INTERNATIONAL RESEARCH JOURNAL OF PHARMACY
www.irjponline.com ISSN 2230 – 8407
Review Article

TRAPA NATANS (WATER CHESTNUT): AN OVERVIEW

Bhatiwal Shalabh, Jain Akash*, Chaudhary Jasmine
M. M. College of Pharmacy, Mullana, Ambala, India

Article Received on: 09/04/12 Revised on: 11/05/12 Approved for publication: 30/05/12

*Email: akash2911@gmail.com

ABSTRACT
Trapa natans (water chestnut), commonly known as singhara in India, belonging to family Trapaceae, is a free-floating plant which grows in shallow water fields, ponds or swampy land. The water chestnut is native to Europe, Asia and Africa where it is well kept in check by native insect parasites. It favours nutrient-rich water with a pH range of 6.7 to 8.2 and an alkalinity of 12 to 128 mg/l of calcium carbonate. The kernels are delicious to eat and contain carbohydrates, proteins and essential minerals and are reported to be used in many ayurvedic preparations as diuretic, aphrodisiac, nutrient, appetizer, astringent, coolant, antidiarrhoeal & tonic. They are also useful in lumbago, sore throat, bilious affections, bronchitis, fatigues & inflammation. The fruits are a good source of nutrition having 16% starch and 2% protein. Stem is used in eye disorders in the form of juice. The plant *Trapa natans* has also been evaluated for various activities such as analgesic, anti-inflammatory, anti-diabetic and anti-microbial. The literature reveals the use of kernels as diuretic, aphrodisiac, nutrient, appetizer, astringent, coolant, antidiarrhoeal & tonic, fruits as good source of nutrition having 16% starch and 2% protein, plant as analgesic, anti-inflammatory, anti-diabetic and anti-microbial and stem in form of juice in eye disorders. The present study will give comprehensive information on the chemical constituents and mainly pharmacological activities of this plant.
Keywords: Trapa, pharmacological activity, ayurvedic, inflammation.

INTRODUCTION

Nature itself is a complete store-house of remedies to cure and prevent almost all ailments of humans. As the population is increasing rapidly, inadequate supply of drugs, high cost of treatment, side effects along with drug resistance has been encountered in synthetic drugs, which has lead to an elevated emphasis for the use of plants to treat human diseases. The healing powers of traditional herbs have been realized since antiquities. This review highlights the traditional and pharmacological account of an important and interesting plant Trapa natans commonly known as singhara nut or water chest nut (English), singhara or simkhata (Hindi) and karimbolam or vankottakkaya (Malyalam) belonging to family *Trapaceae*, Order *Myrtales*, Subfamily *Rosidae*, Class *Magnoliopsida*, Subclass *Rosidae* and Division *Magnoliophyta*.

It is a highly nutritive fruit but has failed to get all importance and attention of food processors because of its availability for only 2-3 months in a year. The fruits of *Trapa* are sweet, astringent, cooling, diuretic and tonic.[1] This medicinal plant is believed to be an important source of new chemical substances with potential therapeutic effects.

MORPHOLOGCAL DESCRIPTION:

Trapa natans is an annual aquatic floating herb having two types of leaves, finely divided feather-like submerged leaves borne along the length of the stem, and undivided floating leaves borne in a rosette at the water's surface. The floating leaves are rhomboid, fan-shaped and have toothed edges, 2-6.5cm diameter, broader than long, denticulate, denate, serrate or incised with entire base, apex acute, red & densely pubescent or villous beneath. The plant's cord-like stems are spongy and buoyant and can reach lengths of up to 16 feet (although typical lengths tend to be in the six to eight foot range). The stems are anchored to the bed of the water body by numerous branched roots[2]. Flowers are white, not much raised above and broad with a short conical, often spinous beak in the centre through which the radicle is protruded, with two spines at two angles, the second pair of spines often wanting.[3] Four-petalled white flowers form in early summer and are insect-pollinated. The fruit is a nut with four 0.5 in 1 cm barbed spines. Seeds can remain viable for up to 12 years, although most will germinate within the first two years. The plant spreads by the rosettes and fruits detaching from the stem and floating to another area on currents or by fruits clinging to objects, birds and animals.

DISTRIBUTION

Trapa natans is an annual aquatic fruit plant found in tropical, sub-tropical and temperate zone of the world. Their natural range of growth includes parts of Southern Europe, Africa and Asia. It has been grown in Europe since the neolithic times and was used commonly as food by the ancient Europeans. As an easy-growing plant, it has become naturalised in parts of the USA since it was first introduced into North America around 1874. It is found in slow-moving rivers, lakes, swamps, ponds and is widely cultivated in Asia. It favours nutrient-rich water with a pH range of 6.7 to 8.2 and an alkalinity of 12 to 128 mg/l of calcium carbonate.

CHEMICAL COMPOSITION

The literature reveals the presence of carbohydrates, phytosterols, saponins, fixed oils and fat in seed extracts and tannins, flavonoids and glycoside in pericarp extract of fruits of T. natans which was further substantiated by thin layer chromatographic studies. The fresh water chestnut kernels are reported to contain the following chemical composition.[4]

Constituent	Percent (wet basis)
Moisture	81.12 ± 0.5
Total soluble solids	7.2 ± 0.2
Total acidity	0.142 ± 0.03
Crude lipids	0.36 ± 0.02
Total ash	1.33 ± 0.04
Crude fibre	0.72 ± 0.02
Total proteins	1.87 ± 0.03
Total sugars	5.63 ± 0.04
Reducing sugars	1.27 ± 0.02
Non-reducing sugars	4.36 ± 0.03

n = 3; a Means (standard deviation) of triplicate analysis.

PHARMACOLOGICAL ACTIVITY

Analgesic activity

Agrahari et al (2010) reported the analgesic activity of methanolic extract of root of *Trapa natans* L.var. bispinosa Roxb by evaluating 200mg/kg & 400mg/kg dose on mice against the standard drug pentazocine at a dose of 30mg/kg. Both doses were found to produce significant ($p < 0.01$) analgesic activity.[3]

Anti-inflammatory Activity

Patel et al (2010) evaluated both pericarp and seed extract of fruits of *Trapa natans* for anti-inflammatory activity by carageenan induced hind paaw edema with 200mg/kg and 300mg/kg dose. Pericarp showed more potent action than seed.[5]

Anti-diabetic Activity

Das et al (2011) reported the antidiabetic activity of methanol extract of *T. napans* fruit peels (METN) in STZ induced diabetes in Wistar rats. METN at the dose of 100 and 200 mg/kg orally significantly ($p < 0.001$) and dose dependently improved oral glucose tolerance, exhibited hypoglycaemic effect in normal rats and antidiabetic activity in STZ-induced diabetic rats by reducing and normalizing the elevated fasting blood glucose levels as compared to those of STZ control group.[6]

Anti-microbial Activity

Parekh and Chanda (2007) reported antibacterial activity of different extracts of *Trapa natans* fruit rind by agar disc diffusion method. Maximum antibacterial activity was observed against Gram negative bacteria. The best antimicrobial activity was with 1, 4-dioxan extract and the least activity was with petroleum ether extract.[1]

Morpho-Physiological Activity

Fasulo (2008) reported the ability of floating lamina of the rhyzophyte *Trapa natans* to bioaccumulate Mn (> 3000 μg g-1) by means of phenolic compounds.[7]

ACTIVITIES OF OTHER SPECIES OF *TRAPA NATANS*

Antibacterial Activity

Razvy (2011) reported the antibacterial activity of fruit extract of two varieties (Green and red) of water chestnut by the disc diffusion method from methanol extract using kanamycin as standard. The extract of red variety of water chestnut (600g) showed high antibacterial potential (31mm) against Bacillus subtilis while green variety (600g) showed highest antibacterial activity (12mm) against both Staphylococcus aureus and Shigella sonnei.[8]

Anti Ulcer Activity

The antiulcer activity of 50% ethanolic extract of the fruits of Trapa bispinosa (Trapaceae) was studied on wistar rats using pyloric ligation and aspirin plus pyloric ligation models by Kar 2010.[9]

Neuroprotective Effect

Vyawahare (2010) reported that the hydroalcoholic extract (500mg/kg, po) of *Trapa bispnosa* decreased fluorescence product and increase in lipid peroxidation and restored glutathione peroxidase and catalase activity in cerebral cortex in the brain of female albino mice.[10]

Immunomodulator Activity

The immunomodulatory effect of aqueous extracts of fruits were reported in rats against sheep red blood cells (SRBC) as antigen by studying cell-mediated delayed type hypersensitivity reaction (DTH), humoral immunity response and percent change in neutrophil count by Samir (2010).[11]

AYURVEDIC PROPERTIES[12]

Rasa : Madhura, Kashaya
Guna : Guru, Snigdha
Virya : Seeta

USAGE

Food

The fruits are either used boiled or roasted or can be dried and ground into flour, which is sometimes used as a substitute for arrowroot flour. The fruits are a good source of nutrition with 16% starch and 2% protein. When raw, the fruits are juicy and crisp, when cooked, the flesh softens but it still remains crunchy. The kernels are good source of minerals, vitamins, carbohydrates, calcium, phosphate, iron, copper, manganese, magnesium, sodium & potassium.[3]

Medicine

This is used in many Ayurvedic preparations as nutrient, appetizer, astringent, diuretic, aphrodisiac, cooling, antidiarrhhoeal and tonic. It is also useful in lumbago, sore throat, bilious affections, bronchitis, fatigues & inflammation. Plant pacifies vitiated pitta, burning sensation, hemorrhages, skin diseases, low back ache and general debility. Fruits are also used in making liniments for the cure of rheumatism, sores & sunburn. It is also said to have cancer-preventing properties. Stem is used in the form of juice in eye disorders.[3]

CONCLUSION

Trapa natans fruit is a good source of nutrition and the whole plant has various positive pharmacological effects. Though it has various pharmacological effects, but it is the need of hour to explore its medicinal values at a molecular level with help of various biotechnological tools and techniques. After reviewing above referred studies, it is concluded that the isolation of compounds of this plant should be done and should be used for further studies to elucidate the molecular mechanism of interaction of its various compounds with human body in different diseases.

REFERENCES

1. Parekh J, Chanda S. In vitro antimicrobial activity of *Trapa natans* L. fruit rind extracted in different solvents. African Journal of Biotechnology 2007 [cited 2011 dec 2]; 6 (6): 766-770, ISSN 1684–5315. Available from: http://www.academicjournals.org/AJB.
2. O'Neill C. R. *Trapa natans*: Water Chestnut (*Trapa natans*) in the Northeast NYSG Invasive Species Factsheet Series: 06-1, Jr. Invasive Species Specialist New York Sea Grant February 2006 [cited 2011 oct 4]. Available from: http://www.waterchestnut.org/Assets/PDF/wcfactsheet.pdf.
3. Agrahari A. K., Khaliquzzama M. and Panda S. K. Evaluation of analgesic activity of methanolic extract of *Trapa natans* l.var. Bispinosa roxb. Roots. Journal of Current Pharmaceutical Research 2010; 01: 8-1 [cited 2011 sept 29]. Available from: http://jcpronline.com/final/134657o.pdf.
4. Singh G. D., Singh S., Jindal N., Bawa A. S. and Saxena D. C. Physico-chemical characteristics and sensory quality of Singhara (*Trapa natans* L.): An Indian water chestnut under commercial and

industrial storage conditions. African Journal of Food Science Vol. 4(11), pp. 693 - 702, November 2010 [cited 2011 oct 4], ISSN 1996-0794. Available from: http://www.academicjournals.org/ajfs.

5. Patel A. S., Patel N. C., Shah M. H., Shah V. N. Evaluation of anti inflammatory activity of fruits of *Trapa natans* linn. International journal of pharmaceutical research and development (IJPRD, 2011, vol3 (6):August2011 (97-102) [cited 2011 sept 29]. International standard serial no. - 0974- 9446. Available from: http://www.ijprd.com/EVALUATION%20OF%20ANTI-INFLAMMATORY%20ACTIVITY%20OF%20FRUITS%20OF%20TRAPA%20NATANS%20LINN.pdf.
6. Das P. K., Bhattacharya S., Pandey J. N. and Biswas M. Antidiabetic Activity of *Trapa natans* Fruit Peel Extract Against Streptozotocin Induced Diabetic Rats. Global Journal of Pharmacology 5 (3): 186-190, 2011 [cited 2012 jan 17], ISSN 1992-0075. Available from: http://idosi.org/gjp/5(3)11/13.pdf.
7. Baldisserotto L. C., Ferroni L., Medici V., Pagnoni A., Pellizzari M., Fasulo M. P., Fagioli F., Bonora A., Pancaldi S. Specific Intra-Tissue Responses to Manganese in the Floating Lamina of *Trapa natans*. Plant Biology, Volume 6, Issue 5, pages 578–589, September 2004 [cited 2012 march 22]. Available from: http://www.ncbi.nlm.nih.gov/pubmed/15375729.
8. Razvy M. A., Faruk M. O., Hoque M. A. Environment friendly antibacterial activity of water chestnut fruits. Journal of Biodiversity and Environmental Sciences (JBES).Vol. 1, No. 1, p. 26-34, 2011 [cited 2011 april 18], ISSN 2220 6663. Available from: http://www.innspub.net/wp-content/uploads/2012/01/JBES-V1-No-1-p26-34.pdf.
9. Kar D. M., Maharana L., Sil S. C., Kar M. K. and Sasmal D.. Anti ulcer activity of ethanolic extract of fruit of *Trapa bispinosa* Roxb in Animals. Scholars Research Library. Der Pharmacia Lettre, 2010 [cited 2011 april 18], 2(2): 190-197, ISSN 0974-248X. Available from: www.scholarsresearchlibrary.com.
10. Ambikar D. B., Harle U. N., Khandare R. A., Bore V. V. and Vyawahare N. S. Neuroprotective Effect of Hydroalcoholic Extract of Dried fruits of *Trapa bispinosa* Roxb on lipofuscinogensis and fluorescence product in brain of D-galactose induced ageing accelerated mice. Indian Journal of Experimental Biology. Vol. 48, April 2010 [cited 2011 april 15], pp. 378-382, ISSN: 0975-1009. Available from: http://www.niscair.res.in/sciencecommunication/researchjournals/rejour/ijeb/ijeb0.asp.
11. Patel S., Banji D., Banji O. J. F., Patel M. M., Shah K. K. Scrutinizing the role of aqueous extract of *Trapa bispinosa* as an immunomodulator in experimental animals. Int. J. Res. Pharm. Sci. Vol-1, Issue-1, 13-19, 2010 [cited 2011 april 15], ISSN 0975 7538. Available from: www.ijrps.pharmascope.org.
12. Ayurvedicmedicinalplants.com. Plants: *Trapa natans* [cited 2011 nov 28]. Available from http://ayurvedicmedicinalplants.com/index.php?option=com_zoom&Itemid=26&page=view&catid=20&PageNo=1&key=13&hit=1.