

A COMPERIHENSIVE STUDY ON MEDICINAL, NUTRITIONAL AND ECONOMICAL ASPECT OF TWO WETLAND CROPS OF DARBHANGA DISTRICT

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Abstract

Darbhanga district in Bihar known by its several wetlands and wetland plant's product because of many rivers flowing through its geographical area. On a number of hydro products, we targeting the two most important those interfere the economical circumstances of Darbhanga, namely, Makhana(*Euryale ferox* Salisbury), and Singhara[*Trapa bispinosa* Roxb.]. Not only these two are locally common food items generating crops, also execute the essential immune-Booster and somehow, a replacement of medicines. Their biochemical content identified multi-vitamins, multi-minerals, both organic and inorganic 'elements' essential to human- health, Proteins, enzymes, Several 'Amino acid compound' fibres , Digestive sugar, 'Steroid compound', Carbohydrates, Alkaloids groups, compounds of Flavonoids, Phenolic compounds, soluble fats, Starch, 'compounds of resins' etc. also they exhibit the medicinal activities, examined, are anti-oxidant, anti-bacterial, anti-diabetic, enzymetic, anti_depression, antifatigue, Cardio and hepato-Protective activity, anti-cancer etc. the study could upgrade the socio-health-wealth shape of Darbhanga district in order to industrializing with their products like biscuits, medicines, 'Multi-vitamins and minerals' like Horlicks, Chawamprash, energy drinks etc .

Keywords: *Euryale ferox*, Phytochemical analysis, Industrialization, *Trapa bispinosa*R.

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Introduction

Makhana

Euryale ferox, locally known(Darbhanga) by Makhana and also Prickly water lily/Fox nuts/*Euryale*/*Gorgon* nuts/*Qianshi* (Chinese)/*Onibusu*(Japanese) almost, produced in - Bihar(largest growing state), West Bengal, Assam, Kashmir, Uttar Pradesh, Tripura, Odisha, Manipur districts of India (largest producing country), (**Dhiraj et al., 2020**) also spread in several countries China (the second largest producing country), Japan, Korea, Russia, Pakistan (**Saima Tehseen et al. 2020**), Bangladesh, Canada. however its production is completely converging to Bihar(Including Darbhanga). 90 % of Makhana production, throughout the world, has been produced by India alone (**Devi KR., 2022**) and further its, almost around 90 % produced by Bihar(Darbhanga, Madhubani, Begusarai, Katihar, Sitamarhi, Purnia, Supaul, Kishanganj, Araria) alone, having globally production 80 % (**Kumar, M et al., 2021; Joseph, A. et al. 2023**). Also the Makhana of Bihar is found to have the best quality in the world's and then of China's. Makhana, in Bihar, mostly grown in the time-period of September-January requires almost about three-six fit standing water during the complete crops period. Makhana are being served in several food menu namely makhana kheer, dal-makhani, roasted makhana, makhana-chat, makhana bread, makhana-veg. etc).

According to **Liyakat, M. et. al. 2022**, Some scientists have abbreviated the “seeds of fox nuts” Black Diamonds and also the Black Gems of the watery area. Fox nuts (Makhana) are high-indexed food items of nutrients and basic needed, essential minerals and compounds worth of saying a ‘dry fruit’. Compared with others, it has low fats. The least glycemic index of Makhana, made it to be used against several chronic diseases as low GI foods are always recommended by FSSI. Not for only nutritional components of Makhana nuts, a large list of its medicinal utility and activity written in ancient literature of medicine, in China and India.

According to **Joseph, A. et al. 2023**, The fox nuts utilization, increases in ‘fast rate’ due to its multi-nutritional benefits, having low content of calories, as well as bad fat factor lower while higher the mineral factor content. Including this Makhana seeds, whatever the form (popped Makhana or powdered, mixed with some other food items) into diet plan, could reduce several micro-nutrient & minerals deficiencies. Also, the seeds (fox nuts) contains HBAC, a very need compound for human being, of HBAC, tested positively, to release insulin, internally, from the pancreatic [β -cells] tendency towards improve in glycaemic control.

Singhara

Trapa natans L. or Trapa bispinosa Roxb. locally known by Singhara in Bihar, also known by Water chestnut/Singada/Kasaronja/ Bull Nut/Jala Buke (Bengal)/simkhata/Karimbolam, vankottakkaya/Pani Fal/Buffalow nut . It is found extensively in Darbhanga and nearby region of Darbhanga District. Singhara is an annual aquatic crops, grown in the area marshes, shallows, tropical and semi-tropical region (Jana, B. R. et al. **2019**) cultivated in rainy season and its production in the months of winter. The Singhara plant was first introduced in New York (the Collins Lake, near Scotia) , edges of Hudson River and Mohawk River nearest about 1884 (Rajkumar, P. et. al. **2022**). The plant of Singhara is also found abundant in southeast Asia, Indonesia and the Southern region of China and in the eutrophic wetlands of Italy and Japan and also in America (Adkar, P. et. al. 2014). Singhara fruits, found under water while its plants are above water surface, used in many forms viz.. raw Singhara, boiled Singhara, flour and bread of singhara, Singhara drinks in general food items. The bread of Singhara bread are being used by local pregnant ladies as medicine, in that period, for their better health. Singhara plant is an annually cultivating plant that starts growing with seeding a single seeding in rainy season and fruits produced in the months of November to February. Each single seed of bull nut can produce ten to fifteen rosettes, that, further can produce another fifteen-twenty seeds meanwhile in the first two starting months (Rajkumar, P. et. al. **2022**). The northeastern regions and the Eastern regions of India are the home (main productive area) to the greatest instances of Singhara (*T. bispinosa*). The Singhara crops can be cultivated without any difficulties, on a large scale, with extra profitability of the land because it does not grow on the other land crops. Farming Singhara, warm humid condition of weather is preferred and it requires summer (The climatic conditions of the region where Singada crops are being farmed economically, the temperature range required, for its germination is more than the temperature 15°C (Meena, S. K. et. al. **2023**).

Biochemical composition

Makhana

Makhana is good resource of natural multivitamins (protein, Polyphenol(Resveratrol, 4-O-methyl gallic acid , Protocatechuic acid), carbohydrates, fibre, Steroid(β -sitosterol , Daucosterol , Fucosterol), magnesium, potassium, Essential oil(Furfural, Pentanoic acid, furancarboxaldehyde , Isocroosol , 2-methylphenol , 1, 2, 3-trimethoxybenzene, Palmitic acid, Pentamethyl benzene, 4-ethylguaiacol), (Jiang, J. et. al. **2023**) phosphorus, iron, zinc and several nutrients) but low in calories, low sodium and cholesterol. (Kumar, M et al., **2021** ; Garg, N., **2020-2021**) Makhana contains the biochemical amino acids (arginine, cysteine, isoleucine, leucine, methionine and glutamine etc.), enzymes, fibres, proteins, minerals (Mg, K, P, Fe, Zn, Ca, Na, Cu etc.) (Devi KR., **2022**), fat etc. (Liyakat, M. et. al. **2022**; Joseph, A. et al. **2023**; Garg, N. et. al. **2022**;)

Singhara

A number of bio-chemical ingredients, useful and helpful to human beings, are present in Singhara. Multi-vitamins and minerals in Singada fruits are iron, copper, carbohydrates, calcium, phosphate, manganese, sodium and potassium, magnesium and minerals (Bharthi, V. et. al. **2015**) . The Singhara plants/kernels having also content of vitamins like thiamine, riboflavin, , vitamin C, vitamin A, Vitamin D-amylase, nicotinic acid and phosphorylases (Bharthi, V. et. Al. **2015**., Vageshwari and Pandey V. N. **2019**., Basu, S. et al. **2023**). The kernels(Singada) is delicious and containing carbohydrates, Minerals proteins and also, it is container of useful Vitamins namely B-1, B-2, B-5 and B-6, E (Singh, G. D. et. al. **2010**).

According to the Meena, S. K. et. al. , in**2023** ,The Singada fruit contains carbohydrate roughly, around 80%, Proteins around 5%, and substantial numbers of several minerals and Multivitamins. Thus, the seeds of Singhara fruit (Kernels) has important and very useful minerals, proteins, and carbohydrates. Additionally, it contains a lot of vitamins namely, E, A, B(B1, B2, B5, B6), C and D; and contains nutrients and minerals (P, Ca, Mg, K, Fe, and Zn), citric acid, lipids and crude fibres. A number of phytonutrients, also includes catechins and epicatechins, something antioxidants and an important ingredient *puchin*, a biochemical substance that functions 'resembling penicillin' are present in it.

Biochemical activities

Makhana

The bio-chemical activities- anti-aging, antioxidant, anti-diabetic, Antimicrobial activity, Antifatigue activity, Antidepressant activity, Cardioprotective activity, Anticancer activity, Hepatoprotective activity, regarding medicinal profit of fox nuts, to human health, examined and observed their positive effect. (Devi KR., **2022** ; Saima Tehseen et al., **2020**, Das, S., Der, P., Raychaudhuri, U. et al., **2006**; Joseph, A. et al. **2023**; Liyakat, M. et. al. **2022**),

Singhara

Singhara, the bull nut tested positive bio-chemical activities, regarding medicinal importance for huma-being. It showed the Bio-chemical activities anti-oxidant, Analgesic (known for pain relieving), anti-diabetic, Anti-microbial activity, Anti-bacterial, Antifatigue activity, Anti -ulcer activity Anti-depressant activity, Cardioprotective activity, Anticancer activity, Hepatoprotective activity, Anti-inflammatory, Neuro-protective property. [Rani, B. et. al; **2016.**, Corovic, R.C. et al. **2020.**, Joshi, S. et al. **2021.**, Bharthi, V. et. al. **2015.**, Basu, S. et al. **2023.**, Rajput J. D. et al. **2023.**, Singh, G. D. et. al. **2010**]

Medicinal utilization

Makhana

Our ancestors had and have been using 'Makhana' as an ayurvedic medicine as well as energy booster however its chemical content and chemical properties influenced and tested to be used against heart-diseases, cancer, high blood-pressure, diabetes, obesity, skin-diseases, nutrient-deficiency diseases etc. [Ahmed, D. et al., **2015**, Das, S., Der, P., Raychaudhuri, U. et al., **2006**. Roasted seeds of Makhana contains the better resolution of phenolics compounds, flavonoid compounds, minerals and anti-oxidants capability, leads to improve in Glycemic Index in, subjected to human being(Liyakat, M. et. al. **2022**). According to Das, S., Der, P., Raychaudhuri, U. et al., **2006**, Makhana, widely, has been using as traditional and natural medicine resource for curing several diseases relative to kidney and spleen's problems, chronic diarrhoea etc., also worked on rats and examined that, the seeds of Euryale ferox could reduce the myo-cardial ischemic reperfusion injuries. According to Ahmed, D. et al., **2015**, Makhana seeds(as drugs) could have improvement property against glycemic index control, lipid profile index, together with enzymetic and antioxidant capacity, in diabetic rats , leads to beneficial effect, in treating to the diabetic related complications.

Singhara

Due to the presence of non-nutritional antioxidants, such as flavonoids, flavones and total phenolic component and the content of carbohydrates, saponins, large amount of multivitamins, phytosterols, saturated fat tannins, flavonoids and glycosides, it has been using as, now days, as Ayurvedic medicines, also in homeopathy medicines, against several diseases(**Rajput J. D. et al. 2023**). Boiled bull nuts, makes an excellent solution(crushed into juice form) for measles patients, drinking on a regular basis for one to two weeks provides better results. Powder of Singhara fruits mixed with lemon juice in a proper ratio, helps to cure eczema. Singhara is also used for the treatment of hair problems because of the presence of certain essential nutrients namely Potassium(K) Zinc (Zn), vitamins B and vitamin E and also it removes toxins from the body (**Rani, B. et. al; 2016**).Singhara plants are very useful in the cure of several diseases like polyuria, diarrhoea, hair problems, dysuria, general weakness, skin diseases, fever, sexually deficiency diseases, sore throat, Severe body pain etc. It is powerful plant with multiple medicinal(Ayurveda and Homeopathy) and nutritional(discussed above) benefits (**Basu, S. et al. 2023**).

Tables of Phytochemical components in Makhana and Singhara

Table- I

Si. No.	Name of ingredients	Contribution(%) in roasted Makhana seeds	Contribution(%) in raw Makhana seeds	Contribution(%) in dried Singhara Kernels	Contribution(%) in raw Singhara Kernels
1.	Proteins	9.7% - 14.6%	7.2 % - 15.8 %	10.5% - 10.9%	3.92 % - 4.88 %
2.	Fibres (crude)	2.32% - 2.54%	0.4% - 7.6%	6.2% - 6.5%	2.01% - 2.09%
3.	Carbohydrates	70.84% -76.9%	57% - 76.1%	21.20% -23.10%	70.50% - 72.40%
4.	Ash	3.35% - 3.45%	0.4% - 0.66%	3.35% - 3.45%	2.22% - 2.37%
5.	Moistures	4.15 % - 5.5%	8.94 % - 12.8%	7.20 % - 7.40%	69.12 % - 81.16%
6.	Fat	0.1% - 0.4%	0.5% - 1.5%	1.71% - 1.9%	0.6% - 0.7%

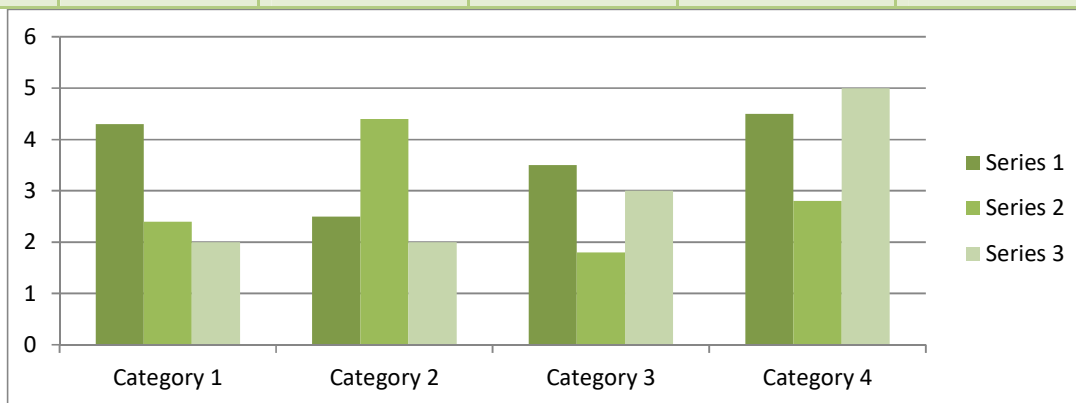


Table- II

Sl. NO	Name of Chemical Elements	Contribution(%) in roasted Makhana seeds	Contribution(%) in raw Makhana seeds	Contribution(%) in dried Singhara Kernels	Contribution(%) in raw Singhara Kernels
1.	Phosphorus (P)	0.053% - 0.056%	0.028 % - 0.066 %	0.053% - 0.056%	0.119 % - 0.123 %
2.	Potassium(K)	0.042% - 0.047%	0.04% - 0.26%	0.042% - 0.047%	0.097% - 0.099%
3.	Iron(Fe)	0.0008% - 0.0010%	0.0001% - 0.001%	0.0037% - 0.0039%	0.0013% - 0.0015%
4.	Calcium(Ca)	0.018% - 0.019%	0.009% - 0.027%	0.101% - 0.125%	0.031% - 0.040%
5.	Zinc(Zn)	0.0011% - 0.0018%	0.0009% - 0.001%	0.021% - 0.028%	0.0011%- 0.0020%

6.	Magnesium (Mg)	0.0139 % - 0.0263%	0.0113 % - 0.060%	0.0139 % - 0.0263%	0.058 % - 0.065%
7.	Copper(Cu)	0.0150% - 0.0482%	0.0238% - 0.071%	0.0012%- 0.0013%	0.0003% - 0.0004%

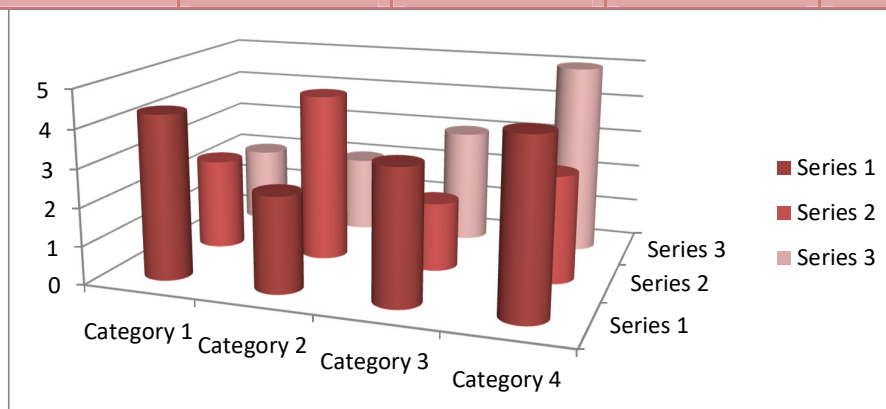
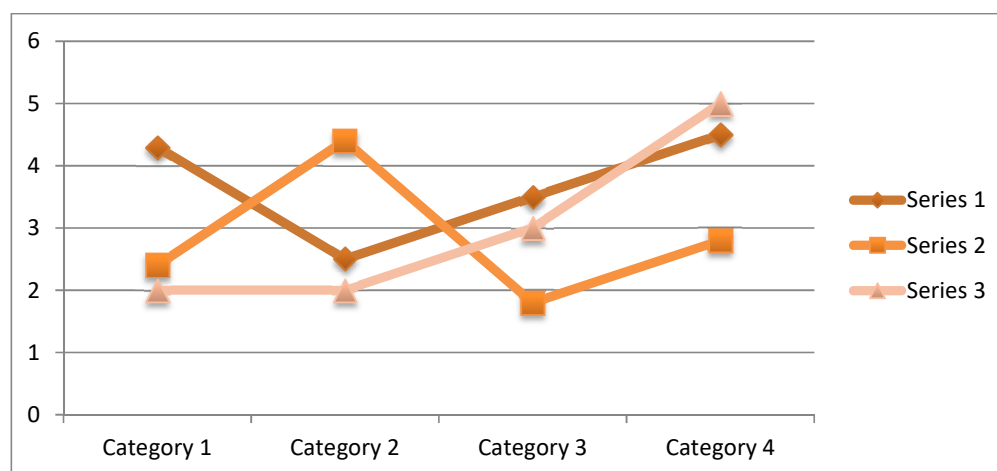


Table of Phytochemical screening in Makhana and Singhara

In different solutions (Aqueous, Alcoholic, Ether, Concentrated(in HCl, H₂SO₄), Petroleum ether etc) of *Euryale ferox* (Makhana) and *Trapa bispinosa Roxb.* (Singhara), following table represents the results of phytochemical screening of Makhana and Singhara, after examined via respective chemical tests.

Si. No.	Tests for the compounds	Biochemical Tests	Result in Makhana+ for present - for absent	Result in Singhara + for present - for absent
1.	Anthraquinones	Ammonium hydroxide test	+	-
2.	Fats	Acrolein test	+	+
3.	Reducing Sugar	Benedict's test	+	+
4.	Carbohydrates		+	+
5.	Protein	Biuret's test	+	+
6.	Glycosides	Borntrager's test	+	+
7.	Terpenoids		+	+
8.	Phenol	Ferric Chloride test	+	+
9.	Tannins		+	+
10.	Resins		+	-
11.	Reducing Sugar	Fehling's test	+	+
12.	Carbohydrates		+	+
13.	Saponins	Foam test	+	+
14.	Alkaloids	Hager's test	+	-
15.	Resins	HCl test	+	-
16.	Starch	Iodine test	+	+
17.	Tannins	Lead Acetate	+	+
18.	Glycosides		+	+

19.	fats	test	+	+
20.	Glycosides	Liebermann burchard test	+	+
21.	Amino Acids	Millon's test	+	+
22.	Carbohydrates	Molisch's test	+	+
23.	Alkaloids	Mayer's test	+	-
24.	Proteins	Ninhydrin test	+	+
25.	Amino Acids		+	+
26.	Flavonoids	Shinoda test	+	+
27.	Steroids	Salkowski reaction test	+	+
28.	Terpenoids		+	+
29.	Alkaloids	Wagner's test	+	-



Conclusion

The study showed 'medicinal and nutritional' interpretation of Makhana and Singhara, grown in Darbhanga district of Bihar. The large no. of chemical elements(Organic and Inorganic) and chemical compounds, having immune-efficiency like dry fruits, curing capacity of several diseases, directed towards not only their globalization use, but also to its industrialization by making several product of Makhana and Singhara mixed with some other dry fruits and food items like biscuits, powdered immuno-booster, drinks, street food items like Chinese foods that could change the socio-economical condition of these two producer as well as could provide jobs to other people of this area.

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