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RESEARCH ARTICLE OPEN ACCESS

A COMPARATIVE STUDY OF ANTIMICROBIAL ACTIVITY OF CERTAIN ESSENTIAL OILS VERSUS COMMERCIAL ANTIBIOTICS

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ABSTRACT

Drugs resistant microbes is a serious problem. As safe alternatives herbal medicines are discovered certain essential oils (non antibiotic substance) have shown fighting potential against drug resistant pathogens Antimicrobial activity of four different essential oils i.e. Tea tree, eucalyptus, menthol and camphor have been evaluated and were found susceptible to both gram positive i.e. *Staphylococcus aureus* and gram negative bacteria i.e. *Escherichia coli*. The antimicrobial susceptibility in each essential oils and commercial antibiotics i.e. Ampicillin and ciprofloxacin were set to determine growth inhibition zone diameters by agar disc diffusion method.

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INTRODUCTION

Essential oils from aromatic spice and medicinal plants have been identified to bear components with antibacterial, antifungal, antioxidant, anti-inflamatory properties being active against fungi and a wide range of gram (+ve) and gram (-ve) bacteria (Gupta Neerja and Saxena Goldy, 2011). 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 alternatives for the treatment of many infectious diseases (Tepe, 2004). World Health Organization (WHO) noted that majority of the world population depends on traditional medicine for health care (Seenivasan Prabuseenivasan, 2006). Medicinal and aromatic plants widely used as medicine and constitute a major sources of natural organic compounds. There has been an increased interest in looking at antimicrobial properties of extracts from aromatic plants particularly essential oils (Milhur, 1997). Essential oils are potential nonhazardous sources of novel antimicrobial compound (Mitscher). Especially against bacterial pathogens gram (-ve) *E. coli* and gram (+ve) *S. aureus* are useful in relation between traditional cures and current Medicines (Mitscher). The antibiotic agents available in the market as Ampicillin and ciplox etc. are cost effective, due to their prolong use infection resistance has been developed against these antibiotics. These antibiotics are hazardous to human health and cause various health syndrome. Due to the antimicrobial activity many of the essential oils would be the futuristic antibiotics and may replace routine prescriptions and could later be applied to more serious conditions. Essential oils and their components are gaining increasing interest because of their relative safe status, their wide acceptance by consumers and their exploitation for potential multipurpose functional use.

MATERIALS AND METHOD

- Selective Essential Oils : Tea-tree, Eucalyptus, menthol & camphor
- Pathogen strains : *E. coli (-ve)*, *S. aureus (+ve)*
- Commercial antibiotics : Ampicillin and ciprofloxacin
- Experiments : Replicated three times.

- Concentration : 5 µl, 10 µl, 15 µl, 20 µl
- Correlation : Interpreted between physicochemical parameters (water solubility and lipophilicity)
- Structure : Related with their antimicrobial activity in accordance to the literature reviewed
- Selective essential oils will be studied for their antimicrobial activity against bacterial strains and compared with activity of commercial antibiotics.

RESULTS AND DISCUSSIONS

- Essential oils of tea tree oil showed best antimicrobial activity even at lowest concentration i.e. 5µl peppermint oil showed good antimicrobial activity at higher concentrations i.e. 15µl & 20µl while Eucalyptus & camphor oil showed good activity at highest concentration i.e. 20µl.
- However all four essential oils were found to be significally bioactive against both gram (+ve) *S. aureus* & gram(-ve) *E. coli* bacteria.

Physicochemical parameters of identified major terpenes

Essential oils	Terpenes	Molecular formula	Molecular weight (g/ mol)	pH	Solubility	Lipophillicity	References
Tea-tree oil	Terpinen-4-ol	$C_{10}H_{18}O$	154.25	7.2	Highly soluble in water, organic solvent	Alcoholic functional group, Terpinen-4-ol damage their function	C.F. Carson, 2002, A. Raman, 1995
Peppermint oil	Menthol	$C_{10}H_{20}O$	156.27	7.4	Soluble in water, Alcohol & Paraffin oil	Due to phenolic group cause cell death	Domenico trombetta, 2005, M.L. Faleiro, 2011.
Camphor oil	Camphor	$C_{10}H_{16}O$	152.23	7.0	Slightly soluble in water, soluble in acetone and chloroform	Due to ketonic group less permeable but damage inner cell	M. Mahboutri 2007
Eucalyptus oil	1, 8-cineole	$C_{10}H_{18}O$	154.24	7.0	Slightly soluble in water, fully or partially miscible in liquids from hydro carbons to polar organics	having ketonic group play less role in permeating cell membrane	M. Mahboutri 2007

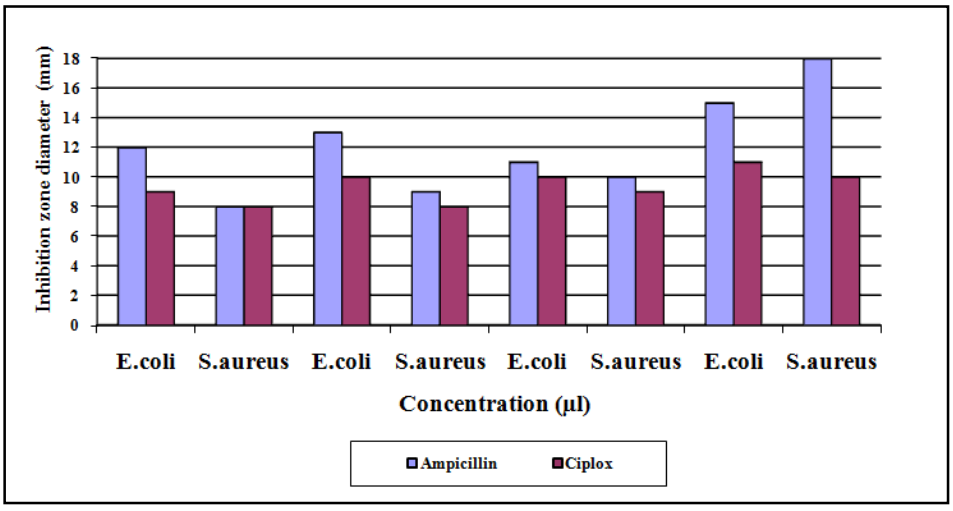

Fig. 1. Growth inhibition zone of commercial antibiotics against E.coli and S.aureus

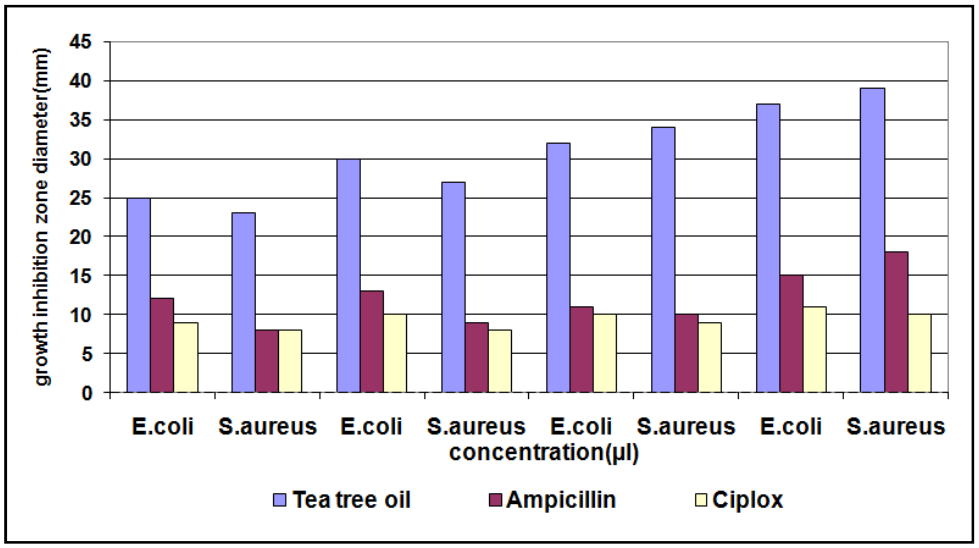

Fig. 2. Growth inhibition zone diameter of Tea-tree oil against E.coli and S.aureus after 24 hrs

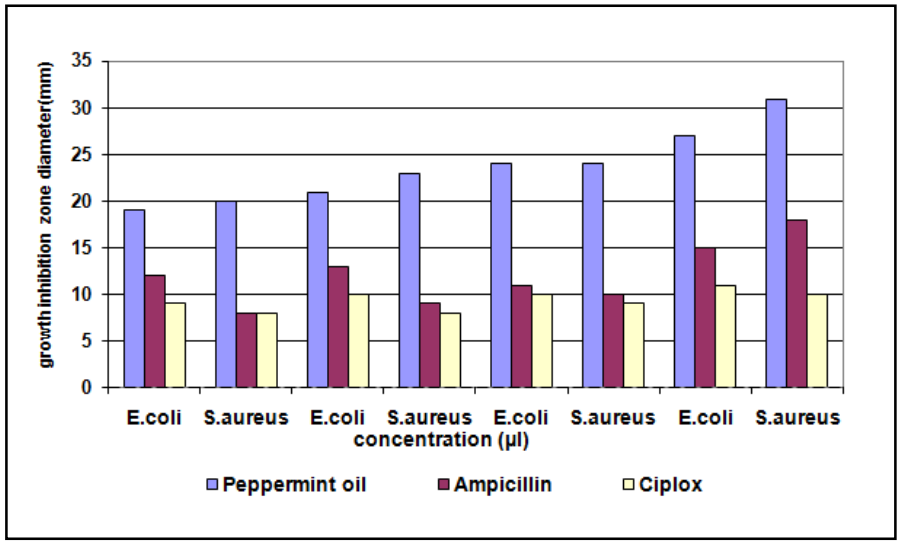

Fig. 3. Growth inhibition zone diameter of peppermint oil against E.coli and S.aureus after 24 hrs

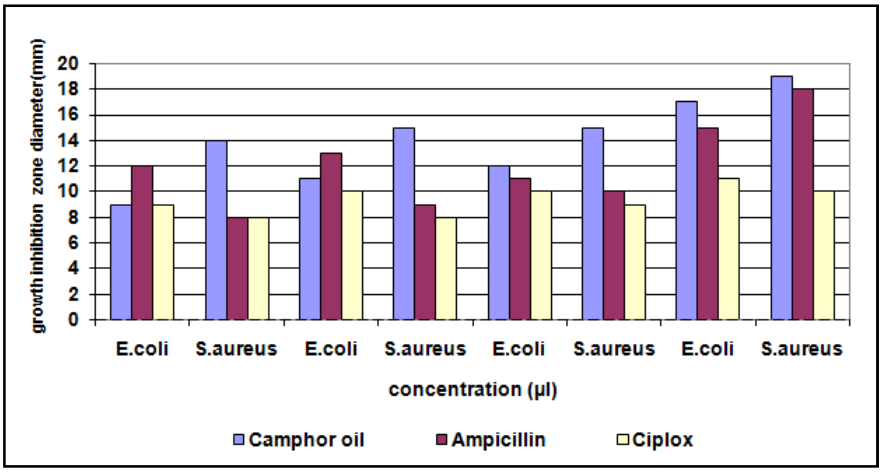

Fig. 4. Growth inhibition zone diameter of Camphor oil against E.coli and S.aureus after 24 hrs

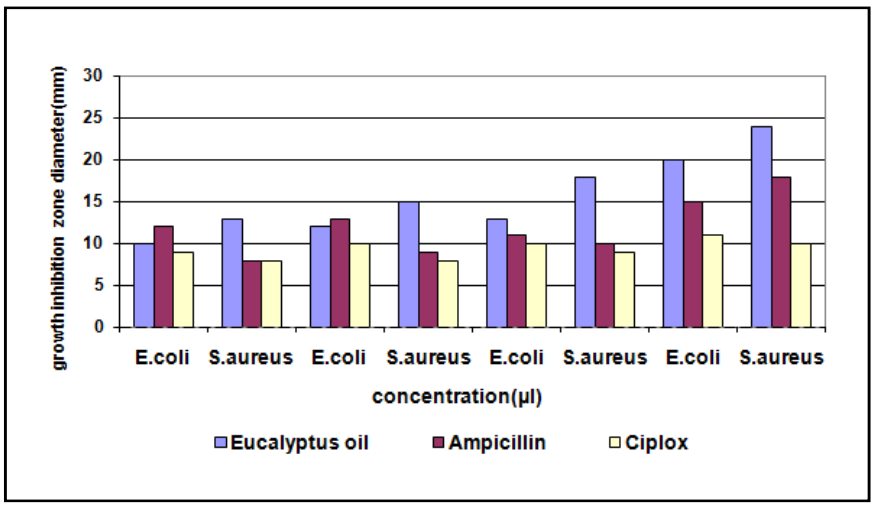

Fig. 5. Growth inhibition zone diameter of Eucalyptus oil against E.coli and S.aureus after 24 hrs

- On comparing their antimicrobial activity with commercial antibiotics (Ampicillin & ciprofloxacin) all four essential oils showed better activity than these antibiotics.
- Terpinen 4-ol was identified major terpenes in tea tree oil. In peppermint oil, camphor and Eucalyptus major terpenes is menthol, camphor & 1-8 cineole.

Identified major terpenes in essential oils were studied for physiochemical properties & relation of structure with their activity.

- Terpinen 4-ol, menthol, camphor & 1-8 cineole are oxygenated terpenes.
- Terpines -4 ol menthol with alcoholic groups had higher solubility and permeability and show higher bioactivity.

- 1-8 cineole and camphor with ketonic group, limited solubility and permeability and not effective as terpinen -4-ol and menthol.
- The structure activity relationship is observed in following trend :- terpinen - 4 ol > menthol > 1, 8 cineole > camphor.

Conclusion

Essential oils from plants provide an environmentally benign toxicologically safe and more efficacious antimicrobial to combat pathogenic bacterial strains. The naturally occurring plant defence material i.e. terpenes could easily replace the hazardous synthetic chemicals/Antibiotics & result in futuristic green antibiotics.

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