

Original Research Article

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Azolla - A Low Cost and Effective Feed Supplement to Poultry Birds

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ABSTRACT

A study was conducted to evaluate the utility of Azolla as a feed supplement to poultry birds. Two species of azolla viz., *A. microphylla* and *A. filiculoides* and two Azolla hybrids viz., Rong ping and TNAU1 were initially analyzed for their nutritional parameters so as to select the suitable Azolla species to feed the poultry birds. Azolla hybrids Rong ping and TNAU1 recorded higher biomass production than wild Azolla cultures. A maximum protein content of 318.20 µg/mg dry weight was recorded by the Azolla hybrid Rong ping. The Azolla hybrid Rong ping also showed maximum carotenoid (2.01 µg/mg) and β carotene (0.64 µg/mg) content. The layer birds fed with Azolla hybrid Rong ping registered an overall egg productivity of 89.0% as against 84.0% recorded by the birds fed with only concentrated feed. The average daily intake of concentrated feed in the birds fed with Azolla was considerably low (106 g) due to nutrient supplementation by Azolla. The total protein content of the eggs laid by the Azolla fed birds was high (14.0 g/100g of edible portion) and the total carotene content of these eggs (440 µg/ 100 g of edible portion) was also higher than the control. The increase in egg productivity, nutritional value and savings in the concentrated feed clearly indicated the suitability of Azolla as a potential feed supplement for poultry birds.

Keywords

Azolla hybrids,
Nutrient
supplementation,
Productivity,
Poultry birds.

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Introduction

Azolla is a free floating water fern that floats in water and fixes atmospheric nitrogen in association with the nitrogen fixing blue green alga, *Anabaena azollae*. Azolla is considered to be a potential biofertilizer in terms of nitrogen contribution to rice crop (Kannaiyan, 1992). Long before its cultivation as a green manure, Azolla was used as a fodder for domesticated animals such as pigs and ducks.

In recent days, Azolla is very much used as a sustainable feed substitute for livestock especially dairy cattle, poultry, piggery and fish. Azolla contains 25-35% protein on dry weight basis and rich in essential amino acids,

minerals, vitamins and carotenoids including the antioxidant β carotene (Ivan *et al.*, 1989). Chlorophyll *a*, chlorophyll *b* and carotenoids are also present in Azolla, while the cyanobiont *Anabaena azollae* contains chlorophyll *a*, phycobiliproteins and carotenoids (Tyagi *et al.*, 1980). Azolla is used as a fodder in North Vietnam, Asia, Africa and China (Anonymous, 1985) and the rare combination of high nutritive value and rapid biomass production make Azolla a potential and effective feed substitute for livestock, particularly poultry birds. Hence, a study was conducted to evaluate the utility of Azolla as a feed supplement to poultry birds.

Materials and Methods

Two species of Azolla viz., *A. microphylla* and *A. filiculoides* and two Azolla hybrids viz., Rong ping and TNAU1 were analyzed for their nutritional parameters such as protein, carotenoids and β carotene contents and also for their biomass production potential so as to choose the suitable Azolla culture to feed the poultry birds.

The biomass production, doubling time and relative growth rate of the selected Azolla cultures were estimated both under field and laboratory conditions. Fresh fronds of Azolla were washed well, blot dried and inoculated @ 500 mg on fresh weight basis in 250 ml conical flasks, each containing 100 ml of nitrogen free IRR medium (Watanabe,1977).

The conical flasks containing the Azolla were kept in a growth chamber at $28\pm 1^\circ\text{C}$ temperature with a light intensity of 3,000 lux for 15 days period. To estimate the biomass production of different Azolla cultures under field conditions, fresh Azolla fronds were inoculated in cement tanks @ 100 g/m^2 and allowed to grow for a period of 15 days by maintaining the optimum growth condition.

After 15 days the weight of the fresh biomass was assessed and from the weight of the initial and final biomass, the doubling time and relative growth rate were calculated following the method of Subudhi and Watanabe (1981).

Doubling time (DT) = t/r

Where,

t = Experimental period

$$r = \frac{\log(W_1 - W_0)}{0.301}$$

Where,

$$\begin{aligned} W_1 &= \text{Weight after 't' days} \\ W_0 &= \text{Weight of initial inoculum} \\ 0.301 &= \text{Constant} \end{aligned}$$

The relative growth rate was estimated using the formula,

$$\text{RGR} = 0.693 / \text{doubling time}$$

Where, 0.693 is a constant.

The carotenoid content of Azolla was estimated calorimetrically by the method of Siegelman and Kycia (1976) and the β carotene content was estimated by High performance liquid chromatography using C_{18} column. The total protein content was estimated as suggested by Lowry *et al.*, (1957).

To find out the utility of Azolla hybrid Rong ping as a feed supplement to poultry birds, fresh Azolla fronds were top dressed to a batch of fifty birds which were fifty one weeks old @ 10.0 g per bird per day as single dose along with concentrated feed of standard composition.

A control batch of fifty birds of same age was maintained which were fed only with concentrated feed. The feed intake, feed left over and egg production were recorded periodically in both the batches of Azolla fed birds and control birds fed with only standard concentrated feed.

The experiment was continued for a period of 17 weeks starting from 51st week of age to 67th week. To find out the effect of Azolla consumption on the nutritive value of the egg, individual egg weight, albumin and globulin content were estimated in eggs laid by Azolla fed birds and birds fed only with concentrated feed.

Results and Discussion

Biomass production and nutritional value of different *Azolla* culture

Among the different *Azolla* species tested for the biomass production, *Azolla* hybrids Rong ping and TNAU1 recorded higher biomass production than wild *Azolla* cultures as shown in table 1.

Azolla hybrid Rong ping recorded the maximum biomass production (3.11 g), followed by TNAU1 hybrid (2.82 g) when grown in growth chamber under controlled condition and the similar trend was also noticed under field condition.

The *Azolla* hybrid Rong ping recorded a doubling time of 5.39 and 5.02 days under laboratory and field conditions respectively.

Among the four *Azolla* species tested, *Azolla* hybrid Rong ping registered the maximum relative growth rate of 0.129 g/g/d under laboratory condition.

Based on the growth conditions, Becking (1979) recorded a doubling time of 2.0 to 19.9 days in different *Azolla* species. Kannaiyan (1988) observed a doubling time of 3.1 days in *A. mexicana* and *A. filiculoides*.

While estimating the protein content of the *Azolla* species under study, a maximum protein content of 318.20 µg/mg dry weight was recorded by the *Azolla* hybrid Rong ping. Among the wild *Azolla* cultures, *A. microphylla* recorded higher β carotene content than *A. filiculoides* and among the hybrids Rong ping showed maximum carotenoid (2.01 µg/mg dry weight) and β carotene (0.64 µg/mg dry weight) content and thus proved its suitability as a feed supplement to poultry birds.

Feeding effect on *Azolla* hybrid Rong ping on the productivity

The data on the egg yield showed that in the layer birds fed with *Azolla* hybrid Rong ping, increased egg yield was noticed due to *Azolla* feeding (Table 2). The *Azolla* fed birds registered an overall egg productivity of 89.00% as against 83.70% recorded by the birds fed with only concentrated feed. The average daily intake of concentrated feed was considerably low (106 g) for birds due to *Azolla* substitution as against 122 g in the control birds. More importantly *Azolla* feeding showed considerable amount of savings in the consumption of concentrated feed (13.0%) leading to reduced operational cost. By considering the average cost of the concentrated feed as Rs. 8.17/Kg, a 13.0% saving in the consumption of concentrated feed due to *Azolla* supplementation ultimately leads to a feed cost saving of 10.0 paise/day/bird and hence a layer unit maintaining 10,000 birds could cut down its expense towards feed to a tune of Rs.1000/day. Anon (1985) reported that in dried form *Azolla* can be substituted for 15-20% of the starchy feed required for pigs. Anon (1985) also reported that live stock gained weight faster when fed with *Azolla* – rice straw mixture.

Rong Ping effect on the nutritional value

While analyzing the nutritional value of the egg laid by the birds fed with *Azolla*, increased egg weight (61.20 g), higher albumin, globulin and carotene contents were noticed (Table 3). Sundararaju *et al.*, (1995) investigated the effect of feeding *Azolla*, *Sesbania* and *Leucaena* proteins on the performance of broiler chicken. They found that that the dried *Azolla*, *Sesbania* and *Leucaena* meals when fed to broiler chicken at 6% level significantly increased the body weight at 4,6 and 8 weeks of age.

Table.1 Biomass production and nutritional value of different *Azolla* cultures

| <i>Azolla</i> cultures | Biomass* (g) | | Doubling time (days) | | RGR (g/g/d) | | Protein (µg/mg dry weight) | Carotenoids (µg/mg dry weight) | β carotene (µg/mg dry weight) |
|--|--------------|-------|----------------------|-------|-------------|-------|----------------------------|--------------------------------|-------------------------------|
| | Lab | Field | Lab | Field | Lab | Field | | | |
| <i>A. microphylla</i> | 2.71 | 715.0 | 5.60 | 5.40 | 0.123 | 0.127 | 253.10 | 1.64 | 0.39 |
| <i>A. filiculoides</i> | 2.82 | 730.0 | 5.43 | 5.34 | 0.126 | 0.130 | 264.30 | 1.69 | 0.36 |
| <i>Azolla</i> hybrid Rong ping | 3.11 | 810.0 | 5.39 | 5.02 | 0.129 | 0.136 | 318.20 | 2.01 | 0.64 |
| <i>Azolla</i> hybrid TNAU1 | 2.97 | 790.0 | 5.41 | 5.14 | 0.127 | 0.134 | 303.10 | 1.86 | 0.51 |
| CD (5%): 0.14 10.45 0.08 0.04 0.005 0.008 4.70 0.08 0.06 | | | | | | | | | |

*Initial inoculums: Lab: 500 mg, Field: 100 mg

Table.2 Effect of feeding the *Azolla* hybrid Rong ping on the productivity in Layer birds

| Age in week | #Egg Productivity (%) | | | # #Concentrated feed intake (g/day/bird) | | | |
|-------------|-------------------------|---------|-------------------------|--|---------|---|------------------------------------|
| | <i>Azolla</i> fed birds | Control | % increase over control | <i>Azolla</i> fed birds | Control | Savings in the concentrated feed (g/day/bird) | % savings in the concentrated feed |
| 51 | 93.0 | 84.7 | 9.80 | 106 | 132 | 26.0 | 19.6 |
| 52 | 91.5 | 86.3 | 6.00 | 106 | 132 | 26.0 | 19.8 |
| 53 | 87.2 | 83.9 | 3.90 | 92 | 132 | 40.0 | 30.5 |
| 54 | 89.7 | 83.6 | 7.20 | 109 | 119 | 10.0 | 8.52 |
| 55 | 88.0 | 85.9 | 2.43 | 109 | 121 | 12.0 | 10.0 |
| 56 | 90.6 | 71.2 | 27.1 | 108 | 107 | - | - |
| 57 | 91.1 | 82.3 | 10.7 | 102 | 124 | 22.0 | 17.6 |
| 58 | 87.8 | 79.2 | 10.9 | 114 | 121 | 7.0 | 6.03 |
| 59 | 89.7 | 80.4 | 11.5 | 101 | 116 | 15.0 | 13.0 |
| 60 | 86.6 | 81.4 | 6.40 | 106 | 120 | 14.0 | 11.7 |
| 61 | 87.8 | 83.6 | 5.05 | 103 | 126 | 23.0 | 17.9 |
| 62 | 88.1 | 84.7 | 4.04 | 99 | 118 | 19.0 | 16.2 |
| 63 | 89.4 | 85.7 | 4.25 | 116 | 120 | 4.00 | 3.04 |
| 64 | 92.7 | 90.3 | 2.65 | 106 | 118 | 12.0 | 10.0 |
| 65 | 80.8 | 81.1 | - | 105 | 117 | 12.0 | 9.50 |
| 66 | 90.3 | 89.7 | 0.62 | 107 | 121 | 14.0 | 11.3 |
| 67 | 89.1 | 88.6 | 0.50 | 106 | 118 | 12.0 | 10.8 |
| Average | 89.0 | 83.7 | 6.64 | 106 | 122 | 16.0 | 13.0 |

t = 1% 4.73**

t=5% 6.77**

** t value significant at 1 and 5% levels

Values represent % egg production by a group of 50 birds

Average per day feed intake by single bird in a group of 50 birds

Table.3 Effect of *Azolla* hybrid Rong Ping on the nutritional value* of egg

| Parameters | Azolla egg | Control | % increase over control |
|--|------------|---------|-------------------------|
| Egg weight (g) | 61.20 | 57.40 | 6.62 |
| Albumin (g /100 g of edible portion) | 3.9 | 3.4 | 14.70 |
| Globulin (g /100 g of edible portion) | 10.1 | 9.5 | 6.31 |
| Total protein (g/ 100 g of edible portion) | 14.0 | 12.9 | 8.52 |
| Carotenes (µg / 100 g of edible portion) | 440 | 405 | 8.64 |

*Values represent mean of three replications

The total protein content of the eggs laid by the *Azolla* fed birds was high (14.0 g/100 g) and the total carotene content of *Azolla* egg (440 µg/100 g of edible portion) was also higher than the control. Ali and Leeson (1995) found that the addition of *Azolla* powder to poultry feed significantly improved the carotene status of the chicken and increased egg production.

In conclusion, the rapid biomass production due to high relative growth rate, increased protein, carotene and β carotene contents and good digestibility of the *Azolla* hybrid Rong ping favoured its use as an effective feed supplement to poultry birds. In Indian conditions, agriculture is very much coupled with poultry farming. *Azolla* is an important low cost input, which plays a vital role in improving soil quality in sustainable rice farming (Kannaiyan, 1995). The twin potential as biofertilizer and animal feed make the water fern *Azolla* as an effective input to both the vital components of integrated farming, agriculture and animal husbandry.

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