# Review on *Melia azedarach*: Phytochemistry, Pharmacological Properties, and Therapeutic Potential

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**ABSTRACT**

The information of medicinal plants and its medicinal significance must have been accumulated in the course of several centuries but it is our misfortune that accurate chemical and pharmacological evaluation of most of these plants have not done till now. Keeping this view, details studies on ethno botanical study of *Melia azedarach*. *Melia azedarach*, commonly known as the Chinaberry tree or Persian lilac, is a medicinal plant widely used in traditional medicine for its diverse therapeutic properties. It is rich in bioactive compounds, including limonoids, flavonoids, alkaloids, and tannins, which contribute to its antimicrobial, anti-inflammatory, antioxidant, anticancer, anti-diabetic, hepatoprotective, and neuroprotective activities. Additionally, *M. azedarach* exhibits insecticidal and pesticidal potential, making it valuable in agriculture. However, concerns regarding its toxicity, variations in phytochemical composition, and limited clinical evidence pose challenges to its medicinal application. This review highlights the phytochemistry, pharmacological effects, toxicity concerns, and future research prospects of *M. azedarach* to establish its potential as a therapeutic agent.

**Key words**: *Melia azedarach*., Meliaceae, Quercetin, Stigmasterol.

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## INTRODUCTION

Overpopulation remains one of the most critical challenges in developing countries like India, with global population projections expected to reach approximately 9.2 billion by the year 2050 (Kaur N. A., 2011). Nowadays, people increasingly rely on both natural and Ayurvedic treatments for healthcare needs (Singh, 2020). Over the past few decades, natural remedies have gained significant importance on the global stage. Diseases have co-existed with life, the study of diseases and their management is important part of our ancient plant worldwide. This helps to getting increase information of medicinal plants. The information of medicinal plants must have been accumulated in the course of several centuries. Herbal plants have ability for the formation of secondary metabolites such as glycoside, alkaloids, steroids, phenolic substances, flavonoids, terpnoids etc. These secondary metabolites are used to treatment of many diseases. India is the largest producer of herbal medicine and is rightly called the "Botanical garden of the world". Since ancient times, civilizations across the world have utilized medicinal plants for their healing properties. The widespread use of herbal medicines and traditional health formulations can be traced back to the early recognition of natural products for their therapeutic benefits ((Sultana, 2013)

*Melia azedarach* Linn, commonly found in many countries, closely resembles the Neem tree. The inner bark is rich in alkaloids, which are primarily responsible for its anthelmintic properties. Additionally, the plant demonstrates various pharmacological activities, including anti-cancer, anti-malarial, antibacterial, and anti-fertility effects (Ervina, 2018); (Malar, 2020)). Recognizing the need for plant-based contraceptives, the World Health Organization (WHO) has established a Task Force on Plant Research to discover new oral, non-steroidal contraceptive agents (Kaur R. S., Rising Trends towards Herbal Contraceptives. J. Nat. Prod. Plant Resour, 2011).

In India, phytomedicinal products have been used for centuries, though scientific validation of these remedies is a relatively recent advancement. Various medicinal herbs have traditionally been employed for antifertility treatments. While only a limited number of contraceptive agents derived from plant extracts have been identified so far, their potential remains significant. However, challenges such as the identification and preservation of the specific active components responsible for these effects continue to hinder progress (Abbasi, 2010). This paper presents a comprehensive review of the botanical classification, phytochemical profile, pharmacological properties, and therapeutic applications of *Melia azedarach*.

*Melia azedarach* is quite a different genus to the Azadirachta tree but are in the same family(Sultana S, 2014)(DJ., 1984)(Britannica, 2015). According to Mabberley, Melia divided into some classes: (1) wild type (2) Chinese cultivars and (3) Indian cultivars. The classes are based on the plants type and the regions where Melia grows. The wild Melia type is a tall forest tree of about 40 m; while Indian and Chinese cultivars are small trees. The wild plants name including *Melia composite* Willd, *Melia dubia* Cav., Dissert, *Melia superba* Roxb., *Melia robusta* Roxb., *Melia australis* Sweet., *Melia candollei*, *Melia australasica*, *Melia birmanica* Kurz., *Melia azedarach.*var *Melia bogoriensis* Koord. M. *composite* which named based on the material collected from. *Melia azedarach* cultivars in China with varieties and subvarieties consist of Melia japonica G. Don. f., *Melia toosendan* Sieb. and

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Zucc., *Melia chinensis* Sieb ex Miq., *M. japonica* G. and *Melia azedarach*. f. albiflora. In India, Melia azedarach.var. *Melia commelini* Medik., *Melia arguta* DC., *Melia sambucina* Bl., *Melia angustifolia* Schum. and Thonn., *Melia guineensis* G. Don*Melia bukayun. Melia azedarach*. is well known as ecological and ethnomedicinal tree used in India, Japan, and China. It is used mostly as timber and natural insecticide and in the traditional medicine.

**Botanical Description of *Melia azedarach***

*Melia azedarach*, commonly known as Chinaberry, is a deciduous tree from the Meliaceae family. It typically grows between 6 to 35 meters tall, featuring a spreading crown and sparsely branched limbs. The bark is brown with narrow furrows, giving it a distinct striped texture (Melia azedarach (Melia).

**Leaves**

The leaves are alternately arranged and bipinnately compound, measuring 30 to 60 cm (1 to 2 feet) in length. Each leaflet is oval to elliptical, ranging from 20 to 70 mm long, with serrated or slightly scalloped edges. The upper surface is dark green with sparse hairs along the veins, while the underside appears lighter and generally smooths (*Melia azedarach*).
(Ashish C. A., 2019)

**Flowers**

During spring, *M. azedarach* produces fragrant, five-petaled lilac-colored flowers arranged in panicles. These blossoms appear in clusters and enhance the tree's ornamental appeal

**Fruits**

The tree bears round, mucilaginous drupes that are 10 to 13 mm (0.4 to 0.5 inches) in diameter. Initially green, they turn yellow or yellow-green upon ripening. The fruits have a wrinkled, sticky texture and contain hard, marble-like seeds. They often remain on the tree throughout winter and into early spring (NC State Extension)



LEAVES



FLOWERS




FRUITS

Table 1. Characteristics from a phytochemical and pharmacological activity found in *Melia azedarach*

| S. no. | Name of compound | Nature of compound | Pharmacological activity | References |
|---|---|---|---|---|
| 1. | Quercetin | Flavonoid polyphenol | Anti-inflammatory,anti- cancer, antioxidant | (Rana, 2019) |
| 2. | Squalene | Hydrocarbon, triterpene | Anti- oxidant, anti- tumor | (Zih-Rou, 2009) |
| 3. | Car vacrol | Monoterpenoids | Antimicrobial, anti-oxidant | (Baser, 2008) |

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| | | | | |
|---|---|---|---|---|
| | | Phenol | | |
| 4. | β-Sitosterol | Phytosterol | Anti-fertility activity, antimicrobial, anticancer, anti-inflammatory activity, antioxidant | (Shrishkumar, 2014) |
| 5. | Hexadecanoic acid | Palmitic acid | antioxidants, anti bacterial, antifungal, nematicide, and pesticide | (Mustapha, 2016) |
| 6. | Stigmasterol | Phytosterol | Antioxidant, Antimicrobial, Antifertility activity, anti-tumor | (Kaur, 2011) |
| 7. | Campesterol | Phytosterol | Antimicrobial, antioxidants,anti bacterial,anti-fungal, Anti-fertility activity | (Bhardwaj, 2014) |
| 8. | 9,12,15-Octadecatrienoic acid ethyl | Fatty acid ester | Anti-inflammatory, Insect Fug, Hypocholesteromic acidCancer preventive, Nematicide, Hepatoprotective, | Rig(Rigoberto, 2017)oberto et al., 2017 |
| 9. | Kaempferol | Phytosterol | Anti-inflammatory, antioxidant, antistress | (Kim, 2020) |
| 10. | Deacetyl-salannin | Methyl ester | Antimicrobial, antioxidants, anti bacterial, anti-fungal, Anti-fertility activity, anti-tumor | (Chauhan, 2018) |
| 11 | Nimbolinin | Triterpene | Anti-bacterial, Antimalarial, Anti-inflammatory, immunomodulatory, Spermicidal | (Shakib, 2020) |

**Antidiabetic Effect of Extracts of *Melia azedarach*:**

*Melia azedarac h*extracts have demonstrated therapeutic potential in managing type 2 diabetes mellitus and its associated complications, supporting their traditional use in Indian medicinal systems. Previous studies have shown that isolated compounds from the leaves and fruits of *Melia azedarach* exhibit significant antidiabetic activity. Specifically, ethanol extracts from the leaves and fruits inhibited the PTP-1B enzyme by 40.7% and 55.9%, respectively, at a concentration of 10 µg/ml, additionally, the chloroform fraction of the fruits and the butanol fraction of the leaves inhibited PTP-1B enzyme by 50.2% and 65.5%, respectively, at the same concentration. All prepared extracts and fractions were evaluated for their in vitro and in vivo hypoglycaemic activities. These evaluations included inhibition of PTP-1B enzyme activity, stimulation of glucose uptake in C2C12 cells, and improvement in blood glucose levels in STZ-induced Sprague-Dawley rats, with metformin serving as the standard hypoglycemic agent.While medicinal plants offer promising therapeutic avenues for

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treating various ailments, they come with both advantages and limitations. Diabetes, as a metabolic disorder, can lead to severe complications if not properly managed. The limited availability of effective antidiabetic agents and the side effects associated with synthetic drugs emphasize the need for new, natural alternatives. Extracts from *Melia azedarach* twigs have shown strong antidiabetic effects both in vitro and in vivo, contributing to their hypoglycemic properties. Ongoing pharmacological and phytochemical investigations aim to identify the bioactive compounds responsible for these effects and to clarify their mechanisms of action. Notably, bark extracts of *Melia azedarach*have yielded several novel compounds, including a new tirucallane-type triterpenoid. Five tirucallane-type triterpenoids demonstrated significant PTP-1B inhibitory activity, which may explain the antidiabetic potential of M. azedarach. These findings contribute valuable insights into the chemistry of the genus Melia and highlight its relevance in the search for effective diabetes treatments.(Zhang SN, 2020)(Chowtivannakul P, 2016)

**In vitro acaricidal effect of *Melia azedarach* embryonated eggs and engorged nymphs:**

The extracts, particularly the petroleum ether extracts, of these plants exhibit significant potential for development as novel acaricidal agents, specifically for controlling the eggs and nymphs of Hyalommadromedarii. The ethanolic and petroleum ether extracts derived from the ripened fruits of *Melia azedarach* demonstrated notable ovicidal activity against the camel tick *H. dromedarii.* Malformations were observed in larvae that emerged from eggs treated with even the lowest concentrations of the tested extracts. The primary bioactive compound present in both Azedarach and Melia species is azadirachtin, which adversely affects insect development.(Ashish, 1999).(Ashish C. A., 2019)

**Traditional Uses of *Melia azedarach***

The root bark is commonly prepared as a decoction and administered to children as an anthelmintic. A dose of one ounce is given every three hours in the morning and evening for several consecutive days, followed by a cathartic. Additionally, leaf juice can also be taken internally to expel intestinal worms. For headaches, especially those associated with tension, the flowers and leaves are applied externally as a poultice. A combination of 15 leaves has been traditionally used to treat hysteria. Leaves and bark are employed both topically and internally for treating leprosy, scrofula, and other skin disorders. A poultice of blossoms is applied for eruptive skin conditions, as it is believed to possess vermicide properties. A bitter tonic is made from root bark decoction in doses of ½ to 1 ounce. The bark is also used to prepare a syrup flavored with vanilla to mask its unpleasant taste.

The bark, leaves, fruits, and especially fresh berries are toxic in large quantities and may lead to narcotism or even death. As few as six to eight fresh berries have been reported to be fatal. However, the berries are also used medicinally for scrofula and leporid arthritis. When dried and soaked in whisky, berries are employed to treat ascribes, tapeworms, and other parasitic worms. Berries boiled in lard are used to treat scorch head.

The blossoms are utilized to treat scalp eruptions and eliminate lice. Seeds are used in managing rheumatism, while the oil extracted from the plant functions similarly to neem oil. The gum from the plant is considered a remedy for splenic hypertrophy is gum.(Nadkarni KM, 1976)

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**Uses in Iranian Traditional Medicine**

In Iranian traditional medicine, the belief is that whole plants or their combinations are more effective than isolated pure chemicals. Key applications include:

**Flowers:** Used for treating brain blockages, calming the elderly and those with cold dystemperament, and easing headaches through inhalation of their scent.

**Leaves:** Used as an antidote to poisons, for intestinal blockages, purulent sores, anthelmintic purposes, kidney stones, vitiligo, leprosy, as a diuretic, emmenagogue, to promote hair growth, and as a lice treatment.

**Fruits:** Employed to promote hair growth, treat vitiligo, leprosy, tinea, head wounds, and as a remedy for phlegm-producing fevers and coughs.(Jafari S, 2013)

Table No. 2: Major Phytochemicals present in flowers extracts of *Melia azedarach*.

| **List of Phytoconstituents** | **References** |
|---|---|
| 2-Pentylfuran, 2-Phenyl ethanol,1,3- Diphenyl-propan-2-ol,4-Hydroxybenzoic acid, Tetradecanoic acid, Hexadecanoic acid, Branched hexadecanoic acid, 5,15- Dimethyl-nonadecane, Hexadecanoic acid, 2,6,10,14-Tetramethyl-octadecane, 14- Methyl-heptadecanoic acid, Heptadecanoic acid, Octadec-9Z-en-1-ol, 9Z,12Z,15Z, Octadecadienoic acid, Octadecanoic acid, Eicosanol, Tricosane, Eicosanoic acid, Docosanol, Eicosanoic acid, Tetracosane, 2Methyltetracosane, Pentacosane, Branched hexacosane, Hexacosane, Heptacosane, Tetracosanoic acid, Branched'pentacosanoic acid, Octacosane, Nonacosane, Triacontane, Hentriacontane, Dotriacontane & ritriacontane | (2. Muhammad MT, 2015) |

**Ethnobotanical importance of *Melia azedarach***

The fruit, the root, and the seed are bitter and poisonous. All parts (the bark, stem, the root and the root bark, the leaves and fruit, the flower including flower oil, the seed, and the seed oil) of *Melia azedarach.* are used as a traditional medicine and was shown in vitro and in vivo various pharmacological properties. Among all parts of the plants, its leaves used most. The leave is used for control insect, mite and nematode pests, for skin disease, for gingivitis mouthwash, to treat diabetes, malaria, fever, and stomachache. Sharma and Paul (Britannica, n.d.)described ethnomedicinal and pharmacological review of *Melia azedarach*. Some ethnomedicinal use was supported by pharmacology research result, but some has supposed of empirical base experience. Among pharmacological test, it was known that insecticidal activities were observed most compared to other pharmacological activities of the plants. The most used parts of the plants were the seed and the leaf of the *Melia azedarach*. Insecticidal mechanism activities of the plants include antifeedant, anti-oviposition, phagoinhibitor, antimolting, larvicidal, adulticidal, and anticholinesterase. Azadirachtin and

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tetranortriterpenoids were supposed compound related to these primary insecticidal activities. Azadirachtin, a toxic constituent of *Melia azedarach*.
, is been commercially product of neem oil.(Sharma D, 2013)Furthermore, (Tariq A S. S., 2017)was review of seventy eight families plants, which ethnomedicinally use as anticancer in some regions. MA was one of four Meliaceae families (MA, Azadirachta indica A. Juss., Trichilia emetica Vahl., and Swietenia mahagoni Jacq.). Among those of four Meliacea's anticancer plants, A. indica was more exposed to in vitro and in vivo anticancer activities potency(Tariq A, 2017)(3. Yang H, 2017)

**Result and discussion**

The present article reviews a details study on a details ethno botanical study of *Melia azedarach* as well as it extracts both possesses the various pharmacological properties and phyto constituent responsible for pharmacological activity.

**Conclsion**

It can be stated that traditional Indian medicinal plants have a history of use as herbal treatments. Many Indian plant species have been studied for their ability to treat cognitive problems. Although the different extract of the plant has several pharmacological importance but medicinal application and clinical application can be made only after extensive research on its bio-activity, mechanism of action, pharmacotherapeutics and extensive safety studies. It also require to research on pharmacognostical, phytochemical and pharmacological aspect. However research going on it would be easier to develop new drugs after extensive studies on mechanism of action & several pharmacological effects. It is expected that it may find application as a novel drug in the future to control various diseases.

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**Bibliography**

**1.**Kaur, N., Chaudhary, J., Jain, A., & Kishore, L. (2011). Stigmasterol: a comprehensive review. International Journal of Pharmaceutical Sciences and Research. 2(9): 2259-2265.

**2.**Singh, B., Pandya, D., & Mankad, A. (2020). A Review on Different Pharmacological & Biological Activities of Azadirachta indica A. Jusm. and Melia azedarach L. Jour. Pl. Sci. Res. 36(1-2): 53- 59.

**3.**Sultana, S., Akhtar, N., & Asif, H.M. (2013). Phytochemical screening and Antipyretic effects of Hydromethanol extract of Melia azedarach leaves in rabbits. Bangladesh J. Pharmacol. 8: 214-217.

**4.**Ervina, M., &Sukardiman. (2018). A review: Melia azedarach L. as a potent anticancer drug. Pharmacognosy Reviews.12(23): 94

 https://doi.org/10.5281/Zenodo.15497853

**5.**Malar, T.R.J.J., Antonyswamy, J., Vijayaraghavan, P., Kim, Y. O., Al-Ghamdi, A.A., Elshikh, M.S., Hatamleh, A.A., Al-Dosary, M.A., Na, S.W., & Kim, H.J. (2020). In-vitro phytochemical and pharmacological bio-efficacy studies on Azadirachta indica A. Juss and Melia azedarach Linn for anticancer activity. Saudi J. Biol. Sci. 27(2): 682–688.

**6.**Kaur, R., Sharma, A., Kumar, R., &Kharb, R. (2011). Rising Trends towards Herbal Contraceptives. J. Nat. Prod. Plant Resour. 1(4):5-12.

**7.**Abbasi, A.M., Khan, M.A, Ahmed, M., & Zafar M. (2010). Herbal medicine used to cure various ailments by the inhabitants of Abbottabad District, North West Frontier Province. Ind. J. Trad. Know. 9(1): 175-183.

**8**.https://keys.lucidcentral.org/keys/v3/eafrinet/weeds/key/weeds/Media/Html/Melia_azedarach__%28Melia%29.htm

**9.**Ashish, Chaudhary, A., Raj Hans, & Verma Kumar, K. (2019). In vitro acaricidal effect of Melia azedarach and Artemisia herba-alba extracts on Hyalommadromedarii (Acari: Ixodidae). Journal of Parasitic Diseases, 43, 696–710.

**10.**https://www.eddmaps.org/species/subject.cfm?sub=3049

**11.**Rana, S., &Asemi, Z. (2019). Quercetin: a natural compound for ovarian cancer treatment. J. Ovarian Res. 12(1): 55. doi: 10.1186/s13048-019-0530-4

**12.**Zih-Rou, H., Yin-Ku, L., &Jia,Y. F. (2009). Biological and pharmacological activities of squalene and related compounds: potential uses in cosmetic. Dermatology Molecules. 14: 540-554

**13.**Baser, K.H.C (2008). Biological and Pharmacological Activities of Carvacrol and Carvacrol Bearing Essential Oils. Current Pharmaceutical Design. 14(29): 3106 – 3119.

**14.**Shrishkumar, D., &Ambavade, P.D. (2014). Ambavade. Pharmacological, nutritional, and analytical aspects of β-sitosterol: a review. Oriental Pharmacy & Experimental Medicine. 14(3): 193-221.

**15.**Mustapha, N.A., & Runner, R.T.M. (2016). GC-MS Analysis and Preliminary Antimicrobial Activity of Albizia adianthifolia (Schumach) and Pterocarpus angolensis (DC). Medicines. 3(3): 2-9.

**16.** Kaur, N., Chaudhary, J., Jain, A., & Kishore, L. (2011). Stigmasterol: a comprehensive review. International Journal of Pharmaceutical Sciences and Research. 2(9): 2259-2265.

 https://doi.org/10.5281/Zenodo.15497853

**17.**Bhardwaj, R., Yadav, A., & Sharma, A. (2014). In vitro and in vivo GC-MS Profile and Antimicrobial Activity of Phytosterols of Datura stramonium. Research Journal of Medicinal Plant. 8(3): 112- 120.

**18.** Rigoberto, V.G., Rodolfo, A.V., & Vera, L.P.(2017). Chemical compounds and biological activity of an extract from Bougainvillea X Buttiana (Var. Rose) Holttum and Standl. International Journal of Pharmacy and Pharmaceutical Sciences. 9(3): 42- 46.

**19.**Kim, J.K., & Park, S.U. (2020). Recent studies on Kaempferol and its biological and Pharmacological activities. Excli. Journal. 19: 627-634.

**20.**Chauhan, M., Mani, P., & Sharma, T. K. (2018). The Antibacterial Activities of Neem [Azadirachta Indicia] Seed Oil-A Review. IOSR Journal of Applied Chemistry. 11(5): 58-63.

**21.**Shakib, U. (2020). Pharmacological activities of neem (Azadirachta indica): A review. International Journal of Pharmacognosy and Life Science. 1(1): 38-41.

**22.**Zhang SN, Huang L, Ma RJ, Yang MF, Wei BF, Song HZ, Wang HS, Tan QG. Chemical constituents from the barks of Melia azedarach and their PTP1B inhibitory activity. Natural product research. 2020 Feb 20:1-6.

**23.**Chowtivannakul P, Srichaikul B, Talubmook C. Antidiabetic and antioxidant activities of seed extract from Leucaena leucocephala (Lam.) de Wit. Agriculture and Natural Resources. 2016 Sep 1;50(5):357-61.

**24**. Su M, Mulla MS. Activity and biological effects of neem products against arthropods of medical and veterinary importance. J. Am. Mosq. Control Assoc. 1999;15:133-52.

**25.**Abdel-Ghany HS, Fahmy MM, Abuowarda MM, Abdel-Shafy S, El-Khateeb RM, Hoballah EM. In vitro acaricidal effect of Melia azedarach and Artemisia herba-alba extracts on Hyalommadromedarii (Acari: Ixodidae): embryonated eggs and engorged nymphs. Journal of Parasitic Diseases. 2019 Dec;43(4):696-7

**26.**Nadkarni, K. M. (1976). Indian materia medica (Vol. 1, 3rd ed.). Bombay: Popular Prakashan.

**27.** Muhammad MT, Lubna, Fayyaz N, Tauseef S, Razaq U, Versiani MA, Ahmad A, Faizi S, Rasheed M. Antibacterial activity of flower of Melia azedarach Linn. and identification of its metabolites. Journal of the Korean Society for Applied Biological Chemistry, Apr. 2015; 58: 219-27.

**28.**Sultana S, Asif HM, Akhtar N, Waqas M, Rehman SU. Comprehensive review on ethnobotanical uses, phytochemistry and pharmacological properties of Melia azedarach Linn. Asian J Pharm Res Health Care 2014;6:26-32.

 https://doi.org/10.5281/Zenodo.15497853

**29.**The Editors of Encyclopedia Britannica. Meliaceae. Encyclopedia Britannica Inc.; 2015. Available from: https://www.britannica.com/plant/Meliaceae. [Last accessed on 2017 Sep 25].

**30**. Mabberley DJ. A monograph of Melia in Asia and the Pacific: The history of white cedar and Persian lilac. Gardens' Bull Singapore 1984;37:49-64.

**31.**Sharma D, Paul Y. Preliminary and pharmacological profile of Melia azedarach L.: An overview. J Appl Pharm Sci 2013;3:133-8.

**32.**Tariq A, Sadia S, Pan K, Ullah I, Mussarat S, Sun F, et al. A systematic review on ethnomedicines of anti-cancer plants. Phytother Res 2017;31:202-64

**33.**Tariq A, Sadia S, Pan K, Ullah I, Mussarat S, Sun F, et al. A systematic review on ethnomedicines of anti-cancer plants. Phytother Res 2017;31:202-64.

**34.**13. Yang H, Choi M, Lee DY, Sung SH. Anti-differentiation effect of B, D-Seco limonoids of Swietenia mahogani. Pharmacogn Mag 2017;13:293-9.

 https://doi.org/10.5281/Zenodo.15497853