ANTIBACTERIAL ACTIVITY OF SOME INDIAN MEDICINAL PLANT: A REVIEW

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ABSTRACT
In the last few years there has been an exponential growth in the field of herbal medicine and these drugs are gaining popularity both in developing and developed countries because of their natural origin and less side effects. There are a growing number of studies reporting antimicrobial activity with traditional medicine. The present review constitutes on plant with antimicrobial activity with some recently isolated phytoconstituents from this plants. The information is recorded in alphabetical order of plant scientific name, family, part used, method used (pharmacological screening method) and references. We also collect the information on isolated phytoconstituents and mechanism of action of constituents.

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1. INTRODUCTION:

Infectious diseases are the world's leading cause of premature deaths, killing almost 50,000 people every day. In recent years, drug resistance to human pathogenic bacteria has been commonly reported from all over the world [1, 2]. The drug resistant bacteria and fungal pathogens have further complicated the treatment of infectious diseases. In the present scenario of emergence of multiple drug resistance to human pathogenic organisms, this has necessitated a search for new antimicrobial substances from other sources including plants.

When we look back upon the last 2000 years of the history of medicine we can see that for most of this period, mankind had no other source of medicine than plants, either fresh or dried. The World Health Organization (WHO) estimates that about 80% of the population living in the developing countries relies almost exclusively on traditional medicine for their primary health care needs. In almost all the traditional medicine, the medicinal plants play a major role and constitute the backbone of the traditional medicine. Indian materia medica includes about 2000 drugs of natural origin almost all of which are derived from different traditional system and folklore practices [3]. India has an ancient heritage of traditional medicine. Indian traditional medicine is based on various system including Ayurveda, Siddha and Unani. The evaluation of these drugs is mostly based on phytochemical, pharmacological, and allied approaches of including various instrumental techniques like chromatography, microscopy, and others. Over 248,000 species of higher plants have been identified and from these 12,000 plants are known to have medicinal properties. However, less than 10% of all plants have been investigated from a phytochemical and/or pharmacological point of view [4].

Herbal medicines were prepared from a variety of plant materials like leaves, stem, roots, and bark. They usually contain many biologically active ingredients and are used primarily for treating mild or chronic ailments. Traditionally herbal medicines provide an interesting, largely unexplored source of potential new drugs. It is of great interest to know whether plants used in folk medicines have potential effect in curing human ailments hence in the present study an attempt was made to review Indian medicinal plants for antimicrobial activity. The aim of this review article was to review the antimicrobial activity of some Indian medicinal plant used in Ayurveda and traditional system of medicine for treatment of diseases caused by microorganisms.
2. **Materials and Methods:**

In this review we collected information from the Chemical abstracts, National & International journals, E-library, Internet & other research materials. The plants selections were based on the effects of phytoconstituents presented in specific animal models for evaluation of Antimicrobial activity.

3. **Medicinal plants with Antimicrobial activity:**

Number of plants species had been reported as antimicrobial activity like *Justicia zelanica, Phyllanthus urinaria, Thevetia nerifolia, Acacia leucophloea, Solanum surattense, Tephrosia purpurea, Jatropha gossypifolia, Pithecolobium dulce, Holoptelea integrifolia, Lantana camara, Saraca asoca, Tamarindus indica, Aegle marmelos, Acacia nilotica, Woodfordia fruticosa, Mangifera indica, Phyllanthus emblica, Chlorophytm borivilianum, Chlorophytm laxum, Chlorophytm tuberosum, Abutilon indicum, Bombax ceiba, Calotropis procera and Bacopa monnieri* and some other plants are described in table no.1 [5-12].

4. **ANTIMICROBIAL ACTIVITY MECHANISMS OF NATURAL PRODUCTS**

Most plants contain several compounds with antimicrobial properties for protection against aggressor agents, especially microorganisms.

Active compounds found in some plants have antiseptic action; for example, thyme has thymol and carvacrol and clove has eugenol and isoeugenol. In some cases, terpenes from essences that are soluble in water have higher antibacterial power than others [13]. The sites or structures of the bacterial cell that are considered targets for action by the components of natural products are illustrated. The action mechanisms of natural compounds are related to disintegration of cytoplasmic membrane, destabilization of the proton motive force (PMF), electron flow, active transport and coagulation of the cell content. Not all action mechanisms work on specific targets, and some sites may be affected due to other mechanisms [14]. Important characteristics responsible for the antimicrobial action of essential oils include hydrophobic components that allow the participation of lipids from the bacterial cell membrane, which disturbs cell structures and make them more permeable [15].
<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Plant Name</th>
<th>Family</th>
<th>Part Used/ Extract used</th>
<th>Method used</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Aloe vera</td>
<td>Apiaceae</td>
<td>Leaves, Bulb</td>
<td>Lowenstein Jensen (L-J) medium and colorimetric BacT/ALERT 3D system.</td>
</tr>
<tr>
<td>2</td>
<td>Anethum graveolens</td>
<td>Apiaceae</td>
<td>Leaf Aq</td>
<td>Agar Diffusion Method</td>
</tr>
<tr>
<td>3</td>
<td>Annona squamosa</td>
<td>Annonaceae</td>
<td>Seeds Aq, Et</td>
<td>Agar Diffusion Method</td>
</tr>
<tr>
<td>4</td>
<td>Asparagus racemosus</td>
<td>Liliaceae</td>
<td>Leaf Aq</td>
<td>Agar Diffusion Method</td>
</tr>
<tr>
<td>5</td>
<td>Betula utilis</td>
<td>Betulaceae</td>
<td>Bark</td>
<td>Agar well diffusion method</td>
</tr>
<tr>
<td>6</td>
<td>Carica papaya</td>
<td>Caricaceae</td>
<td>Leaf Aq</td>
<td>Agar Diffusion Method</td>
</tr>
<tr>
<td>7</td>
<td>Calotropis gigantea</td>
<td>Apocynaceae</td>
<td>Latex</td>
<td>Disc Diffusion Method</td>
</tr>
<tr>
<td>8</td>
<td>Commelina benghalensis</td>
<td>Commelinaceae</td>
<td>Leaf Aq</td>
<td>Agar Diffusion Method</td>
</tr>
<tr>
<td>9</td>
<td>Commiphora wightii</td>
<td>Burseraceae</td>
<td>Stem Aq</td>
<td>Agar Diffusion Method</td>
</tr>
<tr>
<td>10</td>
<td>Ficus benghalensis</td>
<td>Moraceae</td>
<td>Bark Aq</td>
<td>Agar Diffusion Method</td>
</tr>
<tr>
<td>11</td>
<td>Ficus racemosa</td>
<td>Moraceae</td>
<td>Bark Aq</td>
<td>Agar Diffusion Method</td>
</tr>
<tr>
<td>12</td>
<td>Ficus religiosa</td>
<td>Moraceae</td>
<td>Bark Aq</td>
<td>Agar Diffusion Method</td>
</tr>
<tr>
<td>13</td>
<td>Ficus lesila</td>
<td>Moraceae</td>
<td>Bark Aq</td>
<td>Agar Diffusion Method</td>
</tr>
<tr>
<td>14</td>
<td>Jatropha curcas</td>
<td>Euphorbiaceae</td>
<td>Stem Bark</td>
<td>Agar well diffusion method</td>
</tr>
<tr>
<td>15</td>
<td>Lantana Indica</td>
<td>Verbenaceae</td>
<td>Leaves</td>
<td>Agar Diffusion Method</td>
</tr>
<tr>
<td>16</td>
<td>Parthenium hysterophorus</td>
<td>Compositeae</td>
<td>Leaf Aq</td>
<td>Agar Diffusion Method</td>
</tr>
<tr>
<td>17</td>
<td>Pnuica granatum</td>
<td>Punicaceae</td>
<td>Leaf Aq</td>
<td>Agar Diffusion Method</td>
</tr>
<tr>
<td>18</td>
<td>Ocimum sanctum</td>
<td>Labiateae</td>
<td>Leaf Aq</td>
<td>Agar Diffusion Method</td>
</tr>
<tr>
<td>19</td>
<td>Woodfordia fruticosa</td>
<td>Lythraceae</td>
<td>Stems</td>
<td>Disc Diffusion Method</td>
</tr>
</tbody>
</table>
Chemical compounds from essential oils also act on cytoplasmic membrane proteins [13]. Cyclic hydrocarbons act on ATPases, enzymes known to be located at the cytoplasmic membrane and surrounded by lipid molecules. In addition, lipid hydrocarbons may distort the lipid-protein interaction, and the direct interaction of lipophilic compounds with hydrophobic parts of the protein is also possible [16]. Some essential oils stimulate the growth of pseudo-mycelia, evidencing that they may act on enzymes involved in the synthesis of bacterium structural components [17].

**Several compounds and their mechanisms of action on microorganisms are listed below:**

**Carvacrol and thymol**

The structure of thymol is similar to that of carvacrol; however, they differ as to the location of the hydroxyl group in the phenolic ring. Both substances seem to make the membrane permeable [18]. Their structure disintegrates the external membrane of gram-negative bacteria, releasing lipopolysaccharides (LPS) and increasing the permeability of the cytoplasmic membrane to ATP. The presence of magnesium chloride does not influence this action, suggesting a chelating mechanism of different cations on the external membrane[19].

**Eugenol**

Different concentrations of eugenol may inhibit the production of amylase and protease by *B. cereus*. Furthermore, cell wall degradation and cell lysis were also reported [20].

**p-Cymene**

A precursor of carvacrol, this hydrophobic compound provokes greater swelling of the cytoplasmic membrane compared to carvacrol [21].

**Carvone**

When tested at concentrations higher than its minimum inhibitory concentration, carvone dissipates gradient pH and cell membrane potential. The growth of *E. coli*, *Streptococcus thermophilus* and *Lactococcus lactis* may decrease according to the concentrations of carvone, suggesting that it acts by disturbing the general metabolic status of the cell [22].

**Cinnamaldehyde**

Cinnamaldehyde is known to inhibit *E. coli* and *Salmonella* Typhimurium growth at concentrations similar to those of carvacrol and thymol. However, it neither disintegrates the outer membrane nor weakens the intracellular ATP. Its carbonyl group has affinity for proteins, preventing the action of decarboxylase amino acids on *E. aerogenes* [23].
Results and Discussion:
The antimicrobial activity of plants was proven by various examples, in the form of both essential oils and extracts. Thus, this property can be a promisingly in the development of medicines necessary to combat the increasing number of bacterial strains that become resistant to conventional antibiotics. Therefore, given that the literature on tests for the antimicrobial action of plant products is broad, including an increasing number of publications per year, it is highly difficult to relate the countless reports on the antimicrobial action of these products in this review article about a subject of such a great complexity, which requires a multidisciplinary approach constitute a potential source for the production of new medicines and may enhance the effects of conventional antimicrobials, which will probably decrease costs and improve the treatment quality. However, several plants may present antagonistic effects during antibiotic therapy.

An important aspect comprises the search for new compounds that have antimicrobial action and synergism with currently available antimicrobial drugs, since bacteria resistant to conventional medicines are increasingly frequent; consequently, medicinal plants constitute an alternative for infection treatment [24].

Current world-wide interest in traditional medicine has led to rapid development and studies of many remedies employed by various ethnic groups of the world. The information is recorded in alphabetical order of plant scientific name, family, part used and method (table no. 1). The principal families in which such activity has been reported are Apiaceae, Annonaceae, Liliaceae, Caricaceae, Commelinaceae, Burseraceae, Fabaceae, Euphorbiaceae, Moraceae, Malvaceae, Compositeae, Annonaceae, Punicaceae, Labiateae, Rhamnaceae. Several phytoconstituents including Carvacrol and thymol, Eugenol, p-Cymene, Carvone, Cinnamaldehyde, and others obtained from various plant species have proven antibacterial activity.

Conclusion:
In conclusion all the plant species listed and some phytoconstituents described appear to be promising as antimicrobial activity with activity mediated through various mechanisms. However, further experiments will possibly define this pharmacological effect and active phytoconstituents. If confirmed it, may become of importance for human clinical treatments.
REFERENCES:


