Phytoconstituents and Therapeutic Aspects of Neem (*Azardirachta indica)*: A Review

ABSTRACT

It has been centuries since neem plant is known to have medicinal importance to the humans. Whole plant parts have uncountable properties such as antibacterial, antimalarial, antifungal, and anticancerous. Worldwide the extract from different parts of this plant is being used in many herbal and allopathic medicines. It enriches skin and prevent any kind of skin infection. The phytoconstituents such as azadiractin and nimbidin are found in seed oil extract that possesses antimalarial and anti-inflammatory properties. Neem plant also shows great potential to increase the metabolic activity and improves the immunity of the human beings. This review gives a detail overview about the various phytoconstituents present in different parts of neem plant, their effectiveness to cure various diseases and the recent worldwide development in use of this plant.

Key words: Neem; Antibacterial; Antimalarial; Antifungal; Azadiractin; Nimbidin

INTRODUCTION

Azardirachta indica commonly known as the ‘Neem’ in the India. It is known for its property from the many centuries. Mostly it has been considered that the neem tree has never harmed

any of the living beings whether it is about the human beings, birds or any animal. Neem is always useful to everyone. The neem plant is also approved by the US Environmental Protecting Agency to be used as the food crops (Bhowmik, et al.,2010; Giri, et al.,2019). It has been used since the Unani System of Medicine and also in the Indian Ayurveda (Bhowmik, et al., 2010). Also used in modern era in the sector of medicine, cosmetics, pharmaceutical etc. (Bhowmik, et al., 2010). These are found in the region of India, Africa and America also (D Bhowmik, et al.,2010; Giri, et al.,2019). In Sanskrit the neem is termed as the 'Arista' which indicates the meaning related to the perfect, complete and imperishable (Giri, et al.,2019; Naik, et al.2014). It is also considered as the 'reliver of sickness' (Giri, et al.,2019). It can be considered that the non woody part such as leaves, oil, gum, fruits are very much having the beneficial facts (Giri, et al.,2019). Neem is having constituents like Nimbidin, Sodium nimbidate, Azadirachtin, Nimbin and many more constituents which are derived from the seed oil leaf and bark of the neem plant. They majorly act as antimalarial, anti-inflammatory, antibacterial, antifungal and antitumor agent (Giri, et al.,2019). The neem tree can be live up to the 150-200 years (Sharma, et al., 2011). Though the taste of the neem is bitter due to the constituents but is very much beneficial for the human health. The importance of neem is also recognized by the US National Academy of Sciences and termed 'Neem- a tree for solving global problems' in the 1992(Giri, et al.,2019). It is placed in the family of mahogany (Sharma, et al., 2011).

Taxonomic Position of Neem (Imam, et al., 2012; Giri, et al., 2019 Trivedi, et al., 2019)

Order- Rutales

Suborder- Rutinae

Family- Meliaceace

Subfamily- Melioideae

Tribe- Melieae

Genus- *Azadirachta*

Species-*indica*

Usually, a neem tree is about 40-50 feet or higher with a straight trunk and branches spreading long enough to constitute a round crown at the top of the tree trunk. It has dark brown bark with a rough texture and longitudinal fissures on the trunk, its branches have compound leaves which are themselves alternating from each other and are having 5-15 leaflets. The flowered panicles usually grow in the leaf axils and the selel are ovate in shape and about a cm long with white petals having sweet fragrance. Further 12-20 cm long yellow drupes are produced which are usually ellipsoid and glabrous. In reference to the fruits of the tree – they are usually green in colours and become yellow when they ripe with an aromatic and garlic like odour coming from them (Imam, et al.,2012).

With an estimate of over 25 million Neem Plants growing all over India. It is considered as a God by the Hindu population of the country. Neem's ability tolerates literally any kind of soil type ensure its growth in a country like India where a wide variety of weather and soil types are available. This makes it available for the Indians living in Plains as well areas up to an elevation of 1850m (Bhowmik, et al., 2010). It can grow in areas which are sub-arid to sub-humid and is also well known for its drought resistance ability with the help of its extensive and deep root system. Neem can accommodate high to very high temperatures but cannot survive below 4 degrees Celsius (Bhowmik, et al., 2010). With these abilities that makes it survive in the best of the conditions as well as the worst of the conditions making it quite easy to grow throughout the year and in different areas. Neem has a numerous health benefit and is no less than a god to us as its benefits are priceless. It has been used as a medicine for over

5000 years now, as mentioned in the early Sanskrit medical writings such as in both Ayurveda and the Unani System of Medicine (Bhowmik, et al., 2010).

FIGURE 1. Neem tree

Medicinal Uses of Neem Plant Parts

Almost all of the parts of the neem have got health benefits as well as medicinal use. Below are the medicinal uses of each part of Neem. The Bark of the neem tree is used as analgesic, alternative to cure the fever (Paul, Prasad, and Sah, et al., 2011; Trivedi et al., 2019). The Twigs of the neem are used to treat cough, asthma, piles, phantom tumour, intestinal worms, and diabetes (Paul, Prasad, and Sah, et al., 2011). The Leaves of the neem are used to treat the leprosy, eye problem epistaxis, anorexia and cancer (Paul, Prasad, and Sah, et al., 2011). The Flower of the neem tree helps to treat the bile suppression and also used to eliminate the intestinal worms (Paul, Prasad, and Sah, et al., 2011). The Fruit of the neem tree used to treat piles, intestinal worms, urinary disorder, epistaxis, eye problem, leprosy and diabetes (Paul, Prasad, and Sah, et al., 2011). The Seed of the neem is used to treat intestinal worms, leprosy and cancer (Paul, Prasad, and Sah, et al., 2011). The Oil that is obtained from the neem is used in the treatment of leprosy and intestinal worms (Paul, Prasad, and Sah, et al., 2011). The Gum is used to treat skin diseases, wounds and scabies (Paul, Prasad, and Sah, et al., 2011).

FIGURE 2. (a) the bark of neem tree (b) fruit of neem tree

PYTOCONSTITUENTS

Going further in detail, research has been able to find the constituents as well as their source and use in the help/benefit of human which are detailed as below: (Sharma, et al., 2011).

i. Nimbidin: It is found in the Seed oil part of the neem and constitutes the Anti-inflammatory, Antiarthritic, Antipyretic, Hypoglycaemic, Antigastric ulcer, Spermicidal, Antifungal, Antibacterial Diuretic properties of the neem (Bansal, et al., 2010; Sharma, et al., 2011; Raj and Toppo 2013).
ii. Sodium nimbidate: It is responsible for the Anti-inflammatory property in Neem (Bansal, et al., 2010; Sharma, et al., 2011).
iii. Azadirachtin: It is found in the Seeds oil and is responsible for its Antimalarial property neem (Bansal, et al., 2010; Sharma, et al., 2011; Raj and Toppo 2013).
iv. Nimbin: It is found in the Seed oil and has Spermicidal property (Bansal, et al., 2010; Sharma, et al., 2011; Raj and Toppo 2013).
v. Nimbolide: It is found in the seed oil and constitutes antimalarial and Antibacterial property (Bansal, et al., 2010; Sharma, et al., 2011).
vi. Gedunin: It is found in the seed oil and has antimalarial and Antifungal property (Sharma, et al., 2011).

vii. Mahmoodin: It is found in the Seed oil and responsible for Antibacterial property (Sharma, et al., 2011; Raj and Toppo 2013).

viii. Gallic acid, (-) epicatechin and catechin: These are found in the Bark and have the Anti-inflammatory Immunomodulatory property (Bansal, et al., 2010; Sharma, et al., 2011; Raj and Toppo 2013).

ix. Margolone, margolonone and isomargolonone: These are found in the Bark and are responsible for Antibacterial property (Bansal, et al., 2010; Sharma, et al., 2011).

x. Cyclic trisulphide and cyclic tetrasulphide: These are found in the Leaf and have Antifungal property (Sharma, et al., 2011).

xi. Polysaccharides G1A, G1B: These are found in the Bark and are responsible for the Antitumor property (Bansal, et al., 2010; Sharma, et al., 2011).

xii. Polysaccharides G2A, G3A: it is also found in the Bark and has Anti-inflammatory property (Sharma, et al., 2011).

xiii. NB-2 Peptidoglucan: it is found in the Bark and has Immunomodulatory property (Sharma, et al., 2011).

FIGURE 3. leaves of neem

OTHER BENEFITS OF NEEM

Apart from the health benefits and medicinal use there are many other benefits of Neem that can be or cannot be related with health/medicine which are detailed below.

Afforestation

With its ability to grow nearly anywhere as mentioned above, Neem is highly effective to fight with deforestation, desertification, and soil erosion and to reduce excessive global warming. The rate of photosynthesis is very high in Neem and it generates more oxygen than other trees using the same resources. Its products can also assist in water purifying. Also, the temperatures under neem are found to be 10 degrees centigrade lesser than surrounding and also as any other tree it provides shade as well as firewood to the residents living around it (Sharma, et al., 2011).

Neem Good for Soil

It is used as the soil conditioner as it conditions the soil for the irrigation (Roshan and Verma 2015). It increases the quality of the soil. It can be used as the pesticides also (Koul, et al.,

1990; Schmutterer 1990; Isman 1999). The constituent azadiractin is used as the pesticides in the soil to kill the germs and bacteria (Ascher 1993: Roshan and Verma 2015). It acts as insecticides also (Weinzierl 2000).

THERAPEUTIC EFFECT OF NEEM

Antimalarial Activity

In developing countries like India, Burma and in West Africa the aqueous and alcohol extracts of the bark and leaves of neem are used as anti-malaria agents (Isah, et al., 2003). 'Gedunin' is considered to have same effect as quinine on malaria. The antiseptic properties of neem also make it available for use in toothpaste and it is used for the same in countries like India and Germany. The tablet for the antimalarial activity is extracted from the leaves and the barks of the plant that's evaluation is done on the *plasmodium,* in infected mice (Morgan 2009; Norten 1999; Imam, et al., 2012).

Anticancerous Activity

Cancer is the disease which is spread worldwide. The extract that is obtained from the neem plant is seen most effective and have the ability to reduce the effect of the cancerous cell (Paul, et al.,2011; Moneim 2014). According to the researchers of the Japan, Europe and India the substance known as limonoids that is extracted from the parts of neem plant i.e., seed oil bark and leaves can decrease the effectiveness of the cancer cell (Girish and Shankara 2008; Sharma, et al., 2011; Alzohairy 2016).

Male Antifertility Activity

The neem seed oil (NSO) and leaf extracts act as powerful spermicide and significantly inhibited spermatogenesis, decreased sperm motility, count and cessation of fertility (Bansal,

et al., 2010; Sharma, et al., 2011). Findings enabled neem oil formulation ‘sensal’ use in India as powerful contraceptive (Imam, et al., 2012).

Antibacterial Activity

The plant also releases some kind of chemicals. The methanol and the petroleum ether are extracted from the parts of the leaves and tested to be having the antibacterial properties (Mahmood, et al., 2010; Imam, et al., 2012; Sushmitha 2013). The extract obtained from the bark is hexane, used for the antibacterial activity towards the *E. coli* (Barua, et al., 2010: Nishan and Subramanian 2014).

Anti-inflammatory Activity

Due to the presence of the constituents like nimbidin, sodium nimbidate which is extracted from the leaves and the bark are used in curing the inflammation (Alzohairy 2016).

CONCLUSION

Neem is no doubt a wonder plant with numerous uses and benefits that are unmatched with any other plant available on earth. However, that said the area of research from the therapeutic point of view still remains unexplored although now there are some of the uses have been found which remained hidden as Neem was explored more by the Ayurveda, Unani and the traditional methods. Neem is great source – there could be many therapeutic uses which could heal many diseases that is still unknown because the tree is more found in east and in east it has been always kept away from the eyes of the western world because of which the therapeutic potential of Neem is still unexplored. Also, even if we keep the traditional use of Neem as prescribed by Ayurveda and Unani System avoiding the allopathy medicines it could increase the human life as well as decrease any side effects as neem is organic and has no side effects.

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