

BIOCHEMICAL COMPOSITION OF THE FRUITS OF WATER CHESTNUT (*TRAPA BISPINOSA* ROXB.)

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Key words: Aquatic plant, *Trapa bispinosa*, Biochemical composition, Fruits.

Water chestnut (*Trapa bispinosa* Roxb.) or *Paniphal* is a floating annual aquatic plant that is commonly found in the shallow stagnant waters of tropical and sub-tropical countries. Like most other macrophytes, these are self-growing plants that grow in slow moving water up to 5 m deep and are native to warm temperate parts of Asia and Africa. The fruit (nut) of water chestnut is eaten by humans in raw or cooked form. This plant extensively cultivated in fresh water tanks, *beels*, ditches and ponds.⁽¹⁾

In Bangladesh, there exists a variety of water chestnut locally known as *Paniphal* or *Singhara* - an edible aquatic angiosperm. It belongs to the Trapaceae family in the genus *Trapa* and species *T. bispinosa* Roxb. The interesting features of *Paniphal* are the color and shape of its outer cover in which the nut is encased. The nut is covered with a thick jet-black outer cover shaped like a horn. The outer cover is hard, making it quite difficult to peel off to obtain the white nut inside (Fig. 1). The information on the chemical composition of the fruits (nuts) of *Paniphal* in Bangladesh is almost nil.⁽²⁻³⁾ Since aquatic plants are known to differ widely in their chemical composition depending upon species, season and location⁽⁴⁾; an insight into their chemical composition is essential if utilization prospects are to be considered. In Bangladesh very few works on biochemical composition of aquatic macrophytes have been carried out. Recently Alfasane *et al.*⁽⁵⁻⁶⁾ have studied the biochemical composition of the seeds of *Euryale ferox* Salisb. and *Nelumbo nucifera* Gaertn. The natural habitat of the plant has also been decreasing in a high rate. So, considering an *ex situ* culture studies of the plant for its conservation parallel studies on the biochemical composition of its fruits have been undertaken. The purpose of this study was to supplement existing knowledge on aquatic plants by evaluating the chemical and mineral composition of the plant as the suitability of food source.

Water chestnut fruits were collected from the culture pit of Botanical garden, Dhaka University campus. The culture pit measuring 1.5 × 0.75 m where water depth was up to 45 cm. During the fruiting time the ranges of different physicochemical conditions were photosynthetically active radiation PAR 765.83 ± 48.21 µE/m²/sec, day length 12.75 ± 0.10 h, rainfall 114 mm, humidity 90%, air temperature 28.5 ± 0.5°C, water temperature 28.0 ±

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1.00°C, pH 7.25 ± 0.29, alkalinity 2.00 ± 0.35 meq/l, total dissolved solids (TDS) 110.0 ± 2.50 mg/l, conductivity 235.0 ± 6.50 µS/cm, dissolved oxygen (DO) 5.70 ± 1.20 mg/l, nitrate-nitrogen (NO₃-N) 387.99 ± 23.50 µg/l, soluble reactive phosphorus (SRP) 28.78 ± 5.08 µg/l and soluble reactive silicate (SRS) 48.49 ± 4.57 mg/l. Methods applied to measure these physicochemical parameters have been elaborated in Alfasane *et al.*⁽⁷⁾ Thirty (30) fruits were selected for biochemical analysis. The selected fruits (nuts) were then peeled, washed and cut into small pieces and were analyzed for biochemical study. The cut pieces of fruits were crushed afresh in a mortar with the help of a pestle. The crushed material was then used to determine the amount of protein, ash, fat, moisture, fiber, carbohydrate and mineral content after National Institute of Nutrition.⁽⁸⁾ For each parameter six replicates were taken. Moisture content was determined with the help of a moisture meter (IB-30, Brand Chyo, capacity 309, Readability = 0.0019). At room temperature (28.5°C) fresh fruits moisture was determined as well as oven dried fruits at 105°C were used for dried fruits moisture. Mikrokjeldhal method was followed to determine the protein content. Ash was determined with the help of a Muffle Furnace (Model No. Carbolite RHF-1600).

T. bispinosa fruits have been analyzed to determine their nutritional value and showed that the fruits are nutritious containing higher values of carbohydrate and protein (Table 1).

Table 1. Biochemical composition of fruits of *Trapa bispinosa*.

Parameters	Fruits (nuts)	
	Fresh	Dried fruits at 105°C
Moisture %	70.35 ± 1.27	7.30 ± 0.02
Protein %	4.40 ± 0.48	10.80 ± 0.05
Fat %	0.65 ± 0.04	1.85 ± 0.06
Carbohydrate %	22.30 ± 0.89	71.55 ± 0.87
Fibre %	2.05 ± 0.03	6.35 ± 0.09
Ash %	2.30 ± 0.06	8.50 ± 0.38
Calcium mg/100 g	32 ± 1.29	102.85 ± 1.57
Iron mg/100 g	1.4 ± 0.13	3.80 ± 0.09
Phosphorus mg/100 g	121 ± 2.38	325 ± 5.03
Energy Kcal	115.52 ± 1.15	354.85 ± 1.59

Biochemical analyses of fruits of *T. bispinosa* in 100 g, consisting of 22.30 and 71.55% carbohydrate in fresh and dry fruit, respectively. The protein contents were 4.40% and 10.80% in fresh and dry fruit, respectively. The percentage of moisture, fibre, 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, in fresh and dry fruit, respectively (Table 1). The 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, in fresh and dry fruit, respectively (Table 1). In 100 g fresh and dried seeds of *T. bispinosa* produced 115.52 and 354.85 Kcal of energy, respectively.



Fig. 1(A-D). A. Water chestnut plants grown in the culture pit. B. Plants showing fruiting (arrow) stage. C. The water chestnut fruit is covered with a thick jet-black outer cover shaped like a horn protruding from the head of a buffalo. D. The outer cover is hard (above), making it quite difficult to peel off to obtain the white nut inside (below).

Biochemical analyses of seeds of *Euryale ferox* showed that seeds consisting of 61.2% carbohydrate, 15.6% protein, 1.3% fat, 7.6% fibre, 1.8% ash and 12.5% moisture as dry weight basis.⁽⁵⁾ Biochemical analyses of seeds of another aquatic macrophyte namely, *Nelumbo nucifera* in 100 g, consisting of 63.8% carbohydrate, 16.4% protein, 1.6% fat, 4.5% fibre, 1.9% ash and 11.8% moisture as dry weight basis.⁽⁶⁾ Comparing the biochemical composition of above mentioned three aquatic macrophytes, on an average, *T. bispinosa* contained highest amounts of carbohydrate (71.55%) and lowest amounts of protein (10.80%) as dry weight basis. The seeds of three aquatic plants are low in fiber, fat and also in ash.

Howard-Williams and Junk⁽⁹⁾ studied the nutritional values of 27 Amazonian macrophyte species and found 5.3 - 22.2% protein in the whole biomass as dry weight basis. The highest was found in *Azolla microphylla* Kaulf. and the lowest in *Scleria secans* (L.) Urb. and *Rhynchospora gigantea* Link.

The present study has demonstrated that, *T. bispinosa* could be important sources of carbohydrate, protein and minerals, which is suitable for incorporation in human diet.

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(Manuscript received on 9 August, 2010; revised on 9 October, 2010)