**Review on magic fern *Azolla* and its phytochemical screening**

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**ABSTRACT**

The use of *Azolla* for biofuel, biodiesel and several bioactive compounds, such as phenols and flavonoids, tannin saponin, protein, lipid and carbohydrate from prepared extract using various solvent extraction method, is receiving special attention at present because of its high medicinal value, antioxidant property, anticancer property, negative environment impact, less side effect, easily biodegradable and fossil energy towards renewable liquid biodiesel. Because of the high biomass production in few days, *Azolla* is a major promising source for biofuel production. It also plays key role in bioremediation of waste water treatment from industrial waste and removes many toxic chemical from water. *Cyanobacteria anabaena* symbiotically associates with *Azolla* to fix nitrogen from the atmosphere and as such, can be used as bio fertilizer in rice field. This review provides brief account on various phytochemicals secreted by species of *Azolla* and its economic importance.

**Key words**: Bioremediation, bio fertilizer, phenol, tannin, saponin, biodiesel, antioxidant.

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**INTRODUCTION**

*Azolla* is an aquatic ferns widely present in water bodies and native to the subtropics warm and temperate region of Africa, Asia and the America and placed in the family of Salvinaceae. It has stem with lobed leaves and adventitious roots (Huntley and Redalje, 2007; Konar and Kapoor, 1972). Out of the known seven species of *Azolla*, the *Azolla filiculoides* is one of the fern whose reference genome has been published (Costa et al., 2009). *Azolla* is a highly productive plant that doubles its biomass in 3-10 days and yield 8-10 tones /ha in rice field and also has the ability to grow in waste and natural water (Li et al., 2018; Hasan and Chakrabarty, 2009; Khosravi et al., 2005). It grows in quiet and slow moving water but not in the running water. It is a small fern with triangular measuring up to 2.5 cm in length. They are green, blue green or dark red color and coated with tiny hairs. The tiny hairs of the plant are responsible for the velvet appearance and make the top surface of the leaf as water repellent. The hair like roots extended into the water and leave contains *Cyanobacteria anabaena* that symbiotically fixes nitrogen from the atmosphere and can be used as bio fertilizer instead of chemical fertilizer. *Azolla* has many uses such as animal feed, human food, medicine, production of biogas, hydrogen fuel, water purifier, weed control, reduction of ammonia volatilization and generally referred to as Magic Fern.

*Azolla* as biofuel production

Since fossil resources are limited and because of their negative impact on environment, research will be focusing on some alternative and renewable source soalgae will be identified as the best source to produce biofuel and chemical (Wasiullah et al., 2015). In the past decade, the aquatic plant *Azolla* as a macroalgae, owing to its several properties such as rapid multiplication, high biomass production and colonization on the water surface, is gaining significant attention (Mata et al., 2010). In the recent years, there is huge demand for unconventional energy source in order to achieve sustainable alternative (Marchetti et al.,...
The use of biodiesel creates more advantage (Demirbas, 2009; Van, 2005) because it has compatible physical and chemical properties and as such, it can be directly used in diesel engine without eliminating the properties of the engine (Subramanian et al., 2005). Macroalgae that can convert solar energy to chemical energy by CO\textsubscript{2} fixation are now being considered to have tremendous oil production capacity (Gouveia and Oliveira, 2009) and high concentration of fatty acid will attract the use of Azolla as biodiesel (Rai et al., 1981). The bio-oil extracted was transesterified to convert fatty acid to methyl esters and various research have been conducted to estimate biodiesel quantity using fatty acid profile.

**Role of Azolla in phytoremediation of heavy metal from Industrial waste**

Providing clean and affordable water to fulfill human need is one of the greatest challenges of 21st century, and the rapid industrialization, urbanization and increase in population in the last few decades have added to the extra load of pollutant in water resource. Large number of industries including paper, textile, coke, pesticide, pharmaceutical industries will cause discharge of large amount of effluents into water bodies (river, canal, lake) leading to water pollution. Thus, these lead to serious challenge, and among the major pollutants, heavy metals are considered as dangerous threat to the environment because of their accumulation and toxicity in the environment (Lokeshwari and Chandrappa, 2007; Chang et al., 2009; Ganji et al., 2005). Phytoremediation is a new environmental friendly and cost effective technique of removing toxic substances from water and soil by plants. The application of Azolla is a very common practice in phytoremediation. The application of Azolla is a very common practice in phytoremediation, because of its high biomass production and hyper accumulation of pollutant, minerals and heavy metal (Hossein et al., 2014). Hyper accumulation involves adsorption, transport and translocation to areas where large quantities of metal can be stored. Under laboratory condition, it has been found that Azolla has the ability to absorb heavy metal such as zinc, nickel, chromium, cadmium molybdenum etc. without affecting its growth property (Riaz et al., 2012). Currently, Azolla is being applied as biofertilizer in rice paddy field and used as bio absorbent of heavy metal.

**Phytochemical product of Azolla**

Due to modernization of life style and food habitat, which have resulted in the several disease and disorders, people are focusing on herbal medicine for their primary health care (Kayarohana and Kavimani, 2015) and as such, research should be conducted on some herbal based drug which contains some potential bioactive substances that are more safe and easily biodegradable (PatricRaja et al., 2012). From ancient time, several numbers of plants and pteridophyte have been studied because of their efficiency in the production of bioactive compounds. They also produce metabolites that are active against many diseases and as such, act as natural antioxidant (Ames et al., 1993). Antioxidant has the ability to reduce oxidative damage by reactive oxygen species and help in delaying ageing, prevent inflammation and reduce the risk of cancer and several diseases (Duthie et al., 1996; Gracelin et al., 2013). Previous studies on Azolla have shown the presence of various secondary metabolite and bioactive compound such as flavoinds, steroid alkaloids phenols, variety of amino acid and lipids extracted by different solvent extraction method and have also shown different concentrations of secondary metabolites in their extract (Selvaraj et al., 2014). The high quantity of secondary metabolite elicited from extract also indicates antioxidant property in vitro and can be tested using various methods and assay to inhibit the generation of free radical. Since the past decade, the scope of detection of natural antioxidant is increasing because of the toxicity of synthetic antioxidant (Gracelin et al., 2013).

**DISCUSSION**

Aquatic plant has the ability to synthesize several chemical compounds which have several economic, medicinal and environmental importance, and few are consumed by human because of their high nutritional value (Gracelin et al., 2013; Vasu et al., 2009). Plants which secrete the secondary metabolites such as alkaloid, tannin, phenol and saponin are now gaining more attention owing to their medicinal, anticancer and ant diabetic property, etc. The increasing interest of these plants is because of lesser side effect produced by these compounds with medicinal values. Various research conducted on Azolla suggested that it contains considerable quantity of valuable compounds such as flavoinds, steroid alkaloids phenols, saponin etc. The individual compound has medicinal properties. For example phenols have diseases resistance properties; flavonoids have antioxidant and anticancer property; and tannin has anti-inflammatory and antimicrobial property (Geetha and Geetha, 2014).

**Conclusion**

The present study screened the phytochemical profile of the aquatic fern Azolla with different solvent extraction method. The results show that Azolla contain several importance secondary metabolites and bioactive compounds such as alkaloid, tannin, phenol, flavonoids, saponin, lipid, carbohydrate and proteins that have economic importance such as medicinal value antioxidant property, universal feed...
stock, biodiesel and biofuel production. Azolla also possesses all the property of ideal plant for use in phytoremediation, such as fast growth rate, high biomass production and hyper accumulation of wide range of heavy metal. The cake left after the extraction of heavy metals can be a good source of protein rich feed for animals or can be used as green manure or as biofertilizer because of the symbiotic association of Anabaena-Azolla. The unique chemical composition, most attractive and universal feedstock at low cost easy harvest and easy maintenance make Azolla a magic fern. Nevertheless, the detected compound is uncertain so it is recommended to isolate and characterize the individual phytochemical product for better result and its importance.

REFERENCES


