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Original Research Article **Periodontology**

Antiplaque Efficacy of Essential Oils as Compared to Chlorhexidine Gluconate- A Prospective Clinico-Microbiological Study

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Abstract

***Background*:** According to Egyptian pictograms and medical records, non-surgical periodontal treatment (NSPT) has been practised for a very long time. Several clinical studies have depicted relevant clinical results when subgingival irrigation was carried out as an adjuvant therapy to SRP. This study aims to compare essential oils as subgingival irrigant agents with chlorhexidine gluconate (CHX) and sterile saline over a period of 21 days. ***Setting and Design*:** This is a comparative study of three groups (chlorhexidine group, essential oil group, sterile saline group). Each group had ten patients having chronic periodontitis who were randomly assigned and treated with subgingival irrigants. For, the essential oil group, the irrigant was indigenously prepared at chairside. ***Material and Methods*:** Following the initial examination and selection of patients, clinical parameters were noted and collection of plaque samples was done. These samples were then sent for microbiological assay at baseline. SRP was done along with subgingival irrigation at baseline, 7th and 14th day. Clinical parameters were monitored again and plaque samples were sent for microbiological test on the 21st day. ***Results*:** There was no significant difference noted between the groups in any of the clinical parameters. However, regarding microbiological parameter, better results were demonstrated in CHX group and essential oil group compared to sterile saline group that was statistically significant. CHX and essential oil group demonstrated no statistical difference. ***Conclusion*:** The result of this study suggests that essential oils can be used as a subgingival irrigant in the treatment of chronic periodontitis.

Keywords: Subgingival irrigation, chlorhexidine, lemongrass oil, tea tree oil, viable count.

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INTRODUCTION

Periodontitis, the most common reason for tooth loss and the sixth most common disease deleteriously affects oral health, nutrition, self-confidence, and overall health. It initiates with plaque accumulation that forms microbial deposits around teeth which proceeds to gingival inflammation [2]. Periodontal pockets, the major clinical manifestation of periodontitis, serve as an ideal environment for subgingival bacterial biofilms. The cornerstone in the management of chronic periodontitis is the non-surgical periodontal treatment (NSPT) [4]. Non–surgical periodontal therapy emphasizes on the bacterial plaque removal from the root surface and has shown improvement in clinical parameters [5].

Over the past few years, subgingival irrigation aided in successful periodontal therapy as this delivers the antimicrobial agents subgingivally. In the current scenario, several studies have investigated the role of anti-microbial agents like Chlorhexidine (CHX), metronidazole, tetracyclines, povidone-iodine and herbal products like propolis in the treatment of periodontal pockets [6].

Chlorhexidine gluconate is the gold standard mouthwash, most meticulously researched with excellent anti- plaque and anti-gingivitis efficacy. Yet, this mouthwash has reported several side effects on its prolonged usage like staining of tongue and teeth, alteration of taste; mouth ulcers and paresthesia; swelling of parotid glands and heightened formation of supra gingival calculus [7].

Essential oils can effectively penetrate dental plaque and exert a bactericidal effect [8]. Lemongrass oil has evident medicinal properties like antimicrobial, anti-oxidant, antiseptic, astringent, anti-inflammatory, analgesic, antipyretic and carminative property [7]. Tea tree oil could be effective in gingivitis and periodontitis. The main ingredients of tea tree oil are 1,8 cineole and terpinen-4-ol. 1,8-cineole which have ability to suppress inflammation. Terpinen-4-ol also possess anti-microbial properties [8].

Hence, the objective of this study was to evaluate the efficacy of essential oils as subgingival irrigant agent regarding the following parameters as compared to chlorhexidine gluconate and sterile saline over a period of 21 days:

- Clinical parameters.
- Microbiological assay.

MATERIAL AND METHOD

Thirty patients with chronic periodontitis were chosen from outpatient department, Department of Periodontology of our institution.

Ethical Clearance

An overview of the treatment plan was discussed with patients including procedure, risks, and expected outcome, and their full signed consent was received before the study. The study fulfilled the protocols of Declaration of Helsinki on the research ethics committee and was approved by JSS Ethical Committee. This trial was also registered in CTRI (CTRI/2020/11/028802)

Patient Selection

The inclusion criteria of the study were: systemically healthy patients, both males and females with age ranging from 35-55 years having chronic periodontitis, patient exhibiting periodontal pockets with a probing depth of ≥ 5mm at four sites, consenting patients who were co-operative and ready for regular follow up, ≥ 20 remaining teeth. The exclusion criteria were: patients on antibiotic therapy in the previous 6 months, patients who had undergone periodontal therapy in the past six months, pregnant/lactating women**,** smokers**,** patients who were medically compromised and were under therapeutic medications. The Withdrawal criteria were: Patients not completing the follow-ups and at any time, patients with drawing from the study research at his/her own will.

Randomization

Patients were randomly assigned to three groups by computer allocated method, each receiving one of the three subgingival irrigants as described below:

1. **Group A:** Chlorhexidine irrigant.
2. **Group B:** Essential oil irrigant.
3. **Group C:** Sterile saline irrigant.

Subgingival Irrigants Used

- Indigenous natural essential oil irrigant was prepared at the chairside. The natural 2% weight indigenous essential oil irrigant was prepared by [11] (Figure: 1).
  - Distilled water- ½ cup (50 ml).
  - Pure tea tree oil- 2 drops.
  - Pure lemon grass oil- 2 drops.
- Chlorhexidine gluconate 0.2 %.
- Sterile saline.

Figure 1: Essential Oils

Study Design

At baseline, the clinical parameters were documented and subgingival plaque samples were obtained from the selected sites, prior to ultrasonic scaling. The following parameters were recorded: "Plaque index (Sillness and Loe, 1964); Gingival index (Loe and Sillness, 1963); Bleeding index; Pocket probing depth [PD]."

Subgingival irrigation was done at baseline (after ultrasonic scaling), 7th and 14th day.

Collection of Subgingival Samples

In each quadrant, the deepest pocket served the area of interest (Figure: 2). Hence, collection of plaque sample was done using paper points (Figure: 3) from the four sites at baseline and on the 21st day. Site isolation was done with cotton rolls and the supragingival plaque was removed using small cotton pellets.

The samples were instantly placed into a vial comprising 3 ml of pre-reduced anaerobically sterilized Ringer's solution.

Vortexing of the solution was done for one minute (Figure: 4).

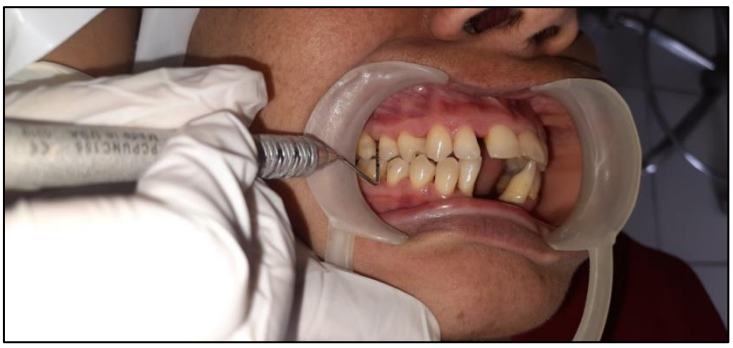

Figure 2: Probing Pocket Depth at Baseline

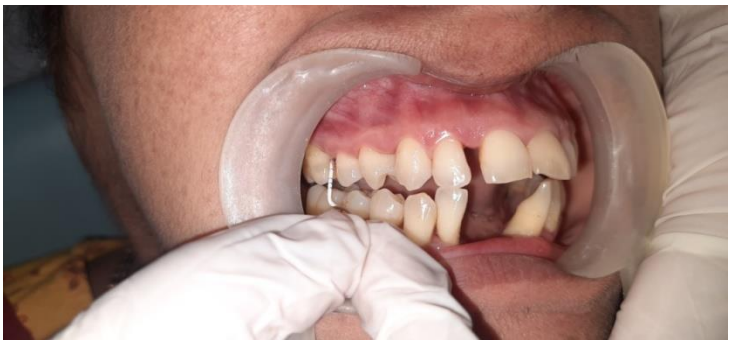

Figure 3: Collection of Subgingival Plaque Sample with Paper Points

Figure 4: Subgingival Irrigation

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Irrigation Protocol

After isolation, 150 ml of allocated solution was used to irrigate the desired areas for five minutes (Figure: 5).

Patients were educated to follow oral hygiene instructions.

At baseline, subgingival irrigation was done after ultrasonic scaling. On day 7th and 14th, only subgingival irrigation was done.

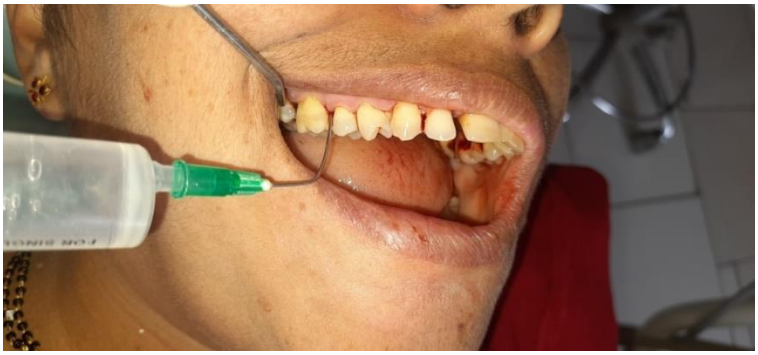

Figure 5: Probing Pocket Depth on 21st Day

Post Irrigation Evaluation

The patients were recalled at 21st day and the clinical parameters were monitored at the desired sites: "Plaque index (Sillness and Loe, 1964); Gingival index (Loe and Sillness, 1963); Bleeding index; Pocket probing depth [PD]" (Figure: 6).

The same pattern of plaque sample collection was followed as described previously.

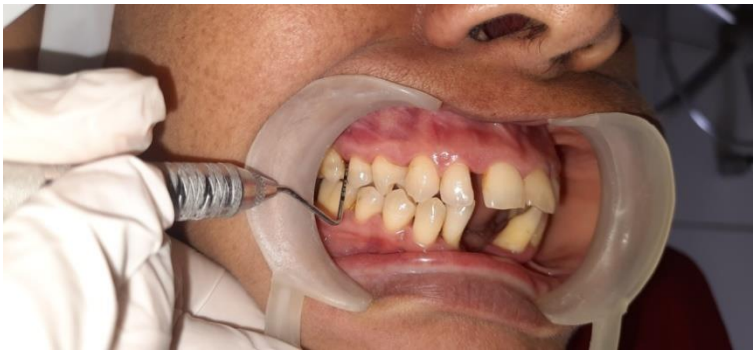

Figure 6: Gram Staining

Microscopic Examination

Within 60 minutes of sampling, a drop of the sample solution was placed on a glass slide and was studied under microscope by gram staining for the presence and distribution of spirochetes, rods and cocci (Figure: 7, 8, 9). The viable counting was done using pour plate method. For this we used nutrient agar medium. After inoculating the bacteria, the medium was incubated for 24-48 hours.

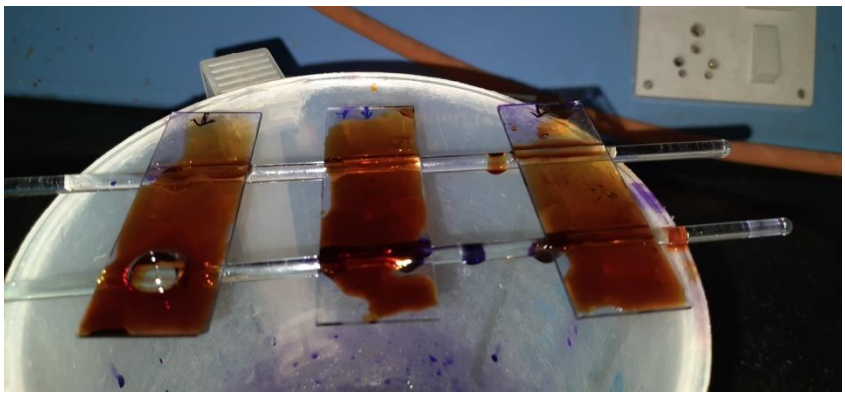

Figure 7: Microbiological Analysis at Baseline

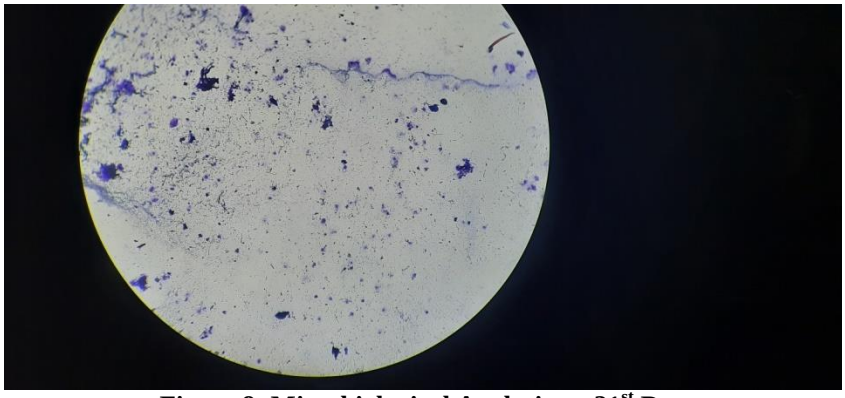

Figure 8: Microbiological Analysis on 21st Day

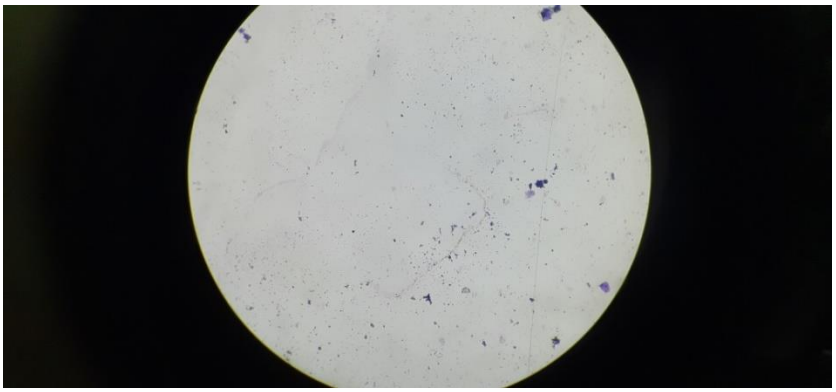

Figure 9: Vortexing Machine

Statistical Analysis

Data was entered in Microsoft excel and evaluated using IBM SPSS Statistics for Windows, Version 24.0. IBM CORP. The results were averaged (mean + standard deviation) for continuous data and number and percentage for dichotomous data are presented in Table.

RESULTS

A total of 30 patients (17 males and 13 females) with a mean age of 38 participated in the study No adverse effect was reported during or after the procedure. In all the groups, there was a significant improvement in the clinical parameters (plaque index, gingival index, bleeding index and probing pocket depth) from baseline to 21 days (P>0.05) (Table: I).

Table I: Full Mouth Scores at Various Time Intervals

Intergroup Analysis								
Group	**Plaque Index (Mean + SD)**		**Gingival Index (Mean + SD)**		**Bleeding Index (Mean + SD)**		**Pocket Depth (Mean + SD)**	
	Base-Line	**21st Day**	**Base-Line**	**21st Day**	**Base-Line**	**21st Day**	**Base-Line**	**21st Day**
Chlorhexidine	1.8+0.64	0.97+0.4	1.54+0.65	7.17+18.1	40.9+31.8	18.2+19.7	5.87+0.76	4.54+0.75
Sterile saline	1.7+0.57	1.02+0.42	1.4+0.68	0.68+0.45	32.22+22.38	13.7+8.4	5.96+0.58	4.96+0.55
Essential oil	2.14+0.4	1.08+0.39	1.9+0.6	0.87+0.4	32.92+21.36	15.9+11.5	5.63+1.05	4.34+0.79
F Value	0.18		1.24		0.25		2.06	
P Value	0.84		0.3		0.78		0.15	

*Significant difference in all the parameters between all the groups

However on intergroup comparison, there was no significant difference in any of the clinical parameters (Table: II). The microbiological analysis showed a significant reduction in the microbiological count from baseline to 21 days. There was a statistically significant difference between chlorhexidine and sterile saline group. There was also a statistically significant difference between essential oil group and sterile saline group. There was no statistical difference between chlorhexidine group and essential oil group (Table: III).

Table II: Site Specific Scores at Various Time Intervals

Parameters	Baseline	21st Day
Plaque Index	2.390 + 0.357	0.944 + 0.397
Gingival Index	2.230 + 0.362	0.730 + 0.255
Bleeding Index	0.664 + 0.155	0.148 + 0.076
Probing Pocket Depth	6.600 + 0.152	3.390 + 0.408

*No statistical difference in any parameter between both the groups

Table III: Microbiological Analysis at Various Time Intervals

Groups	*Mean*	*SD*	*T Value*	*P Value*
Chlorhexidine	47.97%	17.39%	6.888601	<0.01
Sterile saline	18.69%	4.78%		
Chlorhexidine	47.97%	17.39%	0.395025	0.70
Essential oil	45.71%	16.94%		
Sterile saline	18.69%	4.78%	6.510795	<0.01
Essential oil	45.71%	16.94%		

*1. There is a significant difference between Percentage reduction in CHX Group and SS Group
2. There is no significant difference between Percentage reduction in CHX Group and EO Group
3. There is a significant difference between Percentage reduction in SS Group and EO Group

DISCUSSION

Professional periodontal treatment may not always accomplish satisfactory debridement [9]. To overcome the drawbacks of conventional therapy, several antimicrobial agents have been used systemically or locally [10]. The null hypothesis was that antiplaque efficacy is same between essential oils, chlorhexidine gluconate and sterile saline groups. In present study, there was no significant difference in the clinical parameters on intergroup comparison. On the contrary, regarding microbiological parameters, essential oil and CHX showed better results than sterile saline group.

The subgingival irrigant used in the current scenario was prepared by referring to the research done by Khirtika *et al.*, where it has been used as an anticaries mouthrinse. They checked for S. mutans before and after the mouthrinse. The results showed significant reduction of bacteria after mouthrinse [11]. In our study, we focused on the antiplaque efficacy of essential oils as subgingival irrigant.

In another study by Ali *et al.*, CHX was compared with essential oil (1-2% aqueous extract of essential oil mouthwash) against the following parameters: Oral hygine index, plaque index, gingival index and microbiological analysis. The essential oil showed a greater reduction in all the parameters as compared to CHX [12]. The present study also considered periodontal pocket as it's an important clinical parameter for attachment loss.

Ripari *et al.*, studied the efficacy of tea tree essential oil in the treatment of chronic periodontitis and this was compared with the gold standard-CHX. The following clinical criteria were taken into consideration: "gingival index (GI), plaque index (PI), bleeding index (BI), probing depth (PD), the presence of dental dyschromia, and the presence of taste alteration." The authors concluded that tea tree oil showed much better results than CHX which was quite similar to our study. Also, CHX caused taste alteration and dental dyschromia. Also, in our study we took into consideration microbiological parameters that showed significant reduction of viable bacteria [13].

A study by Shivaraj *et al.*, compared the efficacy of SRP followed by 2% lemongrass oil gel as LDD compared to SRP alone. Pocket depth, relative attachment level and gingival index were taken into account. Results demonstrated that the former showed better results than the latter, hence proving the potential of lemongrass oil [14].

A study by Abdul *et al.*, evaluated the efficacy of tea tree oil in impeding the adhesion of pathogenic periodontal biofilms (Aggregatebacter Actinomycetecomitans and P. gingivalis). Tea tree oil was used in 6.25%, 12.5%, 25%, and 50% concentrations. The biofilm colonies were counted using an immunosorbent reader. The authors concluded that the concentration most efficacious in reducing the count was 12.5%. However, the above study conducted was an in vitro on extracted teeth [15].

Alexander *et al.*, conducted a study to check the efficacy of essential oil mouthwash (Listerine) with CHX (0.12%). In the above study only clinical parameters were documented (probing pocket depth and clinical insertion level). The results showed that effectiveness of CHX (0.12%) were higher than essential oil thereby, contradicting our study. In our study besides the clinical parameters, the microbiological assay was also considered.

The biggest advantage of this study is that we combined two different essential oils. Also, since the

irrigant was indigenously prepared at chairside, it was economical for the patient. The irrigant did not show any side effects like chlorhexidine.

The limitations of our study were smaller sample and failure to record patient's satisfaction. Also, the severity and progression of periodontal disease varied among the patients. Our study focused on the overall microbiological picture rather than specific strains of micro-organisms. Hence, within the limitations of the study, essential oil proved to be a substitute for CHX as subgingival irrigant. Further longitudinal studies are required with larger sample size with newer methods to analyze the effect on the microbiology.

CONCLUSION

This study suggested that essential oil is equally efficacious as CHX, hence can be used as an alternative to CHX. Also, we can overcome the drawbacks of CHX that has been a part of controversies since decades.

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CONFLICTS OF INTEREST

There were no conflicts of interest in this study.

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Declaration of Patient Consent

Participants have given their written informed consent.

Date Availability Statement

The data used in the study are available on request by contacting the corresponding author.

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