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Research Article

TEN HIGHLY EFFECTIVE ESSENTIAL OILS INHIBIT GROWTH OF METHICILLIN RESISTANT *STAPHYLOCOCCUS AUREUS* (MRSA) AND METHICILLIN SENSITIVE *STAPHYLOCOCCUS AUREUS* (MSSA)

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ABSTRACT

The purpose of this study was to determine the antibacterial activity of ten essential oils. The ten essential oils were tested on MRSA and MSSA from hospital patients using the disk diffusion (Kirby Bauer) method. Based on this study, all ten oils showed higher effectiveness inhibiting MRSA and MSSA growth than vancomycin, which is the currently used standard for treatment. Essential oils could be especially beneficial towards treating hospital patients with MRSA or MSSA infections in areas where antibiotics are not readily available.

Keywords: Methicillin Resistant Staphylococcus aureus (MRSA), Methicillin Sensitive Staphylococcus aureus (MSSA), Essential oils, Antibacterial .

INTRODUCTION

In order to fight bacterial infections, medicine has largely relied on antibiotics, which are naturally occurring or artificially created chemical substances capable of killing or controlling the growth of bacteria. In present times, however, bacteria have developed resistance to many of the antibiotics commonly used to treat infections[1]. Methicillin Resistant *Staphylococcus aureus* (MRSA) is an example of a 'superbug' or bacterial strain of *Staphylococcus aureus* that has developed resistance to methicillin, an antibiotic which is part of a class known as the beta-lactams. Beta-lactam antibiotics are capable of killing a variety of Gram positive and Gram negative microorganisms by impairing the cell's ability to form peptidoglycan, a necessary component for cell structure and stability. Bacteria that have become resistant developed enzymes known as penicillinases and beta-lactamases, which are capable of destroying the beta-lactam ring structure or functional group of these antibiotics. Methicillin Sensitive *Staphylococcus aureus* (MSSA) causes a type of staph infection that is moderately sensitive to these antibiotics[2].

Essential oils are chemical compounds consisting mainly of hydrogen, carbon and oxygen, and fall into the following two groups: hydrocarbons, which are mostly terpenes, and oxygenated compounds, such as esters, aldehydes, ketones, alcohols, phenols and oxides. For centuries, people have been using essential oils, or fluids extracted from plants, in aromatherapy as well as topical uses, such as soaps for routine washing and antiseptics for healing wounds[3]. The capability of essential oils to act as antiseptics stems from the need of plants to be able to withstand harsh elements of nature, including a large degree of deadly microorganisms. These extracted plant oils have been well documented to provide a natural and highly effective antimicrobial substance[4]. In addition, essential oils were found to be more effective against Gram positive bacteria, including MRSA and MSSA, than Gram negative bacteria. This evidence suggests the more effective permeability barrier Gram-negative bacteria possess may better restrict the penetration of amphipathic compounds than Gram positive microbes[1,5,6].

Previous research conducted with 54 essential oils at Monmouth University revealed excellent antibacterial activity with seventeen of these oils. These seventeen oils were further tested on four known strains of MRSA, as well as MSSA and Methicillin Resistant *Staphylococcus epidermidis*. Ten of these oils proved to have excellent antibacterial activity on three out of the four strains. Present research work involves further testing these ten oils on MRSA and MSSA from hospital patient samples.

MATERIALS AND METHODS

Essential oil supply

The following ten essential oils were purchased from Aphrodisia Products Inc., now West Village Oil Company of Glendale, NY: bay, cinnamon, grapefruit, lemongrass, thyme white, clary sage, wintergreen, clove, allspice, and camphor. According to the supplier, all of the essential oils were extracted by steam distillation with the exception of grapefruit, which was cold expressed from fresh peel.

Bacterial drug resistant organisms used to test antibacterial activity

The microorganisms used as test organisms included Methicillin Resistant *Staphylococcus aureus* (MRSA) and Methicillin Sensitive *Staphylococcus aureus* (MSSA) received from Jersey Shore University Medical Center (JSUMC). Samples of MRSA and MSSA from 12 anonymous hospital patients were retrieved from the JSUMC laboratory on Blood agar plates and tested.

Preparation of Mueller-Hinton II agar medium

BD Difco™ Mueller-Hinton II agar medium provided the necessary nutrients to support the growth of the microorganisms tested and a suitable medium to perform susceptibility testing. It was prepared from a commercially available dehydrated powder as per the manufacturer's instructions.

Disk diffusion (Kirby Bauer) method

The bacteria were cultured in nutrient broth and the disk diffusion test was performed on the Mueller Hinton II agar plates. MRSA and MSSA cultures were prepared to visually match a 0.5 McFarland standard ($1x10^8$CFU/ml) test tube. Mueller Hinton II agar was poured into petri dishes. After solidification, plates with Mueller-Hinton II medium were overlaid with 0.5 ml of patient MRSA or MSSA broth culture.

The experiment was carried out in duplicate under aseptic conditions. Sterile blank discs (6 mm) saturated with 5 µL of one of the ten oils and discs containing the antibiotic standard vancomycin (30 µg) were positioned on the plates. Diameters of zones of inhibition were measured after 24 hours of incubation at 37°C.

RESULTS AND DISCUSSION

The ten essential oils bay, cinnamon, grapefruit, lemongrass, thyme white, clary sage, wintergreen, clove, allspice, and camphor were tested against MRSA and MSSA bacterial samples from 12 different hospital admitted patients in order to determine the ability of the essential oils to act as effective antibacterial agents for drug resistant organisms. This study is

the first to test these ten essential oils against MRSA and MSSA from hospital derived patient samples. Based on this study, all ten essential oils showed higher effectiveness inhibiting MRSA and MSSA growth than vancomycin, which is the currently used standard for treatment (Fig 1). Other studies testing a large number of essential oils and plant extracts also confirmed the success of various essential oils as antimicrobial agents[7-16].The four essential oils with the highest antibacterial activity against MRSA and MSSA were wintergreen, cinnamon, thyme white and lemongrass (Fig 2).

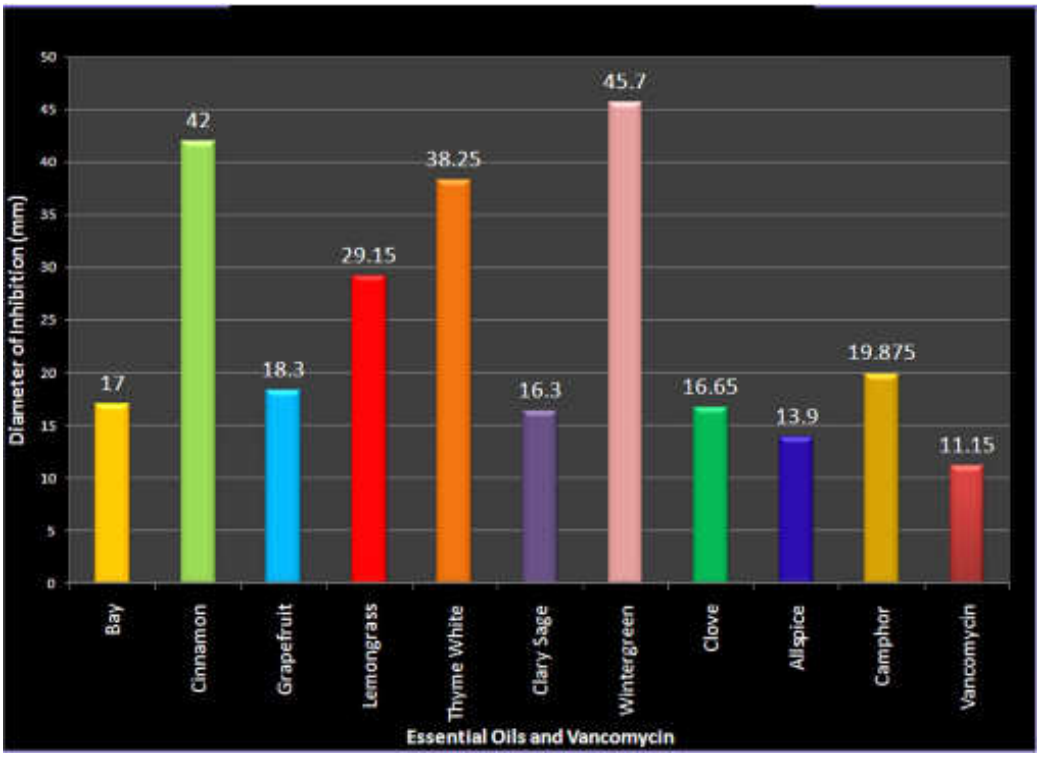

Fig. 1: Antibacterial activity of the ten essential oils against drug resistant bacteria.

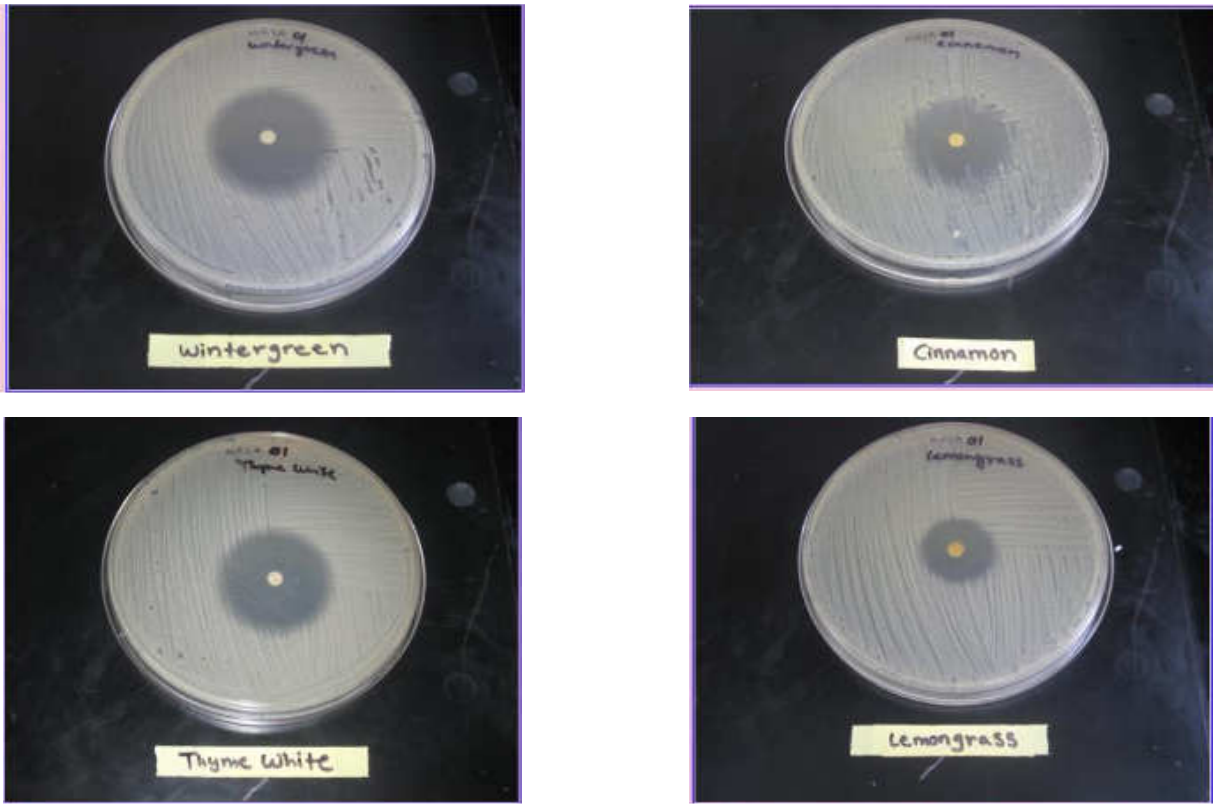

Fig. 2: Four essential oils with highest antibacterial activity compared to the antibiotic standard vancomycin.

CONCLUSION

In summary, our study demonstrated the high effectiveness of ten particular essential oils in inhibiting MRSA and MSSA bacteria from hospital admitted patients. The results indicate these essential oils may be further tested to understand their clinical application as potential dermally applicable ointments to alleviate MRSA or MSSA skin infections. Essential oils could also be particularly beneficial towards treating hospital patients with MRSA or MSSA infections, as well as healing people in underdeveloped countries where antibiotics are not readily available.

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