Research Article

Comparative evaluation of the effect of Green tea, Listerine and Chlorhexidine mouth washes in gingivitis patients: A randomized controlled trial

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Abstract: This study is aimed to evaluate and compare the effects of commercially available Green Tea mouth wash with Listerine and Chlorhexidine mouth wash in gingivitis patients. 48 patients, underwent scaling and were randomly categorized into 4 groups i.e. Group I: patients received green tea, Group II: patients received Chlorhexidine mouthwash, Group III: patients received Listerine mouthwash and Group IV: patients who received placebo mouthwash (distilled water). The plaque index, gingival index and bleeding index of the patients were recorded at baseline followed by scaling and at 14th day and 21st day, postoperatively. The results demonstrated Green tea to be equally effective in reducing the periodontal indices as Chlorhexidine. Significant reduction was seen in plaque, gingival and bleeding indices in all the groups. Use of Green tea mouthwash is an effective antiplaque agent that is comparable to Chlorhexidine mouthwash and can be used as an adjunct to regular mechanical plaque control practices and professional scaling, in gingivitis patients.

Keywords: Green tea (Colgate plax Fresh tea®), Gingivitis, Chlorhexidine, Listerine.

INTRODUCTION

Mechanical and chemical plaque control are the most effective method in preventing periodontal disease. Several plant extracts have been widely used in topical and oral applications for disease treatment[1]. Some of these substances have been associated with side effects limiting their long term use. Of the many herbal extracts Green tea (Camellia sinensis) has numerous medicinal benefits mainly due to its antibacterial and antioxidant properties[2]. Green tea contains phenolic phytochemicals with promising properties to benefit human health which includes a group of polyphenol compounds called catechins[3].

The remedial effects are associated with the catechins present in green tea comprising of epigallocatechin gallate (EGCG), epicatechin gallate (ECG), epicatechin (EC) and epigallocatechin (EGC)[4]. It was suggested that EGCG inhibits the growth and adherence of periodontal pathogens[5].

Various chemical agents have been advocated for the prevention of dental plaque which are either available as dentifrices or in the form of a mouthwash. Although Chlorhexidine regarded as the gold standard for prevention of dental plaque is associated with certain side effects. Hence there is a need for a naturally occurring indigenous and cost effective oral hygiene aid.

Thus the aim of the study was to evaluate the efficacy of green-tea mouthwash as an antiplaque agent.

To the best of our knowledge, previous studies [1, 6-8] that have been carried out regarding green tea and its effect on oral cavity, the green tea solution was prepared in the laboratory and then dispensed for use.

In this study the effect of a commercially available green tea mouth wash(Colgate plax Fresh tea®), was compared with other commercially available Chlorhexidine and Listerine mouth wash.

MATERIALS AND METHODS:

A parallel designed randomized controlled clinical trial was conducted among patients with chronic generalized plaque-induced gingivitis visiting the Department of Periodontology, Rajarajeswari Dental College, Bangalore. All the patients were explained about the study protocol and informed consent was obtained from each subject. Patients with chronic generalized gingivitis and patients with plaque index score ≥1 were included in the study.

Factors as exclusion criteria were medically compromised patients, any long term medications,
smokers and patient who had used any type of antibacterial mouthwash in 4 weeks of commencement.

Final recruited patients were distributed into 4 groups. A total of 48 patients were included and evaluated. All the patients underwent scaling following which they were grouped as: Group 1- 12 patients received green tea mouthwash, Group 2- 12 patients received Chlorhexidine mouthwash, Group 3- 12 patients received Listerine mouthwash and Group 4- 12 patients underwent only scaling and did not use any mouthwash. All patients were instructed to use the mouthwash two times a day, each time 5 ml rinsed for 30 seconds. The Plaque index (Loe & Sillness), gingival index (Sillness and Loe) and sulcus bleeding index (Muhlemann) of each patient was recorded at baseline, 14th day and 21st day postoperatively.

A flow chart based on the patient allotment and study protocol has been described as follows:

### Statistical analysis

Kruskal Wallis test was used to compare the four groups with respect to plaque index and gingival index scores at baseline, 14 day and 21 day and their differences from baseline. Pair wise comparisons of each group regarding plaque and gingival index were done by Mann-Whitney U test. Comparison of four groups with respect to sulcus bleeding index scores and their differences from baseline by one way ANOVA. Pair wise comparisons regarding sulcus bleeding index was done by Tukeys multiple post hoc. P value ≤0.05 was considered statistically significant.

### RESULTS

The plaque index, gingival index and sulcus bleeding index scores when compared from baseline to the 14th day and 21st day postoperatively showed statistically significant reduction in all the groups.

Difference between the Green tea group and Chlorhexidine group in relation to the plaque index showed better results in the Green tea group and was significant from baseline to the 21st day revisit score (P=0.0244) and similarly Green tea was also better when compared to Listerine group and showed a significant difference in the 21st day revisit scores (0.0464).

With respect to the gingival index scores, Green tea showed better results than chlorhexidine group, though it was not statistically significant. Difference between the Green tea and Listerine group showed statistically significant better results in the green tea group (0.0079) at 21st day postoperatively.

In regard to the sulcus bleeding index, comparison between Green tea and Chlorhexidine group showed better results in the Chlorhexidine group at 21st day postoperatively however Green tea group showed better results when compared to Listerine group at the 21st day interval.

A detailed comparison among all the groups related to each index and their values have been listed in the following tables:
Table 1: Comparison of four groups with respect to plaque index scores at baseline, 14 day and 21 day and their differences from baseline by Kruskal Wallis ANOVA

<table>
<thead>
<tr>
<th>Group</th>
<th>Baseline Mean</th>
<th>SD</th>
<th>14th day Mean</th>
<th>SD</th>
<th>21st day Mean</th>
<th>SD</th>
<th>Changes from baseline to BL-14day Mean</th>
<th>SD</th>
<th>BL-21day Mean</th>
<th>SD</th>
<th>14day - 21day Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green tea group</td>
<td>1.59</td>
<td>0.56</td>
<td>1.03</td>
<td>0.47</td>
<td>0.79</td>
<td>0.27</td>
<td>0.56</td>
<td>0.27</td>
<td>0.80</td>
<td>0.44</td>
<td>0.24</td>
<td>0.33</td>
</tr>
<tr>
<td>Chlorhexidine group</td>
<td>1.61</td>
<td>0.55</td>
<td>1.23</td>
<td>0.46</td>
<td>1.08</td>
<td>0.43</td>
<td>0.38</td>
<td>0.20</td>
<td>0.53</td>
<td>0.34</td>
<td>0.15</td>
<td>0.17</td>
</tr>
<tr>
<td>Listerene group</td>
<td>1.59</td>
<td>0.44</td>
<td>1.31</td>
<td>0.37</td>
<td>1.15</td>
<td>0.37</td>
<td>0.28</td>
<td>0.13</td>
<td>0.44</td>
<td>0.16</td>
<td>0.16</td>
<td>0.09</td>
</tr>
<tr>
<td>Scaling group</td>
<td>1.62</td>
<td>0.51</td>
<td>1.35</td>
<td>0.39</td>
<td>1.08</td>
<td>0.41</td>
<td>0.27</td>
<td>0.18</td>
<td>0.54</td>
<td>0.25</td>
<td>0.28</td>
<td>0.11</td>
</tr>
</tbody>
</table>

% of change in GT 35.08%, p=0.00001* 50.26%, p=0.0001* 23.39%, p=0.0262*  
% of change in CH 23.83%, p=0.00001* 33.16%, p=0.0002* 12.24%, p=0.0102*  
% of change in LT 17.80%, p=0.00001* 27.75%, p=0.00001* 12.10%, p=0.0001*  
% of change in SC 16.49%, p=0.00001* 33.51%, p=0.00001* 20.37%, p=0.0001*  
H-value               0.2740          3.6140       6.0730       10.5870     4.7440       6.5400     
P-value               0.9650          0.3060       0.1080       0.0140      0.1920       0.0880     

Pair wise comparisons by Mann-Whitney U test

<table>
<thead>
<tr>
<th>Group vs Group</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>GT vs SC</td>
<td>P=0.7950</td>
</tr>
<tr>
<td>GT vs LT</td>
<td>P=1.0000</td>
</tr>
<tr>
<td>GT vs CH</td>
<td>P=0.9540</td>
</tr>
<tr>
<td>SC vs LT</td>
<td>P=0.5067</td>
</tr>
<tr>
<td>SC vs CH</td>
<td>P=0.7508</td>
</tr>
<tr>
<td>LT vs CH</td>
<td>P=0.8399</td>
</tr>
</tbody>
</table>

*p<0.05, # applied Wilcoxon matched pairs test by ranks

Table 2: Comparison of four groups with respect to gingival index scores at baseline, 14 day and 21 day and their differences from baseline by Kruskal Wallis ANOVA

<table>
<thead>
<tr>
<th>Group</th>
<th>Baseline Mean</th>
<th>SD</th>
<th>14th day Mean</th>
<th>SD</th>
<th>21st day Mean</th>
<th>SD</th>
<th>Changes from baseline to BL-14day Mean</th>
<th>SD</th>
<th>BL-21day Mean</th>
<th>SD</th>
<th>14day - 21day Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green tea group</td>
<td>1.57</td>
<td>0.39</td>
<td>1.21</td>
<td>0.37</td>
<td>0.82</td>
<td>0.32</td>
<td>0.36</td>
<td>0.13</td>
<td>0.75</td>
<td>0.38</td>
<td>0.39</td>
<td>0.31</td>
</tr>
<tr>
<td>Chlorhexidine group</td>
<td>1.48</td>
<td>0.43</td>
<td>1.20</td>
<td>0.40</td>
<td>0.94</td>
<td>0.37</td>
<td>0.28</td>
<td>0.17</td>
<td>0.54</td>
<td>0.23</td>
<td>0.26</td>
<td>0.19</td>
</tr>
<tr>
<td>Listerene group</td>
<td>1.82</td>
<td>0.28</td>
<td>1.53</td>
<td>0.22</td>
<td>1.14</td>
<td>0.31</td>
<td>0.28</td>
<td>0.11</td>
<td>0.68</td>
<td>0.16</td>
<td>0.39</td>
<td>0.22</td>
</tr>
<tr>
<td>Scaling group</td>
<td>1.45</td>
<td>0.53</td>
<td>1.25</td>
<td>0.53</td>
<td>1.09</td>
<td>0.45</td>
<td>0.20</td>
<td>0.11</td>
<td>0.36</td>
<td>0.12</td>
<td>0.16</td>
<td>0.13</td>
</tr>
</tbody>
</table>

% of change in GT 22.87%, p=0.00001* 47.87%, p=0.00001* 32.41%, p=0.0001*  
% of change in CH 19.10%, p=0.00001* 36.52%, p=0.00001* 21.53%, p=0.0006*  
% of change in LT 15.60%, p=0.00001* 37.16%, p=0.00001* 25.54%, p=0.0001*  
% of change in SC 13.79%, p=0.00001* 24.71%, p=0.00001* 12.67%, p=0.0015*  
H-value               7.5090          7.2380       7.3040       7.6090       7.6580     7.1830     
P-value               0.0500*        0.0650       0.0630       0.0500*      0.0030*    0.0660     

Pair wise comparisons by Mann-Whitney U test

<table>
<thead>
<tr>
<th>Group vs Group</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>GT vs CH</td>
<td>P=0.4189</td>
</tr>
<tr>
<td>GT vs LT</td>
<td>P=0.0999</td>
</tr>
<tr>
<td>GT vs SC</td>
<td>P=0.2855</td>
</tr>
<tr>
<td>CH vs LT</td>
<td>P=0.0244*</td>
</tr>
<tr>
<td>CH vs SC</td>
<td>P=0.5067</td>
</tr>
<tr>
<td>LT vs SC</td>
<td>P=0.0282</td>
</tr>
</tbody>
</table>
Table 3: Comparison of four groups with respect to sulcus bleeding index scores at baseline, 14 day and 21 day and their differences from baseline by one way ANOVA

<table>
<thead>
<tr>
<th>Group</th>
<th>Baseline</th>
<th>14th day</th>
<th>21st day</th>
<th>Changes from baseline to</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>Mean</td>
<td>SD</td>
</tr>
<tr>
<td>Green tea group</td>
<td>2.86</td>
<td>0.35</td>
<td>2.59</td>
<td>0.33</td>
</tr>
<tr>
<td>Chlorhexidine</td>
<td>2.81</td>
<td>0.41</td>
<td>2.51</td>
<td>0.39</td>
</tr>
<tr>
<td>Listerene group</td>
<td>2.73</td>
<td>0.36</td>
<td>2.57</td>
<td>0.34</td>
</tr>
<tr>
<td>Scaling group</td>
<td>2.67</td>
<td>0.29</td>
<td>2.52</td>
<td>0.25</td>
</tr>
</tbody>
</table>

% of change in GT
- 9.33%#, p=0.00001*
- 18.95%#, p=0.00001*
- 10.61%#, p=0.0003*

% of change in CH
- 10.68 %#, p=0.00001*
- 19.58 %#, p=0.00001*
- 9.97 %#, p=0.0009*

% of change in LT
- 6.10 %#, p=0.00001*
- 13.11 %#, p=0.00001*
- 7.47 %#, p=0.0010*

% of change in SC
- 5.63 %#, p=0.00001*
- 15.31 %#, p=0.00001*
- 10.26 %#, p=0.0004*

F-value
- 0.6810
- 0.1728
- 0.4935
- 5.9425
- 3.5380
- 0.4987

P-value
- 0.5684
- 0.9142
- 0.6887
- 0.0017*
- 0.0222*
- 0.6851

Pair wise comparisons by Tukeys multiple post hoc procedures

<table>
<thead>
<tr>
<th>GT vs CH</th>
<th>0.9856</th>
<th>0.9275</th>
<th>0.9542</th>
<th>0.8636</th>
<th>0.9995</th>
<th>0.9858</th>
</tr>
</thead>
<tbody>
<tr>
<td>GT vs LT</td>
<td>0.8220</td>
<td>0.9978</td>
<td>0.9542</td>
<td>0.1052</td>
<td>0.0679</td>
<td>0.6622</td>
</tr>
<tr>
<td>GT vs SC</td>
<td>0.5500</td>
<td>0.9457</td>
<td>0.9542</td>
<td>0.0438</td>
<td>0.2663</td>
<td>0.9957</td>
</tr>
<tr>
<td>CH vs LT</td>
<td>0.9539</td>
<td>0.9732</td>
<td>0.7285</td>
<td>0.0165</td>
<td>0.0521</td>
<td>0.8524</td>
</tr>
<tr>
<td>CH vs SC</td>
<td>0.7603</td>
<td>0.9999</td>
<td>1.0000</td>
<td>0.0058</td>
<td>0.2183</td>
<td>0.9995</td>
</tr>
<tr>
<td>LT vs SC</td>
<td>0.9669</td>
<td>0.9829</td>
<td>0.7285</td>
<td>0.9797</td>
<td>0.8996</td>
<td>0.7952</td>
</tr>
</tbody>
</table>

*p<0.05, # applied Wilcoxon matched pairs test by ranks

The graphical representation of the results are listed as follows:
Fig- 2: Comparison of four groups with respect to plaque index scores at baseline, 14 day and 21 day and their differences from baseline

Fig-3: Comparison of four groups with respect to gingival index scores at baseline, 14 day and 21 day and their differences from baseline
Fig-4: Comparison of four groups with respect to gingival index scores at baseline, 14 day and 21 day and their differences from baseline

Fig-5: Comparison of four groups with respect to bleeding index scores at baseline, 14 day and 21 day and their differences from baseline
DISCUSSION

The present study evaluated the effect of mouthwash containing green tea on chronic generalized plaque-induced gingivitis, in comparison with 0.2% Chlorhexidine and Listerine mouthwash. The percentage reduction of plaque index, gingival index, and sulcus bleeding index in the green tea group was 50.26%, 47.87%, and 18.95%, respectively, from baseline to 21st day. The control group (scaling group) also had a reduction in the indices because of positive effects of scaling.

Green tea contains flavonoids, tannin, vitamins, fluoride, and other mineral salts which have a potent anti-bacterial effect[15-17]. Green tea also consists of catechins, which showed an in vitro bactericidal activity against odor-producing, periodontal bacteria, P. gingivalis and Prevotella sp. and also inhibits adherence of P. gingivalis to oral epithelial cells[5-8].

Recently, Kudva et al. investigated the adjunctive effect of SRP and locally delivered catechin via inserted strips into the surrounding pocket for a period of 21 days.[13] They reported a significant decrease in pocket probing depth (P <0.001) yet PI and GI decreased insignificantly when compared to the SRP group (P < 0.05). In addition, a considerable reduction of causative bacteria was observed[9].

Rassameemasmaung et al. studied the effect of green tea mouthwash on oral malodour, plaque, and gingival inflammation in gingivitis patients and at the end of 28 days study period the VSC score reduced by 38.61% along with significant reduction in the plaque index and papillary bleeding index scores[28].

In another study Moghbel et al. assessed the effects of green tea leaves extract on the aerobic mouth bacterial load. A comparative study was conducted on a green tea mouthwash containing 1% tannin with 10% ethanol, an alcohol-free mouthwash, and a green tea herbal mouthwash with a Chlorhexidine 0.2% sample. The herbal green tea extract reduced the aerobic mouth bacterial load by about 32% and prevented plaque formation on teeth[29].

The results of this study were comparable with a study conducted by Jenabian et al. where they compared the effects of green tea mouthwash with another placebo group using saline, along with the routine mechanical plaque control methods. They concluded that a significant improvement was observed in all periodontal indices i.e gingival index, plaque index and bleeding index, during the study[30].

Compounds present in green tea have been studied on dental caries which have shown anticariogenic potential[24,25]. Animals and humans given tea compounds in their drinking water develop fewer dental caries and less plaque formation than those drinking plain water[26]. Drinking green tea may also help prevent sore throats and colds, since it helps fight the bacteria harbouring in the throat. Green tea may prevent bad breath by daily consumption, using it as a
mouthwash before and after brushing teeth, or mixing it with the toothpaste products[27].

The improvements in plaque and bleeding indices using green tea mouth wash, in our study are in commitment with many previous studies[10-14].

The study limits itself with small sample size and lack of microbiological assessment. However the present study suggests that green tea is a promising adjunctive aid in plaque control.

Chlorhexidine has been regarded as a “gold” standard in dentistry for the prevention of plaque and gingivitis. Studies have shown large reductions in plaque formation using Chlorhexidine gluconate, applied topically or as a mouth rinse. The results indicated that twice daily mouth rinse with 0.2% Chlorhexidine gluconate effectively prevented plaque formation[22-27]. In our study, Chlorhexidine mouthwash showed significant reduction in mean plaque and gingival score. In the inter group comparison, it was observed that the reduction in the indices score in the Green tea group was comparable to that of Chlorhexidine group.

CONCLUSION

Within the limitation of the study it can be said that the daily use of green tea mouthwash as an adjunct to mechanical plaque control method may be beneficial to prevent gingival inflammation and reduce plaque scores.

REFERENCES