Research Article

Comparison of antibacterial efficacy of essential oils with 2% chlorhexidine in reducing *Enterococcus faecalis* count

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ABSTRACT

Introduction: The spread of drug-resistant pathogens is one of the most serious threats to successful treatment of microbial diseases. Down the ages, essential oils and other extracts of plants have evoked interest as sources of natural products. They have been screened for their potential uses as alternative remedies for the treatment of many infectious diseases. **Methodology:** Test microorganisms: Bacterial strain used was *Enterococcus faecalis*. The organism was isolated and maintained in nutrient agar slope at 4°C in the Department of Microbiology, Saveetha Dental College. The essential oils, lavender oil, sandalwood oil, peppermint oil, rosemary oil, clove oil, and cinnamon oil were used in the following concentrations – 25 µl, 50 µl, and 100 µl, respectively. **Results:** The antibacterial activity of the essential oils at different concentrations was screened by disk diffusion technique, and the zone of inhibition was measured in mm diameter. The results are given in the table. Peppermint oil was more effective against *E. faecalis* with a zone of inhibition of diameter 45 mm (at conc. of 100 µl), followed by rosemary oil and cinnamon oil with a zone of inhibition of diameter 35 mm (at conc. of 100 µl). **Conclusion:** Our observations confirm that peppermint oil might be considered as an effective antibacterial irrigation solution as it has a zone of inhibition of diameter 45 mm at conc. of 100 µl which is similar to the control chlorhexidine.

KEY WORDS: Antibacterial, Chlorhexidine, Enterococcus faecalis, Essential oils

INTRODUCTION

The spread of drug-resistant pathogens is one of the most serious threats to successful treatment of microbial diseases. Down the ages, essential oils and other extracts of plants have evoked interest as sources of natural products. They have been screened for their potential uses as alternative remedies for the treatment of many infectious diseases.[1] The World Health Organization noted that majority of the world's population depends on traditional medicine for primary health care.

Medicinal and aromatic plants are widely used as medicine and constitute a major source of natural organic compounds. Essential oils have been shown to possess antibacterial, antifungal, antiviral insecticidal, and antioxidant properties.[2,3] Essential oils are a rich source of biologically active compounds. There has been an increased interest in looking at antimicrobial properties of extracts from aromatic plants, particularly essential oils.[4] Therefore, it is reasonable to expect a variety of plant compounds in these oils with specific as well as general antimicrobial activity and antibiotic potential.[5]

Essential oils such as aniseed, calamus, camphor, cedarwood, cinnamon, citronella, clove, eucalyptus, geranium, lavender, lemon, lemongrass, lime, mint, nutmeg, orange, palmarosa, rosemary, basil, vetiver, and wintergreen have been traditionally used by people for various purposes in different parts of the world. Cinnamon, clove, and rosemary oils had shown antibacterial and antifungal activity;[6] cinnamon oil also possesses antidiabetic property.[7,8]

Lemon and rosemary oils possess antioxidant property.[9,10] Peppermint and orange oils have shown anticancer activity.[11,12] Lavender oil has shown antibacterial and antifungal activity; it was also found to be effective to treat burns and insect bites.[13] Sandalwood oil has also been found in

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numerous therapeutic applications in traditional medicines such as Chinese traditional medicine and Ayurveda.

METHODOLOGY

Collection of Materials

The microbial strain selected for the present study was *Enterococcus faecalis*.

Six essential oils were selected for the study.

- Cinnamon oil (*Cinnamomum camphora*)
- Peppermint oil (*Mentha piperita*).
- Clove oil (*Eugenia caryophyllus*).
- Rosemary oil.
- Sandalwood oil.
- Lavender oil.

Agar Well Diffusion Assay

Agar well diffusion assay was the key process used to evaluate the antimicrobial potential of the oils.

The bacterial activity of lavender oil, sandalwood oil, peppermint oil, rosemary oil, clove oil, and cinnamon oil was evaluated against the pathogen *E. faecalis* as mentioned above by agar well diffusion technique.

Broth culture of the bacterial strain compared to McFarland's standard 0.5 was prepared and was inoculated using swab technique in nutrient agar slope at 4°C in the Department of Microbiology, Saveetha Dental College.

Lawn culture of the test organisms was made on the Muller-Hinton agar (MHA-Hi-Media M-1084) plates using sterile cotton swab and the plates were dried for 15 min. Wells measuring 4 mm in depth were made on the agar using sterile cork borer. 100 mL of the essential oil was added to the wells. 2% chlorhexidine was used as positive control. The plates were incubated at 37°C overnight, and the zone of inhibition of growth was measured in mm diameters various concentrations of 25 µl, 50 µl, and 100 µl. All the tests were done in triplicate to minimize the test error.[14,15]

RESULTS

The antibacterial activity of the essential oils at different concentrations was screened by disk diffusion technique and the zone of inhibition was measured in mm diameter. The results are given in Table 1. Peppermint oil was more effective against *E. faecalis* with a zone of inhibition of diameter 45 mm (at conc. of 100 µl) followed by rosemary oil and cinnamon oil with a zone of inhibition of diameter 35 mm (at conc. of 100 µl).

DISCUSSION

Herbs, which are powerful healing agents, must be used appropriately. Herbs contain active ingredients that may interact negatively with prescribed medications or other remedies. It is wise, therefore, to consult a health-care professional in situations in which you question the appropriateness of the herb or its interaction with other remedies.[16] An essential oil is a concentrated hydrophobic liquid containing volatile aroma compounds from plants. Essential oils are also known as volatile oils, ethereal oils, aetherolea, or simply as the "oil of" the plant from which they were extracted, such as oil of clove. An oil is "essential" in the sense that it carries a distinctive scent, or essence, of the plant.[17,18]

Microorganisms have the ability to develop resistance when exposed to a particular agent for a longer time. Recent studies have proved that microorganisms develop resistance to drugs, resistance to chemical agents and also show resistance to the environmental factors. Some strains are referred to as multidrug-resistant strains. Developing an alternative mode using plant products may help in solving this issue. The antimicrobial action of essential oils is extremely good which has not been researched in detail. Although these essential oils have been found to have extremely powerful antimicrobial activity on certain microorganisms, it has been seen that this action does not extend to all microorganisms. Furthermore, research can be done on these essential oils so that a new antimicrobial agent can be utilized in the near future.[19]

Peppermint oil with menthol and menthone as the main components exhibits high antimicrobial activities against Gram-positive, Gram-negative, yeast, and fungi, especially against *Candida albicans*. The combination of peppermint oil with antibiotics could be used to reduce the effective dose of antibiotics and its related side effects.[20]

The antibacterial activity of rosemary has been determined in various assay types based on either minimum inhibitory

Table 1: Antibacteial activity of essesntial oils on *Enterococcus faecalis*

Oils	Concentration 25 µl	Concentration 50 µl	Concentration 100 µl	Control chlorhexidine 100 µl
Lavender oil	15 mm	19 mm	34 mm	25 mm
Sandalwood oil	10 mm	13 mm	15 mm	28 mm
Peppermint oil	22 mm	40 mm	45 mm	45 mm
Rosemary oil	33 mm	38 mm	40 mm	35 mm
Clove oil	23 mm	25 mm	27 mm	26 mm
Cinnamon oil	28 mm	30 mm	32 mm	35 mm

concentration or minimum bactericidal concentration. Some studies have shown the antibacterial activity of rosemary oil against *Escherichia coli*, *Bacillus cereus*, *Staphylococcus aureus*, *Clostridium perfringens*, *Aeromonas hydrophila*, and *Salmonella choleraesuis*.[21] The inhibitory effect of rosemary is the result of the action of rosmarinic acid, rosmaridiphenol, carnosol, epirosmanol, carnosic acid, rosmanol, and isorosmanol. They interact with the cell membrane, causing changes in genetic material and nutrients, altering the transport of electrons, leakage of cellular components, and production changes in fatty acid.[22]

Some studies determined that cinnamon has remarkable antimicrobial activity against some skin infection agents and food pathogens.[23,24] Cinnamon has also been used as a health-promoting agent for the treatment of diseases such as inflammation, gastrointestinal disorders, and urinary infections. Another potential medical use of cinnamon would be with regard to its antimicrobial properties, especially antibacterial activity.[25]

CONCLUSION

Our observations confirm that peppermint oil might be considered as an effective antibacterial irrigation solution as it has a zone of inhibition of diameter 45 mm at conc. of 100 µl which is similar to the control chlorhexidine. This study confirms that many essential oils and plant extracts possess *in vitro* antimicrobial activity. Peppermint oil exhibited the highest antimicrobial activity against *E. faecalis* followed by rosemary oil and cinnamon oil. Sandalwood oil and clove oil showed the least antimicrobial activity. Herbs, which are powerful healing agents, must be used appropriately. The present results, therefore, offer a scientific basis for traditional use of essential oils on various pathogens.

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