

SOME MEDICINAL PLANTS WITH ANTIBACTERIAL ACTIVITY

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ABSTRACT

Bacterial infections are one of the prominent causes of health problems, physical disabilities and mortalities around the world. Symptoms and complications associated with bacterial infections such as fever, chills, headache, nausea, vomiting and organ failures affect patient's life severely. Medicinal plants are a rich source of antimicrobial agents and provide a safer and cost effective way of treating bacterial infections. This article describes the antibacterial properties of *Cassia fistula*, *Acacia aroma*, *Azadirachta indica*, *Ziziphora clinopodioides*, *Argemone mexicana*, *Nephelium lappaceum*, *Punica granatum*, *Phyllanthus discoideus*, *Curcuma amada*, *Embllica officinalis* & *Nymphae odorata* and *Mallotus peltatus*. A review of some patents on herbal products for the treatment of bacterial diseases is provided that highlights the recent technical advancements that have taken place in this area.

Keywords: Bacteria, infection, medicinal plant, extract, patent.

INTRODUCTION

Infectious diseases are disorders caused by pathogenic microorganisms like bacteria, viruses, fungi, protozoa and multicellular parasites. These diseases are also called as communicable or transmissible diseases since they can be transmitted from one person to another via a vector or replicating agent. Infectious diseases account for about half of the deaths in tropical countries.¹ Bacterial diseases are a type of infectious diseases caused by pathogenic bacteria. It is notable that majority of bacteria are non pathogenic and are not harmful to human health. Some bacteria are even helpful and necessary for the good health. Millions of bacteria normally live in the intestine, on the skin and the genitalia. Bacterial diseases results when the harmful bacteria get into a body area, multiply their and thrash the body's defensive mechanism.

Pathogenic bacteria can invade in the body through various routes like inhalation into nose and lungs, ingestion in food or through sexual contact. Once bacteria enter the body, the immune system of the body recognizes the bacteria as foreign intruder and tries to kill or stop them from multiplying. However, even a healthy immune system is not always able to stop the bacteria from reproducing and spreading. As a result bacteria thrive in the body and emit toxins which damage cells and tissues that consequently results in the symptoms of bacterial disease.

Commonly occurring pathogenic bacteria are *Neisseria meningitidis*, which can cause meningitis, *Streptococcus pneumoniae*, which can cause pneumonia, *Helicobacter pylori*, which can cause gastric ulcers, *Escherichia coli* which can cause food poisoning, *Salmonella typhi*, which can cause typhoid, and *Staphylococcus aureus*, which can

cause skin and other infections.²

SYMPTOMS, COMPLICATIONS AND RISK FACTORS OF BACTERIAL DISEASES

General symptoms of bacterial diseases include fever, chills, headache, nausea and vomiting. Bacterial infections if untreated can lead to serious and life threatening complications such as sepsis, kidney and liver failure, toxic shock and even death. Infectious diseases are a leading cause of mortality worldwide.³

People who work in health centers, hospitals and pathology labs remain at a risk of bacterial infections since they have a significant exposure to pathogenic bacteria, such as *Neisseria meningitidis* or *Streptococcus pneumoniae*. Patients having compromised immune system due to diseases such as AIDS are at a high risk of bacterial diseases. People who take drugs such as corticosteroids, which suppress body's natural immunity, are also at risk of developing bacterial diseases. Other risk factors include malnutrition, high stress, genetic predisposition to bacterial infections.

SOME MEDICINAL PLANTS USEFUL IN TREATING BACTERIAL DISEASES

Antibiotic resistance has become a global concern in recent years. This problem is of great significance especially in developing countries because infectious diseases are one of the major causes of mortality in these countries.

Medicinal plants have been found useful in the cure of a number of diseases including bacterial diseases. Medicinal plants are a rich source of antimicrobial agents.⁴ Due to a rapid increase in the rate of infections, antibiotic resistance in microorganisms and due to side effects of synthetic antibiotics, medicinal plants are gaining popularity over these drugs.⁵ Although medicinal plants produce slow recovery, the therapeutic use of medicinal

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plant is becoming popular because of their lesser side effects and low resistance in microorganisms.⁶

Antimicrobial activities of many plants have been reported by the researchers. The antimicrobial activities of medicinal plants can be attributed to the secondary metabolites such as alkaloids, flavonoids, tannins, terpenoids etc. that are present in these plants.⁷ Recent studies with significant findings in this area involving *Cassia fistula*, *Acacia aroma*, *Azadirachta indica*, *Ziziphora clinopodioides*, *Argemone mexicana*, *Nephelium lappaceum*, *Punica granatum*, *Phyllanthus discoideus*, *Curcuma amada*, *Embllica officinalis* & *Nymphae odorata* and *Mallotus peltatus* are emphasized here.

***Cassia fistula*:** Antibacterial and antifungal activities of the flowers of *C. fistula* were examined. Hexane, chloroform, ethyl acetate, methanol and water extracts of the *Cassia fistula* flowers were prepared and tested for this purpose.⁸ All of these extracts showed antibacterial activity against Gram-positive organisms at an MIC (Minimum Inhibitory Concentrations) between 0.078 and 2.5 mg/ml. Among the Gram-negative bacteria, only *Pseudomonas aeruginosa* was found susceptible to the extracts.

***Acacia aroma*:** Seven ethanolic extracts and three aqueous extracts of *A. aroma* were investigated against 163 strains of antibiotic multi-resistant bacteria.⁹ Extracts of *Acacia aroma* were obtained from the leaves, stems and flowers of the plant. To evaluate antibacterial activity of the extracts the disc diffusion assay was performed against several Gram-positive and Gram-negative bacteria. All ethanolic extracts were found active against gram-positive bacteria but among all the extracts only leaf and flower extracts showed activity against Gram-negative bacteria.

***Azadirachta indica*:** Methanolic extract of *A. indica* (neem) leaves was tested for its antibacterial, antisecretory and antihemorrhagic activity against *Vibrio cholera*.¹⁰ The extract of *Azadirachta indica* showed significant antibacterial activity against the multi drug resistant *V. cholerae*. Neem extract showed antisecretory activity on *V. cholerae* induced fluid secretion in mouse intestine and upon oral administration the extract inhibited hemorrhage induced by *V. cholerae* in mouse intestine.

***Ziziphora clinopodioides*:** The essential oil and methanolic extract obtained from aerial parts of *Z. clinopodioides* were evaluated for their chemical composition and antibacterial activity against 52 Gram-positive and Gram-negative bacteria.¹¹ Maximum activity of essential oil and methanol extract was observed against *Acidovorax facilis*, *Bacillus flexus*, *Bacillus spp*, *Bacillus sphaericus*, *Brevibacillus brevis*, *Corynebacterium ammoniagenes*, *Enterobacter sakazakii*, *Erwinia carotovora carotovora*, *Moraxella catarrhalis* and *Xanthomonas arboricola*.

***Argemone Mexicana*:** The column chromatographic fractions of chloroform seed extracts of *A. mexicana* were screened for antibacterial activity and phytochemical analysis.¹² The active fraction showed significant activity against *Staphylococcus aureus*, *Escherichia coli*, *Klebsiella pneumoniae* and *Pseudomonas aeruginosa* with minimum inhibitory concentration of 1.5625 to 3.125 mg/ml.

***Nephelium lappaceum*:** Ether, methanolic and aqueous extracts of the seeds of *N. lappaceum* (rambutan) were

evaluated for their antibacterial activity.¹³ The activity was assessed by disc diffusion and broth macro dilution methods against eight bacterial strains. All the extracts of *Nephelium lappaceum* exhibited antibacterial activity against five pathogenic bacteria. The MIC of the methanolic extract for the most sensitive strain *S. epidermidis* was found to be 2.0 mg/ml.

***Punica granatum*:** Antibacterial, anti-inflammatory and anti-allergic activities of standardized *P. granatum* (pomegranate) rind extract containing 13% w/w ellagic acid were studied by *in vitro* method.¹⁴ The antibacterial activity of the extract of *Punica granatum* was determined by the disc diffusion and broth micro dilution methods. A potent bacteriostatic effect against *P. acnes* (at MIC 15.6 µg/ml) and against *S. aureus* and *S. epidermidis* (at MICs 7.8–15.6 µg/ml) was observed.

***Phyllanthus discoideus*:** Lyophilized aqueous extract of *P. discoideus* leaves was found to show antibacterial activity.¹⁵ The alkaloid fraction of the extract of *Phyllanthus discoideus* inhibited the growth of *E. coli*, *E. faecium*, *P. aeruginosa*, *S. aureus* and *M. smegmatis*. Among the alkaloids identified, viroallosecurinine and securinine alkaloids showed higher activity.

***Curcuma amada*:** The chloroform extract of *C. amada* (mango ginger) rhizome was examined for its antibacterial activity.¹⁶ In the study a novel compound "Amadannulen" was identified and isolated from the *Curcuma amada* extract. Amadannulen showed antibacterial activity against both Gram-positive and Gram-negative bacteria. It also exhibited bactericidal activity against *M. luteus*, *B. cereus* and *B. subtilis* bacteria.

***Embllica officinalis* and *Nymphae odorata*:** Antibacterial activity of the combined extracts of *E. officinalis* seeds and *N. odorata* stamen was evaluated.¹⁷ The activity was determined against *S. aureus* by the agar diffusion method. It was concluded that these extract exhibit a synergistic antibacterial action.

***Mallotus peltatus*:** The crude methanolic extract of *M. peltatus* leaves was found to be active against *S. aureus*, *S. saprophyticus*, *S. faecalis*, *B. subtilis*, *E. coli* and *P. mirabilis* and the dermatophytic fungi *M. gypseum*.¹⁸ The methanol-water fraction of the extract showed similar activity against *Staphylococcus*, *Streptococcus*, *Bacillus* and *P. isolates*.

SOME PATENTS ON HERBAL PRODUCTS FOR TREATING BACTERIAL DISEASES

Patents provide latest technical information to us. A review of some patents that relate with the use of medicinal plants in the treatment of bacterial diseases is presented here. This review provides an insight on the recent technological advances that have taken place in the area of herbal antibacterial therapy.

External preparation composition: An external preparation composition containing *Ratanhia* extract and/or Ratanhiaphenol (one of ingredients in *Ratanhia*) as the main active component was patented.¹⁹ The composition was found useful in the treatment of bacterial and fungal skin diseases. The composition can be formulated as lotions, ointments, suppositories, solid face washes, liquid face washes, creamy face washes, cataplasms, plasters etc.

Bacteriostatic and antibacterial agent containing mango kernel component: Herbal compositions

comprising ethanol, methanol, isopropanol and diethyl sulfoxide extracts of mango kernels were developed.²⁰ The composition exhibits bacteriostatic and antibacterial properties. The extract was effectively used in the preparation of many food and cosmetic products such as creamed corn gratin, thick backed omelet, potato salad, chewing gum, ice cream, mouthwash and toothpaste for preventing dental caries, and bathing agent, soap and emulsion for preventing and treating acne.

Pharmaceutical compositions and method of using the same: A pharmaceutical composition comprising an extract or combination of extracts having an antiviral, antibacterial, or immunomodulating property was developed.²¹ One of such composition contains a combination of extracts of *Radix scutellaria*, *Flos lonicera* and *Fructus forsythiae*. Further, the patent also describes a process for preparing a purified extract of these plants.

Antibacterial and anti-inflammatory compositions with *Inula helenium* extract and water soluble chitosan: A pharmaceutical composition comprising water soluble chitosan and an ethanolic extract of *Inula helenium* (elecampane) roots was patented.²² This composition demonstrated improved antibacterial and anti-inflammatory properties and can be effectively used as food, cosmetics and medicine.

Antibacterial composition having xanthorrhizol: An antibacterial composition containing xanthorrhizol is provided. Xanthorrhizol is obtained from the crude extract of *Curcuma xanthorrhiza*.²³ The composition can be formulated in a wide range of dosage forms including tablet, capsule, soft gelatin capsule, solution, ointment, plaster, granule, lotion, aerosol, suppository, cataplasma, cream, troche, paste, pill and injection.

Antibacterial and antiviral curcuma rhizome CO₂ supercritical extract and method for preparing the same: It was experimentally demonstrated that CO₂ supercritical extract of curcuma rhizome effectively inhibits the growth of *S. aureus* bacteria.²⁴ The extract was found efficient in the treatment of *S. aureus* and type-A influenza virus infected mice. A method of preparing CO₂ supercritical extract of curcuma rhizome is provided in the patent.

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Green tea mouth wash and method of preparation thereof: A mouth wash that contains green tea extract, ethanol, vitamin B₁₂, sodium carbonate, Tween-100, sweetener and deionized water was developed.²⁵ The mouth wash is a diluted, light green and transparent preparation. It was found useful in the dental problems like periodontitis and bleeding gums.

Antibacterial extract: An extract was prepared from the root bark of *Morus australis* for the use as an antibacterial agent.²⁶ The extract contains kuwanon H and sanggenon G as the active compounds. The extract was found useful against *S. aureus* or *S. pneumonia* bacteria.

A Process for the Preparation of Trifla-Gugal Extract: A new process for the preparation and purification of Trifla-gugal extract useful for antibacterial agent, antiseptic and wound healing was provided.²⁷ The Trifla-gugal extract can be used both locally and orally for the treatment of severe bacterial infection of wounds and injuries.

Herbal formulation for treatment of haemorrhoid and the process for preparation thereof: A novel herbal composition for the treatment of haemorrhoid capable of also being used as intoxicant, antibacterial, antimicrobial and laxative agent was developed.²⁸ The herbal composition contains the extracts of *Balsamodendron mukul*, *Bamboo camphor*, *Embelia ribes*, *Terminalia chebula*, *Embelia ribes* and *Term in alia bellerica*. The composition also contains vitamins, amino acids and long chain fatty acids.

CONCLUSION

Many medicinal plants have been found effective in the cure of bacterial diseases. Due to increasing antibiotic resistance in microorganisms and side effects of synthetic antibiotics medicinal plants are now gaining popularity in the treatment of bacterial infections. Medicinal plants are considered as clinically effective and safer alternatives to the synthetic antibiotics. Extensive research in the area of isolation and characterization of the active principles of these plants are required so that better, safer and cost effective drugs for treating bacterial infections can be developed.

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