

NEEM (AZADIRACHTA INDICA): A VERSATILE PLANT

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Introduction

Neem (*Azadirachta indica*) is perhaps the most useful traditional medicinal plant in India. Each part of Neem tree has some medicinal property and thus commercially exploitable. During the last five decades apart from the chemistry of the Neem compounds, considerable progress has been achieved regarding the biological activity and medicinal application of neem. It is now considered as a valuable source of unique natural products for development of medicine against various diseases and also for the development of industrial products.

Azadirachta indica is well known in India and its adjacent countries for more than 2000 years as one of the most versatile medicinal plant having a wide spectrum of biological activity. Each part of tree has been used as traditional medicine for house hold remedy against various human ailments, from antiquity. Neema has been extensively used in Ayurveda. Unani and Homeopathic medicine and become a cynosure of modern medicine. The Sanskrit name of the neem tree is “Arishta” meaning “Reliever of seekness” and

it still regarded as village dispensary in India.

The importance of the neem tree has been recognized by the U.S. National Academy of Sciences, which published a report in 1992 entitled “Neem-A tree for solving global problems. Various partsof the neem tree has been used pas traditional Ayurvedic medicine in India as well as in abroad.

Neem oil, bark and leaf extract has been therapeutically used at folk medicine to control leprosy, intestinal helminthiasis, respiratory disorders, constipation and also as a general health promoter. It used for treatment of rheumatism, chronic syphilitic sores and indolent ulcer hasalso been evident. Bark, leaf, root, flower and fruit together cure morbidity, itching, biliary afflictions, and skin, ulcer, burning sensations.

Some medicinal uses of neem as mentioned in Ayurveda are given below in the table No. 1.

Uses of Neem

- 1. Antibactriral Activity:** The oil from the leaves, seeds and bark possesses a wide spectrum of antibacterial action

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against Gram-negative and Gram-positive microorganism including *M.tuberculosis* and streptomycin resistant strains. It also inhibits *Vibrio cholera*, *Klebsiella pneumoniae*, *M.tuberculosis* and *M.pyogenes*. Anti-microbial effect of neem extract have been demonstrated against *Streptococcus mutans* and *S.faecalis*.

induced hyperglycemia. Aqueous leaf extract also reduces hyperglycemia in streptozotocin diabetes and the effect is possible due to presence of a flavonoid, quercetin.

4. Antifertility Effect: The Neem oil proved spermicidal against rhesus monkey and human spermatozoa in vitro. In vivo studies showed that

Table No. 1: Some medicinal uses of neem as mentioned in Ayurveda

Parts	Medicinal Use
Leaf	Laprosy, eye problem, epistaxis, intestinal worms, anorexia, skin ulcers.
Bark	Analgesic, alternative and curative of fever.
Fruit	Relieves piles, intestinal worms, urinary disorder, epistaxis.
Twig	Relieves cough, asthma, piles, phantom, tumour, intestinal worms, spermatorrhoea, obstinate urinary disorder, diabetes.
Gum	Effective against skin diseases like ring worms, scabies, wounds and ulcer.
Seed/pulp oil	Leprosy and intestinal worms.
Root, bark, leaf, flower, fruit together	Blood morbidity, biliary affliction, itchleaf, flower, ing, skin ulcer and leprosy.

- 2. Antiviral Activity:** The aqueous leaf extract offers antiviral activity against *Vaccina virus*, *Ckikungemya* and measles virus in vitro. The anti-viral and virucidal effect of the methanolic extract of neem leaves have recently been demonstrated against group-B coxsackic viruses.
- 3. Hypoglycemic Activity:** The Aqueous extract of neem leaves significantly decreases blood sugar level and prevents adrenalin as well as glucose

intravaginal application of Neem oil prior to coitus could prevent pregnancy. Ant fertility effect of Neem oil has been studied and suggested to be novel method of contraception. Purified Neem seed extract (Praneem) has also been demonstrated to abrogate pregnancy in both baboons and bonnet monkeys, when administrated orally. The effect is possible due to activation of cell-mediated immune reaction. The mechanism of action of neem oil

appears to be non-humoral, probably mediated through its spermicidal effect and may have less side effects than steroidal contraceptives.

5. **Antimalarial Activity:** The Neem seed and leaf extract are effective against malarial parasites; components of alcoholic extract of leaves and seeds are effective against both chloroquin, resistant and sensitive strains of malarial parasites. Recently, Neem seed extract and purified fraction have been shown to inhibit growth and development of asexual stages of drug sensitive and resistant strains of the human malarial parasite *Plasmodium falciparum*
6. **Antifungal Activity:** The extract of neem leaf, neem oil and seed kernels are effective against certain human fungi including *Trichophyton*, *Epidermophyton*, *Microsporium*, *Trichosporon*, *Geotricum* and *Candida*. Neem extract has also mycotic activity.
7. **Anti Ulcer Effect:** The neem leaf aqueous extract produces anti ulcer effect to restraint cold stress or ethanol orally by preventing mucous depletion and mast cell deregulation (in rabbit). An aqueous extract of neem bark has also shown in laboratory to possess highly potent antacid secretory and anti

ulcer activity and the bioactive compound has been attributed to a glycoside.

8. **Immunostimulent Activity:** The aqueous extract of neem bark possesses anti complement activity, acting both on the alternative as well as the classical pathway of complement activation in human serum. The aqueous extract of stem, bark and leaf also immunostimulant activity as evidence by both humoral and cell mediated responses. Leaf extract, as oral administration causes higher IgM and IgG level along with increased titer of antioalbumin antibody. Neem oil has also stimulated the activity by selectively activating the cell mediated immune mechanism to elicit an enhanced response to subsequent mitogenic or antigenic challenge.
9. **Effect on Central Nervous System:** The Neem extract demonstrated CNS depressant activity in mice. The crude ethanolic extract of stem and root bark showed hypotensive, spasmolytic and diuretic activities.
10. **Anti-Oxidant Activity:** The antioxidant activity of Neem seed extract has been demonstrated in vivo during horse grain germination, which is associated with low level of

lipooxygenase activity and lipid peroxides.

11. Anticarcinogenic Activity: The neem leaf aqueous extract effectively suppresses oral squamous cell carcinoma induced by 7,12-dimethylbenzanthracene (DMBA), as revealed by reduced incidence of neoplasm. Neem may exert its chemopreventive effect in the oral mucosa by modulation of glutathione and its metabolizing enzyme. The neem leaf extract. N-methyl-N' nitroguanine (MNNG) (A carcinogenic material) ;induced oxidative stress has also been demonstrated a protective effect on it and reduced formation of lipid peroxides and enhanced level of antioxidant and detoxifying enzymes in the stomach, a primary target organ for MNNG as well as in the liver and in circulation.

12. Hepatoprotective Activity: The aqueous extract of Neem leaf was found to offer protection against paracetamol induced liver necrosis (in rats). The elevated level of serum aspartate aminotransferase (AST), alanine aminotransferase (ALT) and gamma glutamyl transpeptidase (GGT) indicative of liver damage of the neem leaf aqueous extract.

Biological Activity of Some Neem Compounds

Although a large number of compounds have been isolated from various parts of neem, a few of them have been studied for biological activity.

Nimbidin, a major crude bitter principle extracted from the oil of seed kernels of *A. Indica* demonstrated several biological activities. From this crude principle some tetraterpenes, including nimbin, nimbinin, nimbidinin, nimbolide and nimbidic acid have been isolated.

Nimbidin and Sodium Nimbidate Possess Significant Dosedependent

Anti-inflammatory activity against corraegenin-induced acute paw oedema in rats and formalin-induced arthritis. Antipyretic activity has also been reported and confirmed in nimbidin. Oral administration of nimbidin demonstrated significant hypoglycaemic effect in fasting rabbits. Significant antiulcer effect was observed with nimbidin in preventing acetylsalicylic acid, indomethacin, stress or serotonin-induced gastric lesions as well as histamine or cystamine-induced duodenal ulcers. Nimbidin can also suppress basal as well as histamine and corbachol stimulated gastric acid output and may act as an antihistamine by blocking H₂ receptors, thereby helping as an antiulcer agent. The spermicidal activity of nimbidin and nimbin

(1) reported in rats and human as early as 1959. Nimbidin also demonstrated antifungal activity by inhibiting the growth of *Tinea rubrum*. In vitro, it can completely inhibit the growth of *Mycobacterium tuberculosis* and was also found to be bactericidal. Diuretic activity was also reported for sodium nimbidinate in dogs. Nimbolide (2) has been shown to exert antimalarial activity by inhibiting the growth of *Plasmodium falciparum*. Nimbolide also shows antibacterial activity against *S. Aureus* and *S.coagulase*. Gedunin (3). Isolated from neem seed oil has been reported to possess both antifungal and Antimalaria activities. Azadirachtin (4), highly oxygenated C-secomeliacins isolated from neem seed and having strong antifungal activity has been demonstrated to have antimalarial property as well. It is inhibitory to the development of malarial parasites. Mahmoodin (5), a deoxygedunin isolated from seed oil, has been shown to possess moderate antibacterial action against some strains of human pathogenic bacteria. Condensed tannins-from the bark contain gallic acid, (+) gallocatechin, (-) epicatechin, (+) catechin and epigallocatechin, of which gallic acid (6), (-) epicatechin (7) and catechin (8) are primarily responsible for inhibiting the generation of chemiluminescence by activated human polymorphonuclear neutrophils.

(PMN), indicating that these compounds inhibit oxidative burst of PMN during inflammation.

Conclusion

Neem, the versatile medicinal plant is the unique source of various types of compounds having diverse chemical structure. Very little work has been done on the biological activity and plausible medicinal applications of these compounds and hence extensive investigation is needed to exploit their therapeutic utility to combat diseases. A drug-development programme should be undertaken to develop modern drugs with the compounds isolated from Neem. Although crude extracts from various parts of Neem have medicinal applications from time immemorial, modern drugs can be developed after extensive investigation of its bioactivity, mechanism of action, pharmacotherapeutics, toxicity and after proper standardization and clinical trials, As the global scenario is now changing towards the use of nontoxic plant products having traditional medicinal use, development of modern drugs from neem should be emphasized for the control of various diseases. In fact, time has come to make good use of centuries-old knowledge on neem through modern approaches of drug development. For the last few years there has been an increasing trend and awareness in neem research. Quite a significant amount of

research has already been carried out during the past few = therapeutically and industrially useful preparations and compounds have also been marketed, which generates enough encouragement among the scientists in exploring more information about this medicinal plant. An extensive research and development work should be undertaken on Neem and its products for their better economic and therapeutic utilization.

