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Nutraceutical Studies of the Rhizome of the Genus *Nelumbo* Adans.- A Review

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ABSTRACT

The paper deals with the review on the nutraceutical details of the rhizome of the plant *Nelumbo* having two species worldwide from which *N. lutea* is confined to North America and Canada to an altitudinal range beyond 2400 m a.s.l. whereas the other species *N. nucifera* is distributed throughout the World in the tropical parts up to 1400 m a.s.l. having good nutritional and medicinal properties. The rhizome is considered to be used for the sake of presence of starch, minerals and vitamins particularly vitamin B6, helpful in the mental and physical growth amongst fetus. Very little is known on the traditional use of rhizome of *N. lutea* and its chemical and pharmacological attributes as well as its toxicity needs to be studied in detail as it is not available before inclusion in nutritional diet especially for diabetic and cardiac patients as well as women bearing fetus.

Keywords: *Nelumbo lutea*, *Nelumbo nucifera*, rhizome, nutraceutical, fiber, protein, review

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INTRODUCTION

The genus *Nelumbo* with its 02 accepted species i.e. *N. lutea* (Willd.) Pers. and *N. nucifera* Gaertn belonging to family Nelumbonaceae A. Rich., and is distributed throughout the World . *N. lutea* is native to South East Canada to Mexico, Greater Antilles, Colombia above 2000 m. a.s.l. whereas the other species *N. nucifera* is the native to Amur, Bangladesh, Cambodia, China North-Central, China South-Central, China Southeast, East and West Himalaya, Hainan, India (Assam, Bihar, Manipur and West Bengal), Iran, Japan, Jawa, Khabarovsk, Korea, Laos, Lesser Sunda Is., Malaya, Manchuria, Myanmar, Nepal, New Guinea, North Caucasus, Northern Territory, Pakistan, The Philippines, Primorye, Queensland, South European Russia, Sri Lanka, Thailand, Transcaucasus, Ukraine, Vietnam, Western Australia. In Himalaya it has been recorded from the lakes at an altitude of 1400 m a.s.l.¹. It is the national flower of India and Vietnam.

Etymology:

The genus name is derived from Sinhala: 'නෙළුම' 'nelum' the Tamil name, the name for *Nelumbo nucifera*. The specific name 'nucifera' is derived from the Latin words 'nux' (nut) and 'fera' (bearing), for 'nut-bearing'^{2,3}. The origin of the word 'lutea' for American species *N. lutea* is as the Italian word 'lutea' comes from Latin 'lutum', (loam, clay, soil, dirt, mire, mud). In other words the name 'lutea' in Italian means 'saffron colour' and as per English UK refers to the 'golden yellow colour'.

Nelumbo lutea (Willd.) Pers. is in the name of American lotus and considered as a holy worship related plant also used as a medicine and for food. Tender leaves are used as vegetable, whereas seeds are collected and eaten like nuts, added for the thickening to soups, roasted seeds are similar to chestnuts, or dried and ground into flour to make bread. In Louisiana, green seed pods are considered as a culinary delight^{4,5}.

Nelumbo nucifera Gaertn is the species of lotus which possess historic cultural and spiritual importance. Its flower is considered as a holy flower in Hinduism to worship Goddess Laxmi and Saraswati and Buddhism representing the path for spiritual awakening and enlightenment. In ancient Egypt it has been considered an important symbol, where it represented the path from death to rebirth to the after life. In India the plant lotus is called with its various local and regional names like Ambal, Thamarai, Suriya Kamal, Padma, Ambuja, Pankaja, Blue Lotus, Indian Lotus, Sacred Water lily, bean of India, Kamala, Kanwal, Kamal, etc.

The plant is a rhizomatous aquatic, roots adventitious arising from the nodes of the rhizome. Rhizome cylindrical, shining creamish with several sinuses traversing throughout. Leaves broad floating with long petioles having air spaces; flowers bright fragrant, floating petals pink- pinkish

white, many with overlapping symmetric arrangement; thalamus disc shaped with many suspended seeds. Seeds hard, dark blackish brown in colour. The leaves and flowers float with the help of long stalk that contain air spaces.

Economic Importance:

Leaves of *Nelumbo* are used for wrapping food and as a plate. Flowers are used to prepare lotus perfume. Dried flowers are used in preparation of fragrant herbal tea. Young leaves, petioles and flowers are eaten as vegetables.

Table 1: Nutritional Value of the Rhizome of *Nelumbo nucifera*

Nutritional contents	Quantity in (100g)
Calories	67 mg
Carbohydrates	12.8g
Fat	0 mg
Sugar	0.5mg
Protein	1.7mg
Vitamin C	27.3 mg
Vitamin B	0.3mg
Fibers	2.6 g
Calcium	6.0 mg
Sodium	45mg
Iron	2.4 mg
Zinc	0.2 mg

The majority of the calories in lotus rhizome come from carbohydrates. There are 12.8 grams of carbohydrates in a 100 ml serving of cooked lotus rhizome, with 2.6 grams of fiber and negligible sugar. The rhizome of *N. nucifera* is a healthy source of carbohydrates and fiber that is low in fat and sugar. Lotus root contains several essential vitamins and minerals, such as potassium, calcium, copper, vitamin C, vitamin B6 and iron.

Insoluble fiber softens the stool and increases its bulk, making it easier to pass food through the digestive tract. Getting at least 20 to 30 grams of fiber per day is crucial to prevent constipation and 100 ml of cooked rhizome of *N. nucifera* provides approx 2.6 grams of fibers and contribute to our daily requirement. It also provides choline, iron, and calcium. These micronutrients support a healthy fetus as well. The rhizome intake is beneficial for various nutrient supplements as well as protects the body from various lifestyle diseases like increased cholesterol level. Besides due to richness of folate (Vitamin B₆) it protects the fetus and give better growth and for the treatment of high fever.

Storage Food Safety and recipes

Rhizome of *N. nucifera* is used in a variety of Asian dishes, especially Japanese cuisine, cooked vegetables, pickles, etc. It can be prepared by the common methods of cooking including stir-

frying and steaming. It is also a popular supplement to soups. It can also be used after deep-fry but this method is least accepted due loss of nutrients and several other healthy properties during deep frying. In India too it is widely sold in the vegetable shops and used as vegetable and for pickles mixed with other vegetables or pickle substances. It is available year-round at Asian grocery and vegetable shops in the form of fresh rhizome with firm smooth peels. It can be stored in the refrigerator by removing the upper peels and cutting into pieces or thin slices. Secondly, the rhizomes cut into pieces or slices can also be rinsed in vinegar or lemon juice just to check the change of the colour to brown.

Nutritional value

Various nutritional contents in *N. nucifera* have been described^{6, 7} as given in Table 1. Tender rhizomes, stems and leaves of *N. nucifera* are edible and can be used by cooking with other vegetables, soaked in syrup or in pickles in vinegar^{8, 9}. Rhizome contains 1.7% protein, 0.1% fat, 9.7% carbohydrate and 1.1% ash⁵ and exhibit mild flavour and extensively used in Chinese recipe, while stem on cooking as food and taste like beetroot. The stem contains sufficient quantity of calcium, iron and zinc and used as vegetable as well as in salads in Vietnam^{10,11,12}. In Japan and China as home remedy, its leaves are used for the treatment of summer heat syndrome and used to treat obesity in China¹³. Its petals are used in soups or as a garnish, while the stamens are used in flavoring the tea¹⁴. In Egypt its seeds are used for having much nutritional values¹⁵. The seeds can be used after roasting like popcorn, ground into powder and eaten dry or used in bread making. The roasted seeds are also treated as good substitute for coffee due to presence of saponins, phenolics and carbohydrates in appreciable quantities^{8, 16}.

Various nutritional contents and minerals in seeds and rhizomes of *N. nucifera* have been given in table 1 & 2, and accordingly it is treated as good food for body health but still there is need to estimate more mineral contents in them. The seeds of *N. nucifera* also contain polyphenols, protein, polysaccharides; however, proteins and carbohydrates are the main nutrients of lotus seeds. Low fat content and good proportion of amino acids present in it confer to its unique nutritional values that have attracted attention around the world and multiple studies have assessed the functional components of lotus seeds¹⁷. The various pathways of the use of *N. nucifera* have been shown in figure 2.

Table 2: Estimated minerals in seeds of *Nelumbo nucifera*

Sl. No.	Contents	Value mg/ 100 g
1	Copper	0.0463
2	Magnese	0.356
3	Magnesium	9.2

4	Potassium	28.5
5	Sodium	1
6	Moisture	10.5
7	Energy	348.45 cal/100 g



Figure 1. *Nelumbo nucifera* plant and processed rhizome

Medicinal uses

N. nucifera is a potential aquatic crop grown and consumed throughout Asia. All parts of *N. nucifera* have been used for various medicinal purposes in various systems of medicine including folk medicines, Ayurveda, Chinese traditional medicine, and Oriental medicine. Many chemical constituents have been isolated till date. However, the bioactive constituents of *N. nucifera* are mainly alkaloids and flavonoids. Traditionally, the whole plant is used as astringent, emollient, and diuretic. It is useful in the treatment of diarrhea, tissue inflammation and homeostasis. The rhizome extract is used as antidiabetic and anti-inflammatory agent due to the presence of steroidal

triterpenoid. Leaves are used as an effective drug for hematemesis, epistaxis, hemoptysis, hematuria, and metrorrhagia. Flowers are used for diarrhea, cholera, fever, and hyperdipsia. The rhizomes of the *N. nucifera* are effective as a remedy in constipation, skin and hair falls, reducing the cholesterol, weight loss and as the rich source of Vitamin B especially niacin, folate, vitamin B6, thiamine and pantothenic acid which are required for improving irritability, memory loss, tension and headaches, regulating blood pressure and blood sugar, etc^{18,19}. It increases blood circulation, regulates high blood pressure, checks ringworm, small pox, leprosy, blood in urine, respiratory problems, and as is also rich source of Vitamin A which helps in improving the eye and skin problems and inflammation^{20,21,22,23}.

It is well known to reduce sugar level in diabetic persons and besides, its stem has antibacterial and antiviral properties and regular intake in diet will improve immunity greatly²⁴. The seeds of *N. nucifera* possess the properties of astringent and is beneficial for kidney, spleen, and heart. The astringent property is generally helpful in loss of kidney essence. The seeds are also used as aphrodisiac for sexual functioning in males and leucorrhoea in females too. It is also helpful in fatigue, palpitation and insomnia. The embryo present inside the seed is beneficial for the heart diseases. The seeds are also helpful in heart and liver disorders. It is recommended as an antidote to mushroom poisoning. The leaves are useful along with other herbs to treat sunstroke, dysentery, fever and blood vomiting. In traditional medicine practice, seeds are used in the treatment of tissue inflammation, cancer and skin diseases, leprosy, and as poison antidote. Embryo of lotus seeds is used in traditional Chinese medicine in the name of Lian Zi Xin, which primarily helps to overcome nervous disorders, insomnia, and cardiovascular diseases (hypertension and arrhythmia). Nutritional value of rhizome and seeds of *N. nucifera* is as important as pharmaceutical value. At present different parts of lotus have been taken as functional foods in different ways viz. boiled, slices roasted sauce, pickles, and several others. In this way use of rhizomes, leaves, and seeds of *N. nucifera* is strongly regarded as a potential nutraceutical source.

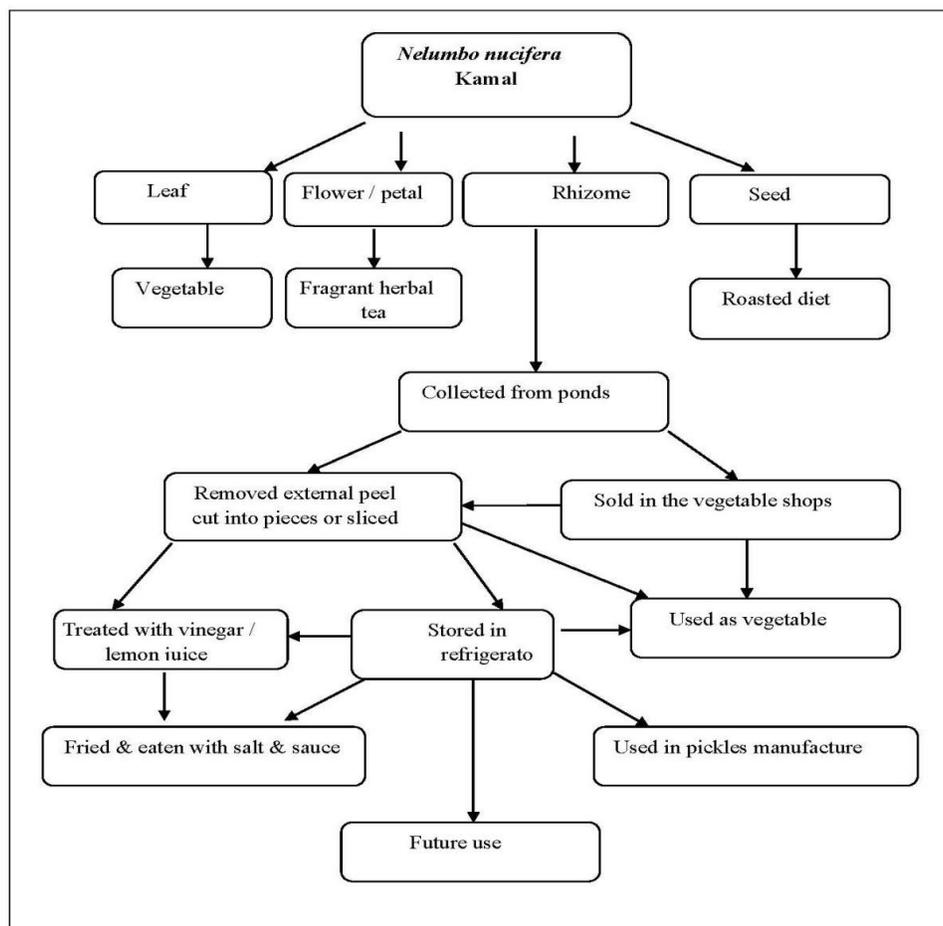


Figure 2: Flowchart showing the pathway of use of various parts of *Nelumbonucifera*

DISCUSSION

The genus *Nelumbo* with its two species i.e. *N. lutea* and *N. nucifera* is an important medicinal plant and both the species are used in medicine and food. Report is available for the use of all its parts of i.e., rhizome, petiole (in the name of stem), tender leaves, flowers, petals and seeds. *N. nucifera* is used in many ways as a source of food and for nutrition and the nutritional values of rhizome and seeds are available^{6,7}

However, it is required to study the nutraceutical values of tender leaves and the petiole. Similarly the leaves and flowers as well as seeds of *N. lutea* are used in America in the name of American lotus^{4,5}. There is need to find out the comparative study of nutraceutical components in rhizome, petiole and tender leaves of *N. lutea* along with *N. nucifera*. Various parts of *N. nucifera* contains antibacterial antidiabetic, antifungal, anti-inflammatory, antioxidant, antipyretic, hepato-protective properties which supports the health benefits of intake of different parts of *N. nucifera*^{18,19,22,26,27,28,29,30,31}. Various nutritional components that have been determined in past shows the beneficial effects of intake of *N. nucifera*, rhizomes and seeds^{7,32}.

CONCLUSION

After going through above literature it is found that the rhizome and seeds of the plant *N. nucifera* have much nutritional value and the rhizome must be included in daily diet. The studies need to be conducted on American lotus *i.e.*, *N. lutea* for comparative status of the two species and after thorough screening it should also be included as nutritional food with sufficient health benefits and should also be undertaken for extension of cultivation of both the species in ponds and lakes for commercial utilization.

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