

Lotus Stem: A Biofunctional Aquatic Vegetable with Multifaceted Benefits

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Lotus (*Nelumbo nucifera*), commonly known as the holy lotus or Asian lotus, belongs to the family Nelumbonaceae and is native to

Asia. It is a perennial aquatic flowering plant whose various parts are widely used for medicinal, nutritional, and cultural purposes. The plant arises from creeping rhizomes

bearing nodes, each producing a single leaf (Matthews & Seymour, 2006). Lotus flowers possess thermogenic properties that help regulate floral temperature and attract pollinators.

The plant bears aerial and floating orbicular leaves with self-cleaning abilities due to their hydrophobic surface. Lotus leaves are traditionally used in herbal medicines for treating hyperlipidemia and regulating blood lipids, whereas its seeds maintain viability for several decades or even centuries. Gas exchange occurs through the leaves: oxygen-rich air is transported to the rhizomes, and excess air escapes through the same pathway.



Different plant parts—buds, flowers, leaves, stems, and roots—contain valuable metabolites such as alkaloids, flavonoids, polyphenols, and steroids. Lotus

also influences cuticular wax formation in plants like *Arabidopsis* by producing extra-long-chain fatty acids. Lotus roots (rhizomes) efficiently absorb water pollutants, including heavy metals, helping to mitigate eutrophication and maintain aquatic ecosystem balance. Additionally, lotus biomass can be converted into biochar with a porous structure suitable for soil amendments and carbon sequestration.

The lotus stem (kamal kakdi) is widely consumed as a vegetable due to its delicate flavor and sweet taste. It is a modified subterranean, elongated rhizome that enlarges during autumn. Typically brown to yellowish-green externally with white flesh and characteristic air cavities, it withstands submergence and low-oxygen conditions owing to its extensive aerenchyma tissue (Lin et al., 2019). Lotus stem is

consumed fresh, dried, fried, roasted, or pickled across India, China, Southeast Asia, and Japan. Lotus stem starch serves as a thickener and stabilizer in food industries.

After the harvesting of flowers and seeds, leftover lotus biomass provides a sustainable resource for producing electrochemical carbon materials, attributed to its high cellulose content and naturally porous anatomy. Various forms of lotus stem are also used in metal fabrication industries for developing energy-efficient, eco-friendly carbon materials.

Nutritional Importance

- High vitamin C content strengthens immunity, prevents oxidative stress, and helps combat viral diseases.
- Considered part of healthy diets due to high dietary fiber and low fat levels.
- Rich in fiber, supporting improved digestion and gut health.
- Contains proteins, carbohydrates, vitamins (Vitamin B6 and C), and essential minerals such as calcium (6 mg/100 g), iron (2.4 mg/100 g), and zinc (0.2 mg/100 g), along with trace elements like copper, magnesium, manganese, and potassium, contributing to its nutritional and therapeutic value (Ogle et al., 2001).
- Dried lotus stem serves as an excellent source of iron, important for healthy blood metabolism.



Fig. Overview of lotus plant in its natural aquatic habitat with submerged stems.

Benefits and Uses

- Phytochemicals in lotus stem aid in preventing cancer, asthma, ulcerative colitis, and cardiovascular disorders.
- Used in traditional medicine to treat diarrhea, dyspepsia, and piles.
- Exhibits antifungal, antibacterial, antiviral, and anti-obesity properties.
- Contains a high amount of starch, useful in textile, food processing, and pharmaceutical industries; also a natural source of cellulose.
- Employed in Ayurveda for treating leprosy, skin allergies, emotional exhaustion, and diuretic problems (Sridhar & Bhat, 2007).
- Aids in red blood cell formation, regulates blood pressure, and enhances blood circulation due to vasodilatory properties (Zaidi et al., 2021).
- Enhances antioxidant activity through amino acids like tryptophan.
- Used in the development of high-performance sodium-ion batteries due to its natural porous structure (Zhang et al., 2018).
- Supports production of porous activated carbon with strong CO₂ adsorption capacity.

- Used to create nitrogen-doped porous carbon with efficient oxygen reduction reaction (ORR) activity and high stability, suitable for electrochemical applications (Weththasinha et al., 2017).
- Lotus stem fibers are used in producing eco-friendly, biodegradable polymer composites.
- Lotus stem flour, after drying, is used as a functional ingredient in health-oriented value-added food products.
- Demonstrates antibacterial activity against *Bacillus subtilis*, *Staphylococcus aureus*, *Pseudomonas aeruginosa*, and *Escherichia coli*.

Conclusion

Lotus stem is an underutilized yet highly valuable part of the lotus plant, offering nutritional, medicinal, industrial, and environmental benefits. Its structural adaptations allow it to thrive under submergence while providing diverse applications ranging from functional foods to advanced industrial materials. The presence of polysaccharides, fiber, essential minerals, vitamins, and bioactive compounds enhances its significance in health, nutrition, pharmaceuticals, and emerging technologies. With increasing interest in natural and sustainable resources, lotus stem holds promising potential in modern healthcare and industrial innovation.

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