

A REVIEW ON PHYTOCONSTITUENTS AND PHARMACOLOGICAL ACTIVITY OF *NELUMBO NUCIFERA*

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Article Received: 30 September 2025 | Article Revised: 19 October 2025 | Article Accepted: 11 November 2025

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DOI: <https://doi.org/10.5281/zenodo.17617661>

How to cite this Article: M. Suganya, Prof. Dr. B. Sangmeswaran, A. Preethi, M. Preethi, S. Priyadharshini, R. Raaghul (2025). A REVIEW ON PHYTOCONSTITUENTS AND PHARMACOLOGICAL ACTIVITY OF *NELUMBO NUCIFERA*. World Journal of Pharmaceutical Science and Research, 4(5), 1006-1010. <https://doi.org/10.5281/zenodo.17617661>



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ABSTRACT

Nelumbo nucifera commonly known as the lotus plant, has been widely used in traditional medicine systems across Asia. Various parts of the plant, including its seeds, leaves, flowers and rhizome, are rich in bioactive compounds like flavonoids, alkaloids and polyphenols. This review summarizes the phytochemical composition and pharmacological effect of lotus extract, emphasizing their antioxidant, anti-inflammatory, antidiabetic, hepatoprotective, neuroprotective and anti-cancer properties. The therapeutic potential of lotus plant extract in managing chronic diseases warrants further clinical validation.

KEYWORDS: *Nelumbo nucifera*, phytochemical composition, antioxidant activity, pharmacological effects.

INTRODUCTION

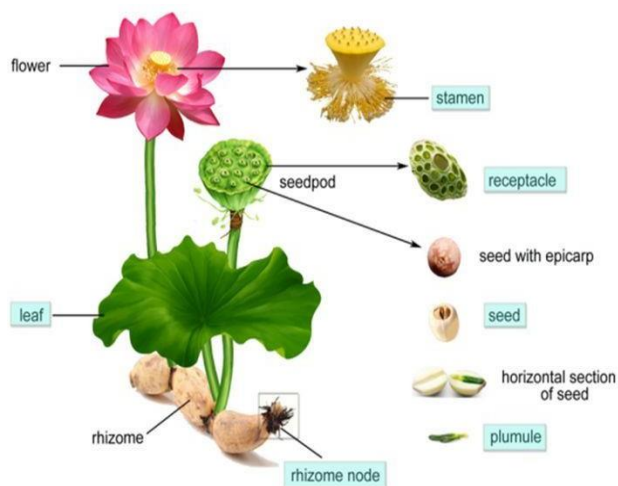
An aquatic perennial, Indian lotus is the national flower of India and Vietnam. The roots of the plant are firmly planted in the soil of the pond or river bottom. The leaves can be seen floating on the top of the water surface. Lotus grows to a height of about 150 cm, with a 3-meter horizontal spread. The leaves can be as large as 60 cm in diameter, while the showy flowers can be up to 20 cm in diameter. The fruits are a conical pod, with seeds contained in holes in the pod. The lotus flower can be seen in hues of pink and white. It is native to Greater India and commonly cultivated in water gardens.^[1]

BOTANICAL DESCRIPTION

Botanical Name : *Nelumbo nucifera*

Family Name : Nelumbonaceae

Kingdom	: Plantae
Division	: Magnoliophyta
Class	: Magnoliopsida
Order	: Proteales
Family	: Nelumbonaceae
Genus	: Nelumbo
Species	: N.nucifera
Popular Name	: Sacred Water Lotus, Sacred Water Lilly, Pink Lotus, Nelumbo Lutea.
Parts used	: Petals, seeds, leaves, roots
Habitat	: Found in ponds and swamps ^[2]



PHYTOCONSTITUENTS & PHARMACOLOGICAL ACTIVITY

1. LOTUS FLOWER

Sepals, petals and stamens are spirally arranged and gradually pass one into another.

Solitary, large 10-25cm in diameter, white pink or pinkish white fragrant peduncles arising from the nodes of the rhizomes sheathing at the base, 1-2cm long, green or blackish green, hard and stout smooth or rough due to the presence of numerous small scattered prickles.^[3,4,5,6]

Category	Major compounds	Pharmacological activity
Alkaloids	Nuciferine, Neferine, o-nornuciferine, liensinine Lsoliensinine	Responsible for sedative, Antiarrhythmic, Antioxidant properties
Flavonoids	Quercetin, Kaempferol Isoquercitrin, Catechin	Potent antioxidant, Anti-inflammatory, Hepato protective
Phenolic acids	Gallic acid, Caffeic acid, P-coumaric acid	Contribute to radical scavenging, Cytoprotective activities
Tannis	Ellagitannis, Pronthocyanidins	Exhibit antimicrobial & antioxidant
Saponins	Various triterpenoid & saponins	Involved in immune modulation & cholesterol regulation
Polysaccharides	Lotus polysaccharide fractions (LPS1-LPS3)	Immunostimulant, Antitumor activities
Essential oil	Caryophyllene, Linalool, Methylantranilate	Fragrance, Anti-inflammatory, Antimicrobial functions

2. LOTUS STEM

Lotus stem is a fleshy part of *Nelumbo nucifera*, pale green to white, long and cylindrical with nodes and internodes. It contains large air cavities [arenchyma], parenchyma rich in starch and scattered vascular bundles. It is spongy, crisp, slight sweet and yields mucilage.^[7,8,9,10]

Category	Major compounds	Pharmacological activity
Alkaloids	Nelumbine, Nuciferine, Liensinine, Neferine.	Responsible for CNS & Cardiovascular effects.
Flavonoids	Quercetin, Kaempferol, Isoquercitrin, Catechin.	Strong Anti-oxidant, Anti- inflammatory.
Phenolic compounds	Gallic acid, Ferulic acid, protocatechuic acid.	Anti- aging, Protective effects.
Tannins	Condensed tannins.	Astringent, Anti- microbial.
Saponins	Triterpenoid saponins.	Anti- inflammatory, Immune modulating.

3. LOTUS LEAVES

The varieties of enormous leaves are aerial and floating, ranging in size from 20 to 90 cm. The leaves are leathery when they are fresh, but after drying, they become nearly membranous and brittle. The lower surface has some brownish red blotching, and the petioles of the aerial leaves are erect and stout white, while those of the floating leaves are not strong enough. The diameter is abruptly acute to form a short tip, and they are petiolate, entire glaucous, non – wettable, strong nerved. Petioles are smooth, greenish or greenish brown in color with small brown spots, the usual length varies from 24.00 to 33.00 cm in case of aerial leaves and 23 to 30cm in case of floating leaves. A transverse cut of the leaf stem always reveals four separate cavities – two large in the center and two small on the periphery – in the petiole.^[11,12,13,14,15]

Category	Major compounds	Pharmacological activity
Alkaloids	Nuciferine, Neferine, Liensinine	Anti-obesity, neuroprotective, cardioprotective.
Flavonoids	Quercetin, Kaempferol, Rutin	Anti- oxidant, Hepatoprotective, Anti- inflammatory
Phenolic acids	Gallic acid, Caffeic acid, Chlorogenic acid	Anti-microbial, antioxidant
Tannins and saponins	Nil	Astringent, Anti- diarrheal
Polysaccharides	Lotus leaf polysaccharides	Wound- healing, Immune support

4. LOTUS RHIZOME

The rhizomes have a length of 60-140 cm and a diameter of 0.5 to 2.5 cm. They are smooth, longitudinally striated, with brown patches, and have nodes and internodes. Their color ranges from yellowish white to yellowish brown when freshly cut, it emits a mucilaginous liquid and has numerous bigger cavities, the fracture is fibrous and tough. There is an indistinct odor. The lotus rhizome contains diverse range of bio active compound including alkaloid, flavonoid, phenolics, tannins, polysaccharides, vitamins and minerals.^[16,17,18,19,20]

Category	Major compounds	Pharmacological activity
Aporphine alkaloid	Nuciferine	Anti-inflammatory, Anti-oxidant, Anti-obesity, Anti diabetic, Hypolipidemic
Bisbenzyl iso quinoline alkaloid	Neferine, Liensinine, Isoliensine	Anti-arrhythmic, Anti-oxidant, Anti fibrotic
Flavonoid	Quercetin, Kaempferol, Catechin, Myricetin	Anti-oxidant, Anti-microbial, Hepatoprotective
Phenolic acids	Gallic acid, Chlorogenic acid, Ferulic acid, Caffeic acid	Anti-oxidant, Anti-microbial, Hepatoprotective, Anti inflammatory
Polysaccharides	Lotus root polysaccharide	Anti-oxidant, Anti-obesity, Anti diabetic, Immunomodulatory
Vitamins	Vitamin-c, B-complex[B1,B2,B6], Niacin	Anti-oxidant, Immune boosting,

		Metabolic regulation
Minerals	Potassium, Phosphorus, Iron, Magnesium	Cardioprotective, Anti-hypertensive, Blood purifying
Carbohydrate	Dietary fibre	Hypocholesterolemic, Improve digestion

5. LOTUS SEED

The seeds are round to oval in shape, hard, and have a smooth outer testa. They are typically brown to dark brown in color with a small depression at one end. It is 1-1.5 cm long and 0.8-1.2 cm wide. Internally, the seed contains a white, starchy cotyledon and a green embryo located centrally, often referred to as the lotus plumule. The seeds are enclosed in the lotus fruit, which is a spongy, cone-shaped receptacle containing multiple seed chambers.

The seed of lotus are unique among aquatic plants for their hard, long-lived structure and remarkable viability often lasting for centuries.^[21,22,23,24,25]

Category	Major compound	Pharmacological activity
Alkaloid	Neferine, Nuciferine, Liensinine, Isoliensinine, Lotusine	Antioxidant, Anti-inflammatory, Neuroprotective, Anticancer
Flavonoid	Kaempferol, Quercetin, Isoquercitrin	Antioxidant, Anti-aging, Anti-inflammatory
Phenolic compound	Gallic acid, Caffeic acid, Chlorogenic acid	Antioxidant, Hepatoprotective, Antidiabetic
Glycosides & Saponins	Flavone glycosides, Steroidal saponins	Immunomodulatory, Cardioprotective
Polysaccharides	Lotus seed polysaccharides (LSPs)	Antidiabetic, Anti-obesity, Immunostimulatory,
Proteins & Amino acid	Essential amino acids, high protein content	Nutritional, Muscle maintenance, Metabolic support
Vitamins & Minerals	B-complex vitamins, Vitamin C, Mg, K, P, Zn, Fe, Ca	Nutritional, Antioxidant, Metabolic health

CONCLUSION

Nelumbo nucifera (Lotus) is a sacred and medicinally important plant with remarkable ethnobotanical, pharmacological, and nutritional value. Various parts of the plant—including the root, seeds, leaves, and flowers—contain a wide range of bioactive phytoconstituents such as alkaloids, flavonoids, tannins, phenolic compounds, and glycosides. These constituents contribute to its diverse pharmacological properties, including antioxidant, anti-inflammatory, antidiabetic, hepatoprotective, cardioprotective, antimicrobial, and neuroprotective effects.

Despite extensive traditional use and promising experimental findings, further clinical studies and mechanistic investigations are necessary to validate its therapeutic potential and establish standardized formulations. The integration of modern pharmacological research with traditional knowledge could promote the development of novel plant-based medicines from *Nelumbo nucifera*, enhancing its role in modern healthcare systems.

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