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Research

Review Article on Investigating the Antibacterial, Antifungal and Antiviral Efficacy of Andrographis Paniculata and Azadirachta Indica Extract Used in Traditional Indian Medicine

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Abstract:
This review highlights the need for additional analytical research to find novel drugs while attempting to summarize the plant's antibacterial and antifungal qualities. There is no denying the importance of natural ingredients in pharmaceuticals. From this perspective, Azadirachta indica is emerging as the cynosure of contemporary medicine. This plant has historically been widely used to treat a wide range of illnesses in both the plant and animal kingdoms. The pharmacological properties of neem plants have been linked to a variety of compounds. Aspergillus flavus, Alternaria solani, and Cladosporium were the three fungal species against which Azadirachta indica (neem) leaf extract was tested for antifungal activity. Ethanolic and methanolic extracts at different concentrations (25%, 50%, 75%, and 100%) were produced and tested against test organisms using disc diffusion. An antioxidant is a chemical that can stop the chain events that harm cells by eliminating free radical intermediates. It can also prevent other oxidation reactions by lowering the stress that causes many degenerative diseases. The versatile tropical herb Andrographis paniculata Nees is said to have numerous therapeutic benefits. This study aimed to assess the antioxidant activity of Andrographis paniculata Nees extracts in hexane, DCM, and methanol in vitro. The toxicity and antifungal properties of neem extract were compared using ketoconazole.

Keywords: Andrographis paniculata**,** Azadirachta indica, Medicinal uses.

Introduction

This tree's multiple applications are described in the ancient texts Carak-Samhita and Susruta-Samhita, which form the basis of the Indian system of natural medicine known as Ayurveda. As a result, the tree is known in Sanskrit as sarva roga nivarini, which means "the curer of all ailments." The Indian subcontinent makes extensive use of its twigs, which serve as a chewing stick. Previous research on neem has demonstrated that it contains active compounds with a variety of therapeutic uses.[1]

Because neem leaves have antibacterial qualities, they may be utilized to reduce airborne bacterial contamination in homes. Additionally, neem seeds have been used in traditional medicine to cure illnesses and infections, particularly those involving the ear and the eye. According to Gbotolorun et al. (2008), administering an alcoholic extract of neem flower to Sprague Dawley rats induces a partial block in ovulation, disturbs the estrous cycle, and may be a perfect anti-fertility agent. Neem's aqueous extract is a potent antiviral and chemotherapeutic drug.[2]

Although it may be grown throughout India, commercial cultivation and high production are better suited for the plains. The annual kalmegh plant grows to a height of three feet. The leaves are 2.5 cm wide and 7.5 cm long. The plant's blossoms are white in color.The seeds are tiny and have a brownish-yellow hue. The plant is referred to as the "King of Bitters" since it is extremely bitter. Antibacterial, antifungal, antiviral, choleretic, hypoglycemic, hypocholesterolemic, and adaptogenic properties have all been documented for A. paniculata.[3]

From seed oil, gedunin and mahmoodin are also

separated. Quercetin and ß-sitosterol are other chemicals that are isolated from fresh neem leaves.

Numerous therapeutic qualities, including anti-inflammatory, immunomodulatory, anti- diabetic, hepatoprotective, neuroprotective, antiulcer, antimicrobial, antioxidant, antimutagen ic, anticarcinogenic, and wound healing, are attributed to these diverse bioactive constituents that have been separated and identified from the various parts of the plant.[4]

For many years, a significant number of workers have contributed to the evaluation and investigation of the plant's biological activities and bioconstituents. This review focuses on and lists the documented proof of Azadirachta's antibacterial and antifungal properties. [5]

The purpose of this investigation was to ascertain the phytochemical and antibacterial characteristics of Andrographis Paniculata (Burn. F.) on enteric bacteria that were isolated from the River Owena in Owena, Nigeria. The study's goals were to ascertain the presence and distribution pattern of indicator bacteria and enteric pathogens in River Owena; ascertain the physicochemical characteristics of the River Owena water sample; investigate the methicillin and vancomycin resistance profile of the isolated organisms; evaluate the antibacterial efficacy of Andrographis paniculata leaf and stem extracts against resistant bacteria isolates; and identify the phytochemical components of the leaf and stem extracts.[6]

Andrographis paniculata

For generations, traditional Asian medicines have successfully employed the herbaceous plant Andrographis paniculata. Since the use of herbal medicines to treat a variety of illnesses is growing, more research is being done in India and throughout the world on plant medicines derived from the Ayurvedic system. It is an annual plant that grows to a height of one to three feet. It is among the most widely utilized herbaceous plants in the conventional Unani and Ayurvedic medical systems. This page summarizes the biological activity from several clinical and preclinical investigations. It is referred to be the "king of bitters" and is also known as Creat in English. It is grown in gardens and flourishes in hedgerows over India's plains.

It flourishes in several other Asian nations as well. Many nations, including China, Hong Kong, the Philippines, Malaysia, and Indonesia, employ it as a traditional herbal remedy. Since the plant has been demonstrated to have "blood purifying" properties, it can be used to treat conditions including skin eruptions, boils, scabies, and persistent, unexplained fevers that are caused by blood irregularities. The aerial portion of the plant is utilized for that purpose. Numerous chemical components, including diterpenes, diterpenoids, glycosides, flavonoids, and flavonoid glycosides, are present in it.

Chemical Structure: - A. paniculata contains andrographolide, a significant bioactive phytoconstituent, primarily in its leaves. Andrographolide has the chemical name 3α, 14, 15, 18-tetrahydroxy-5β, 9βH, 10α-labda-8, 12-dien-16-oic acid γ-lactone. Its molecular formula is C20H30O5, and its weight is 350.4 (C 68.54%, H 8.63%, and O 22.83%). X-ray, 1H, 13 C- NMR, and ESI-MS have been used to study the structure of andrographolide.[7]

Fig.1: Andrographis paniculata Plant https://earthone.io/hi/plant/andrographis%20paniculata?srsltid=AfmBOorT7OWhVLx5lKqHcQLTYPTOMi0u6RkFnUSZ2L3b9te039AAlH1O

Andrographis paniculata's clinical and pharmacological features: -

- **Antimicrobial Effects:** According to earlier research, the combination action of andrographolides and arabinogalactan proteins is responsible for the aqueous extract's notable antibacterial activity.
- **Antiviral Effects:** The expression of Epstein-Barr virus (EBV) lytic proteins, Rta, Zta, and EA-D, during the viral lytic cycle in P3HR1 cells has been shown to be successfully inhibited by 25 μg/ml of ethanolic extract of A. paniculata and 5 μg/mL of andrographolide. According to a recent study, when six medicinal herbs were tested against DENV1-infected Vero E6 cells, A. paniculata exhibited the strongest antiviral inhibitory effects.
- **Infectious Diseases:** Leptospirosis, acute pyelonephritis, pulmonary TB, and tuberculous meningitis have all been

treated using A. paniculata. According to reports, when andrographolide was administered to HIV-positive patients, the CD4+ lymphocyte count increased from a baseline mean of 405 cells/mm3 to 501 cells/mm3. Upper respiratory tract infections (URTIs) have also been treated with A. paniculata.[8]

Phytochemical Components of Andrographis paniculata Leaf and Stem Extracts:

Methanol extracts of the leaf had the maximum weight, according to the yield of the A. paniculata extracts. Alkaloids, saponins, tannins, flavonoids, steroids, terpenoids, and cardiac glyclosides were found in the leaf extract, according to a qualitative analysis of its phytochemical components. With the exception of anthraquianone and phlobatanin, which recorded negative (-ve) results (i.e., absent in the extracts), the majority of the constituents tested positive (+), meaning they were present in the methanol leaf and stem extracts, whereas the majority were absent in the n-hexane leaf extract, with the exception of flavonoid.[9]

Azadirachta indica

India is the birthplace of Azadirachta indica, sometimes referred to as neem or Margosa.

This plant belongs to the genus Azadirachta. It is indigenous to the Indian subcontinent of South Asia and arid regions including Bangladesh, India, Nepal, Sri Lanka, Pakistan, and the Maldives. The plant has long been utilized in Ayurvedic and traditional medicine, and it is currently widely employed in organic farming and cosmetics. Man has been aware of herbal remedies for hundreds of years because their applications have been documented since antiquity. The Vedas and other ancient Hindu literature were the first to discuss the use of herbal remedies for medical purposes. Ayurveda, the medicinal science of Indian culture, relies heavily on these herbs. Many plant species, either in the form of natural herbs or their various extracts, have been shown to have therapeutic effects for a variety of illnesses by practitioners of traditional medicine around the world.

In affluent nations, the majority of people also use traditional folk medicines made from plant ingredients. Nutraceutical food supplements, pharmaceutical intermediates, modern medications, lead chemicals in synthetic drugs, bioactive principles, and constituents in traditional medical systems are all derived from herbal remedies.[10]

Fig.2: Azadirachta indica (Neem) Tree
https://www.freepik.com/premium-ai-image/old-asian-neem-tree-leaves-isolated-bright- colors-botanical-cutout-big-deciduous-tree_175402840.htm

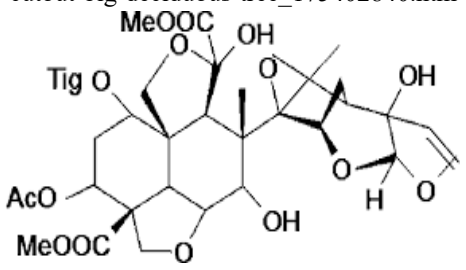

Fig.3: Structure of Azadirachta indica (Neem)
https://www.researchgate.net/figure/Structure-of-Azadirachta-A-Neem- component_fig1_272941950

Antimicrobial activity of Azadirachta indica:-

Neem contains 35 biologically active chemicals and has strong antimicrobial activity. Indian ancestors used to put neem leaves in their beds, books, and cabinets to keep bugs out. Neem leaf juice and twigs are also used as a tonic and to clean teeth.

The fruits and bark of the neem tree have yielded several powerful medicinal chemicals, including limnoods and triterpenoids.

Neem extracts and their various components are crucial for inhibiting a variety of microorganisms, including bacteria, fungus, and viruses. Azadirachta indica methanol and hexane chloroform extracts were chosen based on their ability to inhibit the growth of Escherichia coli, Proteus vulgaris, Klebsiella pneumonia, Bacillus subtilis, Micrococcus luteus, Streptococcus faecalis, and Enterococcus faecalis.[11]

Neem's antibacterial properties:

Neem is typically utilized in pharmaceuticals and medicine.

Neem's stem and bark have strong antibacterial properties against Streptococcus, Serratia species, and Klebsiella. Neem extracts in methanol exhibit antibacterial action against Vibrio cholera, while extracts in chloroform exhibit antibacterial activity against Bacillus subtilis, E. coli, Enterococcus faecalis, and Streptococcus faecalis.

Neem's antifungal properties:

Ethanol and aqueous extracts of Azadirachta indica leaves have demonstrated anti- dermatophytic action when compared against dermatophytes from 88 clinical isolates using the agar dilution technique. In comparison to aqueous extracts, ethanolic extracts demonstrated more obvious action, according to these investigations. Two strains of Aspergillus fumigatus and Aspergillus niger were used to examine the antifungal properties of Azadirachta indica methanolic and acetone extracts. Azadirachta indica's antifungal activity was tested using various neem extracts on a variety of pathogens, including Microsporum gypseum, Aspergillus terreus, Candida albicans, Aspergillus niger, Aspergillus fumigates, and Aspergillus flavus. The results showed that these leaf extracts inhibited the growth of the tested pathogens at varying concentrations.[12]

Neem's antiviral properties:

Neem leaves and bark are highly effective against lymphocytic leukaemia and have been shown to decrease tumors and malignancies. There found evidence of mitotic inhibitory action in leaf extracts. According to a number of findings, neem leaf aqueous extracts have a strong antiviral impact against HSV, smallpox, fowl pox, and polio, as shown by the virus inhibition assay (98100).[13]

Table 1. Azadirachta indica plant parts and their utilization.

Parts	Form	Utilization
Leaf	Traditional medicine	Due to its therapeutic properties, neem leaves have long been used in traditional medicine. They may possess antibacterial, antiviral, antifungal, and anti- inflammatory qualities.
	Agricultural use	They can be used in a variety of ways to control pests in agriculture, such as a spray created by extracting the essence of leaves.
	Herbal preparation	Neem leaves may be pulverized and dehydrated, which makes them useful for creating tea or capsules. People often drink neem leaf tea because of its astringent taste and possible health advantages.
Seed	Oil production	Neem oil, a multipurpose substance used in shampoos, soaps, cosmetics, and pharmaceuticals, is derived from neem seeds. In addition to being high in fatty acids, neem oil contains compounds with insecticidal properties such azadirachtin.[14]
Flower	Medicinal use	Neem blossoms are frequently used in traditional medicine because of their medicinal properties. They act as a blood purifier and have digestive advantages.
	Anthelmintic properties	The anthelmintic properties of neem blossoms help rid the body of intestinal worms. Traditional deworming treatments involve the use of neem flower infusions or decoctions.
Bark	Medicinal purposes	Numerous bioactive substances found in the bark of neem trees, such as quercetin and nimbidin, have analgesic, antimalarial, and antipyretic properties. It has long been used in Ayurvedic medicine to treat ailments like pain, fever, and malaria.
	Industrial use	Tannins found in neem bark are used to dye textiles and tan leather.
	Oral care	Neem bark is found in herbal mouthwash and toothpaste. This substance's antimicrobial properties help maintain dental hygiene and prevent gum diseases like gingivitis.
Twig	Oral hygiene	Neem twigs are used as natural toothbrushes in traditional oral hygiene practices. Neem twigs are thought to help reduce gum disease, teeth decay, and foul breath when chewed on or used as toothbrushes. The antibacterial properties of neem twigs can prevent the growth of germs in the mouth cavity.[15]

Medicinal Uses:

- **Ayurveda:** Since ancient times, neem trees have been a key component of traditional Indian Ayurvedic medicine. Extracts from neem bark, leaves, and oil are used to treat intestinal helminthiasis, leprosy, and

constipation, among other conditions. Many skin conditions are frequently treated with neem oil. Combining fruits, bark, leaves, blossoms, and roots helps treat blood morbidity, itching, skin ulcers, burning feelings, biliary diseases, and phthisis. Root bark and young fruits are tonic, antiperiodic, and substitutes. Bark, gum, leaves, and seeds are used to treat scorpion stings and snake bites. In addition to being astringent, bitter tonic, antiperiodic, and antipyretic, the bark relieves nausea and vomiting.

- **Homeopathy:** Neem is used in homeopathy to treat sternal and rib pain, hand and foot pain, rheumatic discomfort, and extremities pain. It is also used to treat eczema, pemphigus, and scabies. Additionally, it has therapeutic benefits include lowering inflammation, combating infections, and eliminating bacteria and fungus. Despite neem's medical history and some promising scientific data indicating its possible health advantages, it is important to remember that further research is necessary to fully understand the safety and efficacy of neem in medicines.
- **Unani:** Neem is utilized as a re-solvent and blood purifier. The leaves drive out the wind and treat urinary tract lesions. It is used as an emmenagogue and to treat skin disorders. Fruit acts as an astringent in leprosy and bronchitis.

Conclusion

The medical plant Azadirachta indica, also known as neem, has been shown to contain antibacterial, antifungal, antiviral, antimalarial, antiulcer, and other biological properties. It has also been proven to be beneficial in treating bacterial, fungal, viral, and other disorders. Neem plants are becoming more and more popular in the treatment of various ailments due to the adverse effects of synthetic antibiotics and the rise in antibiotic resistance in bacteria. Neem plants are thought to be safer and more therapeutically effective than synthetic antibiotics. Additionally, the plant improves liver and heart functioning by reducing liver damage and treating cardiovascular disease. Additionally, it is incredibly helpful for lung conditions, snake bites, gastrointestinal issues, body aches, allergic responses, the central nervous system, and brain function.

It has been claimed that Andrographis paniculata reduces both human and animal fecundity. Given the plant's beneficial qualities, it can be promoted as a highly significant and safe medicinal herb for humanity.

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