Suresh Gyan Vihar University International Journal of Environment, Science and Technology
Volume 5, Issue 1, Jan 2019, pp. 1-11
ISSN: 2394-9570

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

Wilda Onyancha, Mohammad Irfan Ali

Research Scholar, School of Applied Sciences
Suresh Gyan Vihar University, Jaipur, Rajasthan, India

Corresponding Author E-mail-wilda.62395@mygyanvihar.com

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 an 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 specrum of action against bacteria,viruses,fungi and prozoans by killing and inhibiting their growth..(Harris JC.,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 efficancy of the plant extract.Extaracted 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 sonnei, Staphylococcusepidermidis* 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 extract*Curcuma 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 (Burdock & Carabin.,2009).It is one of the most useful essential oil bearing spices as well as medicinal plants, belonging to the family Umbelliferae/Apiaceae. 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, terpernoids, 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 efficancy 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 tendancy 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, sulphaquinoxaline and danofloxacin) against S. aureus,showed its high efficancy. (Abdeltawabet 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 inhition 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 antioxidative 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 microorganisms. 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

1. Abdeltawab, Ashraf & El-Hofy, Fatma & A. Mobarez, Elham & S. Taha, Hesham & Y. Tawkol, Nancy. (2015). Synergistic effect between some antimicrobial agents and rosemary (rosmarinus officinalis) toward staphylococcus aureus – in-vitro. Benha veterinary medical journal, 28,.2:195-201
2. Abiy, E., & Berhe, A. (2016). Anti-Bacterial Effect of Garlic (Allium sativum) against Clinical Isolates of Staphylococcus aureus and Escherichia coli from Patients Attending Hawassa Referral Hospital , Ethiopia. Journal of Infectious Diseases and Treatment 2:2.18.
3. Adebajo, A.C.; Reisch, J. (2000). Minor furocoumarins of Murraya koenigii. Fitoterapia. 71, 334-337.
4. Ali, R. E. and Rattan, S. I. Curcumin's biphasic hormetic response on proteasome activity and heat-shock protein synthesis in human keratinocytes (2006). Ann N Y Acad Sci ;1067:394-399.
5. Allcock, S., Young, E., Holmes, M., Gurdasani, D., Dougan, G., Sandhu, M., . . . Török, M. (2017). Antimicrobial resistance in human populations: Challenges and opportunities. Global Health, Epidemiology and Genomics, 2, E4.10.1017.
6. Al-Wabel, Professor Dr. Naser & M Fat 'hi, Shawkat. (2012). Antimicrobial activities of spices and herbs. II International Conference on Antimicrobial Research - ICAR2012, 21-23.
7. Amrita, Venugopal & Dasani, Sonal & Shalini, Rai. (2009). Antibacterial Effect of Herbs and Spices Extract on Escherichia coli. Electronic J Biology. 5. Electronic Journal of Biology, 5(2): 40-44.
8. Badreldin H. Ali, Gerald Blunden, Musbah O. Tanira, Abderrahim Nemmar(2007).Some phytochemical, pharmacological and toxicological properties of ginger (Zingiber officinale Roscoe): a review of recent research.Food Chem toxical 46(2):409-20.
9. Bendeddouche M.S., Benhassaini H., Hazem Z., Romane A. (2011) Essential oil analysis and antibacterial activity of Rosmarinus tournefortii from Algeria. Nat. Prod. Commun. ;6:1511–1514.
10. Bhattacharya, L.; Roy, S.K.; Chakraborty, D.P. (1982). Structures of the carbazole alkaloid isomurrayazoline from Murraya koenigii. Phytochemistry. 21, 2432-2433
11. Biljana Bozin, Neda Mimica-Dukic, Isidora Samojlik, and Emilija Jovin.(2007) Antimicrobial and Antioxidant Properties of Rosemary and Sage (Rosmarinus officinalis L. and Salvia officinalis L., Lamiaceae) Essential Oils.*Journal of Agricultural and Food Chemistry 55* (19), 7879-7885.
12. Borlinghaus, Jan & Albrecht, Frank & Gruhlke, Martin & Nwachukwu, Ifeanyi & Slusarenko, Alan. (2014). Allicin: Chemistry and Biological Properties. Molecules (Basel, Switzerland). 19. 12591-12618.
13. Burdock, G. A. & Carabin, I. G. (2009). Safety assessment of coriander (Coriandrum sativum L.) essential oil as a food ingredient. Food Chem Toxicol 47, 22– 34.
14. Cheesman, M. J., Ilanko, A., Blonk, B., & Cock, I. E. (2017). Developing New Antimicrobial Therapies: Are Synergistic Combinations of Plant Extracts/Compounds with Conventional Antibiotics the Solution?. *Pharmacognosy reviews*, *11*(22), 57-72.
15. Chen, I-Nan & Chang, Chen-Chin & Ng, Chang-Chai & Wang, Chung-Yi & Shyu, Yuan-Tay & Chang, Tsu-liang. (2008). Antioxidant and Antimicrobial Activity of Zingiberaceae Plants in Taiwan. Plant foods for human nutrition (Dordrecht, Netherlands). 63. 15-20.
16. Cosentino, M.; Bombelli, R.; Conti, A.; Laura Colombo, M.; Azzetti, A.; Bergamaschi, A.; Marino, F.; Lecchini, S., (2009) Antioxidant Properties and In Vitro Immunomodulatory Effects of Peppermint (Mentha × Piperita L.) Essential Oils in Human Leukocytes. Journal of Pharmaceutical Sciences and Research, 1(3), 33–43
17. Eva, S. B.; Maria, H. T.; Attila, H.; Csilla, R.; and Szollosi, V. (2018).Antioxidant effect of various rosemary (Rosmarinus officinalis L.) clones. Acta Biologica szegediensis., 47(1-4): 111-113.
18. G. Demin and Z. Yingying, (2010) “Comparative antibacterial activities of crude polysaccharides and flavonoids from Zingiber officinale and their

extraction," American Journal of Tropical Medicine, 5.235–238.
19. Gebrehiwot, Hadush & Bachheti, R & Dekebo, Aman. (2015). Chemical composition and antimicrobial activities of leaves of sweet basil (Ocimum basilicum L.) herb. International Journal of Basic and Clinical Pharmacology.10. 869-875.
20. Giri, Bupesh & Amutha, C & Siddhan, Nandagopal & Ganeshkumar, A & Periyasamy, Sureshkumar & Saravana Murali, K. (2007). Antibacterial activity of Mentha piperita L. (peppermint) from leaf extracts - A medicinal plant. Acta agriculturae Slovenica. 89 - 1,. 73 - 79.
21. Gould IM, Bal AM. (2013).New antibiotic agents in the pipeline and how they can overcome microbial resistance. Virulence ;4(2):185–191
22. Gull, Iram & Saeed, Mariam & Shaukat, Halima & Aslam, Muhammad & Samra, Zahoor & Athar, Muhammad. (2012). Inhibitory effect of Allium sativum and Zingiber officinale extracts on clinically important drug resistant pathogenic bacteria. Annals of clinical microbiology and antimicrobials. 11. 11:8
23. Harris, J. C. et al. "Antimicrobial properties of Allium sativum (garlic)." (2001): Applied Microbiology and Biotechnology. (57) 282-286.
24. Hussain AI, Anwar F, Sherazi STH, Przybylski R (2008) Chemical composition, antioxidant and antimicrobial activities of basil (O. basilicum) essential oils depend on seasonal variations. Food Chem 108(3): 986-995.
25. Irfan, uma & ali, sarah. (2016). The antibacterial effect of curry leaves (murraya koenigii). european journal of pharmaceutical and medical research. 3. 382-387.
26. Ji, M., Choi, J., Lee, J., and Lee, Y. (2004).Induction of apoptosis by ar-turmerone on various cell lines. Int J Mol Med ;14(2):253-256.
27. Karuppiah, P., & Rajaram, S. (2012). Antibacterial effect of Allium sativum cloves and Zingiber officinale rhizomes against multiple-drug resistant clinical pathogens. *Asian Pacific journal of tropical biomedicine*, *2*(8), 597-601.
28. Kim, K. J., Yu, H. H., Cha, J. D., Seo, S. J., Choi, N. Y., and You, Y. O. (2005)Antibacterial activity of Curcuma longa L. against methicillin-resistant Staphylococcus aureus. Phytother Res ;19(7):599-604.
29. Lobanovska, M., & Pilla, G. (2017). Penicillin's Discovery and Antibiotic Resistance: Lessons for the Future?. *The Yale journal of biology and medicine*, *90*(1), 135-145.
30. M.N.I. Bhuiyan, J. Begum, M. Sultana (2009), Chemical composition of leaf and seed essential oil of Coriandrum sativum L. from Bangladesh.Bangladesh J Pharmacol, 4 . 150-153
31. Majee, Sutapa & Avlani, Dhruti & Hazra, Banasri. (2018). Synergistic Interaction Between Plant Products and Antibiotics Against Potential Pathogenic Bacteria. Frontiers in Anti-Infective Drug Discovery : 7 .88-152
32. Malu, Samuel & O Obochi, G & N Tawo, E & E Nyong, B. (2009). Antibacterial activity and medicinal properties of Ginger (Zingiber officinale). Global Journal of Pure and Applied Sciences. 15. 3-4.
33. Mandal, Shyamapada & Mandal, Manisha. (2015). Coriander (Coriandrum sativum L.) essential oil: Chemistry and biological activity. Asian Pacific Journal of Tropical Biomedicine. 4. 421-428.
34. Moghaddam, Amir & Shayegh, Jalal & Mikaili, Peyman & Sharaf, Jalil. (2011). Antimicrobial activity of essential oil extract of Ocimum basilicum L. leaves on a variety of pathogenic bacteria. Journal of Medicinal Plants Research. 5. 3453-3456
35. Nabrdalik, Małgorzata. (2016). Antibacterial activity of Ocimum basilicum L. essential oil against Gram-negative bacteria. Post Fitoter. 17. 80-86.
36. Nieto, Gema & Id, Gaspar & , Ros & Castillo, Julián. (2018). medicines Antioxidant and Antimicrobial Properties of Rosemary (Rosmarinus officinalis, L.): A Review. Medicines. 5.: 98.
37. Nishiyama, T., Mae, T., Kishida, H., Tsukagawa, M., Mimaki, Y., Kuroda, M., Sashida, Y., Takahashi, K., Kawada, T., Nakagawa, K., and Kitahara, M. (2005).Curcuminoids and sesquiterpenoids in turmeric (Curcuma longa L.) suppress an increase in blood glucose level in type 2 diabetic KK-Ay mice. J Agric Food Chem 2.959-963.
38. Opalchenova, G & Obreshkova, Danka. (2003). Comparative studies on the activity of basil - An essential oil from Ocimum basilicum L. - Against multidrug resistant

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

39. Petruta, Aelenei & M. Rimbu, C & Guguianu, Eleonora & Dimitriu, Gabriel & Aprotosoaie, Ana Clara & Brebu, Mihai & Horhogea, Cristina & Miron, A. (2018). Coriander essential oil and linalool - interactions with antibiotics against Gram-positive and Gram-negative bacteria. Letters in Applied Microbiology. 10.
40. Pillai R., Trivedi, N. A., & Bhatt, J. D. (2013). Studies on in vitro interaction of ampicillin and fresh garlic extract against Staphylococcus aureus by checkerboard method. *Ancient science of life*, *33*. 114-118.
41. R. Grzanna, L. Lindmark, and C. G. Frondoza, (2005) "Ginger—an herbal medicinal product with broad anti-inflammatory actions," Journal of Medicinal Food.8. 125–132.
42. Rafieian-Kopaei, M. (2012). Medicinal Plants and the Human Needs. J. HerbMed. Plarmacol. 1.1-2.
43. S. Gaherwal, F. Johar, N. Wast and M.M. Prakash (2017).Anti-Bacterial Activities of Allium sativum Against Escherichia coli, Salmonella Ser. Typhi and Staphylococcus aureus International Journal of Microbiological Research 5 (1): 19-22.
44. S. Rivlin, Richard. (2001). Historical Perspective on the Use of Garlic. The Journal of nutrition. 131:1027-1031
45. Sambasivaraju, D & ZA, Fazeel. (2016). Evaluation of antibacterial activity of Coriandrum sativum (L.) against gram and ndash; positive and gram and ndash; negative bacteria. International Journal of Basic and Clinical Pharmacology. 5. 2653-2656.
46. Silva, Filomena & Ferreira, Susana & Queiroz, João & C Domingues, Fernanda. (2011). Coriander (Coriandrum sativum L.) essential oil: Its antibacterial activity and mode of action evaluated by flow cytometry. Journal of medical microbiology. 60. 1549-7852
47. Sriti, J., Wannes, W.A., Talou, T., Vilarem, G. and Marzouk, B. (2011). Chemical composition and antioxidant activities of Tunisian and Canadian coriander (Coriandrum sativum L.) fruit. J Essent Oil Res. 23. 7-15.
48. Sukandar, Elin & Kurniati, Neng & Wikaningtyas, Pratiwi & Agprikani, D. (2016). Antibacterial interaction of combination of ethanolic extract of Zingiber officinale var rubrum rhizome,Boesenbergia pandurata rhizome, and Stevia rebaudiana leaves with certain antibiotics against infectious mouth microbial. 9. 311-314.
49. Sultanbawa, Y. (2011) Plant antimicrobials in food applications: minireview. In: Science against microbial pathogens: communicating current research and technological advances, Formatex. 1084-1093.
50. Teow, Sin-Yeang & Ali, Syed. (2015). Synergistic antibacterial activity of Curcumin with antibiotics against Staphylococcus aureus. Pak J Pharm Sci. 28. 2109-2114.
51. Toroglu S (2007) In vitro antimicrobial activity and antagonistic effect of essential oils from plant species Environ Biol ;28:551-9.
52. Vats, Manisha & Singh, Harneet & Sardana, Satish. (2011). Phytochemical screening and antimicrobial activity of roots of Murraya koenigii (Linn.) Spreng. (Rutaceae). Brazilian journal of microbiology : [publication of the Brazilian Society for Microbiology]. 42. 1569-73. 10.
53. Viviane Araújo Silva, Janiere Pereira da Sousa, Hilzeth de Luna Freire Pessôa, Andrea Fernanda Ramos de Freitas, Henrique Douglas Melo Coutinho, Larissa Beuttenmuller Nogueira Alves & Edeltrudes Oliveira Lima(2016) *Ocimum basilicum*: Antibacterial activity and association study with antibiotics against bacteria of clinical importance, Pharmaceutical Biology, 54., 863-867,.
54. World Health Organization. Antimicrobial resistance 2018 [cited 2018 15 february]. (http://www.who.int/mediacentre/factsheets/fs194/en/).
55. Zorofchian, Soheil & Abdul Kadir, Habsah & Hassandarvish, Pouya & Tajik, Hassan & Abu Bakar, Sazaly & Zandi, Keivan. (2014). A Review on Antibacterial, Antiviral, and Antifungal Activity of Curcumin. BioMed Research International Volume 2014.,12.