

The Effectiveness of Belimbing Wuluh (Averrhoa Blimbi L) Acid Extract as Mouthwash as an Alternative to Relieve Gingivitis

Damanhuri Afsy*)¹, Ari Suwondo², Lanny Sunarjo³
Poltekkes Kemenkes Semarang

Tirto Agung Rd, Semarang Central Java, 50628, Indonesia

Abstract:-

Background: One of the most common dental health problems is gingivitis, which is part of periodontal disease. Gingivitis is a periodontal disease caused by the accumulation of plaque bacteria in the form of *Streptococcus mutans*, *Streptococcus sanguis*, *Actinomyces* species, and *Spirochaeta* found on the tooth surface. *Streptococcus mutans* bacteria are Gram positive (+) bacteria that are facultative anaerobes and are relatively often found in the oral cavity, namely the tooth surface. Mouthwash can be interpreted as a solution with a comfortable taste, antimicrobial properties and can also freshen the mouth. Starfruit contains many active compounds and acts as an anti-microbial such as flavonoids, alkaloids, tannins, and saponins.

Purpose: Proving the effectiveness of sunti starfruit extract (*Averrhoa Blimbi L*) as a mouthwash against gingivitis.

Methods: The type of research used is a quasi-experimental research. The design used is a non-randomized one group pretest-posttest. The population of the study was students of SMA Negeri 4 Semarang, with a total sample of 33 people. The sampling technique uses purposive sampling.

Result: Giving mouthwash of sunti belimbing wuluh acid extract before and after on the status of the gingival index with p value $0.00 < 0.05$, meaning that there is a difference between before using mouthwash and after using mouthwash.

Conclusion: The formulation of sunti belimbing wuluh acid extract mouthwash at concentrations of 25%, 12.5% and 6.25% was effective in reducing the status of the gingival index, but there was no significant difference between the three formulations in reducing the status of the gingival index.

Keywords:- *Gingivitis, Mouthwash extract sunti belimbing wuluh.*

I. INTRODUCTION

The most common dental health problem is gingivitis, which is part of periodontal disease. From the data obtained, the number of gingivitis that occurs in the community is still high. The main treatment for gingivitis is to eliminate the main cause, such as plaque control. Plaque adheres to the tooth surface and can only be removed through mechanical and chemical cleaning. Mechanically, this can be done by using cleaning tools such as toothbrushes and interdental cleaners, while chemical plaque control can be done by gargling with mouthwash.¹

Based on the WHO (World Health Organization) report, the prevalence of periodontal disease in the population aged 35-44 years is 40-75%. High prevalence is often found in young and adult populations, both in developing and industrialized countries.²

Basic Health Research Data (2018), the status of periodontal tissue disease aged 15 years and over according to the characteristics of the Indonesian population is 2.2% no pocket or healthy, 0.4% shallow pocket, 0.03% deep pocket, and 0.74 % bleeding gums. Meanwhile, according to gender, gum bleeding in women was higher by 0.74% and in men by 0.73%, and the prevalence of periodontitis according to characteristics was 74.1%, while those who received gum/periodontal treatment were 0.4%.³

Gingivitis is an inflammatory reaction of the gingiva caused by the accumulation of biofilm in plaque around the gingival margin and an inflammatory response to bacteria. Clinical symptoms of gingivitis are characterized by changes in color, changes in shape, changes in consistency, changes in texture, and bleeding in the gingiva.³

Mouthwash can be interpreted as a solution with a comfortable taste, antimicrobial properties and can also freshen the mouth. In general, commercial mouthwash preparations on the market contain a high enough alcohol content, where the use of mouthwash containing 25% or more alcohol can increase the risk of developing throat, mouth, and pharyngeal cancer by about 50%.⁴

Mouthwash is a preparation in the form of a solution that is used to clean the oral cavity and teeth more cleanly than an ordinary toothbrush. Mouthwash contains basic ingredients in the form of water, fragrance, cleaning agent, dye and alcohol. Based on the active ingredients contained in it, mouthwash can be divided into several types, namely: mouthwash containing antiseptic/antimicrobial active ingredients such as povidone iodine, cetylpyridinium chloride which functions to control the growth of bacteria in the mouth, reduce plaque, heal gingivitis, and treat odor mouth. There are mouthwashes whose active ingredient is fluoride, which helps prevent cavities from forming and prevents tooth decay. Fragrance ingredients can be one of the ingredients in mouthwash. This active ingredient will act as a chemical that is able to neutralize bad breath.⁵

II. METHOD

The type of research used is a quasi-experimental research. The design used is a non-randomized one group pretest-posttest. The sampling technique used is purposive sampling. In this study there were three treatment groups, namely the first treatment group was given a mouthwash with a concentration of 25% sunti belimbing wuluh acid extract, the second treatment group was given a mouthwash with a sunti belimbing wuluh extract with a concentration of 12.5%, and the third treatment group was given a mouthwash with an acid extract. Sunti starfruit with a concentration of 6.25%. The three groups were examined for the gingival index before and after the mouthwash application.

III. RESULTS

A. The yield of belimbing wuluh extract

Dried Simplicia	Thick Extract	Marinade
1,200 gram	294 gram	24,5%

Table 1: Results of the yield of Belimbing wuluh Extract

According to Table 1. The yield of belimbing wuluh acid extract was obtained: 1,200 grams of dry Simplicia, 294 grams of thick extract and 24.5% yield.

B. The results of organoleptic mouthwash of belimbing wuluh extract

No	Mouthwash formulation	Color	Aroma	Flavor	Form	Clarity
1	25%	Dark brown	Typical Orange	Slightly bitter and spicy	Liquid	Clear
2	12,5%	Chocolate	Typical Orange	Slightly bitter and spicy	Liquid	Clear
3	6,25%	Light brown	Typical Orange	Slightly bitter and spicy	Liquid	Clear

Table 2: Organoleptic Test

In table 2. The results of the organoleptic test show that there are differences in the color of the mouthwash formulations at various concentrations, at a concentration of 25% it has a dark brown color, at a concentration of 12.5% it has a brown color and at a concentration of 6.25% it has a light brown color. Distinctive citrus aroma, slightly bitter and spicy taste, liquid form, and clear clarity.

C. pH test results of belimbing wuluh extract mouthwash

Concentration	Results
25%	3
12,5%	3
6,25%	3

Table 3: pH test

In Table 3. The results of the pH test on mouthwash extracts of belimbing wuluh acid with concentrations of 6.25%, 12.5% , and 25% obtained results with a pH value of 3.

D. The results of the homogeneity test of the Belimbing wuluh extract mouthwash

Concentration	Results
25%	Homogeneous
12,5%	Homogeneous
6,25%	Homogeneous

Table 4: Homogeneity Test

In Table 4. The results of the homogeneity test on mouthwash extract of belimbing wuluh acid with concentrations of 25%, 12.5% and 6.25% obtained homogeneous results.

E. Stability test results of belimbing wuluh extract mouthwash

Concentration	Results
25%	No separation
12,5%	No separation
6,25%	No separation

Table 5: Stability Test

In Table 5. The results of the stability test of the belimbing wuluh acid mouthwash extract showed no separation, it can be said that the preparation is stable.

F. The results of the hedonic test/preferred mouthwash of belimbing wuluh extract

Hedonic test results of sunti starfruit extract mouthwash according to color, aroma, taste, and clarity.

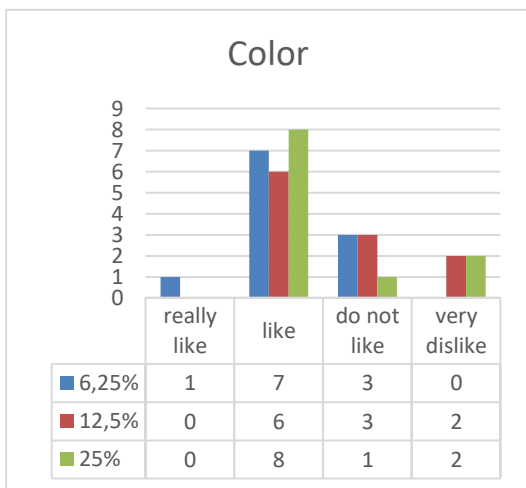


Fig. 1: The results of the hedonic test on the color of the mouthwash of belimbing wuluh acid extract

Figure 1. shows that the highest percentage of respondents' preference level for the color of the mouthwash of belimbing wuluh acid extract is that there is a very favorable formula at 6.25%, favored at 6.25%, and 25%, disliked at 6.25% and 12.5% and strongly disliked at 12.5% and 25%.

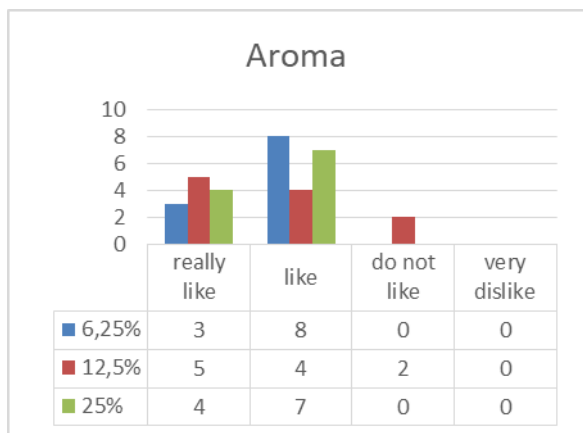


Fig. 2: The results of the hedonic test on the aroma of the mouthwash of belimbing wuluh extract

Figure 2. shows that the highest percentage of the respondents' preference for the aroma of the mouthwash extract of belimbing wuluh acid extract is that there is a very preferred formula at 12.5%, preferred at 6.25%, disliked at 12.5% and there is no formula that very disliked.

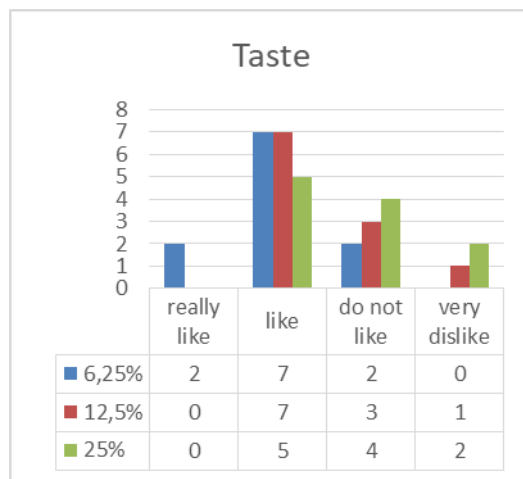


Fig. 3: The results of the hedonic test on the taste of the mouthwash of belimbing wuluh extract

Figure 3. Shows that the highest percentage of preference for the taste of the mouthwash of belimbing wuluh acid extract is that there is a very favorable formula at 6.25%, favored at 6.25%, and 12.5%, disliked at 25%, and very disliked at 25%.

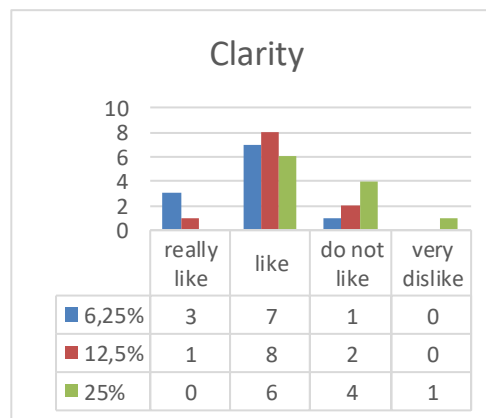


Fig. 4: The results of the hedonic test on the clarity of the Belimbing wuluh extract mouthwash

Figure 4. Shows that the highest percentage of preference level for the clarity of the belimbing wuluh extract mouthwash is that there is a very favorable formula at 6.25%, favored at 12.5%, disliked at 25%, and very disliked at 25%.

G. Gingival index status before and after gargling mouthwash with belimbing wuluh acid extract

No	Formulation	Gingival Index Status	
		Before gargling mouthwash, Belimbing wuluh extract	After gargling mouthwash, Belimbing wuluh extract
1	6,25%	1,69	0,60
2	12,5%	1,76	0,46
3	25%	1,91	0,64
Average		1,78	0,56

Table 6: Results of Gingival Index Status Before and After Gargling With Belimbing Wuluh Acid Extract Mouthwash

In Table 6. The results of the gingival index status before and after gargling the mouthwash of belimbing wuluh acid extract showed that there was a change in the average value of the gingival index status in various formulations. The average status of the gingival index before gargling with belimbing wuluh extract was 1.78 and changed after rinsing with belimbing wuluh extract to 0.56.

Mouthwash formulation	Kolmogorov-smirnov		
	Statistic	df	Sig
Before gargling: 6,25%, 12 % dan 25%	0,144	33	0,079
After gargling: 6,25%, 12,5%, dan 25%	0,157	33	0,038

Table 7: Normality Test of Gingival Index Status Before and After Gargling With Belimbing Wuluh Acid Extract Mouthwash

$P > 0,05 = \text{Signifikan}$

In table 7. The results of the normality test show that there are data that are not normally distributed, it will be continued with a non-parametric test.

Formulation	N	Mean	Df	P
Before rinsing 6,25%	11	42.41		
After rinsing 6,25%	11	20.00		
Before gargling 12,5%	11	48.86		
After gargling 12,5%	11	14.41	5	0,000
Before rinsing 25%	11	52.36		
After rinsing 25%	11	22.95		

Table 8: Kruskal-Wallis Test Results from Gingival Index Status Before and After Gargling With Belimbing Wuluh Acid Extract Mouthwash

$P < 0,05 \text{ Signifikan}$

In Table 8. The results of the Kruskal-Wallis test show that the p-value = 0.000, so $0.000 < 0.05$, it can be concluded that there is a difference in the status of the gingival index before and after rinsing, so the Mann-Whitney follow-up test was carried out. The Mann-Whitney test is used to test the mean of two unequally sized samples.

Mouthwash formulation	N	Mean	P
F1-F2	22	20,34 24,66	0,26
F1-F3	22	20,34 24,66	0,26
F2-F3	22	20,50 24,50	0,30

Table 9: Mann-Whitney Test Results from Gingival Index Status Before and After Gargling With Belimbing Wuluh Acid Extract Mouthwash

$P < 0,05 = \text{signifikan}$

In Table 9. The results of the Mann-Whitney test of gingival index status between groups F1 and F2 showed a p-value = 0.26, so $0.26 > 0.05$ it can be concluded that there is no significant difference between groups F1 and F2 in changes in index status. Gingiva. In the F1 and F3 groups,

the p-value = 0.26, so it can be concluded that there is no significant difference between the F1 and F3 groups in the change in the index gingival status. And between groups F2 and F3 showed a p-value = 0.30, it can be concluded that there was no significant difference between groups F2 and F3 in the change in index gingival status.

Variable	P
Before and after gargling mouthwash extract Belimbing wuluh	0,00

Table 10: Wilcoxon Test Results of Giving Mouthwash with Belimbing Wuluh Acid Extract on Decrease in Gingival Index Status

$P < 0,05 = \text{signifikan}$

Table 10. The results of the Wilcoxon test giving mouthwash of belimbing wuluh acid extract before and after with p-value $0.00 < 0.05$, meaning that there is a difference between before using mouthwash and after using mouthwash, it can be concluded that there is an effect of drug administration. a gargle of belimbing wuluh extract on decreasing gingival index status.

IV. DISCUSSION

A. Belimbing Wuluh Extract as Mouthwash (*Averrhoa Bilimbi L*)

Belimbing wuluh extract mouthwash is a product that can inhibit the growth of *Streptococcus mutans* bacteria and is also used as an alternative treatment of gingivitis. Mouthwash is used because of its very effective ability to reach places that are difficult to clean with a toothbrush and can prevent plaque formation.⁶

The manufacture of Belimbing wuluh extract mouthwash includes several stages of testing, namely organoleptic test, pH test, stability test, homogeneity test, and hedonic test.

B. Organoleptic Test

The organoleptic test was carried out by observing the mouthwash of belimbing wuluh acid extract based on the color, aroma, taste, shape and clarity of the product. The color produced from the three formulas is that at a concentration of 6.25% it has a light brown color, at a concentration of 12.5% it has a brown color, and at a concentration of 25% it has a dark brown color. The distinctive citrus aroma is due to the mixture of ingredients from making mouthwash containing *oleum citri*, a slightly bitter and spicy taste, a liquid form, and clear clarity.

C. Mouthwash pH test

The pH test carried out on each mouthwash formulation obtained the same pH value, namely pH 3. This pH value is the same as that which has been studied by Ega Pratama, 2018. In this study, a pH test was carried out between the Gargarisma preparations of Belimbing wuluh extract with a comparison formula, namely Enkasari mouthwash, then a pH value of 3.⁷ The calculation of the pH limit value of the mouthwash formula in all samples was in the pH range of trade standards seen from the Quality Standards of the

Indonesian Pharmacopoeia IV herbal mouthwash, which is between 5 to 7.

D. Homogeneity test

Formula F1 with a concentration of 25% belimbing wuluh acid extract produced a homogeneous preparation because there was no separation between the ingredients and there were no particles in the mouthwash preparation. Formula F2 with a concentration of 12.5% acid extract of belimbing wuluh produced was the same as formula F1, which was homogeneous because there was no separation between the ingredients and there were no particles in the mouthwash preparation. Formula F3 with a concentration of 6.25% extract of belimbing wuluh acid produced is the same as formula F1, which is homogeneous because there is no separation between the ingredients and there are no particles in the mouthwash preparation.

The homogeneity test performed on each mouthwash formulation obtained the same results, namely homogeneity. This is because there is no separation between the ingredients and there are no particles in the mouthwash preparation. Where a good and good preparation is a homogeneous preparation, there are no particles in the preparation and it is evenly dispersed as a whole so that if it is used in medicine the dosage used can be uniform.⁷

E. Stability test

The results of the stability test on formulas 1, 2, and 3 did not occur separation, it can be said that the preparation is stable. Stability in drug dosage forms is more aimed at the product's ability to maintain the properties and characteristics of efficacy or therapy to remain the same when it was made to the specified limits throughout the shelf-life period.⁸

F. Hedonic test

a) Color

Based on Figure 1. The higher the concentration of the extract used, the effect on the color of the mouthwash, this can be seen from the 25% formulation which is more concentrated in color. And because it gives influence to the respondent to the level of preference.

b) Aroma

Based on Figure 2. There is no significant difference in the aroma of various mouthwash formulas, this is indicated by the level of preference of respondents who on average like the aroma of belimbing wuluh extract mouthwash.

c) Flavor

Based on Figure 3. Shows that concentration affects the level of respondent's preference for taste, the higher the concentration will affect the taste of mouthwash. The respondent's test results showed that the most preferred mouthwash of the belimbing wuluh acid extract was formula 1. Tween 80 could affect the taste of the belimbing wuluh extract mouthwash because tween 80 had a bitter and spicy taste. . The more tween 80 is used, the more bitter and spicy the mouthwash tastes.⁹

d) Clarity

Based on Figure 4. Shows that the higher the mouthwash formulation will affect the respondent's preference for the clarity of the mouthwash. But overall respondents liked the clarity of the mouthwash formulation of belimbing wuluh acid extract.

G. Administration of belimbing wuluh extract mouthwash on the status of the gingival index

The statistical test results of giving mouthwash extract of belimbing wuluh acid before and after on the status of the gingival index with p-value $0.00 < 0.05$, meaning that there is a difference between before using mouthwash and after using mouthwash. The average status of the gingival index before gargling with belimbing wuluh extract was 1.78 and changed after rinsing with belimbing wuluh extract to 0.56. So it can be concluded that there is an effect of giving mouthwash extract of belimbing wuluh acid to decrease the status of the gingival index.

Belimbing wuluh (*Averrhoa bilimbi* L) is a medicinal plant that has antibacterial, antioxidant, antimicrobial, and anti-inflammatory activities (reduces and suppresses inflammation). This plant from the Oxalidaceae tribe contains saponins, calcium oxalate, sulfur, formic acid, tannins, peroxidases, glucosides, potassium citrate, polyphenols, and flavonoids. Flavonoids have anti-inflammatory activity because they can inhibit several enzymes such as aldose reductase, xanthine oxidase, phosphodiesterase, Ca^{2+} ATPase, lipoxygenase, and cyclooxygenase.¹⁰

V. CONCLUSION

- The organoleptic test showed that there were differences in the color of the mouthwash formulations at various concentrations, at a concentration of 25% it had a dark brown color, at a concentration of 12.5% it had a brown color, and at a concentration of 6.25% it had a light brown color. Distinctive citrus aroma, slightly bitter and spicy taste, liquid form, and clear clarity.
- The formulation of sunti belimbing wuluh acid extract mouthwash at concentrations of 25%, 12.5%, and 6.25% was effective in reducing the status of the gingival index, but there was no significant difference between the three formulations in reducing the status of the gingival index.

REFERENCES

- [1.] Purwaningsih, P. P., Darmayasa, I. B. G. & Astiti, N. Pu. A. Elusidasi Awal Daya Hambat Ekstrak Etanol Daun Ketapang (*Terminalia Catappa* L.) Terhadap Pertumbuhan *Staphylococcus Aureus* ATCC25923 Penyebab Gingivitis. 7, 57–64 (2020).
- [2.] Harapan, I. ketut, Ali, A. & Fione, vega R. Gambaran Penyakit Periodontal Berdasarkan Umur dan Jenis Kelamin Pada Pengunjung Poliklinik Gigi Puskesmas Tikala Baru Kota Manado Tahun 2017. 20–26 (2019).
- [3.] Hanifah, F., Kawengian, S. E. . & Tambunan, E. Hubungan antara Status Gizi dengan Gingivitis pada Mahasiswa Program Studi Pendidikan Dokter Gigi Universitas Sam Ratulangi. (2018).
- [4.] Gurning, D., Nathaniel, D., Meila, O. & Sagala, Z. Uji Aktivitas Antibakteri Sediaan Obat Kumur dari Ekstrak

- Etanol 70 % Batang Sambung Nyawa (*Gynura procumbens* (Lour .) Merr .) terhadap Bakteri *Streptococcus mutans*. 15, 58–64 (2018).
- [5.] Almasyhuri & Sundari, D. Uji Aktivitas Antiseptik Ekstrak Etanol Daun Sirih (*Piper betle* Linn .) dalam Obat Kumur terhadap *Staphylococcus aureus* secara in Vitro. 9, 10–18 (2019).
- [6.] Sakinah, N., Dwyana, Z., Tambaru, E. & Rante, H. Uji Aktivitas Sediaan Obat Kumur Ekstrak Daun Miana *Coleus scutellarioides* (L.) Benth Terhadap Pertumbuhan Bakteri *Streptococcus mutans*.
- [7.] Pratama, E. & Arief, A. E. Formulasi Sediaan Gargarisma Dari Ekstrak Buah Belimbing Wuluh (*Averrhoa bilimbi* L) Sebagai Anti Kandidiasis. 3, 11–16 (2018).
- [8.] Oktaviani, A. F., Rahmatullah, S. & Pambudi, D. B. FORMULASI SEDIAAN OBAT KUMUR EKSTRAK ETANOL DAUN SELASIH (*Ocimum basilicum* L .) SEBAGAI UJI AKTIVITAS ANTIBAKTERI *Streptococcus mutans*. 03, 1–9 (2021).
- [9.] P. Oktariani, A. Neni, Farmasi, J. & Indonesia, S. FORMULASI OBAT KUMUR EKSTRAK DAUN BELIMBING WULUH (*Averrhoa bilimbi* L.) DENGAN METODE MASERASI. *FORMULASI OBAT KUMUR EKSTRAK DAUN BELIMBING WULUH (Averrhoa Bilim. L.) DENGAN Metod. MASERASI* 2, 21–31 (2019).
- [10.] Novika, D. S., Ahsanunnisa, R. & Yani, D. F. Uji Aktivitas Antiinflamasi Ekstrak Etanol Daun Belimbing Wuluh (*Averrhoa bilimbi* L .) Terhadap Penghambatan Denaturasi Protein. 3, 16–22 (2021).