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## Water Chestnut (*Trapa natans L.*): Functional characteristics, nutritional properties and applications in food industry: A review

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### ABSTRACT

An annual floating-leaved aquatic plant, the water chestnut (*Trapa natans L.*), is found in temperate and tropical freshwater wetlands, rivers, lakes, ponds, and estuaries. Hydrophytes that produce starch called water chestnut has the potential to serve as a reliable food supply, particularly in flood-prone wasteland areas. It is loaded with minerals and essential nutrients. Water chestnuts are not actually nuts, despite their name. They are aquatic tuber vegetables that may be found in shallow lakes, paddy fields, marshes, and ponds. Water chestnuts are indigenous to numerous islands in the Indian and Pacific oceans, as well as Southeast Asia, Southern China, Taiwan, Australia, and Africa. When the corm, or bulb, acquires a dark brown hue, they are picked. They are a typical ingredient in Asian recipes including stir-fries, chop suey, curries, and salads because of their crisp, white meat, which may be eaten raw or cooked. The huge, nourishing seed of the water chestnut, a native of Eurasia and Africa, has been widely collected since the Neolithic, and it is now grown for food throughout Asia. Water chestnuts have several advantages over other foods, including being particularly nutrient-dense and low in calories. A wonderful source of fibre, water chestnuts may aid in promoting bowel movements, lowering blood cholesterol, neuro-protective, controlling blood sugar levels, and maintaining the health of your gut. In addition, carbohydrates account for the majority of the calories in water chestnuts. Although they are abundant in fibre, potassium, manganese, copper, vitamin B6, and riboflavin, uncooked water chestnuts are 74% water, which means they are often low in calories. Due to its usage in the treatment of gastrointestinal illnesses, genitourinary system disorders, liver, kidney, and spleen disorders, *Trapa natans* is one of the most significant medicinal plants in Indian Ayurveda.

**Keywords:** Water chestnut, Hydrophytes, Anti-diabetic, Riboflavin.

### INTRODUCTION

*Trapa natans L.*, a member of the family Trapaceae, Order Myrtales, Subfamily Rosidae, Class Magnoliopsida, Subclass Rosida, and Division Magnoliophyta, is also known as the "singhara nuts" or "water chestnut" in English, "singhara" or "simkhata" in Hindi, and "karimbolan" or "vankottakkaya" in Malayalam. Despite being a fruit with a high nutritional value, because it is only available for two to three months out of the year, it has not received the full importance and attention of food processors. Water chestnut is harvested on 603,076 acres of land worldwide, with 2,327,495 tonnes produced overall. The fruits of *Trapa* are cooling, diuretic, sweet, astringent, and tonic [1]. Since the Neolithic era, the plant has been grown in Asian nations for its nutrient-rich seeds; the fruits are eaten raw, cooked, or roasted [2]. Natural processes cause the seeds to sprout in ponds, lakes, and marshes in the early month of April. These seeds then send out multiple branching stems that eventually reach the water's surface and form a canopy of floating leaves. It's interesting to note that the seeds may grow under severe anoxia in the low-oxygen lake bottom waters [3]. *Trapa natans L.* is an annual aquatic floating plant with two types of leaves: finely divided submerged leaves that resemble feathers and are carried down the length of the stem, and undivided floating leaves that are carried in a rosette at the surface of the water. The floating leaves are rhomboid, fan-shaped, toothed along the edges, 2-6.5 cm in diameter, longer than wide, denticulate, denate, serrate, or incised along the entire base, apex acute, crimson, and thickly hairy or villous below. Although usual lengths tend to be in the six to eight foot range, the plant's cord-like stems can grow up to 16 feet long and are buoyant and spongy. The numerous branched roots of the stems serve as anchors for them to the water body's bed [4]. The flowers are white, slightly raised above and wide, with a short conical beak in the middle, often thorn-shaped, through which nitrogen protrudes, two spikes in two corners, another pair of spikes often missing [5]. Full sun, slow-moving, nutrient-rich, fresh waters, and a soft substrate are requirements for water chestnut [6]. This particular fruit exhibits wide range of health benefit properties such as it acts as Anti-inflammatory, Anti-diabetic, Anti-microbial, Immunomodulator, Neuroprotective, Anti-Ulcer activity and many more.

**Distribution of water chestnut.**

*Trapa natans L.* is an annual aquatic plant found in tropical, subtropical and temperate regions of the world. Their natural range includes parts of southern Europe, Africa and Asia. It has been cultivated in Europe since Neolithic times and was commonly used as food by ancient Europeans. The light growing plant has become naturalized in parts of the United States since it was first introduced to North America in about 18. It is found in slow-moving rivers, lakes, swamps, ponds, and is widely cultivated in Asia. Prefers nutrient-rich water with a pH of 6.7-8.2 and a calcium carbonate alkalinity of 12-128 mg/l [7].

**Native range and habitat of water chestnut**

Water chestnut is a native of temperate and tropical Eurasia and Africa [8-10]. There are known *trapa* fossils from the former USSR that date back to the Cretaceous [11]. Water chestnut was the dominating aquatic plant of the lake basin during the Neolithic (3300 to 2800 BC), along with floating-leaved species of *Potamogeton*, *Nymphaea*, and *Nuphar*, according to an analysis of sediment from archaeological sites in the village of Pannala, Orimattila, southern Finland. The plant remains point to a nitrogen-rich environment that may have been brought about by human activities [12]. In nearly all of the states of northern India by the late 1970s, water chestnut was widespread [13]. The species flourished as a wild plant in some areas, was intensively farmed in others, and caused issues with overcrowding in still other locations. According to [14], water chestnut lived in the lakes, ponds, ditches, and streams in the Himalayan Valley of Kashmir, where the water was nutrient-rich and supported a variety of aquatic plant species. He also added that the proliferation of aquatic plant growth, which may have been caused by increased water pollution, is mostly responsible for the Kashmir lakes' decreasing.

**Combination of chemical entities**

The literature discloses the presence of tannins, flavonoids, and glycoside in pericarp extract of fruits of *T. natans*, which was further supported by thin layer chromatographic investigations, as well as phytosterols, saponins, fixed oils, and fat in seed extracts. According to reports, the fresh water chestnut kernels have the following chemical make-up [15].

**Table 1:** Chemical-composition of water chestnut

Constituent	Percent (wet basis)
Moisture	81.120 ± 0.50
Total soluble solids	7.20 ± 0.20
Total acidity	0.1420 ± 0.030
Crude lipids	0.360 ± 0.020
Total ash	1.330 ± 0.0400
Crude fibre	0.720 ± 0.020
Total proteins	1.870 ± 0.030
Total sugars	5.630 ± 0.040
Reducing sugars	1.270 ± 0.020
Non-reducing sugars	4.360 ± 0.030

Source: [15]

**Chemical composition of water chestnut fruits and leaf extracts**

The water chestnut supplies vital minerals, proteins, lipids, carbohydrates, vitamins (B1, B2, B5, B6, E, A, and C), dietary fibres, polyphenols such phenolic acids and flavonoids, as well as hydrolysable tannins, according to available data [16]. A total of ten phenolic compounds known to exist in *Trapa natans* leaf extract, with three phenolic acids, gallic, ellagic, and ferulic acid, as well as quercetin 3-O-galactoside (hyperoside), being more abundant than the other substances [17]. The most important substances in the aqueous fruit extract of *Trapa natans L.* are phenolics, which have drawn more attention from scientists because of their strong anti-free radical properties. Due to its high polyphenol content, there is solid evidence that the aqueous extract of *Trapa natans L.* fruit has significant in vitro antioxidant action against free radicals [18].

**Table 2:** The total amount of phenolic, flavonoid, and tannin components included in the fruit extract of water chestnut.

Equivalents/g of dry material	(mg)
Gallic acid	63.8100
Rutin	21.3400
Tannin	17.1100

Source: [18]

**Table 3:** Content of phenolic compounds of methanolic *Trapa natans L.* leaf extract.

Phenolic acids and their derivatives	Flavonoids	Flavonoid Glycosides
∇ Gallic acid hexoside isomer 1 and isomer 2		
∇ Gallic acid		∇ Naringenin-7-O-hexoside
∇ Protocatechuic acid		∇ Kaempferol di-O-hexoside isomer 1
∇ p-Hydroxybenzoic acid		∇ Rutin
∇ p-Coumaric acid hexoside	∇ Quercetin ∇ Pinobanksin	∇ Kaempferol-3-O-glucoside (Astragaloside)
∇ Caffeic acid	∇ Naringenin ∇ Rhamnetin	∇ Quercetin 3-O-rhamnoside
∇ p-Coumaric acid		∇ Quercetin 3-O-galactoside
∇ Ellagic acid		
∇ p-Coumaroyl-digalloyl-O-Glucose		
∇ Ferulic acid		

Source: [19]

### Inorganic components of water chestnut

Many inorganic components, including minerals like phosphorus, calcium, iron, copper, magnesium, manganese, sodium, and potassium, are present in *Trapa natans* [20] 32 mg of minerals were present in 100g of the seeds [21].

### Alleviative Properties of Water Chestnut

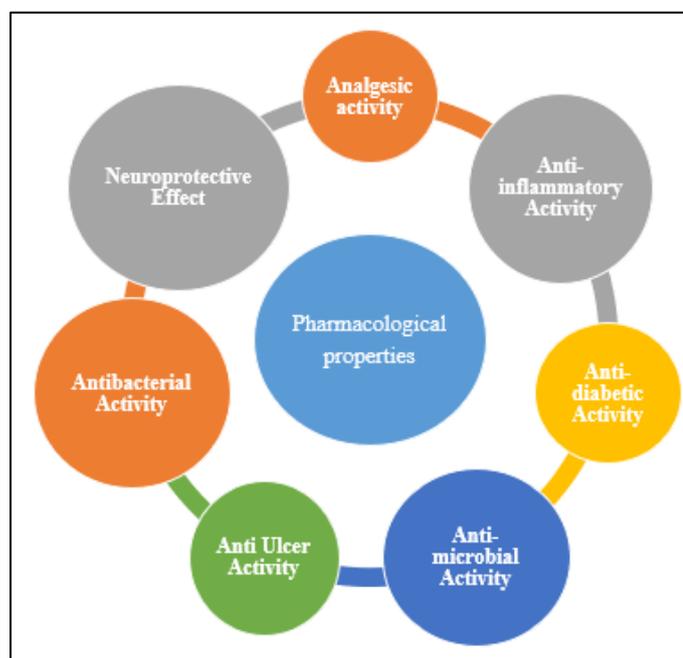


Figure 1: Pharmacological properties of Water Chestnut

### Anti-oxidant property of water chestnut

High concentrations of flavonoids, flavones, and total phenol levels can be found in water chestnuts. While the pericarp extract of the fruits of the water chestnut revealed the presence of tannins, flavonoids and glycosides, alkaloids, Saponins, steroids, and phenolic compound, phytochemical screening of the seed extract of the water chestnut fruits revealed the presence of carbohydrates, Saponins, Phytosterols, fixed oils, and fat [22].

### Analgesic (pain relieving) property of water chestnut

Analgesic medications are crucial to the management of pain, which is a widespread public health issue. The majority of available analgesics for persistent and chronic pain brought on by cancer and damage to the nervous system are comparatively ineffective, have a significant risk of addiction or adverse effects, and, more critically, do not completely alleviate pain in all patients. On comparing doses of 200 mg/kg and 400 mg/kg of the root of *Trapa natans*, *L.var. bispinosa Roxb* on mice to the usual medication pentazocine at a dose of 30 mg/kg, Agrahari *et al.* (2010) reported the analgesic effect of the latter. There was significant ( $p < 0.01$ ) analgesic activity at both dosages [23].

### Anti-inflammatory property of water chestnut

The build-up of cells and exudates in irritated tissues during inflammation, which is a pattern of reaction to injury, enables protection against additional harm. For thousands of years, people have researched inflammation in an effort to understand how to reduce its negative effects on the body. In AD 30, Celsius identified

the four primary symptoms of inflammation (redness, heat, pain, and swelling, or rubor, calor, dolor, and tumour) and utilised leaf extracts to alleviate them [24]. The compounds which help in relieving the inflammation are treated as anti-inflammatory agents. When carageenan-induced hind paw oedema was used to test the pericarp and seed extract of fruits from *Trapa natans L.* for anti-inflammatory activity, 200mg/kg and 300mg/kg doses were used. Pericarp displayed stronger anti-inflammatory activity than seed. These conclude that the pericarp of water chestnut may be considered as an effective anti-inflammatory agent [25].

### Anti-diabetic property of water chestnut

In recent years, a large number of novel anti-diabetic medications have been created and released onto the market to treat diabetic patients with hyper-glycaemia situations, although the majority of them have potential side effects [26]. Consequently, there are restrictions on how long synthetic medicines can be used to treat T2DM. The use of numerous conventional plant medicines for the treatment of diabetes is widespread and offers promising possibilities for the management of T2DM [27]. Herbal medicine is increasingly frequently used to treat T2DM since it is less expensive and easier to obtain than pharmaceutical medications [28]. With few adverse effects, this therapeutic alternative can be utilised as a diabetic treatment together with other diabetic medications or insulin [29]. The majority of plants include bioactive natural compounds like glycosides, alkaloids, carotenoids, flavonoids, terpenoids, and terpenoids, many of which have anti-diabetic properties [30]. These organic supplements made from fruits, vegetables, or traditional herbal medicines can improve pancreatic tissue function by boosting insulin secretion or reducing intestinal glucose absorption [31]. In STZ-induced diabetes in Wistar rats, Das *et al.* (2011) found the anti-diabetic efficacy of methanol extract of *T.napans* fruit peels (METN). METN significantly ( $p < 0.001$ ) and dose-dependently improved oral glucose tolerance at oral doses of 100 and 200 mg/kg. It also demonstrated hypoglycaemic activity in normal rats and anti-diabetic activity in STZ-induced diabetic rats by lowering and normalising the elevated fasting blood glucose levels in comparison to the STZ control group. It shows that water chestnut fruit peels are capable of reducing blood glucose level and stabilizes elevated fasting blood sugar levels at specific concentrations [32].

### Anti-microbial property of water chestnut

To inhibit the growth of harmful and spoilage bacteria, antimicrobials can be applied to food in a variety of ways. These can be either added directly or released gradually from packaging. In this the focus is on three key approaches of integrating antimicrobials into food systems. These techniques may be crucial in lowering dangerous bacteria and so extending the shelf life of products. By using the agar disc diffusion method, Parekh and Chanda (2007) reported the bactericidal activity of several *Trapa natans L.* fruit rind extracts. Gram-negative bacteria exhibited the highest levels of antibacterial activity. 1, 4-dioxan extract had the highest antibacterial activity, whereas petroleum ether extract had the lowest antimicrobial activity [33].

### Anti-bacterial property of water chestnut

Anti-bacterial activity is related to substances that kill or retard the growth of bacteria locally while not generally being hazardous to nearby tissue. The majority of today's antibacterial medications are chemically altered versions of natural substances [34], such as  $\beta$ -lactams (like penicillins), cephalosporins, or carbapenems.

Additionally, fully synthetic antibiotics like sulfonamides and pure natural antibiotics like aminoglycosides are frequently utilised. The agents can generally be divided into two categories: bacteriostatic, which inhibits bacterial growth, and bactericidal, which kills bacteria. Antibacterial medications are essential for combating infectious infections [35]. By employing the disc diffusion method using methanol extract and kanamycin as a reference, Razvy (2011) revealed the antibacterial activity of fruit extract from two types (Green and Red) of water chestnut. While the green variety of water chestnut (600g) had the best antibacterial activity (12mm) against both *Staphylococcus aureus* and *Shigella sonnei*, the red type's extract (600g) shown excellent antibacterial potential (31mm) against *Bacillus subtilis* [36].

#### Anti-ulcer activity of water chestnut

The aggressive digestion capacities of acid plus pepsin and the mucosal barrier coexist in harmony in the stomach. When the natural equilibrium is upset by either increased aggression or decreased mucosal resistance, ulceration results. The development of stomach ulcer is thought to involve a number of elements. According to [37], they include increased acid-pepsin secretion, poor bicarbonate neutralisation, impaired mucus secretion, and precipitate lesions on the mucosal layer. Numerous herbal products have reportedly been shown to have anti-ulcer properties. Using pyloric ligation and aspirin plus pyloric ligation models, [38] investigated the antiulcer activity of a 50% ethanolic extract of the fruits of *Trapa bispinosa* (Trapaceae) in wistar rats.

#### Neuro-protective property of water chestnut

According to a study by Vyawahare (2010), the hydroalcoholic extract of *Trapa bispinosa* (500 mg/kg, po) reduced fluorescence product, increased lipid peroxidation, and restored glutathione peroxidase and catalase activity in the cerebral cortex of female albino mice [39].

#### Phytochemicals present in water chestnut

Water chestnut contains phytates, sphingolipids, alkylphenols, and lignans in addition to carotenoids, phenolic acids, phytosterols, and polyphenolic compounds like flavonoids, proanthocyanins (PAC), and stilbenes, all of which are listed in nutrient database [40]. Nut variety, genotype, environmental factors both before and after harvest, and storage circumstances all have a significant impact on the phytochemical content of nuts. Phenolic acids, flavonoids, stilbenes, and phytosterols are influenced by genotype, but information is missing for many other phytochemical classes. During the cooking process, it was discovered that nut isoflavones, flavanols, and flavanol were more heat resistant than anthocyanins, PAC, and trans-resveratrol. Studies validating these procedures for tree nut phytochemicals are missing, and the extraction solvents used to obtain polyphenols and phytosterols have a significant effect on their quantification [41].

#### Uses of water- chestnut

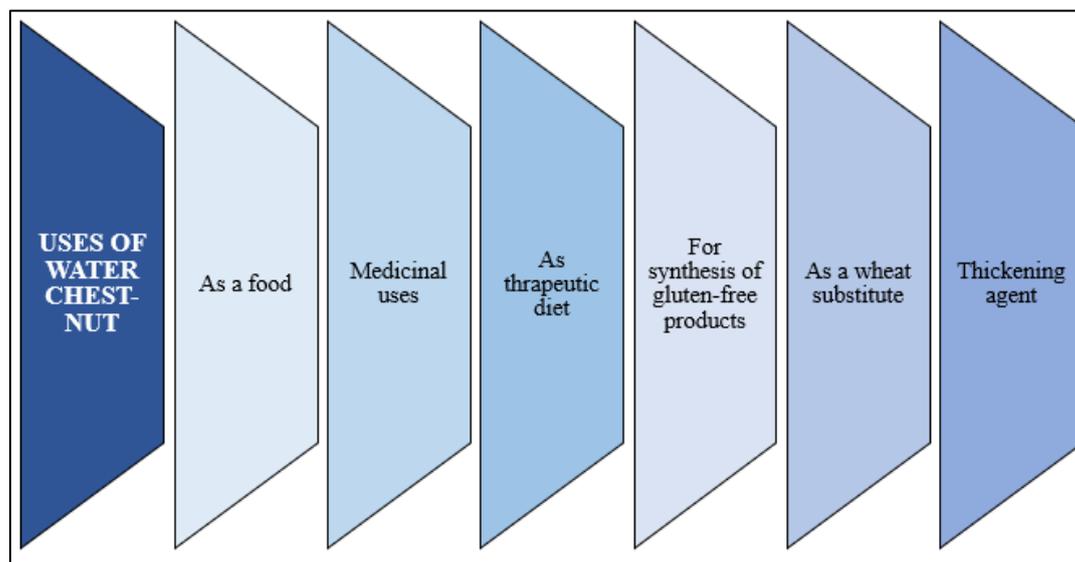


Figure 2: Uses of water chestnut

#### Food

The fruits can be dried and crushed into flour, which is occasionally used as an alternative to arrowroot flour, or they can be used roasted or boiling. With 16% carbohydrate and 2% protein, the fruits are a significant source of nourishment. Fruits are luscious and crunchy when they are raw; when cooked, the flesh softens but still retains its crunch. The kernels are an excellent source of vitamins, minerals, carbohydrates, iron, manganese, copper, manganese oxide, magnesium, sodium, and potassium [42]. The facility at Wular Lake, India, produces 4-5 106 kg of nuts every year, providing practically all of the sustenance for at least 30,000 people for five months of the year [43]. In Bangladesh, China, and India, street merchants sell it both fresh and cooked. The fruit's immature pulp, known as milky water

chestnut, is consumed raw or cooked, and the mature pulp, after being boiled and dried, is used to make recipes. In addition to being eaten as a vegetable, water chestnuts may also be used to make tea and curries. The kernels are made into flour for bread as well as dried and sold as nuts (chapattis or poories). The fruits' nutritional content is analogous to that of wheat [44]. Typically, water chestnut is consumed after boiling. This is a nut with a high nutritional value that can be used to create premium chapatti and sweets in India. People from all socioeconomic situations around the globe are increasingly using this medium-to-low calorie food to make snacks because it has the most nutrients [45]. In developing nations like India, malnutrition is a problem that is generally acknowledged. It is a pervasive issue that has been solved through extensive scientific research and numerous initiatives created by experts in the field to improve people's diets

with novel food formulations made from various nutritional sources [46].

### **Therapeutic food for pregnant ladies**

A pregnant woman is fed porridge prepared with water chestnut flour to avoid bleeding after delivery because water chestnut flour promotes fetal growth and helps treat hypertension in pregnant women. Women who are bleeding can use the dried seeds to halt it. Additionally, it encourages the mammary duct to secrete milk. Water chestnut juice has numerous medicinal uses and eliminates bile and phlegm humor. Also, it increases libido. Water chestnuts are used to treat blood toxins and inflammatory conditions. They are energising substances that lessen tiredness and moderate blood loss from wounds. One cup of water chestnuts has 362.1 mg of Potassium in it. This mineral is necessary for healthy neural and muscular activity. Blood pressure and water retention are both controlled by sodium intake. Water chestnuts are a great way to beat the summer heat because of their superior refreshing qualities. They also possess a wide range of therapeutic and auxiliary qualities. The seeds of water chestnuts are used to treat leprosy and bronchitis, while the juice is used to treat diarrhoea and dysentery. It helps in the treatment of pregnancy-related hypertension and encourages foetal growth [47].

### **Utilization of water chestnut as a substitute of wheat on fasting days**

When it comes to Celiac diseases brought on by the indigestion of gluten (wheat protein), water chestnut (*Trapa natans L.*), locally known as "Singhara" in India [48], which is used as a substitute for cereals in the Indian subcontinent during fasting days, can be a good replacement for wheat flour (WF) [49,50].

### **As a decorative plant**

The fruits of *T. natans* are produced in India and Myanmar and turned into rosaries that are marketed in Italy. Due to its usage as an ornamental aquatic plant, water chestnut has seemingly colonized in several areas of the Eastern United States [51].

### **Medicine**

This serves as a tonic, nutritive, appetiser, astringent, diuretic, aphrodisiac, cooling agent, and so forth in numerous Ayurvedic formulations. Inflammation, lumbago, sore throats, bilious affections, bronchitis, and weariness are other conditions it can help with. Plant calms vitiated pitta, burning, haemorrhages, skin conditions, low back pain, and overall weakness. Fruits are also used to make liniments that are used to treat wounds, sunburn, and rheumatism. Additionally, it is considered to have cancer-preventing qualities. When treating eye conditions, stem juice obtained from water chestnut is employed [52].

### **Water Quality Improvement**

Because they allow for the deposition of sediment and the removal of nutrients while reducing current velocity, aquatic plants are essential for water purification [53]. 84 to 96% of the dissolved inorganic nitrogen entering water chestnut-filled tanks was fixed, according to [54], and just a minor amount of nitrogen was discharged in the outflow water from the tanks. This shows that water chestnut beds in the field could effectively reduce eutrophication of downstream areas by removing a significant amount of nitrogen from runoff streams. However, this function can only be carried out if plants are harvested and removed from the system before to senescence or before plants

start to decompose in the fall. The fall's quick degradation of water chestnut material could have an effect on the water quality [55, 56]. Heavy metals can build up in water chestnuts. Cadmium and nickel concentrations in plants from the outfall area were significantly higher than concentrations in plants from a control site, according to analyses of whole plants sampled in conjunction with a remedial investigation of the Marathon Battery Federal Superfund site at Foundry Cove on the Hudson River. The level of cadmium in samples decreased with increased distance from the outfall. On a dry weight basis, the range for complete plants (n = 9) was 0.96 to 180 ppm nickel, 1.2 to 13 ppm cobalt, and 1.6 to 420 ppm cadmium. But location by location, concentrations of all three metals were consistently greater in water celery than in water chestnut [57]. It is unknown what happens to accumulated metals after the decomposition or animal consumption of water chestnuts.

### **Thickening Agent**

One of the key food components that greatly influences how diverse food products' textural qualities are controlled is thickening agents. In addition to controlling moisture, they give food products structure, flow, stability, and eating qualities. The rheological characteristics of thickeners in any solution depend on a number of variables, including the concentration of the active ingredient, temperature, degree of dispersion, dissolution, electrical charge, previous thermal and mechanical treatment, presence or absence of other lyophilic colloids, and the presence of electrolytes and non-electrolytes. The molecular interactions between macromolecules in the organized matrix have an impact on them. The starch obtained from water chestnut is used as thickening agent for soups and sauces in the food industries and as a potential binder in the pharmaceutical industries [58]. Water chestnut (Singhara) is a great dietary supplement due to its high calcium, potassium, and iron content. In India, singara is mainly produced for human consumption. Depending on the individual, it is frequently eaten as a vegetable, dried flour, and different sweet dishes. The fruit kernel of the water chestnut tree is delectable and rich in nutrients like proteins, carbohydrates, and minerals. Water chestnut is one of the most well-liked starchy sweet dish desserts in Asian countries due to the tenderness, sweetness, and excellent taste of its fruit. The syneresis of water chestnut starch is lower than that of maize starch. It can readily take the place of corn and potato starch when making frozen goods [59].

### **Traditional uses**

Water chestnut was widely used in Asia, including China and India, for therapeutic purposes. Good pharmacological qualities of this plant species, including anti-pyretic, diuretic, hemostatic, constipating, and anti-diarrheal effects, have been known and used in traditional Chinese and Indian medicine since antiquity [60]. It has long been used in India as a remedy for rheumatism, sores, and sunburns in the form of liniments made from the fruits.

### **For the production of gluten-free products**

Patients with celiac disease can use chestnut flour because it is gluten-free and has other healthy qualities. Because lactose in cow milk can cause allergic reactions in children, some experts looked into whether chestnut flour could be used as a substitute for cow milk in the preparation of kid-friendly desserts and soups. According to [61, 62], chestnut flour can also be used to create flakes, pasta, bread, baby formula, and milky puddings. Chestnut flour is high in protein, high in sugar (20-32%), high in starch (50-60%), high in dietary fibre (4-

10%), high in important amino acids (4-7%), and low in fat (2-4%). In addition, it contains a lot of potassium, magnesium, and calcium, as well as vitamins B, C, and E. As most gluten-free goods are currently lacking in vitamin B, iron, and fibre, it is believed that using chestnut flour will be beneficial. Chestnut flour is also utilised in the creation of gluten-free bread because of its nutritional worth [63].

#### For making water chestnut Flour

Chestnut flour is commonly used in bread, breakfast cereals, cakes, cookies, pasta, milky pudding goods, soups, sauces, and gravies. Chestnuts may have positive impacts on nutrition quality and health, and this is causing an increase in interest. In this research, it is

hypothesised that adding chestnut Flour to a variety of foods, especially baked goods, will enhance their nutritional value and functional attributes, helping to develop a variety of product markets. The use of chestnut flour as a substitute flour additive is also believed to exist. Due to its nutritive and sensory qualities, the use of chestnut flour in the food business is growing. It is believed that using chestnut flour in food enrichment will benefit human health because it includes the vitamins E and C, unsaturated oils like omega-3 fatty acids, dietary fibre components, phenolic and antioxidant components, as well as a highly nutritious property value. The market for chestnut flour in the makeup sector is also very strong [64]. The chemical combination of dried water chestnut is as follows [65]

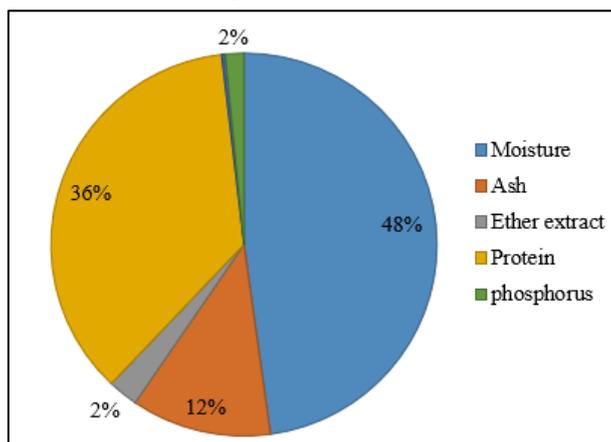


Figure 3: Chemical composition of Dried Water Chestnut Flour

#### CONCLUSION

A valuable ingredient in the food sector due to its distinctive flavour is water chestnut. It is primarily eaten in the form of cooked vegetables, flour, or sweet dishes of various types. Fruits are occasionally consumed raw after boiling and roasting, but only when they are still ripe. It is an excellent source of carbohydrates, proteins, and important minerals and may be compared favourably to other foods. Before boiling or canning, the complete dark-brown corms are peeled. It exhibits many nutritional and functional properties due to which it should be encouraged to include in diet for various health benefits.

#### Conflict of Interest

There is no conflict of interest.

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