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Short Communication

Plants as potential source of antimicrobial agents

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For microbial infections, either caused by bacteria or fungi, antibiotics are employed. After the discovery of antibiotics it was thought that infectious diseases will no longer exist. But due to irrational use of antibiotics, a number of bacterial strains with multi-drug resistance have emerged (khan et al., 2009) and due to infectious diseases millions of people die every year (Dubey et al., 2012). It is a bitter fact that infectious diseases are the leading cause of the premature deaths which result in approximately fifty thousand deaths annually around the globe (Ahmad and Beg, 2001). The unnoticeable use of antimicrobials both in developing and developed countries led to the creation of microbial resistance problems. It also makes the treatment difficult especially in immunocompromised patients (Ahmad and Beg, 2001).

Plants and plant products have been used as medicines since the start of history. Many researchers have conducted research on the plant products to check their antimicrobial effects (Abu-shanab et al., 2004). The oldest known method for healing is the use of plant. Using higher plants for treatment of diseases had started since the man started to live on this planet (Onyeagba et al., 2004). Traditional medicines including the herbal medicines are used at least for primary health care in some domains in almost every country. In the developing countries about 70-95% patients depends on the natural medicines. In 2008 the worldwide market of natural medicine was of 83 billion US$ and on annual basis there is exponential increase in this bill. Legal concerns about the herbal/natural medicines vary widely from state to state and country to country and these medicines are used as self-medicines, health foods, functional foods, homes care remedies, over the counter medicines, prescription medicines etc. The quality of the herbal/traditional medicines is very difficult to control and maintain consistently. WHO in cooperation with its local and regional offices has made Good Agricultural and Collection Practices (GACP) and Good Manufacturing Practices (GMP) in addition to technical support and assistance for standardization for creation of high quality products. For understanding the approaches of quality, safety and efficacy which are based on research are needed to evaluate the traditional or herbal medicines (Robinson and Zhang, 2011). Search for the relief from infection from natural resources (plants etc.) is not a new idea. People from all over the world use the plant products for healing e.g. it is evident that Neanderthals who lived 60,000 years ago in the present day Iraq used hollyhock, and these plants are still widely used in the ethanomedicine all around globe. Hippocrates mentioned 300-400 medicinal plants in the late 5th century B.C (Cowan, 1999). A number of plants contain compounds that have antibacterial property (Khan et al., 2011). Compounds such as emetine, berberine and qunine which are derived from plants are very effective for the infectious microbes (Iwu et al., 1999). On the earth there are more than 3, 00,000 plant species and only about 2% of plants have been checked so for, for their antimicrobial properties. Plants extracts from more than 157 plant families have been described which have potential antimicrobial properties (Narayan et al., 2010). In United States of America (USA) about 1/4th to 1/2th of the pharmaceuticals dispensed have their origin of higher plants (Cowan, 1999). Medicine which in near past had been derived from natural resources include taxol, camptothecin (anticancerous) and artemisinin (antimlarial). These and many other drugs clearly show that plants serve the potential source of medicine even today.

Substances derived from plants have become paramount importance currently because of their numerous functionalities (Baris et al., 2006). Medicinal plants are the greatest source of all kinds of medicines including traditional system of medicines, modern medicines, nutraceuticals and leads for new chemical entities. About 14-28% of higher plants are used as medicines and about 74% of the medicines from plants have been derived after exploiting ethnomedicinal use of plants. The process of introduction of new pharmacological active compounds was started first with the identification of new chemical entity then evaluation of its pharmacological activity then its dosage form development and finally with its pharmacokinetic studies, the similar is the case with therapeutic ingredients of plants origin (Ncube et al., 2008). Herbal medicines are the mainstay of treatment in 75-80% population mainly in the developing countries. Reason is that these have better acceptability due to economy and with no or only a few side effects. In the near past the herbal medicines have seen increased use in the developed countries. Due to emergence of microbial resistance to antimicrobials and side effects associated with synthetic or semi synthetic antimicrobial agents, now our main focus is on plant derived extracts or crude plant products (Parekh et al., 2005; Khan et al., 2009). The above discussion clearly indicates that plants are main focus in near future for the discovery of new antimicrobial agents. Below is given a list of few plants which have proven antimicrobial effects and these may be the source of lead compounds.

No.	**Plant name**	**Part Used**	**Extract**	**Microorganisms used**	**Reference**
1	*Achyranthus aspera, Cynodon dactylon,Lanata camara & Tagetes patula*	Leaves and shoots	Ethanolic	*Bacillus subtilis, Staphylococcus aureu, Pseudomonas aeroginosa*	Narayan, *et al.*, 2010.
2	*Quercus infectoria*	Galls	Aqueous and acetone	*Staphylococcus aureu, Staphylococcus epidermidis, Bacillus subtilis, Escherichia coli, Sallmonella typhimurium, & Pseudomonas aeruginosa*	Basri, and Fan, 2005.
3	*Coccinia grandis L.*	Leaves and stem	Water and ethanol	*Bacillus cereus, Corynebacterium diptheriae, Staphylococcus aureus, Streptococcus pyogenes, Escherichia coli, Klebsiella pneumonia, Proteus mirabilis, Pseudomonas aeruginosa, Salmonella typhi and Shigella boydi*	Farrukh, *et al.*, 2008.

4	*Acacia nilotica, Sida cordifolia, Tinospora cordifolia, Withania somnifer and Ziziphus mauritiana*	Root / Bark	Methanol	*Bacillus subtilis, Escherichia coli, Pseudomonas fluorescens, Staphylococcus aureus and Xanthomonas axonopodis pv. malvacearum Fungus Aspergillus flavus, Dreschlera turcica and Fusarium verticillioides*	Mahesh and Satish., 2008.
5	*Polygonum aviculare*	Whole plant	Acetone, ethanol, chloroform and water	*Escherichia coli, Proteus mirabilis, Pseudomonas aeruginosa, Salmonella typhi, S. paratyphi and Shigella flexneri, Staphylococcus aureus, Bacillus subtilis, and Streptococcus pyogenes, Aspergillus flavus, Aspergillus fumigatus, Aspergillus niger and C. albicans.*	Salama, and Marraiki., 2010.
6	*Heliotropium strigosum*	Whole plant	Ethyl acetate, n-hexane, chloroform and water	*Escherichia coli, Pseudomonas aeruginosa, Klebsiella pneumonia, Staphylococcus epidermidis, Bacillus subtilis* and methicillin resistant *Staphylococcus aureus, Aspergillus*	Hussain, *et al.*, 2010.

				niger, Aspergillus fumigates, Fusarium solani and Aspergillus flavus	
7	*Woodfordia fruiticosa, Adhatoda vasica, Chenopodium ambrosoides, Viburnum cotinifolium, Euphorbia hirta, Vitex negundo, Peganum harmala, Broussonetia papyrifera, Taraxacum officinale, Urtica dioica, Verbascum thapsus, Caryopteris grata* and *Mimosa rubicaulis*	Different parts	Methanol	*Staphylococcus aureus, Bacillus subtilis, Micrococcus luteus, Enterococcus faecalis, Escherichia coli, Pseudomonas aeruginosa, Klibsella pneumonia, Vibrio Cholera, Enterobacter coccus, Aspergilus niger, Aspergilus flavus, Aspergilus fumigates and Rhyzoctonia solani*	Khan, *et al.*, 2011.
8	*Satureja hortensis L., Stachys woronowii R. Mill, Ziziphora clinopodioides Lam. Origanum vulgare L. Letswaart and Sideritis montana L.*	Different parts	Methanol	*Pseudomonas aeruginosa, Klebsiella pneumonia, Staphylococcus aureus, Bacillus megaterium, Candida albicans , Candida glabrata , Epidermophyton sp. and Trichophyton sp.*	Kursat and Erecevit., 2009.
9	*Sapindus emarginatus, Hibiscus rosa-sinensis, Mirabilis jalapa, Rheo discolor, Nyctanthes arbortristis, Colocasia esculenta, Gracilaria corticata, Dictyota spps., and Pulicaria wightiana*	Leaves or whole plant	Water and methanol	*Pseudomonas testosteroni, Staphylococcus epidermidis, Klebsiella pneumoniae, Bacillus subtilis, Proteus morganii, and Micrococcus flavus*	Nair, *et al.*, 2005.

10	*Vernonia amygdalina, Eucalyptus citriodora and Phyllanthus amarus*	Different parts	Water and ethanol	*Vernonia amygdalina (Bitterleaf), Eucalyptus citriodora (Eucalypt) and Phyllanthus amarus*	Sule and Agbabiaka, 2008.
11	*Balanites aegyptiaca and Moringa oleifera*	Leaves	Water acetone and ethanol	*Salmonella typhi*	Doughari *et al.*, 2007.
12	*Parthenium hysterophorus, Stevia rebaudiana* and *Ginkgo biloba*	Leaves	Methanol, ethanol and dichloro-methane	*Escherichia coli, Pseudomonas aeruginosa, Klebsiella pneumoniae, Bacillus subtilis, Enterococcus* spp., and *Staphylococcus aureus*	Fazal *et al.*, 2011.
13	*Acalypha indica, Cassia auriculata, Eclipta alba and Phyllanthus niruri*	Leaves and roots	Water and ethanol	*Escherichia coli, Proteus vulgaris, Staphylococcus aureus* and *Bacillus subtilis*	Chitravadivu *et al.*, 2009.
14	*Prosopis cineraria, Capparis decidua, Tinospora cordifolia, Carissa carandas* and *Cordia Dichotoma*		Benzene, chloroform, acetone methanol and water	*Staphylococcus aureus, Staphylococcus epidermidis, Escherichia coli, Aspergillus niger* and *Candida albicans*	Salar and Dhall, 2010.
15	*Solanum xanthocarpum Schrad. and Wendl.*	Leaves, stem, roots and fruits	Ethanol, benzene, acetone and methanol	*Staphylococcus aureus, S. epidermidis, Escherichia coli, Pseudomonas aeruginosa* and *Aspergillus niger*	Salar and Suchitra, 2009.
16	*Aegle marmelos*	Leaves	Petroleum ether, dichloromethane, chloroform, ethanol and	Micrococcus glutamicus, Lactobacillus bulgaris,	Rajasekaran *et al.*, 2008.

			water	Streptococcus faecalis, Staphylococcus aureus, Bacillus stearothermophilus, Staphylococcus pyogenes, Micrococcus luteus, Bacillus cereus, Escherichia coli and Pseudomonas aeruginosa	
17	*Allium sativum* Linn, *Zingiber officinale* and *Citrus aurantifolia* Linn.	Fruits and rhizome	Water and ethanol	*Bacillus spp., Staphylococcus aureus, Escherichia coli, Salmonella spp.*	Onyeagba *et al.*, 2004.
18	*Ximenia americana*	Leaves	Ethanol	*Escherichia coli, Pseudomonas aeruginosa, Proteus vulgaris, Bacillus subtilis, Staphylococcus aureus, Candida albicans*	Ogunleye and Ibitoye, 2003.
19	*Acacia nilotica, Terminalia arjuna, Eucalyptus globulus, Syzygium aromaticum and Cinnamomum zeylanicum*	Leaves and bark	Ethanol	*Escherichia coli, Klebsiella Pneumonia, Candida albicans, Streptococcus mutans, Staphylococcus aureus, Enterococcus faecalis, Streptococcus bovis, Pseudimonas aeruginosa, Salmonella typhimurium, Escherichia coli, Klebsiella pneumonia, Candida albicans*	Khan *et al.*, 2009.

20	*Syzyium aromaticum, Cinnamomum cassia, Salvia officinalis, Thymus vulgaris and Rosmarinus officinalis*	Water methanol and ethanol	Seeds, bark and leaves	*Staphylococcus aureus, Pseudomonas aeruginosa, Escherichia coli, Bacillus subtilis*	Abu-shanab *et al.*, 2004.

References

Abu-shanab B, Adwan G, Abu-safiya D, Jarrar N and Adwan k (2004). Antibacterial activities of some plant extracts utilized in popular medicine in Palestine. Turkish Journal of Biology, 28(1): 99-102.

Ahmad I and Beg AZ (2001). Antimicrobial and phytochemical studies on 45 Indian medicinal plants against multi-drug resistant human pathogens. Journal of Ethanopharmacology, 74(1): 113-123.

Baris O, Gulluce M, Sahin F, Ozer H, Kilic H, Ozkan H, Sokmen M and Ozbek T (2006). Biological activities of the essential oil and methanol extract of Achillea Biebersteinii Afan. (Asteraceae). Turkish Journal of biology, 30(4): 65-73.

Basri DF and Fan SH (2005). The potential of aqueous and acetone extracts of galls of Quercus infectoria as antibacterial agents. Indian Journal of pharmacology, 1(37): 26-29.

Chitravadivu C, Manian S and Kalaichelvi K (2009). Antimicrobial studies on selected medicinal plants, Erode region, Tmilnadu, India. Middle-East Journal of Scientific Research, 4(3): 147-152.

Cowan MM (1999). Plant products as antimicrobial agents. Clinical Microbiology Reviews, 12(4): 564-582.

Doughari JH (2006). Antimicrobial activity of Tamarindus indica Linn. Troical Journal of Pharmaceutical Research, 5(2): 597-603.

Dubey D, Rath S, Sahu MC, Debata NK and Padhy RN (2012). Antimicrobials of plant origin against TB and oother infections and economics of plant drugs-introspection. Indian Journal of Traditional Knowledge, 11(2): 225-233.

Farrukh U, Shareef H, Mahmud S, Ali S A and Rizwani G H (2008). Antibacterial activities of coccinia grandis L. Pakistan Journal of Botany, 40(3): 1259-1262.

Fazal H, Ahmad N, Ikram ullah, Inayat H, Khan L and Abbasi BH (2011). Antibacterial potential in Parthenium hysterophorus, Stevia rebaudiana and Ginkgo biloba. Pakistan Journal of Botany, 43(2): 1307-1313.

Hussain S, Jamil M., Farhat ullah., Khan A, Farman ullah, Arfan M., Ahmad S and Khatoon L (2010). Antimicrobial and antioxidant activities of the plant Heliotropium strigosum. African Journal of Biotechnology, 9(45): 7738-7743.

Iwu MM, Duncan AR and Okungi CO. (1999). New antimicrobials of plant origin. Perspective of new crops and new uses, Janick J (Editor). ASHS Press, Alexandria, VA: 457-562.

Khan AM, Qureshi RA and Faizan ullah (2011). Antimicrobial activity of selected medicinal plants of Margalla hills, Islamabad, Pakistan. Journal of Medicinal Plants Research, 5(18): 4665-4670.

Khan R, Islam B, Akram M, Shakil S, Ahmad A, Ali SM, Siddiqui M and Khan AU (2009). Antimicrobial activity of five herbal extracts against multidrug resistant (MDR) strains of bacteria and fungus of clinical origin. Molecules, 14(3): 586-597.

Kursat M and Erecevit P (2009). The antimicrobial activities of methanolic extract of some Lamiaceae family collected from Turkey. Turkish Journal of Science and Technology, 4(1): 81-85.

Mahesh B and Satish S (2008). Antimicrobial activity of some important medicinal plant against plant and human pathogens. World Journal of Agricultural Science, 4(S): 839-843.

Nair R, Kalaria T and Chanda S (2005). Antibacterial activity of some Indian medicinal plants. Turkish Journal of Biology, 29(7): 41-47.

Narayan GR, Kartik V, Manoj P, Singh PS and Alka G (2010). Antibacterial activities of ethanolic extracts of plants used in folk medicine. International Journal of Research in Ayurveda & Pharmacy, 1(2): 529-535.

Ncube NS, Afolayan AJ and Okoh AI (2008). Assessment techniques of antimicrobial properties of natural compounds of plant origin: current methods and future trends. African Journal of Biotechnology, 7(12): 1797-1806.

Ogunleye DS and Ibitoye SF (2003). Studies of antimicrobial activity and chemical constituents of Ximenia Americana. Tropical Journal of Pharmaceutical Research, 2(2): 239-241.

Onyeagba RA, Ugbogu OC, Okeke CU and Iroakasi O (2004). Studies on the antimicrobial effects of garlic (Allium sativum Linn.), ginger (Zingeber officinale Roscoe) and lime (Citrus aurantifolia Linn.). African Journal of Biotechnology, 3(10): 552-554.

Parekh J, Jadeja D and Chanda S (2005). Efficacy of aqueous and methanol extracts of some mesicinal plants for potential antibacterial activity. Turkish Journal of Biology, 29(1): 203-210.

Rajasekaran C, Meignanam E, Premkumar N, Kalaivani T, Siva R, Vijayakumar V, Ramya S and Jayakumararaj R (2008). In vitro evaluation of antibacterial activity of phytochemical extracts from leaves of Aegle marmelos (L.) Corr. (Rutaceae). Ethanobotanical leaflets, 12(4): 1124-1128.

Robinson MM and Zhang X (2011). The world medicines situation 2011. Traditional medicines: global situation, issues and challenges, WHO/EMP/MIE/ 2011.2.3: 1-12.

Salama HMH and Marraiki N (2009). Antimicrobial activity and phytochemical analysis of Polygonum aviculare L. (Polygonaceae), naturally grown in Egypt. Australian Journal of Basic and Applied Sciences, 3(3): 2008-2015.

Salar RK and Dhall A (2010). Antimicrobial and free radical scavenging activity of the extracts of some Indian medicinal plants. Journal of Medicinal Plants Research, 4(22): 2313-2320.

Salar RK and Suchitra (2009). Evaluation of antimicrobial potential of different extracts of Solnum xanthocarpum Scdrad. and Wendl. African Journal of Microbiology Research, 3(3): 097-100.

Sule IO and Agbabiaka TO (2008). Antibacterial effects of some plant extracts on selected enterobacteriaceae. Ethnobotanical leaflets, 12(7): 1035-1042.