Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

**E-ISSN:** 2278-4136
**P-ISSN:** 2349-8234
JPP 2019; 8(3): 3157-3160
Received: 19-03-2019
Accepted: 21-04-2019

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# Proximate evaluation of *Azolla pinnata* as sustainable feed supplement for poultry

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**Abstract**
Azolla is a free floating fern rich in proteins, essential amino acids, minerals, vitamins (Vitamin A, $B_{12}$, Beta carotene), bioactive substances and biopolymers. An attempt was made to evaluate the proximate value of *Azolla pinnata* as a feed for poultry. Azolla was cultivated following the NARDEP method. After harvesting it was sundried and stored in polyethylene bags and was further analysed for proximate principles. The dry matter content was 90.03 %, 22.79 % crude protein, 3.59 % ether extract, 15.49 % crude fibre, 19.46% total ash, 38.67 % NFE, 1.93% calcium and 0.26% phosphorus.

**Keywords:** Azolla, proximate evaluation, NARDEP method, poultry, feed supplement

## Introduction
Azolla belonging to the family *Azollaceae* is an aquatic free floating fern, has many species which can be found all over the world especially in tropical and subtropical regions. It grows easily in stagnant water, canals, pond and marshy lands as it can grow easily in water having pH from 4-7. Pillai *et al*., 2002 [23] reported that it is one of the good sources of protein and contains most of the essential amino acids, minerals such as iron, calcium, magnesium, potassium, phosphorus, manganese etc, apart from appreciable quantities of vitamin 'A' precursor beta-carotene and vitamin B12. It is also contains probiotics and biopolymers. Thus, Azolla appears to be a potential source of nutrients and has a considerably high feeding value for livestock (Hossiny *et al*., 2008) [13]. It is considered to be the most promising because of the ease of cultivation, high productivity, good nutritive value and overall without any adverse effects like lipid per-oxidation of meat and meat products (Singh and Subudhi, 1978; Prabina and Kumar, 2010) [31, 25]. *Azolla pinnata* was used as feed in broiler chicken (Balaji *et al*., 2009) [6], laying hens (Alalade *et al*., 2007) [2], Juvenile Black Tiger Shrimp (Sudaryono, 2006) [32], goats (Tamang *et al*., 1993) [34] and buffalo calves (Indira *et al*., 2009) [14]. *Azolla filiculoides* was also used in diets for sows (Leterme *et al*., 2010) [19] and as partial replacement of protein source for growing-fattening pigs (Becerra *et al*., 1990; Duran, 1994) [9, 12]. It contains most of the nutrients which are required for all classes of livestock including poultry and fish. Pillai *et al*., (2002) [23] has also found that the nutrient constitution of Azolla is almost identical to that of commercial poultry feed, except that its protein content is high and calcium content is slightly low. In the view of the facts stated above, the present study was undertaken to explore the proximate composition of Azolla as a feed for poultry.

## Materials and methods
*Azolla pinnata* was cultivated by Nardep method (Pillai *et al*., 2002) [23] with little modifications according to the availability of material. After removing all the roots, pebbles and stones in and around a temporary pit of 2m X 2m X 0.2m dimensions was made under the shade of a tree and covered with plastic sheet of 3m x 3m dimension. Care was taken that the floor of the pit was even and corner of the pit were at the same level to maintain a uniform water level. Surface of the pit was first covered by gunny bags before the layer of plastic sheet to prevent the roots of the nearby trees piercing the plastic sheet then covered with plastic sheet. The outer edges of the sheet were fixed with bricks so that it will not slip during the cultivation period. After making a thin layer soil with 15 kg of sieved soil uniformly spread over the plastic sheet, 2.5 kg of cow dung and 25 g of super phosphate in 10 litres of water was mixed and poured on the sheet slowly. More water was poured to make the water level reach about three forth level of the pit and was checked regularly to maintain this water level. A thorough mixing was done so that the mixture was spread evenly in the pit. After the complete preparation of the pits about 1kg of fresh Azolla was inoculated in the pit with light sprinkling

of water over it. Azolla started to grow rapidly filled the pit within 15-20 days. A mixture of 20 g of Super Phosphate, 1.5 kg of cow dung and 5 g of mineral mixture (Ranmix) was added after every 10 days. This was done to keep the Azolla in rapid multiplication phase, to avoid any nutrient deficiency. Azolla was harvested manually using aluminium mesh nets. After harvesting Azolla was washed thoroughly and sun dried for 2-3 days under shade such that it become crispy and green colour retained. The dried Azolla was collected and packed in plastic bags for further use. A sample of 100 g of sun dried Azolla meal was further used for analysis.

**Proximate analysis of Azolla meal**

Sun dried Azolla meal sample was analyzed for proximate composition (dry matter, crude protein, ether extract, total ash, crude fibre, calcium and phosphorous as per standards using AOAC, 2012 [3]. While as Nitrogen Free Extract (NFE) was calculated using the formula: NFE (%) = 100- (CP% +EE% +CF% +TA%) and calcium content was determined by the precipitation method.

**Result and Discussion**

**Proximate Composition of Azolla**

The values of proximate composition of sun dried Azolla sample are presented in (Table No.1). The dry matter (DM) content of sun dried Azolla meal was 90.03 percent, Crude protein (CP) was 22.79 percent, ether extract (EE) was 3.59 percent, crude fibre (CF) was 15.49 percent, total ash was 19.46 percent, NFE was 38.67 percent, 2.03 percent calcium and 0.48 percent phosphorus.

**Table 1:** Proximate composition of Azolla meal on DM basis

| S. No | Nutrient | % DM |
|---|---|---|
| 1 | Dry matter | 90.3 |
| 2 | Crude protein | 22.79 |
| 3 | Ether extract | 3.59 |
| 4 | Crude fibre | 15.49 |
| 5 | Total ash | 19.46 |
| 6 | Nitrogen free extract | 38.67 |
| 7 | Calcium | 2.03 |
| 8 | Phosphorous | 0.48 |

The proximate composition of sun dried Azolla meal revealed that the dry matter content was 90.3 %. These findings are in close line with the results of Basak *et al*., (2002) [7], Balaji *et al*., (2009) [6], Bhaskaran and Kannapan (2015) [8], Paudel *et al*., (2015) [22], Rout *et al*., (2017) [28], Shinde *et al.,* (2017) [29] and slightly lower than Shukla *et al*., (2018) [30]. The less dry matter content of azolla may act as a hurdle to use it in livestock feed as in bulk requirement to satisfy the DM requirement of livestock is very high (Cherryl *et al*., 2014) [11].

The crude protein percent of Azolla in the present study was found to 22.79 which indicated that due to its protein value Azolla may be used in poultry feed up to some limit. The results are in close line with Alalade and Iyayi (2006) [1], Awodun (2008) [5], Sujatha *et al*., (2012) [33], Ara *et al*., (2015) [4], Shinde *et al*., (2017) [29] and Joysowal *et al*., (2018) [17] but slightly lower than Basak *et al*., (2002) [7], Joydev and Patra (2008) [16], Indira *et al.,* (2009) [14] and Rout *et al*., (2017) [28] where as lower value of CP was obtained by Tamang and Samanta (1993) [34] and Pinkihan, (2013) [24] as 15.4 percent and 10.6 percent respectively. These variations may be attributed to the nutritive values of the inputs added.

The ether extract of Azolla in the present study was found to be 3.59 percent which was almost similar to the results obtained by Basak *et al*., (2002) [7], Balaji *et al*., (2009) [6], Jeberlin and Kumar (2010) [15], Shinde *et al*., (2017) [29] but slightly lower than Joydev and Patra (2008) [16], Indira *et al*., (2009) [14], Cherryl *et al*., (2014) [11], Ara *et al*., (2015) [4] and Joysowal *et al*., (2018) [17]. EE values obtained in this study are higher than the results obtained by Alalade and Iyayi (2006) [1], Sujatha *et al*., (2012) [33], Pinkihan, (2013) [24], Bhattacharyya *et al*., (2016) [10] and Rout *et al*., (2017) [28].

The crude fibre of Azolla obtained in this experiment was 15.49 percent which were in agreement with Basak *et al*., (2002) [7], Jeberlin and Kumar (2010) [15] and Shinde *et al*., (2017) [29] but was lower than the values reported by Indira *et al.,* (2009) [14] and Bhattacharyya *et al*., (2016) [10] and higher than the results obtained by Alalade and Iyayi (2006) [1], Joydev and Patra (2008) [16], Awodun (2008) [5], Balaji *et al*., (2009) [6], Sujatha *et al*., (2012) [33], Pinkihan, (2013) [24], Cherryl *et al*., (2014) [11], Ara *et al*., (2015) [4], Shinde *et al*., (2017) [29] and Joysowal *et al*., (2018) [17].

In present study, it was found that the total ash percent obtained was 19.46 which were slightly similar to the findings of Sujatha *et al*., (2012) [33], Ara *et al*., (2015) [4] and Rout *et al*., (2017) [28] while as higher results were obtained by Pinkihan, (2013) [24] and Cherryl *et al*., (2014) [11]. The results which were lower than the value of present study were revealed by Basak *et al*., (2002) [7], Alalade and Iyayi (2006) [1], Balaji *et al*., (2009) [6], Indira *et al.,* (2009) [14], Jeberlin and Kumar (2010) [15], Shinde *et al*., (2017) [29] and Joysowal *et al*., (2018) [17].

The nitrogen free extract content of Azolla calculated in this study was 38.67 percent, which were more or less similar to the results of Basak *et al*., (2002) [7] Balaji *et al*., (2009) [6], Cherryl *et al*., (2014) [11], Ara *et al*., (2015) [4], Bhattacharyya *et al*., (2016) [10], Rout *et al*., (2017) [28] and Joysowal *et al*., (2018) [17]. On the contrary to these findings, higher values were reported by Alalade and Iyayi (2006) [1], Jeberlin and Kumar (2010) [15], Pinkihan, (2013) [24] and Shinde *et al*., (2017) [29].

From the present study it was revealed that the calcium percent in dried Azolla is 2.03 which were closely similar to the findings of Parthasarathy *et al*., (2001) [21], Pinkihan (2013) [24], Ara *et al*., (2015) [4], Rana *et al*.,(2017) [27], Joysowal *et al*., (2018) [17] while as was lower than the result revealed by Cherryl *et al*., (2014) [11]. Lower values of Ca were reported by Rout *et al*., (2017) [28] and Alalade and Iyayi *et al*., (2006) [1]. In present study phosphorous level was 0.48 percent which were near to the values of Parthasarathy *et al*., (2001) [21], Balaji *et al*., (2009) [6], Kumar *et al*., (2012), Rana *et al*., (2017) [27], Rout *et al*., (2017) [28] and Shukla *et al*., (2018) [30], Joysowal,(2018) [17] while as higher values were reported by and Alalade and Iyayi *et al*., (2006) [1] and Cherryl *et al*., (2014) [11].

The variations which are found in present study of the proximate composition of *A. pinnata* in different studies may be due to agro climatic condition of the region, soil condition, stage of maturity, strains or variety, application of fertilizer and irrigation, genetics and method of analysis.

**Management of Mosquito and Housefly population**

Mosquito and house fly menace are some of the major problems faced by the poultry farmers in and near their poultry shed as poultry manure and stagnant water are their breeding places. There are various methods to manage them. Among them Azolla cultivation near poultry shed or growing Azolla in ponds under poultry sheds in poultry cum fish integration is one of the simplest and safest method. As

Azolla is a floating fern, it covers water surface thus preventing laying of mosquito eggs which reduces mosquito breeding and their development (Rajendaran and Reuben, 1998) [26]. It is believed that reduction in the fly population may be due to the nitrogen fixing ability of Azolla in association with symbiotic blue green algae *Anabaena azollae* as reported by Becking, 1979, however, no literature is available signifying the exact explanation in the reduction of house fly population near Azolla cultivated pits. In present study also reduction in housefly and mosquito population near the pit was observed. This finding is in line with the results of Mahanthesh *et al.,* (2018) [20].

## Conclusion

Based on the results of proximate composition of Azolla in this study, it may be concluded that Azolla may be used as an unconventional feed in poultry diet due to its high protein content. Azolla cultivation may also help to reduce the housefly and mosquito population in and around the livestock farm particularly poultry. It may help to reduce the cost of production of poultry and making it more profitable.

## Acknowledgement

Authors are deeply thankful to the Dean, Directors and Vice Chancellor of Sher-e-Kashmir University of Agricultural Sciences and Technology, Jammu for providing necessary funds especially Head, Division of Livestock Production and Management and Animal Nutrition for providing the facilities for proper execution of research work.

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