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Inhibitory potential of turmeric extract (*Curcuma domestica Val.*) toward the growth of *Streptococcus gordonii* bacteria

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Abstract

Introduction: Dental caries is a disease caused by damage to the hard tissue of the teeth by the metabolic activity of bacteria, one of which is the cariogenic bacteria *Streptococcus gordonii.* Turmeric is one of the most popular spices in Asia with good antibacterial capabilities. Turmeric content such as curcumin can inhibit bacterial growth.

Objective: To determine the potential inhibitory power of turmeric extract on the growth of *Streptococcus gordonii*.

Method: The research is carried out using in vitro laboratory experimental analytical research with a posttest only control group design. The research determined the effect of turmeric extract concentrations of 50%, 12.5%, 3.125%, 0.78% against *Streptococcus gordonii* bacteria on agar media. Statistical data analysis is carried out to determine whether there was a significant effect of turmeric extract on the inhibition of the growth of *Streptococcus gordonii* bacteria in each treatment.

Results: There was a significant influence on the test results between groups of turmeric extract concentration on the inhibitory power of *Streptococcus gordonii* bacteria.

Conclusion: Turmeric extract can inhibit the growth of *Streptococcus gordonii*. Higher concentration of turmeric rhizome extract which can inhibit the growth of *Streptococcus gordonii* bacteria more effectively.

Keywords: Bacteria; Caries; Turmeric Extract; Inhibitory Power; *Streptococcus Gordonii*

1. Introduction

Oral and dental health is an integral part of overall body health because oral health can affect the overall health condition of the body (5). The Federation Dentaire Internationale (FDI) of World Dental Federation states that the most common problem that occurs in the teeth and mouth is dental caries (1).

Dental caries is a disease caused by direct damage to the hard tissue of the teeth by the metabolic activity of bacteria in plaque which causes demineralization of the teeth (14). According to Basic Health Research in 2018, 45.3% of Indonesian people experienced caries. In the 5-9 year age group, the number of children who experienced tooth decay was 54.0% and dental caries in children aged 10-12 years was 1.89% (Riskesdas, 2018). Therefore, it is still necessary to develop effective strategies to combat dental caries.

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Plaque on teeth is the first step in development of dental caries (15). *Streptococcus gordonii* are pioneer bacteria that initiate the formation of plaque on teeth (12). *Streptococcus gordonii* is a Gram-positive bacteria, namely bacteria that are often found in the oral cavity, skin and intestines. In the oral cavity, this bacteria is found in patients with caries or apical periodontitis. This bacteria is also known as an opportunistic pathogen that can cause systemic or local disease (10).

It is found that dental caries is associated with primary cariogenic bacteria such as *Streptococcus mutans* and *Streptococcus sobrinus* in *Streptococci viridans*. However, there are other oral *Streptococcus* bacteria, such as *Streptococcus oralis, Streptococcus gordonii, Streptococcus sanguinis, and Streptococcus salivarius* which will also affect dental caries by modulating biofilm (8).

Turmeric (*Curcuma domestica Val*.) is one of the most popular spices in Asia and is widely available under various brands for consumers to choose from. Based on previous research, it was found that ethanolic extract of turmeric powder from various forms such as homemade, open market, and two commercially packaged brands has antioxidant, anti-inflammatory, and antibacterial activity (7). Herbal medicines are used because their herbal substances are considered not to cause side effects and are safe (13). Turmeric contains compounds such as flavonoids, alkaloids, essential oils, curcumin, tannins, terpenoids and saponins. The health benefits of turmeric far exceed its minor side effects, research has shown that this compound has benefits for inhibiting the growth of *Streptococcus gordonii*, especially the compound curcumin and its essential oil which can inhibit bacterial growth (9). Side effects of turmeric can occur if consuming higher doses because it can damage glutathione which functions as a natural antioxidant in the body (3).

Researchers have done several efforts to prevent the process of caries is by conducting research on the bacteria involved in the caries process, one of which is *Streptococcus gordonii* which is a pioneer bacteria in the formation of plaque on teeth, where this formation of dental plaque, if left unchecked, will cause caries on teeth. Based on the background, researchers will examine the potential inhibitory power of turmeric extract on the growth of *Streptococcus gordonii* bacteria. This research aims to determine the potential inhibitory power of turmeric extract on the growth of *Streptococcus gordonii.*

2. Material and methods

This research is done to examine the potential inhibitory power of turmeric extract on the growth of *Streptococcus gordonii* bacteria used in vitro laboratory experimental analytical research with a post test only control group design. The material tested in this study is turmeric with samples of *Streptococcus gordonii* bacteria in Brain Heart Infusion Broth (BHIB) media, incubated in an incubator for 2x24 hours at a temperature of 37°C.

The equipment used in this research is previously sterilized using an autoclave at a temperature of 121°C and a pressure of 1.5 atm for 15 minutes. Turmeric extract is made using a maceration technique using 96% ethanol. The result of maceration is then evaporated using a rotary evaporator at a temperature of 50°C with the aim of evaporating the solvent mixed with the ingredients during the extraction process so that turmeric extract is obtained in the form of a thick liquid. Bacterial samples are prepared in BHIB medium. Before treatment, turmeric extract is diluted with serial dilution with final results of 50%, 12.5%, 3.125%, 0.78%.

The inhibition test is carried out using a paper disk placed evenly on Mueller Hinton Agar (MHA) media in a petri dish using the spreading technique. Treatment with turmeric extract concentrations of 50%, 12.5%, 3.125%, 0.78% is given to each sterile paper disk in the amount of 0.01 ml with a sterile micropipette. Incubate the petri dish for 48 hours anaerobically at 37°C. After 48 hours, the inhibition zone or clear zone formed around the disk is observed and the diameter of the inhibition zone that appears around the paper disk is measured.

Statistical data analysis is carried out to determine whether there was a significant effect of turmeric extract on the inhibition of the growth of *Streptococcus* gordonii bacteria in each treatment. The data obtained is analyzed using the One-Way Anova test method to determine differences between treatments and calculations carried out using IBM SPSS

3. Results and discussion

This research is done with *Streptococcus gordonii* bacteria given with different intervention, namely Negative Control (K-), as well as turmeric extract with concentrations of 50%, 12.5%, 3.125% and 0.78%. The results were calculated using 3 repetitions or replications so that the total sample was 15 samples of research subjects. The results of the

descriptive analysis show an overview of the information using mean, minimum, maximum and standard deviation values using SPSS Statistics version 26.

The results show that the highest average test results are samples given a concentration of 50% with an average result of 19.23 + 0.10 mm. The smaller the concentration given, the lower the results produced, where a concentration of 12.5% has a value of 14.35 + 0.28 mm, a concentration of 3.125% has a value of 9.65 + 0.13 mm, and a concentration of 0, 78% produces the lowest value compared to other concentrations, except the negative control, which is 0 mm. Descriptive results show that the concentration with the highest measurement results is 50% with a value reaching19.23 + 0.10 mm, and the concentration with the lowest measurement results is 0.78%, the same as the negative control where both groups have a result of 0 mm.

The results of the normality test show significant results (p>0.05), therefore it can be concluded that the data is normally distributed and meets the requirements for use of the One-Way Anova test. The results of the homogeneity test show that between the test groups there is diversity that is not homogeneous, so the difference test can still be continued in the One-Way Anova test analysis. After the One-Way Anova test, data that is not homogeneous can be continued with a Post Hoc test using the Games-Howell test (equal variance not assumed).

The One-Way Anova statistical test was carried out to determine whether there were significant differences in test results between groups. The results of the One-Way Anova test shown that there is a significant influence on the test results between concentration groups. Because there is a significant influence, further analysis was carried out using the Post Hoc test with the Games-Howell test to determine which concentrations were significantly different from other concentrations.

Table 1 Post Hoc Games-Howell Test Result

Groups K (-)	**50%**	**12.5%**	**3.125%**	**0.78%**
50%	0.000*			
12.5%	0.001*	0.001*		
3.125%	0.000*	0.000*	0.001*	
0.78%	1.000	0.000*	0.000*	0.000*

*= Significance of 5% (p < 0,05)

Table 1 shows the results of the Post Hoc test using the Games-Howell test, namely that the negative control concentration had significantly different test results from concentrations of 50%, 12.5% and 3.125% (p<0.05). However, the negative control had the same test results with a concentration of 0.78% (p> 0.05). On average, theconcentration that produced the highest value was the 50% concentration with a value of 19.23 + 0.10 mm and this value was significantly different from the other groups.

This research is a laboratory experimental study to determine the ability of turmeric rhizome extract at concentrations of 50%, 12.5%, 3.12% and 0.78% at inhibiting the growth of *Streptococcus gordonii* bacteria. The antibacterial activity of turmeric rhizomes is done using a caliper to measure the diameter of the inhibition zone formed in the medium after incubation for 48 hours.

This research is carried out using the *Streptococcus gordonii* bacteria. This cariogenic bacteria is a pioneer bacteria that initiates the formation of plaque on teeth. Pioneer bacteria are generally considered commensals or even beneficial in maintaining oral health. However, if dental plaque is not controlled properly it can cause bad effects on the teeth such as dental caries or periodontitis (12).

The antibacterial activity of a plant extract can be influenced by several factors, such as the extract concentration, extract diffusion power, extract solvent, type of bacteria and bacterial resistance to compounds contained in plant extracts. Turmeric rhizome extract is used because of the compounds within such as curcumin, essential oils, flavonoids, saponins and alkaloids. The compounds in turmeric extract are used as antibacterials, where these compounds can damage bacterial cell walls to inhibit the growth of *Streptococcus gordonii* bacteria (6).

The main compound in turmeric rhizomes is curcumin. The mechanism of curcumin's action as an antibacterial is by damaging cell proteins in bacteria, causing a nutrient leak in bacteria which can inhibit bacterial growth (Dai et al.,

2022). The mechanism action of essential oils as antibacterials is by inhibiting cell formation and lysing cell membranes by dissolving phospholipids, and interacting hydroxyl groups with carbonyl groups and bacterial cell membrane proteins therefore these proteins lose their function (11). Flavonoids work as antibacterials by forming complex compounds with dissolved proteins and extracellular proteins, thereby damaging cell membranes (6). Saponin compounds have the ability to inhibit protein synthesis because they accumulate and cause damage to the components that make up bacterial cells (2). The mechanism of action of alkaloid compounds as antibacterials is by disrupting the peptidoglycan components in bacterial cells to disrupt the cell wall layer formation (6).

Based on this research, the four concentrations of turmeric rhizome extract showed antibacterial activity by forming different inhibition zones. The largest inhibition zone results were shown by a turmeric rhizome extract concentration of 50% followed by concentrations of 12.5%, 3.125%, and 0.78% respectively. It can be seen that the results of the experiment with a 50% concentration of turmeric rhizome extract produced the highest antibacterial effect because it showed the largest diameter of the inhibition zone.

4. Conclusion

Based on the results of the research, it can be concluded that there is potential inhibitory power of turmeric extract on the growth of *Streptococcus gordonii* bacteria.

In this research, only results about potential inhibitory power of bacteria against turmeric extract is obtained, therefore further research is needed:

- There is a need for research on turmeric extract in inhibiting other cariogenic bacteria that cause dental caries.
- Biomolecular research is needed on the active content of turmeric extract (*Curcuma domestica Val.*) for better results.

Compliance with ethical standards

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Disclosure of Conflict of interest

I declare no conflict of interest.

References

[1] Alshammary, F. L., Mobarki, A. A., Alrashidi, N. F., & Madfa, A. A. (2023). Association between different behavioral factors and dental caries among children attending the dental clinics in a sample from Saudi Arabia.BMC Oral Health, 23(1), 198. https://doi.org/10.1186/s12903-023-02849-8

[2] Chismirina, S., Sungkar, S., Andayani, R., & Rezeki, S. (2021). Existence of Streptococcus Mutans and Streptococcus Sobrinus in Oral Cavity as Main Cariogenc Bacteria of Dental Caries.

[3] Cianfruglia, L., Minnelli, C., Laudadio, E., Scirè, A., & Armeni, T. (2019). Side effects of curcumin: Epigenetic and antiproliferative implications for normal dermal fibroblast and breast cancer cells. Antioxidants, 8(9). https://doi.org/10.3390/antiox8090382

[4] Dai, C., Lin, J., Li, H., Shen, J., Shen, Z., Wang, Y., & Velkov, T. (2022). The Natural Product Curcumin as an Antibacterial Agent: Current Achievements and Problems. In Antioxidants (Vol. 11, Issue 3). MDPI. https://doi.org/10.3390/antiox11030459

[5] Fiorillo, L. (2019). Oral health: The first step to well-being. In Medicina (Lithuania) (Vol. 55, Issue 10). MDPI AG. https://doi.org/10.3390/medicina55100676

[6] Kasta, G. (2020). Antimicrobial Activity of Ethanol Extract of Rhizome Turmeric (Curcuma Longa L.) For Growth of Escherichia coli, Staphylococcus aureus and Candida albicans. Asian Journal of Pharmaceutical Research and Development, 8(3), 5–8. https://doi.org/10.22270/ajprd.v8i3.712

[7] Khatun, M., Nur, M. A., Biswas, S., Khan, M., & Amin, M. Z. (2021). Assessment of the anti-oxidant, anti-inflammatory and anti-bacterial activities of different types of turmeric (Curcuma longa) powder in Bangladesh. Journal of Agriculture and Food Research, 6, 100201. https://doi.org/10.1016/j.jafr.2021.100201

[8] Meriç, E., Bolgül, B., Duran, N., & Ay, E. (2020). Evaluationof oral streptococci in saliva of children with severe early childhood caries and caries-free. European Journal of Paediatric Dentistry, 21(1), 13–17.https://doi.org/10.23804/ejpd.2020.21.01.03

[9] Oluwafemi, A. G., Ajayi, O. B., & Oseni, O. A. (2022). Phytochemical Screening, Nutritional Composition, and Antioxidant Activities of Turmeric (Curcuma longa) Found in Ado-ekiti, Nigeria. Journal of Applied Life Sciences International, 1–8. https://doi.org/10.9734/jalsi/2022/v25i130278

[10] Park, O. J., Kwon, Y., Park, C., So, Y. J., Park, T. H., Jeong, S., Im, J., Yun, C. H., & Han, S. H. (2020). Streptococcus gordonii: Pathogenesis and host response to its cell wall components. Microorganisms, 8(12), 1–22. https://doi.org/10.3390/microorganisms8121852

[11] Rihayat, T., Hadi, A. E., Aidy, N., Safitri, A., Siregar, J. P., Cionita, T., Irawan, A. P., Hamdan, M. H. M., & Fitriyana,D. F. (2021). Biodegradation of polylactic acid-based bio composites reinforced with chitosan and essential oils as anti-microbial material for food packaging. Polymers, 13(22). https://doi.org/10.3390/polym13224019

[12] Rostami, N., Shields, R. C., Serrage, H. J., Lawler, C., Brittan, J. L., Yassin, S., Ahmed, H., Treumann, A., Thompson, P., Waldron, K. J., Nobbs, A. H., & Jakubovics, N. S. (2022). Interspecies competition in oral biofilms mediated by Streptococcus gordonii extracellular deoxyribonuclease SsnA. Npj Biofilms and Microbiomes, 8(1). https://doi.org/10.1038/s41522-022-00359-z

[13] van Wyk, A. S., & Prinsloo, G. (2020). Health, safety and quality concerns of plant-based traditional medicines and herbal remedies. In South African Journal of Botany (Vol. 133, pp. 54–62). Elsevier B.V. https://doi.org/10.1016/j.sajb.2020.06.031

[14] Zhao, H., Wang, X., Liu, Z., Wang, Y., Zou, L., Chen, Y., & Han, Q. (2023). The effect of argon cold atmospheric plasma on the metabolism and demineralization of oral plaque biofilms. Frontiers in Cellular and Infection Microbiology, 13. https://doi.org/10.3389/fcimb.2023.1116021

[15] Zheng, H., Xie, T., Li, S., Qiao, X., Lu, Y., & Feng, Y. (2021). Analysis of oral microbial dysbiosis associated with early childhood caries. BMC Oral Health, 21(1). https://doi.org/10.1186/s12903-021-01543