



Medicinal Properties of Lotus (*Nelumbo nucifera*) and Its Therapeutic Applications

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Nelumbo nucifera, commonly known as sacred lotus or Indian lotus, is one of the most important aquatic medicinal plants cultivated throughout Asia for its nutritional, medicinal and cultural significance. Every part of the lotus plant, including the rhizome, leaves, flowers, seeds and seed embryos, contains a wide range of bioactive compounds such as alkaloids, flavonoids, polyphenols, glycosides and tannins that contribute to its therapeutic potential. Recent pharmacological studies have confirmed several biological activities of lotus, including antioxidant, anti-inflammatory, antidiabetic, antimicrobial, antiviral, anticancer, cardioprotective and anti-obesity effects. These medicinal properties are mainly attributed to compounds such as nuciferine, neferine, liensinine, quercetin and procyanidins. Besides its pharmaceutical importance, lotus also serves as a valuable functional food due to its rich nutritional composition.

Keywords: *Nelumbo nucifera*, sacred lotus, medicinal plant, phytochemicals, antioxidant, therapeutic applications, nutraceuticals.

Introduction

Lotus (*Nelumbo nucifera*) is an ancient aquatic flowering plant belonging to the family Nelumbonaceae. It is native to India and has been cultivated for thousands of years throughout China, Japan, Southeast Asia and several other Asian countries. Besides its economic value, lotus possesses immense cultural and religious significance. In Hinduism and Buddhism, the lotus flower symbolizes purity, wisdom, prosperity and spiritual enlightenment because it blooms beautifully above muddy water while remaining clean and elegant. Apart from its cultural importance, lotus is recognized worldwide as a highly valuable medicinal plant. Nearly every plant part including rhizomes, leaves, flowers, stamens, fruits, seeds and embryos has therapeutic value. Growing interest in herbal medicines and functional foods has further increased the importance of lotus as a potential source of natural therapeutic compounds. Its excellent nutritional profile combined with potent antioxidant and anti-inflammatory properties makes lotus an attractive candidate for pharmaceutical, nutraceutical and food industries.

Origin and Distribution

Lotus originated in the Indian subcontinent and later spread naturally and through cultivation to Persia, Egypt, China, Japan and many other Asian countries. At present, it is cultivated extensively in India, China, Japan, Australia, Iran, Korea and Southeast Asian countries. China remains one of the largest producers of lotus, where thousands of hectares are cultivated annually for food, medicinal and ornamental purposes.

Nutritional Composition of Lotus

Lotus is considered a highly nutritious aquatic plant because almost every part of the plant is edible and rich in essential nutrients. The rhizomes, seeds, leaves, flowers and stems are

widely consumed in Asian countries as vegetables, traditional medicines and functional foods.

Rhizomes

The underground rhizome is one of the most consumed parts of the lotus plant. It possesses a mild flavour and is widely used in soups, curries, pickles and stir-fried dishes. Nutritionally, lotus rhizomes contain carbohydrates, dietary fibre, proteins, vitamins and essential minerals. Besides serving as an energy source, they also possess medicinal properties including anti-inflammatory and antidiabetic activities.

Seeds

Lotus seeds are regarded as one of the most valuable components of the plant because of their excellent nutritional and medicinal properties. They contain approximately 10–16% protein, 70–72% carbohydrates, small amounts of healthy fats, dietary fibre and several important minerals including potassium, calcium, magnesium, iron, zinc and manganese. Owing to their balanced nutrient composition, lotus seeds are consumed as snacks, flour, beverages and ingredients in bakery products.

Leaves, Flowers and Stems

Young leaves and stems are consumed as vegetables in several Asian countries. Lotus leaves are also traditionally used for preparing herbal teas because of their antioxidant and anti-obesity properties. These edible plant parts contribute valuable phytochemicals, vitamins and antioxidants that promote overall health.

Bioactive Phytochemical Constituents

The remarkable medicinal value of *Nelumbo nucifera* is mainly attributed to its diverse phytochemical composition. Different plant parts contain numerous secondary metabolites that exhibit strong pharmacological activities.

Alkaloids

Alkaloids are the major biologically active compounds found in lotus. Important alkaloids include nuciferine, neferine, liensinine, isoliensinine, dauricine, lotusine, pronuciferine, roemerine and nelumbine. These compounds exhibit cardioprotective, antihypertensive, sedative, anti-arrhythmic and neuroprotective activities. Neferine and liensinine are particularly known for protecting cardiovascular tissues and regulating abnormal heart rhythm.

Flavonoids

Lotus leaves, flowers and stamens contain abundant flavonoids such as quercetin, kaempferol and isorhamnetin derivatives. These compounds possess strong antioxidant, anti-inflammatory and free radical scavenging activities. Flavonoids also help reduce oxidative stress, inhibit lipid peroxidation and protect cells against damage caused by reactive oxygen species.

Phenolic Compounds and Polyphenols

Phenolic compounds contribute significantly to the antioxidant capacity of lotus. They neutralize harmful free radicals, reduce cellular damage and lower the risk of chronic diseases such as cardiovascular disorders, diabetes and cancer. Polyphenols present in lotus seeds and seed pods also help preserve food quality by preventing oxidation.

Procyanidins

Lotus seed pods contain high concentrations of procyanidins, a class of condensed tannins recognized for their exceptional antioxidant activity. These compounds effectively scavenge superoxide and hydroxyl radicals, protecting biological tissues from oxidative damage. Studies have shown that procyanidins from lotus seed pods exhibit antioxidant activity

comparable to well-known synthetic antioxidants, suggesting their potential use as natural food preservatives and nutraceutical ingredients.

Glycosides and Other Phytochemicals

In addition to alkaloids and flavonoids, lotus contains glycosides, tannins, saponins, steroids and various volatile compounds that contribute to its medicinal efficacy. These phytochemicals collectively provide antimicrobial, anti-inflammatory, hepatoprotective and immunomodulatory effects, making lotus a valuable medicinal resource for pharmaceutical research.

Medicinal Properties of *Nelumbo nucifera*

The medicinal importance of *Nelumbo nucifera* has been recognized in traditional systems of medicine for centuries. The presence of alkaloids, flavonoids, phenolic compounds, tannins and glycosides contributes to a wide range of biological activities, making lotus a valuable medicinal plant.

Antioxidant Activity

Oxidative stress caused by excessive production of free radicals is associated with ageing and numerous chronic diseases such as cancer, diabetes, cardiovascular disorders and neurodegenerative diseases. Lotus exhibits remarkable antioxidant activity due to the presence of flavonoids, polyphenols and procyanidins. Procyanidins isolated from lotus seed pods possess particularly strong antioxidant properties, making them promising natural antioxidants for pharmaceutical and food applications.

Antidiabetic Activity

Diabetes mellitus is one of the fastest-growing metabolic disorders worldwide. Traditional medicine has long recommended lotus rhizomes and seeds for regulating blood glucose levels. Scientific investigations have confirmed that extracts from lotus rhizomes exhibit significant hypoglycaemic activity by improving glucose metabolism and reducing blood sugar levels.

Anti-inflammatory Activity

Inflammation is the body's natural defence mechanism; however, prolonged inflammation contributes to numerous chronic diseases. Lotus rhizomes contain triterpenoids, flavonoids and phenolic compounds that exhibit potent anti-inflammatory effects. Experimental studies have demonstrated that lotus extracts suppress inflammatory mediators and reduce tissue inflammation. These findings support the traditional use of lotus in treating inflammatory disorders, skin diseases and painful condition.

Cardioprotective Activity

Cardiovascular diseases remain a major cause of mortality worldwide. Lotus contains several alkaloids, particularly neferine, liensinine and dauricine, which possess significant cardioprotective properties. These compounds help regulate cardiac rhythm, relax blood vessels, lower blood pressure and improve heart function. Neferine has also been reported to inhibit platelet aggregation, thereby reducing the risk of thrombus formation. These findings indicate that lotus has considerable potential in preventing hypertension, arrhythmias and other cardiovascular disorders.

Anticancer Activity

Recent pharmacological research suggests that lotus possesses promising anticancer properties. Ethanolic extracts of lotus inhibit the proliferation of cancer cells by regulating cell cycle progression and suppressing inflammatory cytokines involved in tumour development. Studies have also shown that the alkaloid (S)-armepavine, isolated from lotus, exhibits immunomodulatory activity and may help manage autoimmune diseases while inhibiting abnormal cell proliferation.

Antiviral Activity

Several phytochemicals isolated from lotus have demonstrated antiviral activity against important human viruses. Benzyloisoquinoline alkaloids and flavonoids extracted from lotus leaves have shown inhibitory effects against the Human Immunodeficiency Virus (HIV). Similarly, ethanolic seed extracts have exhibited inhibitory activity against Herpes Simplex Virus Type-1 (HSV-1) by reducing viral replication.

Therapeutic Applications of Lotus

Because of its broad spectrum of pharmacological activities, lotus has numerous therapeutic applications in traditional and modern healthcare systems. Various parts of the plant are utilized for different medicinal purposes:

- Rhizomes are used to manage diabetes, inflammation and digestive disorders.
- Leaves are consumed for obesity management, hyperlipidaemia and fever.
- Flowers are used to treat bleeding disorders, diarrhoea and liver ailments.
- Seeds serve as nutritious functional foods and are traditionally used to improve kidney function, strengthen the body and treat insomnia.
- Seed embryos are valuable in traditional medicine for managing hypertension, cardiac disorders and nervous system diseases because of their high alkaloid content.

Conclusion

Lotus (Nelumbo nucifera) is a remarkable aquatic medicinal plant with exceptional nutritional, pharmacological and therapeutic importance. Every part of the plant—including rhizomes, leaves, flowers, seeds and embryos—contains valuable bioactive compounds such as alkaloids, flavonoids, phenolic compounds and procyanidins that contribute to its diverse medicinal properties. Scientific investigations have confirmed that lotus exhibits significant antioxidant, anti-inflammatory, antidiabetic, cardioprotective, antimicrobial, antiviral, anticancer and anti-obesity activities, thereby supporting its traditional use in Ayurveda and Traditional Chinese Medicine. In addition to its medicinal value, lotus serves as an important functional food because of its rich nutritional composition and health-promoting properties. Therefore, *Nelumbo nucifera* should be regarded as a valuable medicinal resource capable of addressing future healthcare challenges through safe, natural and sustainable therapeutic approaches.

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