Efficacy of Green Tea-Based Mouthwashes on Dental Plaque and Gingival Inflammation: A Systematic Review and Meta-analysis

Abstract

Objectives: The purpose of this study was to conduct a systematic review and if appropriate a meta-analysis of the efficacy of daily rinsing with green tea-based mouthwashes in terms of plaque index (PI) and/or gingival index (GI) as compared to other mouthwashes in plaque-induced gingivitis patients. Materials and Methods: MEDLINE, Cochrane Central Register of Controlled Trials, IndMed, Google Scholar, and major journals were searched for studies up to December 2016. A comprehensive search strategy was designed, and the eligible articles were independently screened for eligibility by two reviewers. Randomized controlled trials in which individuals were intervened with oral mouthwashes of interest were included. Where appropriate, a meta-analysis was performed and standardized mean differences (SMDs) for GI and PI were calculated. Results: A total of 9 articles out of the 311 titles met the eligibility criteria. A meta-analysis was performed for five studies that compared green tea-based mouthwashes with chlorhexidine (CHX). The SMD for PI was -0.14 (95% CI: -1.70, 1.43; P = 0.86 and F = 94%), while that for GI was 0.43 (95% CI: -0.63, 1.49; P = 0.43, F = 89%). Both these estimates suffered from significant heterogeneity. For both PI and GI, two studies were in favor of green tea while three studies were in favor of CHX. Conclusions: Green tea-based mouthwashes can be considered an alternative to CHX mouthwashes in sustaining oral hygiene, especially because of the added advantages provided by such herbal preparations.

Keywords: Chlorhexidine, dental plaque, green tea mouthwash, meta-analysis, systematic review

Introduction

Accumulation of dental plaque on the tooth and the soft tissue adjoining the tooth leads to gingivitis, which is the mildest form of periodontal disease.[1] Microbial plaque that accumulates on the oral soft tissue is the foundation of bacterial colonization on the surface of the teeth and can result in periodontitis and gingivitis.[2] Chlorhexidine was developed in 1950, which is the most used antiplaque agent. However, the long-term usage of chlorhexidine (CHX) is limited by altered taste perception and staining of tooth with prolonged usage, as reported by Fardal and Turnbull.[3] Though CHX has been the gold standard mouthwash in controlling plaque formation,[4] its undesirable side effects such as enhanced ability of calculus formation, bitter taste, and interference with taste[5] have inspired a search for alternatives.

Green tea (Camellia sinensis), which contains adequate amounts of catechins and various other polyphenol compounds, has been shown to possess antibacterial, antioxidant, anti-inflammatory, anti-diabetic, anti-viral, and antimutagenic properties.[6] Various studies have reported green tea to be efficacious against caries and periodontal diseases.[7-13] The aromatic constituents of green tea have exhibited anti-inflammatory properties at the site of inflammation.[6,14] In vivo and in vitro studies have demonstrated the antibacterial activities of green tea catechins (epigallocatechin-3-gallate [EGCG; 59%), epigallocatechin [EGC; 19%], epicatechin-3-gallate [EGC; 13.6%], and epicatechin [EC; 6.4%] including EGCG and EGC) and have reported green tea to be efficacious.[7,13] The list of other components includes, but are not limited to, caffic acid, queretin, chlorogenic acid, gallic acid, myricetin, and kaempferol, the effects of which are still to be studied.[16] In addition, when used as a mouthwash, green tea preparations can obliterate bad breath by suppressing anaerobic bacteria and eradicating the production of volatile sulfur compounds.[17]
There is paucity in the availability of critically appraised summaries on the efficacy of green tea mouthwash for promotion of dental hygiene. This study was, therefore, aimed to gather and evaluate, in a systematic manner, available data on the efficacy of green tea-based mouthwashes on dental plaque and gingival inflammation indices, as compared to other mouthwashes in plaque-induced gingivitis individuals.

Materials and Methods

A comprehensive search strategy was designed and two reviewers independently screened articles for eligibility. Studies were considered eligible for systematic review if they were randomized controlled clinical trials with an intervention group consisting of green tea-based mouthwashes compared to a control preparation, with essential data on plaque and/or gingivitis and with a minimum study duration of 1 to 6 weeks. Eligibility criteria for these trials were plaque-induced gingivitis individuals of any age group and sex without periodontal problems. Studies published in English and studies that reported at least one of the indices (plaque index [PI], gingival index [GI], or bleeding index [BI]) for assessing the severity of dental plaque, gingivitis, or gingival bleeding were included. Additional criteria for inclusion of studies in meta-analysis were the presence of ≥2 indices for severity of disease and reporting mean and standard deviation (SD) for all indices. Reviews, case reports, abstracts, editorials, letters, and historical reviews were excluded. The outcome measures considered for the systematic review were changes in PI or GI or BI, while those for the meta-analysis were changes in PI and GI.

The search was carried out in MEDLINE via PubMed, Cochrane Central Register of Controlled Trials CENTRAL, Google Scholar, IndMed, and Clinical Trials Registry, India. All cross-reference lists of the selected studies were screened for studies that could meet the defined eligibility criteria. The last date of search was December 31, 2016.

The following keywords were utilized to search the databases: “green tea mouthwash,” “tea mouthwash,” “green tea,” “Camellia sinensis,” “plaque,” “dental plaque,” “gingivitis,” “gingival index,” and “chronic generalized gingivitis.” The electronic search strategies are presented in Table 1. These records were subjected to removal of duplicates and then their titles and abstracts were screened for eligibility. As a second step, full-text papers were obtained if they fulfilled the above-mentioned eligibility criteria. Studies were excluded if they did not fulfill all the inclusion criteria. Any disagreement between the two reviewers was resolved and consensus was achieved after a detailed discussion with the third author. The results of systematic review were presented as a narrative synthesis.

Statistical analysis

The primary outcomes were the PI and GI, and their summary measure was calculated using a random-effect model and presented as standardized mean differences (SMDs) with 95% confidence interval (CI) for each index. Heterogeneity was tested using the Tau² test and F statistics. The analysis was performed using the Review Manager software (Version 4.2 for Windows, The Nordic Cochrane Centre, The Cochrane Collaboration, Copenhagen, Denmark).

Risk of bias

The risk of bias was assessed for each study to be included in the meta-analysis. The various types of bias assessed were selection bias, performance bias, detection bias, attrition bias, reporting bias, and others. The between-study biases were assessed by statistical tests for heterogeneity.

In accordance with the guidelines, our systematic review protocol was registered with the International Prospective Register of Systematic Reviews PROSPERO on November 10, 2015 (Registration Number CRD42016051384).

Results

Figure 1 gives the numbers of studies screened, assessed for eligibility, and included in the systematic review and meta-analysis with reasons for exclusions at each stage.

Table 1: Combinations of electronic search strategies for study identification and selection

| Search strategy                                      | Records identified through PubMed - MEDLINE database (n = 304) | Records identified through Cochrane - CENTRAL, IndMed, and Google Scholar (n = 7) |
|------------------------------------------------------|-----------------------------------------------------------------|---------------------------------------------------------------------------------|
| Tea mouthwash and CHX and gingivitis and dental plaque | Records screened according to title and selected (n = 36)         | Records identified after duplicate removal (n = 19)                               |
| Green tea mouthwash and clinical trial and plaque    | Full-text records assessed for eligibility (n = 19)              | Full-text articles excluded, due to insufficient data (Kaur et al): No baseline values (Jenabian et al): No standard deviation values |
| Green tea mouthwash and CHX                         | Studies included in qualitative synthesis (n = 9)                | Studies included in qualitative synthesis (n = 7)                                |
| Green tea and plaque                                |                                                                 |                                                                                  |
| CHX=Chlorhexidine                                   |                                                                 |                                                                                  |

Figure 1: Flowchart summarizing the article selection process
Preliminary screening through database searching identified 304 records and additional sources revealed 7 records. Nine studies were included for qualitative synthesis and seven were included for meta-analysis. The study population in all the selected studies were healthy individuals or those with gingivitis [Table 2].

**Qualitative synthesis**

A general description of the nine studies included in the review is as follows:

Balappanavar et al. conducted a randomized controlled trial (RCT) to evaluate and compare the effectiveness of various mouthwashes on oral health. In the green tea group, mean SD PI at baseline and after 2 weeks were 1.55 (0.03) and 0.22 (0.44) and mean SD GI at baseline and after 2 weeks were 2.44 (0.73) and 1.11 (0.6), respectively; in the CHX group, mean SD PI at baseline and after 2 weeks were 1.52 (0.06) and 0.8 (0.46) and mean SD GI at baseline and after 2 weeks were 2.67 (1.00) and 1.22 (0.83), respectively. Biswas et al. recorded the PI, GI, and BI of the patients suffering from chronic generalized plaque-induced gingivitis at baseline, at 14th day, and at 21st day, postoperatively after giving various mouthwashes. In the green tea group, baseline and final mean SD PI were 1.59 (0.56) and 0.79 (0.27), baseline and final mean SD GI were 1.57 (0.39) and 0.82 (0.32), and baseline and final mean SD BI were 2.81 (0.41) and 2.26 (0.28), respectively.

**Table 2: General overview of studies used for systematic review**

| Author, year, country | Study design | Age group (years) | Population (sample size) | SRP at baseline | Intervention | Duration (weeks) | Mean change from baseline in PI | Mean change from baseline in GI | Mean change from baseline in BI |
|-----------------------|-------------|------------------|--------------------------|----------------|--------------|-----------------|-----------------------------|-------------------------------|-------------------------------|
| Balappanavar, 2013, [11] India | Triple-blind, parallel-design RCT | 18-25 | Healthy (30) | No | 0.5% green tea | 2 | 1.33 | 1.33 | NA |
| | | | | | 0.2% CHX | | 1.44 | 1.45 | NA |
| | | | | | 2% neem | | 0.96 | 1.39 | NA |
| Biswas, 2015, [19] India | Parallel-design, controlled RCT | NA | Chronic generalized plaque-induced gingivitis (48) | Yes | Green tea | 3 | 0.8 | 0.75 | 0.54 |
| | | | | | CHX | | 0.53 | 0.54 | 0.55 |
| | | | | | Listerine | | 0.44 | 0.68 | 0.36 |
| | | | | | None* | | 0.54 | 0.36 | 0.41 |
| Hambire, 2015, [20] India | Triple-blind, controlled RCT | 9-14 | Healthy (60) | Yes | 0.5% green tea | 2 | 0.96 | 1.24 | NA |
| | | | | | 0.2% CHX | | 0.87 | 1.51 | NA |
| | | | | | 0.05% sodium fluoride | | 0.42 | 1.04 | NA |
| Jenabian, 2012, [7] Iran | Single-blind, placebo-controlled RCT | 14-16 | Chronic generalized plaque-induced gingivitis (50) | No | 5% green tea | 6 | 1.08* | 1.6 | 1.21 |
| | | | | | Placebo | | 0.98* | 0.7 | 1.13 |
| Kaur, 2014, [21] India | Single-blind, cross-over randomized study | 18-25 | Healthy (30) | Yes | 0.25% green tea | 1 | 2.83* | NA | NA |
| | | | | | 0.12% CHX | | 2.85* | NA | NA |
| Priya, 2015, [22] India | Single-blind, controlled RCT | 18-24 | Periodontitis (34) | No | 5% green tea | 4 | 1 | 0.78 | 60.81 |
| | | | | | CHX | | 0.89 | 0.86 | 50.3 |
| Radafsahr, 2015, [23] Iran | Double-blind, placebo-controlled, parallel-group RCT | 18-25 | Healthy (40) | No | Green tea | 4 | 0.35 | 0.14 | 24.95 |
| | | | | | (1% tannin) | | 0.47 | 0.27 | 23 |
| Rassameemasmuang, 2012, [24] Thailand | Double-blind, placebo-controlled RCT | 18-60 | Gingivitis (60) | No | Green tea | 4 | 0.32 | NA | 0.09 |
| | | | | | Placebo | | 0.15 | NA | 0.09 |
| Sarin, 2015, [25] India | Triple-blind, placebo-controlled, parallel-group RCT | 18-60 | Healthy (110) | No | 2% green tea | 4 | 1.66 | 0.68 | NA |
| | | | | | Placebo | | 0.13 | 0.05 | NA |

*PI was not evaluated at baseline. It was only assessed post 1 week of intervention. *The fourth group of patients was not given any intervention. They underwent only scaling. Changing trends of periodontal indices were calculated using a GLM repeated measure ANOVA. GLM = General linear model, BI = Bleeding index, CHX = Chlorhexidine, GI = Gingival index, NA = Not available, PI = Plaque index, RCT = Randomized clinical trial, SRP = Scaling and root planing, NA = Not available.
respectively. In the CHX group, baseline and final mean SD PI were 1.61 (0.55) and 1.08 (0.43), baseline and final mean SD GI were 1.48 (0.43) and 0.94 (0.37), and baseline and final mean SD BI were 2.81 (0.41) and 2.26 (0.28), respectively.[19]

Hambire et al. compared the antiplaque efficacy of 0.5% C. sinensis extract, 0.05% sodium fluoride, and 0.2% CHX gluconate mouthwash over a period of 2 weeks in children. In patients who received C. sinensis extract, mean SD baseline and final PI were 1.52 (0.05) and 0.56 (0.40) and mean SD baseline and final GI were 2.34 (0.65) and 1.10 (0.50), respectively; in the CHX group, mean SD baseline and final PI were 1.51 (0.04) and 0.64 (0.46) and mean SD baseline and final GI were 2.68 (1.00) and 1.17 (0.45), respectively; while in the sodium fluoride group, mean SD baseline and final PI were 1.50 (0.07) and 1.08 (0.50) and mean SD baseline and final GI were 2.54 (0.85) and 1.50 (0.65), respectively. The mean PI and GI reduced over the 2-week trial period in the groups. Antiplaque effect was highest with 0.5% C. sinensis extract (P < 0.05) among all the groups.[20]

Jenabian et al. observed a significant decrease in both PI and BI in chronic generalized plaque-induced gingivitis patients receiving green tea or placebo (PI: F[2.5] = 221.67, P < 0.001, observed power = 1; BI: F[3.48] = 373.03, P < 0.001, observed power = 1), with a contrasting pattern of recovery between the groups (PI: F[2.5] = 2.74, P = 0.02, observed power = 0.82; BI: F[3.48] = 5.33, P = 0.001, observed power = 0.98). However, the total baseline-to-6th week difference was not statistically significant (PI: mean difference = 0.06, P = 0.46, observed power = 0.11; BI: mean difference = 0.03, P = 0.63, observed power = 0.07). For GI, they observed a significant improvement in both the study groups (F[2.52] = 166.82, P < 0.001, observed power = 1). Though an overall changing trend in GI was different between the groups (F[2.52] = 18.44, P < 0.001, observed power = 1), the mean difference from baseline to the 6th week was not statistically significant (mean difference = 0.07, P = 0.54, observed power = 0.09).[21]

Kaur et al. reported mean SD PI for the whole dentition for green tea as 2.83 (0.33) and 2.85 (0.35) for CHX in healthy individuals. Comparison of PI between the groups was not statistically significant (P > 0.05).[21]

Priya et al. found that in a RCT, patients receiving green tea had a mean SD baseline and final PI of 2.2 (0.4) and 1.2 (0.3), mean SD baseline and final GI of 2.01 (0.4) and 1.23 (0.2), and mean SD baseline and final BI of 82.71 (32.10) and 21.9 (12.68), respectively. In the CHX group, mean SD baseline and final PI were 2.19 (0.3) and 1.3 (0.2), mean SD baseline and final GI were 2.06 (0.1) and 1.2 (0.2), and mean SD baseline and final BI were 82.5 (13.26) and 32.2 (6.27), respectively. Though there was a statistically significant decrease in the first and second visits (P < 0.05), PI and GI decreased significantly from baseline to the subsequent visits in both the groups, the difference between the groups was not statistically significant. However, patients in the green tea group demonstrated a greater reduction of BI and were statistically significant at the end of both the visits (P < 0.05).[22]

Radafshar et al. (2015) explored the effects of Iranian green tea mouthwash on dental plaque and chronic gingivitis. In patients who used the green tea mouthwash, the mean SD baseline and final PI were 1.61 (0.29) and 1.26 (0.23), mean SD baseline and final GI were 1.47 (0.14) and 1.16 (0.11), and mean SD baseline and final GBI were 45.25 (12.16) and 20.30 (6.25), respectively. In patients who used the CHX mouthwash, the mean SD baseline and final PI were 1.72 (0.38) and 1.25 (0.17), mean SD baseline and final GI were 1.41 (0.10) and 1.14 (0.09), and mean SD baseline and final GBI were 44.55 (8.23) and 21.55 (4.08), respectively. Mean reductions in all the three indices at different time intervals (1st and 4th weeks’ postrinsing) were statistically significant in both the groups. Significant in-group differences, but not between-group differences, were observed in all indices after 4 weeks compared to baseline. The results indicated green tea to be equally effective to CHX for its plaque inhibitory and gingival anti-inflammatory actions. It also resulted in significantly less tooth staining than the CHX mouthwash.[23]

Rassameemasma et al. conducted a double-blind, placebo-controlled RCT, wherein they randomly assigned sixty gingivitis patients to receive either green tea or placebo mouthwash. In the green tea group, baseline and final mean SD PI were 1.29 (0.30) and 0.97 (0.24) while baseline and final mean SD BI were 0.85 (0.24) and 0.76 (0.25), respectively. In the placebo group, baseline and final mean SD PI were 1.1 (0.27) and 1.02 (0.25) while baseline and final mean SD BI were 0.82 (0.35) and 0.73 (0.29), respectively. Even though both PI and BI were significantly reduced in both groups after 28 days, the difference between the two groups was not statistically significant.[24]

Sarin et al. found that in patients who received the green tea mouthwash, mean SD baseline and final PI were 3.43 (0.99) and 1.77 (0.57) and mean SD baseline and final GI were 1.50 (0.34) and 0.82 (0.24), respectively. While in those patients who received placebo, mean SD baseline and final PI were 3.59 (1.01) and 3.46 (1.00) and mean SD baseline and final GI were 1.47 (0.30) and 1.42 (0.35), respectively. They observed a statistically significant (P < 0.05) reduction from baseline in mean SD PI (1.65 [0.68]) in patients who received green tea as compared to those who received placebo (0.45 [0.99]). A similar statistically significant (P < 0.05) reduction was observed in the mean SD GI in the green tea users (0.67 [0.22]) as compared to the placebo users (0.05 [0.11]).[25]
Quantitative synthesis

The initial meta-analysis was performed on seven studies to compare the efficacy of green tea-based mouthwashes with any control preparation. Among these, five studies compared green tea-based mouthwashes with CHX-based mouthwashes, while two studies compared green tea-based mouthwashes with a placebo preparation. Difference in mean and SD values was calculated from the data provided by the studies.

Seven studies, i.e., those by Balappanavar et al.,[18] Biswas et al.,[19] Hambire et al.,[20] Priya et al.,[22] Radafshar et al.,[23] Rassameemasmaung et al.,[24] and Sarin et al.,[25] compared green tea versus a control to evaluate the change in PI and GI. For PI, five studies were in favor of the control while two studies were in favor of green tea. The SMD (95% CI) between the two interventions was 1.60 (−0.27, 3.48; \( P = 0.09 \)) and there was significant heterogeneity (\( \tau^2 = 6.14, P < 0.001 \) and \( F = 97\% \)). For GI, four studies were in favor of the control, two studies were in favor of green tea, and one study was neutral. The SMD (95% CI) between the two interventions was 0.53 (−0.26, 1.33; \( P = 0.19 \)) with significant heterogeneity (\( \tau^2 = 1.03, P < 0.001 \) and \( F = 91\% \)) [Figures 2a and 3a].

Five studies, i.e., those by Balappanavar et al.,[18] Biswas et al.,[19] Hambire et al.,[20] Priya et al.,[22] and Radafshar et al.,[23] compared green tea with CHX to evaluate PI and GI. For both PI and GI, two studies were in favor of green tea while three studies were in favor of CHX. The SMD (95% CI) between the two interventions for PI was −0.14 (−1.70, 1.43; \( P = 0.86 \)) and there was significant heterogeneity (\( \tau^2 = 2.94, P < 0.001 \) and \( F = 94\% \)), while that for GI was 0.43 (−0.63, 1.69; \( P = 0.43 \)) with significant heterogeneity (\( \tau^2 = 1.31, P < 0.001 \) and \( F = 89\% \)) [Figures 2b and 3b].

Two studies, i.e., those by Rassameemasmaung et al.,[18] and Sarin et al.,[25] compared green tea with placebo to evaluate PI and GI. Both the studies were in favor of placebo. The SMD (95% CI) between the two interventions for PI was 5.52 (−0.54, 11.58; \( P = 0.07 \)) with significant heterogeneity (\( \tau^2 = 18.86, P < 0.001 \) and \( F = 99\% \)), while that for GI was 5.18 (−5.02, 15.39; \( P = 0.32 \)) with significant heterogeneity (\( \tau^2 = 53.92, P < 0.001 \) and \( F = 99\% \)) [Figures 2c and 3c].

Risk of bias of individual studies

Selection bias for random sequence generation and allocation concealment, performance bias for blinding of...
participants and personnel, detection bias for blinding of outcome assessment, attrition bias for incomplete outcome data, reporting bias for selective reporting, and other bias were considered for the five studies identified for meta-analysis comparing green tea mouthwash and CHX mouthwash. In all the five studies, the risk of bias was either low or unclear, except for the “other bias: in the study by Radafshar et al. [23] which was found to be high [Figure 4].

Risk of bias

Selection bias for random sequence generation and allocation concealment, performance bias for blinding of participants and personnel, detection bias for blinding of outcome assessment, attrition bias for incomplete outcome data, reporting bias for selective reporting, and other bias were considered. All types of biases were found to be either low or unclear, except for high risk found in “other bias” [Figure 4].

Discussion

With a rise in the incidence of oral diseases and the increased expenditure of traditional restorative treatment in a developing country like India, there is a continuous research to identify effective and safe oral hygiene aids
for patients’ self-care. Though mouthwashes have been in use for prevention as well as curative purposes, their side effects and affordability are of growing concern. The oral biofilm produces an encased and highly protective community of cells that acts as a barrier and as a result is much less influenced by environment, including the introduction of chemical agents.[26] This aspect has received little attention in mouthwash studies. For individuals with existing disease with frank periodontal pocketing, the use of vehicles such as mouthwash or dentifrice to deliver antimicrobial and antiplaque agents has only limited or no effects on the subgingival flora.[27,28]

In the present meta-analysis, which included seven randomized clinical trials with a total of 292 patients, we demonstrated that green tea-based mouthwashes were not significantly different as compared to the standard chemical-based CHX mouthwashes in reducing plaque and gingival inflammation. Of particular interest, there was no significant evidence of any adverse event with green tea mouthwash. The results of this meta-analysis are consistent with those of a previously conducted study, wherein two studies favored the use of herbal products and four studies favored the use of CHX, of the 11 studies that were analyzed.[29]

Balappanavar et al. concluded that green tea showed equal effectiveness on gingiva when compared to CHX.[18] Biswas et al. concluded the use of green tea mouthwash to be an effective antiplaque agent that is comparable to CHX mouthwash and can be used as an adjunct to regular mechanical plaque control practices and professional scaling, in gingivitis patients.[19] Hambire et al. found that CHX and green tea had comparable effectiveness on gingiva and oral health and better than sodium fluoride.[20] Jenabian et al. advocated daily consumption of green tea mouthwash to be beneficial in preventing or curing gingival inflammation, especially in the adolescent population, as they are more prone to periodontal inflammation. They also suggested avoiding its use in patients on anticoagulants and with advanced renal failure due to its Vitamin K and aluminum content, respectively.[7] Kaur et al. observed a comparable plaque reduction by green tea mouthwash and CHX mouthwash, suggesting that the two rinses have similar clinical antiplaque efficacy when used regularly over a 7-day period.[22] Priya et al. proposed the use of green tea mouthwash as an adjuvant to oral hygiene maintenance to prevent and reduce the prevalence of periodontal diseases owing to its antioxidant and antibacterial properties.[22]

Radafshar et al. found green tea mouthwash to be equally efficient as CHX in controlling plaque regrowth and gingival inflammation, with an additional advantage of reduced tooth staining.[23] Rassameemasmaung et al. did not find any effect of green tea mouthwash on reduction in gingival inflammation.[24] Sarin et al. suggested an association between the use of green tea and control of plaque formation and gingivitis.[25]

**Limitations**

Although the major databases were used for the literature search, articles might have been missed because they might not be listed in these sources. The present review encompasses articles published in English language, which may have excluded potentially valuable evidence. Most of the studies did not provide any information on sample size calculation. Hawthorne effect plays a role in evaluating randomized clinical studies. The patients are likely to change their behavior because of their participation in a research project. Initial oral prophylaxis[19,21,22] may have contributed partly to the general reduction of all clinical parameters and hence it cannot be solely concluded that the product investigated is beneficial in reducing plaque and gingivitis. Varied indices were used for dental plaque and gingivitis and the duration for evaluation was not uniform for included studies.

**Conclusion**

Green tea-based mouthwashes can be considered an alternative to CHX mouthwashes in sustaining oral hygiene, especially because of the added advantages provided by such herbal preparations.

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**Conflicts of interest**

There are no conflicts of interest.

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