

Neem (*Azadirachta indica*)

Knowing the Species

Introduction

Neem or Margosa is a botanical cousin of mahogany. It belongs to the family Meliaceae. The latinized name of Neem - *Azadirachta indica* - is derived from the Persian:

Azad = Free,
dirakht = Tree,
i - Hind = of Indian Origin

which literally means:
'The Free Tree of India'.

Neem is an attractive broad-leaved, evergreen tree which can grow up to 30m tall and 2.5m in girth. Its trunk usually straight is 30-80 cm in diameter. Its spreading branches form a rounded crown of deep-green leaves and honey-scented flowers as much as 20m across.

Chemistry of Neem

To give a brief background, chemical investigations of neem were undertaken by Indian pharmaceutical chemists in 1919, whereby they isolated acidic principle in neem oil, which they named as 'margosic acid". However, real chemical research originated in 1942 with isolation of three active constituents, viz, nimbin, nimbidin and nimbinene. In 1963 an Indian scientist extensively examined the chemistry of the active principles of neem. Following the discovery of neem kernel as a locust feeding deterrent, its chemistry has grown considerably. Several compounds have been isolated and characterized. The main feature is that most of them are chemically similar and biogenetically derivable from a tetracycliterpenes. These are also called liminoids (azadirachtin, melianthrol, salanin etc.) bitter principles and occur in other botanical species as well (Rutaceae and Simaroubaceae). The unraveling of high complex structural features and biogenetic interrelationship represent classic piece of work on natural product chemistry. From the practical side these compounds also exhibit a wide variety of biological activity, for example, pesticides, antifeedants, and cytotoxic properties.

Levaes maily yield quercetin (flavonoid) and nimbosterol (β - sitosterol) as well as number of liminoids (nimbin and its derivatives). Quercetin (a polyphenolic flavonoid) is known to have antibacterial and antifungal properties. This may perhaps account for the curative properties of leaves for sores and scabies. Limonoids like nimocinolide and isonimocinolide affect fecundity in house flies (*Musca domestica*) at a dose ranging between 100 and 500 ppm. They also show mutagenic properties in mosquitoes (*Aedes aegypti*) producing intermediates. Fresh matured leaves yield an odorous viscous essential oil, which exhibits antifungal activity against fungi (*Trichophyton mentagrophytes*) in vitro. White crystalline flakes obtained from petroleum ether extract of leaves consisting of a mixture of C 14, C 24, C 31 alkanes were found to exceed or equal the lavicidal activity of pyrethrum extract. The principal

constituents of neem leaves include protein (7.1%), carbohydrates (22.9%), minerals, calcium, phosphorus, vitamin C, carotene etc. But they also contain glutamic acid, tyrosine, aspartic acid, alanine, praline, glutamine and cystine like amino acids, and several fatty acids (dodecanoic, tetradecanoic, elcosanic, etc.).

Besides, the essential oil consisting of sesquiterpene derivatives, the flowers contain nimbosterol and flavonoids like kaempferol, melicitrin etc. Flowers also yield a waxy material consisting of several fatty acids, viz., behenic (0.7%), arachidic (0.7%), stearic (8.2%), palmitic (13.6%), oleic (6.5%) and linoleic (8.0%). The pollen of neem contains several amino acids like glutamic acid, tyrosine, arginine, methionine, phenylalanine, histidine, arminocaprylic acid and isoleucine.

The trunk bark contains nimbn (0.04%), nimbinin (0.001%), nimbidin (0.4%), nimbosterol (0.03%), essential oil (0.02%), tannins (6.0%), a bitter principle margosine and 6-desacetyl nimbinene. The stem bark contains tannins (12-16%) and non-tannin (8-11%). The bark contains anti-inflammatory polysaccharide consisting of glucose, arabinose and fructose at a molar ratio 1:1:1 with molecular weight of 8,400. The bark also yields an antitumor polysaccharide. Besides polysaccharides, several diterpenoids, viz., nimbinone, nimbolicin, margocin, nimbiol, nimbine, etc. have been isolated from stem bark and root bark.

Besides β - sitosterol, 24-methylenelophenol and nimatone, the heartwood contains, calcium, potassium and iron salts. The heartwood on destructive distillation gives charcoal (30%) and pyroligeneous acid (38.4%). Neem wood contains, cellulose, hemicellulose (14.00%) and lignin (14.63%), while wood oil contains β -sitosterol, cycloecalenol and 24-methylenecycloartenol.

The tree exudes a gum, which on hydrolysis yields, L-arabinose, L-fucose, D-galactose and D-glucuronic acid. The older tree exudes a sap containing free sugars (glucose, fructose, mannose and xylose), amino acids (alanine, aminobutyric acid, arginine, asparagines, aspartic acid, glycine, norvaline, praline, etc) and organic acids (citric, malonic, succinic and fumaric). The sap is reported to be useful in the treatment of general weakness and skin diseases.

Seed is very important both because of its high lipid content as well as the occurrence of a large number of bitter principles (azadirachtin, azadiradione, fraxinellone, nimbin, salannin, salannol, vepinin, vilasinin, etc.) in considerable quantities. Azadirachtin has proven effectiveness as a pesticide against about 200 insect species and is reported as non-toxic to humans. Neem kernel lipids are similar to the normal glycerides from other oilseeds and contains oleic acid (50-60%), palmitic acid (13-15%), stearic acid (14-19%), linoleic acid (8-16%) and arachidic acid (1-3%). It is brownish yellow, non-drying oil with an acrid taste and unpleasant odour. The quality of the oil differs with the method of processing.

The composition of neem cake after the extraction of oil varies widely depending on the raw material used for expelling, for example, whole dried fruits, seeds or kernels. The range of the proximate composition in percentage are: crude protein 13-35, carbohydrates 26-50, crude fibre 8-26, fat 2-13, ash 5-18, acid insoluble ash 1-7. The bitter cake has no value as animal or poultry feed. Extraction of cake with 70% alcohol followed by hexane yields a meal free from bitterness and odour, which will be satisfactory as feed. The neem cake is rich in most of the amino acids. It is a potential source of organic manure and contains many plant nutrients, viz., nitrogen 2-3%, phosphorus 1% and potassium 1.4%. It also contains 1.0-1.5%

tannic acid and has the highest sulphur content of 1.07 - 1.36% among the oil cakes. The neem cake contains a large number of triterpenoids, more of which are being discovered.

Local Names of Neem in India and Around the World

Hindi – Neem
Bengali - Nim, Nimgachh
Konkani - Beva-rooku
Marathi – Kadunimb
Gujarati – Leemdo
Tamil - Vembu, Vempu
Punjabi – Nimb
Malayalam - Veppu, Aryaveppu, Aruveppu, Kaippan, Veppu, Vepa
Simhalee – Nimu
Oriya – Nimo
Telegu – Vepa
Kannada - Bevinmar, Kahibevu

English - Margosa, Neem, Indian Lilac
French - Azarirae d'Inde, Margousier
German - Indischer Zadrach
Persian - Azade Darakhte Hindi
Arabic - Azad Darkhtu Hind
Burmese - Tamabin, Kamakha
Malay - Dawoon Nambu, Baypay
Latin - Azadirachta indica A. Juss or Melia azadirachta Linn
Farsi - Azad darkht 1 hindi (Free tree of India)
Singapore - Kohumba, nimba
Indonesia – Mindi
Nigeria - Don goyaro
Spanish – Margosa
Nepal – Nim
Portuguese - Margosa, Nimbo

History of Usage

Neem - the legendary medicinal tree of India, has grown with the human settlement all over the country and has been an integral part of the Indian way of life for centuries. The history of the Neem tree is inextricably linked to the history of the Indian civilization.

The Neem tree has for a very long time been a friend and protector of the Indian villager. For ages Indians have trusted this tree to fortify their health and remedy scores of diseases. In addition, it has been used for protecting food and stored grains and as a fertilizer and natural pesticide for the fields. It has been used for a far wider array of uses than any other tree !

The Neem tree (*Azadirachta indica* A. Juss) was probably India's best kept secret ! Ancient India was envied for its Black Pepper, Cardamom, Saffron, Turmeric, Sandalwood, Silk etc. and these prized ingredients were sought after and taken across the seas to Europe for centuries. The British Raj also failed to grasp the significance of the presence of this tree in every nook and corner of India (barring the Himalayas and the coastal regions). Perhaps, if they had known about the wonderful array of uses of the Neem Tree, it would have become a worldwide phenomenon ages ago!!

For Indians, the Neem tree had many fascinating aspects. For the children this evergreen, attractive tree was a haven from sun and rain - they spent hours in its cooling shade, plucked the sweet ripe fruit for a snack and built tree houses, which they shared with butterflies, birds and bees. This tree was the chosen one because its shade is known to be cooler than any other tree's, and also, no bugs or insects are to be found under it because of its repellent action.

For the women, the neem was the mainstay of the herbal beauty tradition. It was also a source of medicine to treat more than a 100 health problems, from scratches and skin rashes to malaria and diabetes. The women also used it to protect their stored grains and pulses through the year.

For the men folk the tree provided seeds, leaf and bark which could be converted into fertilizer and pest control material. It also provided medicinal potions for their cattle and livestock. Besides, the breeze that blew through the boughs of the tree kept their homes free of bacteria and viruses and cool through the summer.

For centuries Indians planted this tree in the vicinity of their homes and practiced gentle and daily interaction with this extraordinary plant. For women in particular, the Neem proved an invaluable source of health, hygiene and beauty that was freely available. Having a bath with a decoction of neem leaves kept their skin supple and healthy. Neem leaf powder or crushed leaves incorporated into their face packs provided emollient and anti ageing action. The antiseptic properties of neem leaf extracts helped in controlling pimples and acne.

In some parts of India, it was a regular practice to apply coryllium (lamp black) along the side of the eye, particularly by young ladies as a beauty aid to make eyes conspicuous. The common method employed to make lamp black was to take an earthen lamp and put neem oil and a cotton wick in it. When ignited, the wick liberated copious smoke from which lamp black could be collected, by placing a brass cup containing water for cooling, some distance away from the flame. The lamp black deposit was then scraped from underneath the cup and mixed with a small quantity of mustard oil to form a thick paste called Kaajal.

Neem oil was believed to prevent baldness and greying of hair and was used as anti-lice and anti-dandruff treatment. A teaspoon of dried neem leaf powder, mixed with the same quantity of ghee (clarified butter) and honey was known to help control skin allergies.

A mixture of equal quantities of neem seed powder, rock salt and alum mixed well was used for maintaining healthy teeth and gums.

Nimba, the great medicine

for the cure of pitta - aggravations and
for blood purification

- Priyanighantu Harotakyadivarga

All these practices have been validated by modern science. We know today that this extraordinary tree can do all that it can do because of the sheer range of compounds present in it. A 132 to be precise have been identified to date. Modern research has uncovered the secret of its effectiveness. Its powerful antibacterial, anti-fungal, antiviral and antiseptic properties make it particularly effective in treating anything from dandruff to acne, eczema to malaria and cold sores to warts! Ironically, it is this very versatility that for so long has kept this tree and its amazing properties from taking center stage. The mindset that consumers have been shaped into dictates that there has to be a specialist solution to each problem, in order for the solution to be effective. That one tree can solve so many diverse problems is simply suspect in today's market.

The word NEEM is derived from Sanskrit Nimba which means 'bestower of good health'. It has also been known as Ravisambha - sun ray like effects in providing health. The Neem tree has been venerated through the ages in the Indian countryside as it provided hope in any situation and the faith in the miraculous healing powers of this amazing tree led patients with incurable diseases to adopt neem as way life. They lived in the shade of the tree, drank infusion of various part (Leaf, bark, etc) as advised by Ayurvedic tradition. They used young twigs for oral hygiene first thing in the morning, ate tender leaves as salad or cooked leaves with vegetable as food. Neem gums was used as lozenges for dryness of throat and allay thirst. In summer, sweet, ripe fruit were sucked for their sweetish pulp. All this together, probably strengthened their immune system to meet any challenge!!!

Its medicinal properties are documented in the ancient Sanskrit texts - puranas and it is estimated that Neem is present, in one form or another, in 75% of Ayurvedic formulations.

The ancient Indian found many therapeutic uses for the tree and also observed that the tree could survive and grow almost anywhere as long as it was warm and dry. In due course of time, migrating Indians carried it to distant lands ie: Africa, Fiji, Mauritius, Malaysia, Indonesia, Thailand, Cambodia, plantations are reported to be making headway in USA, Mexico, Australia and China and several countries of Latin America.

Neem Oil is generally recommended for skin diseases while neem leaves are used for beauty purposes.

The Neem leaf extracts have a powerful antiseptic, antifungal, antiviral and anti-bacterial effect. Unlike synthetic chemicals that often produce side effects such as allergic reactions, rashes etc. Neem is gentle and does not create any complications.

Unlike Neem seed oil, Neem leaves have a pleasant odour. An extract from neem leaves can be prepared as an alcoholic tincture or as tea. The alcohol extract has a dark green colour and is effective for several weeks. It can be used in anti ageing nourishing formulas, mouthwashes, facewashes, shower gels, soothing gels, face masks, skin toners etc

Did you know?

- The Vedas called Neem sarva roga nivarini, which means 'one that cures all ailments and ills'.
- This tree is considered to be of divine origin, According to Indian mythology, amrita (ambrosia or the elixir of immortality) was being carried to heaven and a few drops of it fell on the Neem tree.
- Another story tells of the time the Sun took refuge in the Neem Tree to escape from the awesome powers of the demons.
- Planting three or more Neem trees during one's lifetime was considered a surefire ticket to heaven.

Contemporary Importance

Neem is currently one of the world's most researched trees. It is a tree that can help solve global environmental and health concerns.

Environmentally, Neem has a reputation as a natural air purifier, exhaling out oxygen and keeping the oxygen level in the atmosphere balanced. Neem's ability to withstand extreme heat and water pollution is well known. It also helps to improve fertility of the soil and to rehabilitate degraded wastelands.

The Neem tree can also play a vital role in controlling soil erosion, salination and preventing floods. But Neem is far more than a tough tree that grows vigorously in difficult sites. Among its many benefits, the one that is most unusual and immediately practical is the control of farm and household pests. Some entomologists now believe that Neem has such remarkable powers for controlling insects that it will usher in a new era in safe, natural pesticides.

The ecosystem is a major issue on the global agenda and preserving the ecosystem is a priority. A UN study predicts that by the year 2050, most of Asia and Africa will be reduced to a dust bowl if we continue the way we are going. Another study by FAO points out that some pests may soon be beyond control! Neem seed contains bio-active fractions that can help in pest management strategies and help us save our environment. This bio-activity of Neem based products has been extensively evaluated and proven. Because of the fear of toxic residues in food products associated with the use of chemical pesticides, there is a growing need for pest control agents of plant origin which do not leave any toxic residues. Though many plant chemicals have been reported to be suitable for this, Neem is the only plant from which the bio-pesticides are commercially manufactured, found effective, eco-friendly and acceptable to the farmers. Neem pesticides are now increasingly used in India on crops like cotton, vegetables, fruit trees, coffee, tea, rice and spices.

If you are discovering Neem for the first time, here are some quick amazing Neem facts:

- the tree is known to cure more than ONE HUNDRED diseases.
- neem is both a pest control material and as well as a fertilizer, making it an invaluable farm companion.
- neem is an intelligent pest repeller - it affects only harmful pests and does not affect useful species in the farm!
- neem has a four-pronged repellent action and complex molecular structure which ensures that pests don't become immune to it.

- it gives more oxygen than other trees, making it a champion pollution fighter.
- just sleeping under the shade of a neem tree is therapeutic.
- the tree is known to halt spreading deserts.
- Its leaf and its extract are a natural substance that don't simply mask symptoms but encourage your body to heal itself.
- Its completely safe and causes no harm or side-effects. It has been used as a health and beauty aid in India for more than 5000 years!
- It was considered a divine tree by ancient Indians.
- A world conference is held every three years to discuss the research and discoveries modern science is making, on this single tree. And there is lots to show and tell!

As if all this wasn't amazing enough, the Neem is a hardy tree that requires almost no water and grows happily on wastelands.

Native to Indo-Burma region, neem is distributed throughout South and Southeast Asia, i.e. India, Pakistan, Bangladesh, Sri Lanka, Burma, Thailand, Malaysia and Indonesia. In addition neem is found in several other countries spread over continents. Neem now has become a global tree.

Neem was introduced to Africa earlier this century. It was brought from India. Now it is planted extensively in the tropical regions of Africa, particularly in the regions along the Sahara's southern fringe.

Indentured labourers from India carried neem with them as a part of the India heritage to many countries to which they migrate such as Fiji, Mauritius and the Caribbean. The tree is now also well established in the Middle East and South America.

In recent times Neem has been introduced into Saudi Arabia, Yemen, China (Hainan Island), and Philippines. Small plantings of neem are also found in USA (South Florida and Hawaii), Brazil and Australia. This presence is, however, scattered and exploratory.

Home Use

Tips on Using Neem

The Neem tree exemplifies Mahatma Gandhi's concept of economy of permanence and has much to offer in solving global, agricultural, environmental and public health problems. No other tree can match Neem's usefulness. Neem rightfully belongs to the millions of ordinary Indians who learnt to put it to use, as it is this knowledge, passed down through generations, that has helped scientists discover Neem's amazing potential. The commercial and industrial prospects of neem are unlimited and exciting. There is no other tree that touches the life and living of such a majority of the country's population.

1. Mix pure dried neem oil with Vaseline in the ratio of 1:5. This combination can be used for repelling insects including mosquitoes as well as for skin disorders, minor cuts, burns, wounds etc.
2. For complete skin protection make a strong tea with neem leaves and add to the bath along with a little rose water.

3. Boil 10 freshly cleaned neem leaves along with cotton with a liter of water for approx. 10 mins. Cool. Use as an eyewash in case of conjunctivitis, itching etc.
4. For athletes' foot and other foot problems, make a strong tea and soak feet.
5. For dandruff and head lice: Massage neem oil mixed with coconut or olive oil into hair and leave for 1 hour. Shampoo. Repeat once weekly for 3 weeks or as long as problem persists.
6. To treat a sore throat without antibiotics, gargle with neem leaf water (add 2 – 3 neem leaves to 300 ml water and cool) to which honey has been added.
7. For acne, pimples, skin infections pure neem leaf powder mixed with water to the affected area.
8. In case of sinusitis, use pure neem oil as nasal drops. Two drops morning and evening.
9. Prevent breeding of mosquitoes by adding crushed neem seeds and neem oil to all breeding areas. Neem products ensure complete inhibition of egg laying for seven days.
10. Add 30 ml of neem oil to 1 ltr of water. Mix well. Add 1 ml of teepol (liquid detergent) and spray immediately for plant protection. Do not store the mixture; make fresh formulation for each spray.
11. Boil 40 – 50 neem leaves in 250 ml of water 20 mins. Cool, strain and refrigerate to use as a astringent.
12. Chewing 2 – 3 neem leaves regularly helps purify the blood and in cases of hyperacidity and diabetes.
13. To ward of mosquitoes, add 5 – 10% neem oil to any oil and light as a diya (lamp).
14. Add shade dried neem leaves for preservation of food grains like rice, wheat, lentils etc. The leaves should be replaced every 2 – 3 months.

Store neem oil in a cool dark place, away from sunlight. In case neem oil solidifies due to low temperatures, put the bottle in warm water (below 95 degree F) to liquefy. Putting the bottle in very hot water may reduce the effectiveness of oil.

Components

Since ancient times, neem has been associated with healing in the sub-continent of India. A large number of medicinals, cosmetics, toiletries and pharmaceuticals are now based on neem derivatives because of it's unique properties.

Bark: Neem bark is cool, bitter, astringent, acrid and refrigerant. It is useful in tiredness, cough, fever, loss of appetite, worm infestation. It heals the wounds and is also used in vomiting, skin diseases and excessive thirst.

Leaves: According to Ayurveda, Neem leaves help in the treatment of vatic disorders (neuro muscular pains). Neem leaves are also reported to remove toxins, purify blood and prevent damage caused by free radical in the body by neutralising them. Neem leaves are reported to be beneficial in eye disorders and insect bite poisons. It treats Vatik Disorders (neuroand muscular pains)

Fruits: Neem fruits are bitter, purgative, antihemorrhoidal and anthelmintic in nature.

Flowers: Neem flowers are used in vitiated conditions of pitta (balancing of the body heat) and kapha (cough formation). They are astringent, anthelmintic and non-toxic.

Seeds: Neem seeds are also described as anthelmintic, antileprotic, antipoisonous and bitter in taste.

Oil: Neem oil derived from crushing the seeds is antidermatonic, a powerful anthelmintic and is bitter in taste. It has a wide spectrum of action and is highly medicinal in nature.

Mixture: Five parts of Neem tree ie. Bark, Root, Fruit, Flower and Leaves together are used in diseases of blood. It is also used in vitiated conditions of excess heat, itching, wound, burning sensation in body and skin diseases.

Following is a informal compilation of sime of the investigations done in Neem in recent past.

The Leaf

Neem leaves are now known to contain nimbin, nimbinene desacetylnimbinase, nimbandial, nimbolide and quercentin.

Neem leaves have shown potential in the following areas:

Studies indicate that tender leaves are effective in Parasitic infections.

A 10% aqueous extract of tender leaves has been found to possess anti-viral properties.

Studies on plasma clotting time using Russel's viper venom have proved that the leaf extract contains a clotting inhibitor. This justifies its use in the treatment of poisonous bites.

A total extract of Neem leaves has shown potential as a potent Hepatoprotective agent

Water extract of Neem leaves have shown significant antiulcer activity

Essential oil from fresh leaves has a mild fungicidal action

Neem leaf extract shows significant Anti-inflammatory effect

Neem leaf extract have shown reduction in the frequency and severity of stress-induced gastric mucosal lesions.

Intraperitoneal administration of Neem leaf, bark and seed extracts revealed immunostimulatory properties of Neem, which are responsible for their anti-HIV effect.

The Fruit and Seeds

Azadirachtins from Neem seed kernel, are among more than a 100 compounds found in Neem. So far twelve azadirachtins have been identified, all the twelve have high level of biological activity.

It has been reported that a single low dose of azadirachtin immunized the kissing bug a transmitter of Chagas disease.

Azadirachtins have shown inhibition of larval, pupal and adult moults and of reproduction and fitness of both plant-feeding and aquatic larvae like mosquitoes.

Gedunin, contained in whole fruit has been shown to possess antimalarial activity.

The Bark

Nimbidin found in neem bark is now known to be antipyretic and non-irritant, and it has found to be effective in treatment of skin diseases such as eczema, furunculosis, arsenical dermatitis, burn ulcers, Herpes labialis, scabies and seborrhaeic dermatitis.

It is also effective in the treatment of skin diseases of unknown origin, such as warts and dandruff.

Extracts of bark have potent diuretic and anti-inflammatory properties.

Nimbidin and sodium nimbidinate contained in neem bark are reported to possess spermicidal activity. Neem bark has shown anti-bacterial activity against various gram positive organisms.