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Nutrient evaluation of *Azolla caroliniana*

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Abstract
The present study was conducted to evaluate the chemical composition of *Azolla caroliniana*. For this *Azolla* was cultivated, harvested and sun dried for feeding livestock. The *Azolla* samples were analysed for Proximate principles. The dry matter content (%) of *Azolla* was 89.00 ± 0.52. The Crude Protein, Crude fibre, Ether extract, Organic matter content of *Azolla* (% of DM) were 23.59 ± 0.28, 14.03 ± 0.57, 3.23 ± 0.15, 78.39 ± 0.20 respectively. Neutral Detergent Fiber and Acid Detergent Fiber were found to be 42.14 ± 0.61 and 36.03 ± 0.29 respectively. The mineral profile revealed that *Azolla* (% of DM) contains Calcium 2.32 ± 0.06 and Phosphorus 0.34 ± 0.04. The chemical analysis revealed that *Azolla* is a good source of protein for livestock feeding.

Keywords: *Azolla caroliniana*, proximate principles, dry matter, livestock, protein

Introduction
Azolla (mosquito fern) is a free-floating aquatic fern of family Azollaceae and order Pteridophyta, nowadays being used as unconventional feed and protein supplement for animals like ruminants, pigs, poultry and fish (Kathirvelan *et al*., 2015) [14]. It is rich in essential amino acids like lysine which is mostly deficit in plant protein sources along with methionine, arginine and carotene. It is good source of protein and it contains almost all 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 found to contain probiotics and biopolymers (Pillai *et al*., 2002) [25]. It has been also known as "green gold mine" because of its high nutritive value and multifaceted uses such as human food, animal feed, medicine, production of biogas, hydrogen fuel, water purifier, weed control, reduction of ammonia volatilization, and super plant due to its fast growth (Wagner, 1997) [39]; (Indira *et al*., 2009) [13]. Thus, Azolla appears to be a potential source of nutrients especially protein and has a considerably high feeding value (Hossiny *et al*., 2008) [11]. On this context, the current work was undertaken to evaluate nutritional value of *Azolla caroliniana*.

Materials and Methods
The present work was carried out at Instructional Livestock Farm (Cattle), College of Veterinary Science, Assam Agricultural University, Khanapara, Guwahati-22. A sample of Azolla (*Azolla caroliniana*) was collected initially from Assam Agricultural University, Jorhat. The whole plant material was used as a mother plant and started growing at Instructional Livestock Cattle Farm, ILF(C), College of Veterinary Science, A.A.U., Khanapara, Guwahati-781022.
For propagation of Azolla (*Azolla caroliniana*), the procedure of Mathur *et al*., (2013) [22] was followed. Two pits of 3.0 M×1.0 M×0.2 M was made under partial shady area and pucca cement structure was constructed. About 50-80 kg sieved fertile soil was added along with 5 kg cow dung (around 1-2 days old) mixed in 10 litres water. Maintaining a depth of 10 cm, about 500 liters of water was added over the pit. Then the fertile soil & cow dung was mixed thoroughly in pit. After that 2.0 kg fresh Azolla was inoculated and spread over the surface of water in the pit. From the top, water (about 1 liter) was sprinkled by hand over the Azolla to align it. The settlement was kept undisturbed for 20 days and harvesting was started after 21 days onwards yielding approximately 2.0-2.5 kg fresh Azolla/day. At regular intervals, the harvested plant materials were sun dried and powdered for about 1 week and stored in plastic bags.
The samples were analysed as per procedure given by AOAC (2007) [5] for finding out Dry matter, Crude Protein, Crude fiber, Ether extract, Total ash, Nitrogen free extract. OM was determined by subtracting the total ash (%) content from 100. Fibre part was fractioned

according to the method of Van Soest (1963) [38]. The estimation of calcium and phosphorus were done as per the modified method of (Talapatra *et al*., 1940) [37].

Results and Discussion

Chemical composition of azolla

The results of proximate analysis of the sun dried Azolla (*Azolla caroliniana*) sample for Dry matter, crude protein, ether extract, crude fibre, nitrogen free extract, total ash, acid insoluble ash, NDF and ADF were presented in the Table 1. The dry matter (DM%) content of sun dried azolla meal was 89.00 ± 0.52. Azolla contained organic matter (% of DM) 78.39 ± 0.20, crude protein (% of DM) 23.59 ± 0.28, crude fibre (% of DM) 14.03 ± 0.57, ether extract (% of DM) 3.23 ± 0.15, total ash (% of DM) 21.61 ± 0.20, calcium 2.32 ± 0.06 (% of DM) and phosphorus (% of DM) 0.34 ± 0.04.

Table 1: Proximate analysis of *Azolla caroliniana* (% DM basis)

Sl. No.	Particulars	Dried Azolla
1.	Dry matter (%)	89.00 ± 0.52
2.	Organic matter (% DM)	78.39 ± 0.20
3.	Crude protein (%DM)	23.59 ± 0.28
4.	Crude fibre (% DM)	14.03 ± 0.57
5.	Ether extract (% DM)	3.23 ± 0.15
6.	Nitrogen free extract (% DM)	37.52 ± 0.76
7.	Neutral detergent fiber (% DM)	42.14 ± 0.61
8.	Acid detergent fiber (% DM)	36.03 ± 0.29
9.	Total ash (% DM)	21.61 ± 0.20
10.	Calcium (% DM)	2.32 ± 0.06
11.	Phosphorus (% DM)	0.34 ± 0.04

The Dry matter (%) content of Dried *Azolla caroliniana* were found to be 89.00 ± 0.52 this agrees the results obtained by Sihag *et al.*, (2018) [33], Kumar *et al*., (2018) [17], Ahmed *et al*., (2016) [1], Higher value was obtained by Samanta and Tamang (1995) [30], Basak *et al*., (2002) [7], Balaji *et al*., (2009) [6], Kumar *et al*., (2018) [17].

The organic matter content of *Azolla caroliniana* (% DM basis) analysed in this study was 78.39 ± 0.20 which found to be in accord with the values obtained by Samanta and Tamang (1995) [30], Bhatt *et al.*, (2020) [8]. The higher value was reported by Anitha *et al*., (2016) [4], Murthy *et al*., (2013) [23], Roy *et al*., (2016) [28], Ahmed *et al*., (2016) [1]. Some scientists also conferred lower value Kumar *et al*., (2018) [17], Cherryl *et al*., (2013) [10].

The crude protein content of azolla (on % DM basis) estimated in the present study was 23.59 ± 0.28 which agrees with Balaji *et al*., (2009) [6], Prasanna *et al*., (2011) [26], Chatterjee *et al*., (2013) [9], Cherryl *et al*., (2014) [10], Kathirvelan *et al*., (2015) [14], Kumar *et al*., (2015) [18], Roy *et al*., (2016) [29], Akhud *et al*., (2017) [2]; Sihag *et al*., (2018), Kumar *et al*., (2018) while some scientists Basak *et al*., (2002) [7], Indira *et al*., (2009) [13], Roy *et al*., (2016) [28], Bhatt *et al*., (2020) [8] reported higher Crude protein values. And lower Crude protein value obtained by Samanta and Tamang (1995) [30], Mandal *et al*., (2012) [21], Srinivas *et al*., (2012) [35], Murthy *et al*., (2013) [23], Ahmed *et al*., (2016) [1], Kumari *et al*., (2018) [20]. This variation may be the sum of reflection for the various responses attributed by Azolla strains to different conditions namely temperature, water density, water P^h maintenance, sun light duration, soil nutrients, etc. However, the versatility in Azolla strains also a major cause of difference in the chemical composition of Azolla.

In the present study, the crude fibre content of *Azolla caroliniana* (% DM basis) obtained was 14.03 ± 0.57 which are in close agreement with the values obtained by Samanta and Tamang (1995) [30] and Balaji *et al*., (2009) [6], Ahmed *et al*., (2016) [1], Cherryl *et al*., (2013) [10], Anitha *et al*., (2016) [4] whereas, the same was higher than the findings of Alalade and Iyayi (2006) [3], Kathirvelan *et al*., (2015) [14], Roy *et al*., (2016) [28], Sihag *et al*., (2018) [33] and lower than the values reported by Basak *et al*., (2002) [7], Rawat *et al*., (2015) [27], Kumar *et al*., (2015) [18].

The finding of ether extract content (% DM basis) of *Azolla caroliniana* in this study was 3.23 ± 0.15, similar findings reported by Basak *et al*., (2002) [7], Balaji *et al*., (2009) [6], Shital *et al*., (2012) [32], Khare *et al*., (2014) [15], Roy *et al*., (2016) [29]. However, the higher values than the present study was reported by Anitha *et al*., (2016) [4] in *A. pinnata* and lower values recorded by Roy *et al*., (2016) [28], Akhud *et al*., (2017) [2].

The Nitrogen free extract content of *Azolla caroliniana* (% DM basis) was found as 37.52 ± 0.76. Similar records were obtained by Chatterjee *et al*., (2013) [9], Roy *et al*., (2016) [28], Kumar *et al*., (2018) [17]. While Anitha *et al*., (2016) [4], Shital *et al*., (2012) [32] Samantha & Tamang (1996) [30], Parashuramulu *et al*., (2013) [24] recorded higher values and Kumar *et al*., (2015) [18], Cherryl *et al*., (2013) [10] recorded lower values than the values found by the current investigation.

The total ash content of *A. caroliniana* (% DM basis) in this study was recorded as 21.61 ± 0.20 which is in close agreement with the finding obtained by Samanta & Tamang (1995) [30]. Slightly higher values were recorded by Cherryl *et al*., (2013) [10] i.e. 24.26% while lower values were obtained by Ahmed *et al.*, (2016) [1], Kumari *et al*., (2018) [20] and Anitha *et al*., (2016) [4] as 19.65%, 19.33% and 17.33% respectively in *A. pinnata*.

The current investigation revealed that the Neutral detergent fibre content (%DM basis) of *Azolla caroliniana* was 42.14 ± 0.61. This finding was comparable with the values recorded by Roy *et al*., (2016) [29] and Kumari *et al*., (2018) [20] in *Azolla pinnata*. However, Indira *et al*., (2009) [13], Kumar *et al*., (2015) [18] Anitha *et al*., (2016) [4], and Roy *et al*., (2016) [28] recorded higher values 72.05%, 54.20%, 54.85% and 59.9% in *A. pinnata* respectively. While Parashuramulu *et al*., (2013) [24] recorded 35.40% Neutral detergent fibre in *A. pinnata*. The variation in values may be attributed due to differences in species. The present investigation revealed the Acid detergent fiber content of *A. caroliniana* (% DM basis) was 36.03 ± 0.29. This can be comparable with Anitha *et al*., (2016) [4] and Kumar *et al*., (2017) [19] in *A. pinnata*.

The mineral profile of *A. caroliniana* was also analyzed and revealed that Calcium content (%DM basis) was 2.32 ± 0.06 which nearer to the findings of Cherryl *et al*., (2013) [10], higher than the observations of Singh and Subudhi (1978) [34], Samanta and Tamang (1995) [30], Anitha *et al*., (2016) [4], Alalade and Iyayi (2006) [3], Kumar *et al*., (2012) [16] in *A. pinnata*. The phosphorus content (% DM basis) of *A. caroliniana* in this study was 0.34 ± 0.04 which is comparable with the findings of Sujatha *et al*., (2013) [36], Shamna *et al*., (2013) [31].

The differences in the value may be due to species difference, variety of climatic condition and/or different in management processes like maintenance of optimum temperature, water concentration, water P^h, nutrients added for the growth of *Azolla*, etc. Soil composition, soil nutrients, etc. also impact greatly on the nutrient composition of *Azolla caroliniana*.

Conclusion

The current investigation revealed that the richness of protein and macronutrients in *Azolla caroliniana* may illustrate it as a potential source of livestock feed. Hence, it can be concluded that *Azolla caroliniana* can be used as an unconventional feed sources in livestock feeding.

References

1. Ahmed HA, Ganai AM, Beigh YA, Sheikh GG, Reshi PA. Performance of growing sheep on Azolla based diets. Indian J Anim. Res. 2016;50(5):721-724.
2. Akhud MW, Ingole AS, Atkare VG, Khupse SM, Deshmukh SV. Effect of Feeding Different Levels of Concentrate Replace with Azolla on Nagpuri Buffalo Calves. J Soils and Crops. 2017;27(2):105-108.
3. Alalade OA, Lyayi EA. Chemical composition and the feeding value of Azolla (*Azolla pinnata*) meal for egg-type chicks. International Journal of Poultry Science. 2006;5:137-141.
4. Anitha KC, Rajeshwari YB, Prasanna SB, Shree JS. Nutritive evaluation of Azolla as livestock feed. Journal of Experimental Biology and Agricultural Sciences. 2016;4(6):670-674.
5. AOAC. Official methods of analysis, 18th edition. Association of Official Analytical Chemists, USDA, Washington, DC, 2007.
6. Balaji K, Jalaludeen A, Churchil RR, Peethambaran PA, Senthilkumar S. Effect of dietary inclusion of azolla (*Azolla pinnata*) on production performance of broiler chicken. Indian Journal of Poultry Science. 2009;44:195-198.
7. Basak B, Pramanik AH, Rahmnan MS, Taradar SU, Roy BC. Azolla (*Azolla pinnata*) as a feed ingredient in broiler ration. Int. J Poult. Sci. 2002;1:24-29.
8. Bhatt N, Tyagi N, Chandra R, Meena DC, Prasad CK. Growth Performance and Nutrient Digestibility of *Azolla pinnata* Feeding in Sahiwal Calves (*Bos indicus*) by Replacing Protein Content of Concentrate with Azolla pinnata during Winter Season. Indian Journal of Animal Research, 2020.
9. Chatterjee A, Sharma P, Ghosh MK, Mandal M, Roy PK. Utilization of *Azolla microphylla* as feed supplement for crossbred cattle. International Journal of Agriculture and Food Science Technology. 2013;4(3):207-2014.
10. Cherryl DM, Prasad RMV, Jayalaxmi P. A study on economics of inclusion of *Azolla pinnata* in swine rations. International Journal of Agricultural Sciences and Veterinary Medecine. 2013;1;50-56.
11. Hossiny H, Setoudeh M, Rokni H, Dehghanzadeh H, Cheraghcheshm M. Using of silage azolla in Guilan male calves nutrition. Proceedings of Third National Congress of Recycling and Reuse of Renewable Organic Resources in Agriculture Islamic Azad University, Khorasgan branch (Isfshan) Agricultural faculty, Waste and waste water Research Centre, 2008.
12. ICAR. Nutrient requirements of animals-Cattle and Buffalo. (ICAR-NIANP), 2013.
13. Indira D, Rao KS, Suresh J, Naidu KV, Ravi A. Azolla (*Azolla pinnata*) as Feed supplement in buffalo calves on growth performance. Indian Journal of Animal Nutrition. 2009;26(4):345-348.
14. Kathirvelan C, Banupriya S, Purushothaman MR. Azolla-an alternate and sustainable feed for livestock. International Journal of Science, Environment and Technology. 2015:4(4):1153-1157.
15. Khare AK. Effect of *Azolla microphylla* supplementation on growth rate and blood constituents of crossbred female calves. M.V.Sc. Thesis. National Dairy Research Institute, Karnal, Haryana, India, 2014.
16. Kumar DS, Prasad RMV, Kishore KR, Rao ER. Effect of Azolla (*Azolla pinnata*) based concentrate mixture on nutrient utilization in buffalo bulls. Indian Journal of Animal Research. 2012;46(3):268-271.
17. Kumar M, Dhuria RK, Jain D, Sharma T, Nehra R, Prajapat UK. A nutritional evaluation of azolla (*Azolla pinnata*) as feed Supplement. Veterinary Practitioner, 2018, 19(1).
18. Kumar R, Tripathi P, Chaudhary UB, Tripathi MK. Nutrient composition, *in vitro* methane production and digestibility of azolla (*Azolla microphylla*) with rumen liquor of goats. Indian Journal of Small Ruminants. 2015;21:126-128.
19. Kumar R, Tripathi P, Chaudhary UB. Influence of Feeding Azolla containing Complete Feed on Performance of Goat Kids. Indian Journal of Animal Nutrition. 2017;34(2):229-232.
20. Kumari R, Dhuria RK, Patil NV, Sawal RK, Sanjay Singh. Chemical composition and pellet quality of *Azolla pinnata* grown in semi-arid zone of India. International Journal of Chemical Studies. 2018;6(3):2031-2033.
21. Mandal RN, Pandey BK, Chattopadhyay DN, Mukhopadhyay PK. Azolla-an aquatic fern of significance to small-scale aquaculture. Aquaculture Asia, 2012 Jan-March, 17(1).
22. Mathur GN, Sharma R, Choudhary PC. Use of Azolla (*Azolla pinnata*) as cattle feed supplement. Journal of Krishi Vigyan. 2013;2(1):73-75.
23. Murthy TNK, Ashok M, Thirumalesh T, Umesh BU, Nataraju OR. Effect of partial replacement of Azolla for concentrate supplement on lactating crossbred cows. Environment and Ecology. 2013;31(2):415-417.
24. Parashuramulu S, Swain PS, Nagalakshmi D. Protein fractionation and *in vitro* digestibility of Azolla in ruminants. Online J Anim. Feed Res. 2013;3(3):129-132.
25. Pillai KP, Premalatha S, Rajamony S, Azolla-A sustainable feed substitute for livestock. Leisa India. 2002;4:15-17.
26. Prasanna SB, Shivakumar MC, Umashankar BC, Naveen Kumar GS, Pardeep MC, Prabhu TM. Influence of feeding azolla on the performance of RAJA-2 Broiler Birds. Indian Journal Animal Production Management. 2011;27:137-141.
27. Rawat N, Kumari K, Singh F, Gilhare Nidhi Rawat, Kumari K, Singh F, Gilhare VR. Effect of *azolla*-supplemented feeding on milk production of cattle and production performance of broilers. Applied Biological Research. 2015;17(2):214-218.
28. Roy D, Kumar V, Kumar M, Sirohi R, Singh Y, Singh JK. Effect of feeding *Azolla pinnata* on growth performance, feed intake, nutrient digestibility and blood biochemicals of Hariana heifers fed on roughage-based diet. Indian Journal of Dairy Science, 2016, 69(2).
29. Roy DC, Pakhira MC, Roy M. Estimation of Amino Acids, Minerals and Other Chemical Compositions of Azolla. Advances in life Sciences. 2016;5(7);2692-2696.
30. Samanta G, Tamang Y. Feeding value of Azolla (*Azolla pinnata*) in goats. Annales de zootechnie. 1995;44(1):62-62.

31. Shamna TP, Peethambaran PA, Jalaludeen A, Leo Joseph Muhammad Aslam MK. Broiler characteristics of Japanese quails (*Coturnix coturnix japonica*) at different levels of diet substitution with *Azolla pinnata*. Animal Science Reporter. 2013;7(2):75-80.
32. Shital S Ghodake, Fernandes AP, Darade Rohini V, Zagade BG. Effect of different levels of Azolla meal on growth performance of Osmanabadi kids, Res. J Animal Hus. & Dairy Sci. 2012;3(1):13-16
33. Sihag S, Sihag ZS, Kumar S, Singh S. Effect of Feeding Azolla (*Azolla pinnata*) Based Total Mixed Ration on Growth Performance and Nutrients Utilization in Goats. Forage Res. 2018;43(4):314-318.
34. Singh PK, Subhudhi BPR. Utilize Azolla in poultry feed. Indian Farming. 1978;27:37-38.
35. Srinivas DK, Kishore KR, Rao RE. Effect of incorporation of sun dried Azolla (*Azolla pinnata*) meal in the concentrate mixture on rumen fermentation pattern of buffalo bulls. Indo-Am. J Agric. & Vet. Sci., 2015, 3(1).
36. Sujatha T, Udhayakumar ID, Kundu A, Jeyakumar S, Jai Sundar Kundu MS. Utilization of raw Azolla as a natural feed additive for sustainable production in nicobari fowl. Animal Science Reporter, 2013, 7(4).
37. Talapatra SK, Ray SC, Sen KC. The analysis of mineral constituents in biological materials. Indian J Vet. Sci. 1940;10:243.
38. Vansoest PJ. Use of detergents in the analysis of fibrous feeds. II. A rapid method for the determination fiber lignin. J Asso. Agr. Chem. 1963;46:829-835.
39. Wagner GM. Azolla: A review of its biology and utilization. The Botanical Review. 1997;63(1):1-26.