azolla). Data on weekly body weight gain up to 20th weeks showed no significant difference between Azolla fed groups and basal diet fed groups; whereas, number of egg production up to 72nd weeks recorded as 62.4±3.4, 110.5±3.1, 116.2±3.2, 120.5±4.6 and 128.2±4.8 in TO_1, TO_2, TO_3, TO_4 and TO_5 respectively. Economic efficiency of Azolla fed birds showed higher economic returns in terms of benefit cost ratio in group TO_5 (4.42) than that of basal diet (3.04) and group where birds were let out for foraging (2.59).

Keywords: Azolla, Egg production, Feed, Growth performance, Poultry

Introduction

Against unfortunate crop loss under the prevailing condition of climate change, poultry farming is considered as insurance to the farmers. Among the various poultry breeds, colour synthetic poultry birds namely, Vanaraja, developed by the ICAR-Directorate of Poultry Research (formerly Project Directorate on Poultry) in Hyderabad, India has been gaining popularity amongst the farmers, as its colour and other phenotypic characteristics are resembles with the indigenous chicken. Though, these birds perform very well in the village conditions, but the availability of quality feed at a reasonable cost is always concern for successful and sustainable production cycle as feed alone accounts for more than 60% of total cost of production (Basak *et al.*, 2002). Therefore, a locally available feed resource with minimal competition with human food is necessary. Azolla, belonging to the family *Azollaceae* as a supplementary feed would be an option for reducing the production cost. This aquatic plant, Azolla which is having higher biomass and protein content and nutritive values can be used for supplementary poultry feed as it can be cultivated rapidly near to the rural poultry unit (Chichilichi *et al.*, 2013). Azolla on dry weight basis contains 25-35% essential amino acids, which is easily digested by poultry besides having vitamins and carotenoids (Maurice *et al.*, 1984). Though, the carbohydrate and fat content of Azolla is very low, but its growth promoter intermediaries and minerals like calcium, phosphorous, potassium, ferrous, copper, magnesium, chlorophyll, carotinoids *etc.* makes it a highly efficient and effective feed for livestock and poultry (Pillai *et al.*, 2005). Within a specific limits as poultry feed, it shows better growth rate, feed conversion ratio, protein and energy utilization efficiency, along with promising economic returns and had no deleterious health effect as compared to the birds reared on normal basal diet (Parashuramulu *et al.*, 2013). Keeping the above point in

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view the present study has been undertaken to explore the growth performance and economics of Vanaraja poultry on Azolla feed supplementation.

Materials and Methods

Location and Period of Experiment

The experimental location lay in 82°86.277′ E to 94°42.903′ E latitude and 27°19.078′ N to 27°44.127′ N longitudes with an altitude range from 180 to 1250 meters above the Mean Sea Level. The average annual rainfall of the study area was 2,467 mm with the highest during July (469.7 mm) and lowest during December (22.0 mm). Average relative humidity of the study area was 70% in the morning and 61% in the evening and temperature range from 15.9 °C to 24.2 °C. The experiment was conducted at adopted villages of *Krishi Vigyan Kendra*, West Siang, Indian Council of Agricultural Research (ICAR), Arunachal Pradesh Centre, Basar, India namely Soi, Nyigam, Bam, Gori to evaluate the utility of Azolla as a feed supplement to the Vanaraja poultry birds under an On farm Trial (OFT) for a period of 72 weeks, from January, 2021 to May, 2022. OFT is a concept of field trial evolved by ICAR, with an objective of evaluating the performance of production technologies and their management practices in the farmers' field under different agro-climatic and farming situations (Baruah *et al*., 2018).

Experimental Design

A total of 300 unsexed Vanaraja chicks were provided to the farmers after an initial brooding period of 4 weeks and simultaneously vaccinated with *Ranikhet* and *Gumboro* disease as per standard vaccination protocol at poultry unit of ICAR-KVK, West Siang instructional farm. During the age of 4th week to 72th weeks all chicks were randomly distributed into five treatments groups with three replicates having 20 chicks each and subjected to dilatory treatment as below.

Technological Option 1 (TO_1): Foraging with no supplementation

Technological Option 2 (TO_2): Basal diet

Technological Option 3 (TO_3): Basal diet + 5% fresh Azolla of basal diet

Technological Option 4 (TO_4): Basal diet + 10% fresh Azolla of basal diet

Technological Option 5 (TO_5): Basal diet + 15% fresh Azolla of basal diet

In TO_2, TO_3, TO_4 and TO_5 groups' chicks were grown in deep litter system and experimental diets were provided as per BIS specification. Whereas, Vanaraja birds of TO_1 were let out for foraging with no supplementation. Water was provided *ad libitum* and 16 hours photoperiod was provided after 14th weeks of age.

Cultivation, Harvesting and Feeding of Azolla

Azolla, (*Azolla pinnata*) collected from the research farm of ICAR-Research Complex for North Eastern Hill Region, Arunachal Pradesh Centre, Basar, India was multiplied at instructional farm of KVK, West Siang as well as at farmers field in polythene lining pits of 4 m × 2 m × 0.2 m (L × W × D) dimensions which was constructed near the shelter of the poultry. The pits were filled with fresh water and then in a 30 liter capacity bucket 2 kg fresh cow dung and 70 g single super phosphate was mixed with water and poured in the pit. After that half kg of fresh Azolla was inoculated in the pit by spreading on the surface. After one month of inoculation, fresh Azolla was harvested, rinsed with fresh water for 4 times to remove the dung smell. To remove excess water, collected Azolla were spread on a water absorbing paper or a wire mesh for half an hour. Calculated amount of fresh Azolla was fed to the different groups' of poultry as per the experimental design.

Feed Conversion Ratio

In each treatment weekly feed consumption by individual bird was calculated up to 20 weeks of age and based on that feed conversion ratio was determined with the following formula.

$$\text{Feed Conversion Ratio (FCR)} = \frac{\text{Weekly feed intake (g)}}{\text{Weekly weight gain (g)}}$$

Evaluation of Production Parameters and Economics of Poultry Rearing

The data on weekly body weight gain and egg production were recorded. Gross expenditure was calculated by adding the variable cost (cost of a day old chicks, cost of feed, cost of vaccine, cost of medicine, feed supplement, cost of labour) and fixed cost (cost poultry shed made with locally available material, depreciation cost on poultry shed, drinker/ feeder). Cost of land was not considered for calculating the gross expenditure as it is available with the farmers. The return was calculated by adding the incomes from the sale of eggs, sale of cocks and spent hens. The benefit cost ratio was estimated for gain in body weight and number of egg produced during the trial period. The different economic parameters were calculated as below.

$$\text{Cost of production per bird (Rs.)} = \frac{\text{Gross expenditure (Rs.)}}{\text{Total number of birds in treatment}}$$

$$\text{Net income (Rs.)} = \text{Gross income (Rs.)} - \text{Gross expenditure (Rs.)}$$

$$\text{Net income per bird (Rs.)} = \frac{\text{Gross income (Rs.)} - \text{Gross expenditure (Rs.)}}{\text{No. of live birds}}$$

$$\text{Benefit Cost Ratio} = \frac{\text{Gross return (Rs.)}}{\text{Gross cost (Rs.)}}$$

Statistical Analysis

The data were statistically analyzed as per Snedecor and Cochran (1994) and using methods like Tabular test (for descriptive statistics) and two-way analysis of variance (ANOVA).

Results and Discussion

Body Weight Gain

Under different feeding trials weekly mean body weight was calculated up to the age of 20 weeks and presented in Table 1. A significantly higher weekly weight gain was recorded in TO^5 group (2295.41±12.91 g) and lowest weight gain was recorded in TO_1 group (1090.32±11.80 g) which was at par with TO_4 (2120.45±11.70 g), TO_3 (2099.50±12.40 g)

Table 1: Weekly mean body weight gain (g) + Standard Error (SE) of Vanaraja birds under different feeding trial

Age of birds	TO_1 (Foraging with no supplementation)	TO_2 (Basal diet)	TO_3 (Basal diet + 5% fresh Azolla of basal diet)	TO_4 (Basal diet + 10% fresh Azolla of basal diet)	TO_5 (Basal diet + 15% fresh Azolla of basal diet)	Remark
Day old	43.54 ± 1.30	45.98 ± 1.23	46.64 ± 1.38	45.45 ± 1.28	44.10 ± 1.33	NS
4th week	375.85 ± 6.17	409.96 ± 10.12	405.85 ± 11.10	385.37 ± 15.74	410.55 ± 11.25	NS
5th week	412.82a ± 5.88	529^{bc} ± 12.91	525bc ± 8.55	520.36^{bc} ± 9.35	530.12^{bc} ± 15.89	*
6th week	455.65^{a} ± 23.55	675.65^{bc} ± 8.65	679.35^{bc} ± 11.45	687.55^{bc} ± 33.16	700.25^{bc} ± 35.61	*
7th week	500.85^{a} ± 25.85	800.25^{bc} ± 12.45	810.24^{bc} ± 12.45	835.92^{bc} ± 24.30	856.86^{bc} ± 24.50	*
8th week	570.55^{a} ± 54.12	908.85^{bc} ± 19.16	925.85^{bc} ± 22.54	985.95^{bc} ± 9.66	1085.55^{bc} ± 17.55	*
9th week	655.55^{a} ± 22.12	1025.56^{c} ± 11.45	1102.90^{c} ± 8.95	1245.82^{b} ± 7.85	1355.85^{b} ± 8.58	*
10th week	705.35^{a} ± 15.20	1295.32^{bc} ± 6.75	1345.55^{bc} ± 21.05	1370.32^{bc} ± 15.12	1395.55^{bc} ± 6.95	*
11th week	785.45^{a} ± 14.04	1465.4^{bc} ± 18.55	1500.82^{c} ± 6.75	1565.97^{b} ± 12.75	1570.58^{b} ± 9.11	*
12th week	890.48^{a} ± 24.56	1670.76^{c} ± 16.34	1750.95^{c} ± 9.45	1845.85^{b} ± 12.16	1890.95^{b} ± 9.55	*
13th week	938.87^{a} ± 31.10	1690.45^{bc} ± 14.02	1800.90^{bc} ± 11.71	1870.85^{bc} ± 9.15	1954.65^{bc} ± 12.25	*
14th week	948.41^{a} ± 11.20	1700.33^{bc} ± 9.45	1845.35^{bc} ± 9.25	1900.65^{bc} ± 11.20	1987.42^{bc} ± 9.55	*
15th week	975.25^{a} ± 10.41	1795.32^{bc} ± 11.22	1890.45^{bc} ± 9.45	1921.54^{bc} ± 9.45	199035^{bc} ± 12.54	*
16th week	1000.37^{a} ± 13.21	1895.39^{bc} ± 11.45	1920.55^{bc} ± 11.20	1945.41^{bc} ± 7.85	2010.47^{bc} ± 10.45	*
17th week	1010.48^{a} ± 17.10	1925.41^{bc}± 9.45	1975.75^{bc} ± 12.45	1980.62^{bc} ± 10.24	2085.45^{bc}± 9.25	*
18th week	1035.65^{a} ± 10.21	1995.45^{bc} ± 9.85	2020.35^{bc} ± 9.85	2000.70^{bc} ± 11.55	2100.55^{bc} ± 7.55	*
19th week	1075.42^{a} ± 13.78	2045.55^{bc} ± 8.42	2076.97^{bc} ± 9.55	2095.76^{bc} ± 12.06	2245.45^{bc} ± 9.42	*
20th week	1090.32^{a} ± 11.80	2085.65^{bc} ± 7.01	2099.50^{bc} ± 12.40	2120.45^{bc} ± 11.70	2295.41^{bc} ± 12.91	*

Means bearing different superscript (a, b, c) in the same row differ significantly; * $p \leq 0.05$

and TO_2 (2085.65±7.01 g). These results are in accordance with the Cambel (1984), Paudel *et al*. (2015) and Joshi *et al*. (2020) who found better weekly weight gain in birds fed with 15% Azolla feed supplementation over basal diet. This might be due to the higher amount of crude protein and metabolizable energy (ME) and better digestion ability of Azolla in the gut of poultry (Basak *et al*., 2002).

Survivability

Up to the age of 21 weeks (Laying period) no significantly difference was observed in birds' mortality (Table 2); which indicates that Azolla as a dilatory supplement has no toxic effect upto the level of 15%. This finding is in accordance with the findings of Basak *et al.* (2002).

Effect on Egg Production

The data on the egg yield up to 72 weeks (Table 2) showed that, in the treatment groups where Azolla fed as supplementation, increased egg production was recorded as 128.2±4.8 numbers in TO_5, 120.5±4.6 numbers in TO_4, 116.2±3.2 numbers in TO_3 in compare with the birds reared in TO_2 group *i.e*., in basal diet (110.5±3.1 numbers) and TO_1 group *i.e*., in foraging with no supplementation (62.4±3.4). These results were in accordance with the Ali and Leeson (1995); which might be due to the high digestible protein and carotene contains in Azolla (Lakshmanan *et al*., 2017).

Feed Consumption and FCR

A significant difference ($P < 0.01$) in weekly feed consumption was observed among the groups at the end of 20 weeks (Table 3). Average highest feed consumption was recorded in TO_2 group (7,569.32 g bird^{-1}) with a FCR of 3.63 followed by TO_3 (7,186.55 g bird^{-1}) with a FCR 3.42, TO_4 (6,811.47 g bird^{-1}) with a FCR 3.21 and TO_5 (6,236.09 g bird^{-1}) with a FCR 2.72. In TO_1, total feed consumption after 4th weeks was not calculated, as in this group birds were reared subsequently in foraging with no supplementation. The lower FCR in Azolla fed groups in compare to the basal diet group indicates that the Azolla fed groups can more efficiently convert feed into food which is in agreement with the findings of Shukla *et al*. (2018). The increased body weight of birds in Azolla fed groups may be due to the apparent capacity of Azolla to supply easily digestible essential amino acids, besides having vitamins, minerals and carotenoids. Replacing the total basal diet by Azolla feed might be another reason for increasing FCR (Sinha *et al*., 2018).

Economics of Production

The estimated returns and other economic parameters were presented in table 4. The cost of production bird^{-1} was highest (Rs. 322.13) in TO_2, followed by TO_3 (Rs. 305.89), TO_4 (Rs. 287.55) and TO_5 (Rs. 261.75). As in TO_1 group, birds were not provided any concentrate feeds; therefore, cost of production bird^{-1} in that group was lowest *i.e.*, Rs. 259.07. Net income bird^{-1} was recorded highest in TO_5 (Rs. 895.19) which was at par with TO_4 (Rs. 805.15), TO_3 (Rs. 758.19) and TO_2 (Rs. 657.16) respectively. The lowest net income

Table 2: Effect of Azolla feeding on egg production (Mean ± SE) of Vanaraja birds under different feeding trial

Group	Total egg production at 40 weeks	Total egg production at 72 weeks	Mortality % at 21 weeks (Laying stage)
TO_1: (Foraging with no supplementation)	25.1 ± 4.8	62.4 ± 3.4	17.5
TO_2: (Basal diet)	42.1 ± 2.9	110.5 ± 3.1	16.9
TO_3: (Basal diet + 5% fresh Azolla of basal diet)	43.2 ± 3.5	116.2 ± 3.2	16.2
TO_4: (Basal diet + 10% fresh Azolla of basal diet)	46.3 ± 2.4	120.5 ± 4.6	15.1
TO_5: (Basal diet + 15% fresh Azolla of basal diet)	48.5 ± 2.6	128.2 ± 4.8	15.5

Table 3: Average feed consumption and feed Conversion Ratio (FCR) of Vanaraja birds at various ages under different feeding trial

Period	Concentrate Feed consumption (g $bird^{-1}$)					t-test
	TO_1	TO_2	TO_3	TO_4	TO_5	
0 to 4 weeks	555.35	559.32	530.50	500.38	480.54	-
4 to 8 weeks	-	889.75	855.30	810.57	755.30	11.28**
8 to 20 weeks	-	6120.25	5800.75	5500.52	5000.25	16.21**
Average	-	7569.32	7186.55	6811.47	6236.09	23.11**
FCR	-	3.63	3.42	3.21	2.72	-

** P<0.01

Table 4: Estimated return from Vanaraja birds under different feeding trial (N = Avg. number of birds $groups^{-1}$ after considering the mortality at 21 weeks)

Sl. No.	Part-iculars	TO_1	Amount (Rs.)	TO_2	Amount (Rs.)	TO_3	Amount (Rs.)	TO_4	Amount (Rs.)	TO_5	Amount (Rs.)
1	Income from sale of eggs at 72 weeks @ Rs. 8.00 egg^{-1}	Avg. egg prod-uction: 62.4 eggs hen^{-1} i.e., 686.4 nos. of eggs	5,491.20	Avg. egg prod-uction 110.5 eggs hen^{-1} i.e., 773.5 nos. of eggs	6,188.00	Avg. egg prod-uction 116.2 eggs hen^{-1} i.e., 1,045.8 nos. of eggs	8,366.40	Avg. egg prod-uction 120.5 eggs hen^{-1} i.e., 1,205 nos. of eggs	9,640.00	Avg. egg prod-uction 128.2 eggs hen^{-1} i.e., 1,282 nos. of eggs	10,256.00
2	Sale of cocks @ Rs. 400.00 Kg^{-1}	Avg. weight: 1.09 Kg. Total weight: 6.54 Kg	2,616.00	Avg. weight: 2.09 Kg. Total weight: 20.90 Kg	8,360.00	Avg. weight: 2.10 Kg. Total weight: 16.80 Kg	6,720.00	Avg. weight: 2.12 Kg. Total weight: 14.84 Kg	5,936.00	Avg. weight: 2.29 Kg. Total weight: 16.03 Kg	6,412.00
3	Sale of spent hens (Rs. 300.00 hen^{-1})	-	3,300.00	-	2,100.00	-	3,003.00	-	3,000.00	-	3,000.00
4	Total gross income (Rs.)	-	11,407.20	-	16,648.00	-	18,089.40	-	18,576.00	-	19,668.00

Table 4: Continue...

Sl. No.	Particulars	TO_1	Amount (Rs.)	TO_2	Amount (Rs.)	TO_3	Amount (Rs.)	TO_4	Amount (Rs.)	TO_5	Amount (Rs.)
5	Gross expenditure (Rs.)	-	4,404.32	-	5,476.31	-	5,200.17	-	4,888.42	-	4,449.77
6	Cost of production bird^{-1} (Rs.)	-	259.07	-	322.13	-	305.89	-	287.55	-	261.75
7	Net income (Rs.)	-	7,002.88	-	11,171.69	-	12,235.23	-	13,687.58		15,218.23
8	Net income bird^{-1} (Rs.)	-	411.93	-	657.16	-	758.19	-	805.15	-	895.19
9	Benefit-cost-ratio (BCR)	-	2.59	-	3.04	-	3.48	-	3.80	-	4.42

TO_1: (Foraging with no supplementation); TO_2: (Basal diet) N = 17 (7 Female + 10 Male); TO_3: (Basal diet + 5% fresh Azolla of basal diet) N = 17 (9 Female + 8 Male); TO_4: (Basal diet + 10% fresh Azolla of basal diet) N = 17 (10 Female + 7 Male); TO_5: (Basal diet + 15% fresh Azolla of basal diet) N = 17 (10 Female + 7 Male)

bird^{-1} was recorded in TO_1 (Rs. 411.93). Among the Azolla-fed groups, group TO_5 showed a highest Benefit Cost ratio (4.42) than that of TO_4 (3.80), TO_3 (3.48), TO_2 (3.04) and TO_1 (2.59) respectively. This result was on par with Joshi *et al.* (2020) which might be due to the fact that, when fresh Azolla having easily digestible essential amino acids used as a feed supplement in a specific quantity in poultry ration, it reduces the feed cost, improves the growth and egg production and finally leads to high Benefit Cost ratio in backyard poultry (Subramanian, 2021).

Conclusion

The present study was conducted at the four adopted villages of *Krishi Vigyan Kendra*, West Siang, Indian Council of Agricultural Research (ICAR), Arunachal Pradesh Centre, Basar, India to explore the performance of growth and economics of Vanaraja poultry on different feeding trials namely, basal diet + 5% fresh Azolla, basal diet + 10% fresh Azolla, basal diet + 15% fresh Azolla in comparison to the basal diet and with traditional foraging where no supplementation of concentrate feed. From the study it can be concluded that, inclusion of rapid biomass producing Azolla up to 15% level along with basal diet in the backyard poultry diet favorers the growth and egg production resulting a Benefit Cost Ratio of 4.42 due its high digestible protein and carotene contains.

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