International Journal of Pharmacy and Analytical Research (IJPAR)

IJPAR |Vol.14 | Issue 3 | Jul - Sept -2025

www.ijpar.com

ISSN: 2320-2831

DOI : https://doi.org/10.61096/ijpar.v14.iss3.2025.498-503

Review

Neem (*Azadirachta indica*): Comprehensive Review and Recent Advances in Plant and Seed Research

Dr. S. Kannan*, J. Jenisha Mol, A. Jenova, P. Ramya

Department of Pharmacognosy, Sri Ramakrishna Institute of Paramedical Sciences, College of Pharmacy, 395, Sarojini Naidu Road, Siddhapudur, Coimbatore - 641 044, Tamil Nadu, India.

*Author for Correspondence: S. Kannan
Email: kannanonline2@gmail.com

Published on: 22 July 2025

Published by:
Futuristic Publications

Abstract

Neem is naturally occurring pesticide that comes from the seed of the neem tree (*Azadirachta indica*). Neem has been extensively used in Ayurveda, Unani and Homoeopathic medicine and has become a cynosure of modern medicine. The Neem seed has been known for its unique properties, in improving the human health and wide range of pharmacological properties, especially as antibacterial, antifungal, antiseptic, antiulcer, anti-infective and antimicrobial properties. This tree has economic potential and continuous to be used worldwide. Extraction of essential neem oil from need seed was carried by soxhelt extraction method using different organic solvents and parameters. Neem oil extraction usually has three different ways; seeds, including… Mechanical pressing, Solvent extraction and Steam distillation. Other methods are used, Super critical fluid extraction (SFE), Microwave-assisted extraction (NA), Maceration, Cold extraction, Aqueous extraction etc... Neem seed kernels prior to their extraction for oil were pre-treated in single stage with different solvents, viz., isopropanol, acetone and ethanol in pure as well as in aqueous forms. The aqueous-ethanol (water: ethanol 15:85 V/V) was also employed for three stage counter-current pre-treatment of neem seeds kernels, which gave the best results. Soxhlet extraction using hexane has 40.35% using ethanol-hexane mixture of 60.40% volume proportion has 43.71% using ethanol 42.65 % and using methanol 42.89%. Mixture of ethanol and hexane gave admirable results. Additionally, present mostly in the seeds, leaves and other parts of the neem. The extracts are also beneficial for heart diseases, hepatitis, fungal infection, malaria, psoriasis and ulcer.

Keywords: *Azadirachta indica*, neem seed, Azadirachtin, nimbin, nimbidol, Pharmacological activities, Hot extraction and cold extraction.

INTRODUCTION

The botanical name of the neem is (*Azadirachta indica*) and it belongs to the family (Meliaceae)[1]. The neem tree well known on the Indian subcontinent for 4000 years [2]. More than 140 compounds have been isolated from different parts of neem. All parts of the neem tree-leaves flowers, seeds, fruits, roots and bark have been used traditionally for the treatment of inflammation, infections, fever, skin disease and dental disorders [3]. It grows about 40-60 feet high. It is used in treating many kinds of diseases in Ayurveda [1]. It also has medicinal uses in the treatment of cancer, in the fight against the malaria vector and it is anti-inflammatory and antiviral [4]. The methods used to extract neem oil are mechanical pressing, Soxhlet Super critical fluid, Microwave and ultrasound. Soxhlet extraction is the most used to obtain bioactive molecules from natural sources [4]. The objective of present study was used Soxhlet extraction method and some selected organic solvent to extract essential oil from neem seed. The effects of parameter such as temperature, time and particle size were studied. As the solvents, we used ethanol, hexane, methanol and ethanol-hexane Mixture [5]. This is due to the large amount of phytochemicals, among which the substance azadirachtin is known as the most efficient for insecticide use, being the main one in biopesticide formulations. [6][7]. Azadirachtin is present in varying concentration in all parts of the plant, but the seeds have the highest concentration of azadirachtin, being more used in the production of oils for insecticide use [8][9][7]. Neem seed oil has in its chemical constitution a diversity of volatile organic compounds (VOCs) belonging to different chemicals classes such as: alcohols, acids, esters, phenols, flavonoids, sulphates, aldehydes, hydrocarbons and terpenes [10][11].

Pharmacological actions

Neem has been extensively used in Ayurveda, Unani and Homoeopathy medicine and has become a cynosure of modern medicine. All parts of the neem tree- leaves, seeds, flowers, roots and bark have been used in traditional medicine. Neem seed extract exhibits a wide assay of pharmacological actions, including antidiabetic, antiviral, antibacterial, antifungal, antiulcer, anti- dental, hepatoprotective, anti-inflammatory, anticancer, antimalarial, antioxidant, analgesics and antipyretic.

Antiviral activity

Aqueous leaf extract offers antiviral activity against vaccinia virus, chikungunya and measles virus. Nimbin and Nimbidin have been found to have antiviral activity. They affect Potato virus x, vaccina virus and fowl Pox virus [12][16][25].

MATERIAL AND METHODS

The fresh bark was collected from Neem tree. The help of a botanist at the department of Botany university of Agriculture Faisalabad was sleeked for identification. The bark was shade dried and grounded into a coarse powder using a grinder (0.25mm sieve). The stock of neem bark powder was dissolved PBS in a 50 ml tube and kept on a Rotatory shaker 4°C overnight. Filtered through 0.22um membrane filter and stored at 4°C until used.

Aqueous leaf extract offers antiviral activity against vaccinia virus, Chikungunya and measles virus. Nimbin and Nimbidin have been found to have antiviral activity. They affect potato virus X, vaccina virus, and fowl pox virus [25].

Antidiabetic activity

The oral effective dose of A.indica leaf extract (400mg/kg body weight) was given once daily for 30 days to high fat diet-induced diabetic rats. At the end of the experimental period, fasting blood glucose, oral glucose tolerance, and the levels of insulin Signaling molecules, glycogen, glucose oxidation in gastroenemius muscle were assessed [13][17].

Material colletion

Azadirachta indica leaves are collected from local areas of Karimnagar (Dist) Andra Pradesh India. The collected plant leaves was sun dried, pulverized by a mechanical grinder, sieved through 40 mesh. about 120g of powdered materials were extracted using ethanol (50oC) using Soxhlet apparatus [17]. The extraction was carried out until the extract to becomes colour less. The extracts is then concentrated by distillation process and dried under reduced pressure. The solvent free semisolid mass thus obtained in under reduced pressure. The solvent free semisolid mass thus obtained is used for the experiment. This semisolid mass contains the active compound Nimbidin [18].

Wistar rats of weight between 150-200gm obtained from Nin, Hyderabad, India were used in the study. The animals were maintained under standard conditions in animal house of vaageswari Institute of pharmaceutical sciences. The rats males 8-10 weeks old with average weight of 150-200g. Animals were housed 3-4 per cage in a temperature- controlled (22+/-1) c room, with a light/dark cycle of 12hr. For a week following their arrival, the animals allowed free access to the standard rat chow diet and tap water they were acclimating to the environment. Rats were also monitored daily and cages cleaned thrice weekly. At the start of the experimental animals were randomly distributed so that body weights, initial triglycerides (TG), total cholesterol (TC), other parameters in all the experimental groups were similar [19].

Antipyretic, anti-inflammatory & analgesics activities

Neem is strongly antipyretic and traditionally used for fevers. A methanol extract of the leaves has been reported to exert antipyretic effects in male rabbits. The ether-soluble fraction of ethanolic neem leaf extract has been demonstrated to possess antipyretic and anti-analgesic effects [14]. Neem seed oil exhibits significant anti-inflammatory activity, With it's effectiveness increasing with dosage [15] [20] [23].

METHODS

Anti-inflammatory

The study sample was divided into six groups with each group consisting of six rats as follows: Group1 : control (distilled water 0.5ml/rat); Group 2: standard (aspirin 200mg/kg body weight orally); Groups 3,4,5 and 6 (NSO 0.25ml,0.5ml,1ml and 2ml/kg body weight, respectively, IP). The volume edema was measured by water displacement method in microburette. Volumes of both the hind paws were measured before and after 1,2,3,4,6,12and 24 hr of carrageenan injection. [19].

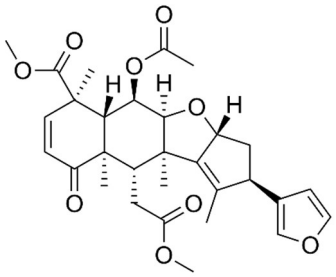
Anti-pyretic

In this study albino rats were randomly divided into groups of six each group consisting of 6 rats, Group 1: control (distilled water 0.5ml/rat); Group 2: standard (paracetamol 100mg/kg intraperitoneally), Group 3,4,5,6 (NLE 62.5, 125, 250, 500mg/kg body weight intraperitoneally respectively). Total volume of the oral dose kept constant at 1ml/rat. It is a randomized control study [18].

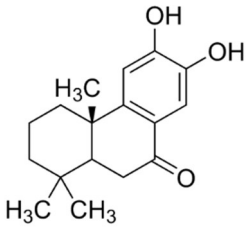
Neem leaf

Antiulcer activity

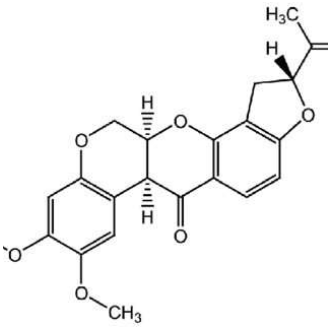
Neem leaf has proven successful in treating stomach ulcers. Its antihistamine and antibacterial compounds can reduce inflammation and destroy ulcer-causing bacteria such as Helicobacter Pylori. Aqueous neem extract is brought about by blocking acid secretion through inhibition of H+-K+-ATPase and by preventing oxidative damage and apoptosis. The potent antiulcer effects exerted by Nimbidin, a constituent of neem leaf, was correlated to its antihistaminic actions mediated H2-receptor blockade[3].



Nimbin



Nimbidin



Azadirachtin

Ranitidine and aspirin were procured from Merck, Bangalore, India, NaoH, Topfer's reagent and Phenolphthalein were obtained from scientific, OEM, Mumbai, India.

Five hundred gram of the powder prepared from shade-dried leaves was subjected to Soxhlet Extraction for 16h using 5 liters of distilled water. The greenish, semisolid AE obtained was dried under partial vaccum using a rotary evaporator. The % yield of the AE of the leaves was 20.34% based on the starting quantity. The doses of 150, 300 and

600mg/kg body weight (b.w) were prepared by suspending the dried AE in distilled water & administering it to the rats by the per (P.O) route. [21].

Neem extract

Anticancer activity

Neem extract studies from is laboratory have demonstrated the chemo preventive potential of neem leaf extracts on MNNG-induced for stomach tumour and 4-nitro quinoline 1-oxide induce oralcarcinogenesis. Aqueous as well as alcoholic extracts of neem leaf effectively Suppressed DMBA-induced HBP carcinogenesis by modulating the cellular enzymes in the target organ, as well as in host liver and blood [3] [22] [23].

Antifungal activity

Neem (*Azadirachta indica*) extract (NE) & NE combined with copper sulfate and boric acid (NECB) were examined for their protective effect against fungal detexioration of mango (Mangifera indica) & rain tree (Albizia Saman) wood. Growth of the white-rot fungus Schizophyllum commune was completely inhibited on solid medium containing 1.8% (W/W) NE or 5% (W/W) NECB. The average weight losses of NE & NECB treated wood blocks inoculated with commune were respectively 4.7% and 3.3% for M.indica and 4.1% and 3.0% for A. saman[7][24].

Neem seeds

Material and methods:

Neem seeds were collected in kunming (Yunnan, china) during July of 2019. The seeds were washed & inside air-dried for one week. The wound fungi under investigation, Trametes versicolor & Gloeophylliantrabeum, were obtained from the Chinese strain preservation centre (Beijing, china). The fungi were preserved in potato dextrose agar (PDA) and stored at 4°C the experimental tree (P.tomentosa) grew in the Yichun area in Heilongjiang province. Sapwood samples (20mm x 20mm x 10mm) were dried to constant weight at 105 °C.

The neem seeds were ground to 20-mesh. A Total of 20g of neem powder was mixed with 280ml of 60%V/V ethanol solution (chang et.al 2018). The mixture was stirred in a water bath at 50°C for 90min. The residual ethanol was evaporated using a vaccum rotary evaporator (RE 52AA; Huanya, Zhejiang, china) The extracts were stored at 4°C For further use. [24].

Neem plnts

Antimicrobial activity

Selection of plants

The neem plant was selected for the study from 23-14/1, Shantiniketan, lingamapally, Hyderabad, AndraPradesh its healthy leaves were collected for the research.

Leaf sample preparation

The collected leaves were completely shade dried and were finely powdered with mortar &pestle. Then the powder was filtered which was approximately 12 grams. Fresh leaves were also collected and cleaned for Neem water extract preparation. [25].

Acknowledgments

I would like to express my heartfelt gratitude to Department of pharmacognosy lab technician R.Venkataswamyu and lab assistant Mrs. G. Maria Roselin for his guidance and support. I am thankful to my institution Sri Ramakrishna Institute of Paramedical Sciences, College of Pharmacy, for providing the resources needed for the completion of this work.

CONCLUSION

Neem is the best nontoxic biological sources for development of modern drugs. Medicinal plants & phytochemicals are receiving growing consideration in recent years for the prevention and treatment of various diseases including cardiovascular disease and cancer, because of their relative safety &efficacy. Neem contains chemicals that might help reduce blood sugar levels, has ulcers in the digestive tract, prevent pregnancy, kill bacteria, and prevent plague from forming in the mouth. Neem seeds are a valuable resource with a wide range uses, including pest control, soil amendment, & potential medicinal application [31]. The efficient extraction of Neem seeds oil was performed by Soxhlet system using the hexane solvent obtaining a good output equal to 23.73%+/- 0.07. It was possible to detect 35 volatile compounds in the neem seeds oil, the extraction of oil from Neem, flowers & seeds with

solvents that are less harmful to the environment, makes it possible to assess its pesticide potential. Additionally, the potential of neem oil as an industrial & hospital cleaning product is highlighted, exploring its antimicrobial, antibacterial and biodegradable properties.

REFERENCES

1. Supriya Dubhashi., Pranay.V., Singaiah.M., Saiwik., V.V.L.N Prasad and Prakash.V., Diwan. V., Studies on extraction and HPLC analysis of Azadirachtin from kenels of neem seeds., *Journal of Advanced Pharmacy Education and Research*; *(WWW.japer.in)* (Jan- Mar 2013)., vol.3 (Issue 1)., Pg no: 27-30
2. Sudhanshu Verma., Shani Kumar Singh., Swati Swayamprabha Pradhan and Abishek Singh., Neem seed and leaf extract on crop protection and production*., International Journal of Plants and soil science.,* vol. 33 (6); (2021)., Pg no:22-27.
3. Subapriya . R., Nagini. S., Medicinal properties of neem leaves., *Department of Biochemistry, Faculty of science.,* (2005)., vol.5., Pg no: 1-8.
4. Simyao Macedo Cabral., Flamys Lena do Nascimento Silva., Pablo Jose Rodrigues., Magale Karine Diel Rambo., Jessyka Ribeiro Santos., Mariana Helena Chaves., Bernardo Ferreira Pinto., Extraction and chemical characterization of neem seed oil., *Journal of Biotech., and Biodiversity (JBB).,* vol. 11 (2023)., 170-181.
5. Bereket Tesfaye., Tilahu Tefera., (2017)., Extraction of essential oil from neem seed by using Soxhlet extraction methods*., International Journal of Advanced Engineering, Management and science., (WWW.ijaems.com)* vol. 3., (Issue 6)., Pg no: 646-650.
6. Perera WPRT, Liyanage AJ ,Dissanayake KGC,Gunathilaka H,Weerakoon WMTDN,Antiviral potential of selected medicinal herbs and their isolated natural products.*BioMed Research International*,v.2021,Pgno :1-8,2021.
7. Rana S,Saxena A..Medicinal chemistry of neem *:Astate of art.Kochi,Kerla ,India*:1,2023.
8. Chaudhary MF ,Ashraf A ,Waseem M, Hayat S, Nadeem HU,Neem oil.In:Inamuddin,Boddula R,Asiri AM(org).*Green Sustainable Process Chemical and Environmental .Elsevier ,2021.Pg no:57-73*
9. Loganathan T.Barathinivas A, Soorya C, Balamurugan S, Nagajothi TG Ramya S, et al. Physiochemical, druggable, ADMET pharmacoinformatics and therapeutic potentials of azadirachtin – a prenol lipid (triterpenoid) from seed oil extracts of *Azadirachta indica* A. Juss. *Journal of drug delivery and Therapeutics,v.11,* n.5, Pg no:33-46,2021.https;//doi.org/10.22270/jddt.vl li5. 4981
10. Gucchait KC, Manna T, Barai M, Karmakar M, Nandi SK, Jana D, Dey A, Panda A, Bhattacharya R, Chatterjee S, Panda S, Raul P, Patra A, Bhattacharya R, Chatterejee S, Panda AK, Ghosh C. Antibiofilm and anticancer activities of unripe and ripe *Azadirachta indica* (neem) seed extracts. *BMC Complementary Medicine and Therapies*, v.22,n.1, pg no 1-18,2022.https://doi.org/10.1186/s12906-022-03513-4
11. Srinivasa. I.V., Neelima.P., Neem (*Azadirachta indica*); International *Journal of economic plants.,* Feb (2022)., vol. 9 (1)., Pg no: 59-61.
12. Shakib Uzzaman., Pharmacological activities of neem (*Azadirachta indica)., International Journal of Pharmacognosy and life science (IJPLS).,* (2020)., vol. 1 (1)., Pg no: 38-48.
13. Subapriya. R., Nagini. S., Medicinal properties of neem., *Department of Biochemistry., Anti cancer agents.,* (2005)., vol. 5., Pg no: 4.
14. Diksha Sharma., Nikhil Kumar., Kapil Kumar Verma., Therapeutic potential of *Azadirachta indica* (Neem) and Phytoconstituent against Disease., *International Journal of Pharmaceutical sciences.,* vol. 2., Issue 10., Pg no: 1-10.
15. Shahid Mahmood., H W agas Amir., Rao Zahid Abbas., Bilal Aslam., and Azhar Rafique., Evaluation of Antiviral Activity of *Azadirachta indica* (Neem) Bark extract against Newcastle Disease virus., *Pakistan Verterinary Journal.,* vol. 38 (1); Pg no: 25-28.
16. Grover K.S., Yadav.V. Medicinal Plants of indica with anti diabetic potential; *J Ethnopharmacolog. 2002;* vol.81 : Pg no: 81-100.
17. Johann Georg Schnitze; diabetes causes & cure : including cure of later diabetes consequences, *Germany : privately printed.* 1980-2002., Pg no: 127-132.
18. Shravan Kumar Dholi., Ramakrishna Raparla., Santhosh Kumar Mankala., Kannappan Nagappan., Invivo Antidiabetic evaluation of neem leaf extract in alloxan induces rats., *Journal of applied Pharmaceutical science.,* vol. 01(04); 2011., Pg no: 100-105.
19. Soumya Santra., Manas Rajan Naik., Rasmirekha Behera., Divya Agarwal., Sanjay Kumar., and Shatilata Patnaik., Anti Pyretic effect of *Azadirachta indica* leaf extract (Neem leaf extract) on Albino Rats., *Research*

Journal of Pharmaceutical (RJPBCS) Biological and chemical sciences., Nov-Dec., 2014., vol. 2(6)., Pg no: 669.

20. Sanjay Kumar., Udaya Kumar Vandana., Divya Agarwal., Jagadish Hansa., Anti-inflammatory effect on leaf extract in Albino Rats., *International Journal of Science and Research (IJSR).,* vol. 4 (8); Pg no: 713-721.
21. Sanjay Kumar., Divya Agarwal., Jyotsna Patnaik., and Shantilata Patnaik., Analgesic effect of neem (*Azadirachta indica*) seed oil on Albino Rats., *International Journal of Pharma and Bio sciences.,* vol. 3., Issue 2., April-June 2012, ISSN 0975-6299.
22. PranjitSantonuBhajoni., Girish Gulab Meshram., Mangala Lahkar., Evaluation of the Antiulcer activity of the leaves of *Azadirachta indica* : An experimental study., *Integrative Medicine International.,* 2016., vol. 3., Pg no: 10-16.
23. Subapriya. R; Bhuvaneswari. V., Ramesh., Nagini. 8, *cell Biochem, funct.,* 2004., vol. 22., Pg no: 1.
24. Dasgupta, T.I; Banerjee., Yadava. P.K ; Rao. A.R., *J. Ethnopharmacol.,* 2004., Pg no: 92-93.
25. Lulu Chang., Yin Liu., Wei wei Zhang., Guoqi Xu., Lihai Wang., and Wenxia Yuan., Antifungal activity and chemical composition of neem seed extract (*Azadirachta indica*. A.)., *Bio Resources.,* vol.17(1)., chang et. al.(2022)., Pg no: 592-603.