

Content available at: <https://www.ipinnovative.com/open-access-journals>

International Journal of Pharmaceutical Chemistry and Analysis

Journal homepage: <https://www.ijpca.org/>

Original Research Article

Antimicrobial properties of some plant essential oils against two human pathogens

Mir Raouf Ahmad^{1,*}, Khushnawaz Ahmad¹¹Dept. of Biotechnology, GloBiL's Agri and Food Enterprises, Lassipoora, Pulwama, Jammu and Kashmir, India

ARTICLE INFO

Article history:

Received 22-11-2022

Accepted 30-12-2022

Available online 06-02-2023

Keywords:

Essential Oils

Antifungal oils

Dandruff

Athlete's foot

ABSTRACT

The antimicrobial activity of essential oils distilled from Tea tree (*Melaleuca alternifolia*) Rosemary (*Rosmarinus officinalis* L.), Lavender (*Lavandula angustifolia* Mill), Eucalyptus (*Eucalyptus obliqua* L'Hér.), Clove (*Syzygium aromaticum*), *Origanum vulgare*, Geranium essential oils and mineral oils were screened against two pathogenic fungi, *Candida albicans* which causes scalp dandruff and *Trichophyton rubrum* that causes athlete's foot while for the testing, poison food method was used.

The purpose of this brief review is to describe the properties of essential oils, principally as antifungal agents, against two most important fungal infections that are Dandruff and Athlete's foot. The invitro studies of the tested essential oils revealed the positive inhibitory on the tested fungal pathogens. The results showed that the essential oil of almost three aromatic plants have the potential to be used for management of two pathogenic fungi, *Candida albicans* which causes scalp dandruff and *Trichophyton rubrum* that causes athlete's foot.

Hence, the essential oils from medicinal plants used in this study hold great potential for the antifungal properties. However mineral oil showed less activity against the four fungi tested as compared to essential oils.

This is an Open Access (OA) journal, and articles are distributed under the terms of the [Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License](https://creativecommons.org/licenses/by-nc-sa/4.0/), which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

For reprints contact: reprint@ipinnovative.com

1. Introduction

Modern civilization has got health conscious about the problems face by them. Athlete's foot, or *Tinea pedis* and Dandruff are among the most common infection of the skin and feet caused by a variety of dermatophytes. These include conditions that affect otherwise healthy individuals. These pathogens most often affect the space between the toes leaves the person uncomfortable. *Trichophyton rubrum* is a typical dermatophyte that cause noninflammatory chronic infections that are easily transmitted that the infection is characterized by skin fissures or scales that can be red and itchy. Dandruff is among the serious problems faced by the modern youth. Use of synthetic chemicals has caused huge financial losses and rendered the pathogens

resistant.

The worldwide problem of infectious diseases has appeared in recent years, and antimicrobial agents are crucial in reducing disease emergence. Essential oils could serve as a promising tool as a natural drug in fighting the problem with these fungi. Essential oils from medicinal and aromatic plants have been explored for their complex volatile compounds, synthesized naturally in different plant parts during the process of secondary metabolism. These naturally occurring compounds have got different types of aldehydes, phenolics, terpenes, and other antimicrobial compounds which help in managing different fungal infections. The antipathogenic activity of essential oils is believed to be due to presence of strong volatile reactive functional groups. Essential oils have been tried in the field of biomedicine against several bacterial, fungal and viral pathogens. Since ancient times, folk medicine and agro-food

* Corresponding author.

E-mail address: kashphytochem@yahoo.com (M. R. Ahmad).

science have benefited from the use of plant derivatives, such as essential oils, to combat different diseases, as well as to preserve food.

In nature, essential oils play a fundamental role in protecting the plants and animals from biotic and abiotic attacks to which it may be subjected. Essential oils have been explored for their bioactive compounds by researchers. The main aim of this study is to investigate the positive potential of essential oils as anti-dermatophytes especially *Candida albicans* and *Trichophyton rubrum*.

2. Essential Oils

Essential oils are natural, volatile, complex plant compounds, oily or lipid-like both polar and non-polar in nature and frequently characterized by a strong fragrance.^{1,2} They are stored in specialized plant cells, usually oil cells or ducts, resin ducts, glands or trichomes (glandular hairs).^{3,4} and may be extracted from the leaves, flowers, buds, seeds, fruits, roots, wood or bark of plants. Essential oils make up only a small proportion of the wet weight of plant material, usually approximately 1% or less.^{3,5} The presence, yield and composition of essential oils may be influenced by many factors, including climate, plant nutrition and stress.⁶

There is an increasing demand to reduce the use of chemicals as antimicrobial agents by providing alternate solution and remedy to combat various infections due to various notorious and aggressive dermatophytes. Over the passage of time microbial resistance against synthetic antimicrobials is the most concern topic. In this direction the hydro-alcoholic extracts or essential oils play a positive role to combat such issues. These substances are the treasures of many versatile molecules that act as broad spectrum antibiotics.

Swiss reformer of medicine, Paracelsus von Hohenheim coined the term “Essential Oil” (EO) in 16th century, well-known for their antiseptic and medicinal properties (analgesic, sedative, anti-inflammatory, spasmolytic, local anesthetic, anti-carcinogenic), they are also used in embalment, and, due to their antimicrobial and antioxidant activity, as natural additives in foods and food products.^{7,8}

3. Antipathogenic Effects of Essential Oils

Essential oils and their constituents have got a wide range of antipathogenic effects. The essential oils extracts from many plants such as Clove, Eucalyptus, lavender, Oregano, Rosemary, and Tea tree have shown considerable antifungal activity against a wide range of fungal pathogens.⁹ Arora and Kaur¹⁰ worked on the antimicrobial activity of essential oils extracted from spices against fungal pathogens and found that garlic and clove extracts limit the growth of several fungal pathogens including several *Candida* species, *Rhodotorula rubra*, *Saccharomyces cerevisiae* and *Trigonopsis variabilis*.

Similar results were observed by Grohs and Kunz¹¹ whom investigated mixtures of ground spices and analysed their efficacy against the *C. lipolytica*. Essential oils extracted from onion and garlic plants contain isothiocyanate which have been found very effective against several fungal infections,¹²

Isothiocyanates have been found effective against *Botrytis*, *Fusarium*, *Penicillium*, and *Cladosporium* species by inactivating the extracellular enzymes through oxidative cleavage of disulfide bonds.¹³ observed the antifungal activity of essential oils and their derivatives on the cell viability, mycelium growth, and mycotoxin-producing ability of molds.¹⁴

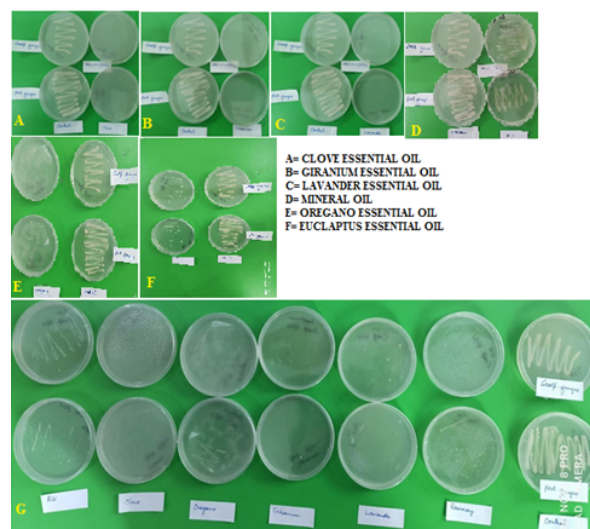


Fig. 1: Antifungal activity of essential oils against *Candida albicans* and *Trichophyton*

4. Materials and Methods

Commercially available essential oils of clove, geranium, oregano, tea tree, rosemary, eucalyptus, and lavender used in this research were purchased from a local distributor in New Delhi India. According to certification, essential oils from plants were pure in form.

A total of two fungal human pathogenic strains were used in this study. They were identified by conventional fungal stains.

The poison food method of antifungal activity was used for antimicrobial testing of essential oils.

Antifungal assessment of the isolated essential oils was conducted using a mycelial radial growth inhibition technique against *Candida albicans* and *Trichophyton*. The oils were diluted with acetone and added to sterilized PDA medium before pouring in 9-cm Petri dishes. The oils were tested at concentrations @ 1000 mg L⁻¹. Incubation of inoculated fungi was conducted for 8 days at a temperature of 27 °C, in PDA plates.

Table 1: The inhibition activity of essential oils against *Candida albicans* and *Trichophyton*

Essential Oils	Rate of Mycelial Inhibition %	
	Against <i>Candida albicans</i>	Against <i>athlete's foot</i> .
Tea tree Melaleuca alternifolia	80 ± 0.00 a	68 ± 0.00 a
Rosemary Rosmarinus officinalis L.	45 ± 0.10 b	30 ± 0.12b
Lavender Lavandula angustifolia Mill	100 ± 0.00 a	100 ± 0.00 a
Eucalyptus Eucalyptus obliqua L'Hér.	20 ± 0.15 c	190 ± 0.00.18 c
Clove Engenia caryophyllus	100 ± 0.00 a	100 ± 0.00 a
Oiganum Origanum vulgare	60.37 ± 0.20 c	47. ± 0.20 c
Geranium	100 ± 0.00 a	100 ± 0.00 a
Mineral oil	05 ± 0.10d	04 ± 0.10d

Note: Values are given as mean ± SD (n = 4). Different superscript letters in the same column indicates significant differences (p < 0.05).

The inoculum of mycelial culture of fungi, taken from 8-day-old cultures, was transferred aseptically to the Petri plates. The plates were incubated at 27°C in the dark. Three replicates were setup with a control. Colony growth was measured after the fungal growth in the control as well as in the treatments. Inhibition percentage of mycelial growth was calculated as follows:

Mycelial growth inhibition (%) = [(DC- DT)/DC]*100
Where DC and DT are average diameters of fungal growth of control and treatment, respectively.⁴

Based on the results obtained, Table 1. As depicted in the Figure 1 it can be concluded that clove essential oil, geranium essential oil, lavender essential oil are the most active inhibitor against *Candida albicans* and *Trichophyton*, while as. rosemary,oreganum and euclaptus essential oils were less effective against the above fungi. Mineral oil as control also doesn't show any antifungal activity against *Candida albicans* and *Trichophyton*.

5. Result and Discusion

5.1. Antifungal activities of selected essential oils

Essential oils have great potential as antimicrobial agents. In the present study, the essential oil extracts from six medicinal plants showed inhibiting activities against the tested fungi *Candida albicans* and *Trichophyton rubrumrubrumrubrum* among the six oils. Three of them clove essential oil,geranium essential oil and lavender essential oils have very good antifungal activities. While

as oregano essential oil, euclaptus essential oil , rosemary essential oil were less active against the tested fungi. Mineral oil tested as control is also having no antifungal activity due absence of antifungal agents The data obtained from the present investigation indicated that the selected essential oils from medicinal plants showed effectiveness in inhibiting the growth of selected fungi. Hence, selected essential oils (clove essential oil, giranium essential oil and lavender essential oils) represent a potential alternative to eliminate microorganisms that can be harmful to human health.

6. Source of Funding

None.

7. Conflict of Interest

None.

Acknowledgments


The authors are very much indebted to the Department of Biotechnology, GloBiL's Agri and Food Enterprises IGC SIDCO Lassipoora for the financial support of the project.

References

- Bakkali F, Averbeck S, Averbeck D, Idaomar M. Biological effects of essential oils: a review. *Food Chem Toxicol.* 2008;46(2):446–75.
- Burt S. Essential oils: their antibacterial properties and potential applications in foods: a review. *Int J Food Microbiol.* 2004;94(3):223–53.
- Pengelly A. The Constituents of Medicinal Plants. 3rd ed. Sydney, Australia: Allen & Unwin; 2004. p. 307–9.
- Başer KHC, Demirci F. Chemistry of essential oils. Springer; 2007. p. 43–86.
- Langenheim JH. Higher plant terpenoids: a phyto-centric overview of their ecological roles. *J Chem Ecol.* 1994;20(6):1223–80.
- Croteau R. Biochemistry of monoterpenes and sesquiterpenes of the essential oils. Haworth Press; 1986. p. 81–133.
- Akhtar MS, Degaga B, Azam T. Antimicrobial activity of essential oils extracted from medicinal plants against the pathogenic microorganisms: a review. *Biol Sci Pharm Res.* 2014;2(1):1–7.
- Swamy MK, Sinniah UR. Patchouli (Pogostemon cablin Benth.): Botany, agrotechnology and biotechnological aspects. *Industrial Crops and Prod.* 2016;87:161–76. doi:10.1016/j.indcrop.2016.04.032.
- Fu Y, Zu Y, Chen L. Antimicrobial activity of clove and rosemary essential oils alone and in combination. *Phytother Res.* 2007;21(10):989–94.
- Arora DS, Kaur J. Antimicrobial activity of spices. *Int J Antimicrob Agents.* 1999;12(3):257–62.
- Grohs BM, Kunz B. Use of spice mixtures for the stabilisation of fresh portioned pork. *Food Control.* 2000;11(6):433–6.
- Ultee A, Smid EJ. Influence of carvacrol on growth and toxin production by *Bacillus cereus*. *Int J Food Microbiol.* 2001;64(3):373–8.
- Juglal S, Govinden R, Odhav B. Spice oils for the control of co-occurring mycotoxin-producing fungi. *J Food Prot.* 2002;65(4):683–7.
- Delacqua PJ, Mazza G. Antimicrobial properties of isothiocyanate in food preservation. *Food Technol.* 1995;49:73–84.

Author biography

Mir Raouf Ahmad, Research Head  <https://orcid.org/0000-0003-2762-5425>

Khushnawaz Ahmad, Research Associate  <https://orcid.org/0000-0002-9422-3592>

Cite this article: Ahmad MR, Ahmad K. Antimicrobial properties of some plant essential oils against two human pathogens. *Int J Pharm Chem Anal* 2022;9(4):184-187.