

Review Article

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Neem and its Derivatives- A Tropical Trove

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ABSTRACT

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Neem, *Azadirachta indica* is the foremost multifaceted, adaptable tree and has enormous potential. Complete neem tree is valuable whether its leaves, bark, root, seeds, flower or fruit is taken into consideration. Its derivatives are known to have antipyorrhoeic, antidermatic, antifungal, antifeedent, insecticidal, nematicidal, antiscabic, diuretic, larvicidal, antiallergenic, spermicidal and other biologically active properties. It is among profoundly exploited plant of Indian inception. This review provides a general outlook chiefly on the natural action and its preventive-promotive therapeutic applications and potentials in most valuable parts of life which makes it a tropical trove in real sense.

Introduction

Meliaceae is also known as Mahogany family. It is a huge family containing 49–50 genera and 620 species, spread in pan-tropical area escalating to temperate zone. In India it amounts to 20 genera and 70 species (Mabberley *et al.*, 2007). The majority of the members of the family are shrubs and big trees such as *Cedrela toona*, *Chloroxylon*, *Azadirachta indica*, *Swietenia mahogani*, *Carapaobovata* etc. Various members of the family are extensively used for timber, fruits, shade and medicinal values. A large number of biologically active compounds have also been identified from family meliaceae (Mabberley *et al.*, 1995). The most important

and most researched tree of this family is Neem, *Azadirachta indica* which also belongs to sub-family Meloideae and tribe Melieae (Thakkar 1997). It is also known as Margosa or Indian lilac, commonly. It is a fast-growing evergreen tree (Pingale 2010). For 4000 or more years, it is being utilized in the ayurvedic medicines owing to its plethora of medicinal properties (Tomar *et al.*, 2011). Acknowledging its importance U.S. National Academy of Sciences has published a report entitled as “Neem- a tree for solving global problems” in 1992 (Yasmin and Sultana 2017). It is also named as “Bitter gem” which means “Karwa Amrit”. Ancient documents like Charak-Samhita and Susruta-Samhita also mentioned the advantages of the Neem.

As it holds the potential in the sector of environment, pest management and medicine due to which it is said to be the foremost promising tree of 21st century. Diverse parts of plant are valuable in diabetes, leukoderma, leprosy, helminthiasis, ulcers, etc. It plays the key part within Ayurveda which is the establishment of the Indian framework of natural treatment (Sateesh, 1998). Neem is acknowledged as a gift of nature to tackle the global problems related to health, agriculture and environment (Venugopal and Visweswaran, 2013).

Neem: A tropical plant

Taxonomic position

Order: Rutales
↓
Suborder: Rutinae
↓
Family: Meliaceae
↓
Subfamily: Meloideae
↓
Tribe: Melieae
↓
Genus: Azadirachta
↓
Species: Indica

Neem is a robust tree that develops energetically in troublesome locales. There are an assessed 25 million trees or above present in all over India. Tamilnadu placed in the first position, followed by Uttar Pradesh which is followed by Karnataka on third position in overall growing of neem tree in India (Tomar *et al.*, 2011). Neem is a huge tree developing around 25 m in tallness with semi-straight to straight trunk, 3 m in circumference and spreading branches shaping a wide canopy. In around 10 years it gets to be completely productive (Raj and Toppo, 2015).The plant is detailed to live up

to two centuries (Yasmin and Sultana, 2017).The tree has flexibility to adapt a wide extend of climatic, topographic and edaphic components (Girish and Shankara, 2008).

Distribution: It is far and wide found from higher elevation highlands to lowlands and is one of imperative constituent in tropical and subtropical evergreen forests (Wongprasert *et al.*, 2011).

Botanical description

Synonym: *Antelaea azadirachta*

Sanskrit synonym: Pakvakrita, nimbaka

Regional names

English: Indian lilac

Hindi: Neem

Manipuri: Neem

Marathi: Nimbay

Tamil: Veppai, Sengumaru

Malayalam: Ariyaveppu

Telugu: Vepa

Kannada: Turakabevu

Bengali: Neem

Urdu: Neem

Assamese:Neem

Gujarati: Dhanujhada, Limba

The bark is fissured or textured, and whitish-grey to reddish-brown. The leaves are alternate and pinnate. The blooms (white and fragrant) are organized axillary, ordinarily more-or-fewer hanging panicles. The fruit is usually glabrous drupe which is olive-like and shifts in shape from elongate oval to roughly roundish as shown in Figure 1 (Wordpress, 2018).

Traditional and scientific applications

Nearly each portion of the tree is finds therapeutic utilize, so much so that the bitter taste of the tree is world renowned and it is still accepted that the more bitter, the way better. Neem is well-known for its tough

wood. Also, various non-wood products are used such as seeds are used for yielding oil and cake. Neem oil is especially used in various roles such as analgesic, anticholinergic, antihelminthic, antihistaminic, antiprotozoal, antipyretic, antiviral, bactericidal, contraceptives, fungicides, insecticides, insect repellents, veterinary medicines, cosmetics, hair oils, lubricants, propellants, shampoos, soaps, toothpaste (Natrajan *et al.*, 2002). Neem cakes are mainly used in animal feed, soil fertilizer, soil moisturizer, soil neutralizer, soil protectant. Leaves are utilized for antidermatic, antifungal, anticlotting agent, antihelminthic, antituberculosis, anti tumour, antiseptic, antiviral, contraceptive, cosmetics, fertilizers, insecticides, nematicides, insect repellents. Twigs for oral deodorant, toothache reliever, tooth cleaners. Bark in antiallergenic, antidermatic, antifungal, antiprotozoal, antitumor, deodorant. Flowers are a basic component of analgesic, curries, nectaries, soaps, stimulant (Jattan *et al.*, 1995). Neem derivatives are also used for mosquito repellent, fumigation concerning hygiene by burning leaves and bark, for the treatment of viral infections such as small pox, chicken pox etc. (Anonymous 2006). Also, a main component of dental hygiene as it reduces the bacterial count and oral plaque index (Chaurasia, 2016).

Various biological active compounds were also extracted from the neem tree and its different parts which are known to be biologically active. Over 135 biological active compounds have been isolated from the diverse parts of neem. Bioactivities of only limited compounds have been examined. These extracted biological active compounds are namely, Nimbidin, Sodium nimbidate, Nimbin, Nimbolide, Gedunin, Azadirachtin, Mahmoodin, NB-II peptidoglycan, Polysaccharides, Polysaccharides GIIa, GIIIa, Polysaccharides GIa, Gib, Cyclic trisulphide

and cyclic tetrasulphide, Margolone, margolonone and isomargolonone, Gallic acid, (-) epicatechin and catechin, Margolone, margolonone and isomargolonone showing various effects such as anti-inflammatory, Antiarthritic, Antipyretic, Hypoglycaemic, Antigastric ulcer, Spermicidal, Antifungal, Antibacterial, Diuretic, immunomodulatory, Antimalarial as shown in Figure 2 (Hail *et al.*, 2020). Neem is also extensively used for other variants viz. adhesives, food from fruits, fuel wood, glue, honey, pulp biogas, resin, tannin, windbreaker, wood preservatives (Biswas *et al.*, 2002).

Neem in agriculture:

Taking into consideration the havoc caused by the synthetic chemicals or pesticides used in modern agriculture has instigated the need to use the neem derivatives in the agriculture sector. To lower the risk, these derivatives can be used in various roles such as organic manure, fertilizer, for pest control or management and fumigants etc. Neem as a manure has shown an impressive omnipresence, because it is eco-friendly and collectively all the compounds found in it offer assistance to increase the nitrogen and phosphorous percentage within the soil. It is wealthy source of sulfur, potassium, calcium, nitrogen, etc.

This property makes neem an excellent biofertilizer which makes a difference by giving the desired supplements to the plants and deficient lands (Joseph *et al.*, 2010). Subsequently, which acts as enricher of the soil decreases the development of bacteria and pest in the soil (Murthy and Sirsi, 1958). Also, it supplements with the macronutrients fundamental for the plant development, and efficient in maximizing the plants yield in future (Pant *et al.*, 1986). Owing to the above said positive effect in the soil it also plays a brilliant role as an organic soil conditioner

which improves the soil health and eventually leads to better growth of plants and increase in yield. As neem has azadirachtin an active ingredient, it protects the plant from the attack of pathogens and insect pest. Presently, ready for use neem based urea-coating agents which aims to impede the growth and activity of the bacteria involved in denitrification process are commercially accessible in India viz. “Nimin”. Also this is available in liquid and powdered form, both (Jagannathan *et al.*, 2014).

Many formulations are commercially available such as Bioneem, Neemark etc which provides utmost protection against pathogenic fungus owing to its antifungal properties. Providing the environment friendly and cheap option which is not recalcitrant in nature and also, does not add to any contamination to land or aquatic resources but adding to the soil fertility (Bhonde *et al.*, 1999).

Neem and sustainable environment

Neem as tree has a great importance in agroforestry and shows a very high potential for sustainable environment. It helps globally to combat the issues of deforestation, soil erosion, and global warming etc (Nigam *et al.*, 1994).

It helps in planting more oxygen world wide as it has high rate of photosynthesis and also maintains low temperature (approx.10°C) beneath the canopy which resolves the issue of increasing global warming and natural cooler in the hottest month of the year. Neem can be used for shade, wind breaks due to its huge canopy, and firewood because of high calorific value, shelter as the wood is termite resistant and robust (Randhawa and Parmar 1993). Neem leaf powder is also used as biosorbent owing to its water purifying property which helps in removing dyes from the water such as Congo red (Bhattacharyya and Sharma, 2004).

Fig.1 Neem and its products

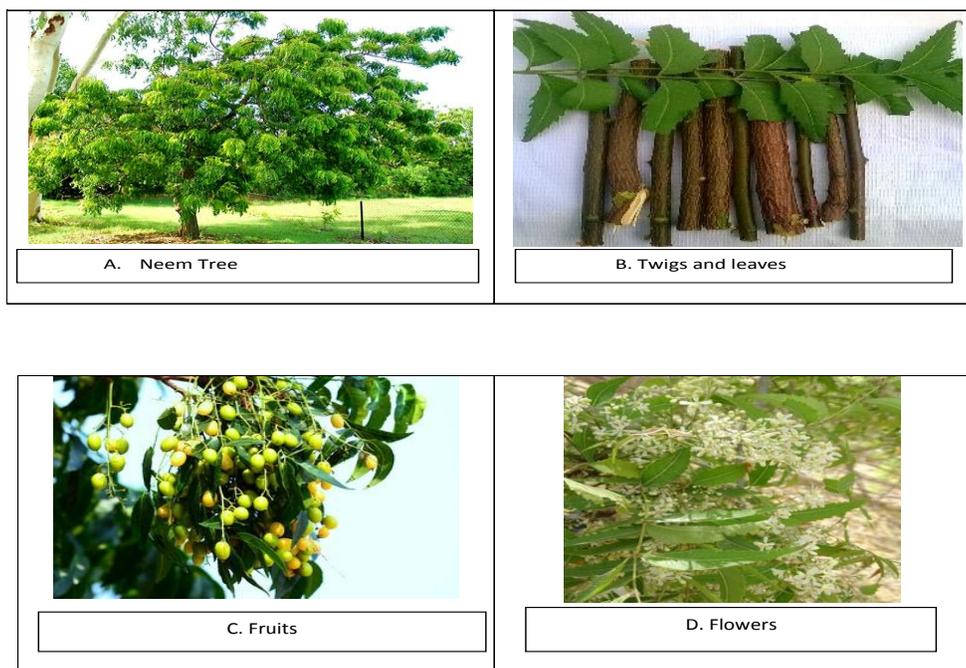
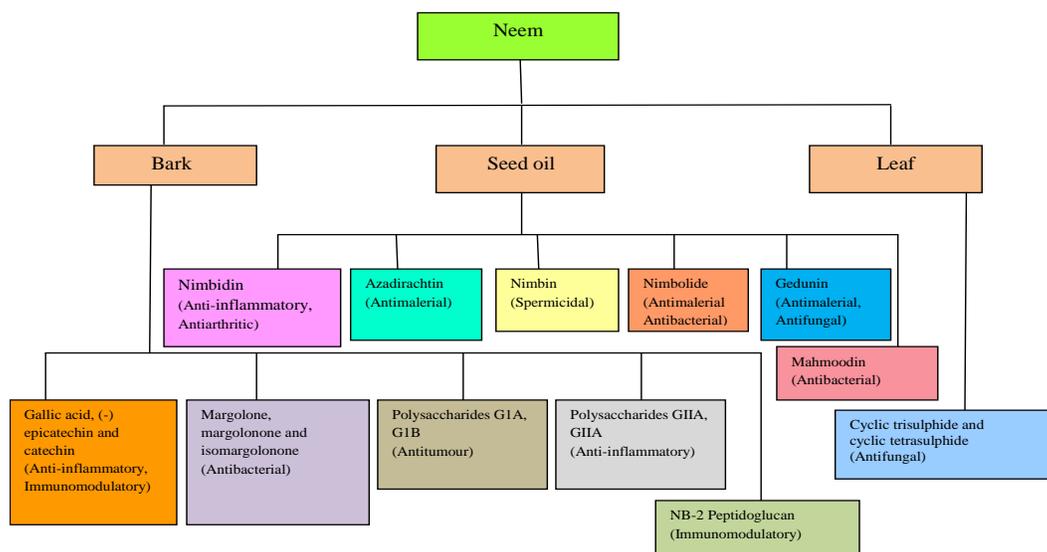


Fig.2 Some biologically active compounds isolated from Neem



Industrial applications

Neem acts as a promising industrial plant as its derivative or the whole plant is extensively exploited in various industries such as pharmaceuticals, agro-biochemical, cosmetics, textile, tanning, food, and livestock feed and supplies etc. It is highly used as the main components in shampoos, toothpaste, face creams, nail oils and soaps against head lice, bacterial and fungal infections. Neem is also being used extensively as nutraceuticals due to its antiviral, antibacterial, antifungal and immunomodulatory properties (Khanna, 1992). They also play their role as bio-rodenticides and bio-pesticides. Neem pulp is utilized in the fermentation and methane production industry as it is a rich source of carbohydrate. Gum, bark, leaves, fruits and seeds provide a huge variety in livestock feeds which consequently helps in keeping up the animal health.

Neem oil and leaves are inseparable part of animal feed as it is a good source of minerals, proteins and carotene. Neem leaves are also used as a part of poultry feed to keep the aflatoxicosis caused by *Aspergillus flavus*

away, which is a major threat to poultry industry (Allameh *et al.*, 2002).

Neem has become an intricate part of large scale as well as small scale industries, latter holding much more potential. Also, including the women self help groups which are dependent on neem and its derivative, to large extent. In the industry sector, annual estimated turnover of azadirachtin is approx. Rs. 1000-1200 crores. This gives a great insight to promote the industries with the help utilizing neem and its derivatives in the coming future (Kumar, 2003).

Therapeutic uses

Since ages, neem has been seen to provide magnificent health encouraging properties. It has been a firm part of all form of medical practices such as Homopathic, Ayurvedic, Unani and Allopathy. Using various parts of neem different diseases are cured related to dentistry, metabolism, skin, hair, heart and kidney related problems as they show various pharmacological activities such as anti-inflammatory, anti-bacterial, anti-viral and antifungal (Subapriya and Nagini, 2005).

The bark is documented to show positive effects in treating vomiting, cough and skin diseases. Neem oil is reported to show pain relieving property subsequently leading to wound healing action (Kumar *et al.*, 2012). Pharmacological hypoglycemic action of neem has also been shown to help in diabetes (Dholi *et al.*, 2011). Neem also curb the growth of malignant cancer due to some flavanoids and other components present in it, which makes it a great candidate to be assessed in the studies of anti-cancerous agents (Rahmani *et al.*, 2014). It also shows efficient role as antifungal against the activity of *Aspergillus* and *Rhizopus*. It also has great impact in skin appearance and lowering down of body temperature owing to its cooling property. As neem has sedative effects, it is also used as stress reliever. It has a potential role in contraceptives as well because it animates the cell and macrophages due to its immune modulant property, it terminates the pregnancy (Giri *et al.*, 2019). Leaf, flower, seeds and bark of neem also helps in the neutralizing the free radicals and plays a very important role as anti-oxidants (Ghimeray *et al.*, 2009).

Safety

Neem and its derivatives are widely used around the globe and hence seem to be quite safe and sound (Kale and Tayade, 2003). It has shown no side effects on animals or humans throughout its usage till date. Neem oil is still continued to be the bone of contention. Although it is natural antioxidant but still in rare cases, complications like vomiting, diarrhea, jaundice along with hypoglycemia are witnessed, if it is consumed in high concentrations (Kumar *et al.*, 2016).

In conclusion the recent years, the organic or plant-based market is very much in demand. Also, it is safe and efficient to use such

products without thinking much about the repercussions. Concluding to which, neem is the immense source of therapeutic and prophylactic potential which needs to be harnessed in the coming future to make our earth a better place to inhabit.

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