

Article Review

Effectiveness of Guava Leaf Extract (*Syzygium Aqueum*) in Inhibiting The Growth of Bacteria *Aggregatibacter Actinomycetemcomitans*

Attidhira Citra Lestari Sudrajat¹, Puspito Ratih Hardhani¹, Ayuda Nur Sukmawati¹, Steffi Triany Arnov¹, Noor Rimawati¹

¹ Faculty of Dentistry, Universitas Muhammadiyah Semarang, Indonesia

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Abstract

The role of *Aggregatibacter actinomycetemcomitans* bacteria can lead to the occurrence of aggressive periodontitis. The bacterium infects periodontal tissue with its virulence factor. Antibacterial administration such as *chlorhexidine* mouthwash is one of the treatments for periodontal disease due to bacteria. Long-term use of chlorhexidine can cause irritation of the oral mucosa, burning sensation, changes in taste perception and the appearance of stains on the teeth. One alternative is to gargle the guava leaf extract water. The antibacterial effect of guava leaf extract is obtained from its chemical compounds, namely *flavonoids*, *phenolics*, *alkaloids*, *ethanol* and *tannins*. This research aims to know the potential of water guava leaf extract (*Syzygium aqueum*) in inhibiting the growth of *Aggregatibacter actinomycetemcomitans* bacteria. A literature review by reviewing research articles from ScienceDirect and Google Scholar using the keywords "*Syzygium aqueum* and *Aggregatibacter actinomycetemcomitans*". Guava leaves contain many derivatives of compounds such as flavonoids, alkaloids, tannins, saponins, and terpenoids. The content of these compounds can be used as antibacterial because they are effective in inhibiting the growth of bacteria. Water guava leaf extract (*Syzygium aqueum*) can inhibit the growth of *Aggregatibacter actinomycetemcomitans* bacteria.

INTRODUCTION

The role of *Aggregatibacter actinomycetemcomitans* bacteria can lead to the occurrence of aggressive periodontitis.¹ Aggressive periodontitis is one of the periodontal diseases that generally affects individuals under the age of 30 years but can also be at an older age. The results of data from RISKESDAS state that the prevalence of the population who have periodontal disease in Indonesia

reaches 73.1% – 75% consisting of young age and adult age.²

Antibacterial administration is one of the options in dealing with periodontal tissue disease.³ Chlorhexidine mouthwash can prevent plaque formation and remove plaque that has formed. Long-term use of 0.2% chlorhexidine has side effects including causing irritation of the oral mucosa, burning sensation, changes in taste perception and the appearance of stains on teeth.⁴ Antibacterial administration is one

Corresponding author:

Attidhira Citra Lestari Sudrajat

attidhiracitra@gmail.com

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of the options in dealing with infectious diseases. However, the uncontrolled use of antibacterials can encourage the development of resistance to the given antibacterial. The use of herbal plants in Indonesia as medicines is part of Indonesian culture. Plants that are mandated as natural antibacterial agents, one of which is *Syzygium aqueum* or guava leaves. The results of the other study of ethanol extracts in the leaves of *S. aqueum* contain 6 types of flavonoids, namely 4-hydroxybenzoic acid, myricetin-3-O-rhamnoside, phloretin, myricetin-3-O-gallate, and myricetin-3-O-glucuronide.⁵ In addition to containing flavonoids, guava also contains terpenoid compounds, tannins and phenolics.⁶ Based on the description above, researchers are interested in knowing the effectiveness of guava leaves (*Syzygium aqueum*) against the growth of the bacterium *Aggregatibacter actinomycetemcomitans*. Because this bacterium is one of the pathogenic bacteria that causes several diseases in the oral cavity, especially periodontitis. Water guava leaf extract is expected as an alternative to prevention and treatment of the oral cavity.

METHOD

The type of research used is literature study, which is a process or activity of collecting data from various literature such as books and journals to compare the results of one study with another. The purpose of this literature study research is to obtain a theoretical basis that can support the solution of the problem under study and reveal various theories relevant to case.⁷

The data used in this study are secondary data. Secondary data is data or information

obtained by researchers from existing and public sources, the data consists of documents, books, previous research, reports.⁸ The secondary data source used in this study is a journal or scientific article that can study the antibacterial extract of guava leaves against *Aggregatibacter actinomycetemcomitans* bacteria.

The data collection technique used in this study is documentation. Documentation according to other research is a method used to obtain data or information in the form of writings, books, images, archives, and images in the form of reports and captions that can support research. The documentation used to collect the data is then reviewed.⁹

The search for articles and journals related to research that will be researched is obtained from google scholar <https://scholar.google.com/>, science direct www.sciencedirect.com, and pubmed www.pubmed.com using keywords that are in accordance with the research taken for further analysis.

RESULT

Search results for journals and scientific articles were conducted on August 29, 2020 on the Pubmed database (<https://pubmed.ncbi.nlm.nih.gov/>), Google Scholar (<https://scholar.google.co.id>), and Science Direct (<https://www.sciencedirect.com/>) related to the potential of guava leaf extract (*Syzygium aqueum*) in inhibiting the growth of *Aggregatibacter actinomycetemcomitans* bacteria using various keywords that have been determined as follows:

Table 1
Keyword Search Results in the source Database

Source database	Keywords	Extract <i>Syzygium aqueum</i>	Antibacterial <i>Syzygium aqueum</i>	Chemicals of <i>Syzygium aqueum</i>
Pubmed	August 29, 2020	12	1	3
GoogleScholar	29 August 2020	3120	1320	2270
ScienceDirect	August 29, 2020	31	7	29

The phytochemical test conducted by other research showed that the water guava leaf extract contains chemical compounds in the form of flavonoids, alkaloids, tannins, saponins, and terpenoids.⁵ This is evidenced by the formation of red or green color after Mg and 3 drops of HCl are added, indicating that the sample contains flavonoids. There is a red or orange precipitate after dissolving with HCl and NaCl indicating the presence of alkaloids. The formation of a bluish-black or green precipitate after being given 2-3 drops of 1% FeCl₃ proves that the sample contains tannin. The formation of stable bubbles or foam after being dissolved in distilled water and homogenized for 30 seconds indicates the sample contains saponins. Meanwhile, the reddish brown color formed after the extract was dissolved in 3 mL of chloroform and dripped with H₂SO₄, indicated that the sample contained terpenoids. According to other research tested various concentrations of water guava leaf extract against *Staphylococcus aureus* bacteria and found the ability to inhibit these bacteria with the least number of colonies at a concentration of 20%.

The results of the phytochemical test of guava leaf extract conducted by other research to test antioxidant activity showed that guava leaf extract contains flavonoids, alkaloids, tannins, saponins and terpenoids which are explained in the following table:

Table 2

Phytochemical Tests of Water Guava Leaf Extract		
Phytochemical Test	Research result	Information
Flavonoids	The solution is red or green	Positive
Alkaloids	Red or orange precipitate	Positive
tannins	Precipitate of bluish black or green color	Positive
Saponins	Stable bubble or foam	Positive
terpenoids	The solution is reddish brown	Positive

The test results from the study also showed the presence of other antioxidant active

compounds such as steroids and polyphenols. Other research carried out extracting guava leaves by maceration with ethanol solvent and obtained antibacterial active compounds contained in guava leaf extract in the form of flavonoids, phenolics and tannins.

DISCUSSION

Antibacterial activity can be aimed at the presence of positive results on phytochemical tests on flavonoid compounds, alkaloids, tannins, saponins and terpenoids.¹⁰ Choerina conducted an antibacterial test of guava leaf extract against the growth of *Staphylococcus aureus* and *Escherichia coli* bacteria, in the study it can be concluded that there is antibacterial activity. When compared to the use of chlorhexidine, guava leaf extract is safer than long-term use of chlorhexidine. Long-term use of chlorhexidine can cause effects such as brownish-yellow stains on teeth and the edges of tooth spills, and a bitter taste. While the use of guava leaf extract is safer from side effects such as those caused by the use of chlorhexidine. Antibacterial tests of guava leaf extract also affect the growth of *Salmonella typhi* bacteria.¹¹ In guava leaf extract, there is also a high content of compounds such as minerals, and vitamin C.¹²

The bacterium *Aggregatibacter actinomycetemcomitans* invades the tissues of the oral cavity by attaching to periodontal tissue or on the surface of the teeth. When bacteria attach to periodontal tissue or tooth surface, *Aggregatibacter actinomycetemcomitans* bacteria will fight against normal flora bacteria in the oral cavity. After that, the bacterium *Aggregatibacter actinomycetemcomitans* will infect the surrounding tissues with a virulence factor.^{1,13,14} One way to prevent bacteria from infecting surrounding tissues is with the use of antibacterials. The use of chemical compounds in guava leaf extract can damage the structure of bacteria, so it

can inhibit the virulence produced by bacteria.

The first chemical compounds are flavonoids. The mechanism of action of flavonoids as antibacterials is divided into 3 ways, namely inhibiting the synthesis of nucleic acids, inhibiting the function of cell membranes, and inhibiting the energy metabolism of bacteria. Flavonoids can inhibit the synthesis of nucleic acids because there are rings A and B that play an important role in the *process of interclass* or hydrogen bonding. The A and B rings will create a buildup of nucleic acid bases in bacteria so that they can inhibit the formation of DNA and RNA.¹⁵ Meanwhile, flavonoids inhibit the function of cell membranes by forming complex compounds with extracellular proteins in bacteria so that the compounds formed can damage the permeability of bacterial cell walls, microsomes, and lysosomes.¹⁶ In addition, flavonoids can inhibit energy metabolism by inhibiting the use of oxygen by bacteria. Inhibition of oxygen use by bacteria will inhibit the formation of metabolism as well so that bacteria will experience cell death.¹⁷ In addition to being antibacterial, flavonoids are also useful as antioxidants.¹⁸

Alkaloids can be used as antibacterials by damaging the constituent components of *peptidoglycan* in bacterial cells, so that the cell wall layer is not formed intact and causes cell death.¹⁶ In addition, in alkaloid compounds there is also an alkaline group containing nitrogen which when reacting with amino acid compounds will result in structural changes in bacteria. The arrangement of amino acids can also cause changes in the genetic balance in the DNA chain so that bacteria will be damaged and encourage lysis which will result in cell death in bacteria.¹⁹

The mechanism of action of tannins as antibacterials is by inhibiting the enzymes *reverse transcriptase* and *DNA topoisomerase* so that bacterial cells cannot

form. Aninhas the ability to turn off microbial cell adhesins, kill enzymes, and interfere with protein *transport* in the inner layer of bacterial cells. In addition, tanin can also damage *cell wall polypeptides* so that the formation of cell walls becomes less than perfect. This causes bacterial cells to become lysis due to osmotic and physical pressure so that bacterial cells will die.²⁰ The *astringent* content in tannins can also increase the toxicity of tannins.²¹ Apart from being antibacterial, tannins also have benefits as an antidote to free radicals in the body.²²

The mechanism of action of saponins as antibacterials isto cause leakage of proteins and enzymes from the cell. Saponins can be anti-bacterial because the surface-active substances are similar to detergents, as a result of which saponins will lower the surface tension of the bacterial cell wall and damage the membrane permeability. The permeability of this cell membrane permeability greatly interferes with the survival of bacteria. Saponins will diffuse through the outer membrane of the vulnerable cell wall and then bind to the cytoplasmic membrane of bacteria so that it can disrupt and reduce the stability of the cell membrane. This causes the cytoplasm to leak out of the cells resulting in the death of cells.^{16,23}

Terpenoid compounds can function as antibacterials by inhibiting growth by disrupting the process of forming membranes or cell walls so that the bacterial cell wall is not formed perfectly.⁶ The mechanism of terpenoids as antibacterials is to react with purines on the outer membrane of bacterial cells to form strong polymer bonds, resulting in the destruction of purines. The destruction of purines will cause the entrance and exit of the compound to decrease the permeability of the bacterial cell membrane which will result in bacterial cells lacking nutrients so that bacterial growth decreases and even results in the death of bacteria.^{16,17}

CONCLUSION

The conclusion of this literature study is that guava leaf extract (*Syzygium aqueum*) which contains flavonoid compounds, alkaloids, tannins, saponins and terpenoids is able to be antibacterial in the oral cavity. Thus, when used as an alternative to mouthwash, it can reduce the occurrence of periodontal infection.

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