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The Effect of Strawberries as a Natural Teeth Whitening Agent on Tooth Surface Roughness: In Vitro Study

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A B S T R A C T

Teeth whitening due to discoloration can be achieved by methods of bleaching. The material used in bleaching conventional methods can have effects on hard tooth tissue, such as increasing tooth surface roughness. Strawberries (*Fragaria x ananassa*) have long been known for being effective in whitening teeth. The aim of the research was to determine the effect of strawberries as a natural teeth whitening agent on tooth surface roughness in vitro. This research is an in vitro experiment. The samples were 24 first premolars of the upper jaw and lower jaw, which were divided into two groups. Group 1 (strawberry juice 100%) and group 2 (carbamide peroxide 10%). Testing tooth surface roughness using tools surface roughness tester, then the data was analyzed using statistical test paired t-test and Mann-Whitney. The results of the study showed that the mean and standard deviation of tooth surface roughness before and after application of strawberry fruit juice was 0.37 ± 0.156 and 0.22 ± 0.129, while the 10% carbamide peroxide group obtained the value of tooth surface roughness before and after application was 0.36 ± 0.118 and 0.37 ± 0.263.

1. Introduction

Teeth whitening is generally done using the method of bleaching. Teeth whitening has been established over the past few decades as a minimally conservative method for improving the human smile when used as a treatment alone or as an initial treatment in combination with restorative techniques. There are two types of procedures, including bleaching intracoronal and bleaching extracoronal. Bleaching intracoronal is a procedure bleaching for non-vital teeth that have had root canal treatment. Meanwhile, bleaching extracoronal is a procedure bleaching that is used on vital and non-vital teeth that are affected by extrinsic discoloration on the enamel surface. The most frequently used materials for bleaching These teeth usually use hydrogen peroxide or carbamide peroxide. Both materials contain the same component, namely hydrogen peroxide, which will decompose into H_2O to O_2. The higher the concentration of hydrogen peroxide used, the brighter the tooth color will be. Another study showed that different concentrations of carbamide peroxide and hydrogen peroxide decreased the microhardness values of tooth enamel and increased the surface roughness after whitening.[1-6]

Strawberries (*Fragaria x ananassa*) have long been known for its many benefits, including naturally brightening the skin, whitening tooth enamel, and preventing the formation of tartar. Apart from that, this fruit has been identified as an effective natural ingredient for whitening teeth. This plant contains ellagic acid and malic acid, which can whiten teeth. Elegatic acid is able to release electrons, causing color

changes in tooth enamel, and can bind these substances. Malic acid is a group of carboxylic acids that have the ability to whiten teeth by oxidizing and neutralizing the surface of tooth enamel to produce a whitening effect.[7-11] This study aimed to determine the effect of strawberries as a natural teeth whitening agent on tooth surface roughness in vitro.

2. Methods

This study is an in vitro experimental research. A total of 24 maxillary and mandibular first premolars were included in this study. Research subjects were grouped into 2 treatment groups, namely group 1 (receiving 100% strawberry juice) and group 2 (receiving 10% carbamide peroxide). The inclusion criteria for research subjects in this study were permanent teeth and tooth crowns still intact, teeth without caries/fractures, teeth without anomalies, and roots fully formed. This study has received approval from the medical and health research ethics committee of the Faculty of Medicine, Dentistry and Health Sciences, Universitas Prima Indonesia.

The strawberries were washed and dried, then weighed 200 grams. Strawberries are mashed without water using a mortar and stamper. Then, put it in a cloth and squeeze it. Then, the pH of the 100% strawberry juice was measured using a pH meter. Each sample was measured using a surface roughness surface roughness tester. Each sample was put into each tube and soaked in artificial saliva for 4 hours.

Group 1 samples were removed from the artificial saliva tube and then soaked in strawberry juice for 8 hours. After that, it was put back into the artificial saliva tube for 4 hours. Group 1 samples were removed again for a second application. The sample was soaked in strawberry juice for 8 hours. Then, the sample was put back into a tube containing artificial saliva. The procedure is repeated for 14 days. Group 2 samples were removed from the artificial saliva tube, and then 10% carbamide peroxide gel was applied to the buccal surface of the teeth for 8 hours. Group 2 samples were rinsed under running water and put back into the artificial saliva tube. The procedure is repeated for 14 days. Data analysis was carried out using SPSS software version 25. Univariate to find out the mean and standard deviation of tooth surface roughness before and after treatment. Test normality with the Shapiro-Wilk test and homogeneity with the Levene Test. A paired t-test was used to analyze the differences in tooth surface roughness before and after being given strawberries, while the group of teeth that were applied with carbamide peroxide was analyzed using the Wilcoxon. Mann-Whitney statistical test to analyze the effect of strawberries as a natural teeth whitening agent on the roughness of tooth surfaces in vitro.

3. Results and Discussion

The results of the Paired t-test in Table 1 below can be stated that there is a significant difference in tooth surface roughness before and after strawberry ($p = 0.001$; $p \leq 0.05$), but in the 10% carbamide peroxide group, there is no significant difference in tooth surface roughness ($p = 0.754$; $p > 0.05$).

Table 1. Differences in tooth surface roughness before and after treatment.

Group	Observation	Tooth surface roughness		p
		Mean	Mean difference	
Strawberry juice	Before	0,37	0,15	0,001*
	After	0,22		
Carbamide peroxide 10%	Before	0,36	-0.01	0,754
	After	0,37		

*Significant (Paired t-test).

Strawberries (*Fragaria x ananassa*) are a potential fruit plant because this fruit contains many phytochemical ingredients, especially phenolic compounds such as flavonoids, alkaloids, tannins, and saponins which are beneficial for health. Apart from that, strawberries also contain vitamin C. anthocyanin, the marker compound quercetin, fiber, potassium, folate, low calories, ellagic acid, and malic acid. Citric acid is a weak acid but has a high level of acid titration, so it has the potential for greater erosion because it makes the pH of strawberries low or acidic. However, the potential for tooth erosion caused by acidic drinks depends not only on the degree of acidity but also on the chelation properties, frequency, and duration of consumption. The roughness of the tooth surface occurs due to porosity in the tooth enamel due to the continuous demineralization process. Rough surfaces cause retention and proliferation of various microorganisms that cause oral problems and periodontal disease.[12-16]

The roughness of the tooth surface can be caused by the side effects of treatment bleaching, namely increasing surface roughness on teeth due to the nature of peroxide, which causes dehydration of the tooth structure. Carbamide peroxide is more commonly used in the procedure of home bleaching than hydrogen peroxide because this teeth-whitening agent is safer to use and causes fewer side effects. A mixture of strawberries and baking soda produces minimal surface roughness of tooth enamel compared to hydrogen peroxide and carbamide peroxide. The results of this study contradict the theory which states that increased surface roughness can occur when teeth are in a demineralized condition when they come into contact with external factors in the form of exposure to acidic foods or drinks that have a pH below 5.5.[17-20]

4. Conclusion

There is an effect of strawberry juice as a natural teeth-whitening agent on the roughness of the tooth surface in vitro ($p \leq 0.05$). There was a decrease in the level of tooth surface roughness after immersion in strawberry juice.

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