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A Review on Lotus (*Nelumbo nucifera)* Seed

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Abstract: ***Nelumbo nucifera or lotus seeds are edible and have been used as a traditional medicine since ages for curing various diseases. The longevity of lotus seed is unique. Researches revealed that it has hepatoprotective, hypoglycemic, immunomodulatory, antianalgesic, antiperkinsonian, antifertility, antidermatophytic, psychopharmacological properties. It can be used as low cost protein and energy supplement. Lotus seed oil is also useful. It is used in different cuisines. This review attempts to cover all the available literature on the seeds of Nelumbo nucifera with respect to its traditional uses, chemical constituents, physicochemical properties, phytoconstituents and summing up of its various physiological, psychological and therapeutic benefits.***

Keywords: traditional medicine, immunomodulatory, anti perkinsonian, psychopharmacological

1. Introduction

Nelumbo nucifera, (2n = 16) commonly known as lotus or sacred lotus is an aquatic perennial plant belonging to family *Nelumbonaceae*. [1] *N.nucifera* is an important aquatic economic plant, not only as a dainty and ornamental flower but also as a source of herbal medicine with strong antipyretic, cooling, astringent, and demulcent properties. The species is of religious significance in South East Asia (hence, the name sacred lotus) and the seeds and leaves are also eaten in this region. [2] Virtually, all parts of the lotus plant are used: the rhizome is used as food, seed as medicine, thalamus as fruit, leaves as plate (thali), stalks as pickle, petals for colour extraction, and tender leaves as food after being blended with vegetables. [3]

Nelumbo nucifera Flower

2. Plant Details

2.1 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: Protaenae;
Order: Proteales;
Family: Nymphaeaceae– Lotus Family;
Genus: Nelumbo Adans – Lotus;
Species: *Nelumbo nucifera* Gaen. – Sacred lotus.

2.2 Morphology

Leaves

Leaves are large, of both types, aerial as well as floating orbicular 20-90 cm. In diameter, abruptly acute to form a short tip, petiolate, entire glaucous, non-wettable, strong cupped in case of aerial leaves and flat in case of floating ones, radiantly nerved, the fresh leaves are leathery, bout on drying they are nearly membranous and brittle, there is more or less brownish red blotching on the lower surface, petioles of the aerial leaves are erect and stout white those of the floating ones are not strong enough. The usual length varies from 24.00 to 33.00 cm. in case of aerial leaves and 23to 30 cm in case of floating, petioles are smooth, greenish or greenish brown in colour with small brown dots sometimes rough with very small, but distinct princkees, odour is distinct, fracture is fibrous. When transversely cut, the petiole of leaf stalk always shows four distinct, large cavities in the centre and small cavities in the periphery.

Fruits and Seeds

Fruit is an aggregate of indehiscent nut-lets. Ripe nutlets are ovoid, roundish or oblongish up to 1.0 cm long 1.5 cm broad, with hard smooth, brownish or greyish black pericarp which is faintly longitudinally striated, pedunculated and one seeded. Seeds fill in the ripe carpel. Fruits of *N. nucifera* have remarkable power of dormancy and indeed the proved longevity of its seeds exceeds that of any known species of flowering plant. Robert Brown, first keeper of botany in the British museum, experimented with fruits of *Nelumbo* at various times between 1843- 1845 showed that they retained the power of germination after 150 years of confinement in glass-topped box.

Flowers

Solitary, large, 10-25 cm in diameter, white pink 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 and stout, smooth or rough due to the presence of numerous small scattered prickles, sepals, petals and stamens are spirally arranged passing gradually one into another.

Rhizomes

The rhizomes are 60-140 cm long 0.5 to 2.5 cm in diameter,

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yellowish white to yellowish brown in colour, smooth longitudinally striated with brown patches, Nodes and internodes are present. When freshly cut is exudes mucilaginous juice and show a few large cavities surrounded by several larger ones, fracture is tough and fibrous. Odour is indistinct. [4]

2.3 Habitat: [2]

Warm-temperate to tropical climates, in a range of shallow (up to about 2.5 m deep) wetland habitats, including flood plains, ponds, lakes, pools, lagoons, marshes, swamps and the backwaters of reservoirs.

2.4 Synonyms: [2]

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

3. About the Lotus Seeds

Seeds of lotus (*Nelumbo nucifera*) are edible, medicinally versatile and used as an important raw material of age-old traditional medical practices like Ayurveda and folk medicine. Powdered popped seeds are eaten dry and useful in bread preparation. Seeds are raw material for Ayurvedic and folk medicines to treat many ailments such as tissue inflammation, cancer, diuretics, skin diseases and as poison antidote. [5] Seeds of lotus are astringent and used to treat hyperdipsia, dermatopathy, halitosis, menorrhagia, leprosy and fever. [6]

The seed extracts have shown hepatoprotective and free radical scavenging effects. Lotus plumele, also known as Lian fang, Lien Tze Hsin, and Lian xu, is the green germ of the mature Lotus seed and is rich in compounds such as alkaloids (demethylcolaurine, isoliensinine, liensinine, Lotusine, methylocrypalline, neferine, nuciferine, and pronuciferine), flavonoids (galuteolin, hyperine, rutin) and some microelements [Zn, Fe, Ca, and Mg]. [7] Seeds contain β-sitosterol, palmitic acid and glucose. Oxoushine and N-norarmepavine isolated from seeds. Seeds afforded isoliensinine, neferine, armepavine and 4'-methylcoclaurine, asimilobine and lirinidine isolated from leaves. Haemostatic activity shown by plant extract attributed to quercetin which was identified in receptacle. [8]

Lotus seeds or lotus nuts are the seeds of plants in the genus *Nelumbo*, particularly the species *Nelumbo nucifera*. The seeds are of great importance to East Asian cuisine and are used extensively in traditional Chinese medicine and in Chinese desserts. The seeds are most commonly sold in the shelled and dried form. Fresh lotus seeds are relatively uncommon in the market except in areas of lotus root and seed production, where they are sometimes sold as a raw snack. [7]

Lotus Seeds

3.1 Types of *Nelumbo nucifera* (Lotus) Seeds

Two types of dried lotus seeds can be found commercially; brown peel and white. The former is harvested when the seed head of the lotus is ripe or nearly ripe and the latter is harvested when the seed head is still fully green, but with almost fully developed seeds. White lotus seeds are de-shelled and de-membraned. The bitter tasting germ of the seed is also removed at the time of harvest using a hollow needle, though some may still remain in the seed due to production oversight. Brown peel lotus seeds are brown because the ripened seed has adhered to its membrane. These seeds are usually cracked in half in order to remove the germ since the seeds are hard enough to make the germs' removal by needle difficult. Eating fresh lotus seeds from a lotus (*Nelumbo nucifera*) seed head. Dried lotus seeds that are sold in packages or in bulk at many Asian markets must first be soaked in water overnight prior to use due to their hardness and toughness. They can then be added directly to soups and congee, or used in other dishes. Lotus seeds or lotus nuts are the seeds of plants in the genus *Nelumbo*, particularly the species *Nelumbo nucifera*. [7]

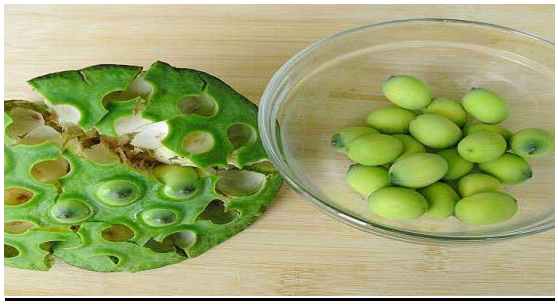

Figure 1 (a)

Figure 1 (b)

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Figure 1 (c)

Figure 1 (a), (b) & (c): Different types of matured Lotus seeds

3.2 Cultivation and Harvest

Seed Germination – a Secret Trait

Significantly, the longevity of lotus seed is phenomenal, with the world's record for long-term seed viability reported as 1300 years for a seed from China. The importance of exceptionally long-term viability of seeds is the secret of their ability to resist ageing for many hundred years – a trait reflected in their possible capability to mend cellular damage. This may be important for future research with regard to senescence and ageing. [3]

4. Aims and Objectives

a) To study the scientific literature on *Nelumbo nucifera* seeds.
b) To look at the information regarding ethnomedicinal and traditional claims on *Nelumbo nucifera* seeds.
c) To assemble the physiological and therapeutic benefits of *Nelumbo nucifera* seeds in a systematic manner.
d) To study the nutritional components and bioactive phytochemicals present in *Nelumbo nucifera* seeds.
e) To list out its pharmacological and industrial application.

5. Review of Literature:

5.1 Cultural Heritage of Lotus seed

In China, the seeds have been traditionally believed to be a symbol of fertility: newly-wed couples are expected to give birth to a male child if they eat food fortified with lotus seeds as an ingredient. [3]

In folk medicines, seeds are used in the treatment of tissue inflammation, cancer, skin diseases, leprosy, poison antidote and generally prescribed to children as diuretic and refrigerant. [9] The fruits and seeds of lotus are astringent and used to treat hyperdipsia, dermatopathy, halitosis, menorrhagia, leprocy and fever .[10] Seed powder mixed with honey is useful in treating cough, while roots with ghee (melted fresh butter), milk and gold promote strength, virility and intellect. Lotus seeds have been reported to possess rich antimicrobial properties .[11] [12] Embryo of lotus seeds are used in traditional Chinese drug called 'Lian Zi Xin', which primarily helps to overcome nervous disorders, insomnia, high fevours (with restlessness) and cardiovascular diseases (e.g. hypertension, arrhythmia).[13]

5.2 Major Chemical Constituents

Seeds contain β-sitosterol, palmitic acid and glucose. Oxoushine and N-norarmepavine isolated from seeds. Seeds afforded isoliensinine, neferine, armepavine and 4'-methylcoclaurine, asimilobine and lirinidine isolated from leaves. Haemostatic activity shown by plant extract attributed to quercetin which was identified in receptacle. [8]

5.3 Physicochemical Properties

Table 1: Nutritive Value of Lotus seeds: [14]

Ash (%)	4.50
Moisture Content (%)	10.50
Crude Fat (%)	1.93
Protein (%)	10.60
Carbohydrate (%)	72.17
Crude Fibre (%)	2.70
Energy (cal/100 gm)	348.45

Table: 2 Percent concentration of various elements of *Nelumbo nucifera* (seeds) [14]

Chromium	0.0042
Sodium	1.00
Potassium	28.5
Calcium	22.10
Magnesium	9.20
Copper	0.0463
Zinc	0.0840
Manganese	0.356
Iron	0.1990

Table 3: Chemical Evaluation of *Nelumbo nucifera* (seeds) [15]

Moisture %	7.26
Oil %	3.62

Table: 4 Physicochemical values of the oil of *Nelumbo nucifera* (seeds) [15]

Saponification Value	175.8
Iodine Value	90
Free fatty acid (as oleic acid)	1.86
Unsaponifiable matter	0.52
Acid value	3.70
Ester value	172.1

Table: 5 Percentage of saturated and unsaturated fatty acids in *Nelumbo nucifera* seed oil and its fractions: [15]

Lipid Fractions	Saturate-d fatty acid (%)	Un-saturated fatty acid (%)	Un-Identified
Whole oil	48.3	41.3	10
Wax ester	48.2	51.7	0.6
Triglycerides	62.4	37.3	0.4
Free fatty acid	53.8	41.2	0.6
1,3 Diglycerides	50.7	47.3	2.0
1,2 Diglycerides	35.8	60.1	5.0
Monoglycerides	65.5	34.9	-
Phosphatidylethanola-mine	50.0	48.6	1.4
Phosphatidylcholines	63.6	34.1	2.3
Lysophalidylethanolam-ine	47.6	46.7	6.5

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5.4 Phytochemical Properties

Alkaloids and Flavonoids

The embryos possess small amount of alkaloids, which are antispasmodic for the intestines and alleviates diarrhoea. The embryos within lotus seeds possess an alkaloid isoquinoline, which is sedative, antispasmodic and beneficial to heart. It dispels pathogenic heat from the heart and spontaneous bleeding due to heat. The major phytochemicals present in lotus seeds are alkaloids (e.g dauricine, lotusine, nuciferine, pronuciferine, liensinine, isoliensinine, roemerine, nelumbine, neferine) .[16]–[19] Dauricine and neferine block the Na+, K+ and Ca^{2+} transmembrane currents in cardiac cells. [19] As anti-arrhythmic, neferine significantly inhibit the rabbit platelet aggregation. [20] [21]

Antioxidant

Lotus seed extract possess hepatoprotective, free radical scavenging properties and antifertility properties. [22] Yen *et al*. (2006) reported the free radical scavenging and protective effects of lotus seed extracts (LSE) against reactive nitrogen, sodium nitroprusside (SNP), peroxynitriteinduced cytotoxicity and DNA damage in macrophage RAW 264.7 cell lines. [23]

Table 6: Phytochemical analysis of *N.nucifera* seeds [6]

Chemical test	*N. nucifera* (methanol)
Alkaloids	-
Carbohydrates	+++
Saponins	-
Proteins	+++
Phenolic compounds	++
Flavonoids	+
Tannins	-

(-) denotes absent, (+) denotes mild, (++) denotes average, (+++) denotes large

Table 7: Antioxidant assay-DPPH free radical scavenging activity [6]

S. No	Sample (µg)	DMSO (µL)	DPPH (µL)	*N. nucifera*		
				M	H	E
1.	20	38.0	2.960	40.415	86.22	23.58
2.	40	36.0	2.960	50.115	88.39	37.78
3.	60	34.0	2.960	57.04	88.67	26.69
4.	80	32.0	2.960	67.89	89.34	29.79
5.	100	30.0	2.960	85.68	91.16	25.77
6.	120	28.0	2.960	90.53	91.24	37.84
7.	140	26.0	2.960	84.98	91.6	35.67
8.	160	24.0	2.960	90.99	92.98	39.67
9.	180	22.0	2.960	92.14	95.06	36.56
10.	200	20.0	2.960	92.84	96.36	42.23
11.	Control	Control	3	-	-	-

'H' denotes hexane extract
'M' denotes methanol extract
'E' denotes ethyl acetate extract

5.5 Antifertility Activity

Malaya Gupta et al. (1996) evaluated the effect of petroleum ether extracts of seeds of *Nilumbo nucifera* on immature female rats and mature male rats. Fractions of petroleum ether extract were administered orally to sexually immature female rats and mature male rats on alternate days up to 15 days. The treatment caused a remarkable delay in sexual maturation in pre-pubertal female rats as evidenced from age of vaginal opening and first oestrus (cornified smear) and reduction in sperm count and motility in mature male rats. The treatments resulted in accumulation of cholesterol and ascorbic acid, while reduction in delta-5-3-beta-hydroxysteroid dehydrogenase and glucose-6-phosphate dehydrogenase activity in the ovary and testis. These observations revealed that the petroleum ether extract results in suppression of genesis of steroids in ovary as well as testis. The result indicated suppression of steroidogenesis in both ovary and testis of the female and male rats respectively. [24]

Anju Mutreja et al (2008) studied the effect of *N. nucifera* seeds on the reproductive system of female rats. 20 female rats were divided into 2 groups, each group having 10 rats. One served as control group and other as treated group. Ethanolic extract of the seeds at a dose of 800 mg/ kg was given to the treated group for 40 days. The result showed that *N. nucifera* seed extract had significantly lowered the weight of the ovary, uterus and vagina as well as protein and glycogen level. But the cholesterol level increased and in addition, the diestrous phase of the oestrous cycle was found to be prolonged. Thus the seed extract has antiestrogenic nature without altering the general physiology of female rats. [25]

Another study was carried out by Alka Chauhan et al (2009) to evaluate the effect of ethanolic seed extract of *N. nucifera* seeds on the male reproductive function and fertility. 50% of ethanolic seed extract was administered orally to the male rats at the dose level of 50,100 and 200 mg/rat/day for 60 days and found out that the body weights were not affected, whereas the weights of reproductive organs decreased significantly after this treatment. There is also significant suppression of cauda epididymal sperm count and motility, fertility was decreased. Oral administration of the extract did not alter the blood and serum profiles, whereas testosterone level of serum, protein, sialic acid, glycogen and fructose content were declined significantly. The concentration of testicular cholesterol was significantly elevated, therefore it can be concluded that *Nelumbo nucifera* treatment has an antispermatogenic effect in male rats. [26]

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 is 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 biogenesis of ovarian steroids at an intermediate stage. [27]

The effect of ethanolic seed extract of *Nelumbo nucifera* on male rat sexual behaviour was done. (Yasothara Wethangkaboworn, 2014) The general mating behaviour was investigated and compared with the standard reference drug, sildenafil citrate. Other behavioural changes were also observed. The results indicated that oral administration of *Nelumbo nucifera* seed extract produced a significant increase in the Mounting Latency and Intromission Latency and caused a significant decrease in the Mounting Frequency,

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Intromission Frequency and Ejaculatory Frequency in Second Series. The study supported the antifertility effect of *Nelumbo nucifera*. [28]

5.6 Immunomodulatory Activity

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. [29]

5.7 Analgesic Activity

Analgesic effect of red and white lotus seeds on albino rats was studied by Vikrama Chakravarthy P et al (2009). 48 adult Sprague Dawly rats were divided into 6 groups. Group I was treated as control group, Group II was treated with standard drug Diclofenac. The methanolic extracts of *N. nucifera* seeds of red and white varieties at 400 mg/kg and 600 mg/kg were fed to Group III, IV and V respectively for 7 days and observation revealed that both lotus seed extracts have considerable analgesic effect. Among all the extracts, the higher dose group of white lotus seed (600mg/kg) exhibited more pronounce activity. [30]

5.8 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 high-fat diet.[31]

5.9 Antiviral Activity

Inhibitory effects of ethanolic extracts of seeds of lotus on herpes simplex type 1 (HSV-1) have been reported by Kuo *et al*. (2005). Ethanolic extracts (100 µg/ml) significantly suppressed HSV-1 replication (IC50 for replication, 50.0 µg/ml). The HSV-1 inhibitory effects of subfractions separated from seeds indicated that NN-B-5 (out of nine main fractions: NN-B- 1 to NN-B-9) extracted from the bioactive NN-B fraction obtained from butanol had the highest suppresser activity. The ethanolic extracts prepared from fresh seeds showed anti-HSV-1 activity (IC50 62.0±8.9 µg/ml). To understand whether NN-B-5 reduced the acyclovir-resistant HSV-1 propagation or not, the TK HSV-1 was strain employed as target and performed the plaque reduction assay. The NN-B-5, at 50 µg/ml had inhibited TK HSV-1 replication in HeLa cells up to 85.9%. These results suggested clearly that NN-B-5 attenuates the acyclovir-resistant HSV-1 propagation. [32]

5.10 Antidermatophytic and Antidiarrheal Activity

The antidiarrhoeal activity of *N.nucifera* seed oil was evaluated and it strongly inhibited the strains namely *Shigella* sp., *Salmonella* sp., *Klebsiella* sp., *Escherichia Coli*., *Pseudomonas* sp., and *Staphylococcus aureus* by disk diffusion method. The inhibitory activity of *N.nucifera* seed oil was pronounced against the dermatophytes like *Malassezia furfur*, *Trichophyton rubrum* and *Trichophyton mentagrophytes* with the extract concentration of 25µg/mL. [34]

5.11 Anti-Parkinsonian Activity:

Methanolic seed extract of *Nelumbo nucifera* was partitioned with chloroform and was investigated by M.Vishnu Vardhan Reddy et al (2014) for its antioxidant and anticataleptic effects in the haloperidol-induced catalepsy rat model by measuring various behavioural and biochemical parameters. Catalepsy was induced by administration of haloperidol (1 mg/kg, *ip*) in male albino rats. A significant reduction in the cataleptic scores were observed in all the drug-treated groups as compared to the haloperidol-treated group; with maximum reduction observed in the *Nelumbo nucifera* (200 and 400 mg/kg body weight) administered group. Biochemical parameters like thiobarbituric acid reactive substances (TBARS); catalase; and superoxide dismutase (SOD), in the brain were assessed. The study concluded that *Nelumbo nucifera* treatment restored the levels of TBARS, Catalase and SOD levels in haloperidol induced catalepsy in rats. [33]

5.12 Neuropharmacological Activity

The neuropharmacological activities of the ethanolic extract of *Nelumbo nucifera* Gaertner seeds were screened in mice and rats. The extracts effect on phenobarbitone sodium induced sleep latency and sleeping time, motor coordination activity, locomotor activity, anxiolytic activity(light-dark model transition in mice, elevated zero maze), cerebral activator activity(nootropic) were evaluated. The ethanolic extract of *Nelumbo nucifera* (50,100 and 200 mg/kg p.o) possess a significant ($p<0.05$) depression in general behavioural tests, and potentiation of phenobarbitone induced sleeping time, and also shows anxiolytic action, in dose dependent manner. The ethanolic extract of *Nelumbo nucifera* gaertner shows nootropic activity on Conditional avoidance response. Therefore it can be concluded that plant could be a valuable contribution to the existing armamentarium of nootropic agent having antistress activity. [8]

5.13 Psychopharmacologic activity

Neferine from lotus seed embryos may have antidepressant activity as indicated by its anti-immobility effects in mice in a forced swimming test94. Neferine is a direct 5-hydroxytryptamine (5- HT) 1A receptor agonist and may inhibit 5-HT reuptake or activation of 5-HT metabolism. The antidepressant effect was comparable with that of maprotiline and imipramine. [41]Sacred lotus seed extract improved scopolamine-induced dementia in rats by inhibiting acetylcholinesterase activity and inducing choline acetyltransferase expression. [42]

5.14 Antioxidant Property

Antioxidant properties and total phenolic content of the extracts of *Nelumbo nucifera* seeds were examined. The extracts were prepared using the solvents water, methanol,

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water: methanol (1:1), ethyl acetate, acetone and chloroform. The acetone extract with the highest amount of total phenolic content (20.12 ± 0.02 g GAE/100 g dried extract), was the most potent antioxidant. The acetone extract of *Nelumbo nucifera* seeds were found to serve as a potential source of natural antioxidants. [35]

A hydroalcoholic seed extract exhibited strong free radical scavenging activity in rats comparable with that of standard vitamin E treatment at 50 mg/kg. Chemical constituents from the seed pod have lipid auto-oxidative, lipoxygenase, and free radical scavenging activity. [36]

Lotus seed epicarp extract as potential antioxidant and anti-obesity additive in Chinese Cantonese Sausage. [37]

5.15 Hepatoprotective Effect

Ethanol seed extracts exhibited hepatoprotective effects against production of serum enzymes and cytotoxicity caused by carbon tetrachloride. The extract also protected against the genotoxic and cytotoxic effects of aflatoxin B1. [38]

5.16 Hypoglycemic Activity:

Sivasankari S *et al* showed the evaluation of hypoglycemic activity of inorganic constituents in *N.nucifera* seeds on streptozotocin-induced diabetes in rats. The trace elements present in the seed ash might play a direct or indirect role on insulin secretion or action in synergetic manner to maintain normoglycemia. [39]

5.17 Reduction of Pulmonary Fibrosis:

Isoliensinine isolated from the seeds reduced bleomycin-induced pulmonary fibrosis in mice. The protective effect was associated with antioxidant activity and reduced expression of inflammatory mediators. [40]
Methanol seed extracts containing neferine inhibited locomotor activity at 50 mg/kg and elicited potent effects at 100 mg/kg. Neferine induced sedation, hypothermia, antifever effects, and anxiolytic effects comparable with those of diazepam but with a different mechanism. [43]

6. Application and Industrial Use:

A study carried out by Chintada Varun Kumar Acharya et al (2014) to identify the seeds of the plant species *Nelumbo nucifera* (lotus) that can produce biodiesel and result showed that lotus seed oil can be used as an alternative source of energy and produce bio fuel. [7]

7. Conclusion

Different parts of *Nelumbo nucifera* are used as food and traditional medicinal purpose. Seeds of lotus are edible and used in cookery since ages. It is also used as a folk medicine to treat a variety of ailments like tissue inflammation, skin disease, poison antidote etc. Lotus seeds are rich in protein, minerals and fatty acids. It is also a source of a range of bioactive compounds like antioxidants, alkaloids, flavonoids etc. Various researches revealed the therapeutic benefits of *N. nucifera* seeds. Studies also identified lotus seeds as a promising source of bio fuel. India is a country where lotus can be found abundantly in wetlands, ponds, lakes, canals etc. Therefore future studies can be done on lotus seeds to evaluate its nutritional and pharmacological significance. Importance should be given on the cultivation of lotus in large scale, processing and proper storage of seeds so that general mass of people can consume lotus seeds as a low cost nutritious food and use it as a low cost medicine for the treatment of diseases

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