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Review Article

REVIEW: PHARMACOGNOSTIC, PHYTOCHEMICAL & PHARMACOLOGICAL EVALUATION OF TRAPA NATANS LINN.

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ABSTRACT

The present study was aimed to pharmacognostic and pharmacological studies of leaves, stem, fruit and roots of Trapa natans Linn. The plant commonly known as "Water Chestnut" in India and is an annual aquatic floating herb occurring throughout the India subcontinent and used traditionally for several medicinal purposes. But less research was carried out being an important medicinal plant it is being adulterated and in the absence of any pharmacognostic information it is very difficult to check the adulteration. The present study was therefore, carried out to provide the requisite pharmacognostic details. Morphological, anatomical and phytochemical aspects of Trapa natans Linn. were carried out. Diagnostic features of Trapa natans Linn. (leaves, stem, fruit and roots) were identified and characterized from the above investigation and presented and involves phytochemicals from the leaves, stem, fruit and and evaluation of their pharmacological studies

KEYWORDS: *Water Chestnut, Trapa natans Linn., Pharmacognostical studies, Pharmacological studies.*

INTRODUCTION

Water caltrop (Singara) is one of the most popular vegetables used in Asia, due to its special feature and medicinal values which; it is found in Taiwan, China and parts of South East Asia [1].

A genus of aquatic herbs, distributed in central and South-East Europe and temperate and tropical Asia. The genus was originally assigned to the family Onagraceae and later under Hydrocaryaceae. Embryologicaland anatomical studies, however, supports its inclusion in a separate, monogeneric family, Trapaceae. Three species, viz. (i) T. bispinosa Roxb. (Fl. Br. Ind.) in part; (ii) T. maximowiczii Korsh. Syn. T. quadrispinosa auct., non Roxb., and (iii) T. natans Linn. syn T. quadrispinosa Roxb. Have been reported from India, but the more prevalent view seems to be that Trapa is a monotypic genus represented by T. natans Linn., a polymorphic species having a number of botanical varieties; of these varieties, var, bispinosa Makino is economically the most important in India [2].

A very variable, handsome, rooted, aquatic herb, occurring almost throughout the greater part of India in lakes, tanks and ponds; also, extensively cultivated for the edible seeds. Stems long, flexuosse, asending in the water, submerged portions possessing pairs of green, pectinate, spreading 'organs' at intervals below the margins of leafscars; leaves floating, crowded at the upper parts of stems, appearing as rosettes, rhomboidal, 5cm.×8cm., often somewhat 3-lobed, lower surface raddish purple to green, upper green, and often variegated, with long, swollen petioles; flowers white, opening above the surface of water in the afternoon, after pollination the pedicels bend down submerging the flowers; fruits bony, turbinate, 2-4cm. long and broad, 4-angled, 2 opposite angles each with a scabrous spine, 2 other spines sometimes obsolete, indehiscent, 1-seeded; seeds white, starchy [2].

Regional names in India:

English - Singhara nut, Water chestnut; Hindi- Sinhaada, Singhara; Kannada - Mullu kombu balli, Mullu kombu beeja, Neeru acrotu, Singhara, Singaade; Malayalam- Karimpolam, Ponaver tsjeraua; Marathi- Shingada, Singhaada; SanskritShrungataka, Jalakantaka, Jalaphala, Jalashaya, Jalavalli; Tamil - Mullikaai, Pannimonthan kizhangu, Sinvaara; TeluguKubjakam, Kubyakam, Pandi gadda [3].

Water chestnut (Trapa natans Linn.) is an aquatic plant, which is usually rooted in the mud; it bears a rosette of floating leaves at the tip of the submerged stem. The Water chestnut Family contains only a single genus and, depending on specific character, as many as thirty species have identified. In our climate, water-chestnut is an annual aquatic plant having both vegetative reproduction and seed production take place. It is reported that seeds of water chestnut is having ample Trapa starch [4-6]. 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.

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Fig. 1: Leaves, stem and root of Trapa natans Linn. Plant

Morphologcal description:

Trapa natans Linn. 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. 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.

Powder Microscopy: The powdered fruit material was stained with phloroglucinol and concentrated HCl to study the lignified cells, trichomes, fibres, xylem vessels, etc.



Fig. 2: Morphology of leaves, stem and root of Trapa natans Linn. Plant

Distribution:

Trapa natans Linn. 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

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Europeans. 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 Trapa natans Linn. which was further substantiated by thin layer chromatographic studies.

Usage of 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.

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 [7-10].

Pharmacological activity:

Anti-microbial Activity:

Parekh and Chanda (2007) reported antibacterial activity of different extracts of Trapa natans Linn. 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 [7].

Agarwal T et al (2011) reported methanolic extract of this plant at the concentration of 200 µg/disc showed a more potent antimicrobial activity against Gram positive (Bacillus subtilis, B. cereus, B. megaterium, Staphylococcus aureus and Staphylococcus β-haemolyticus) and Gram negative (Escherichia coli, Klebsiella, Pseudomonas aeruginosa, Shigella dysenteriae, Shigella flexneri, Shigella sonnei, Shigella boydii, Salmonella typhi A and Salmonella typhi B-56) bacteria than the activity shown by ethyl acetate, chloroform and petroleum ether extracts. The most significant cytotoxic activity in the brine shrimp lethality assay was observed for the chloroform extract [8].

Analgesic activity:

Agrahari et al (2010) reported the methanolic extract of Trapa natans L. var. bispinosa Roxb. roots had shown potential analgesic activity on tested animals. Analgesic activity of the methanolic extract of the T. bispinosa root at a dose of 200 mg/kg and 400 mg/kg was evaluated by tail flick and tail immersion method against the standard drug Pentazocine at a dose of 30 mg/kg. The result suggest a significant analgesic activity which was observed by centrally acting drug [10].

Anti-inflammatory Activity:

Patel et al (2011) evaluated Fruits of Trapa natans L. var. bispinosa, commonly known as Shingoda, were reported to be potential antiinflammatory agent in traditional literatures. Antiinflammatory activity was performed by using Carrageenan induced hind paw edema model. The aqueous extract of pericarp had shown significant anti-inflammatory activity by decreasing paw volume on the 3rd and the 5th hour, while the aqueous extract of seed showed significant antiinflammatory activity by [12].

Anti-diabetic Activity:

Das et al (2011) reported the Antidiabetic activity of methanolic extract of Trapa natans Linn. fruit peels (METN) was studied in Wistar rats. The effect of METN on oral glucose tolerance and its effect on normoglycemic rats were studied. Diabetes mellitus was induced in rats by single intraperitonial injection of Streptozotocin (STZ, 65 mg/kg body weight). Three days after STZ induction, the hyperglycemic rats were treated with METN orally at the dose of 100 and 200 mg/kg body weight daily for 15 days. Glibenclamide (0.5 mg/kg body weight, orally) was used as reference drug. The fasting blood glucose levels were measured on every 5 days during the 15 days treatment. METN, at the doses of 100 and 200 mg/kg, was found to be orally significant ($p<0.001$) and dose dependently improved oral glucose tolerance, exhibited hypoglycemic effect in normal rats and ant diabetic activity in STZinduced diabetic rats by reducing and normalizing the elevated fasting blood glucose levels as compared to those of STZ control group. T. natans fruit peel demonstrated promising antidiabetic activity in STZ-induced diabetis in Wistar rats [13-15].

Morpho-Physiological Activity:

Fasulo (2008) reported the ability of floating lamina of the rhyzophyte Trapa natans Linn. to bioaccumulate Mn (> 3000 µg g-1) by means of phenolic compounds [16].

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 [17].

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 [18].

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 [19].

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) [20].

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Antioxidant activity:

Aqueous extract of Trapa natans Linn. fruits had shown potential in vitro antioxidant activity. The extract was found to contain a large amount of polyphenols and also exhibited an immense reducing ability. The total content of phenolics, flavonoids and tannin compounds was estimated as 63.81 mg of gallic acid equivalents/g of dry material, 21.34 mg of rutin equivalents/g of dry material and 17.11 mg of total tannin equivalent/g of dry material, respectively. Reducing power and inhibition of OH radical induced bovine serum albumin (BSA) oxidation were also determined. The data obtained from the study suggested that the aqueous extract of Trapa natans Linn. fruit rind had significant antioxidant activity against free radicals [21-23].

The effect of hydroalcoholic extract of T. bispinosa (TB) was studied on fluorescence product and biochemical parameter like peroxidation catalase activity and glutathione peroxidase activity in brain of female Albino mice. Ageing was accelerated by the treatment of 0.5 ml of 5% D–glucose for 15 days. This resulted in increased fluorescence product showed an increase in lipid peroxidase and decrease the antioxidant enzyme like glutathione peroxides and catalase in cerebral cortex. After cotreatment with hydroalcoholic extract of TB (500 mg/kg) there was decrease in fluorescence product in cerebral cortex. Moreover, TB inhibited increase lipid peroxidation and restores glutathione peroxidase and catalase activity in cerebral cortex as compare to ageing accelerated control group. Thus the extract was found to be effective as an antioxidative agent which could reverse D-galactose induced ageing changes resulting due to oxidative damage [24].

Physico-chemical analysis:

The physico chemical parameters like moisture content, loss on drying, total ash, acid-insoluble ash, alcohol and water-soluble extractive values were carried out as per the standard procedures of Indian Pharmacopeia [25].

Phytochemical analysis the crude powder or crude drugs extracted in different solvents are tested for the presence of various phytoconstituents such as proteins, carbohydrates, saponin, starch, phenols, flavonoids present in them by standard procedures [26].

Thin Layer Chromatography (TLC) Dried fruit powder was extracted with petroleum ether (60-80 0 C), chloroform and ethanol by using soxhlet extraction apparatus and water bath. The dried extractives were obtained after evaporation of solvent under reduced pressure by rotary evaporator. TLC studies of these extracts were carried out by using, commercially available precoated plates with standardized adsorption layers, i.e. Silica gel 60 F254, (Merck, Germany) at room temperature as per the standard procedures [27].

CONCLUSION

Trapa natans Linn. plant has various positive pharmacological effects. Though it has various pharmacological effects, but it is the need of to explore its medicinal values at a molecular level. 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. To develop and formulation from leaves, stem, fruit and roots extract of plant. To isolation and characterization phytochemical of leaves, stem, fruit and roots by spectral analysis. The results of the above studies throw an immense light on the botanical identity of the plants which might furnish a basis of judging the authentic status of the plant and also to differentiate the drug from its adulterants and substituents. The macroscopic characters were examined for identification of the right crude drug. Pharmacognostical studies were carried out on the basis of detailed botanical evaluation of the plants which included botanical parameters like macroscopy and microscopy along with physiochemical studies as recommended by World Health Organization. From the literature review conclude that only work done on fruit and fruit peel but no work on leaves, stem and root that via so much research scope on leaves, stem and root.

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