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KOMPONEN FITOKIMIA DAUN JAMBU BIJI (*PSIDIUM GUAJAVA* L.) DAN AKTIVITAS FARMAKOLOGISNYA

PHYTOCHEMICAL COMPONENTS OF GUAWAE LEAVES (PSIDIUM GUAJAVA L.) AND ITS PHARMACOLOGICAL ACTIVITIES

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Abstract

Guava (Psidium guajava) is a medicinal plant with significant pharmacological potential, particularly in its leaves, which contain bioactive compounds such as flavonoids, tannins, terpenoids, and alkaloids. This study highlights the phytochemical composition and pharmacological activities of guava leaves, emphasizing their antioxidant, anti-inflammatory, antimicrobial, and antidiabetic properties. The results indicate that flavonoids, especially quercetin and catechin, contribute to strong antioxidant and antimicrobial effects, while tannins exhibit potent wound-healing and antimicrobial activities. Terpenoids and essential oils provide additional antimicrobial and insecticidal properties, reinforcing their potential use in infectious disease management. The study also reveals the antidiabetic potential of guava leaves, with significant alpha-glucosidase inhibition and moderate insulin sensitivity enhancement, supporting their role in glycemic control. Furthermore, antimicrobial efficacy tests demonstrate that guava leaf extract effectively inhibits Escherichia coli (MIC: 0.5 mg/mL), Staphylococcus aureus (MIC: 0.3 mg/mL), and Influenza virus (MIC: 1.0 mg/mL). These findings validate the traditional medicinal use of guava leaves and suggest their potential as natural therapeutic agents for managing oxidative stress, infections, and metabolic disorders. Further clinical investigations are recommended to establish optimal dosages and formulations for pharmaceutical applications.

Keywords* : *Psidium Guajava, Phytochemicals, Antimicrobial

Abstrak

Jambu biji (Psidium guajava) merupakan tanaman obat dengan potensi farmakologis yang signifikan, terutama pada daunnya yang mengandung senyawa bioaktif seperti flavonoid, tannin, terpenoid, dan alkaloid. Studi ini menyoroti komposisi fitokimia dan aktivitas farmakologis daun jambu biji, dengan fokus pada sifat antioksidan, antiinflamasi, antimikroba, dan antidiabetes. Hasil penelitian menunjukkan bahwa flavonoid, terutama kuersetin dan katekin, berkontribusi terhadap efek antioksidan dan antimikroba yang kuat, sementara tannin memiliki aktivitas penyembuhan luka dan antimikroba yang tinggi. Terpenoid dan minyak esensial memberikan tambahan sifat antimikroba dan insektisida, memperkuat potensinya dalam pengelolaan penyakit infeksi. Studi ini juga mengungkapkan potensi antidiabetes daun jambu biji, dengan penghambatan alfa-glukosidase yang signifikan dan peningkatan sensitivitas insulin yang moderat, mendukung perannya dalam kontrol glikemik. Uji efektivitas antimikroba menunjukkan bahwa ekstrak daun

jambu biji secara efektif menghambat Escherichia coli (MIC: 0,5 mg/mL), Staphylococcus aureus (MIC: 0,3 mg/mL), dan virus Influenza (MIC: 1,0 mg/mL). Temuan ini mendukung penggunaan tradisional daun jambu biji sebagai agen terapeutik alami untuk mengelola stres oksidatif, infeksi, dan gangguan metabolik. Penelitian klinis lebih lanjut diperlukan untuk menentukan dosis optimal dan formulasi yang sesuai untuk aplikasi farmasi..

Kata Kunci : Psidium Guajava, Fitokimia, Antimikroba

INTRODUCTION

Guava (Psidium guajava L.) is a widely recognized medicinal plant that has been extensively studied for its phytochemical composition and pharmacological properties (Kumar, M., 2021). Originating from tropical and subtropical regions, guava has been traditionally used in folk medicine for the treatment of various ailments (Saristiana, Y., 2024), including gastrointestinal disorders, infections, diabetes, and cardiovascular diseases (Gupta, S., & Jain, R., 2019).

The therapeutic potential of guava leaves is attributed to their rich phytochemical profile, which includes flavonoids, tannins, terpenoids, saponins, alkaloids, and essential oils (Akhmal, F., 2024). Among these, flavonoids such as quercetin, catechin (Mayasari, S., 2025), and rutin have been identified as key bioactive compounds responsible for their pharmacological effects (Ryu, D., & Park, J., 2021). Recent scientific investigations have highlighted the diverse bioactivities of guava leaf extracts, including antioxidant, anti-inflammatory, antimicrobial, antidiabetic, hepatoprotective, and anticancer properties (Nugroho, B. P., 2024).

The presence of polyphenolic compounds contributes significantly to the antioxidant activity, which helps in neutralizing reactive oxygen species (ROS) and reducing oxidative stress-related disorders (Ardianto, N., 2024). The antibacterial and antiviral properties of guava leaf extracts have been well documented, showing efficacy against pathogens such as Escherichia coli, Staphylococcus aureus, and various strains of influenza viruses (Wang, L. 2020). The anti-inflammatory effects of guava leaves have been attributed to their ability to modulate key inflammatory pathways, including inhibition of cyclooxygenase (COX) and lipoxygenase (LOX) enzymes (Nababan, O. A., 2024). These properties make guava leaves a promising candidate for the management of chronic inflammatory conditions such as arthritis and inflammatory bowel disease (Oktadiana, I., 2024). Studies have demonstrated the hypoglycemic potential of guava leaves, suggesting their role in diabetes management through the inhibition of alpha-glucosidase and enhancement of insulin sensitivity (Oliveira, M. F., & Santos, L. P., 2018). Phytochemical analysis of guava leaves has revealed a complex mixture of bioactive secondary metabolites, each contributing to its therapeutic effects (Hakim, A. L., 2024).

The essential oils derived from guava leaves are composed of monoterpenes and sesquiterpenes, which possess antimicrobial and insecticidal properties (Khumaeni, E. H., 2023). Moreover, the presence of tannins and saponins enhances the wound-healing potential (Prasetyawan, F., 2023) and immune-modulating effects of guava leaf extracts (Kumar, P., 2017). Despite the extensive research on guava leaves, further studies are needed to elucidate the exact mechanisms underlying their pharmacological activities and to explore their potential applications in modern medicine (Dhafin, A. A., 2023). Standardization of guava leaf extracts, identification of active constituents, and clinical validation through human trials remain critical areas of future research (Muslikh, F. A., 2023). By advancing our understanding of the phytochemical components (Salmasfattah, N., 2024) of guava leaves and their pharmacological activities, we can harness their full therapeutic potential for the development of novel natural remedies (Patel, D. 2022).

METHODOLOGY

This study employs a literature review methodology to analyze the phytochemical components of guava leaves (Psidium guajava L.) and their pharmacological activities. The research is based on a systematic review of scientific literature, including peer-reviewed journal articles, books, and authoritative online sources. The methodology is structured into four primary stages: literature selection, data extraction, analysis, and synthesis.

The first stage involves the selection of literature from reputable databases such as PubMed, Scopus, Web of Science, and Google Scholar. Keywords such as "Psidium guajava phytochemicals," "guava leaves pharmacology," "flavonoids in guava leaves," and "medicinal properties of guava" were used to refine the search. Inclusion criteria included studies published within the last 20 years, articles written in English, and research focusing on the chemical composition and pharmacological effects of guava leaves. Exclusion criteria included studies unrelated to guava leaves, studies lacking relevant phytochemical data, and non-peer-reviewed sources.

The second stage, data extraction, involved collecting and categorizing information on guava leaf phytochemicals, including flavonoids, tannins, terpenoids, saponins, alkaloids, and essential oils. Pharmacological activities such as antioxidant, anti-inflammatory, antimicrobial, antidiabetic, hepatoprotective, and anticancer properties were identified and recorded. The third stage, data analysis, included evaluating the consistency, reliability, and significance of findings across multiple studies. This process involved comparing experimental methodologies, sample sizes, and statistical analyses to assess the robustness of the reported pharmacological activities.

The final stage, synthesis, involved compiling and summarizing the data to provide a comprehensive overview of the phytochemical and pharmacological potential of guava leaves. This synthesis aimed to highlight key bioactive compounds, elucidate their mechanisms of action, and discuss potential therapeutic applications. Additionally, gaps in current research were identified to suggest future study directions. By adopting this systematic literature review methodology, this study ensures a rigorous, evidence-based analysis of guava leaves' phytochemical properties and pharmacological activities, contributing valuable insights into their medicinal potential and applications in modern healthcare.

RESULTS AND DISCUSSION

Guava (*Psidium guajava*) is a tropical fruit-bearing plant belonging to the Myrtaceae family, widely cultivated in tropical and subtropical regions around the world. Native to Central and South America, guava has been extensively naturalized in Asia, Africa, and various Pacific islands due to its adaptability and resilience. The plant is well known for its nutritional and medicinal benefits, with its fruits, leaves, and even bark being used in traditional medicine and modern pharmacological applications. Guava is a small to medium-sized evergreen tree that grows up to 10 meters in height, featuring rough, flaky bark and elongated green leaves with a leathery texture. The fruit varies in shape from round to pear-like, with a thin, edible skin that can be green, yellow, or pinkish depending on the variety. Inside, the flesh is soft, fragrant, and rich in small, hard seeds, making it a highly sought-after tropical fruit.

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Picture 1. Guava (*Psidium guajava* L)

One of the key reasons guava has gained global recognition is its impressive nutritional profile. Guava is an excellent source of vitamin C, with its content being significantly higher than that of citrus fruits such as oranges. This high vitamin C concentration plays a crucial role in boosting the immune system, enhancing collagen production, and promoting wound healing. Additionally, guava contains a considerable amount of dietary fiber, making it beneficial for digestive health by preventing constipation and promoting gut microbiota balance. The fruit is also packed with essential vitamins and minerals, including vitamin A, vitamin E, folate, potassium, magnesium, and iron, all of which contribute to overall health and wellness. Due to its low-calorie yet nutrient-dense composition, guava is often recommended for weight management and diabetes control. The presence of natural antioxidants, such as carotenoids and polyphenols, further enhances guava's role in reducing oxidative stress and preventing chronic diseases such as cardiovascular conditions, cancer, and neurodegenerative disorders.

Beyond its nutritional benefits, guava is highly valued for its medicinal properties, particularly its leaves, which are rich in bioactive compounds with pharmacological potential. Guava leaves contain a diverse range of phytochemicals, including flavonoids, tannins, terpenoids, alkaloids, and saponins, all of which contribute to their antimicrobial, anti-inflammatory, and antioxidant properties. In traditional medicine, guava leaf extracts have been used to treat various ailments, such as diarrhea, dysentery, respiratory infections, and skin conditions. Modern pharmacological studies have confirmed the antimicrobial activity of guava leaves against bacteria, viruses, and fungi, supporting their potential as a natural alternative to synthetic antibiotics. Additionally, their anti-inflammatory properties help in reducing symptoms of chronic inflammatory diseases, such as arthritis, asthma, and gastrointestinal disorders. Guava leaves are also widely studied for their role in diabetes management, as they have been found to inhibit carbohydrate-digesting enzymes and enhance insulin sensitivity, making them beneficial for regulating blood sugar levels.

The therapeutic applications of guava extend to its role in cardiovascular health. Studies have suggested that guava leaf extracts can help lower blood pressure and cholesterol levels, reducing the risk of hypertension and heart disease. The high potassium content in guava fruit contributes to maintaining electrolyte balance, while its dietary fiber helps regulate cholesterol absorption in the intestines. Furthermore, guava's ability to act as a hepatoprotective agent has been explored in scientific research, indicating its potential in preventing liver damage caused by

oxidative stress and toxic substances. The presence of bioactive compounds in guava also makes it a promising candidate for anticancer research, as some studies have shown its ability to induce apoptosis and inhibit the proliferation of cancer cells.

Culturally, guava has been an integral part of traditional medicine systems across different regions. In Ayurveda and traditional Chinese medicine, guava is regarded as a cooling fruit that helps balance the body's internal heat and improve digestion. In Latin America, indigenous communities have long used guava leaves as a remedy for gastrointestinal infections and fevers. The plant's versatility extends beyond medicinal uses, as its wood is often utilized for making tools, and its leaves are sometimes used as a natural dye. Guava's economic importance is also significant, as it is cultivated for commercial fruit production, juice processing, and cosmetic formulations due to its skin-rejuvenating properties.

Guava (Psidium guajava) leaves are rich in diverse phytochemicals that contribute to their medicinal properties. As shown in Table 1, the primary bioactive compounds found in guava leaves include flavonoids, tannins, terpenoids, saponins, alkaloids, and essential oils, each playing a crucial role in pharmacological activities.

Table 1. Phytochemical Composition of Guava Leaves

Phytochemical	Function
Flavonoids	Antioxidant, anti-inflammatory, antimicrobial
Tannins	Antimicrobial, wound healing
Terpenoids	Antimicrobial, insecticidal
Saponins	Immune-modulating, wound healing
Alkaloids	Analgesic, anti-inflammatory
Essential Oils	Antimicrobial, insecticidal

Table 1 illustrates the primary phytochemicals found in guava leaves and their corresponding biological activities. Flavonoids, such as quercetin and catechin, contribute significantly to the antioxidant, anti-inflammatory, and antimicrobial effects. Tannins are known for their antimicrobial and wound-healing properties, while terpenoids and essential oils possess strong antimicrobial and insecticidal properties. The presence of these bioactive compounds highlights the multifaceted pharmacological potential of guava leaves.

Flavonoids, such as quercetin and catechin, serve as potent antioxidants, neutralizing free radicals and reducing oxidative stress, which is a major contributor to chronic diseases such as cardiovascular disorders and neurodegenerative conditions. These flavonoids also exhibit strong anti-inflammatory properties by inhibiting inflammatory mediators like prostaglandins and cytokines, making them beneficial in managing inflammatory diseases such as arthritis and asthma. Additionally, flavonoids contribute to the antimicrobial efficacy of guava leaves by disrupting bacterial and fungal cell membranes, leading to microbial death.

Tannins, another significant phytochemical in guava leaves, are known for their astringent properties, which help in wound healing and antimicrobial activity. These compounds inhibit microbial adhesion to surfaces, preventing infections and promoting faster tissue regeneration. Meanwhile, terpenoids and essential oils present in guava leaves also display remarkable antimicrobial and insecticidal properties. Their ability to interfere with microbial cell walls and metabolic pathways makes them effective natural alternatives for combating bacterial and fungal infections. Saponins, on the other hand, act as immune modulators, stimulating the body's defense mechanisms while also enhancing wound healing by promoting collagen synthesis. Furthermore, alkaloids in guava leaves exhibit analgesic and anti-inflammatory effects, making them useful for pain management and inflammatory conditions. The synergistic action of these phytochemicals underscores the pharmacological potential of guava leaves as a natural remedy for various health conditions.

Table 2. Pharmacological Activities of Guava Leaves

Activity	Mechanism
Antioxidant	Neutralization of free radicals
Anti-inflammatory	Inhibition of COX and LOX enzymes
Antimicrobial	Disruption of bacterial and viral cell membranes
Antidiabetic	Inhibition of alpha-glucosidase, enhancement of insulin sensitivity
Hepatoprotective	Prevention of liver oxidative damage
Anticancer	Modulation of apoptosis and cell cycle arrest

Table 2 highlights the major pharmacological activities of guava leaves. Their antioxidant activity helps mitigate oxidative stress-related disorders, while anti-inflammatory properties stem from the inhibition of inflammatory enzymes. The antimicrobial effects are attributed to the disruption of bacterial and viral cell membranes, and antidiabetic effects arise from their ability to inhibit carbohydrate-digesting enzymes and improve insulin sensitivity. These pharmacological effects justify the traditional medicinal use of guava leaves.

The medicinal properties of guava leaves extend beyond their phytochemical composition, as evidenced in Table 2, which highlights their broad pharmacological activities. One of the most notable effects is their antioxidant activity, which plays a crucial role in protecting cells from oxidative damage.

Oxidative stress is a major contributor to chronic diseases such as diabetes, cancer, and cardiovascular disorders, and the consumption of guava leaf extracts may help mitigate these risks. The anti-inflammatory properties of guava leaves stem from their ability to inhibit cyclooxygenase (COX) and lipoxygenase (LOX) enzymes, which are responsible for the production of inflammatory mediators. By reducing inflammation at the molecular level, guava leaves may serve as a natural alternative to nonsteroidal anti-inflammatory drugs (NSAIDs).

Table 3. Antimicrobial Efficacy of Guava Leaves

Pathogen	Minimum Inhibitory Concentration (MIC)
Escherichia coli	0.5 mg/mL
Staphylococcus aureus	0.3 mg/mL
Influenza virus	1.0 mg/mL

Table 3 presents data on the antimicrobial efficacy of guava leaf extracts against common pathogens. The MIC values indicate the lowest concentration at which the extract inhibits microbial growth. The results demonstrate strong antibacterial and antiviral properties, reinforcing their potential as natural antimicrobial agents.

In addition to their antioxidant and anti-inflammatory effects, guava leaves possess potent antimicrobial properties, as shown in Table 3, where their efficacy against *Escherichia coli*, *Staphylococcus aureus*, and the influenza virus is demonstrated. The minimum inhibitory concentration (MIC) values suggest that guava leaf extracts are effective at relatively low doses, making them promising candidates for the development of natural antibacterial and antiviral treatments. The antimicrobial mechanism of guava leaves involves the disruption of microbial cell membranes, inhibition of bacterial enzyme activity, and interference with viral replication, which collectively contribute to their effectiveness in treating infections. These findings reinforce the traditional use of guava leaves in herbal medicine for managing bacterial and viral infections, including respiratory illnesses and gastrointestinal disorders.

Table 4. Antidiabetic Potential of Guava Leaves

Parameter	Effect
Alpha-glucosidase Inhibition	Significant
Insulin Sensitivity Enhancement	Moderate
Blood Glucose Reduction	Considerable

Table 4 outlines the antidiabetic effects of guava leaves. Their ability to inhibit alpha-glucosidase and enhance insulin sensitivity suggests their potential as a complementary treatment for diabetes. These findings support further clinical investigation into guava leaf extracts for diabetes management.

Beyond their antimicrobial properties, guava leaves also exhibit remarkable antidiabetic potential, as summarized in Table 4. One of their key mechanisms of action is the inhibition of alpha-glucosidase, an enzyme responsible for carbohydrate digestion in the small intestine. By slowing down carbohydrate breakdown, guava leaves help regulate postprandial blood glucose levels, which is particularly beneficial for individuals with type 2 diabetes. Moreover, guava leaf extracts have been shown to enhance insulin sensitivity, improving glucose uptake by cells and reducing insulin resistance. This effect is crucial in diabetes management, as insulin resistance is a major factor contributing to poor glycemic control. Additionally, guava leaves have been reported

to significantly reduce blood glucose levels, further supporting their potential as a complementary therapy for diabetes.

The phytochemical composition and pharmacological activities of guava leaves highlight their immense therapeutic potential. Their antioxidant, anti-inflammatory, antimicrobial, and antidiabetic properties make them a valuable natural remedy for a wide range of health conditions. The scientific evidence supporting their medicinal benefits provides a strong foundation for further research and clinical trials to validate their efficacy and safety. With the growing interest in natural and plant-based medicines, guava leaves hold significant promise for future pharmaceutical and nutraceutical applications.

CONCLUSION

Guava (Psidium guajava) is a tropical plant that has tremendous nutritional value and health benefits. Rich in vitamin C, fiber, and antioxidants, guava fruit contributes to the improvement of the immune system, digestive health, and prevention of various chronic diseases such as diabetes and cardiovascular disorders. Not only the fruit, guava leaves also contain various bioactive compounds such as flavonoids, tannins, terpenoids, and alkaloids that have antioxidant, anti-inflammatory, antimicrobial, and potential anticancer properties.

Various studies have shown that guava leaf extract can be used as adjunctive therapy in the management of diabetes, microbial infections, and inflammatory disorders. In addition, its hepatoprotective and cardioprotective effects make guava a natural ingredient with potential for further development in the pharmaceutical and nutraceutical industries. Its utilization in traditional medicine in various cultures further strengthens the empirical evidence regarding its efficacy in maintaining health and treating various diseases. With the growing research on medicinal plants, guava has great potential to be developed in the formulation of natural medicines and health supplements. Therefore, further exploration of its pharmacological mechanisms, clinical trials, as well as the development of guava-based products need to be done to support its wider use in the medical and pharmaceutical world.

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