

Antimicrobial Activity Of Some Essential Oil Bearing Aromatic Plants Against Some Clinically Significant Human Pathogens

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Abstract

In the present investigation essential oil of 12 aromatic plants were selected for examining their antimicrobial activity. The human pathogens *Pseudomonas aeruginosa*, *Escherichia coli*, *Staphylococcus aureus* and *Candida albicans* were selected for antimicrobial activity. Antimicrobial study of the essential oil against the selected pathogens showed that all the essential oils were effective against at least one pathogen. The killing time determination revealed that essential oil obtained from *C. zedoaria*, *P. amaryllifolius*, *Z. rhetsa*, *E. cardamomum*, *M. Koenigii* and *H. acetocella* contains the most effective essential oil. GC-MS analysis was conducted to reveal the bioactive chemical compound of the most potent essential oils.

Key words: Essential oil, antimicrobial activity, aromatic plant, killing time, GC-MS analysis.

Introduction

Essential oils are plant products which are extracted from various plant parts like leaves, shoots, barks, twigs, stems, roots etc. and are directly synthesized from plants which are generally devoid of any artificial chemicals. Essential oils are used from ancient times for its therapeutic and medicinal value. These are used in aromatherapy for the treatment of headache, body pain, mental illness etc and also used for the treatment of several chronic diseases like cardiovascular disease, diabetes, Alzheimer's, cancer etc (Ali et al. 2015). Moreover Essential oils are recognised as safe substances by Human health services and some essential oils contain compounds that can be used as antibacterial additives in food substances (Stefanaskis et al. 2013). Assam is called as "Abode of Angiosperms" as it is full of angiospermic plants and some of the angiospermic plants are aromatic in nature and essential oils can be extracted from them which have medicinal properties. Most of these medicinal plants are used by tribal communities of Assam. Assam is a home for at least 16 tribal groups which are also an important part of Assamese culture and tradition. They generally use their traditional knowledge for curing diseases rather than depending on conventional medicines. Antibiotics were a great discovery in earlier century but as time passes there is emergence of antibiotic resistant pathogens due to overuse or unsubscribed uses. Shortly after the introduction of new antimicrobial compounds the emergence of antimicrobial resistance was observed in patients (Levy et al. 2007). The findings about medicinal plant showed an exciting scientific interest where essential oils has gained special attention because they

represent a distinctive group of possible novel drug compounds due to their chemical and structural variance that makes them functionally versatile. The tribal people who are generally residing on different part of Kokrajhar district of Assam are using some aromatic medicinal plants as part of their traditional knowledge. The aim of this study is to collect some medicinal plants used by these indigenous people and to find antimicrobial activity of the essential oil extracted from the collected plant specimens against some selected human pathogens.

Materials and Methods

The present investigation was carried out in the Mycology and Plant Pathology laboratory, Department of Botany, Gauhati University, Gopinath Bordoloi Nagar, Guwahati, Assam. The samples were collected from Grahampur area of Kokrajhar district of Assam by a field visit. A total of 12 plant specimens were collected and were identified by consulting Herbaria of Botany Department of Gauhati University. The plant specimens were authenticated by Dr. Nilakshee Devi (Taxonomist) Department of Botany, Gauhati University. The leaves of the plants were chopped into small pieces and by using hydro distillation process in Clevenger's apparatus, the oil was obtained and collected in air tight container. The oil extract was then concentrated by using magnesium chloride to obtain essential oil in pure form. The essential oils so obtained were kept in refrigerator at 4°C for further study. The human pathogens which used in this study consisted of three pathogenic bacteria namely *Pseudomonas aeruginosa* (MTCC-424), *Escherichia coli* (MTCC-443), *Staphylococcus aureus* (MTCC-737) and one pathogenic fungus namely *Candida albicans* (MTCC – 227) purchased from IMTECH, Chandigarh. The oil extracts were evaluated for antimicrobial activity by

following agar cup diffusion method.

Results

The name of the 12 different aromatic plants

collected along with their local name and medicinal uses are presented in Table 1. From preliminary assay, it is revealed that the essential oil of *Pandanus amaryllifolius*,

Sl.no.	Plant name	Local name	Family	Medicinal uses
1.	<i>Pandanus amaryllifolius</i>	Bhogpaat	Pandanaceae	Used for the treatment of diabetics, used as infusions
2.	<i>Paederia foetida</i>	Vedai lota	Rubiaceae	Used for gastrointestinal problems, it is used to cure dysentery and diarrhea.
3.	<i>Elettaria cardamomum</i>	Elaichi	Zingiberaceae	Soothes the stomach, reduces gas, bloating.
4.	<i>Murraya koenigii</i>	Narsingha	Rutaceae	It helps in treating dysentery, constipation, diarrhea etc.
5.	<i>Ageratum conyzoides</i>	Azar	Asteraceae	It is used in stomach problem, used in cuts, wounds etc.
6.	<i>Mansoa alliaceae</i>	Garlic vine	Bignoniaceae	Anti-inflammatory
7.	<i>Curcuma zedoaria</i>	Boaz	Zingiberaceae	It improves digestive system, cures digestive ailments.
8.	<i>Glycosmis pentaphylla</i>	Ban jamir	Rutaceae	Use to cure liver diseases
9.	<i>Murraya paniculata</i>	Kamini	Rutaceae	It is used in inflammations
10.	<i>Zanthoxylum rhetsa</i>	Mesta tenga	Rutaceae	It is stomachic and stimulant.
11.	<i>Eryngium foetidum</i>	Baan dhania	Apiaceae	Stomachic relieves gastrointestinal problems.
12.	<i>Hibiscus acetosella</i>	Meskatenga	Malvaceae	It has soothing property, used against gastrointestinal problems.

Elettaria cardamomum, *Murraya koenigii*, *Monsoa alliaceae*, *Curcuma zedoaria*, *Glycosmis pentaphylla*, *Murraya paniculata*, *Zanthoxylum rhetsa*, *Eryngium foetidum*, *Hibiscus acetocella*. After *E. cardamomum*, *Murraya paniculata* has the higher activity against three human pathogens. Again the

essential oil of *Paederia foetida* and *Ageratum conyzoides* were the least effective as they show effectiveness only against one pathogen. After further concentrating the oils, they are examined in secondary agar cup assay; the results are shown in the Table 2.

Name of Essential oil	Human test pathogen			
	Zone of inhibition(mm)			
	S.aureus	E.coli	P.aeruginosa	C. albicans
<i>Pandanus amaryllifolius</i>	12	11	14	--
<i>Elettaria cardamomum</i>	11	--	--	--
<i>Murraya koenigii</i>	17	--	--	--
<i>Monsoa alliacea</i>	--	11	--	--
<i>Curcuma zedoaria</i>	11	11	16	11
<i>Glycosmis pentaphylla</i>	--	--	11	--
<i>Murraya paniculata</i>	11	10	--	--
<i>Zanthoxylum rhetsa</i>	11	--	16	10
<i>Hibiscus acetocella</i>	12	--	17	--
<i>Eryngium foetidum</i>	--	--	--	--

--Sign indicates no significant zone of inhibition(less than 10mm)

After secondary screening the most potent essential oils were further selected for determining their exact time of killing the particular pathogen. The killing time for the essential oil of *Murraya koenigii* against *Staphylococcus aureus* (MTCC-737) was 10 hours. Similarly, the killing time for the essential oil of *Zanthoxylum rhetsa* against *Pseudomonas aeruginosa* (MTCC-424) was also 10 hours. The killing time for essential oil of *Hibiscus acetocella* against *Pseudomonas aeruginosa* (MTCC-424) was 12 hours. After determining the killing time, identification of bioactive compounds of the most potent essential oil was done by GC-MS analysis.

Among all the experiment conducted, it was found that four most effective essential oils like *Curcuma zedoaria*, *Elettaria cardamomum*, *Murraya koenigii* and *Hibiscus acetocella* have shown antimicrobial activity against all the human pathogens. GS-MS analysis was done for these four effective oils to find out the presence of bioactive compounds responsible for their antimicrobial activity. The GC-MS analysis of essential oil of *Elettaria cardamomum* showed compounds like 1, 3-Dioxolane, 4-Pentyl-5-Propyl-2, 2-Bis (Trifluorome) and Cyclohexane, 1, 1-(2-Methyl- 1, 3-Propanediyl) Bis- were as major compound. Again similarly *Murraya koenigii* showed

compounds like Cyclohexacarboxylic acid, Hydroxycarboxylic acid, Oleic acid, Octadecadienoic acid, Cyclopentapropanoic acid- methyl ester, Hexadecanoic acid, Methyl-8-Hexadecen-1-ol, Oleyl alcohol and Cyclohexacarboxylic acid. Essential oil of *Curcuma zedoaria* showed presence of Eucalyptol, Camphore, Borneol, Iso-Borneol, Ricinolic acid, Cyclopentene, 1,2,3-Trimethyl-, Oleyl alcohol, Pentadecanoic acid and Octadecynoic acid (Figure 1). Essential oil of *Glycosmis pentaphylla* showed major compounds like 3-N-Hexylthiolane, S,S-Dioxide, Ricinoleic acid, 2-N-Hexylthiolane, S,S-Dioxide, Oleic acid, 1-Propyl 14-Methyl-Pentadecanoate, Cyclododecanol, Eicosinoic acid.

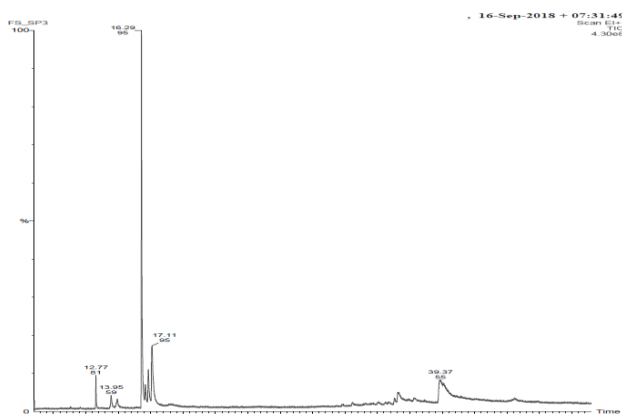


Figure 1: GC-MS chromatogram of essential oil of *Curcuma zedoaria*.



Photo plate: Photograph showing zone of inhibition of essential oil against pathogens.

Discussions

Bacteria and fungi cause diseases to human being from the starting of life in this earth. Bacterial human pathogens like *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *E. coli* causes numerous health problems. *Escherichia coli* causes many common bacterial infections like nausea and vomiting, abdominal pain, cholecystitis, bacteremia, cholangitis and pneumonia, urinary tract infection, diarrhoea, neonatal meningitis etc. *Candida albicans* is the most prevalent cause of fungal infections in people which ranges from superficial mucosal and dermal infections like vaginal yeast infections, thrush and infections with mortality rates (Calderone and Fonzi 2001). Again there is also occurrence of antibiotic resistant of human pathogens like

Pseudomonas aeruginosa, *Staphylococcus aureus* and *Escherichia coli* which are amongst some of the main bacteria with multidrug resistance and they are included in the category of community and hospital acquired pathogens (Fisher and Phillips 2008). Antibiotic resistance is a global matter of concern because there is a no. of cases of antibiotic resistance emerging from all over the globe (Golkar et al. 2014). Scientists are now searching for some approach to control this antibiotic resistance of human pathogen. Use of natural plant product is an emerging field in this regard and use of essential oil to control spread of infection is a promising field and many scientists are working in this field to find out most potent essential oil which may be used directly or in the form of drug to control spread of human pathogen. Essential oil is an excellent plant product which has a promising role in controlling human pathogens. Essential oils are regarded as an important antimicrobial agent because essential oils are variable mixtures of primarily terpenoids, especially monoterpenes and sesquiterpenes and sometimes diterpenes are also present. These secondary metabolites can inhibit or slow the growth of bacteria, yeasts and moulds (Chorianopoulos et al. 2008). In our study, we can say that, in case of human pathogen, these essential oil showed 90% activity against bacterial pathogen, but only 20% of the oil showed antifungal activity in case of human pathogen. Again the effective compounds found in the four most effective essential oils namely *Curcuma zedoaria*, *E. cardamomum*, *Murraya koenigii* and *Hibiscus acetocella*, which gives its affectivity were also reported by several other research workers. Thus the antimicrobial activity of these essential oils against both human and plant pathogens may investigate further for formulation of new drug and may help in reducing bacterial and fungal infections.

Acknowledgement

Authors are grateful to the Department of Botany, Gauhati University for providing resources and space for carrying out the research work.

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