

## Comparative Evaluation of Antiplaque Efficacy between Essential Oils with Alcohol-Based and Chlorhexidine with Nonalcohol-Based Mouthrinses

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ABSTRACT

**Aim and Objectives:** The aim of this study is to compare the antiplaque efficacy of alcohol-based mouthwash with essential oils and nonalcohol-based chlorhexidine mouthrinse in 4 days plaque re-formation study.

**Materials and Methods:** The current research paper is double-blinded, parallel designed clinical trial that was conducted in the Department of Periodontics and Oral Implantology, Kalinga Institute of Dental Sciences, Bhubaneswar. This included ninety dental students of Bachelor of Dental Surgery curriculum (in the age range from 20 to 24 years) Professional cleaning with scaling and polishing was carried out to acquire a zero plaque and gingival index (GI) for all ninety patients at baseline. Ninety patients were randomly divided into three groups with thirty patients in each group named as Group A, B, and C, respectively. Two commercially available mouthrinses, one containing alcohol (labeled as Solution (A) and one without alcohol (labeled as Solution (B) were placed in identical bottles and distributed to Group A and Group B patients. Whereas, the Group C patients were instructed to use warm saline mouth rinse. The statistical analysis was performed using the Statistical Package for the Social Sciences software (Version 18).

**Results:** Essential oils with an alcohol-based and chlorhexidine (CHX) alcohol-free mouthrinse (0.2%) groups compared to normal saline showed significant reductions in GI and PI scores. ( $P < 0.0001$ ).

**Conclusion:** The antiplaque efficacy of both alcohol-based mouthwash with essential oils and nonalcohol based CHX mouthwash were found to be equally effective in 4 days of plaque re-formation.

**KEYWORDS:** Chlorhexidine, essential oils, gingivitis, mouthrinses

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### INTRODUCTION

Gingivitis and periodontitis are the inflammatory condition of gingival and periodontal soft tissues. Different forms of gingivitis and periodontal diseases have been illustrated in many literatures.<sup>[1]</sup>

Plaque and oral biofilms are the main causative factors for gingival and periodontal diseases. Different forms of gingival or oropharyngeal diseases such as gingivitis, periodontitis, and other inflammatory conditions can be prevented and treated using mouthrinses.<sup>[2]</sup>

One of the ingredients that are present generally in every mouthwash is alcohol, Ethanol that is in a concentration

of 0%–27% as compared to the alcohol content of alcohol based drinks like in beer which is 4% and in wine 12%, apart from the various therapeutically active ingredients in the mouthwashes such as essential oils, chlorhexidine (CHX), fluoride,<sup>[3]</sup> potassium nitrate, and benzydamine.

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Except for its use as a solvent ingredient, alcohol in the mouthwash does not have any other medicinal effect because the optimum concentration of 50%–70% is required for alcohol to be able to exert its antiseptic effect, which lags due to its low level of concentration in mouth rinses.

Moreover, in some patients, it has been noticed that the presence of alcohol causes an initial burning sensation, unpleasant taste and dryness of mouth. Furthermore, it has been reported that alcohol-based mouthwash when used continuously for a long period, it is a predisposing factor for oral cancer.<sup>[4]</sup>

Due to this, nonalcohol based mouthrinses have been proved to be equally effective as alcohol-based mouthwashes, with minimal side effects demonstrated by the former.

The Biomed Research International has stated that alcohol-free mouthrinses have a better effect on the gloss, color, hardness and wear of tooth composite restorations.

On the other hand, a salt water mouth rinse can be useful due to a number of different reasons. The use of salt promotes healing. Salt water does not irritate the mucous membrane like other medicinal mouthwash due to its isotonic nature, that means it has same concentrations of salts and minerals that our bodies have.<sup>[5]</sup>

## AIMS AND OBJECTIVES

This study was aimed at comparing the antiplaque efficiency of alcohol-based mouthrinse with essential oils and nonalcohol based CHX mouthrinse in 4 days plaque re-formation.

Comparison of the gingival index (GI) and Plaque Index (Silness and Loe, Loe and Silness) after using either CHX gluconate alcohol-free mouthrinse (0.2%) or with alcohol base mouthrinse (0.2%) twice daily without mechanical plaque control measures, was the primary objective of this study.

## METHODOLOGY

The current research was double-blinded, parallel designed clinical trial that was conducted in the Department of Periodontics and Oral Implantology, Kalinga Institute of Dental Sciences, Bhubaneswar from August 2016 to October 2016. Before start of the study, it was reviewed and passed by the institutional research and ethical committee, respectively. This included 90 dental students of Bachelor of Dental Surgery curriculum (in the age range from 20 to 24 years). Ethical committee letter number: KIIMS/KIIT/IEC/144/2016.

The sample size of ninety was calculated using software G power considering effect size  $f = 0.51$ ,  $\alpha = 0.05$  and 80% power of the study.

## INCLUSION AND EXCLUSION CRITERIA

### Inclusion criteria

1. Subjects with no systemic diseases and conditions
2. Subjects with GI score  $\leq 1$  (as a mean value for all tooth surfaces scored)
3. Subjects with the dentition of  $\geq 20$  teeth with a minimum of 5 teeth per quadrant.

### Exclusion criteria

- a. Subjects with severe malocclusion
- b. Orthodontic appliances and full crowned teeth
- c. Subjects with removable partial dentures and bad oral habits like tobacco chewing, etc.
- d. Subjects with medical or pharmacological history that could compromise the conduct of the study.

## STUDY DESIGN

As per the inclusion and exclusion criteria, ninety participants were selected after excluding the dropouts. In these participants, GI (Loe and Silness GI) and plaque index (Silness and Loe plaque index) were recorded for all the teeth (except third molars) with four sites per tooth for the duration of 4 days.

Initially, the baseline scores for plaque and GI of all ninety patients were brought to zero score on oral hygiene index by professionally cleaning the teeth with scaling and polishing procedure.

After that randomized three groups were made by the flip of coin method (of thirty subjects each, named as Group A, B, and C, respectively).

Two commercially available mouthrinses, one containing alcohol (labeled as Solution A) and one without alcohol (labeled as Solution B) were placed in identical bottles and distributed to Group A and Group B patients. Whereas, the Group C patients were instructed to use warm saline mouth rinse.

The said three groups were further divided in the following manner.

- Group A: Alcohol based mouth rinse - (Labeled as Solution A). These patients were instructed to rinse their mouth with 10 ml of Solution A mouthwash two times in a day in the morning and evening, respectively, for 1 min
- Group B: Nonalcohol based CHX gluconate mouth rinse-(Labeled as Solution B). These patients were instructed to rinse their mouth with 10 ml of Solution B mouthwash two times a day in the morning and evening, respectively, for 1 min
- Group C: Normal saline. These patients were asked

to rinse their mouth with 5 ml of normal saline twice daily for 1 min.

All the participants will be refrained from regular mechanical oral hygiene measures and will be demonstrated how to use the mouthwash samples.

Allocation of mouthwash samples was carried out by the study co-ordinator and the samples were distributed in such a way that the blindness of the examiner as well as the participants gets assured.

After packing and labelling the mouthwash solutions in identical bottles by the study co-ordinator, the patients were instructed to collect the samples in a separate room from where the clinical examination got take place.

Then after an interval of 2 and 4 days, the plaque and gingival scores on the same teeth were recorded for all the ninety participants of three study groups.

The results obtained after 4 days were evaluated statistically using Student's *t*-test and ANOVA.

Number and percentages were derived using MS Excel and SPSS package version 23.0 (IBM SPSS Statistics Developer).

The value of  $P < 0.01$  was considered statistically significant.

## ASSESSMENTS

### Gingival index<sup>[6-8]</sup>

The GI was scored and calculated according to Loe and Sillness.<sup>[6-8]</sup> The overall average gave the final GI score.

### Plaque index

PI<sup>[8-10]</sup> was calculated according to Soparkar's modification.<sup>[5]</sup>

## RESULTS

### EFFICACY

The effects of essential oils mouthrinse with alcohol, CHX mouthrinse without alcohol and normal saline on PI and GI are presented in Figure 1, respectively, and in Tables 1-4. All the variables were lower significantly for both Group A and Group B compared to the Group C in which the variable scores were increased after 4 days.

(Treatment differences [95% confidence interval]: PI [initial], 0.02167 [-0.05338, -0.09671], 0.04733 [-0.01401, -0.10867], respectively; PI [final] -0.00733 [-0.03258, 0.01791], -0.28633 [-0.32705, -0.24562], respectively; GI [initial] -0.02200 [-0.06322, 0.01922], -0.04700 [-0.08470, -0.00930] respectively. GI [final] -0.00650 [-0.02709, 0.01409], -0.18583 [-0.23195, -0.13972], respectively. All  $P < 0.0001$ ); [Table 4].

## DISCUSSION

The outcome of the present research showed a significant reduction in GI and PI scores in both essential oils with an alcohol base and CHX without alcohol-based mouth rinse groups when compared to warm saline group alone, after an oral prophylaxis and 4 days follow up. Clinical studies performed in a 25-year period concluded that CHX mouth rinses were found to be effective in controlling plaque and gingivitis and as an effective adjunct to mechanical plaque control.<sup>[11,12]</sup> The result of this study was in accordance with that of the systematic review.

CHX is considered gold standard among antimicrobial agents which has been constantly evaluated chemical agent for the reduction in the formation of plaque and plaque-induced gingival inflammation.<sup>[13]</sup> Positively charged CHX molecule is rapidly attracted to bacterial cell membrane that is negatively charged resulting in the damage and leakage of intracellular components is considered its antibacterial mode of action.<sup>[14]</sup>

An environment is created where the antibacterial properties of CHX are maintained for several hours depending on factors such as dosage, time of rinsing, oral temperature, the presence of natural or artificial teeth, organic material and salivary pH.<sup>[15,16]</sup> This is due to the attachment of CHX to the teeth, biofilm, tongue, oral mucosa, and salivary proteins which is then slowly secreted into the saliva. The efficacy of CHX is directly proportional to its efficacy.<sup>[17]</sup> The current study concluded that CHX levels were maintained in the oral cavity and its efficacy outcomes confirmed rinsing with 10 ml of either solution to be better effective for controlling plaque and gingivitis compared to warm saline alone.

Essential oils and CHX mouth rinse delivered in combination with or without alcohol base have long been known to exert useful effects against plaque formation and plaque-induced gingivitis.<sup>[18,19]</sup> The results of 6 weeks,

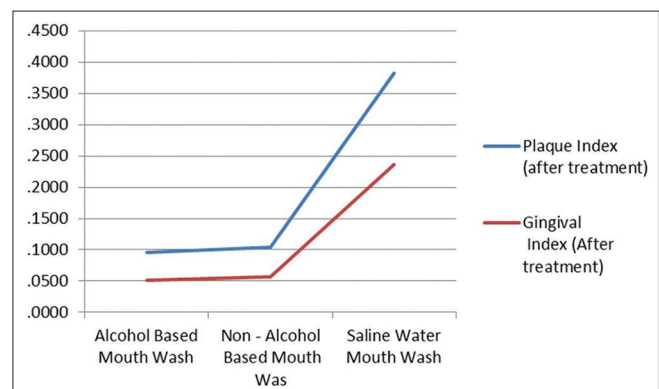


Figure 1: Comparison of anti-plaque efficiency between Group A, B and C

**Table 1: T-test for comparing means between Group A and Group B**

	T-test for comparing means between Group A and Group B						
	df	Significant (two-tailed)	Remarks	Mean difference	SE difference	95% CI of the difference	
						Lower	Upper
PI initial	58	0.566	Nonsignificant	0.02167	0.03749	-0.05338	0.09671
PI final	58	0.563	Nonsignificant	-0.00733	0.01261	-0.03258	0.01791
GI initial	58	0.290	Nonsignificant	-0.02200	0.02059	-0.06322	0.01922
GI final	58	0.530	Nonsignificant	-0.00650	0.01029	-0.02709	0.01409

SE=Standard error, CI=Confidence interval, PI=Plaque index, GI=Gingival index

**Table 2: T-test for comparing means of means between Group A and Group C**

	T-test for comparing means of means between Group A and Group C						
	df	Significant (two-tailed)	Remarks	Mean difference	SE difference	95% CI of the difference	
						Lower	Upper
PI initial	58	0.128	Nonsignificant	0.04733	0.03064	-0.01401	0.10867
PI final	58	0.000	Significant	-0.28633	0.02034	-0.32705	-0.24562
GI initial	58	0.015	Significant	-0.04700	0.01883	-0.08470	-0.00930
GI final	58	0.000	Significant	-0.18583	0.02304	-0.23195	-0.13972

SE=Standard error, CI=Confidence interval, PI=Plaque index, GI=Gingival index

**Table 3: T-test for comparing means between Group B and Group C**

	T-test for comparing means between Group B and Group C						
	df	Significant (two-tailed)	Remarks	Mean difference	SE difference	95% CI of the difference	
						Lower	Upper
PI initial	58	0.343	Nonsignificant	0.02567	0.02686	-0.02810	0.07944
PI final	58	0.000	Significant	-0.27900	0.02025	-0.31954	-0.23846
GI initial	58	0.254	Significant	-0.02500	0.02172	-0.06848	0.01848
GI final	58	0.000	Significant	-0.17933	0.02240	-0.22417	-0.13450

SE=Standard error, CI=Confidence interval, PI=Plaque index, GI=Gingival index

**Table 4: ANOVA test P values of plaque index and gingival index**

	PI (after treatment)	ANOVA test (P)	GI (after treatment)	ANOVA test (P)
Alcohol based mouth wash	0.0963	0.0000	0.0508	0.0000
Nonalcohol based mouth was	0.1037		0.0573	
Saline water mouth wash	0.3827		0.2367	

PI=Plaque index, GI=Gingival index

randomized, double-blinded study proved that CHX/fluoride rinse (0.12%) as an adjunct to routine tooth brushing concluded that there was a significant reduction in plaque and gingivitis scores when it was compared to the control rinse.<sup>[20]</sup> Another large-scale clinical trial concluded that there was a significant reduction in the plaque and gingivitis score when CHX mouthrinse when it was compared with a thymol-containing mouth-rinse solution after 14 days of treatment.<sup>[21]</sup> A reduction of about 28% in plaque accumulation and of about 25% in gingival inflammation was seen in a randomized double-blind study which was conducted in general dental practices in the United Kingdom where CHX mouthrinse was used over 12-week.<sup>[22]</sup> A marked reduction was seen in the gingival and plaque index scores for both the mouth rinses, i.e., with or without alcohol in the present study as well.

In a study conducted recently, a significant reduction was seen in the mean GI, Periodontal Index and bleeding on probing at 1, 2, and 3 months interval using CHX versus the placebo solution.<sup>[23]</sup> The results of the present research conclude that the use of CHX mouth rinse as a supplement to fluoride containing toothpaste may significantly reduce dental plaque and improve gingival inflammation compared to brushing with fluoride toothpaste alone.

With prolonged use of CHX mouth rinse, high percentage of individuals reported with features of TRAEs that included taste sensation alteration, tongue and oral tissue discoloration, burning sensation in the oral cavity, reduced salivary flow, oral desquamation, and loss of sensitivity to sensory stimuli in the mouth. A study conducted by Charles *et al.*<sup>[24]</sup> observed that people found to have significantly greater extrinsic mouth stain by the end of

the 6-month study, a finding that is usually observed in other long-term observational studies<sup>[19,20]</sup> although there were significant reductions of plaque and gingivitis. From the evidence that are available, it is suggested that precipitation of negatively charged dietary chromogens, for example, those from tea, coffee, or red wine, onto positively charged CHX adsorbed onto biofilm coated surfaces results in the variation in the degree of staining from person to person.<sup>[25]</sup> the resultant stain that is observed is extrinsic in nature and can be easily removed by regular prophylaxis. Other characteristic features that have been reported in the literature that generally resolve once the use of CHX is discontinued include taste sensation alteration, burning sensation in the oral cavity, reduced salivary flow (dry mouth), oral desquamation and loss of sensitivity to sensory stimuli in the mouth. These long-term effects of CHX could not be evaluated as the duration of the present study was very short.

Previously, tests conducted by chromic acid and nuclear magnetic resonance spectroscopy tests confirmed the presence of ethanol in essential oil mouthwash and its percentage was confirmed to be 24.5% by gas chromatography testing. Ethanol in the mouthwash, although therapeutically inactive, produces various other effects that do not have any beneficial effects. Epithelial irritation through topical application of alcohol resulted in irritation to the epithelium and had been linked with increased occurrence of tumors, which has been proved in various animal studies.<sup>[20]</sup> Inflammatory changes may also develop that may induce hyperkeratosis and atrophy of mucosa.<sup>[26-28]</sup>

The Student's *t*-test results showed that the postrinsing PI and GI values were statistically significant between Group A and Group C as well as Group B and Group C patients. This indicates that the alcohol-based and nonalcohol-based mouthwashes are superior than normal saline mouthrinses.

In ANOVA test also it showed that alcohol-based and nonalcohol-based mouthrinses are superior to normal saline. However in the present study, we have found no significant results between alcohol-based and nonalcohol-based mouthrinses.

The results showed in the bar diagrams states that the postrinsing plaque index score was reduced in both Group A and Group B patients (In comparison to the prerinsing plaque score). However, the reduction value was found to be more in Group B than in Group A. Whereas in the case of Group C, patients using normal saline the postrinsing plaque score was increased.

On the other hand, the postrinsing GI showed a slightly greater reduction in the scores in Group B patients than

Group A patients. However, the Group C patients have a slight increase in their postrinsing score in comparison to the prerinsing score.

Furthermore, studies that include both microbial analysis and salivary sampling should be carried out to substantiate the results of this study. The study duration is short for evaluating the long-term effects of mouthrinses, therefore long-term studies are needed to be carried out.

## CONCLUSION

CHX mouthrinse containing nonalcohol base 0.2% CHX gluconate and essential oils containing alcohol as the base used twice daily resulted in decreased formation of dental plaque and gingivitis as measured using GI and periodontal index (PI) after 4 days of treatment. As both the groups showed equal results on gingival health, its recommended to use nonalcohol base mouth rinses to avoid side effects of alcohol base mouth rinses, i.e., burning mouth reduced salivary flow, etc.

## FINANCIAL SUPPORT AND SPONSORSHIP

Nil.

## CONFLICTS OF INTEREST

There are no conflicts of interest.

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