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THE POTENTIAL EMPHASIS OF *NELUMBO NUCIFERA* GAERTN IN PHARMACEUTICAL SCIENCES.

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ABSTRACT

REVIEW ARTICLE

Currently, herbal Medicine is the matriarch form of medicine known to fidelity of creature. Herbal medicine is still the underpinning of about 78 - 80% of the world population, particularly in the grow up countries, for primitive health care. Nature yields a medicine being full of extraordinary shrubs, herbs and flowers, which form the ground for many modern medicines. Herbal medicines are getting more influential in the regimen of different disorders because the prevalent synthetic medicines have side effects. For this acumen, a broad scale of the Indian population for their physical and mental health confide largely on traditional system of medicines. *Nelumbo nucifera* commonly expressed as sacred lotus, bean of India, Indian lotus or simply lotus. It is the National flower of India. It symbolizes spirituality, fruitfulness, prosperity, comprehension & illumination.

INTRODUCTION:

History of plant:

In prehistoric times, the lotus was widespread along the banks of the river Nile, together with the closely related species "sacred blue lotus". Lotus belongs to the Nelumbolaceae family and the genus Nelumbo. There are only two species in this genus: Nelumbo nucifera with pink, red or white flowers, distributed in India to China and Southern Asia while yellow flowers, distributed in North and South America [1].

Vernacular Names: [3-5]

Table 1: Showing vernacular names of *Nelumbo Nucifera* Gaertn -

S.N.	Languages	Vernacular Names
1	*Hindi*	Kanwal, Kamal, Puryin, Kanval
2	*English*	The sacred lotus, Indian lotus, Lotus, Chinese water lily

3	*Telugu*	Damara, Tamara, puvow, Erratamara, Kaluva, Erra – tamara –veru, Kalung
4	*Malyalam*	Thamara, Venthamara, Chenthamara, Senthamara,
5	*Tamil*	Thamaraipoo, Tamarai, Arvindan, Thamarai, Paduman, Kamalam, Sarojam Centamarai, Shivapputamara-ver, Ambal
6	*Bangali*	Padma, phool, Salaphool
7	*Punjabi*	Kawal kakri
8	*Marathi*	Kamala
9	*Kannada*	Tavare, Naidile, Tavaregedd, Tavaribija
10	*Udiya*	Padma
11	*Gujrati*	Kamal, Suriyakamal
12	*Arabi*	Nilufer, Ussulnellufir
13	*Assamese*	Podum

Botanical classification [9-11]

Table 2: Showing Botanical classification of *Nelumbo nucifera*

Kingdom	**Plantae**
Subkingdom	Tracheobionata
Superdivision	Spermatophyta
Division	Magnoliophyta
Class	Magnoliopsida
Subclass	Magnoliidae
Superorder	Protaenae
Order	Proteales
Family	Nelumbonaceae
Genus	*Nelumbo*
Species	*N. Nucifera*

MORPHOLOGY:

The sacred lotus is a perennial aquatic plant with rhizomes grows in the mud at the bottom of shallow ponds, lakes, lagoons, marshes & flooded fields Lotus grows a height of about 59 inches, with a 118 inches horizontal spread. The leaves can be as large as 60cm in diameter, while the showy flower can be up to 7.8 inches in diameter. The fruits are a conical pod, with seeds contained inhales in the pod [12].

Fig.1 Lotus Fruit and sedds

Fig.2 Lotous flower, anthers and filament

Fig.3 Lotuus Rhizomes

Fig.4 Whole parts of Lotus plant

Fruits & Seeds: Fruit is an aggregate of indehiscent nut-lets. Ripe nutlets are ovoid, roundish or oblongs up to 3.93 inches long, 0.591 inches broad with hard smooth, brownish or grayish black pericarp which is faintly longitudinally striated, pedunculated & one-seeded. Seeds fill in the ripe care [13]. Fruits of *N.nucifera* have a remarkable power of dormancy & indeed the proved longevity of its seed exceeds that of any known species of the flowering plant [14].

Flowers: Solitary, large, 3.93-9.48 inches in diameter, white, pinkish or pinkish-white fragrant peduncles arising from the nodes of the rhizomes, sheathing at the base, 1-2 cm long, green or blackish green, hard & stout, smooth or rough due to the presence of numerous small scattered prickles, sepals, petals & stamens are spirally arranged passing gradually once into another [15-16].

Rhizomes: Rhizomes are rich in mineral content hence are used as food as well as vegetable in Asian countries. Whereas, tissues are rich in starch, however fresh rhizome has 31.2% of starch with no scent or flavor. Fresh rhizome also contains 9.25% starch, 83.80% water, 0.80% fiber, 1.56% reducing sugar, 2.70% crude protein, 0.41% sucrose, 0.11% fat and 0.06% calcium. Moreover, oxalate compound in rhizome has found to be 84.3 mg in 100 g. When the characteristic property of starch lotus was tested and compared to potato and maize starch, it is found to have a better property of disintegration and binding in pharmaceutical preparations such as tablets. Further researches reveal that rhizome's methanol extract has steroidal, triterpenoid i.e. betulinic acid [64, 67].

Phytochemistry:

Table 3: Various constituents found in the lotus plants [23-26].

S.No	Phytoconstituents	Examples
1	Alkaloids	including nuciferine, neferine, lotusine, isoliensinine, quercitin,and isoquercitrin.
2	Oil	myristic, palmitic, oleic and linoleic acid
3	Flavonoids	isorhamnetin, kaempferol, quercetin, quercetin-3-O-β-Dxylopyranosyl-1,2-β-D-glucopyranosyl glycosides, astragalin, chrysoeriol-7-O-β-D-glucoside, isoquercitrin and hyperin.
4	Antagonistic alkaloids	Asimilobine and lirinidine
5	Glycoside	Nelumbine
6	Water content in rhizomes	83.80 %
7	Fat	0.11 %
8	Ash	1.10 %
9	Calcium	0.06 %
10	Vitamins: Thiamine Riboflavin Niacin Ascorbic acid – 1.5.	 0.22 % 0.06 % 2.1% 1.5%
11	Oxalate	32 %

Distribution in India: It is native of India, Japan, and China. It is found throughout India, extending to N.W. Himalaya, Kashmir, W. Bengal, Central and southern areas of Bihar, Orissa, Maharashtra, in most districts of

South India, especially in the hotter localities [41].

Cultivation: The plants are usually propagated by rhizomes and may also be propagated by seeds. Rhizomes, cut into small pieces, are planted with buds above the soil surface in March – April. Care is taken that enough water is retained in the pond or tub till October. If grown from seeds 10 – 12 kg of seeds is enough to get sufficient seedlings for plantation in one hectare. The plant flowers profusely during hot and rainy seasons and seeds ripen towards the end of rains. It yields approximately 3600 to 4600 kg of rhizomes per hectare, which are ready for harvesting in October [55].

TRADITIONAL THERAPEUTIC USES:

S.NO.	LOTUS PARTS OF PLANT	THERAPEUTIC USES
1	Whole plant	Removes worms; allays thirst, fever, biliousness, vomiting, and strangury
2	Tender leaves	The tender leaves are bitter, cooling; useful in burning sensation of the body, thirst, strangury, piles, and leprosy. The large leaves are used as cool bed sheets in high-grade fever, Diarrhoea[37],
3	Filaments	It is sweet and cooling; it allays cough, thirst, blood defects, skin eruptions and symptoms of poisoning; good in fever and biliousness; beneficial to the eyes and also recommended as a cardiac tonic, bleeding piles[37]
4	Flower	Snake bite[37], heart and brain tonic[35], bronchitis and internal injuries[37], watery eyes[35]
5	Seed	Eye disease[37], the seeds are sweet and flavoury, astringent and slightly bitter, aphrodisiac, sedative to the pregnant uterus, destroy *Kapha* and *Vata*, good astringent in diarrhea and dysentery, and strengthen the body, useful in burning sensation of body, vomiting, and leprosy.
6	Root	For heart-strengthening in high-grade fever, good heart tonic[16], the root is bitter; it cures cough and biliousness; allays thirst, and is cooling to the body. The powdered root is prescribed for piles as a demulcent; also for dysentery and dyspepsia. It is used as a paste in ringworm and other cutaneous affections.
7	Anthers	The anthers are cooling, aphrodisiac, astringent to the taste and in diarrhea; remove *Kapha* and *Pitta*; sedative to the uterus; good in thirst, bleeding piles, inflammations, and poisoning; cures ulcers and sores of the mouth
8	Fruit	It is bitter and astringent, sweet and cooling; removes thirst, blood impurities, *Kapha* and *Pitta*, and foul breath
9	Stem	It is good in strangury, blood complaints, vomiting, and leprosy.

RESEARCH COMBAT: The following activity has been found in various research articles.

Anti-arrhythmic activity: Neferine, an alkaloid isolated from the seed embryo of N. Nucifera, has been reported to have antiarrhythmic effects on rabbit SA nodes and clusters of cultured cardiac myocytes from neonatal rats. Neferine inhibits the slow transmembrane Na+ and/or Ca 2+ current of the myocardium, which leads to its anti-arrhythmic action. Neferine causes non-specific inhibition of the Na +, Ca 2+ and K + cardiac transmembrane currents in guinea-pig papillary muscles and atria, which relates to its anti-arrhythmic activity[32].

Anti-fertility activity: The petroleum ether extract of the seed has been reported to possess anti-fertility activity in female albino mice – at a dose of 3 mg/kg. It blocked the oestrus cycle at the metoestrus stage compared with ethyl oleate. The extract significantly reduced uterine weight and affected the oestrus cycle by blocking the biogenesis of ovarian steroids[77].

Antidiabetic effects: An ethanol rhizome extract reduced the blood sugar level of normal rats and glucose-fed hyperglycemic and streptozotocin-induced diabetic rats [74, 61].

Anti-inflammatory effects: A methanol rhizome extract at dosages of 200 and 400 mg/kg inhibited induced inflammation in rats. The anti-inflammatory activity was comparable with that of phenylbutazone and dexamethasone [48, 67].

Anti-malarial: The leaves have been indicated as a part of the plant responsible for its anti-inflammatory activity [68].

Anti-pyretic: The ethanol extract of stalks of *N.nucifera* was evaluated for its antipyretic potential on normal body temperature and yeast induced pyrexia in rats. The stalk extract showed significant activity in both the models at oral doses of 200 and 400 mg/kg. The stalk extract at a dose of 200 mg/kg was found to produce a significant lowering of normal body temperature up to 3 h and at 400 mg/kg it caused a significant lowering of body temperature up to 6 h after its administration. In the model of yeast provoked elevation of body temperature the extract showed a dose-dependent lowering of body temperature up to 4 h at both the doses and the results were comparable to that of paracetamol, a standard antipyretic agent [44].

Anti-estrogenic effect: Administration of *N.nucifera* to female rats caused estrogen inhibition due to its anti-estrogenic nature. The decrease in the weight of ovary and uterus shows anti-estrogenic nature of *N.nucifera* since anti-estrogenic substance decreases the wet weight of the uterus [66].

Anti-platelet activity: The hydroethanolic extracts of both white and pink *N.nucifera* flowers possess potent antiplatelet activity limited to primary hemostasis in human blood. The flavonoids present in hydroethanolic extract might have prevented the adhesion and aggregation of platelets besides the release of cytoplasmic calcium that stimulates the release of ADP [52].

Anti-analgesic activity: The methanolic extract of red and white lotus seeds is an effective analgesic agent. While comparing the lotus seed extracts, the white lotus seed at 600 mg/kg body weight revealed a higher effect than others [54].

Anti-diarrhoeal activity: The methanolic extract of rhizomes of *N.nucifera* showed significant inhibitory activity against Castor oil-induced diarrhea and PGE2 induced enter polling in rats [60].

Antioxidant effects: The *N.nucifera* had potent therapeutic efficacy in modulating erythrocyte function and structural abnormalities by their remarkable hypocholesterolemic and antioxidant property [58]. Four different chemical analyses document high antioxidant activity from the rhizome knot [90].

Anti-infective effects: Ethanol seed extracts inhibited herpes simplex virus type 1

(HSV-1) multiplication in cells without cytotoxicity by inhibiting gene expression of HSV1 [8, 51, 57].

Anti-allergic effects: A stamen methanol extract containing kaempferol inhibited key receptors and attenuated immunoglobulin E–mediated allergic reactions. [36, 87].

Anti-fertility activity: A petroleum ether extract of seed has been reported to possess anti-fertility activity in female albino mice at the dose of 3 mg/kg. It blocked the oestrus cycle at the metoestrus stage compared with ethyl oleate (0.1ml/20g). The extract significantly reduced uterine weight and affected the oestrus cycle by blocking the biogenesis of ovarian steroids at an intermediate stage [6, 63].

Anti-inflammatory activity: A methanol rhizome extract at dosages of 200 and 400 mg/kg inhibited induced inflammation in rats. The anti-inflammatory activity was comparable with that of phenylbutazone and dexamethasone [48, 67].

Cytoprotective effects: The lotus root extracts may contain a variety of antioxidants, such as carotenoids, lipoic acid, uric acid, and others, and they may also contribute to the protective effects of these extracts against the iron-induced cell death observed here[53].

Effects on lipids and obesity: A research investigated by Chinese herbal mixture containing sacred lotus reduced serum triglycerides and cholesterol in rats fed a high-fat diet [47]. While an ethanol leaf extracts stimulated lipolysis in visceral and subcutaneous adipose tissues in mice. The pathway involved the beta-adrenergic receptor-mediated in energy expenditure and the prevention of diet-induced obesity. The ethanol leaf extract also suppressed body weight gain in mice fed a high-fat diet [48]. Flavonoids enriched leaf extract reduced blood and liver lipids, lipid peroxidation, the release of the liver enzymes AST and ALT, the LDL-C to HDL-C ratio, and lipid accumulation in the liver in a high-fat diet animal model T [49,50]. The effect of the leaf extract on the high-fat–induced lipid metabolic disorder was comparable with the results of silymarin and simvastatin treatment. The flavonoids from the leaf extract may exert antiatherogenic properties by inhibiting vascular smooth muscle cell proliferation and migration [51]. It also showed a significant reduction of gastrointestinal motility in rats, thus indicating its efficacy as an anti-diarrhoeal agent [55].

Hepatoprotective effects: Ethanol seed extracts exhibited hepatoprotective effects against the production of serum enzymes and cytotoxicity caused by carbon tetrachloride. The extract also protected against the genotoxic and cytotoxic effects of aflatoxin B1 [57].

Immunomodulatory effects: A lotus seed ethanol extract inhibited cell-cycle progression, cytokine gene expression, and cell proliferation in human peripheral blood mononuclear cells (PBMCs) [56].

Lipolytic activity: The lipolytic activity of petal extracts of *N.nucifera* was tested. The petal extracts of *N. Nucifera* clearly exhibit lipolytic activity in a dose-dependent manner in murine 3T3-L1fibroblasts. It was also found that the dietary fat is not directly absorbed by the intestine unless the fat has been subjected to the action of pancreatic lipase. Therefore, pancreatic lipase is one of the most widely studied mechanisms for determining natural products and potential efficacy as antiobesity agents. In this study, they reported the inhibitory effects of *Nelumbo nucifera* petal extracts on pancreatic lipase [36, 83].

Memory and Neurogenesis: Positive effects of N. Nucifera rhizome extract were observed on learning and memory function. The test performed for evaluating this effect is a step-through passive avoidance test, however, immune-histo-chemistry was used to determine cell differentiation and proliferation in the dentate gyrus of the hippocampus. To test the cognitive behavior the methanol extract of N. Nucifera rhizome (MNR) was used in Wistar rats. The methanol extract of the N. Nucifera

showed the positive effects of learning, neurogenesis and memory functions in dentate gyrus a part of the hypothalamus [62].

Nootropics: Methanolic extract of rhizomes of *N.nucifera* was found to cause significant reduction in spontaneous activity, decrease in the exploratory behavioral pattern by the head dip and Y maze tests, muscle relaxant activity and potentiating of pentobarbitone induced sleeping time [45].

Psychopharmacologic activity: The alkaloids asimilobine and pyrimidine, isolated from the leaves of the sacred lotus, inhibited the contraction of rabbit isolated aorta induced by serotonin [64]. Neferine from lotus seed embryos may have antidepressant activity as indicated by its antiimmobility effects in mice in a forced swimming test [75].

Other effects: *N.nucifera* leaf extract inhibits neointimal hyperplasia through modulation of smooth muscle cell proliferation and migration. *N.nucifera* can be considered of therapeutic value in the prevention of atherosclerosis because restenosis after percutaneous transluminal coronary angioplasty can be considered a model of "accelerated atherosclerosis [71]. Methanolic extracts from the flower buds and leaves of sacred lotus (*Nelumbo nucifera*, Nelumbonaceae) were found to show inhibitory effects on melanogenesis in theophylline-stimulated murine B16 melanoma 4A5 cells [86].

CONCLUSION:

Ayurvedic healing is completely dependent on herbs, which have certain medicinal value or property. Ayurvedic herbs that have medicinal quality provide rational means for the treatment of many diseases. *N.nucifera* has lots of medicinal properties; its different parts are used to cure many diseases. This review reflects the importance of *N.nucifera* is used in vitiated *Kapha-Pitta dosha* & in discoloration of urine. The whole plant removes worms, allays vomiting, thirst, fever, biliousness & strangury. The root is bitter & its paste is used in ringworm & other cutaneous infections. The stem is used in blood complaints. Tender leaves are astringent, cooling, and useful in the burning sensation of the body. Its flower is recommended as a cardiac tonic. This will furthermore endow with valuable information which will help in getting additional knowledge about *Kamal* & its variable uses.

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