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Azolla- A game changer feed substitute in poultry nutrition

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Introduction

In recent scenario poultry sector in India has showed an unexpected tremendous growth in the last three decades. It is proven as profitable business by delivering wholesome meat and egg with fulfilling demand of major proportion of consumer within a very short time period. The growth of poultry industry is somehow directly proportional to feed industry. Feed occupies a foremost and largest portion of expenditure in poultry industry which is estimated to approximately 2/3rd of total recurring expenditure. But unfortunately cost of the feed ingredients is increased day by day. This is due to scarcity of good quality feeds, increased human and livestock population, rapid shrinkage of cultivated land meant for crop production etc. On the other hand, availability of conventional source of poultry feeds like energy rich ingredients (cereals) and protein rich ingredients (oil seed cakes) are depreciated due to current export policy and increased interest of farmers towards cash crop cultivation. This feed crisis enforces nutritionists to think and search for the use of alternative and unconventional feed resources that are used in feed formulation. Among the submerged water plants, *Azolla pinnata* (a floating fern) can be utilised as non-conventional feed stuff having good nutrient profile replacing the traditional sources.

Azolla pinnata is an aquatic free-floating fern belonging to Salviniacea/ Azollaceae family and pteridophyte order of plant kingdom. This name is subdivided into to first, azo (to dry) and second alloyo (to kill) means drought condition (too much drying) brings the death of that fern (Abd El-Ghany *et al*., 2020). It grows in symbiotic association with blue green algae (BGA) Anabaena azollae, nitrogen fixing bacteria which fixes atmospheric N_2 and change into plant N_2. It can grow in stagnant water of drains,

ponds, canals, rivers and marshy lands of tropical and sub-tropical regions of the world. It is rich source of EAA especially lysine, vitamins like ß-carotene /vitamin-A and vit-B_{12}, growth promoters, minerals like Ca, P, K, Mg, Mn, Fe, Cu etc (Dhumal *et al*., 2009). Total energy (carbohydrate) and lipid content of azolla is extremely low and protein content varies 25-35% (Subramanian *et al*., 2021). It also contains probiotics, carotenoids and biopolymers. It is used as a feed for broilers, duck, fish, pig, rabbit, small ruminants and ruminants. Azolla is utilised as a 1stpreferential fodder supplement by various researchers by virtue of its convenient cultivation method, eye catching profitability and good nutritive value (Joysowal *et al*., 2018). Azolla is evolved as a potent and competent feed substitute for livestock more particularly in poultry birds owing to a proper combo of high nutritive value and rapid biomass production (Lakshmanan *et al*., 2017).

Proximate principles	**Joysowal *et al*., 2018 (% DM Basis)**	**Subramanian *et al*., (% DM Basis)**	**Kumar *et al*., 2018 (% DM Basis)**
Crude protein (CP)	25.08	26.4	22.25
Ether extract (EE)	3.95	3.42	2.45
Nitrogen free extract (NFE)	38.73	41.06	38.61
Crude fiber (CF)	14.39	15.96	11.19
Total ash (TA)	17.5	14.86	25.50
Acid insoluble ash (AIA)	-	-	7.94
Dry matter (DM)	-	-	91.78
Organic matter (OM)	-	-	74.50
Calcium (Ca)	2.06	-	-

Cultivation of Azolla

A water body is made after preparing a pit of (2 x 2 x 0.2 m) and covering it with a silpauline polythene sheet. 10 – 15 kg of sieved fertile soil is uniformly spread over the silpauline sheet. Prepare a slurry by adding 2kg cow dung and 30 g of Super Phosphate mixed with 10 liters of water. Add the slurry over the soil followed by raising the water level up to 10 cm. one kg of fresh pure culture of azolla is placed over the water. This will grow rapidly and fill the pit within 10 – 15 days. A mixture of 20 g of Super Phosphate and about 1 kg of cow dung should be added once every 5 days. From this structure 500-600g of azolla can be collected daily. Azolla is collected with the help of scoop net so that excess water is removed out through the pores of net. Azolla is cleaned with fresh water for twice or thrice to

remove dirt and debris following harvesting. This process also eradicates the dung odor from azolla pit. Then spread the washed azolla over moisture absorbing paper for half an hour to keep it optimum moisture condition. After half an hour azolla is ready for feeding either alone or combination with concentrate mixture. Calculated amount of azolla is provided to birds twice daily.

Effect of Azolla feeding on performance of poultry birds

1. Effect on body weight gain

Azolla shows advantageous impact on body weight gain in broilers without any adverse effect. As azolla is rich source of protein and minerals like calcium, it may directly or indirectly help the bone and muscle for better build up and strengthening. Some report shows that the growth due to azolla feeding is same as growth resulted maize-soyabean diet. When 5-10% of protein source of poultry feed is substituted by azolla it has some positive impact in terms of weekly body weight measurement. Azolla is highly rich in plant protein which may responsible for improvement of body weight by increase in muscle and bone mass. An increased body weight gain of 150 gram/broiler bird (7.1%) is recorded in 30% (W/W) of azolla fed group as compare to control (Badariprasad *et al*., 2018). A 5% increment in body weight is observed by supplementing azolla at 2.5% and 5% level in broiler feed (Dhumal *et al*., 2009). Highest daily body weight gain was recorded in groups fed with 7.5% of azolla than the control and 0.5% azolla fed groups (Kumar *et al*., 2018).

2. Effect on feed conversion ratio (FCR)

Feed conversion ratio is indirect measure of production efficiency. It means the lower the FCR higher is the efficiency of the broilers. Azolla feeding does not significantly decrease the FCR but when we compare it with other ingredients then it shows a better value than others. Improvement in feed conversion ratio is recorded in broilers those are fed azolla as a component of their diet. Better FCR is encountered in broilers at 5% level as compared to 10% or 15% level of sun-dried azolla contain diet (Basak *et al*.,2002).

3. Effect on feed consumption

Factors affecting feed consumption in poultry depends upon the type of bird, age of bird, nutritional requirement, rate of growth in birds, health status of birds, environmental condition etc. The properties like pleasant tasting, optimum fiber content, good nutritionally quality makes the azolla more palatable than other feed that may be the reason for improved feed consumption in bird. When azolla is provided at 7.5% in diet of broiler chicken, a great improvement in dietary consumption is observed

(Alalade *et al*., 2007). Decrease in feed consumption is recorded with an increase in level of azolla at 10-15% in diet of poultry bird (Kumar*et al*., 2018).

4. Act as very good traditional feed replacer

As traditional ingredients of poultry ration are going on expensive and not readily available to the different locality, there is a great demand to explore the alternative feed ingredients. Now a days *Azolla pinnata* is used as cheapest ingredient to maximize the profit of poultry industry. It plays a very good revolutionary feed alternative or replacer not only in poultry sector but also in diary sector. Dried azolla meal at 2.5% level can be used as alternative to soyabean in broiler chicken (Rana *et al*., 2017). 2.6% wheat bran and 2.4% fish meal in broiler feed are substituted safely by introducing 5% Azolla without any deleterious effect (Badariprasad *et al*., 2018). When a smaller proportion of soyabean meal is replaced by three and five percent level of azolla meal had no negative impact on weekly body weight gain of birds (Basak *et al*., 2002).

5. Decrease mortality rate

Improvement of productivity and health condition of birds is attributed by *Azolla pinnata* (as it contains carotenoid and biopolymers which act as natural antioxidant and immunomodulatory agent). Bird mortality during summer season is reduced in 30% azolla (w/w) supplemented birds as compare to complete commercial fed birds. This is because of presence of biochemical constituents like antioxidants, carotene and other vital nutrients in azolla (Badariprasad *et al*., 2018). Moreover, supplying azolla reduces stressful conditions in birds through increasing thyroxine hormone secretion, leading to faster body metabolism and strengthening muscle tissue due to higher protein accretion in birds (Balaji *et al*., 2009). Hemoglobin and total leucocyte count value is also increased in azolla fed groups as compare to control group (Kamel *et al*., 2021). Introduction of azolla meal up to ten percent in broiler diet has unaltered impact on the live ability of bird (Kumar et al., 2018). Azolla meal feeding in broiler improved the antibody titer value as compare to control group at 35th day age (Dhumal *et al*., 2009).

6. Effect on egg production and quality

High albumin, globulin, carotene content in egg and increased egg weight was observed in azolla fed group than control (Lakshmanan *et al*., 2017). The total protein content of eggs of bird fed with azolla was high (14.0g/ 100g edible protein) and total carotene content of these eggs (440 microgram/ 100 g edible protein) was also higher than that of control unsupplemented birds.

7. Economic Advantage

In general, chief ingredients that are used in poultry diets are cereal grains, different plant protein sources (soyabean meal, sunflower oil cake, rapeseed oil cake, til oil cake *etc*), animal protein sources (bone meal, blood meal, fish meal *etc*). Animal protein sources are more superior than the plant protein as it comprises all essential amino acids in an appreciable quantity as compare to others. Though azolla is a conventional feed but rich in protein (25-35%), so by using this, farmers can minimize their feed cost. Cost of feed was decreased by a greater extent by supplementing of azolla at either 5% or 10% or 15% level (Subramanian *et al*.,2021). Higher limit of using Azolla maximum goes up to 7.5% is quite productive and makes broiler industry practical feasible (Kumar *et al*.,2018).A significant higher profitability and economic efficiency in broilers is documented when they are fed with 12% dried azolla (DA) with respect to control groups (Kamel *et al*., 2021).

Conclusion

Azolla is a rich source of essential nutrients like protein, minerals and natural antioxidants, which has a positive impact on growth, feed conversion efficiency, immune status and production of animals and birds. Therefore, it can be used as an excellent source of non-conventional feed.

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