EFFECT OF GREEN TEA TOOTHPASTE ON PLAQUE INDEX

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Abstract

Purpose: The objective of the research was to analyze the effect of toothpaste containing green tea extract on dental plaque index.

Methods: Green tea extract was dissolved in distillled water. Toothpastes containg green tea extract with concentration of 5, 10, and 15% were made. 20 subjects were included in the study. The study was done in five different days. In each day, subjects were asked to rinse with one of the following agents: toothpaste solution of 5%, 10 % or 15 % concentration of the green tea extract, toothpaste solution without green tea extract (control 1) or drinking water (control 2). The application was done in a cross-over method with 3-4 days of wash-out periods. Prior to the application, the teeth of the students were cleansed. Following the cleaning, each student was given a carbohydrate meal. After five hours, plaque index was measured and categorized into 4 categories of very good, good, moderate and bad.

Results: Toothpaste containing green tea with concentration of 5, 10, or 15 % showed higher incidence of good plaque index compared to the two control groups (p < 0.05). Increasing the concentration of green tea in the toothpaste from 5% to 10 % or 15% increased good plaque index incidence significantly (p < 0.05). However, there was no difference in good plaque index incidence between the concentration of 10% and 15% (p>0.05).

Conclusion: the use of toothpaste with concentration of 5, 10, and 15 % of green tea extract can increase the incidence of good plaque index score.

Keywords: Green Tea Extract, Plaque index; Toothpaste

Introduction

Dental caries and periodontal disease are instrumental issues within the area of Oral Health in Indonesia. Based on the Basic Health Research (Riskesdas) in 2007 by Health Research and Development (Litbangkes Depkes RI), only 7.3% of Indonesians brush their teeth correctly, after having breakfast and before sleeping, of which only 5.5 % check their oral health to the dentist routinely (1). This condition has caused so many dental problems in Indonesia, such as dental caries, periodontal disease, oral soft tissue disease, and poor oral hygiene.

A morbidity study on National Household Health Survey (Survei Kesehatan Rumah Tangga; SKRT) in 2001 states that, among 10 groups of diseases about which Indonesians complain, tooth and oral disease tops the list (60%) (2). Another SKRT in 2004 states that 39 % of people in Indonesia have teeth and oral disease. The research further finds that the prevalence of caries for age group of 10 years and above is 71.2%, with a note that the caries severity level is positively correlated with higher age, lower education, and lower economic status. 46% of people above 10 years and have periodontal disease, with more prevalence in the higher age (3). One cause of caries and periodontal disease is the existence of plaque on the tooth surface.

Efforts to inhibit the formation of dental plaque that can cause periodontal disease and dental caries have been promoted and carried out (4). These include chewing gums with certain active substances, mouthwashing, tooth brushing, and gel using. However, the use of the toothbrush remains to be the popular method in maintaining oral health.

Studies have shown that toothpastes used in Indonesia are not yet quite effective to inhibit the formation of plaque on the tooth surfaces which causes dental caries and periodontal disease. This argument can be supported by the high prevalence of dental caries and periodontal disease in Indonesia (2,3). Therefore, there is a necessity to improve the effectiveness of inhibition of the formation of dental plaque. This can be possibly done by adding certain substances to the toothpaste that can potentially inhibit the formation of dental plaque.

Extracts from plants are already used globally in the form of topical or application in the oral cavity. It has been shown that green

tea from Camellia sinensis species, which is not fermented during the process, has several advantages in oral health due to its antibacterial and antioxidant properties (5). Substance closely associated with antibacterial and antioxidant in Green tea extract is a collection of polyphenol components called catechins (6). Polyphenols (catechins) in green tea extract can inhibit Glycosyltransferases enzyme activity, which allows the inhibition of the formation of glucans from sucrose that has a fundamental role in sucrose-dependent adhesion and is contributive to the formation of plaque (7). Polyphenols (catechins) are also able to prevent the growth and activity of tooth decay bacteria which then causes dental caries and periodontal disease (5,6). It has been shown that subjects consuming green tea have lower dental caries and plaque than subjects who only drink mineral water (8).

The effectiveness of green tea extract in reducing formation of dental plaque has been investigated. It has been reported that a mouthwash congaing green tea extracts significantly significantly inhibit plaque deposition in oral cavity (9). However, there in very limited evidence on the effectiveness of toothpaste containing green tea extract.

Green tea is a beverage that is often consumed by Indonesians. Content of green tea extract has substance that can reduce the formation of dental plaque. In addition, green tea is relatively inexpensive, easy to process, and can be found easily in Indonesia. In the other hand, the use of toothpaste is the commonly material that used to protect the oral health. With regular brushing, the formation of plaque in a person will decline, raising one's plaque index. Combination of toothpaste with green tea extract is expected to have a positive influence on the plaque index. Therefore, the purpose of this study is to evaluate the effectiveness of using of green tea extract in toothpaste on plaque control, which is measured by plaque index.

Materials and Methods

Study Design: The present study is a clinical experimental research. The study was done in five different days. In each day, subjects must rinse with one of the following agents: (1) toothpaste solution of 5% concentration of the green tea extract, (2) toothpaste solution with 10% green tea extract, (3) toothpaste solution with 15% of green tea extract, (4) toothpaste solution without green tea extract (0%), or (5) drinking water (Aqua ®, Golden Mississippi, Indonesia). Then, in each day, all subjects had same breakfast, and plaque index was measure 5 hour later. The plaque index measurements in different days were compared to each others. The independent variable is toothpaste with green tea extract (5%, 10%, 15%), toothpaste without green tea extract as the control and drinking water (Aqua ®, Golden Mississippi, Indonesia) as comparison. The dependent variable is the dental plaque index.

Toothpaste preparation: Toothpaste with green tea extract (5%, 10%, 15%) made from sapo medicates, glycerin, calcium carbonate and contain green tea extract, green tea extract in 5%, 10% or 15% concentrations which were made in Tea and Quinine Research Center, Gambung. Green tea is extracted with 1: 50 (gr/gr) ratio between green tea and water. Firstly, green tea must be mashed and then heated with temperature up to 70℃ for 15 minutes. Afterwards, extraction was gradually done until the color of the solution disappear. Next, the solution was evaporated with rotary evaporator machine that produced viscous green tea extract. Toothpastes were made with 5%, 10% and 15% concentrations of the green tea extract.

Toothpaste without green tea extract was made with mix 90% calcium carbonate, 5 % of sapo medicates and glycerin from the total weight.

Clinical phase: 20 subjects were included in this study. The experiment protocol was explained to the subjects, and all subjects signed informed consent form. All subjects received full mouth debridement, and oral hygiene instructions were given to them.

Subjects were asked to rinse with 5 different agents at five different times. Subject were randomized depend on the order of the treatment. In the first treatment, subjects were asked to rinse with toothpaste solution without green tea extract (0) %; in the second treatment, subjects were asked to rinse with toothpaste solution with 5% green tea extract; In the third treatment, subjects were asked to rinse with 10% green tea extract; In the fourth treatment, subject subjects were asked to rinse with 15% green tea extract; and in the last treatment, subjects were asked to rinse with Aqua drinking water. For each treatment, subjects used 5 ml toothpaste solution for 5 minutes. Afterwards, subject had same menu and portion for breakfast. Then, subjects were requested to not eat, rinse, or toothbrush for 5 hours. Subject only could drink mineral water during that period. Consideration of five hours is based on the average of plaque formation on teeth (+- 3 - 8 hours). Furthermore, it is also based on consideration of the subjects' schedule.

After the 5 hours period, plaque index evaluation was conducted through a thorough observation of the dental plaque distribution. We gave subjects disclosing agent and examined each subject with mouth mirror and halfmoon probe. Labial/ buccal and palatal/ lingual surfaces of teeth number 16, 12, 24, 44, 32, 36 were examined and then amount of plaque was converted into the categories of very good, good, moderate, or bad.

Between the first, second, third, fourth and fifth treatment, there was a span of 3-4 days where the subject did not not undergo any treatment. It aimed to eliminate the effect of the previous treatment so as it would not effect to the results of subsequent treatment. This period is also called the washout time, where the subject brushed their teeth twice a day with toothpaste without green tea extract (0%) at home.

Statistical analysis: The differences between the plaque index measurements in the first, second, third, fourth and fifth treatment were analyzed. Data processing was done using the computer program SPSS 17.0. The data obtained in this study are ordinal data. To find out the distribution of research data distribution, descriptive test is presented in a bar chart. Then, to test the hypothesis, Friedman test was used for the subject of research for more than two groups and pairs. Friedman test was followed with the Post Hoe Wilcoxon test to determine the most effective concentration of the green tea extract against plaque index.

Results

The present data shows that there was no subject with very good plaque index score in any group. In the treatment group without green tea extract toothpaste (0%), only one subject had good plaque index score, while the number of subjects with moderate plaque index score are 19. In treatment group of toothpaste with 5% of green tea extract concentrations, the subjects with moderate plaque index score are in majority, and 6 subjects had good plaque index score. The majority of subjects in the groups with toothpaste containing green tea extract 10% and 15% had good plaque index score (Table 1). In the treatment group of drinking water, a bad plaque index score was reported in 1 subject, while the majority showed moderate plaque index (Table 1).

Table 2 presents the statistical comparison of plaque index measurements in different groups. There are significant differences in plaque score measurements between groups with and without green tea extract toothpaste. Plaque index after 5% toothpaste green tea extract concentration treatment was compared to the treatment of (0%) toothpaste without green tea extract and it is significantly different (P <0.05). Plaque index after the 10% green tea extract toothpaste treatment was compared with 5% green tea extract toothpaste treatment and the result was significantly different concentrations of 5% (p <0.05). Whereas plaque index after treatment of 15% green tea extract toothpaste compared to 10% green tea extract toothpaste treatment did not differ significantly (p> 0.05). As a comparison, plaque index in the treatment group of drinking water compared to toothpaste treatment without green tea extract (0%) did not differ significantly (p> 0.05).

Discussion

This study shows that toothpaste containing green tea extract affects the plaque index. There was a significant trend of having good plaque index when toothpaste that contains green tea extract concentrations were used.

The present results showed that good plaque index score was seen more frequently when subject were given green tea extract toothpaste concentration on 5%, 10% and 15%. This finding can be explained by presence of catechin in green tea. The present results are inline with those of a study conducted by Muin and Munandar in 2008 who found a significant difference of dental plaque index score between control groups, which were not given green tea, and treatment group, which were given green tea (10).

According to Sakanaka (1990), the catechin compound is the most responsible agent to inhibit the activity of glucosyltransferase enzyme (7). The compounds which are containing catechin are epicatechin gallate (ECg) and epigallocatechin gallate (EGCg). According to of Naim (2004), the amount of phenolyc hydroxyl group has a correlation with increasing relative toxicity rate of catechin on bacteria, so that the increase of hydroxyl group can increase the inhibition activity of catechin (11). Based on a research by Skobeleva and Bokuchava, it is known that the rate of catechin in ECG is 3-6% of tea dry weight. While the rate of catechin in EGCg is 7-13% of tea dry weight (12). Sakanaka (1997) in his research showed that the minimum amount inhibition concentrate (MIC) of cathecin that is used to inhibit the formation of glucosyltransferase enzyme is 0,025-0,030 mg/ml. In the other hand, Sakanaka also showed that the ideal MIC of cathecin amount to kill S. mutans is 0,5-1 mg/ml (13). From the calculation of 50% concentration of green tea, it contains 0,65-1,265 mg/ml catechin. So, the 5% concentration of green tea extract toothpaste contains 0,05-0,1265 mg/ml, 10% concentration contains 0,13-0,253 ml/ml, and 15% concentration contains 0,2-0,38 mg/ml catechin. The 5%, 10%, and 15% concentration of green tea extract toothpaste showed a higher value than MIC on Sakanaka's research on inhibiting the formation of glucan but not kill the bacteria. Therefore, it can be assumed that using toothpaste containing green tea extract in concentration 5%, 10% and 15% can inhibit the formation of dental plaque through inhibit glucan formation but not kill the bacteria.

Results of this study show the no significant differences between toothpaste containing green tea extract treatment in concentration of 10% and 15% on the index plaque. This is potentially due to the hypothesis that the rate or concentration of catechin in toothpaste containing green tea extract in concentration of 10% and 15% is much higher than MIC catechin, so that any effective difference is not too clearly seen.

Furthermore, moderate and good, but not bad, plaque index scores were reported when using toothpaste application without green tea extract (0%). It might be due to the availability of calcium carbonate in the toothpaste, which can affect the inhibition of dental plaque after tooth brushing.

Drinking water treatment does not provide any additional benefits compared to toothpaste treatment without green tea extract (0%). However, drinking water treatment can also help in reducing the formation of dental plaque. Reduction of dental plaque by drinking water can be explained by study of Seymour and Heasman (1992) who found the interaction between pellicle and bacteria is hydrophobic, so that the presence of water could inhibit the adhesion of bacteria to the pellicle (14).

Conclusion

Within the limitations of the present study, it can be concluded

Plaque Index (N=20)	Treatment of toothpaste containing green tea extract				Aqua®, Golden Mississippi, Indonesia drinking water (Comparison)
	Without green tea extract (0%)	5%	10%	15%	
Very good	0	0	0	0	0
Good	1	6	19	19	0
Moderate	19	14	1	1	19
Bad	0	0	0	0	1

Table 1. The number of subjects with plaque index due to the treatment of toothpaste without green tea extract (0%) and the concentration of 5%, 10%, 15% also Aqua ®, Golden Mississippi, Indonesia drinking water, as a comparison. (N=20)

Concentration	0%	5%	10%	15%	Aqua®, Golden Mississippi, Indonesia drinking water (Comparison)
0%	■	**	**	**	-
5%	**	■	**	**	**
10%	**	**	■	-	**
15%	**	**	-	■	**
Aqua®, Golden Mississippi, Indonesia drinking water (Comparison)	-	**	**	**	■

(**): significantly different: $p < 0,05$
(-): no significant difference: $p > 0,05$

Table 2 Significance of each concentration in green tea extract

that the use of toothpaste with concentration of 5, 10, and 15 % of green tea extract can increase the incidence of good plaque index score. Among the three concentrations, concentrations of 10% or 15% green tea extract in toothpaste are the optimum concentrations.

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