Plant Archives Vol. 25, No. 2, 2025 pp. 1874-1882 e-ISSN:2581-6063 (online), ISSN:0972-5210

Plant Archives

Journal homepage: http://www.plantarchives.org
DOI Url : https://doi.org/10.51470/PLANTARCHIVES.2025.v25.no.2.271

BIOCHEMICAL CONSTITUENTS IN GUAVA : A REVIEW

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(Date of Receiving : 22-07-2025; Date of Acceptance : 07-10-2025)

ABSTRACT

Guava (*Psidium guajava* L.), a tropical and subtropical fruit belonging to the family Myrtaceae, has emerged as a highly valued functional food owing to its exceptional nutritional profile and diverse therapeutic potential. Recognized as a “superfruit” and often referred to as the “poor man’s apple of the tropics,” guava is celebrated for its affordability, unique flavour, and richness in antioxidants, vitamin C, carotenoids, flavonoids, and phenolic compounds, which collectively contribute to its health-promoting properties. Traditionally, different parts of the guava plant, particularly the leaves and fruits, have been employed in folk medicine for managing gastrointestinal disorders, wound healing, ulcers, inflammation, and rheumatic conditions, reflecting its long-standing role in primary healthcare systems. demonstrating that guava possesses a broad spectrum of pharmacological activities, including antioxidant, antimicrobial, anticancer, antidiabetic, hepatoprotective, cardioprotective and anti-inflammatory effects. These bioactivities are primarily attributed to its diverse secondary metabolites, such as terpenoids, essential oils, tannins, esters, aldehydes and polyphenolic compounds. With its unique combination of nutritional richness, traditional medicinal use, and scientifically validated therapeutic effects, guava represents a promising resource for the development of functional foods and nutraceutical formulations aimed at promoting human health and preventing chronic diseases. This review consolidates current knowledge on the nutraceutical properties of guava, emphasizing its phytochemical composition, pharmacological activities, and potential applications in the food and health industries.

***Keywords* :** Nutraceutical properties, therapeutic potential, superfruit, bioactivities and phytochemical composition.

Introduction

Plants are a predominant natural source of numerous bioactive compounds (Kumar *et al.*, 2021). Several diseases have been cured using a variety of plant preparations in folk medicine since ancient times (Sharma *et al.*, 2017) and, presently, cosmetic, pharmaceutical, and nutraceutical industries are paying more attention to plant preparations and pure phytochemicals. The projected growth of the plant preparation market is around USD 86.79 billion by 2024, with the largest market share belonging to the pharmaceutical sector, followed by the nutraceutical industry. Interestingly, the utilization of plant preparations for cosmetics, beverages, food, and medicine is mainly dependent on plant leaves. Among all plant organs, leaves are the largest accumulators of bioactive compounds, such as secondary metabolites. Several recent studies reported phytochemical profiles and biological activities of leaf extracts of various cultivated plants (Amat *et al.*, 2020). Guava (*Psidium guajava* Linn.) is an important fruit-bearing species of the family Myrtaceae, family, is a very unique and traditional plant which is grown due to its diverse medicinal and nutritive properties. It comprises nearly 133 genera and more than 3,800 species worldwide. It is believed to have originated in Mexico, Central America, the Caribbean, and northern parts of South America (Stone, 1970). Today, it is widely cultivated across the tropical and subtropical regions of the world, including India, owing to its ability to adapt to diverse agro-climatic conditions, though it thrives best in relatively dry tropical climates. The fruit is popular for its exotic aroma, pleasant taste and exceptional nutritional value, making it one of the most consumed tropical fruits.

Nutraceutical properties of guava

Globally, guava production is estimated at around 1.2 million tons annually, with India and Pakistan together contributing nearly 50% of the total output (Yahiya, 2018). Because of its affordability and availability, guava is often referred to as the "poor man's fruit" or the "apple of the tropics." Apart from its role as a nutritious fruit, guava holds an important place in traditional medicine. Various parts of the plant roots, bark, leaves, and fruits are known to exhibit multiple pharmacological activities and have long been employed in the treatment of numerous health disorders (Begum *et al.,* 2002). Guava is a valuable source of minerals, vitamins, phenolic compounds, and other functional components, all of which make significant contributions to human nutrition and enhance its acceptance among consumers. Traditional knowledge highlights the use of guava for treating gastrointestinal ailments (such as diarrhea, dysentery, gastric weakness, and anorexia), respiratory problems (including cough, cold, and laryngitis), skin diseases, ulcers, menstrual irregularities, jaundice, nephritis, and rheumatism (Sanda *et al.,* 2011). It has also been reported to be beneficial against malaria, diabetes, and vertigo, while modern studies have revealed its potential anticancer activity.

The term "nutraceutical" was introduced by Stephen DeFelice in 1989, derived from the words "nutrition" and "pharmaceuticals." It refers to any food or food component that not only provides basic nutrition but also confers health benefits, including prevention or treatment of diseases (Keservani *et al.,* 2010). Interestingly, the term has no strict regulatory definition (Gupta *et al.,* 2010) and is often used interchangeably with concepts such as functional foods, designer foods, phytochemicals, or bioactive compounds, leading to considerable confusion in scientific and commercial contexts. Importantly, nutraceuticals are different from dietary supplements, as they are not merely additional components of the diet but are conventional foods naturally incorporated into daily meals that exert health-promoting or therapeutic effects. Nutraceuticals can also be described as natural functional foods or bioactive phytochemicals with properties that help in disease prevention, health maintenance, and overall well-being. They include both macro- and micronutrients such as carbohydrates, proteins, fats, vitamins, minerals, and antioxidants. However, the most significant contributors to their medicinal properties are bioactive compounds, which are generally present in small concentrations, are not categorized as essential nutrients, yet have proven physiological and therapeutic effects (Ajila and Prasadarao, 2010). Moreover, the interactions between functional food components such as prebiotics, probiotics, phytochemicals, and the gut microbiota play a critical role in influencing human health outcomes (Yahia, 2018).

Phytochemicals and bioactive compounds

Guava (*Psidium guajava* L.) is considered one of the most nutrient-dense tropical fruits, often referred to as a "superfruit" due to its exceptional vitamin, mineral, and bioactive composition (Joseph & Priya, 2011). The edible pulp is particularly rich in vitamin C, with concentrations ranging from 200–300 mg/100 g, which is significantly higher than most citrus fruits and fulfills more than four times the recommended daily intake (Barbalho *et al*., 2012). In addition to ascorbic acid, guava pulp contains notable quantities of carotenoids (β-carotene, lycopene in pink varieties) and phenolic compounds such as quercetin, gallic acid, and chlorogenic acid, all of which contribute to its antioxidant potential (Gutierrez *et al.,* 2008). The macronutrient profile of guava shows that it is a low-calorie fruit (68–80 kcal/100 g), containing about 14–15 g of carbohydrates, 1.0–1.5 g of protein, and only 0.3–0.5 g of fat (Singh *et al*., 2001). Its dietary fiber content (5–7 g/100 g) is relatively high compared to many other tropical fruits, supporting digestive health and glycemic control (Barbalho *et al.,* 2012). The fruit is also a good source of potassium (300–400 mg/100 g), which plays an important role in cardiovascular regulation, along with modest amounts of calcium, phosphorus, magnesium, and trace elements such as zinc and iron (Singh *et al.,* 2001).

Beyond the pulp, guava seeds have drawn attention due to their high protein (6–8 g/100 g) and lipid content (8–12 g/100 g), rich in polyunsaturated fatty acids including linoleic and linolenic acids, which are beneficial for cardiovascular and metabolic health. Leaves, though not commonly eaten as food, are widely recognized in herbal medicine for their abundance of polyphenols, flavonoids, tannins, and triterpenoids, which exhibit antimicrobial, antidiabetic, and anti-inflammatory effects (Gutierrez *et al*., 2008). Studies indicate that guava leaves contain up to 10–15 g/100 g of dietary fiber and high amounts of calcium and potassium, making them valuable in nutraceutical formulations (Barbalho *et al.*, 2012). The leaves of guava are especially rich in bioactive compounds, including antioxidants, tannins, antibacterial agents, and anti-inflammatory constituents, which make them effective in reducing oxidative stress, preventing infections, and mitigating chronic illnesses such as cancer (Joseph and Priya, 2011). Because of these remarkable properties, guava is now regarded as a superfruit and categorized as a functional food with nutraceutical potential (Ojewole *et al*., 2008). Overall, guava provides a balanced profile of macro- and micronutrients along with bioactive phytochemicals, establishing it as both a nutritious food and a potent nutraceutical resource. Its compositional diversity across pulp, seeds, and leaves supports its multifunctional role in human nutrition, preventive healthcare, and functional food development.

Table 1 : Nutrient value for 100 g of guava

Nutrient	Value per 100g
Energy	68 Kcal
Fat	0.95 g
Carbohydrate	14.32 g
Protein	2.55 g
Dietary fibre	5.4 g

(Kumar *et al*., 2021)

Vitamins	Value per 100g
Beta-carotene	374 mg
Vitamin B6	0.110 mg
Vitamin C	228.3 mg
Vitamin E	0.73 mg
Vitamin K	2.6 mg
Folate	49 mg
Riboflavin	0.040 mg
Niacin	1.084 mg
Thiamine	0.067 mg

(Naseer *et al*., 2018)

Polyphenols

Polyphenols, a diverse class of plant secondary metabolites, are vital for both plant defense and human nutrition. They contribute to color, astringency, and bitterness in foods while offering antioxidant, antimicrobial, and health-promoting benefits. Structurally, they are characterized by aromatic rings with hydroxyl groups and are classified into phenolic acids, flavonoids, and tannins. Hydrolyzable tannins, common in guava and grapes, break down into gallic or ellagic acid, whereas condensed tannins (proanthocyanidins), composed of catechin and epicatechin polymers, are relatively stable and function as strong antioxidants. Phenolic acids such as gallic, caffeic, chlorogenic, and ellagic acids occur in free or bound forms, often linked to sugars, proteins, or cell wall components, which adds complexity to their extraction. Although studies on guava polyphenols are limited, evidence confirms the presence of flavonols, flavan-3-ols, phenolic acids, and condensed tannins, all of which contribute to its nutraceutical potential and therapeutic relevance (Miean and Mohamed, 2001).

Antioxidants

Guava (*Psidium guajava* L.) is a nutrient-dense fruit with a complex phytochemical profile that underpins its health-promoting properties. Its major constituents include vitamins, tannins, phenolic compounds, flavonoids, essential oils, sesquiterpene alcohols, and triterpenoid acids (Haida *et al*., 2011). The fruit is also valued as a rich source of dietary fiber, vitamins A and C, folic acid, and essential minerals such as potassium, copper, and manganese (*Nadkarni and Nadkarni*, 1999). The pulp contains high levels of ascorbic acid and carotenoids (lycopene and β-carotene), which are associated with antioxidant, antidiabetic, and anticancer activities. Remarkably, a single guava can provide up to four times the vitamin C content of an orange, making it one of the richest natural sources of this vital nutrient (Hassimotto and Genovese, 2005). In addition, strawberry guava (*P. littorale* var. *cattleianum*) has been reported to contain up to 90 mg of vitamin C per serving, exceeding common guava varieties by nearly 25% and contributing fully to daily dietary requirements.The fruit also harbors a wide range of bioactive pigments, including carotenoids and polyphenols such as allocatechin, guaijaverin, leucocyanidin, and amritoside, which enhance its antioxidant potential (Ghosh *et al*., 2010).

Ascorbic Acid

Fruits are recognized as the primary dietary source of ascorbic acid, an essential micronutrient for humans and one of the most widely consumed natural antioxidants. L-ascorbic acid functions as a powerful reducing compound, and its ability to donate hydrogen atoms makes it effective in protecting phenolic compounds and other antioxidants from degradation during food processing (Fennema, 1977). This activity is attributed to the presence of the 2,3-enediol group in its structure. Because of its high reactivity and protective role, ascorbic acid is frequently used as an indicator of nutritional quality in food storage and processing studies (Rishika and Sharma, 2012). Guava is exceptionally rich in vitamin C, containing about

230 mg per 100 g of edible portion, which is nearly five times greater than the amount found in oranges. In fact, guava ranks just below acerola cherry as one of the richest natural sources of ascorbic acid among fruits (Uddin *et al*., 2002).

Carotenoids

Carotenoids represent one of the most abundant classes of natural pigments, second only to chlorophyll, and are responsible for the red, orange, yellow, and even some green hues in a wide range of fruits and vegetables. Structurally, they are tetraterpenoid compounds and are broadly divided into two categories: carotenes, which are purely hydrocarbons, and xanthophylls, which are oxygenated derivatives. These compounds may occur in linear forms, such as lycopene, or in cyclic structures, like β-carotene, which contain five- or six-membered rings at one or both ends of the molecule. Because of their extended conjugated double-bond system and hydrophobic nature, carotenoids are fat-soluble molecules. Guava is considered one of the richest fruit sources of carotenoids, which contribute significantly to its nutraceutical value. The carotenoid profile of guava varies with cultivar, ripening stage, and fruit color, with red- and pink-fleshed guavas typically containing higher concentrations than white-fleshed types. Among the identified carotenoids in guava are lycopene, β-carotene, phytofluene, cryptoxanthin, lutein, and cryptoflavin. Lycopene is the predominant carotenoid in pink and red guavas and is responsible for their characteristic color. It is a powerful antioxidant, recognized for its ability to neutralize singlet oxygen and reactive oxygen species more effectively than other dietary carotenoids. β-carotene, on the other hand, serves as an important precursor of vitamin A and supports vision, immune function, and skin health. Cryptoxanthin and lutein, also present in guava, contribute additional antioxidant activity and play protective roles in eye health and age-related macular degeneration (Rishika and Sharma, 2012).

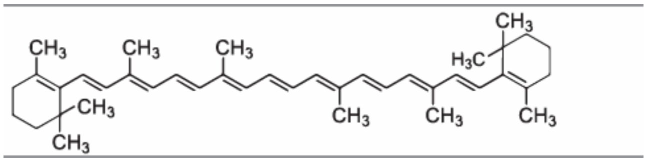

Fig. 1 : Structure of β-carotene (Mercadante *et al*.,1999, Oliveira Dda *et al*., 2010)

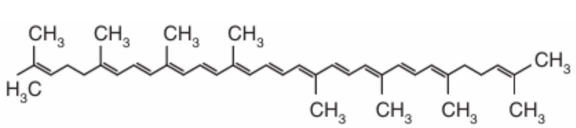

Fig. 2 : Structure of lycopene (Mercadante *et al*.,1999, Oliveira Dda *et al*.,2010)

Leaf Phenolics

Guava (*Psidium guajava* L.) leaves are a particularly rich source of phenolic compounds, which account for many of their therapeutic properties. Among these, gallic acid, catechin, and epicatechin play a critical role in lipid metabolism regulation. These compounds inhibit pancreatic cholesterol esterase, thereby reducing cholesterol absorption and lowering blood lipid levels, making them valuable in the prevention of hyperlipidemia and cardiovascular disease (Barbalho *et al*., 2012). Catechins are also recognized for their role in mitigating type 2 diabetes and obesity, as they improve glucose utilization and exert anti-obesity effects (Gutierrez *et al.*, 2008). The leaf flavonoid quercetin is well documented for its spasmolytic, antioxidant, antimicrobial, and anti-inflammatory activities, and has been associated with reduced cardiovascular mortality and decreased stroke incidence (Joseph & Priya, 2011). Another guava-specific flavonoid, guaijaverin, exhibits strong antibacterial activity, particularly against oral pathogens, making guava leaves a potential candidate for natural oral health products (Prabu *et al.*, 2006). Rutin, another major flavonoid, has been shown to inhibit triglyceride accumulation in adipocytes, contributing to anti-obesity benefits.

Furthermore, naringenin and kaempferol demonstrate cytostatic activity, with kaempferol in particular being highlighted for its anticancer potential due to its ability to inhibit proliferation across different cancer cell lines (Gutierrez *et al.*, 2008). Additional flavonoid glycosides such as morin-3-O-α-L-lyxopyranoside and morin-3-O-α-L-arabopyranoside have been isolated from guava leaves and are associated with pronounced antibacterial activity (Arima and Danno, 2002). The phenolic profile of guava leaves, therefore, not only accounts for their antioxidant and antimicrobial properties but also positions them as a source of nutraceutical compounds with applications in metabolic health, cardiovascular protection, cancer prevention, and infectious disease management. This highlights their importance not only as traditional remedies but also as promising bioactive resources for modern functional food and pharmaceutical industries**.**

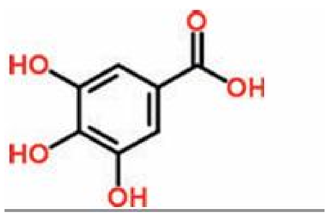

Fig. 3 : Structure of Gallic acid (Chen *et al*., 2015)

Fig. 4 : Structure of Catechin (Chen *et al.*, 2015)

Leaf Oil

Guava (*Psidium guajava* L.) leaves are rich in phytochemicals that account for their wide therapeutic applications. They contain fixed oils, resins, tannins, chlorophyll, fats, cellulose, mineral salts, and essential oils, with cineol as a major constituent (Nadkarni and Nadkarni, 1999). The essential oil fraction is chemically diverse, including α-pinene, β-pinene, limonene, menthol, terpenyl acetate, caryophyllene, β-bisabolene, farnesene, humulene, selinene, cadinene, and curcumene (Morton, 1987). Flavonoids such as quercetin and its glycosides (avicularin and quercetin-3-pyranoside) contribute to strong antibacterial effects, while tannins and triterpenic acids add antioxidant and anti-inflammatory properties (Oliver, 1986). Together, these compounds highlight guava leaves as a reservoir of bioactive metabolites with nutraceutical significance. Phytochemical analysis has confirmed the presence of saponins, alkaloids, flavonoids, terpenoids, and carbohydrates, which act synergistically to enhance antimicrobial action (Bisht *et al.,* 2016).

Pharmacological Activities

Fig. 5 : Pharmacological Activities of Guava

Antioxidant Activity

Guava (*Psidium guajava* L.) is widely recognized as a potent source of natural antioxidants, making it highly valuable for both nutrition and food preservation. In foods, antioxidants play a central role in delaying enzymatic and non-enzymatic browning reactions and in inhibiting lipid oxidation, thereby extending shelf life and maintaining quality (Lin and Yin, 2012). Nutritionally, guava provides a unique blend of antioxidant compounds, including vitamins A, C, and E, alongside an array of phytochemicals such as flavonoids, carotenoids, and polyphenols (Soman *et al.*, 2011). Notably, guava contains exceptionally high levels of vitamin C several times greater than that of citrus fruits making it one of the richest natural dietary sources of ascorbic acid.

Biologically, antioxidants from guava act by neutralizing reactive oxygen species (ROS), which are unstable molecules generated during normal cellular metabolism and environmental stress. These ROS carry unpaired electrons, making them highly reactive and capable of damaging cellular proteins, lipids, and nucleic acids. Guava's bioactive compounds, such as quercetin, lycopene, and gallic acid, have been shown to scavenge free radicals, reduce oxidative stress, and support cellular integrity (Weni *et al.,* 2011). Lycopene, in particular, contributes to the red-pink pigmentation of guava and is a powerful quencher of singlet oxygen, associated with reduced risk of cardiovascular diseases and certain cancers. Similarly, flavonoids and tannins present in guava leaves and fruit not only reinforce its antioxidant activity but also provide antimicrobial and anti-inflammatory benefits. Because of this broad antioxidant profile, guava and its derivatives are increasingly explored as natural alternatives to synthetic preservatives in food products, particularly in stabilizing edible oils and preventing oxidative rancidity (Hernandez *et al.,* 2011). This dual role protecting human health and enhancing food stability positions guava as a promising nutraceutical resource with wide-reaching applications.

Anti-inflammatory Activity

Inflammation is a protective biological response, but its prolonged activation is closely linked with several chronic conditions including arthritis, metabolic disorders, and cancer. Guava (*Psidium guajava* L.), particularly its leaves, has long been used in traditional medicine for alleviating inflammatory ailments such as rheumatism. Modern studies confirm these properties (Rai *et al.,* 2009), attributing them to phytochemicals like flavonoids, polyphenols, and triterpenoids, which exert both anti-inflammatory and analgesic effects. In animal models, aqueous extracts of guava leaves demonstrated significant suppression of acute inflammation and pain, showing a clear dosedependent activity. In addition, carrageenan-induced paw edema experiments in rats showed substantial inhibition of swelling, with higher doses of guava extracts producing over 50% reduction in inflammation. Such findings validate the ethnomedicinal use of guava and highlight its potential as a natural and safe source of anti-inflammatory agents.

Antidiabetic Activity

Guava (*Psidium guajava*) exhibits strong antidiabetic potential owing to its high fiber content and low glycemic index, which help regulate blood glucose levels and prevent sudden spikes. Experimental studies highlight that guava leaves and fruit can protect against diabetes-related complications through their anti-glycative, antioxidant, and anti-inflammatory properties. Leaf extracts have been shown to lower blood glucose and glycosylated hemoglobin in streptozotocin-induced diabetic rats while improving plasma insulin and hemoglobin levels (Burkill, 1997). These effects are attributed to the preservation of pancreatic β-cells from oxidative damage and lipid peroxidation, thereby supporting sustained insulin secretion. The bioactive compounds present in guava, including flavonoids (notably quercetin and guiajaverin), tannins, and triterpenoids, play a key role in its hypoglycemic action (Lutterodt *et al.*, 1999).

Guava (*Psidium guajava*) exhibits significant antimicrobial activity, making it a promising natural alternative to conventional antibiotics. Studies have shown that methanolic and ethanolic leaf extracts are particularly effective against gram-positive bacteria such as *Staphylococcus aureus* and *Bacillus cereus*, while gram-negative species like *E. coli* and *Salmonella enteritidis* are less sensitive (Ryu *et al.*, 2012). The action is believed to occur through disruption of bacterial cell membranes, leading to leakage of vital components. Methanolic extracts also demonstrated strong inhibition against gastrointestinal pathogens including *Pseudomonas aeruginosa*, *Salmonella typhi*, and *Vibrio cholerae*, with *S. typhi* showing the highest susceptibility. Comparisons between solvents revealed that methanol extracts were more potent than aqueous extracts due to better extraction of active compounds (Braga *et al.*, 2014). Beyond leaves, guava bark and root extracts also showed noteworthy antibacterial effects, in some cases comparable to synthetic drugs. Overall, these findings highlight guava as a rich source of bioactive compounds with broad-spectrum antimicrobial potential (Ashrafa *et al.*, 2016).

Anticancer Properties

Guava (*Psidium guajava*) has shown considerable promise as a natural source of anticancer agents, with different plant parts exhibiting potent antiproliferative properties. Studies using guava peel, flesh, and seed against four cancer cell lines A549 (lung), MCF-7 (breast), HepG2 (liver), and HT-29 (colon) demonstrated strong antioxidant and anticancer activities, with the peel and seed extracts being more potent due to higher levels of bioactive compounds such as catechin, galangin, homogentisic acid, gallic acid, kaempferol, and cyanidin-3-glucoside. Similarly, acetone extracts of guava branches (GBA) were found to significantly inhibit HT-29 colon cancer cells, inducing apoptosis through chromatin condensation and cell shrinkage, while reducing cell viability by over 35% at specific concentrations (Burt, 2004).

Mechanistic studies further reveal that guava leaf fractions, particularly hexane extracts (GHF), exert anticancer effects by modulating key signaling pathways involved in tumor development. These include suppression of the PI3K/Akt/mTOR/S6K1 and MAPK pathways, resulting in reduced proliferation, metastasis, angiogenesis, and enhanced apoptosis in prostate cancer cells. Budding guava leaves are especially rich in polyphenols such as gallic acid, catechin, epicatechin, quercetin, and rutin, all of which contribute to strong anticancer activity (Burt, 2004). In addition, guava essential oil has demonstrated antiproliferative action, with notable effects such as inhibition of angiogenesis and cancer cell migration, indicating its chemopreventive potential. Collectively, these findings highlight guava as a valuable source of natural compounds with therapeutic potential for both cancer prevention and treatment.

Antimicrobial Activity

Guava leaf extracts exhibit broad-spectrum antimicrobial activity against both gram-positive and gram-negative bacteria. Methanolic extracts, in particular, show strong inhibition against pathogens such as *Staphylococcus aureus*, *Bacillus cereus*, *Pseudomonas aeruginosa*, and *Vibrio cholerae*. The mechanism involves disruption of bacterial cell membranes, leading to leakage of essential cellular contents. Guava bark and root extracts also show significant antibacterial effects, comparable in some cases to synthetic antibiotics (Braga *et al.*, 2014).

Hepatoprotective Properties

Guava leaves exhibit significant hepatoprotective effects due to their influence on key pathways involved in liver metabolism. Experimental studies have shown that extracts of guava leaves enhance the activity of adenosine monophosphate-activated protein kinase (AMPK) and peroxisome proliferator-activated receptor alpha (PPARα), both of which are essential regulators of lipid metabolism in the liver. These extracts also help improve hepatic insulin sensitivity, thereby protecting against metabolic disorders. Elevated levels of liver enzymes such as alanine transaminase (ALT) and aspartate aminotransferase (AST) are biomarkers of liver damage, including fatty liver disease; administration of guava leaf extract has been reported to reduce these enzyme levels, reflecting improved liver function (Chuang *et al.*, 2008). Since type 2 diabetes mellitus is closely associated with hepatic complications like steatosis, fibrosis, and liver enlargement, guava leaves offer additional therapeutic potential by stabilizing glucose and lipid metabolism. Bioactive flavonoids such as guaijaverin and avicularin contribute to this effect by modulating glucose transport and inhibiting dipeptidyl-peptidase IV activity, thereby lowering blood glucose levels. Overall, guava leaf extracts provide strong protective action against liver dysfunction, particularly in conditions linked to diabetes and metabolic disorders.

Antidiarrheal activity

Guava leaves contain beneficial compounds such as quercetin and quercetin-3-arabinoside, which can be extracted from the foliage. Additionally, the leaves possess a unique substance that exhibits effects similar to morphine, helping to regulate and control muscle tone. Quercetin inhibit intestinal contractions, likely due to its role in promoting calcium absorption. It also has a pronounced effect on the ileum. This suggests that the quercetin present in guava leaves may be a key contributor to their spasmolytic (muscle-relaxing) properties.

Guava (*Psidium guajava*) demonstrates significant cytotoxic properties and shows potential in treating diarrhea caused by toxins from *Escherichia coli* and *Staphylococcus aureus*. Studies have shown that both ethanolic and aqueous leaf extracts of *Psidium guajava*, when applied at a concentration of 80 g/ml in an organ bath, can inhibit over 70% of the contractions induced by acetylcholine and/or potassium chloride in isolated guinea pig ileum. To assess its anti-diarrheal efficacy, researchers measured intestinal propulsion rates in male sprague dawley rats, using morphine as a reference standard. The results indicated that the aqueous leaf extract of *Psidium guajava* effectively reduced intestinal motility, supporting its traditional use in managing diarrhea (Tonal *et al*., 1999).

Anti-Viral Activity of Guava

Guava leaf tea found to inhibit the growth of influenza viruses by preventing their entry into host cells, an effect likely attributed to the presence of flavonols (Sriwilaijaroen *et al*., 2012). Additionally, *Psidium guajava* demonstrated promising therapeutic potential in treating rotavirus-induced enteritis in infants (Wei *et al*., 2000).

Anti-Bacterial activity

Methanolic extracts of guava showed notable antibacterial properties, effectively inhibiting the growth of various bacterial strains including *Staphylococcus aureus*, *Escherichia coli*, and *Shigella spp.* (Chah *et al*., 2006). In addition, leaf extracts such as aqueous, acetone-water, methanolic, spray-dried forms, and essential oil have shown promising antimicrobial activity against both Gram-positive and Gram-negative bacteria, as well as fungi (Fernandes *et al*., 2014). Further research by Bezerra *et al.* (2016) revealed that combining guava leaf extracts with different anstibiotics enhanced their antibacterial efficacy through synergistic interactions.

Conclusion

In summary, the nutraceutical properties of guava (*Psidium guajava* L.) highlight its immense potential as both a dietary powerhouse and a natural therapeutic agent. Enriched with vitamins, minerals, polyphenols, flavonoids, carotenoids, and essential oils, guava demonstrates a wide array of bioactivities, including antioxidant, anti-inflammatory, antidiabetic, antimicrobial, and anticancer effects. Its integration into traditional medicine and growing recognition in scientific research underscore its value in preventing and managing chronic diseases while promoting overall wellness. Given its affordability, accessibility, and versatility, guava stands out as a promising candidate for the formulation of functional foods and nutraceutical products, making it a vital contributor to modern strategies for improving human health and nutrition.

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