ANTIBACTERIAL ACTIVITY OF SOME PLANT EXTRACTS AGAINST SELECTED BACTERIAL STRAINS CAUSING HUMAN INFECTION

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ABSTRACT
Antimicrobial resistance occurs when microorganisms which were initially sensitive to antimicrobial drugs becomes ineffective when exposed to them by not killing or inhibiting their growth. Despite growing worldwide attention to Antimicrobial resistance, there are substantial limitations in our understanding of the burden, distribution and determinants of Antimicrobial resistance at the population level. Importance of population-based approaches to assess the association between antimicrobial use and Antimicrobial resistance in humans has to be well thought-out. Such approaches are needed to improve our understanding of the development and spread of Antimicrobial resistance in order to inform strategies for the prevention, detection and management of Antimicrobial resistance, and to support the sustainable use of antimicrobials in healthcare.

INTRODUCTION
Antimicrobial resistance (AMR) is a worldwide public health threat. Emergence of AMR occurs naturally, but can also be selected for by antimicrobial exposure in clinical and veterinary medicine (WHO, 2015). The misuse of antibiotics has lessened the efficacy of many commonly used antibiotics. The emergence of resistant strains of bacteria has seriously limited our ability to treat bacterial illness, and new antibiotics are desperately needed (Gould IM, Bal AM.,2013) Since the discovery of penicillin drug resistance, most antibiotic development has focused on the discovery of new antibiotics derived from microbial sources, or on the synthesis of new compounds using existing antibiotic scaffolds to the detriment of other lines of discovery. (Mariya Lobanovska and Giulia Pilla, 2017) The reexamination of traditional medicines has become more common and has already provided several new antibiotics.
Traditional medicine plants are likely to provide further new antibiotics in the future. However, the use of plant extracts or pure natural compounds in combination with conventional antibiotics may hold greater promise for rapidly providing affordable treatment options. (Matthew J. Cheesman et al., 2017) Also, the respective mode of synergistic interaction of these plants with conventional antibiotics has been found to have potential effects against drug-resistant bacterial infections (Majee et al 2018). Such approaches are needed to improve our understanding of the development and spread of Antimicrobial resistance in order to inform strategies for the prevention, detection and management of Antimicrobial resistance, and to support the sustainable use of antimicrobials in healthcare. (S. Allcock., 2017).

**HERBS AS ANTIMICROBIAL**

From ancient times plants (herbs) have been used as food, spices, and as curative remedy in many infectious diseases. In Indian recipes as they impart aroma and flavor to food. Natural Herbs and spices are very important and useful as therapeutic agent against many pathological infections, since they possess effective anti-bacterial activity against multi-drug clinical pathogens and can be used for prevention of drug resistant microbial diseases. Increasing multidrug resistance of pathogens forces to find alternative compounds for treatment of infectious diseases. With increasing resistance of microorganisms to antibiotics, there is a shift of choice from allopathic to ayurvedic and naturopathy, where herbs and spices are very common ingredients of medicines. (Venugopal A et al., 2018)

Plant antimicrobials are phytochemicals that play an important role in the plant defense mechanisms against pathogens. These phytochemicals are generally grouped in phenolic compounds (e.g. phenols, phenolic acids, quinones, flavonoids and tannins), terpenoids and essential oils, alkaloids, lectins and polypeptides. The addition of these phytochemicals to foods (revised in (Sultanbawa., 2011)) can extend the shelf-life of products, due to their known antimicrobial and antioxidant properties.

My review is on the most frequently used herbs and spices used all over India as food spices that have antimicrobial properties. Garlic (*Allium sativum*), ginger (*Zingiber officinale*), Curcuma longa (Turmeric), Coriander(*Coriandrum sativum*), basil (*Ocimum basilicum* L.), rosemary (*Rosmarinus officinalis* L.), peppermint
(Mentha piperita), Curry Leaf (Murraya koenigii), which can be used as antimicrobial agents to inhibit bacteria that causes human infection.

**Allium sativum (garlic)**

Garlic is a species in the family Alliaceae grows in many parts of the world and is a popular ingredient in cooking due to its strong smell and delicious taste. However, throughout ancient history, the main use of garlic was for its health and medicinal properties. Its use was well documented by many major civilizations, including the Egyptians, Babylonians, Greeks, Romans and Chinese. Scientists now know that most of its health benefits are caused by sulfur compounds formed when a garlic clove is chopped, crushed or chewed. (Rivlin RS., 2001)

The most famous constituent in garlic is known as allicin. Allicin generated is unstable and quickly changes into a series of other sulfur-containing compounds such as allyl cysteine, diallyl disulfide which are organosulfur compound. It is the key component to which the antimicrobial activity of garlic is attributed; and a volatile molecule that gives it its characteristic odor hence unstable compound that is only briefly present in fresh garlic after it’s been crushed (Borlinghaus. j et al., 2014).

Garlic has long been thought to have antimicrobial properties since it has the ability to fight pathogenic microorganism and has been found having a broad specturm of action against bacteria, viruses, fungi and protozoans by killing and inhibiting their growth. (Harris J C., 2001).

Anti-bacterial effect of crude garlic extract is effective against S. aureus and E. coli (Ephrem Abiy and Asefaw Berhe., 2016).

The type of extraction will determine the efficacy of the plant extract. Extracted garlic as a crude extract and methanolic extract against, *Staphylococcus aureus* *Escherichia coli* and *Salmonella ser. Typhi*, both will give the same inhibition zone towards *E. coli* while the crude extract will give the maximum inhibition zone towards *S. aureus* and maximum inhibition zone towards *S. ser. Typhi* will be observed with methanolic extract (S. Gaherwal., 2014).

Garlic aqueous extract has antibacterial activity to *Escherichia coli*, *Pseudomonas aeruginosa*, *Bacillus subtilis*, *Staphylococcus aureus*, *Klebsiella pneumoniae*, *Shigella sonnet*, *Staphylococcus epidermidis* and *Salmonella typhi* (Irum Gull et al., 2012).
Combination of ampicillin with fresh garlic extract was found to be effective against *S. aureus* by using in vitro method. (Pillai R., 2013).

**Zingiber officinale (ginger)**

Ginger (Zingiber officinale), a member of the Zingiberaceae family, it has been used as a spice as well as medicine in India and China since ancient times. It is a popular spice used globally especially in most of the Asian countries (G. Demin and Z. Yingying, 2010). The major constituents in ginger rhizomes are carbohydrates (50–70%), lipids (3–8%), terpenes, and phenolic compounds (R. Grzanna et al., 2005).

Ginger has antibacterial activity and can be used in treatment of various bacterial infections. When extracted by using solvents, n-hexane, ethyl acetate, ethanolic soxhlet and then assayed for antibacterial activity and bacterial growth inhibition activity, all the extracts have shown antibacterial activity and that the inhibition of bacterial growth (S.P Malu., 2009), the broad spectrum potential of the extract against Salmonella, *E. coli*, Staphylococcus and Vibrio plates, the results (I-Nan Chen et all., 2007). It is considered a safe herbal medicine with only few and insignificant adverse/ side effects. (Badreldin H. Ali et al., 2007). The synergistic interaction between plant extract and the antibiotic was found to inhibit the growth of against *S. aureus*. (Sukandar et al., 2016).

**Curcuma longa (Turmeric)**

*Curcuma longa* L. is a rhizome (root) that comes from the plant of the ginger family (Zingiberaceae) native to India and is used as a spice that gives curry its yellow color in cooking. Its polyphenolic compound curcumin have been subjected to a variety of antimicrobial investigations due to extensive traditional uses and low side effects. Curcumin is the main active ingredient in turmeric, it is a polyphenol compound responsible for the bright yellow color of turmeric, contains the curcuminoids atlantone, bisdemethoxycurcumin, demethoxycurcumin, diaryl heptanoids, and tumerone. Turmeric also contains sesquiterpenoids (Nishiyama, T et al 2005) and the constituent ar-tumerone (Ji, M., 2004).

Antimicrobial activities for curcumin and rhizome extract of *C. longa* against different microorganisms have been reported. The promising results for antimicrobial activity
of curcumin made it a good candidate to enhance the inhibitory effect of existing antimicrobial agents through synergism. Indeed, different investigations have been done to increase the antimicrobial activity of curcumin, including synthesis of different chemical derivatives to increase its water solubility as well as cell up take of curcumin. (S.Z Moghadamtousi et al., 2014).

The use of essential oil from turmeric as a potential antiseptic in prevention and treatment of antibacterial infections has been suggested. Curcuma longa rhizome extracts has been evaluated for antibacterial activity against pathogenic strains of Gram-positive (Staphylococcus aureus, Staphylococcus epidermidis) and Gram-negative (Escherichia coli, Pseudomonas aeruginosa, Salmonella typhimurium) bacteria. essential oil was found to be most active and its activity was compared to standard antibiotics gentamycin, ampicillin, doxycycline and erythromycin in these strains.( R Singh., The ethyl acetate (2002 of extractCurcuma longa L. has demonstrated a higher antibacterial activity than the methanol extract or water extract (Kim, K. J et al.,2005).

Curcumin with combination with Gentamicin, Amikacin, and Ciprofloxacin. Has inhibitory effect against S. aureus. (Teow et al., 2015).

**Coriandrum sativum (coriander)**

Coriander (Coriandrum sativum L.) is a well-known herb widely used as a spice, in folk medicine and in the pharmacy and food industries (Burdon & Carabin.,2009).It is one of the most useful essential oil bearing spices as well as medicinal plants, belonging to the family Umbelliferae/Apiceae. The leaves and seeds of the plant are widely used in folk medicine in addition to its use as a seasoning in food preparation. The C. sativum essential oil and extracts possess promising antibacterial, antifungal and anti-oxidative activities as various chemical components in different parts of the plant. This edible plant is non-toxic to humans, and the C. sativum essential oil is thus used in different ways in foods and in pharmaceutical products therapeutic action.(Shymapada Ma,Mabisha.,2009).

The yield of C. sativum Essential oil and its chemical composition undergoes changes during ontogenesis which affects the aroma of the plant, (M.N.I. Bhuiyan et al.,2009). Coriander oil exhibited bactericidal activity against almost all bacteria tested The results obtained herein further encourage the use of coriander oil in antibacterial formulations.
due to the fact that coriander oil effectively kills pathogenic bacteria related to hospital infections. (Silva F.Ferreira et al.,2011). The antimicrobial activity of Ethanol, Methanol, Acetone, Chloroform, Hexane and Petroleum ether extract of Coriandrum sativum when tested against infectious disease causing bacterial pathogens such as such as E.Coli, Pseudomonas aeruginosa, Staphylococcus aureus and Klebsiella pneumonia. The Methanolic extract of sun dried Coriandrum sativum showed better activity against the most tested organisms.(V.Ratha bai and Kanimozhi.D.,2012). Coriander essential oil and linalool has shown a synergistic interactions with antibiotics (oxacillin, amoxicillin, gentamicin, ciprofloxacin, tetracycline) against both Gram-positive (Staphylococcus aureus) and Gram-negative bacteria (Escherichia coli) (Petruta et al.,2018).

**Basil (Ocimum basilicum L)**

Basil (Ocimum basilicum) is of the Lamiaceae family and its dried leaves as well as its essential oil are used in food industry as aromatic and flavoring ingredients. Also, Ocimum basilicum is commonly used to treat fever, inflammatory, stomach ache, flatulence, constipation and is also used as an antibacterial and antifungal agent . (Rafieian-Kopaei, M.,2012). Leaves and flowering parts of Ocimum basilicum are believed to be rich of different phytochemicals hence, the study was designed to evaluate the phytochemical constituents and antimicrobial activities of the leaves of sweet basil (O. basilicum) herb. Results revealed the presence of many phytochemicals such as alkaloids, tannins, flavonoids, cholesterol, terpenoids, glycosides, phenols, cardiac glycosides, carbohydrates, and phlobatannins. Tests of antimicrobial activity showed that the hydrodistilled oil is effective against all the tested bacterial and strains. However, the crude extract was found not to have antimicrobial activity toward the tested microorganisms. (Hadush Gebrehiwot, R. K.,2003).

Basil extract has various chemical compounds that include α-pinene, camphene, β-pinene, myrcene, limonene, cis-ocimene, camphor, linalool, methyl chavicol, γ-terpineol, citronellol, geraniol, methyl cinnamate and eugenol and other terpenes (Hussain AI et al.,2008). The activity of basil against multidrug resistant clinical isolates from the genera Staphylococcus, Enterococcus and P
seudomonas has been studied. showed a strong inhibitory effect of basil on the test bacteria (G.Opalchenova D.Obreshkova,2003). Essential oils from basil has its efficacy in the treatment and prevention of emergent resistant strains in nosocomial and other bacterial infections. Basil oil possesses a higher ability to inhibit growth in multidrug resistant E.coli. (Sienkiewiez M et al.,2013.) and Pseudomonas aeruginosa, and gram-positive ones including Bacillus cereus, Staphylococcus aureus (Amir Mohammad et al.,2011) Ocimum basilicum essential oil associated with existing standard antibiotics has a tendency of increasing their antibacterial activity, resulting in a synergistic activity against bacterial strains of clinical importance. (Viviane Araújo et al., 2016).

**Rosemary (Rosmarinus officinalis L.)**
Rosemary (Rosmarinus officinalis L.) which has long been known as a spice and medicinal herb belongs to the Lamiaceae family and receiving increasing attention due to its antimicrobial, antiinflammatory, and antioxidative constituents (Eva, S. B et al.,2003).

Several studies have reported that rosemary extracts show biological bioactivities such as, antifungal, insecticide, antioxidant and antibacterial. (Gema Nieto et al., 2018) .It is well known that the biological properties in rosemary are mainly due to observed that the main constituents of the tested essential oil were camphor (37.6%), 1,8-cineole (10.0%), p-cymene-7-ol (7.8%) and borneol (5.4%). phenolic compounds. (Bendeddouche et al.,2018). The most important antibacterial activity of both essential oils was expressed on Escherichia coli, Salmonella typhi, S. enteritidis, and Shigella sonei. (Biljana Bozin.,2007).

Evaluation of rosemary with selected antibiotic gave a positive result of synergistic interaction by inhibiting Staphylococcus aureus strains (Abdeltawab et al.,2014) Evaluation on the antimicrobial activity of ethanol plant extract of Rosmarinus officinalis with five antimicrobial agents of different mechanisms (oxytetracycline Hcl, amoxicillin, cefquinome, sulphaguanoxazoline and danofloxacin) against S. aureus,showed its high efficancy. (Abdeltawab et al.,2013).

**Peppermint (Mentha piperita)**
Peppermint (Mentha piperita L.) is a medicinally important plant that belongs to the family Lamiaceae in the genus Mentha. (Cosentino, M.,2009).The antibacterial
activity of peppermint oil and different extracts of *Mentha piperita* against some Gram-positive and Gram-negative bacterial strains has a wide spectrum of inhibition activity (.Rajinder sigh.,2015) M. piperita leaf extracts against pathogenic bacterial strain were found to be valuable antibacterial agent.( Imran Zamin.,2013). The antibacterial activity in the leaf extracts of Mentha piperita L. against pathogenic bacteria like *Bacillus subtilis*, *Pseudomonas aureus*, *Pseudomonas aerogenosa*, *Serratia marcesens* and *Streptococcus aureus* in aqueous as well as organic extracts found to possess strong antibacterial activity against a range of pathogenic bacteria as revealed by in vitro agar well diffusion method. (Giri et al.,2016.,) Mentha piperita L. with combination with standard antibiotic such as Gentamicin (10 mg), Cephalothin (30 mg), Ceftriaxone (10 mg) showed a wide range of inhibition zone (Toroglu S.,2007 ).

**Curry Leaf (Murraya koenigii)**

*Murraya koenigii*, family Rutaceae, commonly known as Curry leaf plant is a highly valued plant for its medicinal value and characteristic aroma. It is a green leafy vegetable native to India. Curry leaves are natural flavoring agents with numerous health benefits. They contain several medicinal properties Medicinally, these leaves found use in diarrhea, dysentery and to prevent vomiting (Hanan Al Harbi et al.,2018).

The plant is a rich source of carbazole alkaloids.(Bhattacharya, L et al.,1982) and coumarins which has antioxidants properties (Adebajo, A.C.; Reisch, J., 2000) and The petroleum ether, chloroform, ethyl acetate and ethanol extracts of roots of the plant were screened for phytochemical properties and antimicrobial activity been found having a broad spectrum inhibition towards bacteria. Phytochemical screening showed the presence of carbohydrates, alkaloids, steroids and flavonoids in the root extracts of the plant. The study shows that all the extracts possess remarkable antibacterial activity.(Manisha Vats et al.,2011). Both the ethanol and methanol extracts of curry leaves were found to be effective against tested bacterial strains. The clear zones of inhibition in bacterial samples produced by curry leaf extracts were comparable with antibiotics such as Gentamycin and Amikacin. And *Murraya koenigii* extracts have demonstrated antibacterial effects particularly on E.coli and Staphylococcus as
compared to antibiotics such as Gentamycin and Amikacin.

REFERENCES


clinical isolates of the genera Staphylococcus, Enterococcus and Pseudomonas by using different test methods. Journal of microbiological methods. 54. 105


