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CLINICAL EFFECTS OF DIETARY SUPPLEMENTATION OF GREEN TEA POLYPHENOLS ON HALITOSIS AND CHRONIC GINGIVAL INFLAMMATION: A RANDOMIZED SINGLE-BLINDED PLACEBO CONTROLLED TRIAL

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ABSTRACT:

Background: Halitosis and chronic gingival inflammation are oral health related problems prevalent among the adult population. Periodontal disease is a consequence of the extension of gingival inflammation. The success of periodontal therapy lies in the prevention of spread of infection from the gingiva to periodontal structures. Research has been conducted on the effects of green tea catechin on periodontal health. However, there has been no investigation of the clinical effects of dietary supplementation of green tea polyphenols on halitosis and chronic gingival inflammation.

Materials and Methods: The effectiveness of dietary supplementation was evaluated by dispensing Green tea(test group) and Chinese tea (control group) to subjects with clinical evidence of gingival disease and halitosis. After supragingival scaling, polishing and oral hygiene counselling, instructions were given to consume two standard cups per day for a month. Assessments were done at baseline and after one month.

Results: At the end of the study, subjects in the intervention group (n= 14) showed a reduction in the median value of the gingival index from 1.33 at baseline to 1.04 post-therapy and also a decline in halitosis from a median value of 3 prior to therapy to a score of 2 (both = $P<0.05$). The change score showed significant results in both gingival and halitosis indices when compared to the control group which showed no changes from baseline values.

Conclusion: The findings suggest that dietary supplementation of green tea has a significant effect in reduction of clinical parameters of gingival inflammation and halitosis.

Clinical implications: Dietary intake of green tea catechins will prove beneficial for the oral health of the patients, whereby contributing to their general well-being.

Key words: dietary supplementation; gingival inflammation; green tea polyphenols; halitosis

INTRODUCTION

Green tea is one of the most popular beverages in the world with scientifically proven beneficial effects on human health. [1] Fresh tea leaves are unusually rich in the flavanol group of polyphenols known as catechins. Other polyphenols include: flavanols and their glycosides, and depsides such as chlorogenic acid, coumarylquinic acid, and one unique to tea, theogallin (3-galloylquinic acid). Caffeine is present at an average level of 3% along with very small amounts of the

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other common methylxanthines, theobromine and theophylline. The amino acid, theanine (5-N-ethylglutamine) is also unique to tea. Tea accumulates aluminum and manganese. In addition to the normal complement of plant cell enzymes, tea leaves contain an active polyphenol oxidase which catalyzes the aerobic oxidation of the catechins when the leaf cell structure is disrupted during black tea manufacture.

The various quinones produced by the enzymatic oxidations undergo condensation reactions which result in a series of compounds, including bisflavanols, theaflavins, epitheaflavic acids, and thearubigens, which impart the characteristic taste and color properties of black tea. Most of these compounds readily form complexes with caffeine. There is no tannic acid in tea. Thearubigens constitute the largest mass of the extractable matter in black tea but their composition is not well known. The catechin quinones also initiate the formation of many of the hundreds of volatile compounds found in the black tea aroma fraction.[1]

Green tea composition is very similar to that of the fresh leaf except for a few enzymatically catalyzed changes which occur extremely rapidly following plucking. New volatile substances are produced during the drying stage. Green tea is prepared in such a way as to preclude the oxidation of green leaf polyphenols.[1]

Periodontal disease is a consequence of the extension of gingival inflammation to involve the periodontal attachment apparatus. The success of any mode of periodontal therapy lies in the prevention of spread of infection from the gingiva to the deeper periodontal structures.

Previously, the modes of deliver of green tea catechin was via slow release local drug delivery system of hydroxypropylcellulose strips containing green tea catechin into periodontal pockets has been shown to be effective in improving clinical periodontal parameters [2], green tea chew candies [3] and green tea mouthwash [5]. In contrast to the previous studies conducted on the effects of green tea on periodontal health**,** our study used dietary supplementation of green tea polyphenols to analyze for positive influences in reducing the clinical parameters of chronic gingival inflammation and assist in reduction of halitosis. The present study focuses on arresting the process of gingival inflammation and halitosis before it progresses into periodontal disease.

Hence, the rationale of this study is to evaluate the effectiveness of dietary supplementation of traditional green tea herbal therapy in reducing the clinical parameters of gingival inflammation and oral malodor.

MATERIALS AND METHODS:

This study was a randomized single-blinded placebo controlled trial with a

total of thirty subjects. In order to establish a sampling frame of 15 patients as control group and 15 patients as intervention group from a total number of 30 patients, block randomization sampling method was done. The participants of this study were blinded to their assignment to control or intervention groups.

The green tea polyphenols used in this study were green tea bags, containing 2 grams / teabag, rich in polyphenols, amino acids, lipopolysaccharide, potassium, magnesium and vitamin A, B1, B2, C, E PP, H, pantothenic acid, folic acid, inositol and carotene. Chinese tea used as placebo for the control group was Oolong Chinese Tea, containing 2 grams/teabag. All the above mentioned tea was purchased from Purple Cane Enterprise Sdn. Bhd. Malaysia. The ethical approval was obtained from Human and Ethics Committee of Faculty of Dentistry, Melaka-Manipal Medical College, Malaysia. A written informed consent was obtained from all the volunteering subjects for both groups prior to commencement of the study.

In this study, we included 30 subjects with clinical evidence of gingival disease, systemically healthy teetotallers for screening at the out-patient department of Faculty of Dentistry, Melaka-Manipal Medical College, Malaysia. Exclusion criteria included subjects with periodontal disease, pregnant and lactating women, those consuming medications which may induce gingival enlargement, patients who have undergone oral prophylaxis 3 months prior to commencement of this study, subjects using topical or systemic antimicrobial therapy since past 6 months, any subjects already consuming green tea intake for past 6 months. The examination and diagnosis form was used to record the Simplified Oral Hygiene Index (OHI-S)[7], Gingival Index by Loe and Silness using Ramfjord index teeth (GI)[10] and Organoleptic assessment.[6] Both the examiners noted their findings separately and the average of both findings were taken for data analysis to avoid inter-examiner bias.

All thirty subjects with clinical diagnosis of chronic gingivitis received supragingival scaling, polishing and oral hygiene instructions. Thirty teabags of green tea and chinese tea sufficient for 1 month intake were then dispensed to allocated intervention and control groups respectively (Figure 1). Then subjects were instructed to drink 2 cups of tea a day, once in the morning and once in the evening, using a standard cup (Figure 2) provided to all the study participants. A follow-up review was carried out one month later and the results were tabulated.

RESULTS:

Data entry and statistical analysis for comparison of the control and intervention groups were performed using SPSS 2003 version 12.0 (SPSS inc., 233 South Wacker Drive, 11th Floor, Chicago, Illinois 60606-6307, U.S.A.). The characteristics of the intervention and control group at baseline (first visit)

were subjected to comparison (Table 1 and Table 2). After assessment of these statistical differences within each test and control group it was concluded that the variables such as age, sex, ethnicity and gender did not lead to any significant discrepancy in results. Wilcoxon signed ranks test was used to asses statistical differences in age, whereas Mann-Whitney U test and crosstabs were used for ethnicity and gender respectively.

Intervention Group (Green Tea):

After one month of the study the subjects in the intervention group (n= 14, 6 males, 8 females) showed a reduction in the median value of the gingival index from 1.33 at baseline to 1.04 post therapy. Similarly, the test group showed a decline in odour from a median value of 3 prior to therapy to a score of 2. (Table 3). The change score showed significant results in both gingival and odour indices when compared to the control group which showed no changes (Table 4).

Control/Placebo Group (Chinese tea):

The control group gingival and odour index scores were measured at baseline and after one month, alongside the test group. Though median value of the gingival index was shown to drop from 1.2 at baseline to 1.04 following the intake of the placebo, the results however was not as substantial as observed in the test group. As for the median value of the odour index there was no change detected, the score remaining at 2.5 at baseline and post therapy (Table 3). The change score is represented as 0 for both gingival and odour indices for the control group (Table 4).

The comparisons of the pre- and post-therapy values of gingival index score and odour score showed statistically significant difference (P= 0.004 and 0.005, respectively) in the intervention group (Table 3). However, even though there was a definite reduction of gingival index score in the control group it was not statistically significant (P= 0.386). Mann-Whitney U test and Wilcoxon signed rank testing was used to tabulate the results before and after the therapy in both groups.

DISCUSSION:

Bacterial Biofilm and plaque development in the marginal gingival and periodontal pockets is important in the pathogenesis of periodontal disease. Previous studies showed that green tea catechin inhibits the growth of Porphyromonas gingivalis, Prevotella intermedia and Prevotella nigrescens.[11] In addition, green tea catechins with the steric structures of 3-galloyl radial, EGCg, epicatechin gallate (ECg), and gallocatechin gallate, which are the major polyphenols, inhibit the production of toxic end metabolites of P.gingivalis.[11] Breath odor derived from oral cavity is mainly caused by volatile sulphur compounds (VSCs) such as H2S and CH3SH produced through the putrefaction activity of oral microrganisms. (11) Previous studies show

green tea was very effective in reducing oral malodour (significant reduction of CH3SH) due to its disinfectant and deodorant activities, but temporarily.[11]

A pilot clinical study showed that the periodontal treatment with slow-release local delivery of catechin improved periodontal status.[2] However, it is not clear if the daily intake of green tea as a dietary supplement has a beneficial effect on periodontal health. Therefore, the objective of our study was to examine the relationship between the clinical effects of dietary supplementation of green tea polyphenols on halitosis, and also on the clinical parameters of chronic gingival inflammation.

Previous studies on the effect of green tea in the oral cavity varied in their mode of delivery of the tea polyphenols, some in the form of mouthwashes, chewable green tea candies and using local delivery systems. However, this study focuses on the results produced when dietary supplementation of the green tea is given in the form of two standard cups per day, for one month. Another point in comparing previous research with this study is the fact that they all focus on the relationship between green tea and periodontal health[15] as opposed to gingival disease which is the main concern in our study. The rationale behind this being that periodontal disease is a result of the extension of gingival inflammation to involve the periodontal attachment apparatus. The success of any mode of therapy lies in the prevention of spread of infection from the gingiva to the deeper periodontal structures. Hence we sought to prevent further loss of tooth structure by seeing the effect green tea on the early stages of disease process. In contrast to the earlier research our study also assessed the statistical differences within both groups to eliminate any possible bias in the results. There was a modest inverse association between intake of green tea and periodontal disease.[11] In the study using green tea chewable candies, the results indicated oral application of catechins and polyphenols might have a positive influence on the inflammatory reaction of periodontal structure. Immediately after administration, green tea showed the largest reduction in volatile sulfur compounds in mouth air.[11] After conducting the study, it is evident our results are in correlation with previous studies also finding positive results for the effect of green tea in the oral cavity.

In retrospect, the authors feel that there are certain aspects which might have compromised the results to a small extent. The main concern we faced was the drop-out of 1 and 2 subjects respectively, from intervention and control groups. To monitor the twice daily intake of tea by the subjects was a difficult task, however this was overcome by requesting the patients to produce the used tea bags on their one-month visit to the clinic (Figures 3 and 4). To avoid inter and intra examiner variability, the results were tabulated after taking an average of both

examiners assessments of the baseline and post therapy characteristics.

CONCLUSION

The present study suggests that there is a positive relationship between the daily dietary intake of green tea and improvement in gingival health and halitosis. The dietary supplementation of green tea in daily life is relatively an easy habit to maintain especially considering the benefits, such as the decrease in gingival inflammation and oral malodour. Future research should be directed in obtaining a stronger inverse association between the intake of green tea polyphenols and the subsequent effects on periodontal health.

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TABLES:

Table 1: Baseline Characteristics

Variable	Green Tea Median (IQR)	Control Median (IQR)	P value
Age	23 (22-24)	22 (18-24)	0.122
Gingival index	1.034 (1.03-1.55)	1.2 (1.04- 1.39)	0.296
Odour index	3 (2.38-3.5)	2.5 (1-3.5)	0.051

* All values are prior to administration of Green and Chinese Tea

Table 2: Baseline Characteristics

Variable	Green Tea Frequency (%)	Control Frequency (%)	P value
Gender:			
Male	6 (50%)	6 (50%)	0.863
Female	8 (53.3%)	7 (46.7%)	
Ethnicity:			
Malay	1 (33.3%)	2 (66.7%)	0.542
Chinese	7 (46.7%)	8 (53.3%)	
Indian	6 (66.7%)	3 (33.3%)	

* All values are prior to administration of Green and Chinese Tea

Table 3: Before VS After of Gingival index and Odour index for Green Tea and Control Group

Variables	Before Median (IQR)	After Median (IQR)	P value
Green Tea:			
Gingival index	1.33 (1.63-1.54)	1.04 (0.86-1.13)	0.004
Odour index	3 (2.37- 3.5)	2 (1.87- 2.12)	0.005
Control:			
Gingival index	1.2 (1.03-1.39)	1.04 (0.86-1.45)	0.386
Odour index	2.5 (1-3.5)	2.5 (1.75-3)	0.577

Table 4: Change score of Gingival Index and Odour Index between Green Tea and Control Group

Variable	Green Tea Median (IQR)	Control Median (IQR)	P value
Gingival Index change score	0.23 (0.11-0.55)	0 (-0.04- 0.22)	0.024
Odour Index change score	1 (0-1.15)	0 (-0.5-0.5)	0.003

FIGURES:

Figure 1: Tea sachets dispensed to patients for consumption.

Figure 3: Used tea sachets returned to the clinic by the patient, one month later.

Figure 2: Standard cup used by the patients to consume tea

Figure 4: Used tea sachets arranged for counting the number of sachets returned.