Comparison of efficacy rinsing with cocoa seed extract, green tea catechins extract and lime extract to salivary pH in children suffering ECC (Early Childhood Caries)

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Abstract

**Objective:** This study aims to determine whether 12.5% cocoa extract, green tea catechins 30% extract, or 40% lime extract are effective in changing saliva pH to become more alkaline and prevent against dental caries.

**Material and Methods:** This study used purposive sampling with pre-test/post-test control group design. The total sample group included 120 children who fulfilled the criteria. The control group, containing 30 children, was rinsed with distilled water while 90 children were divided into 3 intervention groups containing 30 children each. Each intervention group was treated with either a solution of 12.5% cocoa seed extract, a solution of 30% green tea catechins extract or a solution of 40% lime extract.

**Results:** Using the Friedman Test, rinsing with distilled had no significant effect in changing the pH of saliva into normal alkaline conditions and preventing against dental caries. Significant changes the pH of saliva was found with 12.5% cocoa seed extract after the first 15 minutes resulting in alkaline or normal conditions for prevention of dental caries.

**Conclusion:** The mouthwash solution containing 12.5% cocoa seed extract is most effective to change the pH of the saliva into alkaline and normal state in preventing dental caries.

Keywords: Polyphenols, Green tea extract, Catechins, Essential oils

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Introduction

The prevalence of caries in patients remains high, especially in children. In 1995, The National Oral Health School Survey reported that 87.1% of children aged 5 years old had some degree of tooth caries. Again in 2005, National Oral Health reported that 76.2% of children aged 5 years old had some degree of tooth caries. According to the American Academy of Pediatric Dentistry (AAPD), early childhood caries (ECC) is the presence of one or more damaged, missing or filled primary teeth in children aged 71 months or younger.

Caries is a disease in the hard tissue of teeth characterized by demineralization of dental hard tissue that occurs as a result of bacterial invasion and death of the pulp. The spread of the infection to the periapical tissue can cause pain. As proposed in the theory of caries, there are three factors that influence the occurrence of caries; teeth and saliva, microorganisms, and substrates or food. The process of tooth decay occurs over time and is caused by the interaction between acid-producing bacteria and fermentable carbohydrates. Other host factors include teeth and saliva and in this case, saliva is a major factor that triggers caries.

Teeth are always covered by saliva and the susceptibility to dental caries depends a lot on the saliva environment. Saliva covers or envelops the entire surface of the tissue inside the mouth and about 90 percent of saliva is produced during mastication. The role of saliva is not only for the mastication process but also to protect the tissue inside the oral cavity. In normal circumstances, salivary pH is about 6.8 to 7.2 but some types of carbohydrates are converted by bacteria and result in a decreased pH of the saliva. Natural ingredients from plants in Indonesia can be used to inhibit this process. For example, cocoa beans contain many active components, one of which is polyphenol. Polyphenols contained in cocoa beans can inhibit the growth of Streptococcus mutans that are the main bacteria responsible for the cause of caries. As a natural product that exists in Indonesia, cocoa beans have antibacterial properties demonstrated in research by Purnamasari et al. The effective concentration of cocoa seed extract which could inhibit the growth of Streptococcus mutans was found to be 12.5%.

Another natural product explored is green tea. The benefits of green tea for health are attributed to the polyphenols contained in the tea. The main polyphenols are the catechins group: epicatechin (EC), epigallocatechin (EGC), epicatechin gallate (ECG), epigallocatechin gallate (EGCG), epigallate
(EG) and catechin (C). Polyphenols are not only beneficial to health but they also have antimicrobial and antiviral properties. Tea polyphenols are also active in inhibiting the growth of streptococcus mutans and excellent in reducing the formation of streptococcus mutans. Approximately 25 to 30% of catechins have antibacterial effects such as anti-caries and inhibiting halitosis.\(^9\) That green tea leaf extract suppresses the growth of streptococcus mutans. The combination of green tea compounds is bactericidal against streptococcus mutans.\(^10\)

Citrus aurantifolia, also known as lime, is a plant belonging to the family Rutaceae. Extracts of lime are now widely used in daily life. Lime contains compounds, such as citric acid, amino acids (tryptophan and lysine), essential oils (limonene, lanolin acetate, geranyl acetate, phellandrene, Citral, chamfer lemon, cadinen, acetaldehyde, and aldehyde) and vitamin A, B1 and C, that have a variety of benefits. Studies show that the citric acid extracts have very high antimicrobial activity. Research conducted by Fajriani, et al. shows that lime extract, with a concentration of 40%, can inhibit bacterial growth.\(^11\)

**Material and Methods**

This study uses 12.5% extracts of cocoa seed, 30% catechin extract and 40% lime extract. Cocoa seed extract was made at the Laboratory of Phytochemistry Faculty of Pharmacy, University of Hasanuddin. In this research, the researcher using purposive sampling method with pre-test/post-test control group design. Total sample group was 120 children who met the criteria. The control group, containing 30 children, was rinsed with distilled water while 90 children were divided into 3 intervention groups containing 30 children each. Each intervention group was treated with either a solution of 12.5% cocoa seed extract, a solution of 30% green tea catechins extract or a solution of 40% lime extract. Each sample was given the same intervention. First, saliva was taken before intervention (pre-test). Each group was then asked to rinse with a solution of 12.5% cocoa seed extract, 30% green tea catechins extract, or 40% lime extract. Each child rinsed with 10 mL of the specified solution for 30 seconds. Saliva was taken twice after rinsing, at 15 minutes (post-test 1) and 30 minutes (post-test 2). The saliva was examined by looking at changes in the salivary pH by using a Universal pH meter test. Processing and data analysis was performed using SPSS version 22.0 for Windows.

**Results**

Observations on changes in the pH of saliva after rinsing with 12.5% cocoa seed extract solution, 30% green tea catechins extract solution, 40% lime extract solution and distilled water.

Table 1 and figure 1 show the mean salivary pH before and after rinsing with distilled water as a mouthwash. Before the intervention, the salivary pH was 6.80. After 15 minutes (post-test 1) the pH increased to 6.83 and after 30 minutes (post-test 2) the pH remained the same at 6.83. This means that distilled water solution has no significant effect in changing the pH of saliva into a normal alkaline condition or in prevention against dental caries. Table 2 and figure 2 show

<table>
<thead>
<tr>
<th>Solution</th>
<th>Pre</th>
<th>Post 1</th>
<th>Post 2</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distilled water</td>
<td>6.80 ± 0.407</td>
<td>6.83 ± 0.379</td>
<td>6.83 ± 0.379</td>
<td>0.368*</td>
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</table>

*Friedman Test; p > 0.05: not significant

<table>
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<th>Post 2</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cacao seed extract</td>
<td>6.23 ± 0.728</td>
<td>6.80 ± 0.925</td>
<td>6.87 ± 0.346</td>
<td>0.000*</td>
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</tbody>
</table>

*Friedman Test; p < 0.05: significant

<table>
<thead>
<tr>
<th>Solution</th>
<th>Pre</th>
<th>Post 1</th>
<th>Post 2</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>green tea catechins extract</td>
<td>6.47 ± 0.507</td>
<td>6.03 ± 0.615</td>
<td>6.77 ± 0.430</td>
<td>0.000*</td>
</tr>
</tbody>
</table>

*Friedman Test; p < 0.05: significant
the mean salivary pH before and after rinsing with 12.5% cocoa seed extract solution. Before rinsing, the salivary pH was 6.23, after post-test 1 the pH increased to 6.80, and after post-test 2 it increased to 6.87. This means 12.5% cocoa seed extract solution had a significant influence in changing the pH of saliva into a normal alkaline condition or in prevention against dental caries. Table 3 and figure 3 show the mean salivary pH before and after rinsing with 30% green tea catechins extract solution. The pH of the saliva before rinsing was 6.47, after post-test 1 the pH decreased to 6.03, and after post-test 2 it increased to 6.77. This shows that 30% catechins green tea extract solution has a significant influence on changing the pH of saliva to become more acidic and alkaline. Table 4 and figure 4 shows the mean salivary pH before and after rinsing with 40% lime extract solution. The pH of saliva before rinsing was 6.50, after post-test 1 the pH decreased to 5.13, and after post-test 2 the pH increased to 6.87. This means that 40% lime extract solution has a significant influence in changing the pH of saliva to become acidic and alkaline.

**Discussion**

In the study conducted by Purnamasari et al., the concentration of cocoa seed extracts required to inhibit the growth of Streptococcus mutans is most effective at 12.5%. In research by Fajriani et al., it is shown that a concentration of 40% lime extract can reduce the number of Streptococcus mutans colonies. In research by Palwankar, it is mention that 25-35% of catechins in green tea leaves have antibacterial and anti-caries properties. The data obtained showed there is a change in pH of the saliva before and after the intervention given to the samples (Pre-test/Post-test 1/Post-test 2). There was no significant changes in the pH of saliva after rinsing with distilled water. Rinsing with 12.5% cocoa seed extract resulted in a change in the pH of saliva. This means that 12.5% cocoa seed extract solution had a significant influence in changing the pH of saliva into normal or alkaline conditions that can help prevent against dental caries. After rinsing with 30% catechin green tea extract, we can see a decrease of salivary
pH at after post-test 1 but then there is an increase in salivary pH after post-test 2. This means 30% catechins green tea extract solution has a significant influence in changing the pH of saliva into the acidic, normal, and alkaline conditions. Rinsing with 40% lime extract show a significant reduction of salivary pH after post-test 1 and but there was an increase in pH after post-test 2. This means that 40% lime extract solution has a significant influence in changing the pH of saliva to become acidic, alkaline and normal.

From these results it can be concluded that rinsing with a solution of 12.5% cacao seed extract and 30% green tea catechins extract can increase the salivary pH. However, the cocoa seed extract solution most effectively raises the pH of saliva after each time interval.

**Conclusion**

Based on the analysis results, rinsing with 12.5% cocoa seed extract is most effective in changing the pH of the saliva to become more alkaline or normal and therefore, prevents against dental caries.

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**Conflict of Interest**

The author report no conflict of interest.

**References**