RESEARCH ARTICLE

Effectiveness of Lemon Solution Gargling in Reducing Dental Plaque Index among Senior High Students at Porong, Indonesia

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ABSTRACT Efforts to overcome dental and oral health problems and improve oral hygiene can be done by preventing and eliminating plaque accumulation. Efforts to prevent the appearance of plaque are called plaque control. The results of examining the PHP index in class 11 of SMA Negeri 1 Porong showed that 5 out of 10 respondents had a bad plaque index with a prevalence of 50% with an average PHP index of 3.54. High PHP index. The aim of this research is to determine the effectiveness of gargling using lemon solution with levels of 10% and 15% in reducing the dental plaque index in class 11 students of SMA Negeri 1 Porong in 2024. This type of research is Pre-Experimental research with One Group Pretest Posttest with a sample of students Class 11 of SMA Negeri 1 Porong, totaling 52 students. The data collection instrument used was an examination sheet to measure the PHP index. The analysis technique uses an unpaired T test (Independent T-Test). The test results from the research obtained a ρ value of 0.108 or a significant ρ score above α (0.05). The conclusion from this study is that there is no difference in the effectiveness of gargling using lemon solution with levels of 10% and 15%..

INDEX TERMS Lemon Solution, PHP Index, High School Students

I. INTRODUCTION

Maintaining dental and oral health problems often interfere with daily activities. According to Riskesdas 2018, dental and oral problems in East Java are quite high with a value of 54.22% and only 9.76% of those who receive medical dental services. The proportion of people who brush their teeth every day in Indonesia is 94.7% and only 1.83% brush their teeth properly. This shows that the level of public awareness regarding oral hygiene is minimal [1].

The tissue that surrounds the teeth and has a role in supporting the teeth is periodontal tissue with the gingiva, cementum, periodontal connective tissue and alveolar bone [2]. Diseases with inflammatory and degenerative conditions are periodontal diseases that originate from soft tissue and even the bones that support teeth [3].

Periodontal disease is one of two diseases that occurs in the largest oral cavity in the world. A report from the World Health Organization (WHO) contains the number of people suffering from periodontal disease on a world scale, namely 10 to 15%, young children with gingivitis are 80%, while in general adults have experienced gingivitis, periodontitis and all of them [4]. A disease of the tooth supporting tissue called periodontitis is caused by the presence of pathogenic bacteria in dental plaque. Chronic periodontitis is a common form of periodontitis, and commonly occurs in adults but does not rule out the possibility of occurring in children.

The correlation between chronic periodontitis and plaque and calculus accumulation generally progresses at a slow rate resulting in moderate damage, but accelerated periods of destruction can also occur. The development of a disease is influenced by several factors including local, systemic, and environmental factors that have a negative impact on the normal interaction between the host and bacteria [5].

One of the efforts to prevent dental health problems, especially dental plaque, among students at SMA Negeri 1 Porong is the implementation of the School Dental Health Business (UKGS) program. However, this is still not running optimally because the health service only carries out DMF-T screening and does not carry out promotional activities such

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as education regarding how to maintain good oral and dental health.

Efforts to overcome dental and oral health problems also include other oral hygiene concerns that can be implemented by implementing prevention activities and cleaning plaque accumulation. Efforts to prevent the presence of plaque are generally referred to as plaque control [6]. A thin layer attached to the surface of the teeth and the tissue of the tooth area containing bacteria is called plaque [7].

In general, the mouthwash that is widely used is chlorhexidine. This mouthwash has chemical ingredients which aim to minimize microorganisms by killing cell production, preventing microbial reproduction and inhibiting cellular metabolism. However, using mouthwash containing chemicals can have negative effects, for example changes in tooth color and an imbalance in the number of normal flora in the oral cavity. The change in normal flora is caused by the growth of various types of special bacteria which makes gargling with mouthwash an alternative [8]. The various types of chemical substances contained in mouthwash are antiseptic to antibacterial according to their role in trying to reduce inflammation by inhibiting the development of bacteria and weakening the concentration of bacteria in dental plaque. Mouthwash containing herbal ingredients has now been discovered. One of them is mouthwash containing lemon (Citrus Lemon) [9].

Lemon is a fruit with a round shape, yellow in color, generally 6-9cm in diameter, the fruit has a sour taste similar to lime. Lemons contain citric acid, flavonoids, saponins, limonoids, tannins, terpenoids, and essential oils that act as antibacterials. Another alternative is to use lemon extract. Lemon extract is a solution that can be extracted using a solvent and then made to the concentration required [9].

Dental and oral hygiene actions have several ways, namely mechanical, chemical, and natural, which may affect the process of plaque formation. Not performing good and correct dental and oral hygiene actions will cause plaque to remain on the surface of the teeth, so that plaque buildup will form.

The results of the initial examination carried out at SMA Negeri 1 Porong found 0 respondents (0%) with very good criteria, 2 respondents (20%) with good criteria, 3 respondents (30%) with moderate criteria, 5 respondents (50%) with poor criteria. As well as the average PHP index result of 3.54 in the medium category. In fact, the problem in this research is the poor plaque index in class 11 students at SMA Negeri 1 Porong because half of the respondents in the initial data examination had poor criteria.

Based on the background above, researchers are interested in conducting research on grade 11 students of SMA Negeri 1 Porong because their school time is relatively long which causes uncontrolled plaque growth. Not only that, at this school there has been no research or education regarding dental and oral health. The lack of students' level of insight regarding dental and oral health due to the lack of opportunities for health workers to carry out promotional activities is also the reason for choosing the research location as well as good cooperation from the school in continuing the research.

II. METHODS

This research was conducted at SMA Negeri 1 Porong which was held in October 2023 - May 2024. This research was a pre-experimental type with One Group Pretest Posttest. The population in this study was 60 grade 11 students at SMA Negeri 1 Porong. The data collection process involves direct examination of respondents and carrying out plaque index assessments. The data collection procedure was carried out by researchers by measuring the plaque index value using an observation sheet where respondents previously filled out an informed consent form to be willing to be respondents in this study. The study instruments used were 30 mouth mirrors and disposable sondes, cotton buds, disclosing gel, small plastic bags and a plaque index examination sheet as an observation sheet.

The research process was carried out in one meeting with the procedure of dividing into two groups, namely the first group gargling lemon solution with a 10% concentration of 26 students (50%), and the second group gargling a lemon solution with a 15% concentration of 26 students (50%), then doing examination of the dental plaque index on respondents who were present using the existing observation sheet and applying disclosing solution to the respondent's index teeth. Instruct the target to gargle the lemon solution that has been given for 30 seconds.

The analysis technique used in this research is the difference test, namely the unpaired T-test (Independent T-Test) if the data is normally distributed when testing normality. If the data is not normally distributed when testing normality, apply an alternative test, namely Man-Whitney.

III. RESULT

A. RESPONDENT CHARACTERISTICS

Based on the data presented in TABLE 1, showed that the majority of respondents were women with 42 students (81%) and most of the respondents were 17 years old with 25 students (48%). TABLE 2 showed that the majority of class 11 students who had not been given gargle treatment using 10% lemon solution were 22 students in the medium category and the majority of class 11 students who had been given gargle treatment with 10% lemon solution were 22 students in the good category. TABLE 3 showed that the majority of class 11 students who had not been given treatment gargled using 15% lemon solution as many as 17 students in the medium category. Meanwhile, the majority of class 11 students who had been given the 15% lemon

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solution gargle treatment were 25 students in the good category.

TABLE 5
Characteristics of Class 11 High School Students in 2024

Category	Amount	%
Gender		
Man	10	19
Woman	42	81
Age		
15 years	3	6
16 years	22	42
17 years	25	48
18 years	2	4
TOTAL RESPONDENTS	52	100

TABLE 2
PHP Index Distribution Results Before and After Gargling Using Lemon Solution with a Level of 10%

Category	Before Gargling		After Gargling	
	Frequency	%	Frequency	%
Good	3	11.5	22	84.6
Currently	22	84.6	4	15.4
Bad	1	3.9	0	0.0
Total	26	100	26	100

TABLE 3
Results of measuring the average PHP index before and after gargling using a lemon solution with a concentration of 15%

Category	Before Gargling		After Gargling	
	Frequency	%	Frequency	%
Good	8	30.8	25	96.1
Currently	17	65.3	1	3.9
Bad	1	3.9	0	0.0
Total	26	100	26	100

TABLE 4
Test Results Research Data Differences in the Effectiveness of Gargling Using Lemon Solution with Levels of 10% and 15%

Gargle Lemon Solution	Average Debris Index				
	Before	Mean±SD	After	Mean±SD	Decline
10%	2.48	2.48 ± 0.5	1.27	1.27 ± 0.41	1.21
15%	2.07	2.07 ± 0.62	1.07	1.07 ± 0.48	1.00

Based on TABLE 4 It was found that 26 students before being given the 10% lemon solution gargle treatment had an average PHP index of 2.48 in the medium category and experienced a decrease after gargling the 10% lemon solution to 1.27 in the medium category. So it is known that the PHP index decreased by 1.21. Meanwhile, as many as 26 students before being treated with 15% lemon solution had an average PHP index of 2.07 in the medium category and experienced a decrease after gargling with 15% lemon solution to 1.07 in the good category. So it can be seen that there is a decrease in the PHP index by 1.

TABLE 5
PHP Index Normality Test Results Before and After Gargling Using Lemon Solution with Levels of 10% and 15%

Variable	N	%	ρvalue
Before gargling, use a lemon solution with a concentration of 10% and 15%	26	50	0.448
After gargling using lemon solution with a concentration of 10% and 15%	26	50	0.200

Based on TABLE 5 It is known that before gargling using a lemon solution with levels of 10% and 15% has a ρ value of 0.448 (>0.05). So, it can be concluded that the data is normally distributed. Meanwhile, after gargling using lemon solution with levels of 10% and 15%, it has a ρ value of 0.200 (>0.05). So, it can be concluded that the data is normally distributed.

TABLE 6
Results of PHP Index Analysis Before and After Gargling Using Lemon Solution with a Concentration of 10%

Variable	Category						ρ Value
	Good		Currently		Bad		
	N	%	N	%	N	%	
Before gargling	3	11.5	22	84.6	1	3.9	0,000
After gargling	22	84.6	4	15.4	0	0	

Based on TABLE 6 The ρ value obtained before and after gargling using a 10% lemon solution was 0.000 (<0.05). So, the conclusion is that H1 is accepted, namely the effectiveness of gargling using a 10% lemon solution in reducing the dental plaque index of class 11 students at SMA Negeri 1 Porong.

TABLE 7
Results of PHP Index Analysis Before and After Gargling Using Lemon Solution with a Concentration of 15%

Variable	Category						ρ Value
	Good		Currently		Bad		
	N	%	N	%	N	%	
Before gargling	8	30.8	17	65.3	1	3.9	0,000
After gargling	25	96.1	1	3.9	0	0	

Based on TABLE 7 The ρ value obtained before and after gargling using a 10% lemon solution was 0.000 (<0.05). So, the conclusion is that H1 is accepted, namely the effectiveness of gargling using lemon solution with a concentration of 11% in reducing the dental plaque index of class 11 students at SMA Negeri 1 Porong.

Based on TABLE 8 It can be seen that the mean PHP index after gargling using a 10% lemon solution is 1.27 and the mean PHP index after gargling using a 15% lemon solution is 1.07 with significance sig.(2-tailed) = 0.108. If the sig (2-tailed) value is > 0.05, then H0 is accepted. So the conclusion is that there is no difference in the effectiveness of gargling using lemon solution with levels of 10% and 15% in reducing the dental plaque index in class 11 students at SMA Negeri 1 Porong.

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TABLE 8
Results of Analysis of Differences in the Effectiveness of Gargling Using Lemon Solution with Levels of 10% and 15% on Reducing Dental Plaque Index in Class 11 Students of SMA Negeri 1 Porong

Variable	N	Mean ± SD	Sig.(2-tailed)
After gargling using lemon solution with a concentration of 10%	26	1.27 ± 0.41	0.108
After gargling using lemon solution with a concentration of 15%	26	1.07 ± 0.48	0.108

IV. DISCUSSION

Based on the results of research that has been carried out, it shows that the average index value before and after gargling with a 10% lemon solution has a significant decrease. The plaque index value before gargling using a 10% lemon solution is in the medium category, while the plaque index value after gargling using a 10% lemon solution is in the good category. And based on the research results, it shows that the average index value before and after gargling with a 15% lemon solution showed a significant decrease. The plaque index value before gargling using a 15% lemon solution is in the medium category, while the plaque index value after gargling using a 15% lemon solution is in the good category.

Based on the researchers' observations, it was seen that there was a decrease in the plaque index value before and after gargling using lemon solution at a level of 10% or 15%. This is because the lemon solution contains flavonoid chemical compounds in essential oils which have the function of inhibiting the growth of bacteria [10].

Gargling is an activity that is carried out repeatedly to wash the mouth by moving water or other gargling liquid in the mouth, this is explained in KBBI edition 3 of 2002. Mouthwash is used by gargling with the teeth in a biting position, closing the lips and inhaling from the nose, until the cheeks move up and down for 30 seconds [11]. In fact, after research was conducted, there were several students who had different ways of gargling, namely gargling from the right side then continuing from the left side, and gargling with different gargling frequencies. This can have an influence on research results.

According to previous research, lemon and lime are a type of citrus that is predicted to have similar compounds, namely they can act as antibacterials, including alkaloids, saponins, tannins, flavonoids, triterpenoids, steroids, nitric acid, limonene and essential oils. Based on research by Hidayat, WA, 2014 in Asmawati, 2019, it has been proven that lime extract (Citrus aurantifolia Swingle) has the highest antibacterial activity on Streptococcus mutans, this type of bacteria is the main bacteria found in plaque, and provides the possibility of weakening plaque concentration [12].

Lemon is known to have one of the antibacterial compounds. Lemon solution is used as a mouthwash with the aim of making it easier to use. According to [13]. Mouthwash is defined as a liquid that contains antibacterial substances to minimize the number of microorganisms in the mouth, is used as a rinse for the oral cavity, and is easy to apply.

Lemons and limes contain citric acid in quite high concentrations. According toIndahningrum & Lia Dwi Jayanti, 2020, the acidity of lemons and limes is due to the presence of organic acids in the form of high concentrations of citric acid and can act as one of the factors inhibiting microbial development. The presence of high levels of vitamin C in lime makes lime a fruit that can help cure gingivitis and influenza [11].

Based on the results of data analysis, it was found that there were differences in the effectiveness of gargling using lemon solution with a concentration of 10% and 15% on the average PHP index for class 11 students at SMA Negeri 1 Porong in 2024. In accordance with the results obtained, gargling using a lemon solution with a concentration of 10 % and 15% have the same effectiveness. However, based on the results of research and analysis, it was concluded that gargling lemon solution with a 10% concentration could reduce plaque accumulation more quickly compared to a 15% concentration in 11th grade students at SMA Negeri 1 Porong in 2024. This could happen because there is a possible factor, namely the strength of gargling. in each different respondent,

According to previous research, plaque control measures can be carried out mechanically and chemically. Mechanical plaque control can be done by brushing your teeth and using dental floss, while chemically it can be done by applying mouthwash [15]. According to previous research, the negative impact of long-term use of mouthwash containing chemical compounds is that it can cause an imbalance in the normal flora in the mouth. Mouthwash made from natural ingredients is currently being developed in Indonesia as an ingredient that has passed scientific tests in terms of benefits and safety [16].

One example of using a mouthwash that contains natural ingredients is using lemon solution. Lemon solutions with levels of 10% and 15% have a similar effect in minimizing the plaque index on teeth, this is proven by a decrease in dental plaque index before and after the treatment given.

V. CONCLUSION

Based on the research results, it can be concluded that the average PHP index for class 11 students of SMA Negeri 1 Porong in 2024 before gargling using a 10% lemon solution was 2.48 in the medium category, whereas after gargling using a 10% lemon solution experienced decreased to 1.27 in the good category. The average PHP index for class 11 students at SMA Negeri 1 Porong in 2024 before gargling using a 15% lemon solution was 2.07 in the medium category, whereas after gargling using a 15% lemon solution it decreased to 1.07 in the moderate category. Good. The difference in the effectiveness of gargling using lemon solution with levels of 10% and 15% in reducing dental plaque index in class 11 students at SMA Negeri 1 Porong in 2024 has the same effectiveness. However, based on the results of research and

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analysis, it can be concluded that gargling with a 10% lemon solution can reduce plaque accumulation more quickly compared to 15% levels in class 11 students at SMA Negeri 1 Porong in 2024. The results of this research are in accordance with the research objective, namely knowing the effectiveness of gargling using lemon solution with levels of 10% and 15% on reducing the dental plaque index in class 11 students of SMA Negeri 1 Porong in 2024 with the result that there was no difference in the effectiveness of gargling using lemon solution with levels of 10% and 15% on reducing the dental plaque index in 11th grade student at SMA Negeri 1 Porong.

It is recommended that health workers can provide encouragement and promotive activities to the school community of SMA Negeri 1 Porong, especially students, to gargle with lemon solution as an attitude of concern for oral hygiene when conducting counseling and periodic inspections at school.

It is hoped that future researchers can develop further research such as a longer research duration so that the research results are more accurate. The research results also explain that there are disturbing factors that occur. This can be used as a reference so that future researchers will be more thorough and careful when conducting research.

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