

Medicinal potentialities of lesser duckweeds *Lemna minor* L. (Araceae) against common pathogenic microbes - a review

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Abstract - *Lemna minor* L. (Araceae) is a cosmopolitan, free floating aquatic macrophyte that is found abundantly in small nutrient rich stagnant water bodies such as ponds, ditches and lagoons. It is commonly used as a source of food for fishes and poultry birds owing to its high protein content. This macrophyte is capable of accumulating nutrients and minerals from water and reproduces at the very faster rate among all tracheophytes. In general, high phosphate and nitrogen content in water is essential for its luxuriant growth. The present review emphasises on the different medicinal potentialities of the common duckweed *Lemna minor* L.

Index Terms- *Lemna minor* L., Duckweeds, extracts, Ethanolic & Nanoparticles

Introduction

Most of the pathogens are facultative pathogens causing a global problem and encountering huge loss to mankind. The infective agents transmitted from various agencies like air, water or vectors are now resistant against most of the antibiotic drugs and thus creating huge economic loss. Secondary metabolites from plants such as flavonoids, alkaloids, tannins, saponins etc show significant antimicrobial activity (Dahiya and Purkayastha, 2012.). In traditional medicinal practices many plant species were used since ages. Ineffectiveness of many medicines against pathogenic microbes made it inevitable for exploring new medicinal properties of plants. For making new therapeutic agents the most important sources are plants. 30-35 % of medicines are derived from naturally occurring plants (Clarkson et al 1993).

Duckweeds are free floating aquatic macrophytes belonging to the family Lemnaceae growing in stagnant or slow moving waters enriched in organic sewage. These are the smallest flowering plants which mainly includes five genera namely *Lemna*, *Wolffia*, *Spirodela*, *Landoltia* and *Wolffiella* (Effiong and Sanni, 2010). The greater part of each plant is a small organised thallus or frond like structure provided with air pockets. Reproduction mainly occurs through vegetative mode and sexual reproduction is quite rare in occurrence.

Lemna minor L. belongs to the most common duckweed which is cosmopolitan native throughout most of Africa, Asia, Europe and North America (Duke et al 2002). The plant possess 2-3 leaves which are oval, broad, light green with generally 3 veins. The leaves are provided with air pores that help the plant body to float. It bears a single root having 1-2 mm in length. Flowers are rarely produced that remains covered by a membranous scale. Flowers bear a single ovule and two stamens. The vegetative growth in *Lemna minor* L. shows cyclical senescence and rejuvenation phases under nutrient availability. There is a definite life span of each frond after which new fronds appear. *Lemna minor* L (Gould and Bal, 2013.). has been used widely as a model for evaluation of toxicity of many substances due to its smaller size, easy growth and ease of culturing.

Systematic Position of *Lemna minor* L.

Kingdom- Plantae

Order – Alismatales

Family – Araceae

Genus – *Lemna*Species – *L. minor* L.**Ethno medicinal importance of *Lemna minor* L.**

- In traditional medicinal practices *L.minor* L. is used variously. The whole plant body is used in curing cough by many people residing in Sialkot, Pakistan (Duke et al 2002).
- In Hazaribagh district of Bihar, boiled leaves are used as antiscorbutic and astringent.
- The leaves are also used for curing skin diseases and ophthalmic disorders.(Meyer et al 1982)
- It is also used in treatment of oedema and urine infections (Quinn 2002).

Medicinal properties of *Lemna minor* L.

In this review we are focussing on the antibacterial and antifungal property of *L.minor* L.. due to increase in antibiotic resistance, the need of discovering new therapeutics are now becoming a challenge for the research community. *L.minor* L. possess significant effect on selected pathogens, particularly water borne pathogens.

Antibacterial property-

Using minimum inhibitory concentration, minimum bactericidal concentration and disc diffusion assay, the antibacterial property on water borne bacteria were studied. Brine shrimp assay technique was used for testing the toxicity of the sample. The methanolic extract of the sample was used for studying the effect on pure culture of bacterial species namely *Vibrio cholerae*, *Staphylococcus aureus*, *Sterptococcus agalactiae*, *Escherichia coli*, *Aeromonas hydrophila*, *Pseudomonas putida* (Cowan 2004). The disc diffusion assay method yielded negative result as no inhibition zones were noticed in all the replicates of the tested bacterial cultures. However the minimum inhibitory concentration results showed that methanolic extracts were able to reduce the growth of the tested bacteria (Lal et al 2004) . At concentration greater than 2mg/ml the reduction of growth was found to be maximum in *S.aureus*. The toxicity of plant extracts in different polar solvents are best treated in the alternative model of shrimp. Positive results indicated that the methanolic extracts of *L.minor* L (Gulcin et al 2004).. Previous results indicated that positive correlation LC₅₀ of brine shrimp and LD₅₀ of animal models. LC₅₀- 140.64 mg/ml shows slight toxicity to humans (Mikulasova 2011).

Table no-1. MIC and MIB of water borne bacterial pathogens treated with methanolic extract of *Lemna minor* L. (Mann and Markham, 1998 , Oussalah 2006)

Bacteria	MIC Mg/ml	MBC Mg/ml
<i>Streptococcus agalactiae</i>	2.0	>2.0
<i>Aeromonas hydrophila</i>	1.9	2.0
<i>Escherichia coli</i>	1.9	2.0
<i>Pseudomonas putida</i>	1.8	2.0
<i>Vibrio cholera</i>	1.9	1.5
<i>Vibrio alginolyctus</i>	1.8	2.0
<i>Staphylococcus aureus</i>	1.8	2.1

Another study on antibacterial property was conducted using water extract and ethanolic extract of leaves of *L.minor* L. (Klančnik et al 2010). The bacteria were cultured in tryptone soya broth which is a highly nutritious media. Studies showed that that clear inhibition zones was noticed when both the extracts were tested against *Staphylococcus epidermidis*, *Staphylococcus warneri*, *Citrobacter koseri*, *Bacillus cereus*, *Bacillus subtilis* and *Streptococcus pneumonia* (Bonjar 2004). In another study the methanolic extracts of *L.minor* leaves was found quite effective in preventing growth of *Shigella flexneri*, moderate toxicity was observed in case of *Bacillus subtilis*, *Pseudomonas aeruginosa* and *Micrococcus luteus*. (Kang et al , 2011).

Antifungal property-

Previous researches have shown that water extract and ethanolic extract exhibits antifungal property. The invitro growth of two test organisms namely *Candida parapsilosis* and *Candida glabrata* was inhibited when treated with both these extracts (Teisseire and Vernet, 2001). Miclinazole was used for positive control (Karahan et al 2016). The *L.minor* L. was successfully used for synthesis of ecofriendly silver nanoparticles which seems to be quite stable at room temperature (Hamidi et al 2014).. Their structure was determined using TEM, FTIR & XRD showing that the particles ranges from 10-20nm (Davies, J. and Davies, D. 2010.). This particles show remarkable antifungal property against *Aspergillus flavus*.

Anti Oxidant property-

Previous researches have indicated that water extract and methanolic extract of *L.minor* L. possess antioxidant property following ferric thiocyanate method. By comparing with BHA, alpha tochopherol and trolox the free radical scavenging activity of water extract and methanolic extract was determined (Zhishen et al 2001). Inhibition of lipid peroxidation was found to be maximum at 45µg/ml of both extracts and was higher than trolox and alpha tochopherol (Gulcin, 2005.). The hydrogen peroxide scavenging activity was also quite high in both the extracts. (Teisseire &, Vernet . 2001).

Discussion-

Lemna minor L. possess low to moderate antibacterial property. The methanolic , etanolic and aqueous extracts of *L.minor* L. possess mild antifungal property. As it can be seen from the present review, both gram positive and gram negative bacteria comes under the antibacterial property of *L.minor* L (Lui et al 2016). The antibacterial property was found to be highest against *Shigella flexneri*. However moderate activity were observed in *E.coli*, *B.subtilis*, *P.putida*, *V. Cholera* when compared with standard antibiotics such as streptomycin, rifamycine. Nanoparticles synthesised by *L.minor* L. using silver nitrate shows stability at room temperature. the nanoparticles show strong antifungal property against *A.flavus*., *C. Parapsilosis* and *C. flexneri*. also show moderate susceptibility of ethanolic extracts and methanolic extracts of *L.minor* (Ruch et al 1994). These two extracts also show significant antioxidant property when compared with BHA, alpha tochopherol and trolox (Fankam et al. 2015) . The hydrogen peroxide scavenging activity and lipid peroxidation was also higher in comparison with BHA, alpha tochopherol and trolox (Mai et al 2001).

Conclusion-

From the above review it can be concluded that *Lemna minor* L..is a potent drug yielding plant. The antibacterial action of the leaf extract ranges from moderate to high against different Gram positive and Gram negative bacteria. The anti fungal property was also found to be quite effective against two species of *Candida*. However silver assisted nanoparticles synthesized from *L.minor* L. can be potentially used as antifungal agent. The plant also possess significant antioxidant property as evident from the above review. So *L.minor* L. can be a good source of pharmaceuticals for the future specially against resistant microbes and can open new avenues of research against antibiotic resistant bacteria.

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