

Azolla pinnata - A Unconventional Ruminant Feed

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Abstract

Azolla pinnata is an aquatic fern with enormous potential as livestock feed due to its high content of protein, essential amino acids, vitamins, growth promoter intermediaries, beta-carotene, appreciable quantities of bio-polymers and minerals such as potassium, ferrous, copper, magnesium, zinc etc. On a dry weight basis, *Azolla* consists of 25-35 percent protein, 10-15 percent mineral, 7-10 percent amino acids and bio-active substances. Carbohydrate and oil content in *Azolla* is very low. All these biochemical constituents along with rapid multiplication rate make *Azolla* an ideal organic feed substitute for livestock. Livestock can easily digest *Azolla* due to its high protein content and low lignin content. *Azolla* feeding increases milk production (10-15 percent), meat by weight (8-10 percent) and egg laying capacity (10-15 percent) in milch animals, goats and chicks respectively. Due to these properties *Azolla pinnata* is recommended as a potential unconventional protein supplement for livestock during lean period of year in rain fed areas. The technology has promising climate change, adaptive capacity and is helpful in area of where climate change is a threat to livestock production because of impact on quantity and quality of feed crops, fodder and forage.

Keywords: *Azolla pinnata*; livestock; milk; supplement

Introduction

The demand for milk and meat has been increasing and so animal husbandry, as a profitable occupation is expanding. However, there is a substantial decline in fodder production, owing to decreasing area under forest and grasslands. The fodder availability from various crops has also decreased largely due to introduction of high yielding dwarf varieties. The shortage of fodder is, therefore being compensated with commercial feed, resulting in increased cost of production of meat and milk (Pillai *et al.*, 2002). The search for alternatives to green fodder and concentrates led to identification of a wonderful plant *Azolla*, which holds the promise of providing sustainable feed for livestock. *Azolla pinnata* is a free floating, rapidly growing aquatic fern on water surface. It floats as small, flat and compact green mass. Under ideal conditions it grows exponentially, doubling its biomass in every three days. There are at least eight species of *Azolla* worldwide *i.e.* *Azolla caroliniana*, *Azolla circinata*, *Azolla japonica*, *Azolla mexicana*, *Azolla microphylla*, *Azolla nilotica*, *Azolla pinnata* and *Azolla rubra*. The common species of *Azolla* in India is *Azolla pinnata*. *Azolla* produces

more quality protein as compared to other livestock feeds. Also, the bio-mass production is almost 4-10 times compared with other common feed.

These two parameters are very important to enhance economic livestock production and establish *Azolla* reckoned as 'The Super plant'.

Azolla pinnata is an aquatic fern that belongs to family *Azollaceae* and genus *Azolla*. Its diameter varies from 2.5-15 cm (Lumpkin and Plucknett, 1980). It can double its weight in 3-5 days and from a starting weight of 1 ton/ha, it can reach upto 1530 ton/ha in about 20 days (Khan, 1983). Anon (1985) estimated that one hectare of *Azolla* can provide protein equivalent to 790-1100 kg soybean grains in one month. The optimum temperature for growing *Azolla* is 18-28°C with pH of 4.5-7 (Kathirvelan *et al.*, 2015). *Azolla* (*Azolla pinnata*) is a good alternative protein source that might also be used to provide rumen undegradable dietary nitrogen (Jayasuriya *et al.*, 1988). *Azolla* has symbiotic relationship with nitrogen fixing blue-green algae *Anabaena azollae*, which increases the protein content of *Azolla* and contains approximately all amino acids specially Lysine, pro-vitamins (Hossiny *et al.*, 2008) and Vitamin B₁₂ (Leterme *et al.*, 2010). Also, because *Azolla* has a low lignin content, it is easily digested by livestock and can be utilized as green feed

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Table 1: Comparative fodder nutritive value

Fodder	Crude protein (%)	Fibre / Digestive nutrient content (%)	Fodder
Roughages	-	More than 18	Less than 60
Concentrates	-	Less than 18	More than 60
Legumes	16-20	30	Less than 60
Azolla	25	10	60-65

Source: NDDDB Study at Anand

supplement for dairy cattle (Prabina and Kumar 2010; Chatterjee *et al.*, 2013). According to Sanginga and Van Hove (1989), the chemical composition of *Azolla* varies depending on variety of parameters, including soil chemical composition, ambient circumstances (such as light intensity, heat and humidity) and contamination.

Materials and Methods

Azolla Production

Considering the nutritive value of *Azolla* developed a cost effective prototype of *Azolla* cultivation for mass multiplication and its feeding to livestock. CVAS, Navania model for cultivation of *Azolla* is described as below:

The *Azolla* was cultivated in water troughs of size 12.5 m X 1.0 m X 0.40 m. The bottom of water trough was sealed with cement and maintained uniform layer of water in the trough.

A thin layer of about 10 cm of fine soil was spread and then it was filled with water and maintained a constant level of water. About 2-2.5 kg of cow manure was dissolved in 3.5 liters of water and spread evenly in water trough. At *Azolla* unit, there was a total of eighteen water troughs in which *Azolla* was produced. Fresh *Azolla* seeds were inoculated in water troughs at 0.5 kg/m². *Azolla* was spread all over the trough within fifteen days and built up a thick mat like structure. To sustain the production of *Azolla* 50 mg of superphosphate and around 2-2.5 kg of cow manure were included once every 15 days.

Around 30 percent of water was replaced with fresh water once every 15 days to prevent overabundant nitrogen collection. Water troughs were cleaned and the water and soil were replaced periodically. *Azolla* was harvested and washed three times to avoid superfluous material before feeding to livestock.

Environmental factors for better growth (Kumar and Chander, 2017)

1. Water 7-11 cm deep is required and salinity of water adversely affects it.
2. Temperature-20-28°C.
3. Relative humidity 65-80 percent.
4. The pH of soils is 5.0-7.2.

Precautions for better growth (Biswas and Sarkar, 2013)

Plant should not be allowed to enter maturity stage or sporulation stage by periodic application of cow dung slurry, superphosphate and other macro and micronutrients except nitrogen. Temperature should be retained 30°C in case the temperature goes up, the light intensity should be maintained by providing shade net or other devices. Bio-mass should be removed every day or an alternative days to avoid overcrowding. pH should be tested periodically to see that it never goes below 5.5 above 7. Seed stock is maintained separately and treated with pesticides and fungicides. *Azolla* should be well washed with water before feeding to livestock to get rid of smell of cow dung. Biomass collected from field applied with pesticide should not be used as feed for livestock.

Conclusion

Azolla can be used as an ideal feed substitute for cattle, fish, pig and poultry, apart from its utility as a biofertilizer for wetland paddy. It is popular and cultivated widely in other countries like China, Vietnam and Philippines etc. and is yet to be taken up in India, in a big way. The production technology has to be standardized to the diverse and different agro-climatic zones of the country, to enable its wider spread. It may conclude that employing *Azolla* in animal feeding improves animal performance and save feeding costs.

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Dr. Mohan Wani appointed as Director - NCCS



Dr. Mohan Wani took charge as Director of Pune based National Centre for Cell Science (NCCS), a research institute of Department of Biotechnology (DOBT), Ministry of Science and Technology on 15th June, 2022.

Dr. Mohan Wani did his Master in Veterinary Surgery from Nagpur Veterinary College and Doctorate in Human Medicine from St. George's Hospital Medical School, University of London, England. He was awarded with 'Commonwealth Fellowship' during his Doctorate. He has undertaken innovative basic and translational research in field of 'Pathophysiology of bone and cartilage remodelling in important skeletal diseases such as osteoporosis, rheumatoid arthritis and osteoarthritis'. He also has expertise in stem cell science and regenerative medicine. Dr. Wani has supervised several doctorate, medical/dental and Veterinary students and mentored many post-doctoral fellows. His research work is published in reputed journals and has been patented. He is recipient of several prestigious awards including B.M. Birla Science Prize, DBT National Bioscience Award, Tata Innovation Fellowship, Elected Fellow of National Academy of Sciences (NAS), Indian National Science Academy (INSA), National Academy of Medical Sciences (NAMS) and National Academy of Veterinary Sciences (NAVS).