Azadirachta indica(neem): an all-purpose medicine

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Abstract

As a member of the Meliaceae family, neem (Azadirachta indica) is a rich source of antioxidants. In general, it has been used extensively in Chinese, Ayurvedic, and Unani prescriptions, especially in the Indian Subcontinent for the treatment and preventative activity of many illnesses. 140 distinct mixes may be created using different portions of neem. All components of the neem tree, including the leaves, flowers, seeds, organic products, roots, and bark, have historically been used to treat irritability, contaminations, fever, skin conditions, and dental problems. Neem leaf's medicinal benefits have been highlighted in particular. Immunomodulatory, relaxing, antihyperglycemic, antiulcer, antimalarial, antifungal, antibacterial, antiviral, cell-reinforcing, antimutagenic, and anticarcinogenic activities of neem leaf and its components have been demonstrated.

Keywords: Neem, anticancer, antidiabetic, antimicrobial, antimalarial.

Introduction

Since the beginning of time, Indians have been aware of neem's medicinal benefits. The advantages of Neem's fruits, seeds, oil, leaves, roots, and bark are mentioned in the earliest Sanskrit medicinal works. Each was utilised in the Ayurvedic and Unani medical systems of India, and it is being utilised in the production of contemporary pharmaceuticals, cosmetics, toiletries, and medications.In the Indian subcontinent, the neem tree has long been referred to as the "wonder tree"(Debjit Bhowmik et al2010).Mankind has long been aware of herbal treatments. Traditional medical practitioners have detailed the therapeutic usefulness of several indigenous herbs for a variety of illnesses. Neem, also known as Azadirachta indica, is a tree that has long been utilised in both agriculture and medicinal. India has a large native plant population called Azadirachta indica. Several researchers have looked at the herb Azadirchata indica's therapeutic potential

(Natarajan et al., 2003). A distinct portion of Azadirachta indica (Meliaceae family) is used in traditional medicine in the unique region close to nature (Uko and Kamalu, 2001; Angel Ezhilarasi et al., 2016). Neem leaves in particular are a "Storehouse" of chemical substances.There are ethnopharmacological studies that back up their usage of oral leaf extracts to treat bacterial and worm illnesses. Alkaloids, flavonoids, glucosides, steroids, soluble carbohydrates, tannin, hydrogen cyanide, and azadirachtin are responsible for this potent pathogenic activity (Matinise et al.,2017). The transition metal nanoparticles have a number of established results that demonstrate cytotoxicity against bacteria, as is seen from the deformation of the morphology of the cells, in surface modification with plant extract.Plant extracts include phenolic chemicals such flavonoids that are soluble in water, non-toxic, biodegradable, and can serve as reducing agents for the production of metal oxide (Rajaet al., 2018; Angel Ezhilarasi et al., 2018; Valdez and Gomez,2016; Karimiana and Pirib, 2013. It has been acknowledged to have powerful inhibitory and bactericidal effects in addition to the anti-fungal, anti-inflammatory, and anti-angiogenesis activities, in addition to its deep function in the field of high sensitivity biomolecular detection, catalysis, biosensors, and medicine (El-Chaghaby & Ahmad, 2011; Veerasamy et al., 2011). This plant is widely available in India, and since ancient times, every component of the tree has been utilised as a domestic cure for a variety of human maladies as well as for the treatment of viral, bacterial, and fungal diseases (Omoja et al., 2011). It is used in situations of inflammatory skin problems and aids in the maintenance of a robust immune system. Neem has historically been used to treat ailments that cleanse the blood and skin. Neem's impact on the skin is possibly its most lauded benefit. As general antiseptics, preparations made from the tree's leaves or oils are employed.Neem is beneficial in treating most epidermal disorders, including acne, psoriasis, and eczema, because of its antibacterial qualities(Debjit Bhowmik et al., 2010). It was claimed that the bitterness of neem balanced the sweetness.

Indians used to use hot water with neem leaves soaked in it as their bath. Topical application of neem has been used often to treat skin conditions and allergic responses since there have been no reports of any negative side effects. Neem may also be used topically to treat warts, chicken pox, and smallpox using its antiviral properties. Its capacity to prevent a virus from growing and spreading is a contributing factor in its efficacy. Cuts, burns, sprains, earaches, headaches, and fevers can all be treated using neem's pain-relieving, anti-inflammatory, and fever-reducing components. The utility of neem extracts in treating malaria has been supported by several research

that have been done on the topic.Neem has several uses in both organic farming and human and animal health. Neem has potent antiviral and antibacterial properties. But it differs from other herbs in that class of broad antimicrobials in certain ways. Neem oil is frequently included in a range of lotions and salves. It works well for treating a variety of skin conditions, such as eczema, psoriasis, dry skin, wrinkles, rashes, and dandruff(Debjit Bhowmik et al., 2010).

Chemical components and characteristics

Neem includes a bitter fixed oil, nimbidin, sodium nimbidate, gallic acid, catechin, and polysaccharides, which are used as anti-inflammatory compounds.

- Nimbidin has anti-arthritic, hypoglycemic, antipyretic, diuretic, and anti-gastric ulcer properties.
- Antifungal (cyclic trisulfide, nimbidin, and gedunin)
- (Nimbidin, Nimbolide, Mahmoodin, Margolone, Margolonone, and Isomargolonone)
- Antibacterial (Nimbin, Nimbidin, spermicidal, isomargolonone, mahmoodin
- Antimalarial (nimbolidfe, gedunin, azadirachtin)
- Antitumor (polysaccharides)
- Immunomodulatory (NB-II peptoglycan, gallic acid, epicatechin, catechin)
- Hepatoprotective (liquid extract of neem leaf)
- Antioxidant (neem seed extract) (Rajendaran et al., 2019)

Morphology of Azadirchata indica's leaves

AI leaves are compound imparipinnate, green, petiolate, and alternating with 7–19 leaflets. The opposite, lanceolate leaflets have serrated edges, an acuminate apex, and an asymmetric base. The upper side of leaflets is a dark green, while the lower surface is a paler green. The midrib is more noticeable on the bottom surface of their pinnate reticulate venation. The leaflets are paper-like in texture and range in size from 3 to 9 cm in length by 1 to 3 cm in width. Each leaflet bears a cylindrical, green petiolule with a diameter of 0.01 to 0.05 cm and a length of 0.3 to 0.5 cm.

The scent and taste of crushed leaflets are astringent and unpleasant (Siddiqui et al., 1992).

Phytochemicals present in Azadirchata indica's leaves

With regard to its extensive and historical applications, several secondary metabolites, including flavonoids, terpenoids, and oil rich in terpenes, have been extracted from AI leaves and structurally characterised. Mahmoodin and Naheedin were segregated by Siddiqui in 1992 (Susmitha et al., 2013), (Siddiqui et al., 1992). The extracts of AI leaves underwent thorough phytochemical

examination by Hossain's team. They discovered that hexane extract contained butyl palmitate, methyl petroselinate, phytol, methyl iso heptadecanoate, hexadeca methylcyclooctasiloxane, and (2E)-3,7,11,15-tetramethyl-2-hexadecen-1-ol. Isobutyl Stearate, Nonadecane, and 2,6,10,14-Tetramethylheptadecane Oxalic acid, 2-ethylhexyl tetradecylest, and heptacosane are present in chloroform extract, while methanolic extract contains toluyl aldehyde, methyl 14-methylpentadecanoate, lineoleoyl chloride, phytol, methyl iso heptadecanoate, and methy iso heptadecanoate (Hossain et al., 2013), (Valdez and Gomez, 2016). When tested on mammalian animals, Banerjee et al. (2014) extracted neem leaf glycoprotein (NLGP) with immune-modulatory action (Banerjee et al.,2014).

The pharmacological effects of AI leaves

Because AI leaves contain a variety of phytochemicals, they have traditionally been used to treat a range of illnesses. The suitable and widely used pharmacological model has been used to evaluate several of these pharmacological actions in science. Activity in wound healing (area of injury in rats)(Chundran et al.,2015), tumor-fighting capacity (Cell line MTT test) (Sharma et al.,2014), neuroprotective effect(Rats exposed to cisplatin develop neurotoxicity)(Moneim et al.,2014), cardiovascular protection(Rats' myocardial infarction caused by isoprenaline) (Peer et al.,2008), Hepatoprotective action(Rats' livers were damaged by paracetamol) (Bhanwra et al.,2000)

ANTIBACTERIAL IMPACT OF NEEMNANO-EMULSION (NE)

Antibiotic resistance develops as a result of the harmful bacterium V. vulnificus being exposed to them repeatedly. This makes it necessary to switch to natural therapeutic plants like neem from antibacterial drugs (Kim, J.H 2012). Neem's MIC (Minimum Inhibitory Concentration) was assessed in relation to the pathogenic bacterium V. vulnificus. Neem's antibacterial efficacy against V. vulnificus was demonstrated by the MIC (150 g/mL) values. Utilizing the Sterile Disc Method and the Well Diffusion Method, the MIC of neem was calculated (Bohora et al.,2010). According to a research, the control well technique did not exhibit a zone of inhibition when the NE (Neem) was present at a concentration of 150 g/mL. This is because of other factors (Han, F et al.,2007). Between NE-loaded sterile disc and antibiotic disc (of commercial availability), antibacterial activity was compared. The zone of inhibition for the NE was 21.6 mm by 1.5 mm, whereas the zone for the commercially available tetracycline was 32.3 mm by 1.5 mm, according to the study (Kim, J.H 2011).

E. coli and S. typhi are less vulnerable to neem extract than Vibrio cholerae and Bacillus subtilis, which were both more inhibited by Azadirachta indica. Salmonella typhi (10 mm), Escherichia coli (11 mm),Vibrio cholerae (17 mm), Bacillus subtilis (17 mm).

ANTIOXIDANT ACTIVITY

Free radicals and oxygen species are the primary causes of the development of many illnesses. Therefore, reducing free radical activity is a crucial step in disease prevention. Reactive oxygen species and free radicals are rendered inactive by antioxidants. Additionally, it controls reactive oxygen species to prevent them from attacking any biological system. They make the antioxidant enzyme active. This ant's oxidative enzyme guards against the harm caused by free radicals and reactive oxygen species. Neem, Azadirachta indica, is thought to have antioxidant properties. Antioxidants are abundant in neem leaves, seeds, bark, and oil. According to a research in the literature, the antioxidant capacity and in vitro antioxidant activity of several crude extracts of Azadirachta indica (neem) leaves were as follows: methanol extract > hexane extract > ethyl acetate extract > chloroform extract (Biswas et.,2002).

ANTICANCER ACTIVITY

Cancer is a significant global health issue. It is a multifaceted illness. A change in the molecular structure and genetic composition causes the cancer to progress. Chemotherapy is used to cure cancer in the modern world, however it has negative consequences on the body's normal cells. According to the literature, there are several approaches to cure cancer, including activating cellular proliferation, apoptosis, tumour suppressor genes, and a number of other molecular pathways to stop the formation of cancerous cells. According to a study, the active components of neem, flavonoids, are crucial in the prevention of cancer (Paul et.,2011). Neem oil has been discovered to include mutagenic effects of 7,12-dimethylbenz(a)anthracene. The cytotoxic effects of nimbolide were examined using human choriocarcinoma (BeWo) cells. Azadirachtaindica has a variety of chemicals, and these substances work to inactivate numerous cancer-related genes like VEGF, NF-B, and PI3K/Akt while activating tumour suppressor genes . According to reports, neem works well to activate tumour suppressor genes and to block the VEGF and phosphoinositide PI3K/Akt pathways. According to a research, it also stimulates apoptosis, inhibits NF-B signaling, and activates the cyclooxygenase pathway (Kumar et.,2011).

Effect of Neem on Oncogene

A mutant gene is referred to as an oncogene. Oncogene play a critical part in the onset and spread of malignancies. To determine how leaf extract affected the expression of the c-Myc oncogene in 4T1 breast cancer BALB/c mice, an experiment was conducted. The outcomes demonstrated that, in comparison to the cancer control group, the 500 mg/kg neem leaf extract (C500) group significantly suppressed the expression of the c-Myc oncogene (Efferth et.,2011).

Effect of Neem as Anti-Inflammatory

Numerous plants have anti-inflammatory properties. An earlier study found that neem leaf extract, given orally at a concentration of 200 mg/kg, significantly reduced inflammation in rats using the cotton pellet granuloma assay. Dexamethasone, however, is less effective than neem extract. According to published research, nimbidin inhibits neutrophil and macrophage activities that are related to inflammation (Govindachari et.,1998).

HEPATOPROTECTIVE EFFECT OF NEEM

A research was conducted to determine the hepatoprotective role of azadirachtin-A in carbon tetrachloride (CCl4) caused hepatotoxicity in rats, and the findings of the study's histology and ultrastructure analyses supported this conclusion. Pretreatment with azadirachtin-A dose-dependently decreased hepatic necrosis. In addition, the study's findings demonstrate that azadirachtin-A pretreatment at higher dosage levels somewhat returns the rat liver to normal (Singh et.,1997)

Antifungal Activity

Aspergillus and Rhizopus, two seed-borne fungus, were examined to determine the effectiveness of various neem leaf concentrates. The results confirmed that both infectious species' development was fundamentally hampered and controlled with both alcoholic and water extricate. An investigation found that when compared to fluid concentrate, alcoholic neem leaf concentrate was the most effective in preventing the growth of both parasite species(Lessa Singh et., 2010). Another discovery showed the antimicrobial function of watery neem cake concentrates in the prevention of spore germination against three sporulating organisms, such as C. lunata, H. pennisetti, and C. gloeosporioides f. sp. mangiferae. The investigation's findings also revealed that methanol and ethanol concentrate of Azadirachta indica in India provided growth inhibition against Aspergillus fla(Kher et.,1997).

Conclusion

One of the most significant sources of medications comes from plants. Since ancient times and up to the present day, the globe has a wealth of information on the benefits of medicinal plants in enhancing human health's capacity to deal with unpleasant and challenging situations. The fight against the occurrence of infectious diseases like malaria and chronic illnesses including age-related degenerative diseases, cancer, and cardiovascular disorders is one of the key objectives of the Millennium Development Goals. Secondary metabolites from medicinal plants are abundant and have promise as medication sources and therapeutic value. The utilisation of plant extracts as medicinal agents is gaining more and more attention. Neem is a plant with pharmacological potential for usage as a cure-all. Neem is a potential source of anticancer, anti-diabetic, anti-inflammatory, and antibacterial medicines, according to the literature review.

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