

Azolla: An Alternate Unconventional Livestock Feed

Charlotte Coretta Rodricks

Assistant Professor, Department of Animal Genetics and Breeding, Shekhawati Veterinary College, Sikar, Rajasthan

Corresponding Authors: drcharlotterodricks@gmail.com

Abstract

An economic and sustainable alternate feed source, Azolla species can be found growing naturally in stagnant ponds, marshy land or can be cultivated artificially in man-made set ups. Commonly found in the tropics and subtropics it is a free-floating water fern with long free hanging roots and has previously been used as a bio fertilizer. Of late, due to its ability to double its mass within 4-5 days and its nutritional value, several studies have been undertaken to study its properties and use it as an alternate source of feed for livestock. In South East Asia, China, Brazil and many other countries, Azolla is mostly cultivated along rice fields. Studies in different countries have reported its use as an alternate source of feed for fish, ducks, pigs and even cattle and have been met with various degrees of success. It has been commonly referred to as a *green gold mine* due to its various uses and contains high protein and low lignin content. Despite evidence about its use as a potential source of feed for livestock, there are still challenges, it has to overcome before farmers can implement it on a larger scale.

Introduction

Although India has 2.4 percent of the world's geographical area, it holds around 20 percent of world's livestock population, i.e. 535.82 million. The population has increased by 4.6 percent over the previous livestock census in 2012. Feed and fodder are the foundation of livestock rearing. The cost of feed alone accounts for 70 percent of the total cost of livestock production. In the current scenario, owing to the demand to produce more from less, there is high over exploitation of resources. The expenditure incurred by farmers who engage in animal husbandry as a business has increased due to the fact that, the cost of animal feed has increased. This along with climatic changes has resulted in current research focusing on alternate sources of feed to meet the nutritional requirements of livestock.

Azolla species has been postulated to be an alternate source of feed either as a supplementary feed source or to replace conventional sources of feed. It is

known as duckweed, water fern or mosquito fern, fairy mass and water velvet and is an aquatic plant comprising of triangular or polygonal leaves (Van Hove and Lejeune, 2002). The nomenclature for Azolla is derived from Azo (to dry) and ollyo (to kill) indicating that high heat can easily kill off the plant. It comprises of six species, viz. *A. filliculoides*, *A. caroliniana*, *A. mexicana*, *A. microphylla*, *A. nilotica* and *A. pinnata* and belongs to the Salviniaceae family, order Pteridophyta. The six species of Azolla can be further classified as Section Rhizosperma (megasporeocarps have nine floats and unbarbed or absent glochidia) and Section Azolla (megasporeocarps have three floats and barbed glochidia).



Fig. 1 Polygonal leaves of Azolla

Properties of Azolla

Azolla has a symbiotic relationship with the nitrogen-fixing blue-green alga *Anabaena azollae*, which increases the protein content of Azolla, making it one of the greatest alternative feed ingredients as a source of protein, with 25-30 percent protein, 7-10 percent amino acids, vitamins (Beta Carotene, vitamin A, vitamin B12), 10-15 percent minerals (calcium, potassium, phosphorus, ferrous, magnesium, copper, etc.), and antioxidants. On a dry matter basis, it contains 20-30 percent crude protein, 4-5 percent ether extract, 14-16 percent crude fibre and 15-18 percent

total ash. It contains 2.58 percent calcium and 0.26 percent phosphorus. Methionine content is low, but lysine content is more than twice of that of maize.

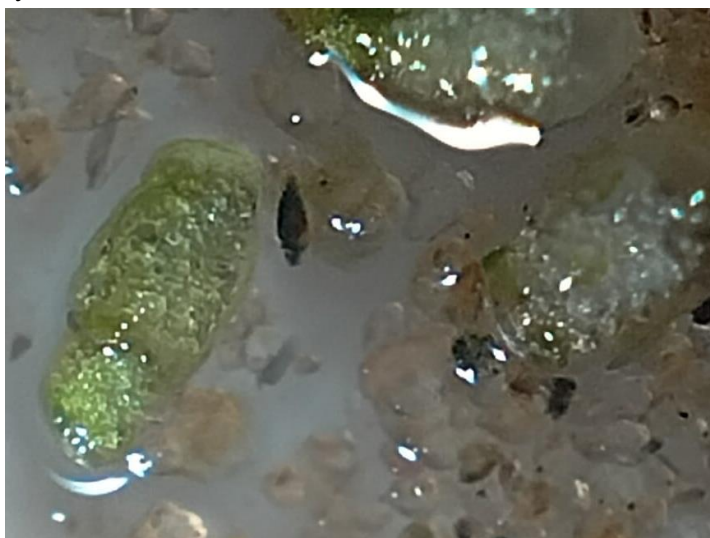


Fig. 2 Azolla under 20X when photographed as such

It ranges from 1-3.0 cm in length and 1-2 cm in breadth. Azolla requires 30-50percent sunlight while being able to tolerate a temperature range of 20-35 °C. It requires a relative humidity of 80-90 percent and a water pH value of 5 to 7. A water surface plant comprising of a main stem (rhizome) with alternating leaves and adventitious roots along the stem, the leaves have two lobes, an upper lobe which is aerial and green and a lower lobe which is thin and colourless and is submerged below the surface.

Use in Animal Feeds

Harvested Azolla has a shelf life of 3 days and needs to be washed thoroughly before using. Fresh azolla is better as an animal feed than dried azolla due to its higher palatability and nutritional composition. Low in carbohydrates and fats, Azolla can either be used as a supplementary feed or on its own. It has been reported that one kg of feed requires 12-14 kg of Azolla as a replacement. When introducing animals to Azolla start off with 20 percent of the total feed before gradually increasing it to prevent the animals from rejecting the Azolla feed, directly or indirectly. In lactating cattle, it was reported that Azolla increased the milk production by 15-20 percent. When Sahiwal female calves were fed with a concentrate replacement of 15 percent and 30 percent Azolla it was found that it increased their average daily gain (Bhatt *et al.*, 2021). Kumari *et al.*, in 2018 reported about the average daily gain in body weight in camel calves when they were fed a diet of Azolla at 2percent and 4percent levels.

In 2012, Kumar *et al.*, reported that 25percent of the total protein content of concentrate mixture of graded Murrah buffalo bulls could be used without any creating any safety concerns to the animals. A study by Basak *et al.*, in 2002 reported that upto 5 percent Azolla meal on DM basis in broiler ration led to an improved performance in the birds. Tamang and Samanta in 1993, reported that sun dried Azolla can be fed to Black Bengal kids at 20percent of the concentrate mixture. A similar study on Jalauni lambs performed by Das *et al.*, in 2017, found that Azolla could replace 25percent of mustard cake protein fed to them, without any incident. In a feeding trial on pigs, it was reported that those animals fed with a mixture of concentrate + Azolla gained significantly more weight than those animals fed solely on concentrates alone (Zhuang-Ta *et al.*, 1987).

Table 1 Fresh Azolla that can be given as a supplementary feed to animals (FAO,2010)

Species	Azolla Quantity (grams)
Cow/ Buffalo/ Pig	1500-2000
Goat	50-500
Layer/ Broiler	20-30
Rabbit	100

Conclusion

While Azolla cultivation works as an alternate and cheap feed source, it has been reported that it is unable to tolerate climatic extremes making it unsuitable for use in very hot or cold places unless the temperature is maintained. Although good yield of Azolla was reported up to 3 months, following this it turned to brownish pink before deteriorating. Despite removing the water and soil after a period of 5 months, initial yields of Azolla were not replicated, thereby prompting the farmers to give up and shy away from Azolla cultivation. It was also observed that Pythium species leads to root destruction in Azolla and Weevil insects have been known to destroy entire Azolla cultivations. To further complicate the situation, some farmers reported that livestock refused to consume Azolla if it was the only source of feed. While Azolla can be cultivated on a small scale with a fair amount of success, for it to be utilized in the field more research needs to be undertaken with a larger number of animals, under varying climatic conditions and in different geographical locations.

Acknowledgement

The author would like to thank Dr. Ravi Regar, Assistant Professor, Shekhawati Institute of Agriculture for providing Azolla specimens for the pictures required for this article. All pictures in this article were photographed by the author herself.

References

- Basak, B., Pramanik, M. A., Babib, R., Muhammad, S., Tarafdar, S.U. and Roy, B.C. (2002). Azolla (*Azolla pinnata*) as a Feed Ingredient in Broiler Ration. *International Journal of Poultry Science*, 1 (1): 29-34.
- Bhatt, N., Tyagi, N., Chandra, R., Meena, D.C. and Prasad, C.K. (2021). 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*, 55(6):663-668.
- Das, M. M., Agarwal, R. K., Singh, J. B., Kumar, S., S., Singh, R. P., & Kumar, S. (2017). Nutrient intake and utilization in lambs fed *Azolla microphylla* meal as a partial replacement for mustard cake in concentrate mixture. *Indian Journal of Animal Nutrition*, 34:45-49.
- Kumar, Srinivas D., Prasad R.M.V., Kishore Raja K., Rao Raghava E. (2012). Effect of *Azolla* (*Azolla pinnata*) based concentrate mixture on nutrient

utilization in buffalo bulls. *Indian Journal of animal research*, 46(3):268-271.

- Kumari, R., Dhuria, R. K., Patil, N. V., and Sawal, R. K. (2018). Effect of different levels of azolla (*azolla pinnata*) incorporation in pelleted complete feed on growth performance of camel calves. *Journal of Camel Practice and Research*, 25, 307-309.
- FAO Electronic Conference Proceedings on Successes and failures with animal nutrition practices and technologies in developing countries. 1-30 September 2010.
- Tamang, Y. and Samanta, G. (1993). Feeding value of *Azolla* (*Azolla pinnata*) an aquatic fern in Black Bengal goats. *Indian Journal of Animal Sciences*, 63(2):188-191.
- Van Hove, C and Lejeune, A. (2002) The *Azolla*: *Anabaena* Symbiosis. In: *Biology and Environment: Proceedings of the Royal Irish Academy*, September 2002 Commentaries on cyanobacterial symbioses, pp 23-26
- Zhuang-ta, Z., yu-Si, K.e., de-Quan, l., bing yuan, d. and xi-lian, l. (1987). Utilization of *Azolla* in agricultural production in Guangdong province, China. In *Azolla utilization: Proc. Workshop on Azolla use*, Fuzhou, Fijian, China, Manila, International Rice Research Institute.
