



The Effectiveness of Vegetable Starfruit Juice (*Averrhoa bilimbi*) and Rosella Tea (*Hibiscus sabdariffa* L) Against the Inhibition of Dental Plaque Formation

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Abstract

Edited by: Ana Vucurevic
Citation: Imran H, Kurniawati N, Amiruddin A, Nurdin N, Wirza W, Wilis R. The Effectiveness of Vegetable Starfruit Juice (*Averrhoa bilimbi*) and Rosella Tea (*Hibiscus sabdariffa* L) Against the Inhibition of Dental Plaque Formation. Open Access Maced J Med Sci. 2022 Apr 14; 10(G):599-602.
<https://doi.org/10.3889/oamjms.2022.8787>
Keywords: Effectiveness; Vegetable starfruit; Rosella tea
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Received: 28-Jan-2022
Revised: 31-Mar-2022
Accepted: 04-Apr-2022
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Funding: This research did not receive any financial support
Competing Interests: The authors have declared that no competing interests exist
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BACKGROUND: Dental disease is a significant public health problem. Various efforts have been made to maintain oral health by utilizing natural ingredients from plants. One of the natural ingredients often used among the community is Vegetable Starfruit Juice (*Averrhoa bilimbi*) and Rosella Tea.

AIM: The purpose of this study was to analyze the effectiveness of Starfruit and rosella tea (*Hibiscus sabdariffa* L) on the Inhibition of Dental Plaque Formation.

METHODS: Design this research is an experimental study with a post-test design only. The research was conducted in Gampong Batoh, Lueng Bata District, Banda Aceh City, from June 26 to October 04, 2021. The study population was the community of Gampong Batoh, Banda Aceh City. The sample in this study used a purposive sampling technique. The sample in this study met the criteria and was willing to assist in implementing the research by signing the informed consent. The number of research samples was 40 people.

RESULTS: The results showed a significant difference in the effectiveness of Starfruit juice and rosella tea on the inhibition of plaque formation based on time duration ($p < 0.05$). The group that rinsed with rosella tea solution had more effective inhibition than the group that rinsed with vegetable Starfruit juice solution ($p < 0.05$). Vegetable Starfruit (*A. bilimbi*) and Rosella Tea contain bioactive compounds such as alkaloids, flavonoids, saponins, and tannins that can act as antibacterial agents in inhibiting the growth of *Staphylococcus aureus*.

CONCLUSION: Vegetable Starfruit Juice (*A. bilimbi*) and Rosella Tea (*H. sabdariffa* L) effectively inhibit the formation of dental plaque.

Introduction

Dental caries affects 60–90% of children and about 100% of adults worldwide [1], [2]. Periodontal disease in its simplest form is chronic gingivitis [3]. Regardless of age, sex, or race, periodontal disease affects more than 90% of the population [4]. Poor oral and dental health are a major public health problem in Indonesia, with approximately 89% and 74% of the population suffering from caries and periodontitis, respectively [5]. One of the most important measures to maintain good oral health is regular dental visits to assess the risk of oral health problems and provide preventive care [6]. The 2018 national health survey estimates that 96% of Indonesians have not visited the dentist in the past year [5]. Several factors influencing the utilization of dental services have been identified in other countries, such as age, gender, marital status, area of residence, education, income, health insurance, and individual health needs, including dental pain and self-perceived oral health [7], [8]. Dental caries is a disease that is often found in every social stratum of Indonesian society. Dental plaque is a major etiologic

factor of periodontal disease, especially plaque-induced gingivitis [9], [10]. Dental plaque is a soft deposit that forms a biofilm layer and adheres tightly to the surface of the teeth and gums. Effective removal of dental plaque is important for maintaining periodontal and oral health [11]. Control of microbial plaque with self-care efforts is important to prevent plaque accumulation. Plaque control can be done mechanically or chemically. Chemical control of dental plaque is an adjunct therapy that can facilitate the removal and prevent the accumulation of microbial plaque [12]. Chemical and mechanical plaque control is recommended for optimal oral hygiene [13]. Various chemicals have been used in toothpaste and mouthwashes, and some have been shown to reduce dental plaque formation [14], [15]. Increasing resistance to synthetic antimicrobials have prompted the search for alternative products with natural ingredients, currently in the manufacture of drugs and the use of antimicrobials derived from plant sources. One of them is Starfruit and Rosella. Starfruit is one of the plants used by the community for medicine. Starfruit water can be used as a mouthwash in patients with a sore throat, can overcome bad breath due to the fragrance from the fruit's skin, and overcome

inflammation. Starfruit is widely used as a dental treatment containing bioactive compounds that can act as antibacterial agents in inhibiting bacterial growth [16]. The Rosella flower is known as a plant with many properties, one of which is antibacterial [17].

Besides having a delicious taste and being productive as antioxidants, rosella flower petals can also produce full pharmacological effects such as antibacterial, antiseptic, anti-inflammatory, and reducing heat. Rosella flowers contain polyphenols, several vitamins, minerals, and 18 kinds of amino acids. The effectiveness of vegetable Starfruit juice and rosella tea on time duration-based inhibition of plaque formation?

Methods

This study uses an experiment with a post-test design only design model. The research was conducted in Gampong Batoh, Lueng Bata District, Banda Aceh City, from June 26 to October 04, 2021. The research population was the Batoh village community, Banda Aceh City. The sample in this study used a purposive sampling technique. The sample in this study met the criteria and was willing to assist in implementing the research by signing the informed consent. The number of research samples was 40 people. The study sample was selected with the criteria of permanent teeth, no missing teeth, calculus index 0, teeth not crowding, not using ortho or removable dentures, DMF-T index below 5, no dentinal caries or pulp, and people who have age 25–45 years. Research materials include Vegetable Starfruit Juice (*Averrhoa bilimbi*), Rosella Tea (*Hibiscus sabdariffa* L), Dental examination tools (diagnostic set), Disclosing solution, cotton, and alcohol, Handschoen, and masks. The measuring instrument used to assess plaque scores is the Patient Hygiene Performance Modified by Martens and Although (PHP-M) Index. Before the examination, the patient's teeth were smeared with disclosing solution and lightly rinsed. The surface of the teeth examined was the buccal and lingual surfaces. The entire surface of the teeth was smeared with disclosing solution, starting from the right lower back tooth to the right upper back tooth. Examination using a mouth mirror to see whether there is staining on the index teeth. The data that have been obtained from this research is entered into a table for observation and data assessment. The data were then analyzed and processed using SPSS. Data usually distributed and homogeneous, parametric statistical tests are used: Paired sample t-test for comparative analysis of pre-test and post-test in each group – Independent sample t-test for comparative analysis of the treatment and control groups. The Research Ethics Committee of Polytechnic of Health-Ministry of Health, Mataram,

Indonesia approved this study, with approval number: LB.02.03/7833/2019.

Results

Data collection was carried out from June to October for 40 people from Batoh Village, Banda Aceh City, where samples were given a solution of vegetable Starfruit juice and a solution of rosella tea by gargling for 2 min. The data collection results were obtained based on the examination of the PHP-M index before and after the solution was given. The results of data processing obtained when conducting research can be seen as follows:

Differences in plaque score between before and after gargling with vegetable Starfruit juice

The results of the study on samples in looking at plaque scores using the PHP-M index (Table 1) showed a decrease, seen before gargling with a solution of vegetable Starfruit juice had a mean value of 0.28 with the highest plaque score of 0.50 and the lowest score of 0.13. After gargling with a solution of vegetable Starfruit juice, the plaque score decreased with a mean of 0.14 and the highest score was 0.29, and the lowest score was 0.02. Before conducting the paired sample t-test, the normality test was first carried out with the Shapiro–Wilk test. The test results before and after gargling showed $p > 0.05$, which means that the data were normally distributed. The results of the statistical test with the paired sample t-test obtained $p = 0.000$ where $p < 0.05$, which means that there is a significant effect of gargling a solution of vegetable Starfruit juice on decreasing plaque scores.

Table 1: Plaque scores before and after gargling with vegetable Starfruit juice for the Batoh village community, Banda Aceh City

Plaque Score	Shapiro–Wilk	Mean	Maximal	Minimal	p-value
Before	0.860	0.28	0.50	0.13	0.000
After	0.696	0.14	0.29	0.02	

Source: Primary data, 2019.

Differences in plaque score between before and after gargling rosella tea solution

The study results on samples in viewing plaque scores using the PHP-M index (Table 2) showed a decrease, seen before gargling with rosella tea solution had a mean value of 0.29 with the highest plaque score

Table 2: Plaque score before and after gargling rosella tea solution

Plaque Score	Shapiro–Wilk	Mean	Maximal	Minimal	p-value
Before	0.667	0.29	0.45	0.13	0.000
After	0.244	0.09	0.20	0.04	

of 0.45 and the lowest score of 0.13. After gargling with rosella tea solution, the plaque score decreased with a mean of 0.09 and the highest score was 0.20, and the lowest score was 0.04. The normality test results using the Shapiro–Wilk test showed $p > 0.05$, where the data were normally distributed. The statistical tests with the paired sample t-test obtained $p = 0.000$ where $p < 0.05$, which means that there is a significant effect of gargling rosella tea solution on decreasing plaque scores.

Differences in inhibition of plaque formation between gargling with vegetable Starfruit juice and gargling rosella tea solution

Based on Table 3, it is known that the plaque score after gargling with vegetable Starfruit juice solution obtained a mean value of 0.14, and the plaque score after gargling with rosella solution obtained a mean value of 0.09. The results of statistical tests using the independent sample t-test showed that the post-test p-value was 0.015 and p-value of the difference before and after rinsing was 0.046 where $p < 0.05$, it can be concluded that there is a difference in the inhibition of plaque formation between gargling with a water solution. Vegetable Starfruit juice and rosella tea solution were more effective at inhibiting plaque formation than vegetable Starfruit juice solution.

Table 3: Differences in the inhibition of plaque formation between gargling with vegetable Starfruit juice and gargling with rosella tea solution for the Batoh village community, Banda Aceh city

Variable	Mean	p-value post test	p-value difference
Vegetable Starfruit Juice	0.14	0.015	0.046
Rosella tea solution	0.09		

Discussion

The study results found a significant difference in the effectiveness of vegetable Starfruit juice and rosella tea on the inhibition of plaque formation based on time duration ($p < 0.05$). The group that rinsed with rosella tea solution was more effective in inhibiting plaque formation than the group that rinsed with Starfruit juice solution ($p < 0.05$). In the treatment group, gargling with rosella tea solution resulted in a more significant mean reduction in plaque scores than the group given a vegetable Starfruit solution. The decrease in plaque index scores may be due to rosella tea containing polyphenols which have antibacterial activity by inhibiting the development of streptococcus sanguis bacteria which triggers the formation of dental plaque. The antibacterial effect of rosella tea solution can suppress plaque bacteria and its products to reduce the average plaque index score. In addition, there is a flavonoid content in the rosella tea solution that works by denaturing bacterial cell proteins. The

mechanism of plaque formation is through internal cleavage and surface deposition. Rosella flowers have some antibacterial properties against plaque-causing bacteria [17]. The chemical content of rosella flower petals consists of organic acids, phenolic compounds, flavonoids, and anthocyanins [18]. Water extract of rosella petals at a concentration of 10% with the diffusion method was able to inhibit gram-positive bacteria *Staphylococcus aureus* and *Streptococcus pyogenes* [19]. Starfruit was used as comparative test material in this study, because they both contain bioactive compounds that can act as antibacterial agents. In inhibiting bacterial growth, Starfruit extracted using the maceration method with ethanol solvent was found to contain bioactive compounds such as alkaloids, flavonoids, saponins, and tannins that can act as antibacterial agents in inhibiting the growth of *S. aureus*, *Escherichia coli*, *Salmonella typhi*, and *Pseudomonas aeruginosa* [20]. Starfruit extracted using the maceration method with aquadest-ethanol solvent contains tannins and terpenoids that can inhibit the growth of *Bacillus subtilis*, *S. aureus*, *E. coli*, *Listeria monocytogenes*, and *Enterobacter aerogenes* [21]. Starfruit extracted using the soxhletation method with methanol solvent showed the presence of flavonoid compounds, phenols, tannins, and alkaloids that could inhibit the growth of *S. aureus*, *B. subtilis*, *Klebsiella pneumoniae*, and *Serratia marcescens* [22], [23].

Conclusion

There was a significant difference in the effectiveness of vegetable Starfruit juice and rosella tea on the inhibition of plaque formation based on time duration ($p < 0.05$). Hence, it can be concluded that the group that rinsed with rosella tea solution was more effective in inhibiting plaque formation than the group that rinsed with vegetable Starfruit juice solution ($p < 0.05$).

References

1. Nimbalkar G, Garacha V, Shetty V, Bhor K, Srivastava KC, Shrivastava D, et al. Microbiological and clinical evaluation of Neem gel and Chlorhexidine gel on dental plaque and gingivitis in 20-30 years old adults: A randomized parallel-armed, double-blinded controlled trial. *J Pharm Bioallied Sci* 2020;12(Suppl 1):S345. https://doi.org/10.4103/jpbs.jpbs_101_20 PMID:33149484
2. World Health Organization. Oral Health Surveys: Basic Methods. Geneva: World Health Organization; 2013.
3. Moran JM. Chemical plaque control--prevention for the masses. *Periodontol* 2000. 1997;15:109-17. <https://doi.org/10.1034/j.1532-2210.1997.15109.x>

- doi:10.1111/j.16000757.1997.tb00110.x
PMid:9643238
4. Rodrigues IS, Tavares VN, Pereira SL, Costa FN. Antiplaque and antigingivitis effect of *Lippia sidoides*: A double-blind clinical study in humans. *J Appl Oral Sci.* 2009;17(5):404-7. <https://doi.org/10.1590/s167877572009000500010>.
PMid:19936516
 5. Badan Penelitian dan Pengembangan Kesehatan. Laporan Nasional RISKESDAS 2018. Jakarta, Indonesia: Lembaga Penerbit Badan Penelitian dan Pengembangan Kesehatan (LPB); 2019. <https://doi.org/10.14203/press.298>
 6. Chi DL, Carpiano RM. Neighborhood social capital, neighborhood attachment, and dental care use for Los Angeles Family and Neighborhood Survey adults. *Am J Public Health.* 2013;103(4):e88-95. <https://doi.org/10.2105/AJPH.2012.301170>
PMid:23409881
 7. Santoso CM, Bramantoro T, Nguyen MC, Bagoly Z, Nagy A. Factors affecting dental service utilisation in Indonesia: A population-based multilevel analysis. *Int J Environ Res Public Health.* 2020;17(15):5282. <https://doi.org/10.3390/ijerph17155282>
PMid:32707974
 8. Danquah EP, Agyemang SA, Amon S, Aikins M. Routine medical and dental examinations: A case study of adults in Tema community 20 in Ghana. *Int J Health Promot Educ.* 2020;58(6):320-32. <https://doi.org/10.1080/14635240.2019.1695529>
 9. Barnett ML. The rationale for the daily use of an antimicrobial mouth rinse. *J Am Dent Assoc.* 2006;137(Suppl):16S-21. <https://doi.org/10.14219/Jada.archive.2006.0408>
PMid:17035671
 10. Colombo AP, Tanner AC. The role of bacterial biofilms in dental caries and periodontal and peri-implant diseases: A historical perspective. *J Dent Res.* 2019;98(4):373-85. <https://doi.org/10.1177/0022034519830686>
PMid:30890060
 11. Lang NP, Attström R, Löe H, editors. Proceedings of the European Workshop on Mechanical Plaque Control: Status of the Art and Science of Dental Plaque Control: Castle of Münchenwiler, Berne, Switzerland, May 9-12, 1998. Switzerland: Quintessence Publishing (IL). 1998.
 12. van der Weijden GA, Hioe KP. Using a manual toothbrush, a manual toothbrush, a systematic review of the effectiveness of self-performed mechanical plaque removal in adults with gingivitis. *J Clin Periodontol.* 2005;32(Suppl 6):214-28. <https://doi.org/10.1111/j.1600051X.2005.00795.x>
PMid:16128840
 13. Serrano J, Escribano M, Roldán S, Martín C, Herrera D. Efficacy of adjunctive anti-plaque chemical agents in managing gingivitis: A systematic review and meta-analysis. *J Clin Periodontol.* 2015;42(Suppl 16):S106-38. <https://doi.org/10.1111/jcpe.12331>
PMid:25495592
 14. Moran JM. Home-use oral hygiene products: mouth rinses. *Periodontol.* 2000. 2008;48:42-53. <https://doi.org/10.1111/j.16000757.2008.00260.x>.
PMid:18715355
 15. Teles RP, Teles FR. Antimicrobial agents used in the control of periodontal biofilms: Effective adjuncts to mechanical plaque control? *Braz Oral Res.* 2009;23(Suppl 1):39-48. <https://doi.org/10.1590/s1806-83242009000500007>
PMid:19838557
 16. Houessou LG, Lougbegnon TO, Gbesso FG, Anagonou LE, Sinsin B. Ethno-botanical study of the African star apple (*Chrysophyllum albidum* G. Don) in the Southern Benin (West Africa). *J Ethnobiol Ethnomed.* 2012;8(1):40. <https://doi.org/10.1186/1746-4269-8-40>
PMid:23046832
 17. Walton RJ, Whitten DL, Hawrelak JA. The efficacy of *Hibiscus sabdariffa* (rosella) in essential hypertension: A systematic review of clinical trials. *Aust J Herb Med.* 2016;28(2):48-51.
 18. Varma SR, Sherif H, Serafi A, Fanas SA, Desai V, Abuhijleh E, et al. The antiplaque efficacy of two herbal-based toothpastes: A clinical intervention. *J Int Soc Prev Community Dent.* 2018;8(1):21-7. https://doi.org/10.4103/jispcd.JISPCD_411_17
PMid:29629325
 19. Nafisa D, Dewi W, Rachmawati E. Antibacterial efficacy of Rosella (*Hibiscus sabdariffa* Linn) flower extract against *Streptococcus sanguis*. *Padjadjaran J Dent.* 2015;27(1). <https://doi.org/10.24198/pjd.vol27no1.26691>
 20. Abukakar MG, Ukwuani AN, Shehu RA. Phytochemical screening and antibacterial activity of *Tamarindus indica* pulp extract. *Asian J Biochem.* 2010;5(4):310-4. <https://doi.org/10.3923/ajb.2008.134.138>
 21. Gupta C, Prakash D, Gupta S. Studies on the antimicrobial activity of Tamarind (*Tamarindus indica*) and its potential as food bio-preservative. *Int Food Res J.* 2014;21(6):2437-41.
 22. Abraham CM. Antibacterial effects of *Averrhoa bilimbi* L. fruit extracts. *Int Res J Biol Sci.* 2016;5(8):72-4.
 23. Yusni Y, Meutia F. Action mechanism of Rosella (*Hibiscus sabdariffa* L.) used to treat metabolic syndrome in elderly women. *Evid Based Complement Alternat Med* 2020;2020:5351318. <https://doi.org/10.1155/2020/5351318>