

# Review on Herbal Potentials as Antibiotics

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**Abstract:** In this review article we study about the herbal antibiotics and different herbs act on body as antibacterial and discuss its classification, nomenclature, mechanism and its different properties also discuss about natural antibiotics as beneficial than chemical or synthetic antibiotics

**Keywords:** Herbal antibiotic; classification; necessity

**Introduction:** in this review article we study about different herbal plant and their active constituents act as an antibiotics/antimicrobial. Medicinal plants are used throughout the world as the source of effective and powerful drugs. Medicines prepared from the natural herbs are relatively inexpensive and stored for long time at normal temperature [1]. The rapid development of antimicrobial drug-resistant pathogens and their spread around the world are amongst the most serious threats to public health and to successful antibacterial treatment [2].

Commonly observed pathogens are including *Staphylococcus aureus*, *Salmonella*, *Shigella*, coagulase-negative *Staphylococcus*, *Enterococcus* sp., *Escherichia coli*, and *Pseudomonas aeruginosa*, are some of the main multi-drug-resistant bacteria.

Bacterial resistance to multiple antibiotics is a health problem. Essential oils (EOs) possess antibacterial properties and have been screened as potential sources of novel antimicrobial compounds. Terpenes and terpenoids are components derived from Eos [3].

Polyphenols are secondary metabolites ubiquitously distributed in all higher plants, which have important roles as defense against plant pathogens and animal herbivore aggression and as response to various abiotic stress conditions, such as rainfall and ultraviolet radiation. As regard to chemical structure, they comprise a wide variety of molecules with polyphenol structure and are generally divided into flavonoids and nonflavonoids [3].

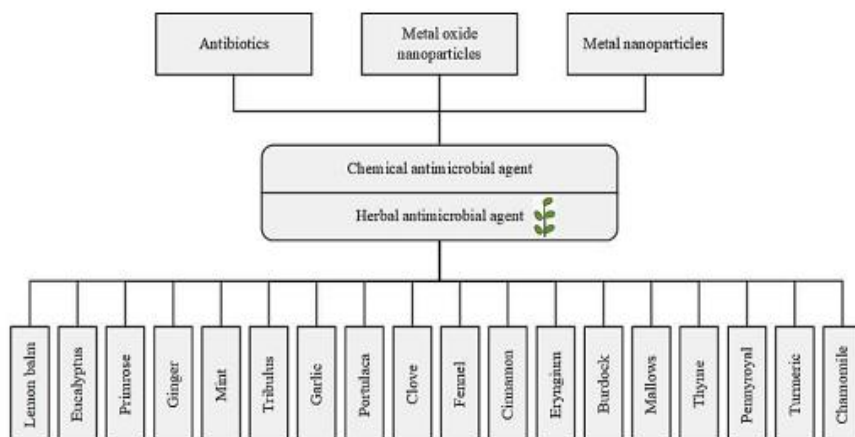


Figure 3. The antimicrobial agents' classification based on their different substances.

Fig 1 antimicrobial agents

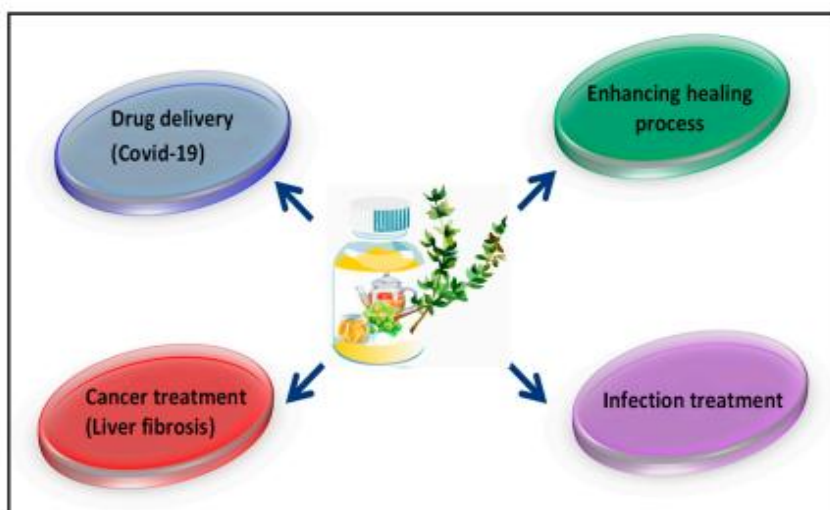


Figure 5. The future trend of herbal materials.

Fig no. 2 The future trend of herbal materials

Table 1: Herbs act as an antibiotics

Species (herb)	Phytochemical constituent	Family	Biological activity	Mechanism of action
<b>Garlic</b> (Allium sativum) <b>Fruit</b>	Allicin	Amaryllidaceae	antioxidant, immunomodulatory activities, antidiabetic, anticancer, antibacterial, cardioprotective, and	by inhibit the production of enzymes which are responsible for various role of the bacteria such as cell structure formation and energy production and survival of bacteria without

			anti-inflammatory effects	energy is impossible
<b>Honey</b> Honeycomb	Its Hydrogen Peroxide	Apidae.	tuberculosis, eye diseases, throat infections, bronchial asthma, worm infestation, eczema, constipation, wounds, healing of ulcers	effectively by providing a protective coating
<b>Ginger</b> Rhizome	Phenolic Acids, Gingerols, Paradols, And Shogaols	Zingiberaceae	antioxidant, antidiabetic, antimicrobial, renoprotective, antihypertensive, antiulcer, anti-inflammatory, cardiovascular, analgesic, and gastrointestinal activities	antimicrobial properties by inhibiting the formation of biofilms. The ginger can normalize the production of acid in stomach so the activity of bacteria H. pylori bacteria grow in stomach in the presence of acid can be reduced acidity by ginger
<b>Clove</b> ( <i>Syzygium aromaticum</i> )	Eugenol, Eugenyl Acetate, A-Humulene, 2-Heptanone, And B-Caryophyllene	Myrtaceae	antimicrobial, antioxidant, anti-inflammatory, antimutagenic, anticancer, and anti-allergic properties.	destroy the outer layer of bacterial cells by inhibit the production of protein synthesis and it results the inhibition of bacterial growth and in last death of bacteria.
<b>Species (herb)</b>	<b>Phytochemical Constituent</b>	<b>Family</b>	<b>Biological activity</b>	<b>Mechanism of action</b>
<b>Tulsi</b> Leaves	Ocimum Sanctum	Mints	antimicrobial activity	At the 4% concentration level these having maximum antimicrobial activity and enhances immunity and metabolic functions with lowering stress and possessing antioxidant property
<b>Black cumin</b> ( <i>Nigella sativa</i> )	Thymoquinone And Thymohydroquinone	Buttercups	Antibiotic	N. sativa having suppressive activity against gram-negative and gram-positive bacteria

<b>Seed &amp; oil</b>				
<b>Rosemary</b>		Mints	Antibiotic	
<b>Mango</b> Magnifera indica <b>Fruit</b>	Polyphenolics , Flavonoids, Triterpenoids. Mangiferin A Xanthone Glycoside	Anacardiaceae	antibacterial	of mango showing inhibitory effect against coliform and E. coli. Trituration of mango kernel or its extract is being used in food products or cosmetics because of its bacteriostatic and antibacterial properties
Onion (Allium cepa) <b>bulb</b>	Cysteine	Lily	Antibiotic, Antioxidant, anti-inflammatory	
<b>Species (herb)</b>	<b>Phytochemical Constituent</b>	<b>Family</b>	<b>Biological activity</b>	<b>Mechanism of action</b>
<b>Portulaca</b>	Ascorbic Acid, A- Tocopherols, Omega-3 Fatty Acids, Apigenin, Gallotannins, Quercetin, And Kaempferol	Portulacaceae	Antioxidant and antimicrobial	portulaca are the main factor of the biomedicine activity of this plant. Therefore, this plant can naturalize free radicals such as ROS in lipid chains. Hence, it can inhibit the further oxidation of lipid
<b>Species (herb)</b>	<b>Phytochemical Constituent</b>	<b>Family</b>	<b>Biological activity</b>	<b>Mechanism of action</b>
<b>Eryngium</b>	Flavonoids, Phenolic Acids, And Coumarins	Apiaceae	antimicrobial and antioxidant activity, antidiuretic, antitussive, aphrodisiac, appetizer, and stimulant	
<b>Cinnamon</b>		Lauraceae	antioxidant, antimicrobial, and anticarcinogenic	
<b>Thyme</b>	Carvacrol,	Lamiaceae	antibacterial,	the higher phenolic content

(Thymus vulgaris) Leaves	Thymol, And Phenols		antioxidant, antitussive, spasmolytic, anticancer, and anti-inflammatory	of thyme is responsible for the high radical scavenging and antioxidant properties
<b>Species (herb)</b>	<b>Phytochemical Constituent</b>	<b>Family</b>	<b>Biological activity</b>	<b>Mechanism of action</b>
<b>Pennyroyal</b> (Mentha pulegium)		Lamiaceae	antioxidant and antimicrobial	
<b>Fennel</b> (Foeniculum vulgare)		Apiaceae	antioxidant, antimicrobial, and anti-inflammatory	
<b>Mint</b> (Mentha)		Lamiaceae	antioxidant and antimicrobial	
Eucalyptus	Flavonols, Hydroxybenzoic Acids, And Hydrolyzable Tannins	Myrtaceae	Antimicrobial	
<b>Persian cumin</b>	carvone and limonene	<b>Apiaceae</b>		
<b>Tribulus leaves</b>		Zygophyllaceae	antioxidant, cardiotoxic, antimicrobial, antihypertensive, anticancer, and analgesic	antioxidant activity, radical scavenging, and its ability to strongly inhibit lipid peroxidation

**1. Garlic:**



It is very powerful herb for the treatment of antibiotic-resistant disease. Allicin is the most important active constituent found in garlic which is more powerful than standard Penicillin has excellent antimicrobial functions.. Biofilms which act as defence mechanisms of bacteria's and fungus, the allicin inhibits the formation of biofilms because biofilms can makes the treatment of infections very difficult and other active ingredient exist in garlic known as Ajoene that was using in treatment Extract of garlic can also be used for the cure of herpes viruses and influenza and many forms of bacteria like Salmonella and Escherichia coli (E. coli) as a very effective treatment [1]

Furthermore, other studies have reported that garlic shows antioxidant ability including one research which analyzed this ability using in vivo experiments .It exhibit antibacterial activity against a varied range of different bacteria (Gram-positive and Gram-negative) such as Klebsiella, Enterococcus faecalis, Pseudomonas, Salmonella typhi, Proteus, Staphylococcus aureus, and Escherichia coli [4]

## 2. Honey



It not having only nutritional value but also having health benefits as a traditional medicine that are used in the curing of. From ancient time honey applied on wounds to heal and prevents infection as antibiotics and nowadays it useful in treating chronic wounds, burns, ulcers, skin sores Wounds infected with methicillin-resistant Staphylococcus aureus treated with honey very. The character of honey like as glucose oxidase, hydrogen peroxide, low water acidity and honey prevent the growth of bacteria and yeast

## 3. Ginger



Ginger (the rhizome of *Zingiber officinale*) is native to Asia and has been used as a medicine for more than two thousand years around the world Ginger contains polyphenol It can affect type one and type two diabetes because it can inhibit the metabolism of carbohydrates and lipids, Extract of ginger shows high antimicrobial activity against dissimilar strains of bacteria such as S. aureus, E. coli, and Salmonella typhi ,Ginger has been used in several countries as a one of the most significant anticancer

medicines based on the exogenous antioxidant activity of this plant. Therefore, it can be used as a treatment of diseases caused by free radicals[4]

#### 4. Clove



Water extract of clove effective against various kinds of bacteria including *E. coli*, *Staphylococcus aureus*, *Pseudomonas aeruginosa*. Active constituents of clove, eugenol which having excellent antibacterial properties. Eugenol has antibacterial activity against *S. typhi*

Clove (*Syzygium aromaticum*), from the Myrtaceae family, is one of the most effective antimicrobial and antioxidant herbs. This herb is one of the traditional herbs primarily local to Asia and Africa. Based on the bioactive components of clove such as eugenol, eugenyl acetate,  $\alpha$ -humulene, 2-heptanone, and  $\beta$ -caryophyllene, it can display many pharmacological activities such as These bioactive components allow clove to demonstrate one of the highest potent antioxidant activities among other herbal medicines. Previous studies have reported the sufficient antibacterial property of clove extract and oil against different strains of bacteria (Gram-positive and Gram-negative) [4]

#### 5. Tulsi



Tulsi plant mostly leaf (dried or fresh) are used and mainly three types are commonly found. *O. tenuiflorum* (or *O. sanctum* L.) contain two phytochemically and botanically different varieties like Rama tulsi (green leaves) and Shyamatulsi (purplish leaves) and *Ocimum gratissimum* is another variety of Tulsi called as Vanatulsi (dark green leaves)

Tulsi having antibiotics activity against many bacteria like *Candida albicans*, *Staphylococcus aureus*, *Escherichia coli* because of presence of active constituents in it. *Ocimum sanctum* L. fixed oil having antibacterial activity in which found higher content of linoleic acid in against *Pseudomonas aeruginosa*, *S. aureus* and *Bacillus pumius*, the aqueous extract of *Ocimum sanctum* L. showed zones of inhibition

against *Klebsiella*. Ursolic acid, Eugenol and carvacrol present in Tulsi possess antimicrobial activity against *Streptococcus mutans*

## 6. Turmeric



Turmeric is one of the herbal medicines used traditionally. Due to the existence of curcumin (a polyphenolic compound), the extracts of turmeric have shown antimicrobial and antioxidant activity. Therefore, the phenolic compound of curcumin is responsible for its antioxidant activities. Fresh turmeric contains zingiberene, while the most significant curcuminoid presented in turmeric is curcumin. Curcumin is known for its inhibitory action on microorganisms such as *E. coli*, *S. aureus*, *Salmonella typhimurium*, and *Pseudomonas aeruginosa*. In numerous literature works, turmeric's extracts have been shown to have strong antioxidant properties. The main active compound of turmeric (curcumin) shows strong radical scavenger activity. It can scavenge RNS (reactive nitrogen species) and ROS such as superoxide radicals, alkoxy radicals, peroxy radicals, hydrogen peroxide, singlet oxygen, proximalities, hydroxyl radicals, and nitric oxide by three active sites through the electron transfer and hydrogen abstraction.

It is a very well-known Indian spice which having antimicrobial properties and flavor. The chemical constituent Curcumin derived from the rhizome of *C. longa* is an active constituent of turmeric which having very important role in treatment of UTI (Urinary Tract Infections), stomach inflammations as antibacterial as well as antibiofilm activity.

## 7. Rosemary



It acts as effective natural antibiotic without side-effects in salmonella infections and staph infections and much effective in fighting quorum sensing bacteria. The Rosemary oil shown antibacterial activity of against *Bacillus cereus*, *E. coli*, *Staphylococcus aureus*, *Salmonella choleraesuis*, *Aeromonas hydrophila*, *Bacillus cereus*, *Staphylococcus aureus* and *Clostridium perfringens*



## 8. Black cumin



*Nigella sativa* is a herbal plant which is also called black cumin. The seed or its oil is also used as a carminative, diuretic, lactagogue and vermifuge from past. It is also used in the cure of rheumatic diseases, fever, warts, bites of snake and asthma. Thymoquinone and thymohydroquinone obtained from the extraction and isolation of the volatile oil of *N. sativa* having suppressive activity against gram-negative and gram-positive bacteria. Diethyl ether extract of *N. sativa* having a combining effect with gentamicin and streptomycin exhibit synergistic effect with tobramycin, spectinomycin, erythromycin, nalidixic acid, doxycycline, chloramphenicol, co-trimoxazole, lincomycin, and ampicillin.

## 9. Mango



*Mangifera indica* commonly known as mango belonging to the family Anacardiaceae is the most popular fruit-bearing tree in the world. It is a good source of vitamin A. The main active constituents are polyphenolics, flavonoids, triterpenoids. Mangiferin, a xanthone glycoside, is a major bio-active constituent. Seed kernel extract. Acetone leaf extract of mango shows antibacterial activity against *S. typhi*.

## 10. Onion



*Allium cepa* is also called as bulb onion or garden onion, and is the widely grown species of the genus *Allium*. It having powerful flavonoids that have antibiotic effects and contain therapeutic sulfur compounds called cysteine sulphoxides and also having proteins, carbohydrates and phosphorus. If we eat white onion as raw regularly it showed its antioxidant and anti-inflammatory properties. Raw onion is also helpful in reducing swelling from bee stings and onion extract are used in the treatment of topical scars; onion used to treat intestinal infections from ancient time and antibacterial activity was evaluated against *V. cholerae*. By using disc diffusion method its revealed that *Allium sativum* was viricidal and had MIC of its aqueous extract is obtained to be 5–15 mg/dl and with acetone extract it was obtained to be 2.5–5 mg/dl *Allium* extract considered as a natural preservative or food additive. In addition to its nutritional values it also having the antibacterial activities against lots of both gram-negative and gram-positive bacteria including *Bacillus subtilis*, *Salmonella*, and *E. coli*

### 11. Persian cumin



*Carum carvi* is also called as Persian cumin belongs to family Apiaceae, mostly contain volatile oil carvone and limonene. The fruits can be used as whole with pungent or anise-like flavor and aroma because of essential oils present in it. *C. Carvi* is used as antispasmodic, carminative and appetite enhancing agents. *C. Carvi* essential oils controlled the Gram-positive and Gram-negative bacteria . Caraway essential oil showed the maximum effect on *Acinetobacter* spp, *E. coli*, *staphylococcus aureus*, *Proteus* spp. and minimum effect on *Pseudomonas aeruginosa*

### 12. Portulaca



Portulaca is one of the traditional herbs from Asia. It has been reported to have potent antimicrobial and antioxidant activity. Several researchers have declared the biomedicine activities of portulaca over the past decades, The antioxidant and antimicrobial property of portulaca is related to its components such as ascorbic acid, a-tocopherols, omega-3 fatty acids, apigenin, Gallo tannins, quercetin, and kaempferol. The antioxidant activity of portulaca is primarily related to omega-3 fatty acids . Previous studies have shown the antimicrobial effects of this plant against different bacteria and fungi . Furthermore, the pectic polysaccharide of this plant has been shown to have high antiviral properties against spatial viruses such as simplex virus type II Portulaca can be shown antibacterial activity against different bacteria (Gram-positive and Gram-negative) such as Pseudomonas aeruginosa, Neisseria gonorrhoea, E. coli (Escherichia coli), Streptococcus faecalis, Bacillus and S. aureus (Staphylococcus aureus)[4]

### 13. Tribulus



Tribulus (*Tribulus terrestris*) is from the Zygophyllaceae family. This herb is native to Southern Asia, Europe, and Africa ,This plant has shown several pharmacological activities including antioxidant, cardiogenic, antimicrobial, antihypertensive, anticancer, and analgesic characteristics ,The Iranian and Turkish Tribulus has been shown to have high antibacterial activity , The antimicrobial activity of different extracts from Tribulus was examined against Antioxidants 2020, 9, 1309 7 of 36 eleven microorganisms including E. coli, S. aureus, Bacillus cereus, Corynebacterium diphtheria, Salmonella typhimurium, Candida albicans, Proteus vulgaris, K. pneumonia (Klebsiella pneumonia), S. marcescens (Serratia marcescens), and Pseudomonas aeruginosa. Previous studies have found that all types of

Tribulus extracts such as chloroform and ethanol extracts demonstrate high antimicrobial properties against various microorganisms, Tribulus extract has been investigated for its. Past studies have reported that this herb can play the primary role as an authoritative natural source of antioxidants. Therefore, it can be useful in inhibiting pathologies of free radicals. Previous studies have investigated the extract of Tribulus as a high source of flavonoids[4]

#### 14. Eryngium



Eryngium (Eryngium) is one of the plants native to Central and Southeast Europe, America, and Central Asia. This plant belongs to the Apiaceae family. The different components of eryngium include flavonoids, phenolic acids, and coumarins which are key factors of the pharmacological property of this plant, Based on the presence of this component, eryngium shows high antimicrobial and antioxidant activity. Previous studies have proved that the high antioxidant activity of eryngium is due to the presence of flavonoids in the plant extract. Some researchers have reported that this plant shows antibacterial, anti-yeast, antiviral, and antifungal activity, while the results also indicate that polyacetylenes of this plant demonstrated antifungal and antibacterial abilities. The extracts and essential oil of this plant show high antibacterial properties against *S. aureus*, *Listeria monocytopenia*, *Bacillus*, *E. coli*, *Salmonella typhimurium*, *P. acnes.*, *S. bovis*, *S. pyogenes*, *S. dysgalactiae*, *S. pneumonia*, and *Pseudomonas*[4]

#### 15. Cinnamon



Cinnamon (*Cinnamomum verum* and *Cinnamomum zeylanicum*) is one of the plants that belong to the Lauraceae family. This traditional herbal medicine is from Australia and Asia, Based on the antioxidant, antimicrobial, and anticarcinogenic activities of this plant, it is widely used in medical industries, Previous investigations have found cinnamon to have antimicrobial characteristics, Cinnamon has been traditionally used for its antiseptic, antioxidant, and antimicrobial properties. Previous studies have investigated the antimicrobial activities of cinnamon against various bacteria, such as *Bacillus* and *E. coli*, Cinnamon oil has shown antibacterial effects against *E. coli*, *Listeria monocytogenes*, *Bacillus*, *Enterococcus faecalis*, *Salmonella typhimurium*, *Pseudomonas aeruginosa*, *Yersinia enterocolitica* and *Staphylococcus aureus*, This strong antimicrobial activity is based on the presence of cinnamaldehyde

and eugenol in cinnamon essential oil. Bacteria such as *Campylobacter jejuni* have been shown to be more inhibited by the essential oil of cinnamon compared to other Gram-negative bacteria such as *Escherichia coli*, Other researchers have demonstrated the mechanism of the antimicrobial action of the essential oil of cinnamon against cell walls of *Listeria monocytogenes*, *E. coli*, and *S. aureus*[4]

## 16. Thyme



Thyme (*Thymus vulgaris*) is one of the active antimicrobial herbal medicine plants which belong to the Lamiaceae family. It is more active against different bacteria and can inhibit the growth of bacteria such as *Lactobacillus plantarum*, *Brochothrix thermosphacta*, and *Brevibacterium linens*. This potent antimicrobial ability is related to the presence of high concentrations of carvacrol, thymol, and phenols in the extracts and essential oils of thyme, Thyme extracts and essential oil have demonstrated a long list of medicinal properties, such as antibacterial, antioxidant, antitussive, spasmolytic, anticancer, and anti-inflammatory characteristics. The extract of this plant has been traditionally used as an antitumor medicine due to its antioxidant property. Numerous studies in the literature have demonstrated that the higher phenolic content of thyme is responsible for the high radical scavenging and antioxidant properties of this medicinal plant. The structural variability of extracts and oils of thyme has been the subject of numerous studies. Some studies on the antimicrobial activity of thyme plants have evaluated the composition of thyme extracts and oil influenced by growing conditions, the genotype, and ontogenic development. The antimicrobial ability of thyme has been reported against *Pseudomonas aeruginosa*, *S. aureus*, *Klebsiella pneumoniae*, *E. coli*, and *Bacillus*

## 17. Pennyroyal



Pennyroyal (*Mentha pulegium*) is one of the aromatic herbs belonging to the Lamiaceae family. This herb is native to Europe, Asia, and Africa, Based on the high antioxidant and antimicrobial ability of this plant, its extracts and essential oils have been traditionally used in medicine, especially for skin diseases,

aromatherapy, and cosmetics ,Numerous studies have demonstrated the bioactive properties of this plant in different countries around the world, including Portugal, Turkey, Iran, and Greece, by focusing on the chemical composition of pennyroyal ,In the last decade, some researchers have demonstrated the antioxidant properties of pennyroyal extracts and essential oil by focusing on the chemical composition of this plant Phenols are the most bioactive component of the extracts and essential oil of pennyroyal. This organic compound has been shown to contain an OH functional group that is bound directly to the aromatic ring, and the hydrogen atom of the OH functional group can snare peroxy radicals. Therefore, it can prevent the oxidation of other compounds ,Finally, the presence of phenol compounds is the reason for the antioxidant characteristic of this herbal medicinal plant , Some researchers have studied the relationship between concentrations of the extract and essential oil of pennyroyal and their antioxidant activity. These results have shown a direct relation between the antioxidant activity and phenol content. The essential oil of this plant has also been shown to possess high antibacterial activity ,The antimicrobial ability of this plant is related to the presence of neo-menthol, pulegone, and menthone. Most studies have shown a strong antimicrobial ability of pennyroyal against different bacteria including *E. coli*, *S. typhimurim*, *Yersinia enterocolitica*, *Bacillus cereus*, *Listeria monocytogenes*, *Staphylococcus aureus*, *Clostridium perfringens*, *Helicobacter pylori*, *Brochothrix thermosphacta*, *Pseudomonas aeruginosa*, and *Klebsiella*

## 18. Fennel



Fennel (*Foeniculum vulgare*) is one of the herbal medicinal plants belonging to the Apiaceae family. Its native habitats include shores of Mediterranean Sea. There are some studies on the radical scavenging activity of fennel . These studies have revealed that the antioxidant ability of this plant is due to the presence of high phenolic content in its extracts. Fennel has been shown to have high antioxidant ability. The antioxidant ability of the extract of this plant is due to numerous antioxidant processes such as free radical scavenging, superoxide anion radical scavenging, total antioxidant, and hydrogen peroxide scavenging ,The strong antioxidant characteristics of ethanol extracts and essential oil of this plant have been demonstrated by in vitro studies ,The hydro-ethanolic extracts of this plant have shown to possess free radical scavenging characteristics directly proportional to the content of phenolic compounds of fennel extract. The extracts and essential oil of this plant have been demonstrated to have significant antioxidant, antimicrobial, and anti-inflammatory properties [56]. The antimicrobial property of the essential oil (EO) and extract of fennel has been proven using the disk diffusion method . Fennel extracts and essential oils have demonstrated high inhibitory activity against *Bacillus megaterium*, *Escherichia*

coli, *Bacillus pumilus*, *S. aureus*, *Pseudomonas putida*, *Pseudomonas syringae*, *Salmonella typhi*, *Bacillus cereus*, *Micrococcus luteus*, *Klebsiella pneumonia* and *Bacillus subtili*

Chamomile (*Matricaria chamomilla*) is one of the traditional herbal medicines. This plant is part of the Asteraceae family and is still used in different medical applications, such as pharmaceutical and cosmetic industries. Chamomile has the high antimicrobial ability of the extract and essential oil (EO) of this plant against various bacteria (Gram-positive and Gram-negative) including *E. coli*, *Salmonella typhimurium*, *S. aureus*, and *Bacillus*. The high antimicrobial ability of this plant is also due to the high contents of phenolic compounds. Chamomile contains flavonoids, terpenoids, phenolic compounds, apigenin, and matricin

## 19. Mint



Mint (*Mentha*) is one of the aromatic perennial herbs belonging to the Lamiaceae family. It has been used for various applications, such as pharmaceuticals and cosmetics applications. The EO and aqueous extracts of mint potentially have antioxidant properties due to the existence of phenolic compounds. Mint essential oil has been shown to be an effective alternative short-term treatment of irritable bowel syndrome in humans, due to its anti-inflammatory abilities. The antioxidant activity of this plant exclusively relies on its chemical composition and can prevent oxidative stress at the cellular level or in a living organism. Other studies have reported the use of mint extract as an antioxidant and antimicrobial bioactive natural extract. Numerous studies have revealed the inhibitory ability of this plant depending on the type of bacteria and its strong antimicrobial ability against Gram-positive bacteria, especially *S. aureus*. Other studies have reported that the antimicrobial effect of this plant with different oil concentrations. Mint oil shows strong antimicrobial ability against different bacteria including *S. aureus*, *S. epidermidis*, *E. coli*, *Bacillus cereus*, *Enterococcus faecalis*, and *Cronobacter sakazakii*

## 20. Eucalyptus



Eucalyptus (*Eucalyptus*) is a member of the Myrtaceae family. It is called the fever tree based on its strong antimicrobial ability. This herbal medicine is native to the Mediterranean, Australia, and

Tasmania area and it has been used as traditional medication for the treatment of numerous diseases including diabetes, pulmonary tuberculosis, bacteria and fungal infections, and influenza. The medical applications of eucalyptus are based on the high antioxidant and antimicrobial abilities of its essential oil. High concentrations of several polyphenolic compounds including flavonols, hydroxybenzoic acids, and hydrolyzable tannins have been found in the extract of eucalyptus. These compounds are the reason for the high antimicrobial and antioxidant activity of eucalyptus. Recent studies have revealed the strong antibacterial ability of eucalyptus against *S. aureus*, *Listeria monocytogenes*, *Bacillus*, *Klebsiella pneumoniae*, *Enterococcus faecalis*, *Pseudomonas aeruginosa*, *Salmonella Enteritidis*, and *Escherichia coli*.

## 21. Primrose



Primrose (genus *Oenothera*) is a member of the Onagraceae family. Primrose shows numerous pharmacological effects including antimicrobial and antioxidant properties. This herbal medicine has been traditionally used for skin treatment. The oils and extracts of primrose may also be used as natural antioxidants. The most important component of primrose includes various phenolic compounds which have been shown to be responsible for the antioxidant and free radical scavenging ability of primrose. Numerous researchers have reported that the antioxidant activity of this plant is due to its phenolic components. Another group of chemical compounds present in primrose is triterpenoids.

The antioxidant ability of primrose ethanolic extracts has been demonstrated in the literature. It has been reported that the lipophilic triterpenoid esters present in essential primrose oil are the reason for the effective antioxidant activity of this plant. Methanolic extracts of primrose were also demonstrated to possess potential antioxidant ability.

## 22. Lemon Balm





Lemon balm (*Melissa officinalis*) is one of the traditional herbal medicines belonging to the Lamiaceae family. This herbal medicinal plant grows in North America, Europe, and Asia. Its use as a medicinal plant originated from Mediterranean countries. The lemon balm has been used for several purposes such as medicine. The extracts and EO of the lemon balm plant have some pharmacology effects including antimicrobial, anticancer, antibacterial, anti-cardiovascular diseases, antioxidant, anti-inflammatory, antispasmodic, and antiviral properties. Some studies have demonstrated the effectiveness of lemon balm against different diseases such as HIV-1, cancer, and Alzheimer's. Lemon balm is a rich source of phenolic compounds such as thymol and carvacrol which are the potential reason for the antibacterial and antioxidant activity of the lemon balm plant. The antimicrobial characteristics of lemon balm have been used against Gram-negative bacteria including *E. coli*, *Salmonella typhi*, *Pseudomonas aeruginosa*, *Proteus*, and *Klebsiella* and Gram-positive bacteria including *S. aureus*, *Sarcina lutea*, beta-hemolytic *Streptococcus*, and *Bacillus cereus*.

### 23. Mallows



Mallow (*Malva sylvestris*) is another herbal medicinal plant which belongs to the Malvaceae family. This herb is native to Europe, America, and Asia [284]. The extract of this plant has high phenolic content and high antimicrobial properties. However, there is little clinical evidence regarding the use of mallow. The antibacterial effect of this herb has been reported against different bacteria (Gram-positive and Gram-negative) including *S. aureus*, *Bacillus cereus*, *E. coli*, *Klebsiella pneumoniae*, *Salmonella typhimurium*, *Listeria monocytogenes*, *Proteus vulgaris*, *Streptococcus pyogenes*, *Micrococcus luteus*, *Pseudomonas aeruginosa*, and *Mycobacterium smegmatis*.

#### ➤ Components Of Essential Oils With Antimicrobial Activity

Components of EOs derived from terpenes and their oxygenated derivatives, terpenoids, have been extensively evaluated. In vitro studies have shown active inhibition of bacterial growth with varying results. EOs in combinations can produce additive antimicrobial activity, and EOs in combination with other antimicrobials can improve antimicrobial effectiveness. Amongst the most evaluated components are cinnamaldehyde (the major constituent of cinnamon oil), geraniol, thymol analogues, menthol and carvacrol (major ingredient of *Zataria multiflora*) [9–11]. Although clinical applications of EOs and their components have been limited, some components have been incorporated into creams, lotions, drops or liposomal formulations that are applied externally

#### ➤ **Why Is Natural Antibiotics Better Than Synthetic?**

The results of both experiments suggest that some natural antibiotics are as effective as pharmaceutically produced antibiotics in inhibiting the growth of bacteria. Unlike pharmaceutically produced antibiotics, drug resistance does not develop against naturally occurring antibiotics

#### ➤ **When To Use Prescribed Antibiotics**

Antibiotics prescribed for better recovery from illness and to prevent the spreading diseases. But currently drug-resistant diseases come in knowledge so doctors do not prescribe antibiotics if that are not much necessary. Antibiotics are given to inhibit the spread of very infectious diseases from having more harmful and give high recovery rate from illness. Antibiotic should be taken only when it prescribed and prescription should not be shared and neither should left-over before time even if feels better then completion of prescription prescribed. Medical expert tries their best to developed herbal antibiotics for antibacterial resistance because bacterial infection gives lots of threat to life [28].

#### ➤ **Why Is Herbal Antibiotics Needed?**

Antibiotics used during any bacterial infection causing lots of side effect by disturbing natural functions of the body and destruction of good bacteria. These unwanted effects of antibiotics can completely kill or inhibited by the replacing with natural antibiotics. Herbal antibiotics gives effect by not just as bactericidal, but also boosting the body's natural power or immunity for future to save from bacterial infections. Mostly drug resistance does not develop with herbals antibiotics which many times we seen in pharmaceutically produced antibiotics and natural antibiotics does not give the bactericidal effect against beneficial bacteria which lived in our bodies and help us in many ways.

#### ➤ **Mode Of Action Of Crude Drug**

There are lots of crude drugs which having the antibacterial properties. The active constituents of the crude drugs like garlic, ginger, turmeric having approximately same mode of action on bacteria by reducing or inhibits the bio-films growth and rendering it so sensitive as antibacterial herbal drugs. The active constituents of clove and tulip also having the same pharmacological activity by blocking the production of genetic materials DNA and protein and inhibits the bacterial growth.

#### ➤ **Antibacterial Spectrum Of Crude Drugs**

There are two types of bacteria according to gram staining ie. gram positive and gram negative. These drugs having the broad-spectrum antibiotics, mostly drugs are given positive results in both cases like gram positive and gram negative. Tulsi, Turmeric, *Carum carvi*, *Allium cepa*, *Nigella sativum* give their

positive antibacterial properties on both type of bacteria like *Bacillus subtilis*, *Salmonella*, *E. Coli* and *Staphylococcus aureus*.

### ➤ Risks Of Natural Antibiotics

It is not necessary that anything that is natural is counted as safe. Its only depends on amounts and concentrations of active ingredients of drug taken. Taking garlic in high concentration may enhance the risk of bleeding so not suggested for people having surgery or taking blood thinners. There are lots of phyto-chemicals having antibacterial efficacy but they are not used as commercial antibiotics still. So, plants must be explored for getting proper recognition of their therapeutic values, safety & efficacy which results so herbal can replace & used as an alternate of synthetic drug

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