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A review on phytochemical prospects of mangroves and their medicinal importance.

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Abstract:

Mangroves are world's most dynamic ecosystems and sustain genetically diverse community of terrestrial and aquatic flora and fauna. They provide innumerable direct and indirect benefits to human beings. Mangrove plants are salt loving halophytes, distributed in tropical and subtropical zones around the earth. In present days, these mangrove plants have become a major topic of discussion in aspect of bio prospecting of pharmaceutically important bioactive compounds. Moreover, different parts of mangrove plants are used in folklore medicines for having some curative and protective properties against different chronic diseases. In nature, more than 65 species of mangrove plants, 18 species are found to be widely used by local medical practitioners in many countries like India, Africa, Southeast Asia, South America, Australia etc. Furthermore, ethnobotanical records regarding medical use of mangrove plants are very limited and very unique. This review mainly focused on different phytochemical compounds derivative from leaves, barks, stems, roots, flowers, fruits and seeds of mangrove plants. The most valuable bioactive compounds obtained from these plants are polyphenols, flavonoids, alkaloids, carotenoids, tannins, saponins, steroids, aminoacids, carbohydrates, proteins, vitamins etc. This review also focus on pharmacological activities of mangrove plants including antimicrobial, antiinflammatory, anti-ulcer, antidiarrhoeal, anticancer, antidiabetic, anti-HIV, antinociceptive, hepato-protective, anti-arthritis, analgesic, antioxidant and cytotoxic activities.

Keywords: Bioactive compounds, Ethano botany, Folklore medicine, antibacterial, anti-inflammatory.

Introduction:

Mangrove forests are most dynamic and productive tropical ecosystems of the earth. India harbors some of the best mangrove forests of the world which are located in the alluvial deltas of the major rivers such as the Ganga, Mahanadi, Godavari, Krishna, Cauvery and also on the bay of Andaman and Nicobar Islands. It covers about 6,749 sq km along the 7,516.6 km long coastline including island territories. They are highly potential because these ecosystems are always under stress which leads to the production of certain compounds for their survival. The ecological and economic benefits and traditional uses and products of mangrove ecosystems are many and varied. Many economic important species like prawns, crabs, shrimps and marine fish are associated with mangroves. Traditionally, the mangroves have been exploited by the local communities for firewood and charcoal and their uses include the construction of dwellings, furniture, boats and fishing gear and the making of tannins for dyeing and leather production. The mangroves provide food and a wide variety of traditional products and artifacts for mangrove dwellers. Mangroves species have been used in folklore medicines and extracts from mangrove species have proven inhibitory activity against human, animal and plant pathogens. Some of the mangrove species are produce bioactive compounds that may control microbial growth and activity also. The preliminary studies have demonstrated that the mangrove plant extracts have antibacterial activity against pathogenic bacterial strains. Mangrove extracts can also be the possible sources of mosquito lavicides, antifungal, antiviral, anti-cancer and anti-diabetic compounds. At present there is a need to investigate for new antimicrobial agents because infectious diseases are still it is a global problem. The main purpose of the present study is to identify the potentiality of mangroves as medicinal plants.

Chemistry of Mangrove Plants:

The chemistry of mangrove plants is little known, there have been some examples in recent years to support the need to study the chemistry of the mangroves. The chemistry of mangrove plants tends to establish that they may be a source of new compounds along with providing a new source for many known biologically active compounds. They may have great potential as a source of new agrochemical and toxic compounds. Retinoids, alkaloids, terpenoids are among the classes of natural products which provide numerous toxins. Toxin in plants often has the role of feeding repellents. A remarkable number of insecticidal plants seem to have been recognized first as fish poisons. Knowledge of the toxins in higher plants has led to a variety of useful drugs. These toxin compounds are still used clinically for the treatment of diseases. The physiological activity of an alkaloid manifests in an extreme toxicity. Many of these alkaloids have useful pharmacological properties at sub lethal dosage and have become established as valuable drugs in medicine. However numerous mangroves and mangrove associates are recommended in traditional medicine as active against various diseases. Few workers have investigated the reputation of such plants by performing *in vitro* and in *vivo* experiments in order to demonstrate, whether there are any

protective effects, using drugs or mixtures of drugs prepared using traditional formula. Very little attempts have been made to investigate the veracity of these assertions in controlled experiments. Even though there are few recent investigations of the chemical constituents describing several novel compounds. A very little research has been carried out to identify the chemical compounds directly responsible for the specific biological activity.

The Knowledge of the chemical constituents of mangroves is desirable, not only for the discovery of new therapeutic agents and these sources are very important in the preparation of folklore remedies. Metabolites, some with novel chemical structures, and belonging to a diversity of chemical classes, have been characterized from mangroves and its associates. Aliphatic alcohols and acids, amino acids and alkaloids, carbohydrates, carotenoids, hydrocarbons, free fatty acids including polyunsaturated fatty acids (PUFAs), lipids, pheromones, phenolics, steroids, glycosides, tannins and other related compounds. Among the latest additions are an array of substances from gums and glues to alkaloids, saponins and other substances are play an important role in modern medicine.

Importance of Mangroves:

Mangroves are unique in nature and they grow in intertidal zones of harshly saline environments because they can tolerate regular flooding and also able to obtain fresh water from salt water. Mangroves are important natural habitats for many rare marine species. Mangrove root system provides a natural habitat for number of marine organisms such as barnacles and oysters. They provide protected feeding and breeding habitats for some of the rare species like crustaceans, shellfish and other economically important species. Many of these attached organisms, especially cyano bacteria and algae filter the saline water. They also contribute to the food web, aiding a multitude of marine species such as snapper, tarpon, jack, oysters, crabs, and shrimp. Many migratory birds also depend on mangroves for food and shelter. Some species of animals find shelter in mangrove roots and branches, and the branches serve as nesting grounds for many coastal birds such as egrets, herons, brown pelicans, and roseate spoonbills.

Ecological and Economic Importance of Mangroves:

Mangrove forests play a vital role in shoreline protection. The mangrove plants are very useful in sea shore erosion. The mangroves are generally called as coastal guards of the nature. Mangroves are found in a relatively small area of originally 17 to 20 million hectares in the world. Mangrove area is used to refer to large variety of coastal systems which vary in productivity and in their makeup and which have differing hydrological and ecological features, depending upon the coastal morphology. They act as “coastal stabilizers, shelter belt areas, barrier of the sea erosion and as a nutrient export zone to open ocean. With regards to animal and plant resources, there occurs a total number of 193 plant species, 397 fish species, 259 crab species 256 mollusk species and 450 insects, more than 250 species of mammals, other plants and animals species diversity at global level. With respect of global warming, mangroves play an important role

in controlling the attendant sea level rise, coastal erosion and long-term community stability and also have an excellent potential of medicinal values. According to available data, out of 65 mangrove species, 12 species are widely used by local medical practitioners in many countries like Africa, South East Asia, South America and Australia. These 12 species viz. *Acanthus licifolius, Aegiceras carniculatum, Avicennia officinalis, A. marina, Ceriops decandra, Exocoecaria agallocha, Nypa fruticans, Rhizophora apiculata, R. mcronata and Sonneatia apetala* are used to cure some deadly diseases like leprosy, elephantiasis, tuberculosis, malaria, dysentery, ulcers and other diseases.

Mangroves as Medicinal Plants:

Mangroves and mangrove associates contain poisonous substances, which also show biological activities such as antifungal, antibacterial, antifeedant, molluscicidal, and pesticidal properties. Extracts from different mangrove plants are reported to possess diverse medicinal properties such as antibacterial, anthelmintic. Among the latest additions are an array of substances from gums and glues to alkaloids and saponins and other substances play vital role in modern medicine. Mangrove plants are a rich source of steroids, triterpenes, saponins, flavonoids, alkaloids, tannins. Plant saponins which are glycosides of both triterpenes and sterols are soluble in water and possess the property of forming stable 'soapy' froth when shaken with water. The saponins are used as natural detergents and fish poison was known to native people of some countries like Africa and Andaman and Nicobar islands. Plant saponins are commercially sought after as starting materials for the synthesis of steroidal hormones. Plant saponins have other interesting biological activities such as spermicidal molluscicidal antimicrobial, inflammation-inhibiting, and cytotoxic activities. There are many types of flavonoids such as flavans, catechins, chalcones, flavonones, flavones, flavanols and isoflavonoids used as therapeutic agents extracted from the some mangrove plants. At the same time it has been recognized that several classes of flavonoids show antioxidant activity toward a variety of oxidizable compounds. The majority of natural products used in medicine today are alkaloid in nature and they normally exert some type of pharmacological activity, usually on the nervous system. Evidence from both *in vivo* and *in vitro* experiments indicates that the basic nitrogen compounds such as amino acids and alkaloids include many representatives that are potent inhibitors of various biological oxidative processes.

Tannins are water soluble polyphenols which differ from most other natural phenolic compounds in their ability to precipitate proteins such as gelatin from solution. This property, sometimes called astringency, is the reason for their past and present use in the tanning of animal skins and is the basis of a qualitative chemical test for the presence of tannins in plant extracts Polyphenols present in medicinal plants and present in food and beverages contribute to the prevention of diseases. Tannins are distributed in two groups according to their structures: proanthocyanidins which are phenolic polymers (condensed tannins), and hydrolysable tannins which are polymers of phenolic esters. Several biological activities such as

cytotoxic, anti-neoplastic, antibacterial, antiherpetic, anthelmintic, are reported for tannins and many proanthocyanidins and they provide defense against herbivores or invading parasites. Their potential value as cytotoxic and antineoplastic agents and as antimicrobial agents, for example in wood preservation or prevention of dental caries, has been demonstrated. Common uses of mangroves in 'bush' medicine are given in Table 1. *Avicennia officinalis* produces pharmacologically significant steroidal saponins and sapogenins. A triterpenoidal saponin isolated from *Acanthus illicifolius* and a new type of alkaloid isolated from *Atriplex vesicaria* have revealed anti leukemic activity and the alkaloid may be an active bactericidal component . *A. vesicaria* which is also rich in tannins is an antitumor agent. Extracts of *Brugueira sexangula* bark were active against for tumors. A chemical and pharmacological survey of plants in the Australian region revealed that several mangrove plants possess antiviral activity. Among them were several plants from the mangrove habitat which included species of *Avicennia, Bruguiera, Excoecaria, Heritiera, Juncus, Rhizophora, Sonneratia*, and *Barringtonia asiatica, Camptostemon schultzi, Podocarpus dispermus*, and *Cyanometra iripa* (Collins et al. 1990). Sixteen different mangrove plants have been tested for antiviral activity. *A. illicifolius, A. marina, B. cylindrica, E. agallocha, R. mucronata, R. lamarkii. Salicornia brachiata, Sesuvium portulacastum, Sueda maritima, and S. monica* exhibited antiviral activity against TMV. Of these, the extracts of the seeds of *B. cylindrica* and the leaves of *E. agallocha* exhibited the highest activity (>70%). Extracts of seaweeds, seagrasses and mangroves from the southeast coast of India have been tested *in vitro* for antiviral activity against Newcastle disease, vaccinia, Semliki Forest, encephalomyocarditis and hepatitis B viruses. The leaf extracts of *B. cylindrica* and bark of *R. mucronata* showed antiviral activity against all the viruses tested. Two systematic antiviral resistance-inducing proteins have been isolated from the leaves of *Clerodendrum inerme*. *Pongamia pinnata*, an Indian medicinal plant used in the *Ayurvedha* and *Siddha* traditional medicine systems for the treatment of skin and genitalia also possess antiviral properties. *Acanthus illicifolius, Avicennia marina and E. agallocha* showed significant analgesic activity but were less effective when compared to morphine. A triterpenoidal saponin isolated from *Acanthus illicifolius* is useful in the treatment of paralysis, asthma, rheumatic pains and has revealed analgesic and anti-inflammatory activities. The spirit extracted from *Clerodendron inerme* and *A. illicifolius* is anti-inflammatory. According to folk medicine the fruits of the large glabrous shrub *Lumnitzera racemosa* are curative in skin disorders. *Clerodendron inerme* is reported to exhibit uterine stimulant activity and febrifugal and pesticidal properties . Antifungal compounds have been characterized from *Diospyros* spp., *H. littoralis* and *X. granatum* .The young unripe fruits of *X. moluccensis* strongly inhibit the respiratory reactions of mitochondria from rat liver. The bark pressings of *Xylocarpus granatum* and *X. moluccensis* are used as curative medicine for several fevers including malaria. Extracts from the bark of *Rhizophora apiculata, R. mucronata, Ceriops decandra, Xylocarpus granatum, X. moluccensis* and *Laguncularia racemosa* are considered to have astringent, antidiarrhoea, antiemetic and haemostatic. The fermented juice of the *Sonneratia apetala* fruit is useful for arresting haemorrhage. The mature fruits of *X. moluccensis* are used as aphrodisiacs. Fresh leaves are used in the form of poultices against atonic and gangrenous ulcers.

Cigarettes prepared from the chopped stem bark are smoked to relieve the pain of sinusitis. In Indo-China the leaves and young shoots are crushed, mixed with alcohol, and applied to the back in cases of lumbago, and also are used for rheumatic pains and in baths to treat scabies. According to the Indian 'materia medica' a soft reddish substance (*Tejbala*) obtained from the lower part of the trunk of *E. agallocha* was reputed as an 'aphrodisiac tonic'. This may be the cause of it's over exploitation, as happens with all plant and animal products 'reputed' to be aphrodisiacs. However, *E. agallocha* may have been exploited in these regions for other reasons. Being a member of the Euphorbiaceae, it exudes an acrid milk sap, or latex rich in alkaloids. In traditional medicine this sap and decoctions from different parts of the plant (mainly the leaves) are used for different purposes, such as purgatives, and against epilepsy. A paste made from the wood is applied externally on ulcers and leprous sores or, alternatively, the ulcers and sores are exposed to the smoke from the wood. Two antimicrobial substances have been obtained from a mangrove isolate of the fungus *Preussia aurantiac.*

Table 1: Medicinal uses of mangrove plants

Acanthus illicifolius ***	Aphrodisiac, asthma, blood purifier, (Fr), diabetes, diuretic, dyspepsia, hepatitis, leprosy (Fr, L, R) neuralgia, paralysis, ringworms, rheumatism, skin diseases, snake bites, stomach pains, (B, Fr, L).
Acanthus ebracteatus ***	Antiseptic, blood purifier, boils, (Fr), colds, (B, Fr), gangrenous wounds, (B), rheumatism, (L), skin allergies, (B), snake bites, (B, Fr, L).
Avicennia alba ***	Antifertililty, skin diseases, tumors, ulcers, (Resin).
Bacopa monniera ***	Nerve tonic, (L).
Balanites aegyptica *	Abdominal pains, intestinal disorders, malaria, purgative, Aleepingsickness, syphilis, (L).
Calophyllum inophyllum *	Anticancer, disinfectant, (B, L), bone fracture, (Fr), eye diseases, (B).
Derris uliginosa ***	Arrests haemorrhages, (Fr), antispasmodic, stimulant, (B).
Derris trifoliata ***	Laxative, (L, R, T).
Excoecaria agallocha ***	Epilepsy, (L, Sap), conjunctivitis, dermatitis, haematuria, leprosy, (L, Sap, St), purgative, (L, sap), toothache, (Sap).
Fagara zanthoxyloides *	Dental hygiene, (St).
Heritiera littoralis ***	Iarrhoea, (St).
Hibiscus tiliaceus *	Ear infections, (Flowers).
Hippomane mancinella *	Conjunctivitis, (L, Sap).
Ipomoea pes-caprae *	Jelly fish sting dermatitis, (L).
Kandelia rheedii ***	Diabetes, (B, Fr, L).
Lumnitzera racemosa **	Antifertility, asthma, diabetes, snake bite, (Fr).
Murrayella periclados *	Antibiotic, (B).
Nypa fruiticans ***	Aasthma, diabetes, leprosy, rheumatism, snake bite, (L, Fr).
Pluchea indica **	Fever, (L, R), gangrenous ulcers, (L), rheumatism, scabies, (L, Shoots), Sinusitis, (B, St),.
Oncosperma tigillarius ***	Clinical lesions of skin and genitalia, (B, L, St), fever, (L), piles.
Pongamia pinnata *	Scabies, (L), sinus, (B), skin diseases, stomach pain , rheumatism, (L), and intestinal disorders, (B).
Rhizophora apiculata ***	Antiemetic, antiseptic, diarrhoea, haemostatic, (B), hepatitis, (B, Fl, Fr, L), stops bleeding, typhoid, (B).
Rhizophora lamarckii ***	Hepatitis, (Flowers, L).
Scaevola sericea *	Antiseptic, anti-inflammatory, coughs, diabetes, eye infections, gastrointestinal disorders, headache, stings and bites, (B, L).
Xylocarpus granatum **	Cholera, fever, malaria, (B).

*** Mangroves,** Mangrove Minors ,* Mangrove Associates,
B: Bark, L: Leaves, Fr: Fruits, R: Roots, St: Stems.

Protection of Mangroves:

Mangrove forests are among the most naturally fertile and biologically productive area of the estuarine ecosystem. Mangroves colonize the strip of land between the lowest and highest water levels determined by the changing tides along the sheltered tropical and subtropical wetland ecosystems. Extremely high amounts of fish ad shrimps biomass are to be found in mangrove areas. More than 1145 species of plants and animals were distributed around the world mangroves .The tidal forests provide the human society essential material like fuel, building materials for houses, boats and fishing equipment, honey, sugar, vinegar, and alcoholic drinks, raw materials for household utensils and clothing, tanning agents and traditional medicinal remedies. Mangrove forests will be regarded as a high-value ecosystem such as above sources of these long-term utilization of mangrove is only possible if one takes the ecological, economic and social value of this ecosystem into consideration as most essential for the eco-balance. Although mangroves can be damaged by natural events, human destruction of mangroves has been more common. We suggest that the conservation of mangrove forest habitats not focus on a single environmental "type" and instead protect a range of conditions that are suitable for a variety of mangrove species. Finally, mangroves should be the object of conservation practices, not only for their own sake, but most of all for the purpose of a balanced, sustainable non-degrading type of use of the tropical coastal zone.

Conclusion:

Conventionally, the mangroves are used as fire wood and charcoal and more over used for manufacture of dwellings, furniture, boats and fishing gear and production of tannins for dying and leather production, solitary few species are used traditionally for therapeutic diseases.. These plants require instantaneous consideration for carrying out detailed chemical and pharmacological evaluations. Such investigations can lead to the finding of narrative bioactive compounds to facilitate determination assist to consider the efficiency of herbal remedies. Mangroves are rare and important tropical forest types to generate. They have the ability to grow where no other vascular plants can. Because of their extreme habitats these plants have evolved special methods of survival. Production of unique chemicals may be one such strategy. Marine organisms and plants produce novel metabolites unique to the environment. It is therefore reasonable to assume that the mangrove plants produce metabolites which may in turn be unique to them and are of interest to the 'curious' chemist . Studies of potential commercial importance are needed, focusing on the extraction of tannins and the use of the plants for the production of methanol, acetic acid and coal tar. Secondly, the chemistry of mangrove plants is of growing importance because of their great potentials a source of novel agrochemicals and compounds of medicinal value.

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