Original Research

Efficacy of green tea and chlorhexidine mouthwash on gingivitis- A comparative clinical study

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ABSTRACT:
Background: Gingivitis is an early reversible disease. There are various mouth washes available that may be used for treating this condition. Most frequently used mouth wash is chlorhexidine though there are several side-effects associated with its use. Green tea is an herbal mouth wash with negligible side-effects. The aim of this study was to compare the effectiveness of green tea as well as chlorhexidine use on gingivitis. **Materials and methods**: This was a prospective, cross-sectional study that included 300 study respondents who were categorized into two groups (n=150, each). Group I subjects were treated with green tea while Group II participants were treated with chlorhexidine. Clinical parameters measured were gingival index, plaque score and bleeding on probing score. Unpaired T test' was performed on collected observations. **Results**: Statistically significant P values ($P<0.05$) were obtained for all study groups. **Conclusion:** Green tea shows better results against gingivitis when compared to chlorhexidine.
Keywords: Gingivitis, green tea, chlorhexidine, plaque, bleeding.

INTRODUCTION

Green tea or Camellia sinensis represents 20% of tea production around the world. It is widely consumed in Asian, Middle-Eastern and few regions of North America. It is non-fermented form of tea that is produced by drying followed by steaming of fresh leaves for preventing poly-phenol oxidase. [1] Functional food has been defined as "healthy foods or ingredients contained within foods that have the potential health benefits which are beyond their nutritional content when they are consumed at regular basis in standard quantities as constituent of variegated diet". Green tea is most commonly consumed functional beverage around the world. [2] Health-promotion activity of green tea is due to its poly-phenolic constituents namely, catechins of which Epigallocatechin-3 gallate and epicatechin-3-gallate are of importance. The poly phenolic content within green tea is greater than black tea i.e., 30% to 40% higher when compared to 3% to 10%, respectively. Thus, green tea has higher anti-oxidant properties and has potent anti-inflammatory properties along with

activity against various bacteria and viruses. Green tea also has significant anti-carcinogenic along with anti-ageing properties. [3,4,5,6]
Majority of biological properties of green tea are due to its catechin fraction which comprises approximately 30% of dry weight of its leaves. The potent anti-oxidants that constitute freely available catechins include catechin, gallocatechin, epicatechin, epigallocatechin and galloyl catechins like epicatechin gallate, epigallocatechin gallate and gallocatechin gallate.[7]
Green tea may also contain other constituents such as carotenoids, tocopherols, ascorbic acid and minerals for example, Cr, Mn, Se or Zn along with few phyto-chemical compounds.[5] Various therapeutic as well as biological actions of catechin include decreased risk of pathological conditions which may include cardio-vascular disorders, strokes, obesity and malignancies. [8]
The preventive function of green tea in development as well as progression of various oral diseases has been demonstrated in chronic periodontitis due to its

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effectiveness on variety of periodonto-pathogens, effectiveness on host immunological mechanisms and on dental caries by exerting effects on a variety of cariogenic enzymes, bacterial bio-film, F1Fo-ATPase and agmatine deiminase and effects on oxidative stress mechanisms.[9]

Chlorhexidine is considered gold standard as an anti-biofilm agent due to its sustainability, retentiveness in oral cavity and slow rate of release that allows anti-plaque effectiveness. Although, chronic use of chlorhexidine has been associated with various side-effects, for example, discoloration of teeth, alterations in taste and desquamation of oral mucosa. Various in vitro studies have confirmed toxicity of chlorhexidine over fibroblasts, thus, proving it's cytotoxic and genotoxic nature. [10,11,12]

In contrast, Green tea has not been shown to demonstrate side-effects and it also exhibits effectiveness against inflammatory processes and has anti-oxidant properties.[13] The Epigallocatechin-3 gallate component has been found to reduce expression of matrix metalloproteinase-9 (MMP-9) in osteoblasts and also, causes inhibition of osteoclastic cells. Hence, green tea can be effective in preventing resorption of alveolar bone among patients suffering from periodontal diseases. [14]

The most accepted tool for delivering various anti-microbiological medications after use of toothpastes is the use of mouthwashes. [15] A mouth-wash is basically liquid that contains medicaments and is held in the oral cavity followed by swishing by using peri-oral muscles for eliminating various organisms. All mouth washes have an ability for delivering therapeutic effects all around within the oral cavity including various surfaces of teeth surface which includes inter-proximal regions where in even the tooth-pastes cannot reach effectively. [12]

Although, chlorhexidine in mouth-wash form is highly effective in controlling plaque, it must not be used in long run due to some of the un-pleasant side-effects.

On the other hand, both plants along with various plant extracts exhibit activity that may cause enhancement of immune response, exert anti-inflammatory and anti-carcinogenic activities. [13]

Thus, herbal mouth-washes are medicated liquids that exhibit anti-inflammatory, anti-microbial as well as analgesic activity.

There are broadly two types of mouthwashes a) chemical and b) herbal. Chlorhexidine containing mouth-washes constitute the chemical type of mouth-wash. Most of plant extracts exert an anti-microbiological property which may be effectively used for maintenance of good level of oral hygiene. Various naturally occurring herbs for example, triphala, tulsi, neem, clove oil and pudina have been used either alone or in combination.[16] Bleeding from gums, halitosis, oral ulcers and prevention of decay of teeth may be effectively treated by using these herbal types of mouthwash liquids and additionally, these do not exhibit any side-effects. Thus, the primary purpose of using these mouthwashes is that these may be used at homes as a routine tool for maintaining adequate oral hygiene. [17]

Thus, the aim of present study was to determine the efficacy of green tea and chlorhexidine mouthwash on gingivitis.

MATERIALS AND METHODS

This was a prospective cross-sectional single-blinded, randomized controlled study that was undertaken to assess the differences between the use of green tea and chlorhexidine against gingivitis. A total of 300 patients who satisfied eligibility criteria of study were enrolled in this study. Written information data sheets were given to the study respondents with detailed information regarding nature of this study and proposed objectives of mouth washes used. A total of 300 study respondents were randomly categorized into two groups- a) Group A: It comprised of 150 subjects with gingivitis and were treated with Green tea extract and b) Group B: This group comprised of 150 patients diagnosed with gingivitis and were treated using chlorhexidine mouthwash. The study protocol was approved by the Institutional Research and Ethical Committee. The age-range of the study participants was between 18 to 24 years. This was a single observer study for eliminating any observation bias from the study. For study eligibility, following were the inclusion as well as exclusion criteria. Inclusion criteria were a) patients with ≥ 1 gingival index score at more than 60% sites, b) ≥ 1 plaque index score, c) probing depths measuring ≤ 3 mm and no clinical attachment loss.

Exclusion criteria for the study were a) Those patients who were being administered either systemic and/or topical steroidal and/or non-steroidal anti-inflammatory agents; b) patients who were prescribed antibiotics during the last six weeks previously to conducting this study; c) use of fixed and/or removable orthodontic appliances, d) presence of any pathology, e) individuals with any physical or mental disability that can result in an inability to perform self-maintained oral hygiene and f) patients who underwent oral prophylaxis in the last 6 months were excluded from the study.

PREPARATION OF GREEN TEA EXTRACT AND MOUTH WASH

Green tea leaves were fragmented into small pieces. 100 grams of crushed leaves were then soaked in 500 ml ethanol for duration of 48 hours. After this, the suspension was filtered, kept in a plate and were placed in a hot air oven which was maintained at a temperature of 50° Centigrade for 3 to 4 days, following which the extract was stored. In final step, mouthwash from green tea at a concentration 5% was prepared by addition of 0.5 g extract in 100 ml distilled water. This mouthwash was then stored in glass bottles measuring 75 ml.

All selected patients were provided the mouth rinses as per the group i.e, either a green tea mouth wash or chlorhexidine mouth wash which were randomly allocated and patients were coded for eliminating any bias in the study. This allocation of respective mouth-washes was concealed from the study observer. Patients belonging to either group were then given instructions for using the respective mouth wash 30 minutes following brushing of teeth. Both printed as well as verbal instructions regarding oral hygiene were given to all study respondents. Modified bass technique for tooth brushing was then demonstrated to the patients using study models.

Clinical measurements were observed at baseline before beginning of the study, on follow-up at 15th day, and at 4 weeks duration. Also, every patient's perception regarding taste, odor or any similar change were observed and recorded. All measurements were performed by a single examiner who was completely blinded in order to mask type of mouth wash which was used. Decoding of mouth washes prescribed was done following completion of acquisition of complete data and completion of the study.

On each of the visit, supra-gingival plaque scoring was performed by making use of Turesky modification of Quigley-Hein plaque index. [18]

Scoring of inflammation of gingiva or gingivitis was performed by using Loe's gingival index. [18] Indexing of bleeding of gingiva was performed by using the bleeding index proposed by Ainamo and Bay. [18] Clinical assessment of gingival inflammation was performed before performing plaque scoring to avoid masking of gingivitis following application of plaque disclosing agents.

Presence of staining on surfaces of teeth was noted by using gingival modification of stain index. Each of the examined tooth was further divided in four zones. Intensity of each of the tooth zone was then scored in a subjective manner as follows: 0 = No staining, 1 = light staining or yellow appearance, 2 = medium staining or brown appearance and 3 = heavy staining or black color. [18]

STATISTICAL ANALYSIS

All the observed data was entered in Microsoft Excel worksheet, 2007 and descriptive analysis was performed. Obtained results were then analyzed by using the SPSS software version 17.0 (IBM Corporation, Chicago, IL, USA). Statistical analysis was performed by using the unpaired 't-test' for assessment of differences between the studied groups.

RESULTS AND OBSERVATIONS

A significant reduction in gingival index (GI), plaque index, and bleeding index for both the mouthwashes at first and second visits was observed (Tables 1 and 2).

Table 1: Table demonstrating comparison between mean plaque index scores in both the study groups

Visits/follow-up for plaque index	Mean ± SD		P values
	Green tea	Chlorhexidine	
Baseline	2.6 ± 0.9	2.5 ± 1.3	0.531
First recall	1.7 ± 0.5	2.1 ± 0.7	0.034
Second recall	1.3 ± 0.2	1.6 ± 0.2	0.023

Table 2: Table showing comparison between mean gingival indices in both study groups

Visits for gingival Index	Mean ± SD		P values
	Green tea	Chlorhexidine	
Baseline	3.21 ± 0.08	3.29 ± 0.09	0.821
First recall	2.02 ± 0.12	2.31 ± 0.61	0.021
Second recall	1.03 ± 0.20	1.08 ± 0.21	0.032

Table 3: Table showing comparison between mean bleeding indices in both the study groups

Follow-up visits for bleeding index	Mean ± SD		P values
	Green tea	Chlorhexidine	
Baseline	0.56 ± 0.12	0.49 ± 0.11	0.610
First recall	0.34 ± 0.43	0.37 ± 0.9	0.021
Second recall	0.23 ± 0.11	0.29 ± 0.12	0.012

Graph 1: Graph illustrating P values
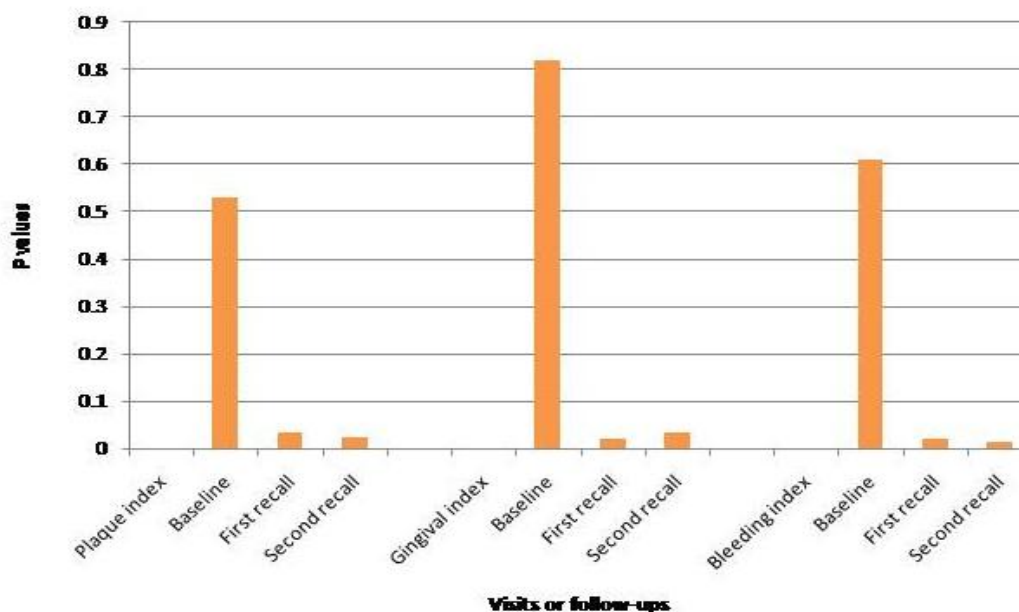
Plaque index score demonstrated statistically significant reduction in first and second visits ($P < 0.05$). Gingival index scores were also found to decrease significantly from values at base-line to subsequent recall visits. However, study participants who were prescribed green tea mouth-wash showed greater reduction in bleeding scores ($P < 0.05$). Statistical significance ($P < 0.05$) was observed at the end of both the visits.

DISCUSSION
In present study, gradual reduction in plaque, gingival as well as bleeding indices were observed. On inter-group comparisons, statistically significant P values were obtained. Our findings have been supported by a number of researchers as discussed below.
Mazur et al (2021) in their meta-analysis observed that treatment using Green tea exerted a medium positive effect in reduction of Gingival Index; Plaque Index; Gingival bleeding index and bleeding on probing BOP with respect to controls. Medium positive effects were observed in decreasing Clinical Attachment Loss and extremely significant effect on reduction of periodontal pocket depth. [17]
Saima and Ahmed (2019) reported a statistical significance in the reduction of plaque as well as gingival scores following treatment for a duration of 30 days. Although various herbal mouthwashes have demonstrated an ability for maintaining adequate levels of oral hygiene on a day to day basis, however, it has less effectiveness when compared to chlorhexidine mouth-rinse for treating conditions like- any trauma, gingivitis and periodontitis. [19]
Mustafa and Baban (2019) observed a statistically significant (P<0.001) decrease in various clinical parameters of periodontal health along with inflammatory bio-markers such as- C-reactive protein, alkaline phosphatase levels and Malondialdehyde in follow-up at 30 days following periodontal therapy.

Significant difference (P<0.05) was obtained on comparing clinical periodontal parameters and inflammatory markers following periodontal treatment. Non-significant difference were obtained on comparing gingival indices, levels of clinical attachment, C reactive protein levels, alkaline phosphatase and Malondialdehyde levels. [20]
Raju et al (2017) observed that the mean gingival along with plaque indices scores were found to be reduced in all subjects who were prescribed chlorhexixine, Listerine and green tea mouthwash. Although, mouthwash containing green tea was reported to exhibit highest difference in mean values of gingival and plaque indices obtained from baseline to 15th day. [21]
Thomas et al (2016) observed that the anti-microbial activity of green tea mouth wash was significantly higher ($P = 0.005$) against *Streptococcus Mutans* when compared to Chlorhexidine mouthwash. However, chlorhexidine containing mouthwashes were found to have significantly better activity ($P < 0.001$) against lactobacilli species when compared to green tea mouth wash. However, no efficacy as observed for green tea mouthwash against Candidal species. [22]
Sarin et al (2015) reported significant decrease in mean gingival and plaque indices following use of green tea as a mouthwash for a duration of 28 days. [23]
Sargolzaie N et al (2015) noted significant difference (p=0.001) in bleeding indices on comparing 0.2 % Chlorhexidine; green tea and aloe vera containing combination with placebo. [24]
Deshpande et al (2012) in a similar study demonstrated the efficacy of green tea in causing reduction of deposition of plaque and bleeding from gingiva. [25]
Hirasawa et al (2002) demonstrated the antibacterial activity of green tea against Prevotella and P.

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gingivalis. They postulated that the anti-bacterial activity was attributed to interference with dental biofilm formation at gingival margins, restricting their adhesion and infiltration of epithelial cells by the pathogenic microorganisms. These results in reduction in production of cytokines which reduces inflammation of gingiva. [26]

CONCLUSION

Our study has demonstrated that a subsequent decrease in severity of gingivitis takes place after using both green tea and chlorhexidine mouth washes. However, better results were observed when subjects used green tea as mouthwash. Regular use of herbal based mouth wash helps in maintaining gingival and periodontal health with significantly lesser degree of adverse side-effects.

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