



(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.<sup>9</sup> That green tea leaf extract suppresses the growth of streptococcus mutans. The combination of green tea compounds is bactericidal against streptococcus mutans.<sup>10</sup>

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.<sup>11</sup>

## 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 1** Differences in mean of salivary pH in each time interval in sample rinsing with distilled water

Solution	Pre	Post 1	Post 2	P-value
	Mean ± SD	Mean ± SD	Mean ± SD	
Distilled water	6.80 ± 0.407	6.83 ± 0.379	6.83 ± 0.379	0.368*

\*Friedman Test:  $p > 0.05$ : not significant

**Table 2** Differences in mean of salivary pH in each time interval in sample rinsing with 12.5% cacao seed

extract	Pre	Post 1	Post 2	P-value
	Mean ± SD	Mean ± SD	Mean ± SD	
Cacao seed extract	6.23 ± 0.728	6.80 ± 0.925	6.87 ± 0.346	0.000*

\*Friedman Test:  $p < 0.05$ : significant

**Table 3** Differences in mean of salivary pH in each time interval in sample rinsing with 30% green tea catechins extract

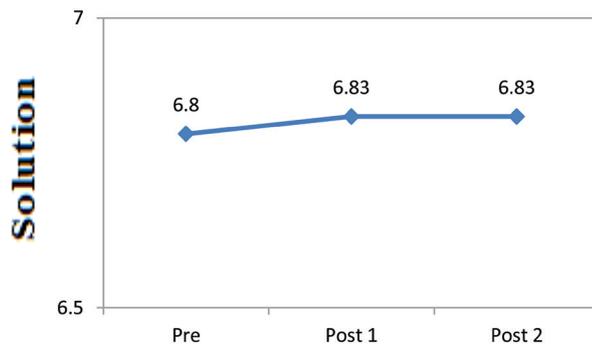
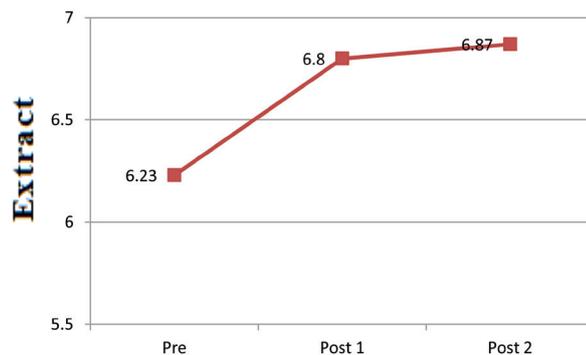
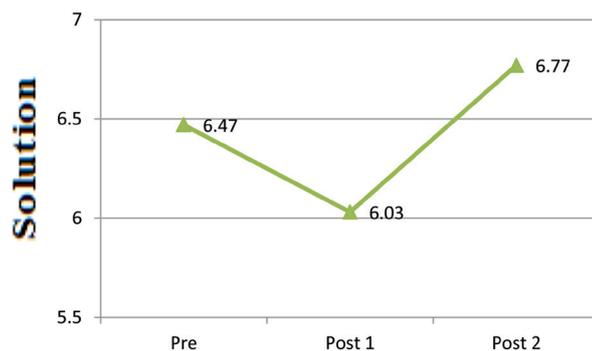
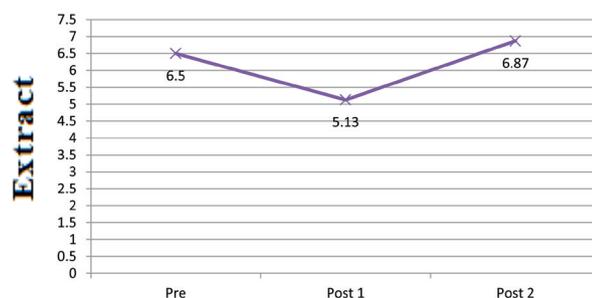
Solution	Pre	Post 1	Post 2	P-value
	Mean ± SD	Mean ± SD	Mean ± SD	
green tea catechins extract	6.47 ± 0.507	6.03 ± 0.615	6.77 ± 0.430	0.000*

\*Friedman Test:  $p < 0.05$ : significant

**Table 4** Difference in mean of salivary pH in each time interval in sample rinsing with 40% lime

extract	Pre	Post 1	Post 2	P-value
	Mean $\pm$ SD	Mean $\pm$ SD	Mean $\pm$ SD	Mean $\pm$ SD
Lime extract	6.50 $\pm$ 0.509	5.13 $\pm$ 0.629	6.87 $\pm$ 0.507	0.000*

\*Friedman Test:  $p < 0.05$ : significant

**Figure 1** Distilled water**Figure 2** Cacao seed extract**Figure 3** Green tea catechin extract**Figure 4** Lime extract

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 mentioned that 25-35% of catechins in green tea leaves have antibacterial and anti-carries properties.<sup>8,9,11</sup>

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. There was an increase in the pH of saliva after each time interval. 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.

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