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Antimicrobial Properties and Phytochemical Analysis of Some Medicinal Plants: A Review

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Abstract: ***Traditional herbal medicine systemhas a long history and a strong base in preventing and treating different types of human diseases. Plants play a very important role, from the very starting or first part of human existence, human has made to learn or experience themselves with plants and used them in a number of ways. Nature has already provided or endowed us with a variety of plants with immense and great medicinal values which improved human health. India is one of the 12 megadiversity regions of the world. In most parts of the world people stillrely on traditional medicines which are cheap and safe unlike the conventional synthetic drugs. Herbal medicines are used for the treatment of many infectious diseases throughout the history of mankind. The use of herbal crude/raw/natural drugs in large area and their remedies have importantly increased throughout the world. Increased in antibiotic resistance by microorganisms has led to the phytochemical screening of medicinal plants for their antimicrobial activities. However, there is much scope for further/future systematic research in screening Indian medicinal plants for their phytochemicals and estimating their potential in protecting against different types of diseases. Efforts must be made in order to ensure safe, effective and affordable treatments for wide range of diseases by traditional methods which use locally available medicinal plants. The scientific and authentic (real and true) researches on these aspects are to be done in order to make full use of and derived benefits from traditional knowledge of medicinal plants. This review examines the potential uses of medicinal plants for its antimicrobial properties against human pathogens.***

Keywords: Phytochemicals, antimicrobial, medicinal plants, pathogenic microbes, traditional herbal medicines

1. Introduction

Due to excessive use of antibiotics, resistance of pathogenic microbeshas increased a lot. Scientists, therefore are looking to find out new antimicrobial drugs in order to overcome this problem. Many complex phytochemicals are produced by greater number of plants for their defence mechanisms in order to fight unwanted predators, microorganisms, against stress, etc. These phytochemicals include steroid, phenol, tannin, flavonoids, indole, alkaloids, glycosides, carbohydrates, proteins, volatile oil and essential oil. Antimicrobial activity like antibacterial, antiviral, anthelminthic, anticancer and anti - inflammatory property were known to possess by phytochemical terpenoids. Whereas, other phytochemicals like alkaloid, saponin, tannin, flavonoids were also known to have their activity against pathogens and as a result support the antimicrobial activities of medicinal plants. Antifungal and antibacterial properties of glycosides were also informed. Phenols and flavonoids possess antioxidant, anti - allergic and antibacterial properties. Saponins possess anti - inflammatory, antiviral and plant defence activities [1].

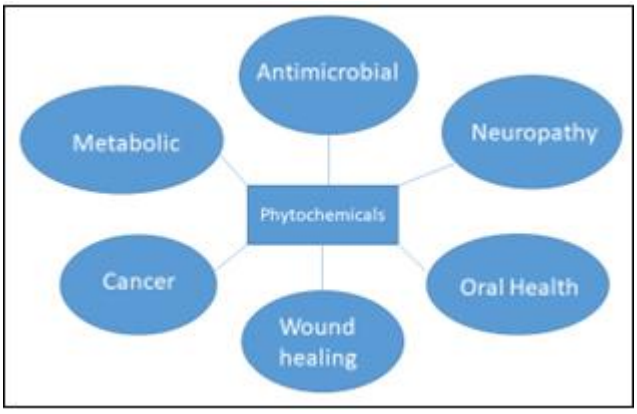

Figure 1: Medicinal properties of phytochemicals.

Nearly 80% of medicinal plants reported from Asia are from forest. And in India, over 70% of medicinal plants are found in tropical forests, while about 30% are found in temperate forests and alpine areas of the Himalayas [2].

The consumers of medicinal plants in Asia and South Asia are ordinary people, particularly rural populations. However, in the recent time there is an increasing demand for manufactured herbal medicines and cosmetics among the urban populations. Export business of botanicals to developed countries is a fast growing business in India and Pakistan, both of which rank high on the list of countries exporting raw ingredients for drugs [3]. The growing trends in the demand for herbal products for common ailments and

for skin/hair care cosmetics show that there will be a significant rise in the coming years [4]. It should be noted that approximately half of India's population i. e, about 500 million people - use twigs of *Azadirachta indica, Acacia nilotica*, the root bark of *Juglans regia* and some other species as toothbrushes every day. In terms of cost, as equivalent to a tube of toothpaste and a toothbrush at 1 USD a month, this works out to 6, 000 USD million per annum. This is several times more than the combined value of all medicinal plant - related exports from the country.

The important and necessary medicinal properties of plants lie in some chemical constituents known as secondary metabolites. In human body these secondary metabolites produced an exact or fixed physiological action against human diseases. In a variety of ways these secondary metabolite/bioactive compounds of plants can be categorized i. e., based on their biosynthetic origin, solubility properties, biosynthetic and the occurrence of some key functional groups [5].

Using plants in a traditional way as herbal medicines are either made by using one plant or by combination of 2 or more plants. The effectiveness of these will depend upon the proper parts of plants used, its biological potency which in turn will depend upon the presence of the required quantity and nature of secondary metabolites in a raw drug [6].

Chandra [7] analysed the antimicrobial potential of *Lagerstroemia indica* and *Annona reticulata* leaf extracts against human bacterial pathogens viz., *Klebsiellapneumoniae, Staphylococcus auerus, Salmonella typhi, Proteus vulgaris* and *Pseudomonas aeruginosa*. The study demonstrated that the selected medicinal plants are potentially good sources of antibacterial against the above mentioned pathogens. The phytochemical screening showed the presence of different types of compounds like terpenoids, tannins, deoxy sugars, saponins, phenolic compounds, and flavonoids which may contribute for the antimicrobial action of the above medicinal plants.

Chowdaiah et al. [8] conducted experiments on effects of phytochemicals against multi - drug resistant (MDR) *Streptococcus mutans* which were isolated from dental plaque sample. Phytochemical extraction from *Myristica fragrans* (nutmeg) seed (MFS) and leaves (MFL), cloves (*Syzigium aromaticam*), *Punica granatum* fruit peel (PGP), *Morus alba* L. plant type I (MLP I) and *M. alba* L. plant type II leaves (MLP II) were done using solvent maceration with methanol, ethanol and water. Extracts were tested for antimicrobial properties against*S. mutans* using antibiotic sensitivity test by agar well diffusion method and then were subjected for screening and identification of active phytochemical groups by chemical tests and high performance thin layer chromatography. In the screening of medicinal plants clove bud, nutmeg seed and pomegranate peel showed effective antimicrobial activity against MDR *S. mutans.*

Olivia et al. [9]worked on a well know medicinal plant, *Hibiscus asper* belonging to family Malvaceae. Phytochemical and GC - MS profiling of aqueous methanolic fraction of these leaves revealed the presence of bioactive compounds like flavonoids, tannin, phenols, saponins, alkaloids, glycosides, terpenoids, and steroids. These phytochemicals may be accountable for curing and treatment of illness, diseases and disorders.

Ingleetal. [10] studied on a species belonging to family euphorbiaceae known as *Jatropha curcas.* Plant extracts were prepared by using solvents such as methanol, aqueous methanol, acetone, ethyl acetate and hexane by using different methods like cold percolation, reflux extraction and warm extraction. They noticed that the extraction produced/acquired from polar solvents (methanol and aqueous methanol) were more as compared to non - polar solvents (ethyl acetate and hexane). Methanol was found to be the best solvent and reflux extraction was observed to give more yield among all the methods. Preliminary phytochemical analysis helps in searching chemical constituents in the plant material that may lead to their quantitative estimation and also in locating the source of pharmacologically active chemical compounds.

Manash et al. [11] studied phytochemical analysis offive native medicinal plants of north east India (Assam) and their antimicrobial activities. *Oldenlandia corymbosa, Ricinus communis, Lpomea aquatica, Xanthium strumarium, Mentha piperita* were analyzed for various phytochemicals present and their antimicrobial activity. The plant extracts were tested for their antimicrobial activity by well diffusion method using Nutrient agar against human pathogenic bacteria like *Staphylococcus aureus* and *Escherichia coli*. *Xanthium strumarium* (leaves, roots) and *Mentha piperita* (stem) were reported to have a strong antimicrobial activity against *Staphylococcus aureus* and the plant extract of *Ricinus communis* (leaves, stem, roots) and *Lpomea aquatica* (stem) had shown antimicrobial activity against *Escherichia coli.*

2. Conclusion

The world is abundant of natural and medicinal plants. In different parts of the country nature has given or presents us with a lot of botanical wealth and with a very large quantity or amount of distinct types of plants. Ancient people were interested in medicinal plants but nowadays, in this modern age people are also becoming more interested in medicinal plants than ever before because they have the ability for producing several advantages to society most often to mankind, particularly in the field of medicine and pharmacological. So, plants play a basis role in primary health care and in treatment of diseases/disorder and illness in traditional way of treatment.

However, herbal medicines are popular in folk culture, the understandings of the phytochemical and the mode of action of plant based medicines are of great importance for the development of safe and effective drugs.

3. Future Prospects

1) Development of pharmaceutical, food, cosmetic and beverage industries with less side effects.
2) Treatment of acute, sub - acute and chronic diseases.

3) Formulation of new medicine with no side effects or very least /minimal /not effects at all. The golden facts are that, use of such medicines treatments is independent of any groups and the sexes.
4) Formulation of new medicine against new type of diseases (for both microbes and non - microbes disease) and most importantly evolution/ development/ progress of new antimicrobial drugs against microbes which are antibiotic resistance and has been globally widespread.
5) Formulations of new cosmetic products with less side effects.
6) Source of foreign exchange.

Table 1: Mechanism of action of some plant compounds against Gram - negative strains

S. No.	Compound	Source	MIC value range	Action mechanism	Reference
1.	Acetone extract	*Hypericum roeperianum* G. W. Schimp ex A. Rich var. *Roeperianum*	0.09 - 0.28mg/ml	Regulation of IL - 7 & stimulation of $CD4^+$ & $CD8^+$ lymphocytes	Mwitwari et al. [12]
2.	Acetone extract	*Cremaspora triflora* (Thonn.) K. Schum	-	Not reported, possibly cell wall related.	Elisha et al. [13]
3.	Acetone extract	*Heracleum maximum* Bart.	-	Not reported, possibly cell wall related.	Elisha et al. [13]
4.	Acetone extract	*Pittosporum viridiflorum* Sims	-	Not reported, possibly cell wall related.	Elisha et al. [13]
5.	Acetone extract	*Bolusanthus speciosus* (H. Bolus), *Calpurnia aurea* (Aiton) Benth ssp. aurea	-	Not reported, possibly cell wall related.	Elisha et al. [13]
6.	Acetone extract	*Maesa lanceolate* Forssk	-	Not reported, possibly cell wall related.	Elisha et al. [13]
7.	Acetone extract	*Elaeodendron croceum* (Thunb.) DC	-	Not reported, possibly cell wall related.	Elisha et al. [13]
8.	Acetone extract	*Morus mesozygia* Stapf ex A. Chev	-	Not reported, possibly cell wall related.	Elisha et al. [13]
9.	Methanolic extract	*Oxalis cornicuate* L.	25 - 100 mg/ml	Polyphenols binding to bacterial proteins inhibiting adhesion & microbial growth.	Mukherjee et al. [14]
10.	Pectin	*Spondias dulcis* Parkinson	5.68 - 44.45 µg/ml	Putative strong oxidizer – generation of high ROS amount (reactive oxygen species).	Ciriminna et al. [15]
11.	Pelargonic Acid	*Solanum lycopersicum* L.	15.62 ± 00 – 31.25 ± 00 mM	Cell membrane damage and lysis	Kumar [16]
12.	Propolis	*Trigona* spp.	0.87%	Several mechanisms: increase in cell membrane permeability; reduction of ATP production; lowering mobility, disturbance of membrane potential; stimulation of host immune system.	Przybylek & Karpinski [17]
13.	Essential oil	*Cinnamomum zeylanicum* Nees.	3.125 – 12.5 µl/ml	Growth inhibition without disintegrating the outer membrane or intracellular ATP depletion.	Nazzaro et al. [18]

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Conflict of Interest: Nil

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