

## Uses, Phytochemical Screening and Nutrient Value of *Trapa* (Water Chestnut) - A Review

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### ABSTRACT

*Trapa bispinosa* Roxb. which belongs to the family Trapaceae is a small herb well known for its medicinal properties and is widely used worldwide. *Trapa bispinosa* or *Trapa natans* is an important plant of Indian Ayurvedic system of medicine which is used in the problems of stomach, genitourinary system, liver, kidney, and spleen which may be due to high quantity of minerals, ions, namely, Ca, K, Na, Zn, and vitamins, saponins, phenols, alkaloids, flavonoids. In the present study, the recent reports on nutritional, phytochemical, and pharmacological aspects of *Trapa bispinosa* Roxb., as a medicinal and nutritional food, are reviewed.

Key words: Water chestnut, Nutrient Value, Phytochemical Screening, *Trapa* flour, Antimicrobial activity

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### INTRODUCTION

*Trapa natans* is a floating rooted aquatic annual herb which belongs to the family Trapaceae which has been cultivated globally for the nutritious nut it produces. It is an extremely important food crop in China and India and is protected in Europe. It favours nutrient rich water with pH range between 6.7 and 8.2 and the alkalinity between 12 and 128 mg/L of calcium carbonate. (Bhatiwal *et al.* 2012). The morphology of *Trapa* has Submerged, Flexuous stem and roots that anchor into the mud and extend upwards to the surface of the water, its leaves are rosette of floating, fan-shaped, crowded on the upper part of the stem 3.5-5 cm long, rhomboid, somewhat truncate at the base, reddish-purple beneath; Each leaf having a slightly inflated Petiole

and biseriate: submerged leaves are opposite, linear and dieback to be replaced by roots. Flowers few, four-merous, small, auxiliary, solitary, pure white, reddish sepals, pink petals. Flowering typically in June where as fruits and seed large drupe or nut obovoid, angular, 2.0- 5 cm long, and broad, with two opposing, spreading flattened very sharp spinous horn at either side that develop from hardened sepals and two pseudo spines where sepals senesce. The water chestnut forms thick bed in water surface. In Santhal Pargana region of Jharkhand it is cultivated in large scale, the authors have tried to take the photographs of different cultivation, harvesting selling process of water chest nut, which are shown below.



**Trapa cultivation and harvesting at Barharwa**



**Picture From Gumani**



**Use of Trapa in Chatth Festival**



**Harvesting Trapa**



***Trapa bispinosa***



***Trapa* after harvesting**



**Trapa sold near pond side and in the market**



**Trapa sold near pond side and in the market**

**Trapa and its uses:** It is bitter, astringent, stomachic, diuretic, febrifuge, and antiseptic. The whole plant is used in gonorrhoea, menorrhagia, and other genital affections. It is useful in diarrhoea, dysentery, ophthalmopathy, ulcers, and wounds (Chatterjee and Prakash, 1995). These are used in the validated conditions in pitta, burning sensation, dipsia, dyspepsia, haemorrhage, haemoptysis, diarrhoea, dysentery, strangely, intermittent fever, leprosy, fatigue, inflammation, urethrorrhea, fractures, erysipelas, lumbago, pharyngitis, bronchitis and general debility, and suppressing stomach and heart burning. (Rahman *et al.* 2001). Water chestnut kernels were used to treat rabies, poisonous animal bites, diarrhoea, amoebic dysentery, and other conditions in the U.S.S.R. (Shishkin and Bobrov, 1974). Proximate composition of Russian water chestnut nuts (presumably fresh) was 15% protein, 7.5% fat, 52% starch, 3% sugar, and 22.5% water (Shishkin and Bobrov, 1974). The upper portion of the stem was used in poultices as a discutient and the expressed juice in eye diseases (Nadkarni, 2007). In addition to serving as food for people and animals, water chestnut has been recommended for paper pulp, fertilizer, fish food, compost, and biogas fuel (i.e., methane generated from organic material via anaerobic digestion). Besha and Countryman (1980) analysed the efficiency of anaerobic digestion of water chestnut to produce methane as a fuel for generating electricity. They estimated a potential yield of  $1.16 \times 10^{11}$  kJ ( $1.29 \times 10^4$  MW of electricity) annually from the 2000 ha of water chestnut in New York State, and stated that the residue after anaerobic digestion could be used as a cattle feed supplement (Besha and Countryman 1980). Water chestnut has been composted on a small scale for garden fertilizer, which raised the question of contamination. In 1980 sample of water chestnut from the Hudson River at Beacon, New York, contained 0.8 ppm cadmium, 0.05 ppm mercury, and 0.15 ppm PCBs (dry weight basis). Ward Stone (NYS DEC, letter to Pete Seeger dated 23 September 1980) stated that application of 90 kg (wet mass) of water chestnut to a vegetable garden would not add dangerous amounts of toxic substances and

would add less cadmium than commercial fertilizer. Individual water chestnut hulls being sold in New York City, and have seen a variety of jewellery, curios, and sculpture incorporates the hulls. Bailey and Bailey (1976) stated the nuts were used in rosaries. *Trapa natans* var. *bispinosa* nuts are said to have been used in offerings to the “darker gods,” and the nuts are advertised on the Internet as charms to ward off evil (Yronwode 2002). Due to the hulls in shoreline wrack, water chestnut is one of the most asked species along the tidal Hudson River, and names such as “devil-nut” are sometimes used. Water chestnut is sold internationally as an aquarium plant and for garden pools (Herklots 1972, Derman 2000), and is used for these purposes in North America although it is considered weedy and troublesome in gardens (Bailey and Bailey 1976).

Use of *Trapa bispinosa* starch produced better results in terms of lowering synergies and increasing water holding capacity, viscosity, and overall acceptability for all sensory attributes. Addition of *Trapa bispinosa* starch did not influence the taste and overall acceptability. *Trapa bispinosa* starch 1.25% gave most excellent results for water holding capacity, synergies, and viscosity and *Trapa bispinosa* starch 0.75% gave most excellent results for all sensory attributes. Yoghurt shelf life was increased up to 25 days (Malik *et al.* 2012). Starch as Additive in Pharmaceuticals. (Tulyathan *et al.* 2005.) *Trapa bispinosa* can be used as antimicrobial agent which has evaluated antifungal activity of fruit extracts of different water chestnut varieties (Razvy *et al.* 2011).

#### **Phytochemical Screening:**

The phytochemical screening demonstrated the presence of carbohydrates, glycosides, alkaloid, saponins, and tannins. Total phenolic and flavonoid content of the *Trapa bispinosa* Roxb. extracts were determined by using the Folin-Ciocalteu reagent and aluminium chloride ( $AlCl_3$ ) method, respectively. *Trapa bispinosa* contains a great quantity of non nutritional antioxidants, such as flavonoids, flavones, and total phenol contents. Flavonoids are present in plant tissues, such as fruits, vegetables, nuts, seeds, and leaves, in relatively high

concentrations. Flavonoids act as natural antioxidants. Phytochemical screening of seed extract of *Trapa bispinosa* fruits reveals the presence of carbohydrates, saponins, phytosterols, fixed oils, and fat, while the pericarp extract of the fruits of *Trapa bispinosa* revealed the presence of tannins, flavonoids and glycosides alkaloids, saponins, steroids, and phenolic compound. The literature reveals the presence of saponins, tannins, flavonoids, and glycosides in the pericarp extract of fruit (Bhatiwal *et al.* 2012). The kernel is delicious and contains carbohydrates, proteins, and essential minerals. It also contains plentiful B vitamins (including B1, B2, B5, and B6), E, A, and C vitamins. Seeds also contain thiamine (Singh *et al.* 2011). Based on the phytochemical screening, methanol was selected as the choice of solvent as it showed greater extraction of phytochemicals. The extracts were further tested for antimicrobial and antioxidant activity. The antimicrobial activity was done against both *Gram positive* and *Gram negative bacteria*. The methanolic extract showed highest activity, almost double, against the *Gram positive bacteria* than the acetone and aqueous extracts. However, none of these extracts were effective against the *Gram negative bacteria*. Furthermore, it was observed that the antimicrobial activity of the peel extract was higher as compared to the fruit. The antioxidant activity was carried out by the Hydrogen peroxide scavenging method and it was found that the peel has more anti-oxidant activity (27.08%) compared to the fruit which showed only 18.75% activity. From the anti-microbial study and the antioxidant study, it was thus concluded that the methanolic extract of the peel of *T. bispinosa* is more potent antimicrobial and antioxidant agent as compared to the methanolic extract of fruit of *T. bispinosa*. The presence of secondary plant metabolite in the peel makes it a powerful antimicrobial against the gram-positive bacteria (Anjali *et al.* 2018).

**Nutrient value** –Nutritional and biochemical analyses of fruits of *Trapa bispinosa* in 100 g showed 22.30 and 71.55% carbohydrate, protein contents were 4.40% and 10.80%, a percentage of moisture, fiber, ash, and fat contents were 70.35

and 7.30, 2.05 and 6.35, 2.30 and 8.50, and 0.65 and 1.85, mineral contents of the seeds were 32 mg and 102.85 mg calcium, 1.4 and 3.8 mg Iron, and 121 and 325 mg phosphorus in 100 g, and seeds of *Trapa bispinosa* produced 115.52 and 354.85 Kcal of energy, in fresh and dry fruits, respectively (Faruk 2012). Chemical analysis of the fruit and fresh nuts having considerable water content citric acid and fresh fruit which substantiates its importance as dietary food also reported low crude lipid, and major mineral present with confirming good amount of minerals as an iron and manganese potassium were contained in the fruit, Crude fiber, total protein content of the water chestnut kernel. The presence of  $\beta$ -amylase and a considerable amount of phosphorylases and tannins has been reported in the kernels (Khare 2007).

Parameters	Fresh Fruits	Dried fruits at 105°C
Moisture %	70.35 ± 1.28	7.30 ± 0.02
Protein %	4.30 ± 0.47	9.80 ± 0.05
Fat %	0.65 ± 0.04	1.89 ± 0.06
Carbohydrate %	22.30 ± 0.89	71.55 ± 0.87
Fibre %	2.05 ± 0.03	6.35 ± 0.09
Ash %	2.35 ± 0.06	8.50 ± 0.38
Calcium mg/100g	32 ± 1.29	102.85 ± 1.56
Iron mg/100g	1.4 ± 0.13	3.80 ± 0.09
Phosphorus mg/100g	121 ± 2.38	325 ± 5.03
Energy Kcal	115.52 ± 1.15	353.75 ± 1.59
B- Carotene(µg)	60 ± 2.06	92 ± 3.73
<b>Crude fiber</b>	2.13 ± 0.03	2.27 ± 0.05
<b>Vitamin – C (mg)</b>	1.1 ± 0.02	0.9 ± 0.02
<b>Total phenol</b>	0.5 ± 0.01	0.6 ± 0.02

These results are closely related to a recent report by Alfasane *et al.* (2011) who demonstrated that water chestnuts (*Trapa bispinosa* Roxb.) contained moisture 70.35%.

**Flour:** The fresh, tender kernels are sweet, delicious and farinaceous, and the flavour resembles that of chestnuts and they are nutritious. The nuts are eaten raw when tender and fresh or after cooking or boiling and roasting. The meal prepared by grinding the dried kernels is used as a substitute for cereal flour and is also sometimes used as an adulterant of butter.

**The nutritive values of flour, prepared from dried kernels are as follows:**

S.N	Amino acid	Green Varieties	Red Varieties
1.	Alanine	+	+
2.	Arginine	+	-
3.	Aspartic acid	-	-
4.	Asparagine	-	+
5.	Cystine	+	-
6.	Valine	-	-
7.	Glutamine	-	+
8.	Glutamic acid	+	+
9.	Histidine	-	-
10.	Hydroxyproline	-	-
11.	Isoleucine	-	-
12.	Leucine	+	+
13.	Lysine	+	+
14.	Methionine	-	-
15.	Phenylalanine	-	-
16.	Proline	+	-
17.	Serine	-	-
18.	Threonine	-	-
19.	Tyrosine	+	+
20.	Tryptophan	+	+

As shown in Table, nine amino acids were detected in the green variety whereas, eight amino acids were detected in the red variety. The amino acids, glutamic acid, tryptophan, tyrosine, alanine, lysine and leucine were present in both of the varieties. Moreover, cysteine, arginine and proline were detected only in the green variety. Furthermore, the red variety but not the green variety contained free amino acids, glutamine and asparagines. +, -: Signs indicate the presence and absence of amino acid in the indicated variety, respectively

The partial substitution of rice, ragi or jowar in the diet of rats to an extent of 25% by flour of water chestnut is reported to have shown significantly larger gains in the body-weight of rats as compared with the corresponding unsubstituted diets. The biological value of the proteins of water chestnut was found to be higher than that of proteins in

wheat. The starch isolated from the flour, consists of 15% amylose and rest amylopectin, coating penetrating qualities, and gelatinizes quickly at low temperature and also suitable for textile-sizing as a good substitute for corn-starch in ice cream manufacture.

## RESULT AND DISCUSSION

*Trapa bispinosa* plant has various positive pharmacological effects. Though it has various pharmacological effects, but it is the need 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 phyto chemical of leaves, stem, fruits and roots by spectral analysis. The result of the above studies throws 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 substituent.

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