International Journal of Agriculture Sciences
ISSN: 0975-3710 & E-ISSN: 0975-9107, Volume 12, Issue 24, 2020, pp.-10483-10485.
Available online at https://bioinfopublication.org/pages/jouarchive.php?id=BPJ0000217

Review Article

AZOLLA MEAL AS AN ALTERNATIVE PROTEIN FEED SUPPLEMENT FOR POULTRY

SHARMA R.K., PATHAK A.K.* AND SHARMA R.K.
Division of Animal Nutrition, Faculty of Veterinary Sciences & Animal Husbandry, Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu, Jammu, 181102, Jammu and Kashmir, India
*Corresponding Author: Email - dranand_pathak@yahoo.com

Received: December 01, 2020; Revised: December 25, 2020; Accepted: December 26, 2020; Published: December 30, 2020

Abstract: Azolla can be fed to all classes of poultry either in a fresh or dried form as meal. It can be given directly or mixed with concentrates to poultry. Azolla meal is considered as the most economic, high nutritive, efficient locally available alternative and eco-friendly sustainable protein feed supplement for poultry. Since the cost of feeding is a significant factor contributing the economic viability of poultry industry, it can be reduced by incorporating cheaper un-conventional feed resources in poultry feed formulation. It is a potential source of protein, amino acids, minerals, vitamins and other beneficial phytochemicals as feed additives. Thus, it can be used in poultry feed as potential and income generating highly efficient and effective alternative protein feed ingredient for poultry.

Keywords: *Azolla, Nutrient profile, Poultry performance*

Citation: Sharma R.K., *et al*., (2020) Azolla Meal as an Alternative Protein Feed Supplement for Poultry. International Journal of Agriculture Sciences, ISSN: 0975-3710 & E-ISSN: 0975-9107, Volume 12, Issue 24, pp.- 10483-10485.

Academic Editor / Reviewer: Dr Vipul N Kapadia, Bajaj Gagan

Introduction

The demand for poultry products (egg, meat, and meat products) in India is generating new potential in the profitability of poultry (broiler, layer and duck, *etc*.) rearing as an occupation. At the same time, there is a substantial decline in good quality feed and feed ingredients availability. In addition, the areas under food crops are also declining owing to urbanization and industrialization. Besides shortage of locally available good quality conventional feed ingredients is one of the major constraints for profitable poultry production. Moreover, the high cost of conventional feed ingredients is largely due to the exorbitant price and scarcity of conventional feed ingredients. Thus, depending on groundnut cake (GNC) and soybean meal (SBM) as the sole source of protein in poultry diets are gradually becoming economically impracticable in our country. Since the cost of feeding is a significant factor contributing the economic viability of poultry industry, it must be reduced by adopting new measures in poultry feed formulation. Hence to make poultry production as a lucrative enterprise, there is a great need to use alternate protein supplement replacing the conventional protein sources [1]. To meet the present and future demands of the growing human population certain new strategies are to be adapted to meet the input requirements for production of poultry and their products. This has led to find alternate sources of good quality unconventional feed for efficient poultry production. The concept of using aquatic plants for feeding purpose is now receiving special attention. The search for alternatives to conventional protein supplements to different categories of poultry, a wonderful plant called azolla, which holds the promise of providing a sustainable alternative protein supplements for poultry. Azolla meal is considered as the most economic, high nutritive, efficient locally available alternative and eco-friendly sustainable protein feed supplement for poultry. The most commonly found forms of Azolla are *Azolla pinnata, A. filiculoides, A. rubra, A. microphylla, A. imbricata and A. caroliniana*. *A. pinnata* is the most widely distributed species in India and throughout the world in both tropical and temperate regions. A. pinnata is a small aquatic floating fern that lives in symbiosis with the nitrogen fixing blue-green algae; it has a high nitrogen fixing ability. It is a potential source of nitrogen and thereby a potential non-conventional protein feed supplemented to broiler chicken [2] and laying hens [3]. Thus, it can be used in poultry feed as potential and income generating highly efficient and effective alternative feed ingredient for poultry [1, 4]. Farmers around the world use them as a feed for poultry due to its high productivity, good nutrient profile and its capacity to fix atmospheric nitrogen and to grow in unexploited niches. The high degree of cellular multiplication of water fern makes its biomass rich in nitrogen and protein contents [5].

Nutrient profile of Azolla meal

Due to fast growth of human and livestock population including poultry which has increased the need for food and feed in the developing countries demand those alternative feed resources must be identified and evaluated. More also, the scarcity of locally produced protein supplements for poultry diets worldwide has created a need to find alternative feed resources. Hence, widely cultivated azolla needs to be turned attention towards exploitation its dried meal as alternative protein supplements in poultry nutrition. It grows in association with the blue-green alga Anabaena azollae, is perhaps the most promising from the point of view *i.e.* good nutritional profile. The CP content of azolla meal is lower than that of GNC and SBM meal (42 – 48% CP), which are the conventional sources of plant protein in poultry feed. Azolla was found to be a very nutritive and cheap organic substitute for poultry. Like most aquatic plants, azolla is rich in protein (19-30% DM) minerals (10-20 % DM) and can be used as a source of major and trace minerals (such as Calcium, Phosphorus, Magnesium, Iron, Copper, Manganese and Zinc, etc) apart from appreciable quantities of Pro-vitamin A (b-carotene), vitamins A and vitamin B12[6-8]. However, Shoukat Ara *et al*. [9] reported 22.06 percent crude protein, 3.62 percent ether extract, 14.3 percent crude fibre, 33.4 percent nitrogen free extract, 18.1 percent total ash, 2.04 percent calcium and 0.65 percent phosphorus in Azolla on DM basis. Amino acid profile of azolla depends on the species, but the lysine content is relatively high (4-6 % of the protein) which is the most limiting amino acid in most of the cereals. Although, amino acid analysis indicated that lysine, arginine, isoleucine, leucine, phenylalanine, glycine and valine were predominant. However, the sulphur-containing amino acids did not meet the recommended value of 3.5g/100g protein.

Thus, any attempt to replace conventional high quality ingredients in diets for non-ruminants should give recognition to differences in lysine content and deficiencies of the sulphur-containing amino acids. Therefore, these limiting amino acids are added to make azolla meal a complete source of amino acids. It is also found to contain probiotics, biopolymers, growth promoter intermediaries, minerals and proliferate without inorganic nitrogen fertilization [8]. The high xanthophyll content in aquatic plants makes them superior to alfalfa meal in imparting colour to egg yolk and poultry skin pigmentation.

The essential amino acid profile of azolla was favourably comparable to that of other vegetable proteins. However, lysine and sulphur containing amino acids, methionine and cysteine were deficient in *A. microphylla* as is true for most of the leaf proteins. But it is rich source of arginine, histidine, isoleucine, serine and tryptophan. Alalade and Iyayi[10] revealed that Azolla meal is rich in leucine, lysine, arginine and valine, while tryptophan and sulphur containing amino acid were deficient.

Previous study reported that the apparent and true metabolizable energy values of A. pinnata were 1529 and 1855 kcal/kg DM, respectively suggesting that composition of azolla has lower energy content when compared to bran and oil cakes such as sunflower cake. However, Alalade and Iyayi[10] reported the gross energy content of *A. pinnata* as 2039 Kcal/kg DM while Balaji *et al*. [2] recorded the gross energy of Azolla as 1807 kcal/kg DM.

Dietary incorporation in poultry diets

Since azolla contains most of the nutrients which are required for all classes of poultry. Azolla can be fed to broilers and layers 10-20 percent, respectively, without any adverse effects [2,3]. Feeding of azolla in poultry improves the weight gain of broilers and increases the egg production in layers. Hence the azolla can be used as unconventional potential feed resource for poultry along with promising economic returns. In laying hens, azolla could be included at 20% level in diet replacing sesame meal. In duck's diets, azolla could be included to supply 20% of crude protein. Similarly, azolla could replace 10% of mustard oil cake in diets of fattening ducks [11] and could be incorporated up to 30% in diets of laying ducks [12]. There is a general consensus that dried azolla in broiler diets should be limited to 5% as higher levels tend to depress nutrient utilization and performance. While in pullet chicks, azolla could be included safely up to 10% [3], whereas, fresh azolla could replace 20% or more of a commercial broiler diet [13].

Effect on poultry performance and economy

Previous workers observed significant (P<0.01) improvement in live weight of broiler chicks than that of control diet fed birds (1579g) when they were fed with 5 percent Azolla meal replacing sesame meal (1637g) at 6 weeks of age, while lower live weights were recorded in 10 and 15 percent azolla incorporated diets. Similarly, Dhumal *et al*. [14] reported that the partial replacement of SBM at 2.5 and 5 percent levels by azolla meal has no adverse effect on weekly body weights of broilers. However, in third, fourth and fifth weeks, the body weights were higher than that of control. Whereas, Balaji *et al*. [2] reported no significant difference in cumulative feed efficiency of birds fed 0, 1.5, 3.0 and 4.5 percent Azolla incorporated diets.

The nutrient content and feeding effect of azolla at 50, 100, 150 and 200 g/ kg in laying hen diets by replacing sesame meal up to 200g/ kg in diet resulted in better egg mass output and feed conversion ratio (FCR). Furthermore, Sujatha *et al*. [15] recommended that azolla is a good feed additive for sustainable egg production in Nicobari fowl with no reconciliation in immune-competence, but profitable due to savings on feed cost. In another study with A. pinnata was found to have potential as cheap, safe and high-density nutrient-rich feed for quails but inclusion rates higher than 5% depressed growth performance and feed conversion.

Rai *et al*. [16] livelihood security as well as income. The 10 % dried azolla could replace maize and soybean on an equal digestible protein basis in broiler diets. However, dietary inclusion of azolla meal up to 7.5% was beneficial in terms of improved performance and nutrient utilization without any deleterious effect on carcass quality with reduced feed cost in Chabro chicks [17]. Furthermore, Kumar *et al*. [18] recorded better body weight gain and feed consumption, lower FCR and similar DM digestibility and nitrogen balance in broiler chicken fed sun dried azolla at 2.5, 5, 7.5 and 10% levels. Although, Varadharajan *et al*. [19] observed significant difference in carcass characteristics with respect to giblet, back and wings percentage while other parameters were insignificant in Japanese quails fed different levels of azolla meal though the azolla meal incorporation in quails' diet up to 6%, considered safe and economical without affecting the feed consumption and carcass traits.

Similarly, Naghshi *et al*. [20] reported significant improvement in daily weight gain and FCR at 5% azolla powder compared to control and other levels of azolla containing diets. There was no mortality among the experimental groups. Dietary supplementation of 5% azolla powder significantly increased carcass efficiency percentage and thigh relative percentage, while, the lowest its percentage related to diets containing 15% azolla. In an experiment of Alalade *et al*. [3] observed that the PCV, RBC, Hb and WBC values were similar and within the normal range for the growing pullet fed with 0, 5, 10 and 15 percent azolla meal-based diets. Although, Pravina and Kumar [4] explored the potential of dried azolla as a feed supplement in concentrate feed of 120 Ven Cobb broiler chicks. They observed that dietary supplementation of concentrate feed with dried azolla at 7.5% resulted in 2.6% increase in body weight and decrease in feed consumption as well as higher antibody titre against Ranikhet virus in birds fed diet containing dried azolla meal at 10% level.

Effect on carcass characteristics and gut morphology

Dhumal *et al*. [14] reported no significant difference in feed conversion ratio among the control, 2.5 and 5 percent azolla dietary treatment groups, thus inferring that 5 percent level of incorporation of azolla in broiler diets may not adversely affect FCR. However, higher dressing percentage (69.66%) at 8 weeks of age in broiler birds fed 5 %azolla diet compared to control (67.79), 10 (65.76), 15 (65.38) and 20 % (65.19) azolla fed groups. They also reported significant difference (P<0.01) in the weights of organs *viz*., heart, gizzard and giblets in birds fed 15 and 20 percent azolla supplemented diets.

Shoukat Ara *et al*. [9] determined the effect of dietary inclusion of high fiber (14.3%) azolla on small intestinal histo-morphology of broiler chicken fed the basal diet (control), whereas in other treatment groups fed basal diet, fish meal was replaced by azolla meal at 5, 10, 15 and 20%. They observed that the replacement of fish meal by azolla beyond 5% level significantly decreased villus height in duodenum, jejunum and ileum. The highest duodenal, jejunal and ileal villus heights were recorded in control group. No significant effect was recorded on crypt depth of duodenum, jejunum and ileum among different treatment groups.

Conclusion

Dietary supplementation of fresh as well as dried azolla meal could replace protein feed resources in commercial poultry feed from 10 to 20 percent as fresh and 5 to 10 percent as dried azolla meal in broiler and layer birds, respectively, without affecting nutrient utilization, health status, growth/ production performance and carcass characteristics.

Application of research: At these levels in different categories of poultry, azolla meal could be considered as a promising alternative suitable locally available un-conventional protein feed supplement for poultry. Its supplementation may be eco-friendly, sustainable approach for improving farmers' income and producing healthy poultry meat and eggs for consumers.

Research Category: Veterinary Sciences & Animal Husbandry

Acknowledgement / Funding: Authors are thankful to Division of Animal Nutrition, Faculty of Veterinary Sciences & Animal Husbandry, Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu, Jammu, 181102, Jammu and Kashmir, India

****Research Guide or Chairperson of research: Dr A. K. Pathak**

University: Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu, Jammu, 181102, Jammu and Kashmir, India

Research project name or number: MVSc Thesis

Author Contributions: All authors equally contributed

Author statement: All authors read, reviewed, agreed and approved the final manuscript. Note-All authors agreed that- Written informed consent was obtained from all participants prior to publish / enrolment

Study area / Sample Collection: SKUAST, Jammu, 181102

Cultivar / Variety / Breed name: Poultry animals

Conflict of Interest: None declared

Ethical approval: This article does not contain any studies with human participants or animals performed by any of the authors.
Ethical Committee Approval Number: Nil

References

[1] Pathak A. K., Sharma R. K. and Rastogi A. (2014) *Azolla, Future Potential Feedstuffs for livestock. In, Livestock Health and Production with Emphasis on Hilly Areas. (S. K. Gupta et al. edin,) Published by Noton Press, Chennai*-600 005. pp. 115-127.

[2] Balaji K., Jalaludeen A., Churchil R.R., Peethambaran P.A. and Senthil Kumar S. (2009) *Indian Journal of Poultry Science*, 44 (2),195-198.

[3] Alalade O.A., Eustace A., Iyayi E.A., Taiwo O. and Alalade (2007) *Journal of Poultry Science*, 44, 273-277.

[4] Prabina B. J. and Kumar K. (2010) *Asian Journal of Animal Science*, 5, 20-22.

[5] Kumar V., Kumar P., Singh J. and Kumar P. (2019) *International Journal of Phytoremediation*, 392-403.

[6] FFD (2013) www. Orissaahvs .com/File/ FeedFodder Development /Azolla.pdf.

[7] Letermea P., Londono A. M., Munoj J. E., Jeimmy, Suarez, Bedoya C. A., Souffrant W. B. and Andre B. (2009) *Animal Feed Science and Technology*, 149, 135-148.

[8] Kathirvelan C., Banupriya S. and Purushothaman M.R. (2015) *International Journal of Science, Environment and Technology*, 4(4), 1153-1157.

[9] Shoukat Ara., Adil S., Banday M. T., & Khan M. A. (2015) *Journal of Poultry Science and Technology*, 3, 15-19.

[10] Alalade O.A. and Iyayi E.A. (2006) *International Journal of Poultry Science*, 5(2), 137-141.

[11] Tiwari S. P., Kumari K. and Gendley M. K. (2009) *Proceedings of IV World Waterfowl Conference, 11-13 November, Thrissur*, 196.

[12] Sujatha T., Kundu A., Srivastava R. C., Jeyakumar S., Kundu M. S., Jaisunder and Singh A. K. (2009) *Proceedings of IV World Waterfowl Conference, 11-13 November, Thrissur*, 175-180.

[13] Namra M. M. M., Hataba N. A. and Abdel Wahed M. (2010) *Egypt Poultry Science*, (30)(III), 747-762.

[14] Dhumal M.V., Siddiqui M.F., Siddiqui M.B.A. and Avari P. E. (2009) *Indian Journal of Poultry Science*, 44 (1), 65-68.

[15] Sujatha T., Udhayakumari D., Kundu A., Jeyakumar S., Sundar J. and Kundu M.S. (2013) *Animal Science Reporter*, 7 (4), 146-152.

[16] Rai R. B., Dhama K., Damodaran T., Hamid Ali., Sweta Rai, Balbir Singh and Bhatt P. (2012) *Veterinary Practitioner*, 13 (2), 250-254.

[17] Mishra D. B., Roy D., Kumar V., Bhattacharyya A., Kumar M., Kushwaha R. and Vaswani S. (2016) *Indian Journal of Poultry Science*, 51(3), 259-263.

[18] Kumar M., Dhuria R. K., Jain D., Nehra R., Sharma T., Prajapat U. K., Kumar S. and Siyag S. S. (2018) *Journal of Animal Research*, 8 (4), 629-632.

[19] Varadharajan A., Gnanasekar R. and Kothandaraman S. (2019) *The Pharma Innovation Journal*, 8(4), 1143-1145.

[20] Naghshi H., Khojasteh S., Jafari M. (2014) *International Journal of Farming Allied Science*, 3(1), 45-49.