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Antimicrobial Properties of Medicinal Plants: A Systematic Review

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ABSTRACT:
Man's requirements for food, clothes, shelter, flavourings, scents, and medicines have all been met by plants. Ayurvedic, Unani, Chinese, among other complex ancient medical systems, have their roots in plants. Some significant medications that are still in use today were developed by these medical systems. Nowadays, the quest for novel molecules has taken a somewhat different path where everyone is guided by the study of medicinal property to other sources and classes of chemicals. The richness of the tropical flora in this contributes significantly to its ability to provide new leads. But the Convention for Biological Diversity (CBD) also calls for addressing the questions of sovereignty and property rights. The aforementioned are highlighted in this study, along with an overview of the classes of molecules found in plants and some illustrations of the kinds of molecules and secondary metabolites that have contributed to the creation of these pharmacologically potent extracts. The study also discusses the use of plant-based ingredients in the creation of functional foods, the necessity to validate plant extracts, and the importance of safety, effectiveness, and quality in phytomedicine.

Keywords: Phytomedicine, Convention for Biological Diversity, Ayurvedic, Secondary metabolites.

INTRODUCTION:

Humans have always depended on nature to provide for their fundamental necessities, including food, clothes, housing, transportation, fertilisers, tastes and scents, and not to mention, medicines [1]. The foundation of complex traditional medical systems, which have been around for thousands of years and are still giving mankind new treatments, is plants. Despite the fact that some of the therapeutic benefits ascribed to plants have turned out to be false, medicinal plant therapy is founded on centuries' worth of scientific research [2,3]. The first records, written on clay tablets in cuneiform, are from Mesopotamia and date from about 2600 BC; among the substances that were used were oils of Cedrus species (Cedar) and Cupressus sempervirens (Cypress), Glycyrrhiza glabra (Licorice), Commiphora species (Myrrh) and Papaver somniferum (Poppy juice), all of which are still in use today for the treatment of ailments ranging from coughs and colds to parasitic infections and inflammation [4-8].

According to Egyptian herbal remedies, bishops weeds (Ammi majus) can be used to cure vitiligo, a skin disorder that is characterised by a loss of pigment. More recently, a medication (b-methoxypsoralen) was created from this plant to treat T-cell lymphoma, psoriasis, and other skin conditions [9].

There is still interest in looking to nature for possible chemotherapeutic medicines. More than half of all medications used in clinical settings worldwide are made from natural materials and their derivatives. No less than 25% of the total is provided by higher plants [10,11].

Over the past 40 years, at least a dozen potent medications have been created from flowering plants, including the diosgenin from Dioscorea species, which is the basis for all anovulatory contraceptive drugs, reserpine and other anti-hypertensive and sedative alkaloids from Rauwolfia species, pilocarpine, which is used to treat glaucoma and dry mouth, and two potent anti-cancer medications [12].

The tropical woodlands are home to around 125,000 of the world's blooming plant species. There is still a huge pool of potential medicine species in tropical rain forests. They continue to supply natural product chemists with priceless molecules that serve as the foundation for the creation of brand-new medications [13]. As of now, just around 1% of tropical species have been investigated for their potential as pharmaceuticals, there is a tremendous possibility for discovering more molecules [14]. For species that are restricted to tropical rain forests, this proportion is substantially smaller. About 50 medications have so far originated from tropical plants. The high yearly extinction rate is cause for concern, to put it mildly, as the availability of unknown medications for

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contemporary medicine has frequently been touted as one of the most significant reasons for safeguarding tropical forests [15-18].

Herbal uses from ancient to present time:

The bulk of people on this globe still get their daily medical treatment from their traditional materia medica (medical plants and other things). The WHO estimates that 80% of the world's population, primarily those in developing countries, rely on plant-derived medicines for their healthcare, and that one-fourth of all medical prescriptions are formulations based on substances derived from plants or plant-derived synthetic analogues [19].

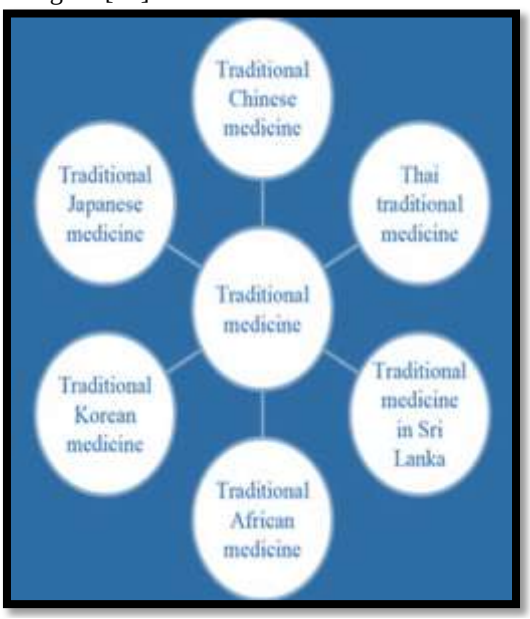

Figure 1: Types of traditional medicines.

It is possible that traditional societies' extensive knowledge of herbal treatments evolved via trial and error over many years, with the most effective treatments being carefully transmitted verbally from one generation to the next. For many years, the history of pharmacognosy, or the study of materia medica, which were derived from natural sources, mostly plants but also minerals, animals, and fungus, was the same as the history of pharmacy [20].

Ancient medicine has influenced modern allopathic medicine, and it is expected that many significant new treatments will be found and made available for purchase in the future, as has been the case up until now, by following the cues given by conventional wisdom and firsthand experiences. Almost all civilizations have well-established traditions, some of which have rarely been examined at all, while European traditions are particularly well-known and have had a significant impact on current pharmacognosy in the West. The study of these traditions offers insight into how the discipline has evolved and serves as an intriguing illustration of human capacity to create a variety of cultural practices [21-24].

Because humans did not have the scientific knowledge to explain and predict the therapeutic activity of plants, the usage of medicinal herbs is frequently connected with witchcraft and superstition in various cultures. The Doctrine of Signatures, which has aspects in many of the world's healing traditions, is one example of such an absurd idea. It is predicated on the idea that a plant's appearance may provide hints about its therapeutic capabilities; this is seen as God's stamp on the plant [25].

Although many who utilise traditional treatments might not be familiar with the scientific underpinnings of their medications, they are aware from personal experience that certain medicinal plants can be quite powerful when taken in therapeutic doses. We are better able to comprehend the therapeutic properties of plants and their potential as multifunctional chemical agents for treating complex medical diseases now because we have a better grasp of how the body works. Medicinal plants often include combinations of several chemical components that can work alone, together, or synergistically to enhance health [26-28].

Ayurvedic medicine (Indian Traditional Medicine)

The oldest medical system is Ayurveda, which is possibly even older than traditional Chinese medicine. It is regarded as the starting point of systemized medicine. It is actually a realistic and all-encompassing set of rules to keep the system in harmony and balance. Many of the theories attributed to Dioscorides, who inspired Hippocrates, are believed to have originated in India [29].

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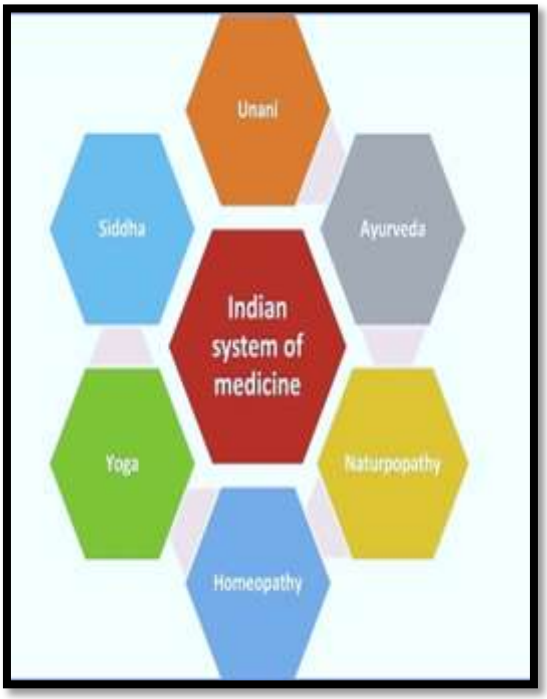

Figure 2: Indian system of medicine

Greek and Middle Eastern works on medicine make mention of concepts and medications with Indian origins, but ancient Hindu writings on medicine make no mention of foreign remedies. Ayurveda, which means the science of life, is derived from the Indian words ayar (life) and veda (knowledge or science). A long life is said to be the key to obtaining righteousness (dharma), riches (artha), and pleasure (sukha), therefore adhering to the method will assist ensure one has one [30].

Traditional Medicinal plants:

Traditional medicine and global ethnomedicine have traditionally used medicinal herbs. This chapter provides a brief overview of the state-of-the-art and emerging developments in the genomes, evolution, and phylogeny of medicinal plants [30]. The origin and evolution of plant genotype and metabolic phenotype, interaction between medicinal plant genomes and environment, correlation between genomic diversity and metabolite diversity, and other topics are all addressed in these dynamic fields that sit at the nexus of phytochemistry and plant biology [31].

To speed up the breeding of traditional medicinal plants and turn them into a living factory of pharmaceutical chemicals, the applications of cutting-edge genomic technology can be applied beyond crop plants to traditional medicinal plants. In the context of developing drugs based on natural products, the use of molecular phylogeny and phylogenomics in predicting chemodiversity and bioprospecting is also underlined [32]. To demonstrate the growth of our knowledge base and the paradigm shift to omics-based approaches, which update our understanding of plant genome evolution and allow for the molecular breeding of medicinal plants as well as the sustainable use of plant pharmaceutical resources, we summarise the representative case studies of medicinal plant genome, phylogeny, and evolution [33].

Medicinal properties of Neem:

Neem has grown popular in contemporary medicine due to its significant usage in Ayurveda, Unami, and homoeopathic treatments. Neem produces a wide range of chemically varied and structurally complex physiologically active chemicals. From various neem plant components, more than 140 distinct chemicals have been discovered [34]. The neem tree is almighty and a revered gift from nature. The neem tree is mostly grown in the Indian subcontinent and is regarded as the most significant and beneficial medicinal plant. Neem, a traditional remedy, is a Meliaceae (mahogany family) member. Its botanical name nowadays is Azadirachta indica [35]. Neem is an evergreen, tall, and rapidly growing tree that may grow to a height of 25 metres and a diameter of 2.5 metres. It has a lovely canopy of deep green leaves and honey-scented blossoms. More than 100 different bioactive chemicals found in neem have potential uses in agriculture, animal care, public health, and even the control of human fertility [36]. It has a wide range of possible applications since it contains herbal extracts that are used to cure infections and have been used for centuries because they are environmentally friendly and have few adverse effects [37].

Antimalarial activity of neem:

The bark and leaves of Azadirachta indica were used to make a tablet solution, and its antimalarial effects were evaluated. on mice infected with Plasmodium yoellinigeriensis. The effects of the tablet suspensions on schizonticidal effects were minimally therapeutic, moderately suppressive, and highly prophylactic [38]. In chemo-suppression, the chloroquine tablet suspension at a concentration of 62.5 mg/kg body weight and the leaf and bark tablet suspensions at a concentration of 800 mg/kg each produced normal

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parasitaemia rates of 79.6%, 68.2%, and 99.5%, respectively. Similar to the curative therapy, pyrimethamine at a concentration of 0.35 mg/kg and tablet suspensions at 800 mg/kg each resulted in a normal parasitaemia decline of 75.3%, 65.6%, and 98.3% for the leaf, bark, and pyrimethamine, separately [39].

Anticancer activity of neem:

Numerous biologically active substances, including as nimbin, nimbidin, nimbolide, and limonoids, are present in A. indica. Quercetin and -sitosterol were the first polyphenolic flavonoids isolated from fresh neem leaves [40]. Through antitumor activity, antioxidant activity, and the inhibitory effect exerted on the development of malignant cells by modulation of cellular proliferation, tumour suppressor genes, and apoptosis [41], all of those compounds occupy essential roles in the development and management of cancer.

Trish et al. examined the chemopreventive ability of A. indica leaf extract in a murine carcinogenesis model system using Swiss albino mice that were 7 weeks old. They found that dosages of neem leaf extract decreased the occurrence of tumours. The findings showed that at least 35 physiologically active compounds were present in the Indian neem tree [42].

Antibacterial activity of neem:

According to the results of this study, NE can be a powerful antibacterial agent for the treatment of illnesses caused by harmful bacteria at lower doses without posing any health risks to people. To evaluate the effects of the nano material at the cellular level, the in vitro toxicity research on immune cells is crucial [43] Humans are protected against infections by humoral and cell-mediated immunity thanks to lymphocytes, which are immune cells. The most popular method for examining the cytotoxicity and genotoxicity of neem extracts used for medicinal purposes is human lymphocytes [44].

Antifungal activity of neem:

The antifungal effects of neem are as important to research as its antibacterial and antimalarial capabilities. To assess the antifungal activity of Azadirachta indica (Neem) leaf extract, three fungi species were used: Aspergillus flavus, Alternaria solani, and Cladosporium. Neem oil has successfully treated a variety of fungal illnesses brought on by the aforementioned fungi. It has literally saved my life [45]. By using the tube dilution approach, A. indica leaf and seed extracts were reported to have antidermatophytic action against several dermatophytes, including C. albicans and Trichophyton rubrum, T. violaceaum, Microsporumnanum, and Epidermophyton floccosum [46].

Neem extracts from the leaves and seeds were tested for their minimum inhibitory concentration (MIC) and minimum fungicidal concentration (MFC) against a variety of dermatophytes. The scientists discovered that differences between the treated and untreated dermatophytes' growth curves were statistically significant. Neem leaf and seed extracts had MICs of 31 and 15 g/ml, which were both adequate to kill Trichophyton rubrum, T. mentagrophytes, and Microsporumnanum[47].

More than 140 chemicals that were isolated from various areas of the tree make up the great majority of physiologically active, chemically varied, and structurally variable compounds found in neem. The first polyphenolic flavonoids that were isolated from freshly picked neem leaves were quercetin and ß-sitosterol, which were known to have antibacterial and antifungal activities. The same scientists used HPLC to separate the active components of neem organic extracts and discovered that their concentrations of key substances such 6-deacetylnimbin, azadiradione, nimbin, salannin, and epoxy-azadiradione had substantial activity when tested on many pathogenic fungi [48-50].

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