

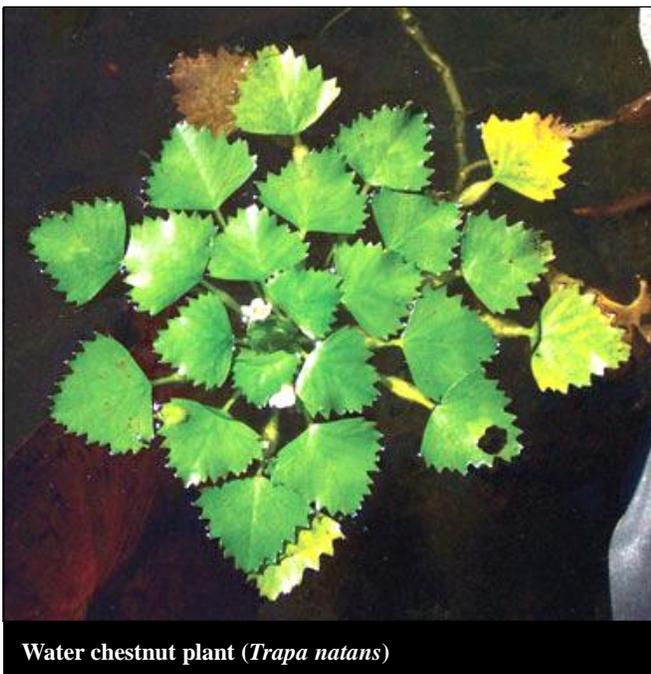
Water caltrop: A potential crop of water bodies

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Another name of water caltrop is water chestnut. Water chestnut (*Trapa natans*) is one of the most important minor fruit crops grown in India. It is an aquatic nut crop grown mainly in the tropical and sub-tropical region, as submersed plant community. It also thrives in the soft nutrient rich waters in lakes, ponds and streams with a neutral to slightly alkaline pH. The plant is well adapted to life at the water's edge and prospers even when stranded along muddy shores.



Water chestnut plant (*Trapa natans*)

Name analysis : The water caltrop is any of three extant species of the genus *Trapa*: *Trapa natans*, *T. bicornis* and the endangered *Trapa rossica*. It is also known as water chestnut, buffalo nut, bat nut, devil pod, ling nut, lin kok, ling kio nut, or singhara. The species are floating annual aquatic plants, growing in slow-moving water up to 5 m deep, bear ornately shaped fruits, which in the case of *T. bicornis* resemble the head of a bull or the silhouette of a flying bat. Each fruit contains a single very large, starchy seed. *T. natans* and *T. bicornis* have been cultivated in China and India for the edible seeds. The

generic name *Trapa* is derived from the Latin words of “thistle” and “calcitrappa” (a four-pointed weapon as the seeds have four points), calcitrappa is another common name for the water caltrop. The Chinese name is língjiào, líng meaning “caltrop” and jiào meaning “horn”. This is often rendered as ling nut by English-speakers. In India, the plant has different regional names, such as singhada, pani-phal in Hindi, or shingoda in Gujarati. This fruit's Bengali name is Paniphal, Singda or Singara. Two most common Indian names are Paniphal and Singhara. The plant's name in Japanese is hishi, a word meaning “diamond- or lozenge-shaped”. The most common type in India is *Trapa bispinosa* and the common type in China is *Trapa bicornis*. While the water chestnut seed has four horns, its edible relative *Trapa bikornis* (Horn Nut) has only two. Still, it is painful to step on though. *Natans* means floating. *Bikornis* means two horns. The seed is rich in carbs, fat, protein, sugar, and vitamins B₁, B₂, C, calcium, phosphorus and iron. *T. natans* other names are Jesuit nut/water caltrops.

Biology : (1) Feather-like roots up to 8 cm long develop where the submerged leaves drop off, and are often mistaken for feather-like leaves, (2) The water caltrop's submerged stem reaches 12 to 15 ft (3.6 to 4.5 m) in length, anchored into the mud by very fine roots, (3) It has 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 have saw-tooth edges and are ovoid or triangular in shape, 2–3 cm long, on inflated petioles 5–9 cm long, which provide added buoyancy for the leafy portion, (4) Four-petalled white flowers are 8 mm long, form above the water surface in early summer and are insect-pollinated, (5) The fruit is a woody or bony nut, about 3 cm wide, with two or four (1 cm long) stout spines or horns. *Trapa bicornis* is similar to *Trapa natans*, but has two spines on the fruit instead of four. Each fruit contains a single seed, (6) Seeds can remain viable upto 12 years, although most 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, and animals.

Area of cultivation : Singharas grow throughout the East of India: West Bengal, Jharkhand, and Bihar are examples of such regions. Bihar in particular cultivates the fruit extensively in its districts of Darbhanga, Madhubani and Samastipur. Not unlike other shelled nuts, caltrops are an autumn and early winter delight. Singharas are planted in June and bear fruit in November.

Scientific classification of water caltrop:

Kingdom : Plantae

(Unranked) : Angiosperms

(Unranked) : Eudicots

(Unranked) : Rosids

Order : Myrtales

Family : Lythraceae

Subfamily : Trapoideae

Genus : *Trapa*

Species : *Natans, bicornis, rossica, bispinosa*

Plant characteristics : The water chestnut is an aquatic plant and bears a rough, thick-skinned, not particularly good-looking fruit that has a single large white-colored seed inside. The plant is grown in ponds, marshes, and seasonal and perennial lakes. More than two-thirds of the plant remains submerged in the water. The upper leaves float on the surface of the water while the lower ones remain submerged just beneath the surface, giving a mat-like appearance to the water surface. The petioles or leaf stalks are swollen and contain air to help keep the upper leaves afloat. The plant has no primary roots, while the secondary adventitious roots are of two types. One type of root fixes the plant to the muddy substrate, while the other type floats free, being attached to the underside of the leaf base. These have photosynthetic activity as well. The flowers open above the water surface. After pollination they submerge themselves so that the fruit can develop. Therefore, the fruit or singhara is always found under the leaves, and when it is mature, it drops off on its own and is fished out with the aid of a net.

Common uses of water caltrop:

– They are dried to make water chestnut flour which is used to make Indian roti or Indian flatbread. Water chestnut flour requires much less water than wheat flour. It's best to go by feel to assess the proper amount of water required. From a nutritional standpoint, singharas should be regarded as a starch and not so much flour, though it is often used as a flour substitute.

– The nuts can be eaten raw, though they are usually boiled.

– Singhara flour is used in many religious festivals

like Navratri, and consumed during the days of fasting by devotees who are allowed to partake of this flour as it is not made of grain and it is generally consumed as phalahar (fruit diet).

– The flour is also added to milk by vendors to make milk creamier.

– The flour can also be used to make a batter for deep frying.

– These nuts are also used in baking and cooking.

– Using powder made by roasting and grinding the nut, make halwa.

– Make barfi (Indian marzipan, basically) using ground water chestnut as the base instead of cashew.

– Add simple oil, salt, pepper to boiled waternuts and enjoy. These ingredients may be sautéed for additional flavor.

– Make a batter by taking nut flour, salt, and slowly adding water until a paste forms. Dip in veggies such as pumpkin, yam, or sweet potatoes and deep fry.

– Whip up savory pancakes by adding water to the nut flour, oil and spices. They will have the consistency of crepes and can be served with savory potato filling or rasam and coconut chutney.

– Make puri (an Indian version of Indian fry bread) by mashing boiled potato with water chestnut flour, oil, and spices.

– Use the flour as the base for samosa dough.

– If boiling water chestnuts, add star anise: it will highlight the nut's sweetness and make the home smell lovely while cooking.

Uses in various countries : It was possible to buy water chestnuts in markets all over Europe until 1880. In northern Italy, the nuts were offered roasted, much as sweet chestnuts (*Castanea sativa*) are still sold today. In many parts of Europe, water chestnuts were known and used for human food until the beginning of the 20th century. Today, however, it is a rare plant. Several reasons for its near extinction exist, such as climate fluctuations, changes in the nutrient content of water bodies, and the drainage of many wetlands, ponds, and oxbow lakes.

Health benefits: Singhara has been widely used in ayurvedic and unani systems of medicine. Some of the health benefits of singhara or Indian water chestnut (*Trapa bispinosa*) are:

– It is cooling and is an ideal aid to counter summer heat.

– The juice of water chestnut relieves the feeling of nausea and also improves the appetite in kids.

– It relieves swellings and cleanses the blood.

– Singhara maintains the proper functioning of the thyroid as it contains useful minerals like iodine and manganese.

– It is a good source of energy.

– It is rich in polyphenolic and flavonoid antioxidants and therefore possesses antibacterial, antiviral, anticancer and antioxidant properties.

– The seed has a detoxifying effect on the body and therefore is very useful to those who suffer from jaundice.

– A paste of the seed helps to treat cracked heels.

– The acrid juice is used to control diarrhea and dysentery.

– The dried seed treats bleeding and miscarriage issues in women.

– The fruits are used to treat sore throat, anemia, fractures, urinary disorders, bronchitis and leprosy.

– Powdered singhara relieves cough.

– To treat measles, chestnuts are boiled in water and the water drunk to alleviate the infection. It is best given from the 3rd day to 9th day of symptoms.

– The fruit reduces inflammations, treats leucorrhoea, acts as an aphrodisiac and also treats sex-related men's issues.

– Singhara seed powder mixed with lemon juice will help cure eczema if applied regularly.

– The seed treats hypertension during pregnancy and improves fetal growth.

– Consumption of nuts increases semen, and is thus recommended for fertility.

– Nuts have cytotoxic and antimicrobial properties.

– Nuts have possible antiulcer activities.

– Nuts have neuroprotective properties that may reverse oxidative damage in the brain caused by aging.

– Nutrients in singhara or water chestnut (*Trapa bispinosa*)

Nutrient.....	Amount/100 grams
Water.....	48.2 g
Protein.....	3.4 g
Fat.....	0.2 g
Carbohydrates.....	32.1 g
Sugars.....	3.3 g
Energy.....	730 calories
Dietary fibre.....	14.9 g
Calcium.....	17.6 mg
Zinc.....	0.4 mg
Iron.....	0.7 mg
Sodium.....	0.8 mg
Potassium.....	468 mg

Nutrition benefits : (a) Gluten free, (b) Low in fat, (c) Cholesterol free, (d) Low in sodium, (e) High in potassium, (f) Rich in minerals: calcium, iron, zinc and phosphorus, (g) Contains moderate amounts of fibre, (h) Good source of energy

Precautions : (a) Do not eat singhara if suffering from constipation, as it has astringent properties and constipates, (b) Do not drink water after eating singhara, (c) Do not consume in excess, as it might cause bloating and abdominal pain.

Fasciolopsiasis, a parasitic fluke : One reason why officials might be reluctant to mention that it is edible is that the plant easily picks up a variety of toxic metals. Boiling reduces the metals. Grown in bad water it collects toxins but boiling reduces the problem. There is another reason to boil the seeds even though they can be eaten raw *i.e.* Fasciolopsiasis. Fasciolopsiasis is an ailment resulting from infection by the trematode *Fasciolopsis buski*, an intestinal fluke of humans. It is a disease that can be transmitted from the surfaces of water chestnuts and other water plants. During the larval stage of their life flukes leave their water snail hosts. They swim away to form cysts on the surfaces of water plants, including the leaves and fruit of water chestnut. If infected water plants are consumed raw or undercooked, the flukes can infect humans, pigs and other animals. It is very common particularly where people and pigs live together and share similar water resources.

Cultivation : The singhara or water chestnut plant requires full sunlight for good growth, and water with a rich organic content but a low concentration of salts. On a larger scale they are grown in flooded fields like rice. These fields are ideally located below a water source like a dam so that the water level can be maintained with a gravity flow. They can also be grown on dam and pond edges but only if the water level is controllable and stable.

Varieties of chestnut : No standard variety of water chestnut is released till now. But nuts with different husk colour like green, red or purple and a blending of red and green colour are recognized. Kanpuri, Jaunpuri, Desi Large, Desi Small etc. are the names of some types of water chestnuts referred to the growers in West Bengal and other parts of eastern India.

Propagation of chestnut : Propagation of the plant is commercially done by seeds. The fully mature nuts are placed in container with little water to germinate the seeds. The sprouted seeds are sorted out and broadcast in the nursery tanks. At the beginning of monsoon, the seedlings are lifted from the nursery tanks and planted in pond, at a

spacing of 1-2 meters or 2-3 meters when the soil of the pond is fertile.

Climatic requirement to grow chestnut : Water temperature of 12-15°C is absolutely necessary for the fruit to germinate while 20°C is required for development of the flower. The temperature range throughout the year is dependent on continental climatic conditions, *i.e.* high temperature during spring and summer and low in winter is beneficial for successful production of the crop.

Soil : As it is an aquatic plant, soil does not play so much important role for its cultivation. But it is found that water chestnut gives better yield when the soil of the water bodies is rich, friable which is well manured or fertilized.

Nutrient management : Water chest-nut requires some specific nutrient elements for better growth and development. Fertilizer with moderate amount of poultry manure is very essential for higher yield. But it needs little application of phosphorus and potassium. It can thrive well under a pH range of 6 to 7.5. Growers from different parts of the world uses dolomite (a form of lime that contains magnesium) to adjust pH is which one of the most important works during nutrient management practice. In West Bengal, application of 30-40 kg of urea in per ha area of pond after about a month of transplanting and again after another 20 days is highly recommended.

Transplanting : It is recommended that plants are first grown in a low nutrient nursery plot and transferred when stems are about 300 mm tall. This reduces the growth period in ponds by upto 6 weeks. Tops may be trimmed if they are too tall at transplanting. Care should be taken at the time of transplanting so that seedlings kept moist but not submerged.

Water for chestnut crop : The soil should be kept flooded with 100 mm to 300 mm of water throughout the growing period. A greater depth of water is tolerated by the plants but they do not prosper. Water should drained off prior to harvesting.

Intercultural operations : Reduction of water in the pond due to drought may create difficulty and in such case, it should be replenished with water from other source. Luxuriant vegetative growth of the plant may result in highly fertile condition of the medium with lower productivity of the plants and hence, mild pruning become necessary in such case. Regular eradication of aquatic weeds, especially, *Hydrilla* and *Eicchornia* is utmost important during the cropping season.

Flowering time of chestnut : The flowering time of water chestnut vary from one place to other place. But in general it flowers during July and August.

Fruit development : During the summer months the fruits develop at the basal portion of the rosettes. In autumn the leaves change colour from green to purple-brown, the rosettes dissolve and the fruits started to sink to the bottom of the lake or pond water and anchor with their thorns in the silty sediment. The cycle starts again in the following spring.

Harvesting : Harvesting of nut is usually done at the month of September and it is continued up to month of November. For the purpose of harvesting, specially made rafts are used by the growers. In the southern part of West Bengal, yield of fresh nut range between 2500-3800 kg per ha area of pond which could be increased upto 5000 kg per ha by applying about 50 kg of urea per ha of pond along with eradication of weeds.

Yield : 2500-3500 kg per ha

Storage : Harvested kernel can be stored in the bottom of the fridge in sealed plastic bags or containers to prevent them from drying out. There are always a few that rot during storage and need to be sorted out from time to time. This rot is often due to even slight damage to the skin during harvesting and later handling. They keep quite well in the ground where they grew while the temperature stays low enough to maintain dormancy. Dried out kernel or ones that have been frozen will not grow. They also keep very well in cool damp sand. We can keep kernel under this condition for over a year for seed purpose.

Removal of seed cover : Not only is the fruit oddly shaped, it has two to four short, thick, blunt projections jutting out of the thick seed coat. The seed is triangular in shape, white and thick, with a mild sweet taste. The seed coat of the raw singhara is difficult to remove with the fingers. It can be either is removed by slicing it into two pieces, or by boiling the fruit which makes the seed coat soft enough to remove by hand. The seed coat colors the hands black when one handles the fruit.

Spread : Water caltrop drops seeds during winter. The seeds germinate in the mud during the warmer months, and grow stems that reach the water surface and produce rosettes. A single seed may give rise to 10 to 15 rosettes. Each rosette can produce upto 15 to 20 seeds. The plant spreads when rosettes break allowing the fruits to detach from the stem and float away. The fruit can also be spread by birds and other animals. Seeds can remain viable for upto 12 years, although most will germinate in the first two years. If the fruit dry out they will not contain viable seeds.

Impact : Water caltrop is a floating aquatic plant that grows in slow-moving water upto 5 m deep, with its stems



Chinese Water Chestnuts (*Eleocharis dulcis*)

rooted in the soil beneath the water. Water caltrop forms large populations that can create nearly impenetrable mats across wide areas of water, out-competing native plants and making waterways inaccessible. Sharp spines on the fruit create a hazard for humans and animals. Water caltrop has been cultivated around the world as an ornamental water plant, and as such, it is likely to be found in farm dams, water features and fish ponds, or in ponded and slow-moving water bodies near towns. Two species of the *Trapa* genus—*Trapa natans* and *Trapa bicornis*—are referred to as water caltrop. Water caltrop is also known as water chestnut, but is not related to Chinese water chestnut (*Eleocharis dulcis*), which is cultivated for its edible tubers.

Chinese water chestnut : The Chinese water chestnut is from a different plant, *Eleocharis dulcis*, which provides an edible corm. A corm is a small swollen vertical underground stem that becomes bulbous; this part, the corm, is edible. Chinese water chestnut is not a nut, fruit or seed; they are edible roots with a distinctly nutty flavour and consider as one kind of aquatic vegetable. *Eleocharis dulcis*-plant is invasive in nature. It is also grown in ponds and the edible tuber is then harvested for food. The Chinese water chestnut is member of the sedge family (Cyperaceae) and are true aquatic plants growing only in

water. They are cultivated for their 1-2 inch rhizomes. The tubers look somewhat like gladiola bulbs and are dirty brown in colour on the outside. Harvesting is still considered a major constraint to cultivation of water chestnut in soil. One little plant can spread to fill up a 6'x6' water garden in a season. To avoid confusion, the Chinese water chestnut is often referred to by its Cantonese name of 'Matai' which means 'horse hoof.' They need to be completely submerged with a controlled level of water for most of the life of the crop similar to paddy crop and it is preferable to drain the water for harvesting. *E. dulcis* other names are waternut/horse's hoof (matai)/ hon matai/ Kweilin matai/ Pi chi/ Pi tsi sui matai/ Kuro-kuwai/apulid/ Haeo chin/Cu nang/ohkuru guai.

Conclusion : India is to sustain 16 per cent of the world's population on 2.4 per cent of the global land area. It has to feed its burgeoning population using 3 per cent and 5 per cent of global farm land and water resources. Hence, its dependence on aquatic resources for production of additional food is obvious and shall become more and more obligatory. To feed the ever-increasing population of our country we are bound to produce more. Not only feeding, for clothing, housing, for medical purpose, providing raw material to industry etc. Therefore, produce more now-a-days is a compulsion, not optional. In this respect farmers are pressurising much more on land, but there is other way *i.e.* vast inland water bodies. If we able to use this water bodies properly, it will help in boosting agricultural production in our country. Different things we get from water bodies *i.e.* fish, lotus, lily, water chestnut etc. If we provide quite emphasis on water bodies, it will obviously return tremendous production so our production will get a holistic approach. It is seen that sometimes/or most of the time vast water bodies are staying unused. If our farmers use those water bodies and cultivate fish, lotus, lily, water chestnut and other aquatic plants obviously farmers will get more returns. Considering the need of the hour –we will always try to find out new ways to enhance agricultural production because we know agricultural progress is the core of national progress.

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