J. Agric. Res. Technol., Special Issue (1) : 015-022 (2022) DOI: https://doi.org/10.56228/JART.2022.SP103

Recent Research on Therapeutic Properties of Lotus: A review

Savita[1], Sonu Kumari[2], Monika Yadav[3*] and B. S. Beniwal[4]
Department of Horticulture, CCSHAU, Hisar - 125 005 (India)
Corresponding Email : savitadhillon152@gmail.com

Abstract

The bioprospecting of lotus seeds has a promising future as an alternative protein supplement and potential pharmaceutical source. Because there are no detailed reports on the toxic effects of long-term consumption of lotus seeds and their products, more research is needed. Although the nutraceutical value of lotus seeds has been established, more precise exploration of value-added compounds may be beneficial in health promotion. Lotus seeds, like other edible seeds, are vulnerable to microbial contamination and spoilage. Contaminant and spoilage microflora (bacteria and fungi), their toxins, and control measures will help to popularise the use of lotus seeds. Because lotus seeds have potential nutraceutical benefits, combining their flour with other nutritionally dense legumes (e.g., soybean) or millets (e.g., finger millet) will be extremely beneficial in developing low-cost proteinaceous and health food supplements to combat malnutrition and specific ailment.

Key words :

The lotus is native to India, but it was widely diffused throughout ancient Persia, Egypt, and Asia. It was first introduced to Europe in the 18th century as a type of water lily, and it can now be found in modern botanical gardens all over the world. Lotus plants are widely grown in Australia, China, India, Iran, and Japan, among other places (Anonymous, 1966). The lotus blossom is often featured in religious writings and paintings, as well as literature and oral traditions of numerous Asian nations, as a symbol of beauty and purity in both Hindu and Buddhist religions. The lotus blossom is often featured in religious writings and paintings, as well as literature and oral traditions of numerous Asian nations, as a symbol of beauty and purity in both Hindu and Buddhist religions. It was cultivated as an industrial crop over 40,000 acres in China in 1999. (Guo, 2009). Lotus was brought to Japan from China and has been cultivated there for over 1000 years (Komatsu *et al.*, 1975). It is widely distributed in India and is reported even from Himalayan lakes at altitudes of up to 1400 metres (Polunin and Stainton, 1984). Lotus seeds ('kamal gatta') are offered in Indian marketplaces as a vegetable or as a raw material for Ayurvedic medication manufacture (Anonymous, 1992). Lotus seeds and roots are popular health foods, and the alkaloid produced from them (liensinine) is beneficial in treating arrhythmia (Ling *et al.*, 2005).

Methods

In the search for relevant material, a variety of electronic and scientific search engines and specialised reference tools were employed, including Google Scholar, web of science, scientific literature, publishing sites, and electronic databases. In addition, a systematic search was conducted in online research libraries such as E-library and specific pharmacological publications to obtain comprehensive information on Lotus's therapeutic uses as a herbal treatment.

1, 2. and 4. Department of Horticulture, 3. Department of Vegetable Science.

Findings

A. Botanical Characteristics : The Nelumbonaceae family includes Nelumbo nucifera, which has a number of common names (including Indian lotus, Chinese water lily, and sacred lotus) as well as synonyms (Nelumbium nelumbo, N. speciosa, N. speciosum and Nymphaea nelumbo). Lotus is a slender, elongated, branched, creeping aquatic herb with nodal roots; leaves are membranous, peltate (60-90 cm and above), orbicular and concave to cupshaped; petioles are long, rough, with small distinct prickles; flowers are white to rosy, sweet-scented, solitary, hermaphrodite.

B. Nutritional value : The tender rhizomes, stems, and leaves of lotus can be cooked with other vegetables, steeped in syrup, or pickled in vinegar (Anon, 1992). (Phillips and Rix, 1995). Rhizomes contain 1.7 percent protein, 0.1 percent fat, 9.7% carbohydrate, and 1.1 percent ash (Reid, 1977), have a mild flavour, and are often used in Chinese recipes, whereas stems can be cooked as food and have a beet-like flavour (Hedrick, 1972; Tanaka, 1976). In Vietnam, Ogle *et al.* (2001) reported the use of lotus stem (which contains 6, 2.4, 0.2 mg 100^{-1} g calcium, iron, and zinc, respectively) as a salad vegetable. Lotus leaves are used as a home remedy to cure summer heat syndrome in Japan and China, as well as to treat obesity in China (Ono *et al.*). The stamens are utilised to flavour the tea, while the petals are floated in soups or used as a garnish (Facciola, 1990). Egyptian lotus seeds contain 14.8 percent crude protein, according to Ibrahim and ElEraqy (1996). Because the green embryos in the seeds are bitter, they are normally removed before being sold as a food product. The seeds can be popped like popcorn, powdered and eaten dry, or used to make bread. The roasted seeds are a good coffee substitute and contain significant amounts of saponins, phenolics, and carbs (Anon., 1992; Ling *et al.*, 2005). N. nucifera seeds have 10.5 percent moisture, 10.6-15.9% protein, 1.93-2.8 percent crude fat, 70-72.17 percent carbohydrate, 2.7 percent crude fibre, 3.9-4.5 percent ash, and 348.45 calories per 100 grammes of energy (Reid, 1977; Indrayan *et al.*, 2005). Chromium (0.0042 percent), sodium (1 percent), potassium (28.5 percent), calcium (22.1 percent), magnesium (9.2 percent), copper (0.0463 percent), zinc (0.084 percent), manganese (0.356 percent), and iron are among the minerals found in lotus seeds (0.199 percent).

C. Pharmaceutical value

Traditional knowledge : The lotus plant has a wide range of medical applications, according to traditional knowledge. The entire plant is astringent, emollient, diuretic, and sudorific, with antifungal, antipyretic, and cardiotonic properties. The lotus plant's many parts can be used to treat diarrhoea, tissue inflammation, and haemostasis (Yu and Hu, 1997). Due to the presence of asteroidal triterpenoid, the rhizome extract exhibits anti-diabetic (Mukherjee *et al.*, 1997a) and anti-inflammatory activities (Mukherjee *et al.*, 1997b). Pharyngopathy, pectoralgia, spermatorrhoea, leucoderma, small pox, diarrhoea, dysentery, and cough are all treated with rhizomes. The stem is used as a diuretic, anthelmintic, and to cure strangury, vomiting, leprosy, skin disease, and nervous weariness in traditional Ayurvedic medicine. Young leaves boiled in goat's milk with Mimosa pudica can be used to treat rectal prolapse, and the leaves boiled with Mimosa pudica can be used to treat diarrhoea. During fevers and inflammatory skin diseases, leaf paste can be applied to the body. Hematemesis, epistaxis, hemoptysis, hematuria, and metrorrhagia are all treated with leaves (Ou, 1989). Lotus leaves can be used to treat hyperlipidemia in rodents (La Cour *et al.*, 1995; Onishi *et al.*, 1984). The leaves are also diuretic and astringent, making them useful for treating fever, perspiration, and strangury, as well as acting as a styptic (Chinese Materia Medica, 1977). The leaves and flowers can be used to cure a variety of bleeding diseases, and flower ingestion is indicated to help with conception. Diarrhoea, cholera, fever, hepatopathy, and hyperdipsia can all be treated with flowers. Seeds are used in traditional medicine to treat tissue inflammation, cancer, skin illnesses, leprosy, poison antidote, and are commonly given to youngsters as a diuretic and refrigerant (Chopra *et al*., 1956). Hyperdipsia, dermatopathy, halitosis, menorrhagia, leprosy, and fever are all treated with lotus fruits and seeds, which are astringent (Nadkarni, 1982). Coughs can be treated with seed powder mixed with honey, while roots cooked in ghee (melted fresh butter), milk, and gold improve strength, virility, and intellect. Lotus seeds have been found to offer a wide range of antibacterial properties (Mukherjee *et al*., 1995; Mukherjee, 2002). The embryo of lotus seeds is utilised in a traditional Chinese medicine known as 'Lian Zi Xin,' which is used to treat neurological disorders, sleeplessness, high fevours (with restlessness), and cardiovascular illnesses (e.g. hypertension, arrhythmia) (Chen *et al*., 2007).

Alkaloids and flavonoids : The alkaloids in lotus flowers expand blood arteries and lower blood pressure. The leaves are bitter and delicious, and they contain a variety of flavonoids and alkaloids (Shoji *et al*., 1987). The embryos contain a minor amount of alkaloids, which act as an antispasmodic in the intestines and help to relieve diarrhoea. The alkaloid isoquinoline, found in the embryos of lotus seeds, is calming, antispasmodic, and heart-healthy. It removes pathogenic heat from the heart and prevents heat-related haemorrhage. Alkaloids (e.g. dauricine, lotusine, nuciferine, pronuciferine, liensinine, isoliensinine, roemerine, nelumbine, neferine) are the most common phytochemicals found in lotus seeds (Tomita *et al*., 1961; Furukawa *et al*., 1965; Wang *et al*., 1991; Qian, 2002). In cardiac cells, dauricine and neferine block the Na+, K+, and Ca2+ transmembrane currents (Qian, 2002). Neferine inhibits rabbit platelet aggregation considerably as an anti-arrhythmic (Li *et al*., 1990; Yu and Hu, 1997). Lim *et al*. (2006) investigated the inhibitory components of N. nucifera stamens in rat lens aldose reductase (RLAR) (a key enzyme in the polyol pathway linked to diabetes). RLAR is inhibited by the methanol extract of the stamens. Lotus plants yielded thirteen flavonoids and seven glycosides, as well as four non-flavonoid chemicals. Those flavonoids with 3-O-alpha-lrhamnopyranosyl - (1 6) were found among the separated flavonoids. glucopyranoside groups on their C rings, such as kaempferol3-O-alpha-l-rhamnopyranosyl-(16)-beta-dglucopyranoside and isorhamnetin 3-O-alpha-l-rhamnopyranosyl-(16)-beta-dglucopyranoside and isorhamnetin 3-O-alpha-l-rhamno-pyranosy In vitro, -betad-glucopyranoside has the highest level of RLAR inhibitory action, with IC50 values of 5.6 and 9.0 M, respectively.

Antioxidants : The antioxidative enzyme modifications in seedlings of N. nucifera, which responds to oxygen shortage via germination under water, were examined by Ushimaru *et al*. (2001). They discovered that superoxide dismutase activity, Seedlings had reduced levels of dehydroascorbate reductase and glutathione reductase germinated in darkness under submerged conditions (SD) than those found seedlings germinated in the dark and in the air (AD). The activity of ascorbate peroxidase was higher in SD seedlings than in AD seedlings, while the activity of catalase and monodehydroascorbate reductase was essentially identical in SD and AD seedlings. Leaf stalk extract has antipyretic properties (Sinha *et al*., 2000), whereas leaves and stamen have antioxidant properties (Jung *et al*., 2003; Wu *et al*., 2003). Lotus seed extract has antifertility, hepatoprotective, and free radical scavenging effects (Sohn *et al*., 2003). Yen *et al*. (2006) studied the free radical scavenging and protective activities of lotus seed extracts (LSE) against reactive nitrogen, sodium nitroprusside (SNP), peroxynitrite-induced cytotoxicity, and DNA damage in macrophage RAW 264.7 cell lines. The inhibitory effects of seeds extracted with water (LSWE), ethyl acetate (LSEAE), and hexane (LSHE) were investigated. All of the extracts reduced nitric oxide accumulation in LPS-activated RAW 264.7 cells. The extracts (0.01-0.2 mg ml^{-1}) inhibited the buildup of nitric oxide after SNP breakdown in a dose-dependent manner. LSEAE has the highest inhibitory activity potency, followed by LSWE and LSHE. The effect of three seed extracts on macrophage DNA damage revealed that RAW 264.7 cells incubated at 37°C for 2 hours with extracts (0.01-0.2 mg ml^{-1}) showed no significant difference in tail movement between the control and sample, indicating that seed extracts do not induce DNA damage in RAW 264.7 cells. In macrophage RAW 264.7 cells, the comet test demonstrated that all extracts could reduce DNA damage caused by SNP. In macrophage RAW 264.7 cells, the LSWE, LSEAE, and LSHE (at 0.2 mg ml^{-1}) reduced peroxynitrite-induced DNA damage by 63, 59, and 38 percent, respectively. When it came to avoiding tyrosine nitration, the extracts studied were also excellent peroxynitrite scavengers. At higher concentra-tions (0.2 mg ml^{-1}), LSWE, LSEAE, and LSHE inhibited 3-nitrotyrosine synthesis by 29.0, 21.0, and 8.0 percent, respectively. Because of their ability to inhibit tyrosine nitration, these findings show that extracts produced from diverse solvents are excellent peroxynitrite scavengers. Rai *et al*. (2006) used in vitro and in vivo models to investigate the antioxidant potential of a hydro-alcoholic extract of lotus seeds. The extract contained 7.61 percent total phenolics, which had substantial free radical scavenging activity as demonstrated by low IC50 values (16.12 g ml^{-1}) in 1,1-diphenyl-2-picryl hydrazyl, which were equivalent to rutin (IC50, 18.95 g ml^{-1}). The extract had higher activity (IC50, 84.86 g ml^{-1}) than conventional rutin (IC50, 152.17 g ml^{-1}) in the nitric oxide technique. In Swiss Albino mice, no symptoms of acute toxicity were observed up to an oral dose of 1,000 mg kg^{-1} body weight. Procyanidins (also known as condensed tannins) are a form of plant phenol found throughout the plant kingdom. Ling *et al*. were the first to investigate the procyanidins discovered in non-edible portions of the lotus (2005).

The procyanidins in lotus pods were extracted in Me_2CO-H_2O and refined using Sephadex LH-20 column chromatography to a purity of 98 percent. The M + H peak values of 291.1, 579.2, 731.2, 867.2, 1019.4, and 1155.3 indicate that the extract contains monomers, dimers, and tetramers of procyanidins, with dimmers, catechin, and epicatechin base units containing the most. The extracted lotus pod procyanidin was a pale red brown amorphous powder. The extract contained 90.7 percent total polyphenols and 98.3 percent procyanidin, according to spectrometric analysis. According to the procyanidin B2 calibration curve, the procyanidin of lotus pod extract was 63.2 percent, showing variations in procyanidin. The scavenging action of various doses of lotus pod procyanidin on superoxide free radicals (O_2) was calculated as an IC50 of 17.6 mg l^{-1}, which is similar to 0.3 mg l^{-1} vitamin C. The scavenging effect of the procyanidin extract on •OH increased with increasing concentration, and the IC50 was 10.5 mg l^{-1}, equivalent to 4.1 mg l^{-1} vitamin C. The antioxidant activity of lotus pod procyanidin extract in lard oil and soybean oil systems was explored further. After 11 days under the same conditions, the peroxide values of the control and lard oil systems containing 0.05, 0.1, and 0.2 percent procyanidin extract of lotus seed pod were 54, 22, 18.04, and 20 mM kg^{-1}, respectively. At 60°C and varied procyanidin concentrations, the extract demonstrated a stronger antioxidant activity than the others at 0.1 percent procyanidin. On the eighth day, procyanidin extract inhibits auto-oxidation of lard in the same way that butylated hydroxytoluene (BHT) does. According to the findings, procyanidin partially inhibits lard autoxidation, making 0.1 percent procyanidin a powerful antioxidant.

Antisteroids : In the testis and ovary of rats, Gupta *et al*. (1996) found that seed extract of N. nucifera had an antisteroidogenic effect. On alternate days for up to 15 days, sexually immature female rats and mature male rats were given fractions of petroleum ether extract orally. In pre-pubertal female rats, the therapy induced a significant delay in sexual development, as demonstrated by the age of vaginal opening and first estrus (cornified smear), as well as a reduction in sperm count and motility in mature male rats. The therapies caused an increase in cholesterol and ascorbic acid levels in the ovary and testis, as well as a decrease in delta-5-3-beta-hydroxysteroid dehydrogenase and glucose-6-phosphate dehydrogenase activity. These findings demonstrated that petroleum ether extract suppresses steroid synthesis in both the ovary and the testis.

Antipyretic : Chopra *et al*. (1958) discovered that N. nucifera has antipyretic properties. Similarly, Sinha *et al*. (2000) reported that an ethanol extract of lotus stalks had antipyretic properties against both normal body temperature and yeast-induced pyrexia in rats. The extract (200 mg kg^{-1}) significantly reduced body temperature up to 3 hr after administration, while 400 mg kg^{-1} significantly reduced body temperature up to 6 hr. In the yeast model, provoked elevation of body temperature resulted in dose-dependent lowering for up to 4 hours at both doses, with results comparable to paracetamol, the standard antipyretic agent (150 mg kg^{-1}).

Anticancerous : According to Liu *et al*. (2004), lotus ethanolic extracts inhibit cell proliferation and cytokines in primary human peripheral blood mononuclear cells activated by phytohemagglutinin (a specific mitogen for T lymphocytes). Liu *et al*. (2006) investigated the effects of lotus (S)-Armepavine (C19H23O3N; MW313) on T cell proliferation. The potential benefit of (S)-armepavine on systemic lupus erythematosus (SLE) was studied in MRL/MpJ-lpr/lpr mice, which had disease characteristics similar to human SLE. The SLE characteristics of MRL/MpJ-lpr/lpr mice treated orally with (S)-armepavine for 6 weeks were evaluated. The findings showed that (S)-armepavine prevented lymphadenopathy and increased the lifespan of MRL/MpJ-lpr/lpr mice. The treatment with (S)-armepavine resulted in a significant dose-dependent decrease in both cytokines (T lymphocyte-mediated cytokines) production. The results were as follows: 83.95.1 pg ml^{-1} in control mice vs. 54.54.7 pg ml^{-1} in mice treated with 10 mg kg^{-1} day^{-1} (S)-armepavine for IL-2, Pb0.01; 44.34.5 pg ml^{-1} in control mice vs. 12.01.3 pg ml^{-1} in mice treated with 10 mg kg^{-1} day^{-1} (S)-armepavine for IFN-, Pb0.01. Furthermore, (S)-armepavine inhibited IL-2 and IFN- transcripts in human peripheral blood mononuclear cells. Liu *et al*. (2006) concluded that (S)-armepavine could be used as an immunomodulator to treat autoimmune diseases such as SLE.

Antiviral : Kashiwada *et al*. (2005) isolated anti-HIV benzylisoquinoline alkaloids and flavonoids [-(+)-1(R)-Coclaurine, (-)-1(S)-norcoclaurine, and quercetin 3-O-b-D-glucuronide] from lotus leaves. The first two compounds have strong anti-HIV activity [EC50, 0.8 and 125 and >25, respectively], while the third is less effective (EC50 2l g ml^{-1}). Other benzylisoquinoline, aporphine, and bisbenzylisoquinoline alkaloids (liensinine, negferine, and isoliensinine) isolated from lotus leaves and embryo demonstrated potent anti-HIV activity (EC50 values of 9.9, >8.6, and >6.5, respectively). Nuciferine, an aporphine alkaloid, also had an EC50 of 0.8l g ml^{-1} and a TI of 36. Kuo *et al*. reported inhibitory effects of ethanolic extracts of lotus seeds on herpes simplex type 1 (HSV-1) (2005). Ethanolic extracts (100 g ml^{-1}) inhibited HSV-1 replication significantly (IC50 for replication, 50.0 g ml^{-1}). The HSV-1 suppressive effects of seed subfractions revealed that NN-B-5 (out of nine main fractions: NN-B1 to NN-B-9) extracted from the bioactive NN-B fraction obtained from butanol had the highest suppressive activity. The anti-HSV-1 activity of ethanolic extracts prepared from fresh seeds was demonstrated (IC50 62.08.9 g ml^{-1}). To determine whether NN-B-5 reduced acyclovir-resistant HSV-1 propagation, the TK HSV-1 strain was used as a target and the plaque reduction assay was performed. At 50 g ml^{-1}, NN-B-5 inhibited TK HSV-1 replication in HeLa cells by up to 85.9 percent. These findings strongly suggested that NN-B-5 inhibits the spread of acyclovir-resistant HSV-1.

Anti-obesity : Ono *et al*. (2006) investigated the pharmacological mechanism of lotus N. nucifera leaf extract (NNEantiobesity)'s effect in mice and rats. The effect of leaf extract on digestive enzyme activity, lipid metabolism, and theromogenesis in mice treated for five weeks resulted in concentration dependent inhibition of -amylase and lipase activities as well as upregulated lipid metabolism and UCP3 mRNA expression in C2C12 myotubes. In vitro, the NNE also inhibited the activities of -amylase and lipase. NNE inhibited lipase more effectively (IC50, 0.46 mg ml^{-1}) than -amylase (IC5, 0.82 mg ml^{-1}). The extracts reduced body weight, parametrial adipose tissue weight, and liver triacylglycerol levels in mice with obesity caused by a high fat diet, and UCP3 mRNA expression in skeletal muscle was elevated.

References

Anonymous. 1966. The Wealth of India - A Dictionary of Indian Raw Materials. Volume 7, Council of Scientific Industrial Research, New Delhi, India.

Anonymous. 1992. The Wealth of India. Volume 3, Council of Scientific Industrial Research, New Delhi, India.

Arunyanart, S. and Chaitrayagun, M. 2005. Induction of somatic embryogenesis in lotus (Nelumbo nucifera Gaertn.). Scientia Horticulturae 105: 411-420.

Chen, Yi., Fan, G., Wu, H., Wu, Y. and Mitchell A. 2007. Separation, identification and rapid determination of liensine, isoliensinine and neferine from embryo of the seed of Nelumbo nucifera Gaertn. by liquid chromatography coupled to diode array detector and tandem mass spectrometry. Journal of Pharmaceutical and Biomedical Analysis 43:99-104.

Chinese Materia Medica. 1977. Jiangsu New Medical College, Peoples Publishing House, Shanghai, China.

Chopra, R. N., Nayar, S. L. and Chopra, I. C. 1956. Glossary of Indian Medicinal Plants. Council of Scientific Industrial Research, New Delhi, India.

Chopra, R. N., Chopra, I. C. and Handa, K. L. 1958. Indigenous Drugs of India. 2nd Edition, U.N. Dhur and Sons Pvt. Ltd., Calcutta, India.

Facciola, S. 1990. Cornucopia: A Source Book of Edible Plants. Kampong Publications, California.

Famurewa, J. A. V. and Raji, A. O. 2005. Parameters affecting milling qualities of undefatted soybeans (*Glycine max* L. Merill) (1), Selected thermal treatment. International Journal of Food Engineering 1: 1-9.

FAO. 1994. The State of Food and Agriculture. FAO agricultural series #27, FAO/UN, Rome.

Furukawa, H., Yang, T. H. and Lin, T. J. 1965. Effect of Nelumbo nucifera rhizomeextract on blood sugar level in rats. Yakugaku Zasshi 85: 472-475.

Gupta, M., Mazumder, U. K., Mukhopadhyay, R. K. and Sarkar, S. 1996. Antisteroidogenic effect of the seed extract of Nelumbo nucifera in the testis and the ovary of the rat. Indian Journal of Pharmaceutical Science 58: 236-242.

Hedrick, U. P. 1972. Sturtevant's Edible Plants of the World. (ed Hedrick. U.P.). Dover Publications, New York.

Ibrahim, N. and El-Eraqy, W. 1996. Protein content and amino acid composition of Nelumbo nucifera seeds and its evaluation as hypoglycaemic agent. Egyptian journal of pharmaceutical sciences 37: 635-641.

Indrayan, A. K., Sharma, S., Durgapal, D., Kumar, N. and Kumar, M. 2005. Determination of nutritive value and analysis of mineral elements for some medicinally valued plants from Uttaranchal. Current Science 89: 1252-1255.

Jung, H. A., Kim, J. E., Chung, H. Y. A. and Choi, J. S. 2003. Antioxidant principles of Nelumbo nucifera stamens. Archives of Pharmacological Research 26: 279-285.

Kashiwada, Y., Aoshima, A., Ikeshiro, Y., Yuh-Pan, Chen, Furukawa, H., Itoigawa, M., Fujioka, T., Mihashi, K., Cosentino, M. L., Susan, L. Morris-Natschke and Lee, K. H. 2005. Anti-HIV benzylisoquinoline alkaloids and flavonoids from the leaves of Nelumbo nucifera and structure-activity correlations with related alkaloids. Bioorganic Medicinal Chemistry 13: 443-448.

Komatsu, E., Tsukahara, A., Amagaya, H., Okazawa, N., Noguchi, T. and Okuyama, T. 1975. Lotus. In: The Cultivation and Management in Aquatic Vegetables (ed Izaki, M.). Ie-No-Hikari Kyokai Press, Tokyo, 9-94. Kuo, Y.-C., Lin, Y.-L., Liu C.-P. and Tsai, W.-J. (2005). Herpes simplex virus type 1 propagation in HeLa cells interrupted by Nelumbo nucifera. Journal of Biomedical Science 12: 1021-1034.

La Cour, B., Molgaard, P. and Yi, Z. 1995. Traditional Chinese medicine in treatment of hyperlipidaemia. Journal of Ethnopharmacology 46: 125-129.

Li, G. R., Qian, J. Q. and Lu, F. H. 1990. Effects of neferine on heart electromechanical activity in anaesthetized cats. Zhongguo Yao Li Xue Bao 11: 158-161. Lim, S. S., Jung, Y.J., Hyun, S. K., Lee, Y. S. and Choi, J. S. 2006. Rat lens aldose reductase inhibitory constituents of Nelumbo nucifera stamens. Pyhtotherapy Research 20: 825-830.

Ling, Z. Q., Xie, B. J. and Yang, E. L. 2005. Isolation, characterization, and determination of antioxidative activity of oligomeric procyanidins from the seedpod of Nelumbo nucifera Gaertn. Journal of Agricultural and Food Chemistry 53: 2441-2445.

Liu, C. P., Tsai, W. J., Lin, Y. L., Liao, J. F., Chen, C. F. and Kuo, Y. C. 2004. The extracts from Nelumbo nucifera suppress cell cycle progression, cytokine genes expression, and cell proliferation in human peripheral blood mononuclear cells. Life Sciences 75: 699-716.

Liu, C. -P., Tsai, W. -J., Shen, C. -C., Lin, Y. -L, Liao, J. -F., Chen, C. -F. and Kuo, Y. -C. 2006. Inhibition of (S)-armepavine from Nelumbo nucifera on autoimmune disease of MRL/MpJ-lpr/lpr mice. European Journal of Pharmacology 531: 270-279.

Michaelsen, K. F. and Henrik, F. 1998. Complementary feeding: A global perspective. Nutrition 14: 763-766.

Mukherjee, P. K. 2002. Quality Control of Herbal Drugs - An Approach to Evaluation of Botanicals. 1st Edition, Business Horizons, New Delhi, India.

Mukherjee, P. K., Giri, S. N., Saha, K., Pal, M. and Saha, B. P. 1995. Antifungal screening of Nelumbo nucifera (Nymphaeaceae) rhizome extract. Indian Journal of Microbiology 35: 327-330.

Mukherjee, P. K., Saha, K. and Saha, B. P. 1997a. Effect of Nelumbo nucifera rhizome extract on blood sugar level in rats. Journal of Ethnopharmacology 58: 207-213.

Mukherjee, P. K., Saha, K., Das, J., Pal, M. and Saha, B. P. 1997b. Studies on the antiinflammatory activity of rhizomes of Nelumbo nucifera. Planta Medica 63: 367-369.

Nadkarni, A. K. 1982. The Indian Materia Medica. Volume 1, Popular Prakashan Pvt. Ltd., Bombay, India.

Ogle, B. M., Dao, H. T. A., Mulokozi, G. and Hambraeus, L. 2001. Micronutrient composition and nutritional importance of gathered vegetables in Vietnam. International Journal of Food Science and Nutrition 52: 485-499.

Onishi, E., Yamada, K., Yamada, T., Kaji, K., Inoue, H., Seyama, Y. and Yamashita, S. 1984. Comparative effects of crude drugs on serum lipids. Chemical & Pharmaceutical Bulletin 32: 646-650.

Ono, Y., Hattori, E., Fukaya, Y., Imai, S. and Ohizumi, Y. 2006. Antiobesity effect of Nelumbo nucifera leaves extract in mice and rats. Journal of Ethnopharmacology 106: 238-244.

Ou, M. 1989. Chinese-English Manual of Common-used in Traditional Chinese Medicine. Joint Publishing Co. Ltd., Hong Kong.

Phillips, R. and Rix, M. 1995. Vegetables. Macmillan Reference Books, London.

Polunin, O. and Stainton, A. 1984. Flowers of the Himalayas. Oxford University Press, New Delhi, India.

Qian, J. Q. 2002. Cardiovascular pharmacological effects of bisbenzylisoquinoline alkaloid derivatives. Acta Pharmacologica Sinica 23: 1086-1092.

Rai, S., Wahile, A., Mukherjee, K., Saha, B. P. and Mukherjee, P. K. 2006. Antioxidant activity of Nelumbo nucifera (sacred lotus) seeds. Journal of Ethonopharmacology 104: 322-327.

Ramsbottom, J. 1942. Recent work on germination. Nature 149: 658.

Reid, B. E. 1977. Famine Foods of the Chiu-Huang Pen-ts'ao. Southern Materials Centre, Taipei.

Shoji, N., Umeyama, A., Saito, N., Iuchi, A., Takemoto, T., Kajiwara, A., Ohizumi, Y. 1987. Asimilobine and lirinidine, serotonergic receptor antagonists, from Nelumbo nucifera. Journal of Natural Products 50: 773-774.