

Medicinal plants and their antimicrobial activity

[Science](#), [Biology](#)



INTRODUCTION

During the centuries that have gone by, the indigenous systems of medicine has become extensive and heterogeneous. Out of about 2, 000 items recorded in medical literature, less than 200 are of mineral and animal origin the rest are derived from herbal sources. The herbal material has been built up in the course of centuries and every region of world has contributed to its development.

Traditional medicinal methods are playing vital role in covering the basic health needs in many of the developing countries. The medicinal plants are providing the source for the development of new anti-infective drugs. Due to the antibacterial and antifungal activities of these plants researchers are interested to carry out the antimicrobial screening of these plants to reveal their active constituents.

Many herbal drugs are used in preparations prescribed by practitioners of indigenous medicine in different regions others are used as household remedies by common people. Spices are shown to possess healthful worth and they especially have worth in antimicrobial activity. The plant parts which are constitute of the spices contain essential oil and other chemicals which give them fragrant, aromatic, pungent, bitter or other properties of aroma and taste. The aroma and flavoring properties of spices are attributed mainly to their essential oil content and composition. Synthetic medicines though used largely in modern world, have been found to be associated with different side effects. By observing adverse drug reactions of synthesized chemical medications, efforts are currently being made to look for the

products of natural origin. The frequency of the resistant bacteria and the number of drugs to which they are resistant is increasing at an unpredictable rate and has begun to compromise the efficient treatment of the patients. Because of these cases the herbal medicines are thought to be better alternatives, many of the pharmaceutical industries are depending on spices and herbs for the preparation of different medicines.

It is considered that about 80% of the world population need herbal medicines because they are considered as safe and have much effect on pathogens.

Aspergillus flavus, *Clostridium botulinum*, *Staphylococcus aureus*, *Salmonella typhimurium* are considered as food pathogens, spices which contain essential oils have bactericidal activity against these pathogens. Several spices are studied and it is found that some of the spices also have antilisteric activity which prevents from listeria and those spices are commonly used in industries. *Aspergillus flavus* produces aflatoxin which can be responsible for acute hepatitis, immunosuppression and hepatocellular carcinoma whereas another fungus named as *Aspergillus niger*, if it is inhaled with large amount of spores then it can cause serious lung disease, aspergillosis and fungal ear infections so several spices are available which can be used as antifungal and can inhibit the growth of fungi.

Spices have different medicinal properties. Some spices are beneficial in cases of colic, for the alleviation of coughs and pharynx complaints, for chest trouble. They are also helpful in cases of gastritis and dyspepsia. Some spices have value in treating rheumatism, neuralgia, bronchitis. The

antiseptic properties of clove and thyme have a place in mouth washes and throat sprays. Garlic, mustard, cinnamon, ginger, onion and cloves have high rate of antimicrobial activity as they are most studied spices and the components present in them which have antimicrobial activity are known. Ginger is thought to be useful in cancer treatment and as well as in treatment of nervous system disorders. The spices which are most commonly used in medicines are clove, ginger, garlic, turmeric, coriander seeds, mint, onion, thyme.

HISTORY OF MEDICINAL PLANTS:

Plant oils and extracts have been used for wide variety of purposes for about many thousands of years some of the uses of plants are like they were used in drinks for flavoring them like lime, fennel or juniper were used in drinks, rosewood and cedar wood were used in perfumes.

In 200 BC, Chinese used spices to refresh their breath when they have to speak with the emperor for maintaining their good image and also to remove off odor. The extracts and essential oils have secret constituents that help in inhibiting the microbial growth and prevent their activities.

Hippocrates in the late fifth century B. C. mentioned 300 to 400 medicinal plants. In the first century A. D. Dioscorides wrote *De Materia Medica*, a medicinal plant catalog which became the model for modern book of collection of drugs. The Bible offers descriptions of approximately 30 healing plants. Frankincense and myrrh both have the status of great worth due to their medicinal properties. It is also reported that they have antiseptic properties and they were even employed as mouthwashes. During the dark

ages the Arab and Asian cultures were busy in compiling their ancient medicine whereas in the West the golden age of the history saw revival of ancient medicine, which was largely composed of medicinal plants.

MEDICINAL PLANTS AND ANTIMICROBIAL ACTIVITY:

A great shift has been observed from the prescription of antibiotics to the medicinal plants. About 250, 000 to 500, 000 plants are used as medicinal plants. From the ancient past man has used medicinal plants for treatment of several common infectious diseases and some of them are still used as part of treatment of various diseases. For example the bearberry (*Arctostaphylos uva-ursi*) and cranberry (*Vaccinium macrocarpon*) juice are used to treat urinary tract infections whereas garlic (*Allium sativum*) and tea tree (*Melaleuca alternifolia*) are used as broad-spectrum antimicrobial agents. The essential oils and extracts of these plants are used for treatment of infectious diseases but rather than the extracts, essential oils have greater use in treatment of infectious diseases of respiratory system, urinary tract system, gastrointestinal and biliary system and sometimes also use for skin treatment like for acne and other skin problems. Another medicinal plant which is generally found in Africa is *Alchornea cordifolia*. It is used as an important plant medicine for treatment of pain, rheumatism, arthritis, piles, toothache, inflammatory diseases, it is also used to treat sexually transmitted diseases like gonorrhoea and syphilis. Studies also suggest that lime (*Citrus aurantifolia*) juice and various combination of lime juice can also have greater effect on several bacterial species.

Generally the mechanism of essential oils that how it works against microbes is unclear. It is also thought that antimicrobial activity of essential oils is

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dependent on several factors like complexity of essential oils, its ability of vaporization, their insolubility in water.

The chemical named as phenolics are the most dominant chemicals found in these plants and several studies have revealed that gram positive bacteria are most sensitive to these chemicals. Other than phenolics some other antimicrobial compounds are also present in medicinal plants such as polyphenols, quinones, tannins, flavones, flavonoids and flavonols. In most of the cases all of these antimicrobial compounds provide defense mechanism to plants against predation of microbes, insects etc.

PHENOLICS AND POLYPHENOLS:

Some of the best bioactive phytochemicals carries with it a single substituted phenolic ring. Cinnamic and caffeic acids are common representatives of huge group of phenylpropane derived compounds that are within the highest oxidation number. The common herbs tarragon and thyme both of them contain caffeic acid, which is thought to be very effective against viruses, bacteria, and fungi.

QUINONES:

Quinones are aromatic rings with two ketone substitutions. They are ubiquitous in nature. They have a characteristic property that they are highly reactive. These compounds are responsible for the browning in cut or injured fruits and vegetables and are an intermediate in the melanin synthesis pathway in human skin.

TANNINS:

It is a general name for a group of polymeric phenolic substances capable of tanning leather or used in precipitating gelatin from solution. It was thought that the consumption of tannin containing beverages, especially green teas and red wines, can cure or prevent a variety of diseases.

FLAVONES, FLAVONOIDS AND FLAVONOLS:

Flavones are phenolic structures containing one carbonyl group. The addition of a 3-hydroxyl group yields a flavonol. Flavonoids are also hydroxylated phenolic substances but occur as C6-C3 unit linked to an aromatic ring. Since they're notable to be synthesized by plants against micro-organism infection, it should not be surprising that they have been found in vitro to be effective antimicrobial substances against a wide variety of micro-organisms.

Extensive researches have been done on flavonoids because of their occurrence in green tea. It was observed some time ago that tea has antimicrobial activity. Flavonoid compounds exhibit inhibitory effects against multiple viruses.

Clinical microbiologists are interested in the topic of antimicrobial plant extracts because of the two main reasons which are; firstly, it is very likely that these phytochemicals will find their way into the arsenal of antimicrobial drugs prescribed by physicians and secondly, the public is becoming increasingly aware of problems with the over prescription and misuse of traditional antibiotics. In addition, many people are interested in having more autonomy over their medical care. A lot of plant items are promptly accessible on the counter from home grown providers and characteristic

nourishment stores and self-prescription with these substances is basic with no symptoms.

ANTIBACTERIAL AND ANTIFUNGAL ACTIVITY OF SPICES:

The contamination of food by micro-organisms may result in food spoilage and may lead to food borne diseases. The increasing rate of multi drug resistant and disinfectant resistant bacteria like *Staphylococcus aureus*, *Escherichia coli*, *Pseudomonas aeruginosa* are likely to cause severe diseases in human which can also result in death. The resistivity of micro-organisms are also increasing because of use of chemicals like weak acids which are used for increasing shelf life of food and to prevent them from spoilage but, along with increase shelf life of food and spoilage prevention it is also making many of the pathogenic microbes resistant to weak acids. Along with antibacterial activity the spices like clove, thyme, cinnamon, and oregano also have antifungal activity. These spices efficiently work against *Aspergillus flavus* which is considered to be the most harmful fungi.

The enterohemorrhagic *E. coli* O15: H7 is responsible for large number of food borne disease outbreaks in various parts of the world in which the developing countries are also included. *Aeromonas* spp. which is ubiquitous in the aquatic environment also have broad host range and is associated with causing diarrhoea in humans.

In Turkey, the Turkish people defined spice as the mixture of natural compounds which are extracted from the seeds, fruits, flowers, root and leaves of plants. Generally spices are used as the substances which increases the taste and flavor of food whereas spices also have bactericidal

and bacteriostatic characteristics. Gram negative bacteria are generally considered more resistant as compare to gram positive bacteria. The essential oils which are present in cinnamon and clove named as carvacrol and eugenol are thought to have very strong antimicrobial activity whereas cumin seeds and red pepper have weak antimicrobial activity.

SPICES AND FOOD PRESERVATION:

The food products which have been introduced in the markets nearly on daily basis, they require longer shelf and also require protection from pathogenic microbes which may spoil food products so for this purpose several different types of additives are added to protect them from microbes and also for enhancing their shelf lives but there are also some disadvantages of these chemicals so by looking at these problems alternative way is suggested which is that instead of using chemicals one can also use spices and plants because spices and plants have antimicrobial activity which can inhibit the growth of pathogenic microbes and they also do not have any kind of disadvantage and side effects.

ANTIMICROBIAL ACTIVITY OF BLACK PEPPER:

Black pepper belongs to Piperaceae family. Black pepper is considered as a fruit which is dried and is used as seasoning and also as spice. When it is dried it is also called as “Peppercorns”. It is commonly known as “King of spice”. Black pepper is largely used as flavoring agent in foods. In Asian countries pepper commonly used is cooking recipes and also used in traditional medicinal systems like it is used in carminative mixture it is also use for treatment of antiseptic diuretics, cough, leprosy and melanoderma because of the substances present in it. The piperamides present in black

pepper are responsible for its spicy taste and it is present in the skin and seeds of the fruit. Little bit of bitter taste which is present in black pepper is due to the presence of piperine which is the major chemical constituent present in it. The extract of black pepper inhibits the growth of *Aspergillus niger*, *Candida albicans*, *Saccharomyces cerevisiae*, *Pseudomonas aeruginosa* and *Bacillus subtilis*.

The medicinal uses of black pepper include, it is used as antibacterial, antifungal, antiapoptotic, antidepressant, antidiarrheal, anti-inflammatory, antimutagenic, antioxidative, antipyretic, antispasmodic, antitumor, to improve appetite and digestive power, anti-cold, anti-cough, dyspnea, for curing from throat diseases, anti-intermittent fever, anticolic, anti-dysentery, and it also helps in getting rid of worms and piles. The extract and essential oil found from black pepper can cause physical and morphological alterations in the cell wall and membrane of *E. coli*. The chemical components found in black pepper have antimicrobial activity and further exploration of these components can help us to increase our knowledge about antimicrobial action of these components.

ANTIMICROBIAL ACTIVITY OF GINGER:

Ginger (*Zingiber officinale*), it is a medicinal plant which has been used widely in all over the world from the ancient times. Ginger can be used for the treatment of arthritis, cramps, rheumatism, sprains, sore throat, muscular pain, constipation, vomiting, hypertension, indigestion, dementia, fever and for many infectious diseases. Ginger is said to have direct antimicrobial activity and it can be used as the treatment of bacterial infections. Ginger is universally acceptable and is relatively inexpensive and <https://assignbuster.com/medicinal-plants-and-their-antimicrobial-activity/>

it can be tolerated by many people. It is “ Generally Recognized as Safe” (GRAS) by the US FDA (Food and Drug Administration).

The Zingiber is a genus which belongs to the family Zingiberaceae. Ginger (Zingiber officinale) is a rhizomatous perennial herb, reaching up to 90 cm long. Rhizomes of ginger are aromatic, thick lobed, pale yellowish, bearing simple alternate distichous narrow oblong-lanceolate leaves. Gram-positive and the gram-negative bacteria named as Escherichia coli, Staphylococcus aureus, Staphylococcus epidermidis, Klebsiella pneumoniae, Enterococcus faecalis, Salmonella typhimurium, Pseudomonas aeruginosa, Proteus sp., Bacillus cereus, Bacillus subtilis, Bacillus megaterium and Streptococcus faecalis shows that they are sensitive to ginger. Ginger rhizome is extensively used in food industries and those people who use traditional medicine have great interest in ginger plant products.

ANTIMICROBIAL ACTIVITY OF GARLIC:

In Russia, garlic is referred as Penicillin. Garlic called as nature’s wonderful plant because it boosts immune system and also gives protection from certain microbes and diseases. It can kill bacteria, fungi, viruses and can also lower blood pressure, blood sugar, blood cholesterol and it can also prevent from blood clotting and it have anti-tumor properties. Garlic have sulfur constituents which are thought to have antiviral properties against coxsackie viruses, herpes simplex viruses type 1 and 2, vaccinia viruses, vesicular stomatitis virus, human immunodeficiency virus type 1 and human rhino virus type 2. Researchers from Japan have also found that garlic can also protect from influenza virus and parainfluenza virus.

Allicin, a sulfur-containing natural compound with many different biological properties is responsible for the typical smell and taste of freshly cut or crushed garlic. Since ancient times mankind has had to face many different kinds of disease and there was much speculation about their causes. Reports about the targeted use of garlic as an antimicrobial agent go back to the famous Louis Pasteur and in World War I extracts of garlic were used in antibacterial and antiseptic therapeutics. Allicin showed promising activity both in vitro and in vivo against many plant pathogenic fungal species, including pests, which are of economic importance for example, *Botrytis cinerea*, *Plectospherella cucumerina*, *Alternaria brassicicola* and *Magnaporthe grisea* were strongly inhibited in vitro by allicin in fresh garlic juice in a plate diffusion assay using spore seeded agar. Allicin can also easily be applied topically to fungal infections of the skin and hence attempts were made to use allicin in the therapy of *Candida*-infections. Interestingly, allicin's activity was comparable to the frequently used antimycotic agent fluconazole. It became clear that the induction of apoptosis was crucial for the anti-cancer effect of allicin.

ANTIMICROBIAL ACTIVITY OF GREEN CHILLI:

Human used green chili pepper from very long time ago and then the peppers become very common and are used in diet of many cultures. Green chili pepper belongs to the family of Solanaceae. Green chili peppers are widely used as spices. The flavor and smell of chili peppers varies. Chili peppers have wide range of uses which include pharmaceutical, natural coloring agents and cosmetics, as an ornamental plant in households, and as the active ingredient in most defense repellants like pepper spray. The

antimicrobial effect of chili peppers extract was observed on many food borne and human pathogenic bacteria from different studies and bacteria which shows sensitivity against chili extract includes *Bacillus subtilis*, *Escherichia coli*, *Salmonella typhimurium*, *Pseudomonas aeruginosa*, *Staphylococcus aureus*, *Vibrio cholera* and *Helicobacter pylori*.

ANTIMICROBIAL ACTIVITY OF CLOVE:

Cloves (*Syzygium aromaticum*) used as Chinese medicine and herbalism.

Cloves are also used in carminative to increase hydrochloric acid present in stomach to improve the constriction and relaxation of intestinal muscles.

Cloves are also used in dental emergencies and other than that cloves are also used as antimutagenic, anti-inflammatory, antioxidant, antiulcerogenic, antithrombotic, antiparasitic and antibacterial agents.

Cloves are used in seasoning of food. It have antimicrobial activity against many gram positive and gram negative organisms and also have antifungal activity. The antimicrobial activity of clove is mainly due to the presence of eugenol compound. Clove extracts can inhibit the growth of *Pseudomonas aeruginosa*, *Candida albicans*, *Staphylococcus aureus* and *Klebsiella pneumonia*.