



Effectiveness Difference of Pomegranate Peel Extract and Green Tea on Salivary pH

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ABSTRACT

Published Online: March 07, 2023

Background: The acidic environment due to the interaction of bacteria in the oral cavity triggers the occurrence of dental caries. It is characterized by the increased of bacterial activity at critical pH (4.5-5.5). Mouthwash is used as an antibacterial, but it has unwanted side effects. Herbal mouthwash is considered as an alternative, such as pomegranate peel extract and green tea which have been tested for their effectiveness against *Streptococcus mutans* bacteria.

Objective: To provide information on the differences in the effectiveness of pomegranate peel extract and green tea on salivary pH.

Methods: This is an experimental study with a pretest-posttest control group design. Normality test using Shapiro-Wilk, and statistical test using Paired T-Test and Independent T-Test.

Results: There was a significant difference in effectiveness between pomegranate peel extract and green tea on salivary pH.

Conclusion: Pomegranate peel extract is able to increase salivary pH while green tea lowers salivary pH. This difference in effectiveness allows for different indications to take advantage of the two types of herbs.

KEYWORDS:

Green tea, pomegranate peel extract, salivary pH.

INTRODUCTION

The oral health of the Indonesians needs attention from medical staff. Oral health in Indonesia according to Riskesdas data in 2013 showed an increase in the percentage of the population who had oral health problems from 2007 which was 23.2% to 25.9%.¹ Oral health that is not maintained properly will be a triggering factor for dental caries due to the formation of dental plaque.² Federation Dentaire Internationale (FDI) stated that dental caries is still the most common disease and is a dental problem with the largest proportion in Indonesia, that is 45.3% based on the results of the 2018 Basic Health Research (Riskesdas).³

The risk of dental caries is influenced by oral hygiene factors. Complex interactions between carbohydrates and bacteria *Streptococcus mutans* causes an acidic environment in the saliva.

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**Cite this Article: Poetry Oktanauli, Pinka Taher, Azyyati Patricia Zikir, Margaretha Herawati, Dhea Adena Shara (2023). Effectiveness Difference of Pomegranate Peel Extract and Green Tea on Salivary PH. International Journal of Clinical Science and Medical Research, 3(3), 48-52*

Acid produced by bacteria causes demineralization process on the enamel surface. Dental caries occurs due to the demineralization process that is not balanced with tooth remineralization. The growth of acidogenic bacteria such as *Streptococcus mutans* and *Lactobacillus* it is easy to occur when the pH of saliva is low, around 4.5 to 5.5, so that saliva parameters are a factor that plays an important role in the process of dental caries.^{2,4,5}

Brushing your teeth and using mouthwash is an effort to keep your teeth and mouth clean. Mouthwash is commonly used to clean the oral cavity, prevent dental caries and periodontal disease because it contains antimicrobials with a comfortable taste, easy to use and useful for refreshing the mouth.^{6,7} Based on the composition, mouthwash is divided into three types, namely herbal mouthwash, non-alcoholic mouthwash, and alcoholic mouthwash.^{8,9}

Herbal ingredients are the right consideration as an alternative to maintain optimal oral hygiene. The use of herbal ingredients as mouthwash can minimize unwanted side effects and has scientifically proven benefits and safety.¹⁰ Pomegranate peel extract and green tea are natural ingredients with minimal side effects and have been tested for their

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effectiveness against bacteria *Streptococcus mutans* and plaque accumulation.^{11,12,13}

Pomegranate peel extract has outstanding antimicrobial activity against *Streptococcus mutans* present in the oral cavity and has proven its potential as an anti-cariogenic agent.¹⁴ In addition to pomegranate peel extract, green tea also has the ability to reduce and inhibit the growth of *Streptococcus mutans* because it contains catechins so that it is effective in reducing dental plaque index. Green tea contains fluoride in catechins which are weakly alkaline.^{13,15} Based on this background, this study aims to determine the difference in effectiveness between pomegranate peel extract and green tea on salivary pH.

MATERIAL AND METHODS

This research was conducted at the Laboratory of the Faculty of Dentistry, University of Prof. Dr. Moestopo (Religious) on March 16, 2022. The number of research samples used were 32 samples of artificial saliva with a pH of 6.8 which were divided into two treatment groups, group 1 treatment with pomegranate peel extract and group 2 treatment with green tea. Salivary pH measurements were carried out before treatment and 100 seconds after treatment.

The type of research used is experimental research, with a pretest-posttest group design. The sample used in this study was McDougall's artificial saliva with the composition of Sodium Phosphate (Na_2HPO_4), Potassium Diphosphate (KH_2PO_4), Potassium Chloride (KCl), Sodium Chloride (NaCl), Sodium Bicarbonate (NaHCO_3), Urea ($\text{CO}(\text{NH}_4)_2$) with a pH of 6.8.¹⁶

Preparation of pomegranate peel extract solution was carried out by 3 grams of pomegranate peel extract

powder brewed with 200 ml of warm water, then stir until homogeneous and reached room temperature. The solution was divided into 16 parts with the volume of each solution was 10 ml which would be exposed to each artificial saliva sample. Before mixing, the pH measurement of the pomegranate peel extract solution was carried out first.

Preparation of green tea solution is done by brewing one green tea bag for 2-3 minutes with 200 ml of warm water until it reaches room temperature. The solution is divided into 16 parts with the volume of each solution is 10 ml which will be exposed to each artificial saliva sample. Before mixing, the pH measurement of the green tea solution was carried out first.

Preparation samples were carried out through artificial saliva with a volume of 10 ml and a pH of 6.8 were grouped into two groups. Group 1 was exposed to a solution of pomegranate peel extract, group 2 was exposed to a solution of green tea. Each group consisted of 16 samples of artificial saliva.

Saliva pH measurement is carried out using a pH meter which must be cleaned and calibrated before use. Calibration of the pH meter using a standard pH or called a buffer pH. The pH meter calibration step is carried out according to the instructions on the packaging.

This study used the Shapiro-Wilk normality test. The data can be declared normally distributed if the significance value is > 0.05 and abnormally distributed if the significance value < 0.05 . Because the data were normally distributed, statistical analysis used Paired T-Test for comparison before and after treatment in each solution, and Independent T-Test for comparison of results after treatment of the two herbal ingredients.

RESULT

The results in this study can be seen in the following table:

Table 1. Frequency Distribution Pretest-Posttest in the Pomegranate Peel Extract and Green tea Group

Variable	Mean	SD	Median (Minimum-Maximum)
Pomegranate Peel Extract Pretest	6.8	.00000	6.8000 (6.80-6.80)
Pomegranate Peel Extract Posttest	6.8919	.04778	6.9000 (6.78-6.97)
Green Tea Pretest	6.8	.00000	6.8000 (6.80-6.80)
Green Tea Posttest	6.5400	.08824	6.5250 (6.38-6.78)

Analysis of the descriptive data in table 1 shows that the pH of saliva before treatment with pomegranate peel extract and green tea has a value mean, median, minimum and maximum each of 6.8 with a standard deviation of 0.00000 indicating that all values in the data are the same. The greater the value of the standard deviation of a data, then greater the distance between each data point and the mean value. The pH value of saliva after treatment with pomegranate peel extract increased with a value of mean, median, minimum and

maximum respectively 6.8919, 6.9000, 6.78, 6.97 with a standard deviation smaller than the mean that is 0.04778 indicates that the value of mean can be used as a representation of the entire data. Salivary pH value after treatment with green tea decreased with a value of mean, median, minimum and maximum are 6.5400, 6.5250, 6.38, 6.78, respectively, with a standard deviation smaller than the mean that is 0.08824 indicates that the value of mean can be used as a representation of the entire data.

Table 2. Data Normality Test

Treatment Group	Shapiro-Wilk		
	Statistics	df	Sig.
Salivary pH with Pomegranate Peel Extract	.965	16	.744
Salivary pH with Green Tea	.903	16	.090

*Shapiro-Wilk, $p > 0.05$, Saliva pH value was constant when the Variable Group = Pomegranate Peel Extract Pretest and Green tea Pretest.

The results of the normality test based on table 2, the posttest data were considered normally distributed because the p value > 0.05 , which was 0.744 in the pomegranate peel extract posttest and 0.090 in the green tea posttest. The pretest data of pomegranate peel extract and green tea had constant values. When showing the value of the data spread, the normal distribution has a number of main characteristics, one

of which has the same mean, median, and mode values. Therefore, the distribution is called unimodal. Based on this distribution theory, the pretest data of pomegranate peel extract and green tea were considered normally distributed, so the test used parametric tests, namely the Paired T-Test test for the paired group and the Independent T-Test test for the unpaired group.

Table 3. Test Results for Differences in Saliva pH Before and After Treatment

	Sig. (2-tailed)
Pomegranate Peel Extract Pretest-posttest	0.000*
Green Tea Pretest-posttest	0.000*

* $p < 0.05$, CI 95% (Paired T Test)

In table 3, the results of the Paired T-Test statistic test, the Asymp value. Sig. (2-tailed) for the pomegranate peel extract treatment group in table 3 of 0.000, the value is smaller than 0.05, it can be interpreted that there is a significant difference between the salivary pH before and

after the pomegranate peel extract treatment. Meanwhile, in the green tea group, the Asymp value was obtained. Sig. (2-tailed) of 0.000, the same value is smaller than 0.05, it can be interpreted that there is a significant difference between saliva pH before and after treatment with green tea.

Table 4. Differences in Saliva pH After Treatment with Pomegranate Peel Extract and Tea Green

	Sig. (2-tailed)
Saliva pH after Pomegranate Peel Extract Treatment	0.000*
Salivary pH after Green Tea Treatment	

* $p < 0.05$, CI 95% (Independent T Test)

In table 4, the results of the Independent T-Test statistical test obtained the Asymp value. Sig. (2-tailed) of 0.000, the value is smaller than 0.05, it can be interpreted that there is a significant difference in effectiveness between pomegranate peel extract and green tea on salivary pH.

peel extract on the number of Streptococcus mutans which concluded that pomegranate peel extract has the potential as an anticariogenic agent that can increase salivary pH.¹⁴ This is not much different from the benefits of green tea in Putri's research in 2019 which has the potential as an anticariogenic so that it can increase the pH of saliva due to its catechin content.¹⁷

DISCUSSION

This study was conducted to examine the difference in effectiveness between pomegranate peel extract and green tea on salivary pH. Pomegranate peel extract and green tea used in this study are products of BPOM (Food and Drug Supervisory Agency) which are commonly consumed by the public. Salivary pH values were measured 100 seconds after exposure to pomegranate peel extract and green tea in artificial saliva which had a neutral pH of about 6.8. In 2016, Umar et al conducted a study on the effect of pomegranate

The first study using pomegranate peel extract showed an increase in salivary pH (mean salivary pH became 6.89 from the initial pH of 6.8). The results of this study are in line with the research of Umar et al in 2016 and Kadam et al 2019 which stated that rinsing pomegranate peel extract was able to increase the pH of saliva.^{12,14} This increase in salivary pH has a positive impact on the oral cavity, because it can increase the occurrence of remineralization. The

existence of a remineralization process will reduce the possibility of caries.⁵

In the previous theory, normal pH values ranged from 6.5-7.¹⁸ The average salivary pH value after exposure to pomegranate peel extract was 6.89. This can be caused by the absence of antibacterial interactions as in the actual condition of the human oral cavity. Previous research on pomegranate peel extract was assessed to be able to increase salivary pH due to its anticariogenic effect. The decrease in the number of cariogenic bacteria can result in reduced acid production resulting in an increase in salivary pH.¹⁹ This is also stated in the research of Umar and Kadam regarding the anticariogenic effect of pomegranate peel extract which is able to increase the pH of saliva. However, the anticariogenic effect was also influenced by the concentration level of the pomegranate peel extract, the higher the concentration of the pomegranate peel extract, the greater the inhibition zone.²⁰ In addition, the time factor also has an effect, based on the results of Kadam's research in 2019 there were differences in the difference in the increase in salivary pH at different time measurements, namely 10 minutes, 30 minutes and 60 minutes. The highest salivary pH value occurred 60 minutes after gargling with pomegranate peel extract.¹²

In the second study, there was a decrease in salivary pH after exposure to green tea (the mean salivary pH value decreased to 6.54 from the initial pH of 6.8). The results of this study are in line with Yusriyanti's research in 2016 with the results of a decrease in salivary pH after gargling green tea at the first 15 minute interval.²¹ The impact of decreasing salivary pH can cause tooth demineralization, if the salivary pH of the oral cavity is low (4.5-5, 5) will facilitate the growth of acidogenic bacteria such as *Streptococcus mutans* and *Lactobacillus*.⁵

The decrease in the pH value of saliva can occur because the buffer capacity takes 30-60 minutes for return to normal. This is in accordance with the results of Yusriyanti's 2016 study, an increase in salivary pH occurred after 30 minutes.²¹ Different with the research of Putri et al in 2019 which stated the effectiveness of green tea increasing salivary pH. However, this is due to the antibacterial ability of the catechin content in green tea against *Streptococcus mutans* bacteria. Catechins can inhibit the growth of *Streptococcus mutans* bacteria by binding to components of the bacterial cell wall and damaging the lipid bilayer thereby increasing salivary pH due to a reduced number of bacteria that can produce acid in the oral cavity.¹⁷

The results of statistical tests in this study showed a significant difference in effectiveness between pomegranate peel extract and green tea on salivary pH. If pomegranate peel extract is able to increase the pH of saliva, it can minimize the occurrence of an acidic circumstances in the oral cavity so as to prevent dental caries and can be used as an alternative mouthwash with herbal ingredients that are safe for long-term use and minimize various side effects that can be caused. On the other hand, if there is a decrease in salivary pH in green

tea, it will cause an acidic circumstance in the oral cavity that triggers dental caries. The effect of lowering the pH can be used in the oral cavity that is too alkaline, because if there is an increase in the pH of saliva (alkaline) it will result in the formation of calculus.¹⁸

This research is expected to provide benefits as a reference for further research in the field of dentistry, but there are some limitations. The limitation of this study was that it did not involve human subjects because the time of the study coincided with the Covid-19 pandemic. Another limitation, the assessment of changes in salivary pH in this study was only carried out at a certain time, namely 100 seconds after exposure, so there was no comparison of results with a longer time duration.

Based on this research, it can be concluded that there is a significant difference in effectiveness between pomegranate peel extract and green tea on salivary pH. Pomegranate peel extract tends to increase salivary pH, while green tea tends to decrease salivary pH. This difference in effectiveness supports the different indications for utilizing the two types of herbs.

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