



EFFECTIVENESS OF BAKING SODA TOOTHPASTE WITH XYLITOL TOOTHPASTE ON REDUCING PLAQUE INDEX IN STUDENTS AT SDN 58 BANDA ACEH

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ABSTRACT

Sodium bicarbonate or better known as baking soda is a chemical compound with the formula NaHCO_3 which is included in the salt group and is often found in the form of white powder crystals. Xylitol is a natural carbohydrate sweetener that cannot be broken down by bacteria in the oral cavity. Based on the initial examination of 10 students who were examined, 6 children were in very bad criteria and 3 children were in bad criteria, 1 child was in good criteria in the PHP-M calculation. This study aims to determine the effectiveness of toothpaste containing baking soda and toothpaste containing xylitol in reducing the plaque index in students at SDN 58 Banda Aceh. The research used was a quasi-experimental (quasi-experimental) with a pretest-posttest design. The sample in this study, totaling 68 people, was carried out using a random sampling technique. Show the results of the independent sample T-Test, the sig value (2-tailed) $p = 0.000$ is smaller than $\alpha = 0.05$ ($p < \alpha$), and H_a is accepted. It can be concluded that there is effectiveness in using toothpaste containing baking soda and xylitol toothpaste in reducing the plaque index in students at SD Negeri 58 Banda Aceh. It is recommended that students use toothpaste containing xylitol because research results show that xylitol toothpaste is better at reducing plaque index scores.

Keywords: Plaque, Baking Soda Toothpaste, Xylitol Toothpaste

INTRODUCTION

Dental caries, which can affect babies, adults and teenagers, is the most common dental and oral disease in the general public. Dental caries is very important for human life¹.

Plaque, bad breath, and food debris are mechanically removed from the teeth using toothpaste. The purpose of toothpaste is to support the maintenance of oral health¹. Brushing your teeth with toothpaste is one way to maintain oral health. There are many types of toothpaste available with different contents and purposes².

Baking soda is a chemical compound that can be used as an alternative to teeth whitening. The whitening process using baking soda occurs due to an oxidation reaction by sodium bicarbonate and oxygen. Another advantage of baking soda is that it has low abrasive properties, alkaline properties, is easy to obtain, cheap, and easy to use.³

Sodium bicarbonate, sometimes known as baking soda, has been used as an antibacterial ingredient in toothpastes and mouthwashes in recent years. Baking soda is an antimicrobial ingredient that is often found in almost all toothpastes.⁴

Plaque and tooth stains can be removed with toothpaste components which are abrasive and contain baking soda (Sodium Bicarbonate). According to (Randy, 2014), there is no obvious difference between the two toothpastes containing fluoride and baking soda because their antibacterial properties have been proven to successfully remove plaque germs⁵.

Xylitol is a natural sweetener made from carbohydrates that cannot be metabolized by oral microbes. Bacterial cell death and decreased capacity to produce acid can occur due to xylitol's interference with bacterial energy synthesis. Toothpaste containing xylitol has the ability to prevent the growth of *Streptococcus mutans* and minimize dental plaque. Consuming 5-10 grams of xylitol per day is still considered within safe limits⁶.

Many factors can cause caries. Dental plaque that forms between the teeth is one of the causes of caries. When compared with adults, children aged 8 to 12 years seem to experience the plaque production process more quickly. When people neglect oral hygiene, a layer of bacteria known as dental plaque forms on the surface of their teeth. This layer of bacteria consists of germs called *streptococcus mutans*, which reproduce in the intercellular matrix.¹

Plaque formation can be prevented through preventive measures, especially brushing your teeth and using toothpaste. Various toothpaste products with different compositions from various companies are available on the market. A prominent example is toothpaste that contains xylitol and baking soda in its components¹.

If you look at dental and oral health problems in Indonesia based on age, more than 75% of teenagers have a plaque score of 2.0–3.0, which is a bad category on the plaque index, according to basic health research statistics (Risksedas) in 2018. Plaque is a layer The soft collection of microorganisms adheres tightly to the tooth surface. Plaque is one of the main causes of tooth decay and oral problems because it can cause caries and periodontal disease.

Plaque cannot be removed by rinsing the mouth alone but can be cleaned mechanically and chemically by brushing the teeth with toothpaste. ⁷

Based on the 2018 Riskesdas results, 45.3% of the Indonesian population experienced tooth decay. As many as 54.0% of children aged 5-9 years experienced similar types of tooth decay. In children aged 10-12 years, the average tooth decay index is 1.89% ⁸.

One of the problems that needs attention in Indonesia is dental and oral health. Based on 2018 Basic Health Research (Riskesdas) data, as many as 57.6% of people have dental and oral health problems. This figure exceeds the 2013 Riskesdas results with a percentage of 25.9%. In Aceh Province, it was found that 47% of people suffer from dental caries. While 90.7% of people brush their teeth every day when showering in the morning and evening, only 2.8% of people do it correctly ².

Based on the results of research from Aulia in 2018, it states that moderate requirements include a plaque score before using toothpaste containing baking soda and xylitol. When toothpaste with xylitol is used, the plaque score falls into the good category; When toothpaste with baking soda is used, the plaque score falls into the medium category. This shows that toothpaste containing xylitol reduces the plaque index more effectively than toothpaste containing baking soda.

METHODS

This type of research is a *Quasi experiment* with a pretest-posttest design, This design was carried out to determine the relative effectiveness of toothpaste containing baking soda compared to toothpaste containing xylitol in reducing the plaque index in students at State Elementary School 58 Banda Aceh. The population in this study was class IV students at State Elementary School 58 Banda Aceh, totaling 205 students. In this study, The sample taken in this study used random sampling method of 68 children at State Elementary School 58 Banda Aceh with the criteria of being 7-12 years old and willing to be respondents for 2 weeks.

The research site to conduct the effectiveness of toothpaste containing baking soda and toothpaste containing xylitol will be carried out at State Elementary School 58 Banda Aceh. This research will be conducted from April 27 to May 4 2024. The instruments used in this research were the Patient Status Card (KSP), Informed Consent, Diagnostic Tool Set, Disclosing, Toothpaste containing baking soda, Dental Toothpaste containing xylitol, and Toothbrush.

RESULTS AND DISCUSSION

Research Results

Based on research conducted from 27 April to 4 May 2024, which lasted for a week, with respondents from the 58 Banda Aceh State Elementary School, there were 68 children, divided into 2 groups of 34 students each, from which each respondent was taken carried out by pulling slots in each class, data collection was obtained from examining the Plaque Index before and after using baking soda toothpaste and xylitol toothpaste. The research results can be seen as , the following results were obtained:

Table 1
Frequency Distribution of Respondents Based on Gender For students at SDN 58 Banda Aceh

No.	Gender	Baking soda toothpaste		Xylitol toothpaste	
		Frequency	Presentation	Frequency	Presentation
1	Laki-laki	13	38,2 %	17	50 %
2	Perempuan	21	61,8 %	17	50 %
	Amount	34	100 %	34	100 %

Based on table 4.1, it can be seen that of the 68 respondents who used baking soda toothpaste and xylitol toothpaste, the majority were female, namely 38 people (55.9%).

Table 2
Frequency Distribution of Respondents Based on Age For Students at SDN 58 Banda Aceh

No.	Age	Frequency	Persentation (%)
1	6 years	2	2,9 %
2	7 years	3	4,4 %
3	8 years	7	10,3 %
4	9 years	13	19,1 %
5	10 years	15	22,1 %
6	11 years	15	22,1%
7	12 years	13	19,1
	Amount	68	100%

Based on table 4.2, it is known that the most respondents in the 10 and 11 year old category were 15 respondents with a percentage of 22.1% and the fewest respondents were in the 6 year old category, 2 respondents with a percentage of 2.9%.

Table 3
Dental Plaque Index Score Before and After Brush your teeth with Baking Soda Toothpaste.

No.	Category	Frequency	Before (%)	Frequency	After (%)
1	Very Good (0-15)	0	0 %	3	3,7 %
2	Good (16-30)	8	23,5 %	18	52,9 %
3	Bad (31-45)	17	50 %	12	35,3 %
4	Very Bad (46-60)	9	26,5 %	1	2,9 %
Amount		34	100 %	34	100 %

Showed that the dental plaque index score was in the bad group (50%) before using baking soda toothpaste to brush teeth and was in the bad category (35.3%) after using baking soda toothpaste.

Table 4
Dental Plaque Index Score Before and After Brush your teeth with Xylitol Toothpaste

No.	Category	Frequency	Before (%)	Frequency	After (%)
1	Very Good (0-15)	0	0 %	4	11,8 %
2	Good (16-30)	8	23,5 %	22	64,7 %
3	Bad (31-45)	18	52,9 %	8	23,5 %
4	Very Bad (46-60)	8	23,5 %	0	0 %
Amount		34	100 %	34	100 %

Showed that the dental plaque index score was in the bad group (52.9%) before using xylitol toothpaste to brush teeth and was in the bad category (23.5%) after using xylitol toothpaste to brush teeth.

Table 5
Frequency Distribution of PHP-M Checks on Usage Baking Soda Toothpaste and Xylitol Toothpaste Before And After Using among students at SDN 58 Banda Aceh

Pemeriksaan PHP-M	Mean	SD
Nilai <i>Pretest</i> Baking Soda	38.32	10.998
Nilai <i>posttest</i> Baking Soda	28.41	8.794
Nilai <i>Pretest</i> Xylitol	37.82	11.025
Nilai <i>posttest</i> Xylitol	23.91	8.515

Showed a decrease in the mean value of the php-m plaque index examination after using baking soda toothpaste by 9.91 from the pretest 38.32 to 28.41 at posttest, and the php-m plaque index examination after using xylitol toothpaste was 13.91 from pretest 37.82 to 23.91 at posttest.

Table 6: Results of the Effectiveness Test of Baking Soda And Toothpaste Xylitol Toothpaste Against Decreasing Plaque Index For students at SDN 58 Banda Aceh

Variabel	Mean	P Value
Check the plaque index value before using baking soda toothpaste and the plaque index value after using baking soda toothpaste	9.912	0.000
Plaque index examination values before using xylitol toothpaste and plaque index values after using xylitol toothpaste	13.912	0.000

Showed significant values for baking soda toothpaste ($p=0.000$; $p<0.05$) and xylitol toothpaste ($p=0.000$; $p<0.05$). This shows that students at SDN 58 Banda Aceh can reduce their plaque index by using toothpaste containing xylitol and baking soda.

DISCUSSION

Based on the results of research involving 58 State Elementary School students in Banda Aceh and 68 respondents who were divided into two treatment groups, namely the group that used xylitol toothpaste and the group that used baking soda toothpaste. Table 3 above illustrates how the php-m plaque index value decreased with the criteria being very good for 3 people (3.7%), good for 18 people (52.9%), poor for 12 people (35.3%), and very bad as much as 1 person (26.5%) after using baking soda toothpaste. Before using

baking soda toothpaste, the most common criteria found were bad for 17 people (50%), very bad for 9 people (26.5%), and good for 8 out of 8 people (23.5%).

Table 4 shows that before using xylitol toothpaste, the criteria most often found were bad for 18 people (52.9%), good for 8 people (23.5%), and very bad for 8 people (23.5%). However, after using xylitol toothpaste, the php-m plaque index value decreased with very good criteria of 4 people (11.8%), good criteria of 22 people (64.7%), and poor criteria of 8 people (23.5%).

From table 5 above, it shows that there was a decrease in the mean php-m plaque index examination value after using baking soda toothpaste by 9.91 from pretest 38.32 to 28.41 at posttest, and php-m plaque index examination after using xylitol toothpaste. amounted to 13.91 from pretest 37.82 to 23.91 at posttest. During the pre-test and post-test, there was a significant difference based on the results of the Paired T-test, baking soda toothpaste $p=0.000$ ($p<0.05$), and xylitol toothpaste $p=0.000$ ($p<0.05$), at a confidence level of 95%, it can be concluded that there is effectiveness in reducing the plaque index in students at State Elementary School 58 Banda Aceh.

As seen in Table 6 above, there are significant values for xylitol toothpaste ($p = 0.000$; $p < 0.05$) and baking soda toothpaste ($p = 0.000$). This shows that using toothpaste with baking soda and xylitol can help children at SD Negeri 58 Banda Aceh reduce their plaque index. The research on Reducing Plaque Scores in Students of SMPN 6 Banjarbaru is comparable to this research. Unequal Use of Toothpaste Including Baking Soda and Xylitol⁹.

The findings of this study support the use of paired sample t-tests and Pearson significance tests to demonstrate that xylitol toothpaste reduces plaque index. With a p value of 0.000, the test found a significant difference ($p < 0.05$) in the reduction of plaque index between toothpastes containing xylitol and those containing baking soda. Because baking soda and xylitol have antibacterial qualities that can stop the development and growth of plaque as well as the growth of streptococcus mutans bacteria in plaque, using toothpaste that contains these two ingredients can help prevent plaque buildup.

The growth of Streptococcus mutans serotype E is influenced by toothpaste containing xylitol in vitro. Because xylitol has antimicrobial effects and has the ability to prevent plaque formation. It is thought that oral bacteria, such as Streptococcus mutans, cannot ferment xylitol. Because enzymes are not made, xylitol is antimicrobial and has the ability to penetrate cells and be locked there. Xylitol cannot be broken down during this phase, which causes the accumulation of increasingly large amounts in the cells. According to Ghassemi and Vorwerk, baking soda affects the antibacterial activity of toothpastes

containing baking soda because it dissolves quickly and has a slow-acting antibacterial effect.⁹

Xylitol can interfere with bacterial energy production, causing bacterial cell death and reducing the potential for bacterial acid production. *Streptococcus mutans* bacteria do not have enzymes to utilize xylitol for the synthesis of extracellular polysaccharides and cannot utilize xylitol as an energy source to produce acid products. Xylitol has antibacterial capabilities through inhibiting bacterial growth through metabolic reactions. The antibacterial properties of xylitol can be used as an adjunct for dental and oral hygiene.⁶

based on researchers' theory that using toothpaste with baking soda and xylitol can reduce the plaque index. This is due to the fact that both types of toothpaste contain antibacterial agents, which help in the removal of bacteria; However, table 4.7 shows that xylitol toothpaste is more effective in reducing plaque. The degree of plaque reduction varies when toothpaste containing baking soda is used compared to xylitol. This may be the result of varying toothbrushing methods across samples; some only brush the outside of their teeth, while others clean their teeth thoroughly. by paying attention to the right time, approach and technique when cleaning your teeth. According to research findings, some students are still unsure about the right time or method to brush their teeth with baking soda and xylitol toothpaste. Therefore, researchers offer guidelines for maintaining oral and dental hygiene.

The results of this study strengthen the research conclusions. Aulia Puteri Shiddiek and Naning K. Utami (2018) found a similar effect on the growth of *Streptococcus mutans* when toothpaste containing xylitol was used. This shows how xylitol works to lower plaque scores by stopping bacterial growth.

This finding is supported by research by Amnur AN (2014) which compared the effects of fluoride toothpaste with toothpaste containing xylitol on dental plaque. Because toothpaste containing xylitol is able to inhibit the development of plaque, this study found quite a big difference between toothpaste containing only fluoride and toothpaste containing fluoride and xylitol.

This finding was confirmed by research by Ike Fitria Nitasari in 2017. Toothpaste with xylitol showed a greater reduction in the amount of plaque on the surface of the teeth compared to toothpaste without this ingredient. Xylitol may reduce the ability of bacteria to adhere to enamel by changing their metabolism. This removes any obstructions and allows the tongue to spontaneously remineralize cavities.

Apart from that, Sri Hidayati, ddk (2020) also supports the results of this research. Because baking soda dissolves easily, its antibacterial power is not as strong as baking soda. However, baking soda can still damage the structure of the bacterial matrix and the bonds that bind germs to the tooth surface. The results of research comparing the antibacterial properties of triclosan with baking soda toothpaste show that triclosan is superior in preventing the growth of plaque-causing bacteria.

Thus, it can be said that there is a strong correlation between the ability of the two toothpastes to reduce the plaque index, namely baking soda toothpaste and xylitol toothpaste. The results of the study showed that toothpaste containing xylitol was superior to toothpaste containing baking soda in terms of reducing plaque formation. Thus, in terms of reducing the plaque index in students at SDN 58 Banda Aceh, xylitol toothpaste and baking soda toothpaste have quite significant differences.

CONCLUSION

From the research results, it can be seen that there is significant effectiveness of using baking soda toothpaste with xylitol toothpaste in reducing the plaque index for students at SD Negeri 58 Banda Aceh. A more detailed explanation of the results of this research is as follows:

Average value of plaque index before and after using baking soda toothpaste. The results of the study showed that the average value of plaque before using baking soda toothpaste was 38.32. After using baking soda toothpaste there was a decrease to 28.32.

Average value of plaque index before and after using xylitol toothpaste. Before using xylitol toothpaste, the average value of plaque index was 37.82. After using xylitol toothpaste this value decreased to 23.91. This shows the effectiveness of baking soda toothpaste with xylitol toothpaste in reducing the plaque index Paired T-Test Results Paired T-Test results show differences in plaque index values before and after using baking soda toothpaste and xylitol toothpaste as follows: baking soda toothpaste: 0,000 and xylitol toothpaste: 0,000.

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It is recommended that all students at SD Negeri 58 Banda Aceh brush their teeth with the right time and technique and use dental paste containing xylitol to reduce the plaque index more significantly.

It is hoped that parents will pay more attention to the health of their children's teeth and mouth by monitoring how and when to brush their children's teeth appropriately. As well as recommending toothpaste containing xylitol to reduce the plaque index on teeth. Likewise, schools are increasing the role of educators in conveying knowledge, which should be accompanied by insight related to dental and oral health.

Further research is needed to determine whether xylitol toothpaste is more successful than baking soda in preventing plaque buildup, or to compare the types and amounts of bacteria present in plaque before and after application of xylitol toothpaste.

It is hoped that health professionals can provide advice on toothpaste that is suitable for dental and oral health or that can reduce the plaque index. In addition, provide guidance to school-age children to increase their understanding of correct toothbrushing practices and maintaining oral health.

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