Comparative evaluation of antimicrobial efficiency of tea tree oil and chlorhexidine on *Streptococcus mutans*

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**ABSTRACT**

**Introduction:** *Streptococcus mutans* is the most common organism causing dental caries. Various chemotherapeutic agents are available that help in treating the bacteria, with each having their own merits and demerits. Tea tree oil is extracted from Melaleuca leaves (Myrtaceae family). Cineole is a skin-irritating substance and terpinen-4-01 is presumed to be the most important antimicrobial agent of the tea tree oil. The aim of the study is to evaluate the antimicrobial efficiency of tea tree oil and chlorhexidine (CHX) on *S. mutans.* **Materials and Methods:** The antibacterial activity of tea tree oil was screened against *S. mutans* using agar well diffusion assay, and the zone of inhibition was recorded. **Result:** In this present study, the inhibition levels of tea tree oil and CHX were tested with *S. mutans.* The inhibition is different at different concentrations. However, it may also be noted that CHX is found to be more potent than tea tree oil in the majority of the concentrations. **Conclusion:** Tea tree oil has a significant antimicrobial effect compared to controlled group. The tea tree oil was as effective as an antacaries mouthwash as CHX.

**KEY WORDS:** Antimicrobial, *Streptococcus mutans*, Tree tea oil, Zone of inhibition

**INTRODUCTION**

Oral diseases such as dental caries and periodontal diseases are caused by microorganisms belonging to the resident microflora rather than by classic microbial pathogens.[1] Oral microbial flora is dominated by Gram-positive microorganisms, and hence dental plaque which is formed on the tooth surface contains Gram-positive cocci and bacilli.[2] With the exponential advancement in the field of dentistry, various preventive measures have emerged targeting the causative factors of the oral diseases.[3] Dental plaque which forms on the tooth surface exists in a state of biofilm which means the microorganisms present in the plaque live in communities and they are held together in a matrix. Plaque accumulation is one such factor which predisposes the individual to both dental caries and periodontal disease.[4,5] Salivary microfloras such as *Streptococcus mutans* and other predisposing factors lay an important role in the initiation and progression of dental diseases such as dental caries.[5] Chemotherapeutic and antimicrobial agents aiming at these predisposing factors, therefore, play a significant role in the prevention of these oral diseases and have a dramatic impact on improving the oral health of the individual.[6]

Among the plethora of oral hygiene products available, chlorhexidine (CHX) has been the mouthwash of choice due to its dramatic therapeutic effect, but its various side effects such as taste alteration, supragingival calculus formation, and desquamation of oral mucosa have restricted its usage in pediatric age group.[10] CHX, being one of the most popular mouth rinses, has shown to significantly reduce the level of oral *S. mutans.*[11] Moreover, it also causes extrinsic staining by attaching to the polyphenolic and tannin group of beverages such as tea and coffee. Alternative agents based on herbal extracts are, therefore, of particular interest. Tea tree oil is extracted from the tree *Melaleuca alternifolia* that grows in Australia and has been shown to have many beneficial medicinal uses as an antiseptic, antifungal, and antibacterial agent.[12] Studies indicate that *M. alternifolia* is extracted from the leaves and twigs by steam distillation, and the
yield is about 1.8% and that the main chemical component to have antimicrobial activity in tea tree oil is attributed to terpinen-4-ol.[19] Hence, the aim of the present study is to evaluate and compare the effect of tea tree oil and CHX and when used as an antacaries mouthwash.

MATERIALS AND METHODS

Bacterial strain used was S. mutans. The organism was isolated using selective media Mutans-Sanguis agar and maintained in nutrient agar slope at 4°C in the Department of Microbiology, Saveetha Dental College.

Methodology

The tree tea oil was loaded onto sterile filter paper discs measuring 6 mm diameter in the following concentrations 50 µl, 100 µl, and 200 µl. The discs were dried and kept aseptically.

Screening of Antibacterial Activity (Disc Diffusion Technique)

Brain heart infusion medium was prepared for a subculture to check the viability of bacteria. 10 uL of each sample was then inoculated onto the medium with the help of sterile loops. The culture plates were then incubated for 24 h at 37°C. The colony forming units were then calculated, and the antimicrobial efficacy was thereafter determined. Disc diffusion assay was used to measure antibacterial activity. Various disk with different concentrations of 50, 100, and 200 was placed and control disk was placed and kept in an incubator after 24 h the zone of inhibition was calculated. Zone of inhibition was measured around the filter paper in millimeters with a Vernier caliper.

RESULTS

In this present study, the inhibition levels of tea tree oil and CHX were tested with S. mutans and the results were shown in Figure 1. When the concentration of tea tree oil and CHX was 50, the inhibition level of S. mutans was found to be 17 mm and 19 mm. When the concentration of tea tree oil and CHX was 100 µl, the inhibition level of S. mutans was found to be 15 mm and 13 mm. When the concentration of tea tree oil and CHX was 200, the inhibition level of S. mutans was found to be 29 mm and 33 mm.

DISCUSSION

In the present study, the inhibition levels of tea tree oil and CHX were tested with S. mutans species. From the above graph, it has been shown that the inhibition is different at different concentrations. However, it may also be noted that CHX is found to be more potent than tea tree oil in the majority of the concentrations. This factor has to be taken into consideration during preparation for oral care.

Groppo et al. conducted a study based on the comparision of the antimicrobial activity of garlic, tea tree oil, and CHX against oral microorganisms. Tea tree oil and garlic have been reported as an effective agent to be used as an alternative to CHX.[14] A bacterial lawn technique on agar plates for each tested bacterium has been carried out. In the results of the present study, it was reported that tea tree oil possess potent antibacterial action of the strains tested due to the presence of a significant zone of inhibition.[14] A study comparing agar and dilution techniques in broth presented statistical differences between these methods.[15,16] When evaluating the antimicrobial activity on planktonic cultures, the values for the minimum inhibitory concentration (MIC) of the tea tree oil, using the diffusion method in agar, S. mutans (ATCC 25175) and S. mutans (JC-2) were found to be 1000 µg/mL.[17] The previous study has identified MIC values lower than Lactobacillus rhaminosus (300 µg/mL) and higher for S. mutans (2500 µg/mL).[18] Differences in MIC values can be justified by the different strains tested, as well as by the method of obtaining the essential oil, its seasonality, or place of cultivation.

CHX is a potent chemotherapeutic agent considered to be the gold standard in the reduction of oral pathogens. CHX readily binds to the charged bacterial surfaces and acts against Gram-positive and Gram-negative bacteria. CHX gluconate is a cationic biguanide with broad-spectrum antimicrobial action, whose effectiveness in decreasing the formation of dental biofilm (plaque) and gingivitis have been demonstrated in several clinical studies. It is considered as the positive control (gold standard), to which all other anti-plaque agents should be compared. Its advantages are based on its substantivity property.[19] Its antibacterial action is due to an increase in cellular membrane permeability followed by coagulation of the cytoplasmic macromolecules.[20] The antibacterial action may also due to an increase in cellular membrane permeability followed by coagulation of the cytoplasmic macromolecules. It is representative of the cationic group that is highly effective against
S. mutans infection. Its superior effect is due to the fact that it retains its antimicrobial effect as its remains adsorbed to the tooth surface even after its clearance from saliva.\[21,22\]

**CONCLUSION**

Tea tree oil has a significant antimicrobial effect compared to controlled group. The tea tree oil was as effective as an anticaries mouthwash as CHX. Future studies have to be aimed at increasing substantivity of herbal mouthrinses so that a potential alternative to CHX alone with intense antimicrobial activity and cost-effective preventive strategies for caries can be used.

**REFERENCES**


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