

Azolla: Uses, role and Effect in poultry nutrition

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Abstract:

Azolla is a plant-based feed that is rarely used for animal feed, which does not compete with human food. It can be a valuable protein supplement for many animal species such as ruminants, poultry, pigs and fish.

The bio-composition of Azolla makes it one of the most economical, effective and sustainable feed substitutes for poultry. Therefore, the incorporation of it as an alternative protein ingredient in poultry ration could make poultry production economically efficient.

Key words: Poultry, Azolla, Proteins, Alternative, Economical.

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I. Introduction

In Tunisia livestock, is one of the main pillars of the national economy and presents the first source of cash income of rural households. In this livestock sector, poultry farming is a survival strategy for the population. Indeed, traditional poultry farming is easily accessible to rural households and therefore manages to generate more income due to the low level of initial investment required in terms of initial investment (Grégoire et al.2019). It is therefore necessary to improve and then promote improved traditional poultry production. But this poultry farming is faced with several constraints, among which is feed, which represents 60 to 80% of the cost of poultry production costs in poultry farming¹. The recent globalization of the livestock feed world has produced series of linkages to a few raw materials that are also very sensitive to any speculative movement of the main world capital funds. Specifically, in relation to protein sources, soybean meal has been set up as the unquestionable reference that marks the price behavior of the rest of the products competing for the percentage of protein (mainly rapeseed and sunflower meal)².

The use of local, non-conventional feeds in animal feed appears to be an endogenous solution. To this end, the research and development of locally available alternative food resources available locally should allow to improve the productivity of poultry while controlling input costs such as Azolla³.

II. Azolla: uses

Azolla is a non-rooted aquatic plant, floating freely on the surface of fresh water⁴. The fine stem, strongly branched, carries adventitious roots forming at regular intervals on the stem. In the axils of some leaves, secondary stems develop with the same characteristics the same characteristics as the main stem. The leaves are in the shape of scale of less than half a millimeter long and bordered of a broad membranous band⁵. It is present in the tropical and temperate regions and it has been used for at least a thousand years in rice fields as a companion plant, due to its ability to not only fix nitrogen⁶, but also block light to prevent competition from other plants, except for rice, which is transplanted large enough to overtake water through the Azolla layer⁷. It has numerous pharmacological consequences and can be used as antioxidant, immune-stimulating, hepato-shielding, phytoremediation, bioremediation and additionally as nutritious material. Azolla carries nutrients (B12, beta carotene, diet A), biopolymers, minerals and amino acids. Azolla is rich in hint minerals and carotene. It looks to be potentially hepatoprotective drug towards hepatotoxic substances. Its decoction (focused liquor of plant) has anti-inflammatory, antioxidant, and anti-apoptotic traits, making it an appealing preventive and therapeutic drug in opposition to exquisite hepatotoxicity⁸. It may be given directly or mixed with concentrates to livestock, rooster, sheep, goats, pigs and rabbits. It takes some days for the animals to get used to the flavor of azolla, therefore it's recommended to feed it with the concentrates in the initial stages.

As a matter of fact, Azolla can be a valuable protein supplement for poultry. It contains an average of 20,6% as fresh and 21,5% as dried and also contains an average of 5 g lysine/100 g protein and has a relatively well-balanced amino acid profile.



Picture 1: azolla on a rice field

Table 1: Nutrient contents of Azolla (g/kg as DM).

| Proximate principle | Azolla meal |
|-----------------------|-------------|
| Dry matter | 89.91 |
| Crude protein | 21.56 |
| Ether extract | 3.37 |
| Crude fiber | 15.05 |
| Nitrogen free extract | 43.69 |
| Total | 16.33 |

Source (feedipedia,2015).

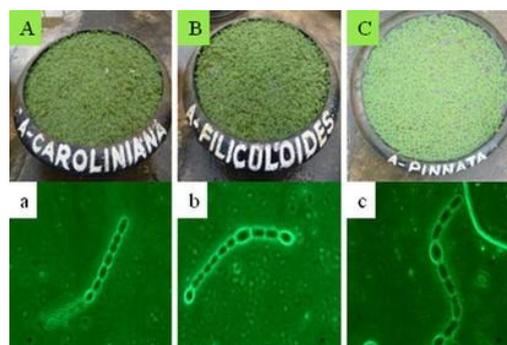
III. Different type of Azolla

The Azolla genus has only a few species, which are all true floating aquatic ferns.

The Carolina fern, *Azolla caroliniana*: is a small annual fern that grows in warm, sunny waters. Originally native to the Brasilia region of Brazil, it can be found as far away as the United States, in the state of Carolina, and also in Mexico and the West Indies. Sometimes called an invasive plant, even a water plague, it has colonized stagnant waters in Europe and Asia⁹.

The false fern, *Azolla filiculoides*: forms a lovely mossy carpet, green in the shade, reddish-brown if the exposure is sunny. Like duckweed, it covers the surface completely, provided it is placed in warm, non-calcareous water containing some organic matter in suspension. It is native to the American continent, from the south of the United States (California) to Argentina, passing by Brazil, Chile, etc. It is the most resistant species, growing even up to 5 000 meters of altitude in the Andes⁹.

The *Azolla pinnata* or floating fern is rarely found in the trade in Europe, it differs from other species only by some meristic data and its geographical origin: East Africa, Asia and Australia⁹.



Picture 2: different type of azolla

IV. Various form of azolla

Azolla can be fed to rooster sparkling or dried and if so, as is or added to pellets, or ultimately after silage. It ought to be referred to that all right measures should be taken to prevent the presence of any poisonous pesticide inside the feed in opposition to the presence of any toxic pesticide inside the feed biomass. Finally, there should be a length of version, as is frequently the case whilst a new type of feed is brought into animal rations.

Sparkling Azolla: This method of presentation of Azolla entails no processing and no denaturation of the compounds, but it cannot be saved and its very excessive water content makes it very costly to transport over lengthy distances and it is not applicable for all animals. But, if this is the case, it is straightforward to get a partial tending by way of spreading the Azolla on a drying vicinity. A few hours are typically enough to reduce the moisture content material from 95% to much less than 50%¹⁰.



Picture 3: Sparkling azolla

Dried Azolla: Because the moisture content of Azolla is in particular high, it is not economically desirable to take into account another dehydration technique than solar drying. However, this implies the provision of appropriate drying areas near the harvesting website online, suitable climatic situations and sooner or later sufficient manpower. The operation calls for an initial spreading of the biomass in a layer up to 10 cm thick which is then turned over 2 or 3 times a day, typically for three to four days. Drying, executed below properly situations, has little impact on the dietary cost however seems to have a bad effect at the organoleptic traits, as a minimum for a few animals. It allows n storage and delivery over long distances as well as the manufacturing of pellets¹⁰.



Picture 4: Dried azolla

Azolla in silage: Some Chinese farmers ensile the excess biomass from the spring manufacturing and preserve it to feed their animals in the course of the wintry weather. The approach defined beneath appears to work properly, but variations are definitely possible. Azolla to be stored in silos have to be clean and barely dry (approximately 60% moisture content material). They may be packed in cement silos or in plastic luggage. Whilst the layer reaches 30 cm, salt and corn flour are sprinkled on pinnacle at a fee of 5 g and 50 g respectively in keeping with kg of azolla earlier than piling on a brand-new layer and repeating the technique. The silo is then protected. Fermentation takes much less than a month and its product can be saved for two years¹⁰.



Picture 5: Azolla packed in plastic bags

V. Azolla growing steps

- 1- Create a pool for growing Azolla.

In order to create the Azolla growing pond, pick a partially shaded area because Azolla needs 30% sunlight, too much sunlight will destroy the plant. An area under a tree is preferable.

If you decide to grow azolla on a large scale, you can make small concrete reservoirs, otherwise you can make it any size you want.

- 2- Dig the ground for the pool, level the ground, and then spread the plastic sheet on it to prevent water loss. Make sure the pond is at least 20 cm deep.
- 3- Add some soil evenly over the plastic pool liner. For a pond size of 2M X 2M, add 10-15 kg of soil. Azolla needs phosphorus to grow well, you can use Super Phosphate with 4-5 days old cow manure. it increases the available nutrients.
- 4- fill the pond with water about 10 cm from the edge, which will allow the azolla to float freely, then leave the pond for 2-3 days for the ingredients to settle.
- 5- After 2-3 days, add the Azolla culture to the pond by gently rubbing the Azolla in your hands. It helps to break the Azolla into smaller pieces for faster propagation.
- 6- After two weeks, start harvesting. In a 2M X 2M pond, you can harvest 1kg of Azolla each day¹¹.



Picture 6 and 7: azolla's cultivation

VI. Effect of Azolla feeding on poultry performance

In the recent past, few studies have been carried out in poultry in order to evaluate the effect of dried Azolla on the growth and feed conversion ratio (FCR) some of them were experienced on growing black turkeys under intensive system the results showno significant difference among the different groups of turkeys in the average weekly weight gain during the entire experiment but FCRwas significantly positive ($p<0.05$)¹².

Other studies were focusedon the effectof incorporating dried azolla (*Azolla pinnata*) biomass in chicken rations in improved traditional poultry farming¹³, these studies showed that rations that received Azolla incorporation werebetter than the control in terms of growth performance¹⁴.

The live weights of the broilers in one of them were higher in the rations that received different portions of Azolla incorporation compared to the control¹⁵. Theweight performance, feed intake and feed conversion ratio of the broiler chicks showed that the higher the inclusion of *Azolla pinnata*,the better for a partial substitution of roasted soybean meal in the feed ration of broilers. The availability of this resource and

the ease of its cultivation in ponds make it an alternative to reduce the production costs of broilers in traditional improved traditional breeding system¹⁶⁻¹⁷. This form of valorization of this invasive aquatic plant can contribute to reduce its environmental impact. And it is the same case as another study showing that rations that received 5.5 to 12% of Azolla were better than the controls in terms of growth performance compared to the control¹. The weight performance, feed intake and feed conversion ratio of broiler chicks that the inclusion of 12% Azolla pinnata is optimal for a partial substitution of roasted soybean meal in the of roasted soybean meal in the broiler feed ration¹, and it can go even to 15%.

Azolla not only has a positive effect on growth but also on meat quality and it has been proven scientifically in some studies. In layers, the use of Azolla improves productivity in terms of egg quantity and quality as Azolla contains pigments, minerals, and essential amino acids. Moreover, azolla improves carcass traits at processing.

VI. Conclusion

Research and development of locally available alternative feed resources such as azolla help to improve poultry productivity while controlling input costs, but feeding trials still needed to be conducted to establish digestibility and metabolic utilization, levels of inclusion, productive and economic efficiency of using these unconventional and local feed resources. This utilization must also be done carefully or needed to be moving precaution in order to take into account the potential anti-nutritional factors contained by some of them which could cause toxic effects to livestock.

References

- [1]. B. OUEDRAOGO, S. OUEDRAOGOS, Z. S. NIKIEMA, J. S. ZOUNDI, L. SAWADOGO. Effets de l'incorporation de la biomasse d'azolla (*Azolla pinnata*) séchées dans les rations du poulet en aviculture traditionnelle améliorée
- [2]. Sankar, V., P. Senthilkumar, N. Sribalaji, P. Nalini, L. Arun and Muralidharan, J. Effect of Feeding Azolla Meal on Growth Performance of Mecheri Sheep. 2020
- [3]. W. A. Abd El-Ghany, Yazar Adı Yazar Soyadı. A Review on the Use of Azolla Species in Poultry Production. 2020.
- [4]. Council for Agricultural Science and Technology (CAST). (2013).
- [5]. SUBERBIELLE NICOLAS, YOHAN PETIT. Plan Régional de Gestion Azolla Filiculoïde. 2015.
- [6]. D. C. ROY, M. C. PAKHIRA AND S. BERA. A Review on Biology, Cultivation and Utilization of Azolla. 2016.
- [7]. N. Bhatt, R. Chandra, Suresh Kumar, K. Singh, N. Singh, Raj neesh, Amit Kumar, Sin gh, Surya Pratap Singh Chauhan. Nutritive Analysis of Azolla pinnata and its Cultivation during Winter Season. 2020.
- [8]. P. CHAUDHARY, D. MITRA, B. MAHAKUR and P. JANMEDA. Azolla: Uses, Role, Benefits and Importance in Crop Production. 2020.
- [9]. OOREKA Experts. Azolla. 2019.
- [10]. C. VAN HOVE. Azolla and Multiple Uses with Emphasis on Africa. 1989.
- [11]. NEWS MAGAZINE. Aquaponie, production agricole. Fourrage vert : l'azolla. 2019.
- [12]. Mayank Shukla, Amitav Bhattacharyya, Pankaj Kumar Shukla¹, Debashis Roy, Brijesh Yadav and Rajneesh Sirohi. Effect of Azolla feeding on the growth, feed conversion ratio, blood biochemical attributes and immune competence traits of growing turkeys. 2018
- [13]. Mangesh Kumar. Effect of Inclusion of Sun-Dried Azolla (*Azolla pinnata*) at Different Levels on the Growth and Performance of Broiler Chicks. 2018
- [14]. Srinivas, K.D., Prasad, R.M.V., Kishor, K.R and Rao Ragharama, E. Effect of Azolla (*Azolla pinnata*) based concentrate mixture on nutrient utilization in buffalo calves. Indian Journal of Animal Research. 46(3): 268-271. 2012.
- [15]. Bhattacharyya, A., Shukla, P.K., Roy, D. and Shukla, M. Effect of Azolla supplementation on growth, immunocompetence and carcass characteristics of commercial broilers. J. Anim. Res., 6: 941-945. 2016.
- [16]. Mangesh Kumar R. Dhuria, D. Jain, T. Sharma, R. Nehra, UK Prajapat. Effect of feeding Azolla pinnata on the growth and performance of broiler chicks. 2018
- [17]. N. SAIKIA, D. SANCOTA? RUPJYOTI HAZARIKA. Effect of feeding azolla meal to broilers: a field study in assam. 2014
- [18]. FAO 2015. Feedipedia: An online encyclopedia of animal feed, retrieved from www.feedipedia.org on 27.05.2015
- [19]. C. VAN HOVE. Azolla and Multiple Uses with Emphasis on Africa. 1989.
- [20]. NEWS MAGAZINE. Aquaponie, production agricole. Fourrage vert : l'azolla. 2019.
- [21]. Mayank Shukla, Amitav Bhattacharyya, Pankaj Kumar Shukla¹, Debashis Roy, Brijesh Yadav and Rajneesh Sirohi. Effect of Azolla feeding on the growth, feed conversion ratio, blood biochemical attributes and immune competence traits of growing turkeys. 2018
- [22]. Mangesh Kumar. Effect of Inclusion of Sun-Dried Azolla (*Azolla pinnata*) at Different Levels on the Growth and Performance of Broiler Chicks. 2018
- [23]. Srinivas, K.D., Prasad, R.M.V., Kishor, K.R and Rao Ragharama, E. Effect of Azolla (*Azolla pinnata*) based concentrate mixture on nutrient utilization in buffalo calves. Indian Journal of Animal Research. 46(3): 268-271. 2012.
- [24]. Bhattacharyya, A., Shukla, P.K., Roy, D. and Shukla, M. Effect of Azolla supplementation on growth, immunocompetence and carcass characteristics of commercial broilers. J. Anim. Res., 6: 941-945. 2016.
- [25]. Mangesh Kumar R. Dhuria, D. Jain, T. Sharma, R. Nehra, UK Prajapat. Effect of feeding Azolla pinnata on the growth and performance of broiler chicks. 2018
- [26]. N. SAIKIA, D. SANCOTA? RUPJYOTI HAZARIKA. Effect of feeding azolla meal to broilers: a field study in assam. 2014
- [27]. FAO 2015. Feedipedia: An online encyclopedia of animal feed, retrieved from www.feedipedia.org on 27.05.2015