

A REVIEW ON *NELUMBO NUCIFERA*

Pharmaceutical Science

R. Lavanya

Lecturer in Pharmacy, KDR Government Polytechnic, Wanaparthy

ABSTRACT

Nelumbo nucifera known by numerous common names including Indian lotus, sacred lotus or simply lotus is one of the most important medicinal plants. The pharmacological studies have shown that *N. nucifera* possesses various pharmacological activities like antioxidant, immunomodulatory, anti-Parkinsonian, hypoglycemic, antiviral, antibacterial, antifungal, anti-inflammatory, antipyretic, analgesic, anti cancer, antiobesity and antithrombotic activities. This review consists of a discussion on the various biological activities of the plant.

KEYWORDS

Nelumbo nucifera, Pharmacological, extracts.

INTRODUCTION

Herbal Medicine is the oldest form of medicine known to mankind. It is the most widely practiced form of medicine in the world according to World Health Organization. *Nelumbo nucifera* is an aquatic perennial herb and belongs to family Nelumbonaceae^[1,2]. The roots of the plant remain anchored within the muddy base of the water bodies. The leaves are 60cm large in diameter and float atop the surface of the water.

SYNONYMS^[3]:

English – Sacred lotus;
Hindi – Kanwal, Kamal;
Sanskrit – Ambuja;
Telugu - Thamarā, Kamala.
Tamil – Ambal, Thamarai, Padma, Pankaja, Kamala;
Gujarat – Suriyakamal;
Malayalam – Tamara;
French – Nelumbo;
German – Indische lotosblume;
Persian – Nilufer.

TAXONOMIC CLASSIFICATION^[4]:

Kingdom: Plantae – Plants;
Sub Kingdom: Tracheobionta – Vascular Plants;
Super Division: Spermatophyta – Seed Plants;
Division: Magnoliophyta – Flowering Plants;
Class: Magnoliopsida;
Subclass: Magnoliidae;
Super order: Proteanae;
Order: Proteales;
Family: Nymphaeaceae – Lotus Family;
Genus: *Nelumbo* Adans – Lotus;
Species: *Nelumbo nucifera* Gaen. – Sacred lotus.

Nelumbo nucifera Leaves, flowers, rhizomes, roots, fruits and seeds have been claimed to possess various medicinal values.

Antioxidant Activity

When there is an increase in the accumulation of free radicals in the human body, then it can damage the cells and tissues through strong oxidation. As age increases, free radical scavenging ability of body decreases though affects the body's normal metabolism and its functions and therefore leads to chronic diseases or the aging reactions, which can cause several health problems^[5]. Hence, lotus plant is of great importance in the identification of potent radical scavenger which can remove the increased free radicals from the body, particularly which we obtain from daily food. Lotus seeds contain huge amounts of unsaturated fatty acids, therefore which increases their longevity due to which they are very popular. It also constitutes a significant amount of glutathione and ascorbic acid and also as well as several physiologically active substances which maintain life processes and activities. These active substances remain as such for or remain unchanged for many years and may contribute to metabolic processes^[6].

Immunomodulatory Activity

The hydroalcoholic extracts of seeds and rhizomes possess immunomodulatory activity. It was reported that the extracts show a stimulating effect on the defense system by regulating the

immunological parameters. The lotus plant parts also have enough therapeutic benefits in case of immunomodulation^[7]. Immunomodulatory activity of the hydroalcoholic extracts of rhizomes and seeds of *N. nucifera* were reported by Singh Virendra Kumar et al (2011). It was found out that the extracts have stimulating effect on the defence system by modulating the immunological parameters and the plant parts have potential therapeutic benefits on immunomodulation^[8].

Anti-Parkinsonian Activity

Nelumbo nucifera's methanolic seed extract was subdivided with chloroform and was studied by M. Vishnu Vardhan Reddy et al. (2014) for its anticataleptic and antioxidant effects in haloperidol - Induced catalepsy rat model through measuring many biochemical and behavioral parameters^[9].

Hypoglycemic Activity

The experiment of hypoglycemic activity of inorganic constituents in lotus seeds on Streptozotocin-induced diabetes in rats was studied by Sivasankari et al. The trace elements present in ash of seed is seen to play an indirect or direct role in the secretion of Insulin or works in a synergetic manner to control normoglycemia^[10]. A methanolic extract of rhizome was taken which amazingly decreased the blood sugar level of normal, Streptozotocin-induced and glucose - fed hyperglycaemic diabetic rats when compared with other control animals. This was to demonstrate the oral hypoglycaemic effect of lotus^[11]. From the lotus rhizome's nodes, tryptophan (an antidiabetic constituent) has been extracted by analysis of spectroscopic evidence^[12].

Antiviral Activity

W-K Cho et al., investigated the effect of WLL (water extract of lotus leaf) on viral infection using fluorescent microscopy and fluorescence-activated cell sorting (FACS) analysis with green fluorescent protein-tagged Influenza A/PR/8/34 virus. Plaque inhibition assay and cytopathic effect detection assay were used to confirm the antiviral effect of WLL. WLL significantly inhibited influenza viral infection, in a dose-dependent manner. Immunofluorescence (IF) analysis confirmed that WLL reduces influenza HA, NA, M2, and NP protein expression. WLL strongly reduced both HA and NA activity of IAV. Among six components in WLL, isoquercitrin exerted a potent antiviral effect^[13].

Antibacterial And Antifungal Activity

Nelumbo nucifera (Lotus plant) leaf extracts were prepared using different solvents (hexane, acetone and methanol) and evaluated for antioxidant and antimicrobial activity by arjun et al., 2012. DPPH (1,1-Diphenyl-2-picrylhydrazyl) free radical scavenging activity was high in methanolic leaf extract of *N. nucifera* compared to other extracts. Methanolic leaf extract showed maximum antibacterial activity against *Bacillus subtilis* whereas hexane and acetone showed maximum antifungal activity against *Candida albicans*. All solvent extracts exhibited high antifungal activity compared to standard^[14].

Anti-Inflammatory Activity

Tissue inflammation is harmful and it can cause tissue injury and lead to diseases like atopic dermatitis, rheumatoid arthritis, and asthma^[15]. Pieces of evidence have been found which say that cytokines released by T cells such as IL-10, IL-4 in reaction to antigen stimulation play a part in lung inflammation and asthma^[16]. *Nelumbo nucifera* leaf extracts (NLEs) effectively reduced the expression and productions of

pro-inflammatory mediators such as IL-1 β , IL-6, TNF- α , PGE₂, and NO. NLEs also reduced NF- κ B activity by inhibiting inhibitor of NF- κ B phosphorylation. Both extracts contained catechin and quercetin, bioactive compounds of NLEs^[17].

Antipyretic Activity

The antipyretic potential of lotus's stalk ethanol extract was studied by Sinha et al.; 2000. The extract was applied on normal body temperature and yeast induced pyrexia by using rat in in vivo model. 200mg/kg dose of extract declines the body temperature for 3 hours after application, while 400mg/kg dose declines the temperature for up to 6 hours^[18].

Analgesic Activity

Vikrama Chakravarthy P et al. (2009) studied the analgesic effect of white and red lotus seeds on Albino rats. 6 groups were divided which constituted 48 adult Sprague Dawley rats. After the experiment, the results revealed that both kinds of lotus seed extracts possess analgesic effect. The more pronounced activity was shown by the higher dose group with 600mg/kg of white lotus seeds. The analgesic effect can also be evaluated by inhibiting the production of cyclooxygenase of prostaglandin^[19].

Anticancer Activity

The medicinal application of *Nelumbo nucifera* in the treatment of various diseases demonstrated its anticancer effects. Neferine, an alkaloid from *N. nucifera* was found to exert cytotoxicity on liver cancer cells HepG2 in a dose-dependent manner. They evaluated its anticancer potential by studying its effect on mitochondrial membrane potential, intracellular calcium levels, cell membrane integrity, apoptotic body formation and DNA fragmentation in cultured HepG2 cells^[20]. In another study it was found that hepatocellular carcinoma (HCC) is one of the most aggressive malignant diseases and is highly resistant to conventional chemotherapy. Neferine, a major bisbenzylisoquinoline alkaloid derived from the embryos of *Nelumbo nucifera*, has been reported a few physiological activities. However, the mechanisms of anticancer effects are not well understood and its detailed activities on Hep3B cells have not been determined^[21].

Antithrombotic Effect

Neferine, an alkaloid from *Nelumbo nucifera* remarkably prevents thrombus formation by inhibiting platelet activation, adhesion and aggregation, as well as promoting disassembly of pre-formed platelet aggregates. The inhibitory effects of neferine on platelet activation might be relevant in cases involving aberrant platelet activation where neferine could be used as an antiplatelet and antithrombotic agent^[22].

Antiobesity And Hypolipidemic Effect

Studies have shown that ethanolic extract of *N. nucifera* have inhibitory effect on adipogenesis and has a beneficial effect on reducing adipose tissue weights, ameliorating blood lipid profile, and modulating serum leptin level in rats fed a highfat diet^[23].

CONCLUSION

Different parts of *N. nucifera*, including the leaves, rhizomes, seeds and flowers, have been reported to have therapeutic potential in traditional medicine for the treatment of various diseases.

REFERENCES

1. Sheikh SA. Ethno-medicinal uses and pharmacological Activities of lotus (*Nelumbo nucifera*). Journal of Medicinal Plants Studies. 2014; 2(6):42-46.
2. Wong CF. Origin and historical record of *Nelumbo nucifera*, Eds. China Institute of Botany, China lotus, Beijing, Academia Sinica, Science Publishers, 1987; 1-8.
3. Dhanarasu S, Al-Hazimi A. Phytochemistry, Pharmacological and Therapeutic Applications of *Nelumbo nucifera*, Asian Journal of Phytomedicine and Clinical Research. 1(2), 123–136, 2013.
4. Mukherjee P K, Balasubramaniam R, Saha K, Saha B P, Pal M, Ancient Science of life Vol No XV, Page 268 - 276, 4 April 1996.
5. Yen G, Chen H, Lee C. Measurement of antioxidative activity in metal ion-induced lipid peroxidation systems. J Sci Food Agric. 1999; 79:1213-121.
6. Li Y, Wei Y, Xu B. Study on the ABA content and SOD activity in ancient lotus and modern lotus seeds. Chin Bull Bot. 2000; 17:439-442.
7. Singh VK, Sharma PK, Dudhe R, Kumar N. Immunomodulatory effects of some traditional medicinal plants. J. Chem. Pharm. 2011; 3(1):675-684.
8. Singh V K, Sharma P K, Dudhe R, Kumar N, Immunomodulatory effects of some traditional medicinal plants, J. Chem. Pharm. Res., 3(1):675-684, 2011.
9. Reddy VVM, Singhal M. Evaluation of AntiParkinsonian Activity of Seed Extract of *Nelumbo nucifera*. Int J Pharm Bio Sci. 2014; 5(2):469-485.
10. Sivasankari S, Mani, Iyyam Pillai S, Subramanian SP, Kandaswamy M. Evaluation of hypoglycemic activity of inorganic constituents in *N. nucifera* seeds on streptozotocin-induced diabetes in rats, Biol Trace Elem Res. 2010; 138:226-237.
11. Mukherjee PK et al. Hypoglycemic activity of *Nelumbo nucifera* rhizome (methanolic extract) in streptozotocin induced diabetic rats. Phytother Res. 1995; 9:522-524.
12. Lee MW, Kim JS, Cho SM, Kim JH, Lee JS. Antidiabetic constituent from the nodes of lotus rhizome (*Nelumbo nucifera* Gaertn.). Nat Prod Sci. 2001; 7:107-109.

13. W-K Cho et al. Antiviral effect of Lotus (*Nelumbo nucifera* Gaertn.) Leaf Water Extract against Influenza A Virus. *Planta Med* 2022; 88(15): 1568-1569.
14. P. Arjun, S. Mohana Priya, P.S. Saranya Sivan, M. Krishnamoorthy and K. Balasubramanian. "Antioxidant and antimicrobial activity of *Nelumbo nucifera* Gaertn. leaf extracts", *J. Acad. Indus. Res.* Vol. 1(1) June 2012; 15-18.
15. Goodman RB, Strieter RM, Martin DP et al. Inflammator cytokines in patients with persistence of the acute respiratory distress syndrome. *American Journal of Respiratory and Critical Care Medicine.* 1996; 154(3):602-611.
16. Mukherjee PK, Saha K, Das J, Pal M, Saha BP. Studies on the anti-inflammatory activity of rhizomes of *Nelumbo nucifera*. *Planta Medica.* 1997; 63(4):367-369.
17. Eunkyo Park, Gyoung Deuck Kim, Min-Sun Go, Dodan Kwon, In-Kyung Jung, Joong Hyuck Auh, and Jung-Hyun Kim. Anti-inflammatory effects of *Nelumbo* leaf extracts and identification of their metabolites. *Nutr Res Pract.* 2017 Aug; 11(4): 265–274.
18. Sinha S, Mukherjee PK, Mukherjee K, Pal M, Mandal SC, Saha BP. Evaluation of antipyretic potential of *Nelumbo nucifera* stalk extract. *Phytotherapy Research,* 2000; 14(4):272-274.
19. Chakravarthi PV, Gopakumar N. Evaluation of Analgesic Activity of Lotus seeds (*Nelumbo nucifera*) in Albino Rats. *Veterinary World.* 2009; 2(9):355-357.
20. Poornima P, Quency RS and Padma VV: Neferine induces reactive oxygen species mediated intrinsic pathway of apoptosis in HepG2 cells. *Food Chem* 2013; 136(2):659-67.
21. Yoon JS, Kim HM and Yadunandam AK: Neferine isolated from *Nelumbo nucifera* enhances anti-cancer activities in Hep3B cells: molecular mechanisms of cell cycle arrest, ER stress induced apoptosis and antiangiogenic response. *Phytomedicine* 2013; 20(11):1013-22.
22. Zhou YJ, Xiang JZ, Yuan H, Liu H, Tang Q, Hao HZ, Yin Z, Wang J and Ming ZY: Neferine exerts its antithrombotic effect by inhibiting platelet aggregation and promoting dissociation of platelet aggregates. *Thromb Res* 2013; 132(2): 202-10.
23. You J S, Lee Y J, Kim K S, Kim S H, Chang K J. Antiobesity and hypolipidaemic effects of *Nelumbo nucifera* seed ethanol extract in human pre-adipocytes and rats fed a high-fat diet, *J Sci Food Agric*, 2013.