

The Effectiveness of Belimbing Wuluh Fruit Extract (*Averrhoa bilimbi* L) as A Smear Layer Cleanser

Nur Asmah,¹ Syamsiah Syam,¹ Ira Asnita Sembiring², Yusrini Selviani³, Amirah Syalsabilah⁴

¹ Department of Conservative Dentistry, Faculty of Dentistry, Universitas Muslim Indonesia, Makassar, Sulawesi Selatan, Indonesia

² Department of Periodontics, Faculty of Dentistry, Universitas Muslim Indonesia, Makassar, Sulawesi Selatan, Indonesia

³ Department of Oral Medicine, Faculty of Dentistry, Universitas Muslim Indonesia, Makassar, Sulawesi Selatan, Indonesia

⁴ Student, Faculty of Dentistry, Universitas Muslim Indonesia, Makassar, Sulawesi Selatan, Indonesia

Corresponding Author: asmahnur@gmail.com

ARTICLE INFO : Received, February 8, 2024; Revised, April 17, 2024; Accepted, June 2, 2024; Published, June 22, 2024
ORCID : Nur, A ([0000-0002-4202-1366](https://orcid.org/0000-0002-4202-1366)); Syam, S ([0000-0002-5280-1550](https://orcid.org/0000-0002-5280-1550)); Sembiring, I. A ([0000-0001-5219-6373](https://orcid.org/0000-0001-5219-6373)); Selviani, Y ([0009-0004-5855-111X](https://orcid.org/0009-0004-5855-111X)); Syalsabilah, A ([0000-0001-5219-6373](https://orcid.org/0000-0001-5219-6373))
DOI : [10.24815/jds.v9i1.40434](https://doi.org/10.24815/jds.v9i1.40434)

ABSTRACT

Background: Root canal treatment is an effort to maintain the function and aesthetics of teeth. The smear layer is formed from the remains of instrumentation composed of organic and inorganic components. A smear layer in the tooth root canal will benefit the adhesion and colonization of microorganisms, block the action of disinfectant solutions, and prevent medicaments in the tooth root canal from penetrating the dentin tubules in the tooth root canal walls. Irrigation can be used for cleaning and disinfection in areas of the root canal that cannot be reached using instruments. Starfruit contains alkaloids, saponins, tannins, flavonoids, phenols, and triterpenoids. **Objective:** To determine the effectiveness of star fruit extract (*Averrhoa bilimbi* L) as a smear layer cleaning agent. **Materials and Methods:** This researcher used laboratory or experimental testing called Post Test Only Control Design. Samples were taken using the purposive sampling technique involving four treatments and six repetitions. The statistical test used is the Mann-Whitney test. **Results:** Based on the Mann-Whitney test, the test results obtained a p-value of 0.093 which is more significant than 0.05 (p-value > 0.05). The results showed no significant difference between the 17% EDTA and 35% extract treatment groups regarding smear layer cleanliness. The 35% extract group is as good as the 17% EDTA group. **Conclusion:** star fruit extract (*Averrhoa bilimbi* L) is 35% effective in cleaning the smear layer.

Keywords: Fruit star extract (*Averrhoa bilimbi* L), Smear Layer, Root Canal Cleanliness

ABSTRAK

Latar Belakang: Perawatan saluran akar merupakan salah satu upaya untuk mempertahankan fungsi dan estetika pada gigi. *Smear layer* adalah suatu lapisan yang terbentuk dari sisa-sisa instrumentasi yang tersusun atas komponen organik dan anorganik. Keberadaan *smear layer* dalam saluran akar gigi akan menguntungkan adhesi dan kolonisasi mikroorganisme, menghalangi aksi larutan disinfektan serta menghambat medikamen dalam saluran akar gigi berpenetrasi ke tubuli dentin di dinding saluran akar gigi. Irigasi dapat digunakan untuk pembersihan dan disinfeksi di area saluran akar yang tidak di jangkau dengan menggunakan instrumen. Buah belimbing wuluh memiliki kandungan alkaloid, saponin, tanin, flavonoid, fenol, dan triterpenoid. **Tujuan Penelitian :** Mengetahui efektivitas ekstrak buah belimbing wuluh (*Averrhoa bilimbi* L) sebagai bahan pembersih *smear layer*. **Bahan dan Metode :** Peneliti ini menggunakan pengujian pada laboratorium atau disebut uji eksperimental *Post Test Only Control Design*. Sampel diambil menggunakan tehnik *Purposive Sampling* dengan 4 perlakuan dan 6 kali pengulangan. Uji statistik yang digunakan yaitu uji *mann-whitney*. **Hasil :** Berdasarkan uji *mann-whitney* hasil uji diperoleh nilai *p-value* sebesar 0,093 yang lebih besar daripada 0,05 (*p-value* > 0.05). Hasil menunjukkan bahwa tidak ada perbedaan signifikan antara kelompok perlakuan EDTA 17% dan ekstrak 35% terhadap tingkat kebersihan *smear layer*, kelompok ekstrak 35% sama baiknya dengan kelompok EDTA 17%. **Kesimpulan :** Ekstrak buah belimbing wuluh (*Averrhoa bilimbi* L) 35% efektif dalam membersihkan *smear layer*.

Kata Kunci: Ekstrak Buah belimbing Wuluh (*Averrhoa bilimbi* L), *Smear layer*, kebersihan saluran akar

1. Introduction

Root canal treatment is an effort to maintain the function and aesthetics of the tooth. It aims to prevent reinfection by eliminating microorganisms and pulp tissue in the root canal. The biomechanical preparation stage consists of mechanical instrumentation and irrigation. Mechanical instrumentation that aims to facilitate the process of irrigation and root canal filling can produce a

smear layer¹. The smear layer is formed from instrumentation debris composed of organic and inorganic components, consisting of dentin particles, residual vital or necrotic pulp tissue, and bacterial components. The inorganic component of the smear layer consists of tooth structure and some non-specific inorganic contaminants².

A smear layer in the root canal will favor the adhesion and colonization of microorganisms, inhibit the disinfectant solution, and prevent the medicament in the root canal from penetrating the dentinal tubules in the root canal wall³. Irrigation can be used to clean and disinfect root canal areas that are not reached with instruments. Other cleaning and disinfection can be done chemically and mechanically, as well as removing bacteria, especially pulp tissue biofilm, dentin debris, and smear layer, with reachable irrigation materials⁴.

The most commonly used irrigation solution for root canal irrigation is Ethylene Diamine Tetra Acetic Acid (EDTA). Ethylene Diamine Tetra Acetic Acid (EDTA) is a chelating agent that removes non-toxic inorganic smear layers. EDTA has little antibacterial activity and is not active in dissolving organic tissue, so it cannot dissolve the organic smear layer. In addition, EDTA has an erosive effect with dentin⁵. Indonesia is a tropical country rich in flora diversity that can be utilized as traditional medicine, including belimbing wuluh. Belimbing wuluh contains alkaloids, saponins, tannins, flavonoids, phenols, and triterpenoids. Additionally, star fruit has antioxidant activity⁶. This research, the researcher is interested in conducting an update by using Belimbing Wuluh fruit to conduct the study with different concentrations.

2. Material and Methods

This research design is a laboratory experiment with a post-test-only control design model. The type of research conducted is True Experimental. This study had 24 samples, of which four kinds of treatment groups were repeated six times.

3. Result and Discussion

The appearance of smear layer cleanliness on the root canal wall that has been irrigated with belimbing wuluh fruit extract (*Averrhoa bilimbi* L) with a concentration of 25%, 30%, 35% and EDTA 17% was photographed with SEM magnification 4000 X in each group.

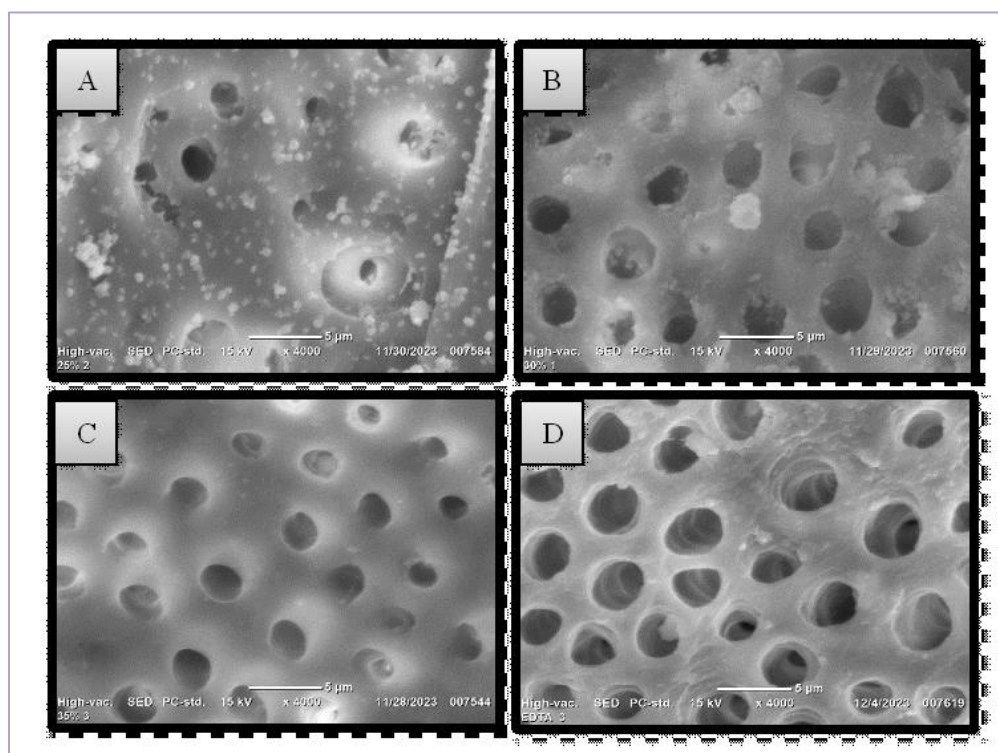


Figure 1. SEM Profile of photographic results of 4000 X magnification: (A) 25% extract; (B) 30% extract; (C) 35% extract; (D) 17% EDTA

Table 1. Smear layer cleanliness score assessment on the root canal walls irrigated

Sample	25% Extract	30% Extract	35% Extract	17% EDTA
1	3	2	2	1
2	5	2	2	1
3	3	3	1	1
4	3	3	2	1
5	3	3	2	2
6	4	2	1	1

Table 2. The descriptive analysis of smear layer cleanliness assessment

Fruit Extract	Mean	Std Deviation	Normality Test	Homogeneity Test
25% Extract	3.5	0.84	0.006	0.11
30% Extract	2.5	0.55	0.004	
35% Extract	1.67	0.52	0.001	
17% EDTA	1.17	0.41	0	

The results of the descriptive analysis of the 25% extract treatment show an average value of 3.50 with a standard deviation of 0.84. The 30% extract treatment shows an average value of 2.50 with a standard deviation 0.55. Meanwhile, the 35% extract treatment showed an average value of 1.67 with a standard deviation 0.52. The 17% EDTA treatment showed an average value of 1.17 with a standard deviation of 0.41. This indicates that the highest average value is obtained at 25% extract concentration, while the lowest average is at 17% EDTA.

Table 3. Analysis of comparative smear layer cleanliness assessment

Fruit Extract	Mean	Std Deviation	p-value
25% Extract	3.5	0.84	0.11
30% Extract	2.5	0.55	
35% Extract	1.67	0.52	
17% EDTA	1.17	0.41	

Based on the Kruskal Wallis test results on the treatment group, the smallest mean value in the 17% EDTA treatment was 1.17, with a standard deviation of 0.41. The largest mean value occurred at a 25% extract concentration of 3.50 with a standard deviation of 0.84. The Kruskal Wallis test results obtained a p-value of 0.000, smaller than 0.05 (p-value <0.05). The 25%, 30%, 35%, and EDTA 17% extract treatment groups given significantly affect smear layer cleanliness. Furthermore, further tests were carried out using the Mann-Whitney test to see the most significant treatment effect.

Table 4. Analysis of comparative smear layer cleanliness assessment

Fruit Extract	Mean	Post hoc			
		25% Extract	30% Extract	35% Extract	17% EDTA
25% Extract	3.5		0.031*	0.003*	0.002*
30% Extract	2.5			0.030*	0.005*
35% Extract	1.67				0.093
17% EDTA	1.17				

The results showed no significant difference between the 17% EDTA and 35% extract treatment groups on the level of smear layer cleanliness. The 35% extract group was as good as the 17% EDTA group. This research was conducted to know the effectiveness of star fruit extract (*Averrhoa bilimbi* L) as a smear layer cleaner. Based on research conducted by Rahmiati A. et al. (2017), it is stated that a minimum concentration of 25% can inhibit the growth of *Streptococcus mutans* bacteria. The formation of the inhibition zone is due to the presence of chemical compound components contained in the star fruit, which acts as an antimicrobial. Riza et al. (2008) also stated that in addition to the quality and quantity of substances present in medicinal plants, environmental factors such as climate, soil, sunlight, and plant growth conditions are determined by where plants grow ^{7,8}.

The results of research conducted by Dewantoro Z et al. (2017) explain that there are differences in the results of star fruit extract with concentrations of 5%, 20%, 35%, 50%, 65%, and 80% which have no antibacterial effect on *Staphylococcus aureus* ⁹. It is assumed that star fruit extract (*Averrhoa bilimbi*

L) is not able to penetrate the thickness of the cell membrane of *Staphylococcus aureus* bacteria because these bacteria have a cell membrane wall thickness of 20-80 nm.

Based on research by Khasanah C.U et al. (2015), it is explained that mangosteen peel extract (*Garcinia magostana* L) at a concentration of 100% can clean the smear layer on the root canal wall ¹⁰. The study conducted by Maulidiyah D.D et al. (2021) stated that 50% of cocoa pulp juice could clean the smear layer on the tooth root canal wall. This is because EDTA 17% and 50% cocoa pulp juice can be a chelating agent that can clean inorganic components in the tooth root canal wall ¹¹.

This research uses ethylenediamine-tetraacetic acid (EDTA 17%), an amino polycarboxylic acid that is almost colorless and water-soluble. Ethylenediamine-tetraacetic acid (EDTA 17%) is used as an irrigation solution and also as a chelation agent, capable of reacting with calcium ions in the dentin of the root canal wall to form soluble calcium chelation and remove the mineral part of the smear layer. EDTA alone is less effective in cleaning the smear layer and has no antibacterial effect ³. EDTA use causes erosion of the root canal wall due to hyper-decalcification, to minimize erosion, the EDTA solution can be applied in a shorter time and in small amounts ¹².

The research uses belimbing wuluh fruit (*Averrhoa bilimbi* L), which contains flavonoids, alkaloids, glycosides, tannins, saponins, and starch/aleurone. Research by Epasinghe DJ et al. (2016) explains that flavonoids effectively inhibit demineralization. This indicates that belimbing wuluh fruit extract also contains flavonoids that can remineralize due to demineralization from 17% EDTA irrigation solution, which has toxic properties when applied directly to the root canal as a smear layer cleaner ¹³. The results of this study indicate that star fruit extract (*Averrhoa bilimbi* L) with a concentration of 25% has low root canal wall cleanliness, and 30% concentration has good criteria in cleaning root canal walls when compared to 25% concentration. In comparison, a 35% concentration of star fruit extract (*Averrhoa bilimbi* L) 35% is more effective than 25% and 30% of star fruit extract (*Averrhoa bilimbi* L). This proves that the higher the concentration used, the higher the ability to clean the root canal. However, star fruit (*Averrhoa bilimbi* L) does not have a more extraordinary ability than EDTA 17% as a smear layer cleaner in dental root canals.

4. Conclusion

Based on the research, star fruit extract at 25% and 30% is less effective in cleaning the smear layer, while a 35% concentration is proven effective. The 35% concentration is the best for cleaning the smear layer. The Author suggests that further tests, such as in vivo and toxicity tests, should be conducted so that star fruit extract (*Averrhoa bilimbi* L) can be maximally utilized as a natural irrigation solution.

5. References

1. Surbakti AJb, Mozartha M, Bellinda M. The Effect of 20% Curcuma Longa Extract on Smear Layer Cleaning in Apical Third of The Root Canal. B-Dent Jurnal Kedokteran Gigi Universitas Baiturrahmah 2022;9(2):220-28.
2. Setianingrum ID, Suardita K, Subiyanto A, Wahjuningrum DA. Perbedaan daya pembersih kavitas saponin ekstrak kulit manggis (*Garcinia mangostana* Linn) 0,78% dan asam sitrat 6% (The difference of 0,78% saponin from mangosteen pericarp extract and 6% citric acid for cleanliness of cavity). Conservative Dentistry Journal 2019;7(1):6-11.
3. Deviyanti S. Potensi Larutan Chitosan 0,2% Sebagai Alternatif Bahan Irigasi dalam Perawatan Saluran Akar Gigi. Jurnal Ilmiah dan Teknologi Kedokteran Gigi 2018;14(1):6-11.
4. Puspita D, Djuanda R, Evelyn A. Perbedaan Kebersihan Sepertiga Apikal Saluran Akar dari Smear Layer Menggunakan Sistem Aktivasi Ultrasonik dan Sonik. SONDE (Sound of Dentistry) 2019;4(1):26-32.
5. Dennis NY, Prasetya W. The Ability of Root Canal Irrigant With Ethanol Extract of Lerak Fruit (*Sapindus Rarak* Dc) in Removing Root Canal Smear Layer (A Sem Study). IOSR Journal of Dental and Medical Sciences 2017;16:24-30.
6. Yanti S, Vera Y. Skrining Fitokimia Ekstrak Daun Belimbing Wuluh (*Averrhoa bilimbi*). Jurnal Kesehatan Ilmiah Indonesia / Indonesian Health Scientific Journal 2019;4(1):41-46.
7. Ahyar Riza FH, Indra Basar Siregar, Abdullah Oes. Effectiveness of Wuluh Starfruit Leaf (*Averrhoa bilimbi* Linn) Extract on The Growth *Streptococcus mutans* In Vitro. Journal of Syiah Kuala Dentistry Society 2023;8(2):206-10.
8. Rahmiati A, Darmawati S, Mukaromah AH. Daya hambat ekstrak etanol buah belimbing wuluh (*Averrhoa bilimbi* L) terhadap pertumbuhan *Staphylococcus aureus* dan *Staphylococcus epidermidis*

- secara in vitro. Paper presented at: Prosiding Seminar Nasional & internasional, 2017; UNIMUS | Universitas Muhammadiyah Semarang.
9. Dewantoro Z, Widodo S. YA, Ciptaningtyas VR. Pengaruh Pemberian Ekstrak Daun Belimbing Wuluh (*Averrhoa bilimbi* L.) Terhadap Pertumbuhan Bakteri *Staphylococcus Aureus* Secara in Vitro. Jurnal Kedokteran Diponegoro (Diponegoro Medical Journal) 2017;6(2):7.
 10. Kandaswamy D, Venkateshbabu N. Root canal irrigants. J Conserv Dent 2010;13(4):256-64.
 11. Maulidiyah DD, Lestari S, Nugroho R, Supriyadi S, Aju Fatmawati DW. The effectiveness of 50% cocoa pulp juice on removing smear layer of root canal dentin. Jurnal Kedokteran Gigi Universitas Padjadjaran 2021;33(3):188-94.
 12. Khasanah CU, Setyorini D, Lestari S. Effectiveness Of Mangosteen Pericarp Extract (*Garcinia mangostana* L.) 100 % For Cleaning The Smear Layer On Root Canal Dentin. Paper presented at: Proceedings Book FORKINAS VI FKG UNEJ 14th-15th 2016, 2017; Jember.
 13. Epasinghe DJ, Yiu CK, Burrow MF, Tsoi JK, Tay FR. Effect of flavonoids on the mechanical properties of demineralised dentine. J Dent 2014;42(9):1178-84.

Authors Contribution

Contribution	Asmah N	Syam, S	Sembiring, I A	Selviani, Y	Syalsabilah, A
Concepts or ideas	√				
Design	√		√		
Definition of intellectual content	√	√	√	√	
Literature search	√				√
Experimental studies	√	√	√	√	√
Data acquisition	√				√
Data analysis	√	√	√	√	√
Statistical analysis	√	√	√	√	√
Manuscript preparation	√				√
Manuscript editing	√	√	√	√	√
Manuscript review	√	√	√	√	√



JDS (Journal of Syiah Kuala Dentistry Society) is an Open Access Journal licensed under a Creative Commons Attribution-ShareAlike 4.0 International License. This license authorizes the utilization, replication, modification, distribution, and reproduction of the article in any medium or format, provided that due credit is given to the original Author (s) and the source, a link to the Creative Commons license is provided, and any alterations made to the article are duly indicated.

Citation Format: Asmah N, Syam S, Sembiring IA, Selviani Y, Syalsabilah A. The effectiveness of belimbing wuluh fruit extract (*Averrhoa bilimbi* 1) as a smear layer cleanser. J Syiah Kuala Dent Soc. 2024; 9(1): 64–68.

Publisher's Note: The authors of this article assert that all claims made herein are exclusively their own and may not necessarily reflect the views of their respective affiliated institutions or those of the publisher, editors, and reviewers. The publisher does not provide any guarantee or endorsement for any product subject to evaluation in this article or any claim made by its manufacturer.