International Journal of Botany Studies
ISSN: 2455-541X; Impact Factor: RJIF 5.12
Received: 18-11-2020; Accepted: 03-12-2020: Published: 15-12-2020
www.botanyjournals.com
Volume 5; Issue 6; 2020; Page No. 504-507

Plant derived antimicrobial agents: Review

Monika Gahlot, Shreyoshi Tarapdar, Megha Duggal, Shubham Tyagi, Priyank Vyas, Amit Gupta*
Department of Biotechnology, Graphic Era Deemed to be University, Dehradun, Uttarakhand, India

Abstract
Medicinal plant products have been used for the last so many years pertaining to treat various healths disorders and be able to prevent or cut the burden of various infectious diseases. Overall, the knowledge of these medicinal plant products in terms of its taxonomy and its medicinal properties has been transmitted all over the world. In literature, active compounds were reported and synthesized or modified structurally and showing its effectiveness against various infectious diseases and used for other medicinal purpose as well. According to the literature, antimicrobial activity of many plants is reported and scientifically confirmed with the increasing number of reports on various pathogenic microorganisms resistant to antimicrobials. So, these medicinal plants derived products may be effective and potentially control the growth of various microbial pathogens in diverse type of situations or specific case of disease treatment. Therefore, various pharmaceutical companies developing some new type of antimicrobial drugs especially due to the constant emergence of microorganisms resistant to conventional antimicrobial. In the present work, we emphasized on various medicinal plant products with its antimicrobial properties are reviewed.

Keywords: Medicinal plants; antimicrobial; pathogens; disease

Introduction
Natural products were obtained through medicinal plant products and these are available in the form of pure compounds or extracts and give some unlimited opportunities especially for new drug candidate leads because of the unequalled availability of chemical diversity. Due to its chemical diversity, new drug candidate who may be identified through common phytochemical screening assays, chromatographic techniques such as HPLC (High performance liquid chromatography) and non-chromatographic techniques such as immunoassay and Fourier Transform Infra-Red (FTIR). Historically, medicinal plant products generally used as traditional medicine and considered as one of the major source of natural antimicrobial based substances or compounds for the treatment of various infectious diseases [1, 2]. Different classes of antimicrobial substances are reported and considered them as one of the major defence systems pertaining to protect them against various biotic (living) and abiotic (non-living) stresses or components. However, there is a great demand for those extracts especially medicinal plants with antimicrobial activity against various infectious diseases or pathogens have been reported or still is under progress [3, 4].

The antimicrobial agent is a common term used for antibiotics i.e. antifungal, antivirals and antiprotozoans. These agents are chemical or natural substances which act on pathogenic microbes either by killing them (microbicidal) or by reducing the growth (microbiostatic) [5]. In recent time a wide range of synthetic and semi synthetic antimicrobial drugs are available on the market which tends to have a lot of side effects. Therefore, the use of antimicrobial agents obtained from natural sources is an alternative better choice with lesser side effects. In literature, medicinal plants may contain various secondary metabolites which play crucial roles in microbial infection [6, 7]. Likewise plants, animal based products also having anti-microbial agents or showed properties e.g. milk and egg albumin etc. A large collection of bio-molecules from marine organisms are also reported and showed a great interest to compete with pathogenic microbes. In a recent study, WHO has informed that more than 80% of people are totally relies chiefly on traditional medicinal practices which involve medicinal plant extracts. As per the literature, ancient Egyptians including Greeks used specific molds and plant extracts were reported to treat various kinds of infection [8].

One of the microbiologists (Louis Pasteur and Jules Francois Joubert) observed antagonism in some of the species of *bacteria* and discussed the merits including demerits of controlling these interactions in medicine. In 1928, Alexander Fleming firstly reported and discovered a natural powerful antimicrobial fungus i.e. *Penicillium*. The substance i.e. antibiotic extracted from the fungus and named as *Penicillin* in 1942 and it was successfully used and applied to treat *Streptococcus* infections. But now a day, antibiotic resistance has become a serious problem and affects almost every bacterial species and this problem is steadily reporting worldwide [9, 10].

Antimicrobials agents
Phytochemicals obtained from medicinal plant products such as alkaloids, flavonoids, diterpenes, triterpenes are the major source for antimicrobial agents. The most familiar example is seen in case of farming where Benomyl, chlorothalonil and captan are commonly used in plant diseases whereas in agriculture, imazalil and triadimefon are used and applied in order to control fungal infection of fruit and vegetables.

Similarly, major groups of plant derived compounds (phenolic acids, quinones, saponins, flavonoids, tannins, coumarins, terpenoids, and alkaloids) were isolated and

identified and showed antimicrobial activities [11, 12]. Most familiar examples are

- Rose is a perennial plant, belonging to the genus Rosa and family *Rosaceae*. There are approximately 10,000 species of rose among which majority of species have been found to possess a variety of antimicrobial properties in their leaves, stems and roots. Rose petals and leaves are known to help us in flushing toxins from our body and are also known to help in chest congestion and provide relief to throat. Rose plant as a whole have shown antifungal, antibacterial and antioxidant properties in many research studies. The ethanolic, acetone and aqueous extract of rose petals are found to be highly sensitive towards certain species of both gram positive and gram negative bacteria. As per the literature, ethanolic extract of rose petals is found to be more potent as compared to other extracts in inhibiting or reducing the growth of certain bacterial species such as *B. subtilis*, *E. Coli* and *S. aureus.* This activity is mainly due to the presence of antimicrobial components obtained from rose petals which include alkaloids, tannins, saponins, anthraquinones, glycosides, steroids, flavonoids, carbohydrates, and amino acids. In addition, essential oils extracted from rose flower also considered and claimed its antimicrobial and antioxidant properties. The essential oil extracted from rose has proved to be very effective in inhibiting the growth of *Staphylococcus aureus*, *Enterococcus faecalis*, *Escherichia coli*, *Klebsiella pneumonia* and *Pseudomonas aeruginosa* [13, 14].
- Berries include a wide range of fruits, such as strawberries, black berries, bilberry, raspberry, red currant, cranberries, etc. Berry plants possess a number of phenolic compounds, often in the surface layer of the plant or in the fruit or berry. The phenolic compounds are mainly found or reported in berry plants especially in the form of flavonoids, phenolic acids, lignans, and polymeric tannins. Ellagitannins is the major phenolic acid found in raspberry plant. The most common phenolic acids present in berries are derivatives of either hydroxycinnamic acids or hydroxybenzoic acid and this is most commonly found in strawberries. In contrast, these antimicrobial agents are supposed to be very important for keeping a healthy gastrointestinal tract in human. *Helicobacter pylori*, a causative agent of gastritis which is responsible for conditions like ulcer, indigestion and weak digestive system. Other pathogens which likely cause gastric infections like Campylobacter jejuni, *Escherichia coli, and Salmonella enterica* are also found to be sensitive towards the phenolic compounds found in berries. In addition, antimicrobial properties specially obtained from cranberries have shown to inhibit the *H. pylori* and *E. coli*, which are responsible for causing urinary tract infection. In some recent study, cranberry extract has strongly shown antimicrobial against gram-positive bacteria like *B. cereus E-727, Clostridium perfringens E-861T*, and *Staphylococcus epidermidis* [15, 16].
- *Guava*, small evergreen tree which is 2-6 inches long and 4 inches wide approximately. This plant as a whole have been found very beneficial to human health and has been used as traditional medicine for a long period of time to treat conditions like malaria, diarrhoea, vomiting, ulcers, toothache, inflamed gums, controlling diabetes, managing hypertension and obesity. The genus *Pisidum* consists of approximately 150 species out of which most commonly cultivated species of *Psidium* is *P. guajava* (commonly called as guava).The antimicrobial activities of the stem, roots, bark, leaves have shown to inhibit both gram positive and gram negative bacteria such as *Staphylococcus aureus.* The leaf extract have shown antimicrobial properties against the acne causing microbes too. The antimicrobial agents obtained from this plant are terpenoids, flavonoids, glycosides, phenols and tannins but however this plant is devoid of saponins [17, 18].
- Lemon is one of the important parts of our diet, which is an important source of Vitamin C, but one fact about lemon where people are still unaware about its antimicrobial property and its potential to act as anticancer agent. Not only the fruit but leaves, roots, stem of lemon is very rich in antimicrobial components.Citrus flavonoids have a large spectrum of biological activity including antibacterial, antifungal, antidiabetic, anticancer and antiviral activities. Flavonoids may act as antioxidant source and helps to modulate enzymatic activities which help to inhibit cell proliferation. The peels of lemon are rich in flavonoids, glycosides which have the defensive mechanism towards pathogen invention. A very rare type of antimicrobial agent, polymethoxylated flavones which have several bioactivities is also found in lemons, especially in the peels. One of the studies where scientists showed the existence of essential oils including various metabolites or compounds like protopine and corydaline alkaloids, lactons, polyacetylene, acyclic sesquiterpenes, hypericin and pseudohypericin, which is highly effective towards various bacterial pathogens. Skin floras e.g. *Pseudomonas* and *Micrococcus* are effectively declining or inhibited through the actions of phytochemicals that are reported in lemon, especially in fruit for which it is found to be healthy for skin and the juice is applied on skin as a traditional form of skin care in many regions. Phytochemical analysis of lemon leaves, fruits, stem, root have revealed that it contains antimicrobial agents like carbohydrates, phenol, alkaloids, amino acids, saponin, steroids, reducing sugar, glycosides and terpenoids which helps to kill a number of bacteria, fungal and viruses for which lemon extracts are considered as an important ingredient of making sanitizers [19, 20].
- Two species of *Artemisia* i.e. *Artemisia annua* and *Artemisia vulgaris* has been studied and claimed its antimicrobial properties against a wide range of gram negative bacteria. One of the oldest species of *Artemisia* i.e. *Artemisia afra* is considered as one of the oldest known medicinal plants reported in Southern Africa. In addition, this plant species mainly applied and used to cure various infectious diseases including common cold, diabetes mellitus, bronchial complaints and stomach disorders. In addition, *Artemisia afra* oil also reported and contained higher amount of α - thujone and a lower 1,8 - cineole content an claimed its broad spectrum of antimicrobial activity towards *Streptococcus pyogenes*, *Listeria monocytogenes* and *Acinetobacter johnsonii*. In addition, *Salmonella typhi* shows the lowest sensitivity towards the action of

the plant's antimicrobial components, while *Pseudomonas aeruginosa* and *Pseudomonas fluorescens* showed no sensitivity at all. In general, gram positive bacteria show more sensitivity towards the antimicrobial components of the plant then the Gram positive bacteria [21].

- *Aloe vera* (family *Alliaceae*), medicinal plant is mainly used and also applied in Ayurvedic, Homoeopathic and Allopathic streams of medicine. One of the most essential or crucial element or component of Aloe vera gel which contained various bioactive constituents that is more essential with respect to human health care. One of the studies claimed that Aloe vera gel showed antioxidant and antimicrobial activity and also showed some declining in pathogenic growth rate as well. In short, this immunobiological based activity is done only through existence of active moieties that is reported with in this gel [22].
- One of the diverse groups of secondary metabolites i.e. flavonoids are reported especially in fruits and vegetables. In contrast, flavonoid from medicinal plant products especially leaves of *Mangifera indica* and *Syzygium cumini* and showing its antimicrobial activity against bacterial pathogens. In short, flavonoids *Mangifera indica* and *Syzygium cumini* should provide beneficial effects with respect to human health care [23].

Conclusion

The antimicrobial activity of medicinal plant products was proven through some examples but this property should be applied for the synthesis and development of effective medicines against increasing number or count of bacterial strains that become highly resistant to conventional antibiotics.

References

1. Cowan MM. Plant products as antimicrobial agents. Clin Microbiol Rev. 1999; 12(4):564-82.
2. Nascimento GGF, Locatelli J, Freitas PC, Silva GL. Antibacterial activity of plant extracts and phytochemicals on antibiotic-resistant bacteria. Braz J Microbiol. 2000; 31(1):247-256.
3. Alzoreky NS, Nakahara K. Antibacterial activity of extracts from some edible plants commonly consumed in Asia. Int J Food Microbiol. 2003; 80(3):223-230.
4. Coutinho HDM, Costa JGM, Siqueira-Júnior JP, Lima EO. *In vitro* anti-staphylococcal activity of Hyptis martiusii Benth against methicillin-resistant *Staphylococcus aureus* MRSA strains. Rev Bras Pharmacogn. 2008; 18:670-675.
5. Talbot GH, Bradley J, Edwards JE, Gilbert D, Scheid M and Bartlett JG. Bad bugs need drugs: an update on the development pipeline from the antimicrobial availability task force of the infectious diseases society of America. Clinical Infectious Diseases. 2006; 42(5):657–668.
6. Nielsen TRH, Kuete V, Jäger AK, Meyer JJM, Lall N. Antimicrobial activity of selected South African medicinal plants. BMC Complementary & Alternative Medicine. 2012; 12:74.
7. Kaleeswaran B, Ilavenil S, Ravikumar S. Screening of phytochemical properties and antibacterial activity of *Cynodon dactylon* L. International Journal of Current Research. 2010; 3:83–88.
8. Ultee A, Bennink MHJ, Moezelaar R. The phenolic hydroxyl group of carvacrol is essential for action against the food-borne pathogen *Bacillus cereus*. Appl Environ Microbiol. 2002; 68(4):1561-1568.
9. Brown D. Antibiotic resistance breakers: can repurposed drugs fill the antibiotic discovery void? Nat Rev Drug Discov. 2015; 14(12):821–832.
10. Khameneh B, Diab R, Ghazvini K, Fazly Bazzaz BS. Breakthroughs in bacterial resistance mechanisms and the potential ways to combat them. Microb Pathog. 2016; 95:32-42.
11. Gupta A, Khamkar PR, Chaphalkar SR. Applications and uses of active ingredients from medicinal plants. Indian Journal of novel drug delivery. 2014; 6(2):106-111.
12. Gupta A, Patil SS, Pendharkar N. Antimicrobial and anti-inflammatory activity of aqueous extract of *Carica papaya*. Journal of Herbmed Pharmacology. 2017; 6(4):148-152.
13. Ulusoy S, Boşgelmez-Tinaz G, Seçilmiş-Canbay H. Tocopherol, carotene, phenolic contents and antibacterial properties of rose essential oil, hydrosol and absolute. Curr Microbiol. 2009; 59:554–558.
14. Gochev V, Wlcek K, Buchbauer G, Stoyanova A, Dobreva A, Schmidt E, *et al*. Comparative evaluation of antimicrobial activity and composition of rose oils from various geographic origins, in particular Bulgarian rose oil. Nat Prod Commun. 2008; 3:1063–1068.
15. Nohynek LJ, Alakomi HL, Kähkönen MP, Heinonen M, Helander IM, Oksman-Caldentey KM, *et al.* Berry phenolics: antimicrobial properties and mechanisms of action against severe human pathogens. Nutr Cancer. 2006; 54(1):18-32.
16. Puupponen-Pimia R, Nohynek L, Hartmann-Schmidlin S, Kähkönen M, Heinonen M, Määttä-Riihinen K, *et al.* Berry phenolics selectively inhibit the growth of intestinal pathogens. J Appl Microbiol. 2005; 98(4):991-1000.
17. Tyagi S, Tyagi R, Rathour S, Chamoli P, Gupta A. Phytochemical investigation and antimicrobial evaluation of *Psidium guajava*. International Journal of Botany studies. 2020; 5(4):85-87.
18. Mani A, Mishra R, Thomas G. Elucidation of diversity among *Psidium* species using morphological and SPAR methods. Journal of Phytology. 2011; 3:53–61.
19. Rathour S, Rawat P, Tyagi S, Ghosh K, Gupta A. Phytochemical analysis, antioxidant and antimicrobial activity of *Raphanus sativus* and Citrus Limon Peel. International Journal of Botany studies. 2020; 5(3):452-456.
20. El-Mahrouk EM, Abido AI, Radwan FI, Hamed ES, El-Nagar EE. Vegetative growth and essential oil productivity of lemongrass (*Cymbopogon citratus*) as affected by NPK and some growth stimulators. International Journal of Botany studies. 2018; 3(6):48-55.
21. Bertea CM, Freije JR, Van Der Woude H. Identification of intermediates and enzymes involved in the early steps of artemisinin biosynthesis in *Artemisia annua.* Planta Medica. 2005; 71(1):40–47.
22. Kambhoj A, Gupta A, Shaikh A. Evaluation of antioxidant and antimicrobial Potential in *Aloe vera* gel. EC Pharmacology and Toxicology. 2019; 7:1100-1108.

23. Ghosh K, Tyagi S, Gupta A. Analytical and immune pharmacological studies of flavonoids: *Mangifera Indica* and *Syzygium Cumini*. Biomedical & Pharmacology Journal. 2020; 13 (2):899-906.