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A Review On: Phytochemical and Pharmacological Activity of Guava Plant.

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Abstract: Since ancient times, we used guava leaf tea from Psidium gujava Linnaeus as a remedy for gastroenteritis and paediatric diarrhoea. The well-known tropical tree Psidium guajava, or guava, is widely farmed for its fruit. Guava has a lengthy history of use as a medicine in many nations. Treatments for diarrhoea, dysentery, gastroenteritis, hypertension, diabetes, cavities, pain alleviation, and improved locomotor coordination can all be achieved using this herb. For treating oral ulcers, cough, diarrhoea, and some wounds with swollen gums, it's leaf extract is employed. Its fruit is a good source of minerals, iron, calcium, phosphorus, and vitamins A and C. It has a high concentration of organic and inorganic substances like secondary metabolites, such as polyphenols, antioxidants, antiviral substances, and anti-inflammatory substances. Guava's phenolic chemicals aid in the treatment of malignant cells and delay premature skin ageing. Terpenes, caryophyllene oxide, and p-selinene all have calming effects when present. In this review we focused on the pharmacological, phytochemical constituents and antimicrobial activities of this plant.

Keywords: Pseudium gujava, guava leaves, medicinal use, Antimicrobial activity, Essential oils, phytochemistry and pharmacological use.

Introduction: Guava, or Psidium guajava, is endowed by nature with a variety of crucial nutrients. Guava is thought to have been introduced to India by the Portuguese after being commercially grown in South Africa. Guava is a fruit that is fairly widespread in Asian nations, although it is more common in western nations, Indonesia, Pakistan, Bangladesh, and South America. Due primarily to its medical qualities. It is a tiny tree from the Myrtaceae family [1]. As long as the soil is fertile and the climate is tropical or subtropical, the tree can be grown there. India currently produces the most guavas, followed by China, a neighbouring country [2]. Many countries have used the roots, leaves, bark, stem, and fruits of the guava tree to cure stomachaches, diabetes, diarrhoea, and other health issues. Dark green, elliptical, and oval in shape, guava leaves (Psidii guajavae folium; GL) are distinguished by their obtuse-type apex. Guava leaves, combined with the pulp and seeds, are used to treat several gastrointestinal and respiratory conditions as well as to boost platelets in dengue fever patients [3]. The antispasmodic, cough sedative, anti-inflammatory, anti-diarrheic, anti-hypertension, anti-obesity, and antidiabetic effects of GLs are also commonly utilised [8]. The effectiveness of GL isolates as powerful antitumor, anticancer, and cytotoxic drugs has also been demonstrated in studies using animal models [4, 5].

Figure. Guava fruit and leaves.

Botanical Classification:

Kingdom	Plantae - Plants
Subkingdom	Tracheobionta Vascular plants
Superdivision	Spermatophyta Seed plants
Division	Magnoliophyta Flower plants
Class	Magnoliopsida Dicotyledonous
Subclass	Rosidae
Order	Myrtales
Family	Myrtaceae
Subfamily	Myrtoideae
Tribe	Myrteae
Gender	Psidium
Species	Psidium gujava

Morphology of plant:

- Height: 3-10 m high.
- Spread: 30 cm or more.
- Trunk: Woody, hard, smooth.
- Uniformity: Irregular.
- Growth rate: 5-8 years to grow.

1. Phytochemical Activity:

Essential oils are abundant in GLs (Table 2). 1,8-cineole and trans-caryophyllene are two of the main components of GL essential oil. Using gas chromatography (GC) and gas chromatography/mass spectrometry (GC-MS), Chen et al. [8] discovered 50 chemicals in GL essential oil, with -caryophyllene, -pinene, and 1,8-cineole being the main ones. A distinct profile of GL essential oil from the Philippines was discovered to contain significant components such as limonene, -pinene, -caryophyllene, and longicyclene [6]. While Tunisian guava leaf oil showed a larger level of veridiflorol and trans-caryophyllene, Ecuadorian GL essential oil had a higher content of monoterpenes (limonene and -pinene) [7,8]. In contrast to earlier investigations, Soliman et al [9].identified a higher concentration of monoterpenes in GL essential oil. Sesquiterpenes were the predominant constituent in those other studies. El-Ahmady and others [10]. Reported that the main components of GL essential oil are 4-selin-7(11)-enol, 4-selinene, 4-caryophyllene, and 4-caryophyllene oxide. Another study used gas chromatography-mass spectrometry to identify 64 distinct components in essential oil extracted from GLs (GC–MS). Caryophyllene, which functions as an antioxidant, anticancer, anti-inflammatory, and antibacterial agent, was discovered to be predominately abundant among them (24.97%) [11]. According to this study, the concentrations of monoterpenes, oxygenated esquiterpenes, and non-oxygenated sesquiterpenes were 73.67, 12.94, and 8.55%, respectively.

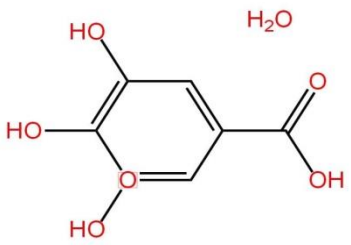
1.1. Essential oil components of Gauva leaves:

Compounds	Content/composition reference
α-Pinene	1.53%
Benzaldehyde	0.83%
p-cymene	0.52%
lemonene	54.7%
1,8-ceneole	32.14%
β-*cis*-Ocimene	0.28%
γ-Terpinene	0.38%
α-Terpineol	1.79%
β-Caryophyllene	2.91%
α-Humulene	0.77%
Total identified constituents	95.85% [11]

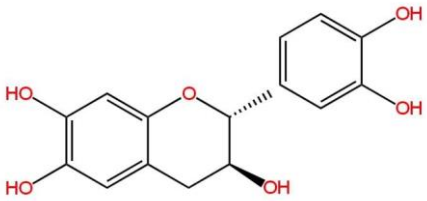
1.2. Phenolic Compounds:

Due to their antihyperglycemic effects, GLs are frequently used as a traditional medicine source in Asian nations. They contain high-quality bioactive polysaccharides, proteins, lipids, essential oils, vitamins, and minerals, as was discussed in the preceding sections. Phenolic acids, flavonoids, triterpenoids, sesquiterpenes, glycosides, alkaloids, and saponins are a few of the secondary metabolites found in GLs. Phenolic compounds (PCs) are important bioactive molecules that give GLs their anti-inflammatory and hypoglycemic activities. These PCs typically play a significant part in controlling numerous physiological and metabolic processes in the human body. Using high-performance liquid chromatography-diode array detector-quadrupole time-of-flight tandem mass spectrometry, over 72 distinct phenolic compounds have been identified in GLs [12]. Additionally, it has been revealed that GLs include thirty different flavonoids, seventeen different triterpenoids, and nineteen different sesquiterpenoids [5]. In addition, psiguanins A-D (1-4) [13] and sesquiterpenoid-diphenylmethane meroterpenoids (psiguadials A and B) [14] were also discovered in GLs. Epidemiological research has demonstrated the protective effects of polyphenolic substances against chronic illnesses as diabetes, cancer, and cardiovascular and neurological diseases [15]. In order to combat chronic diseases, phenolic chemicals alter a variety of physiological processes, including cell proliferation, enzymatic activity, cellular redox potential, and signal transduction pathways [16].

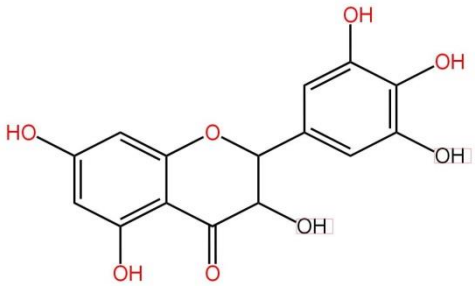
Structures :



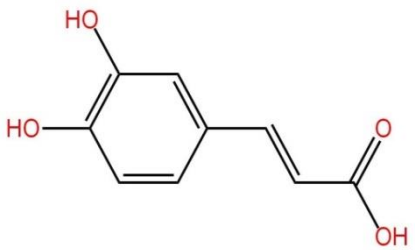
Gallicacid



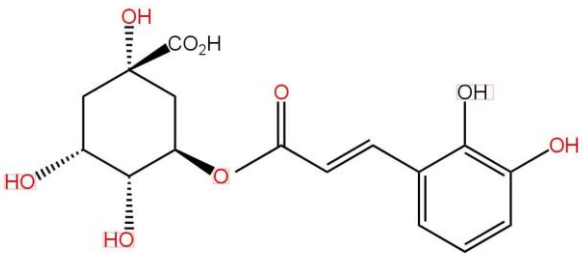
Catechin



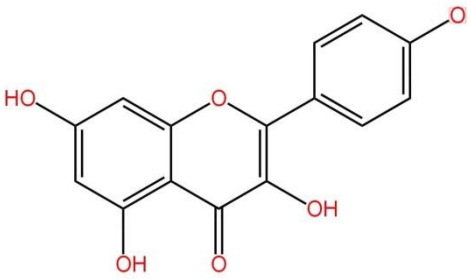
Myricetin



caffeicacid



Chlorogenic acid



Kacmferol

One of the most bioactive phenolic chemicals found in GLs is quercetin. The potential of bioactive compound-rich diets to reduce the risk of the onset of a variety of chronic diseases has garnered a lot of interest in recent years. Reversed-phase thin layer chromatography (RP-TLC) was used to monitor the separation of seven pure chemicals from the GL fraction that is soluble in ethyl acetate (EtOAc): quercetin, avicularin, apigenin, guaijaverin, kaempferol, hyperin, and myricetin. The chemical structures were clarified using nuclear magnetic resonance spectroscopy and mass spectrometry [17].

Using high-performance liquid chromatography combined with electrospray ionisation quadropole-time-of-flight mass spectrometry (HPLC-TOF-ESI/MS), Wang et al. extracted and studied phenolic components from non-fermented guava leaves (NFGLs) and fermented guava leaves (FGLs). Gallic acid, rutin, chlorogenic acid, avicularin, isoquercitrin, quercitrin, and kaempferol were found in the NFGL and FGL samples, according to the scientists. Quercetin, rutin, gallic acid, avicularin, and isoquercitrin made up around 65% of the chromatogram's total peak area. Another study found that GL extract contained higher levels of catechin (2.25%) and epicatechin (1.45%), but lower levels of gallic acid, chlorogenic acid, quercetin, caffeic acid, and epigallocatechin gallate [18].

2. Pharmacological activity:

Psidium gujava has been utilized as an anticancer/anti-tumor, anti-diabetic from the ancient time since it is thought to have therapeutic characteristics.

2.1. Anticancer/Antitumor Activity:

Cancer is a complex health condition that can be recognised by changes in cell proliferation or a decline that results in apoptosis [19]. Several external and internal variables that contribute to the excessive generation of reactive oxygen species can cause it (ROS). This may lead to DNA or RNA single- or double-strand breaks, base mutations, chromosomal breakdowns and reorganisations, DNA cross-linkage, nucleic acid degradation, lipid peroxidation-induced damage to cell membrane integrity, and the development of tumours [20]. Guavas are rich in the antioxidant Lycopene, which is essential for preventing and combating cancer. Prostate cancer and breast cancer are the two that respond best overall. Guavas with red flesh (when dissected) have higher lycopene content than those with other colours. Free radicals are neutralised by lycopene, which also works to stop new free radicals from forming. Numerous studies concluded that guava budding leaves are a viable anti-androgen-sensitive prostate cancer agent because they exhibit anti-prostate cancer action in a cell line model [21]. Guava also has a healthy amount of carotene, which is believed to protect against both lung and mouth cancer.

2.2. Antidiabetic Activity:

Guava leaves are peeled and consumed on an empty stomach in China to combat diabetes. Guava fruits and leaves have the ability to reduce blood sugar levels, according to a study on mice by the Medicinal Research Laboratory in Allahabad [22], when the fruit is consumed without the peel. Inhibition of intestinal glycosidases by Psidium guajava leaf effects on postprandial hyperglycemia has been examined by a number of authors, suggesting a breakthrough in the treatment of diabetes (type II). Additionally, the high fibre content of guava slows down the gut's absorption of glucose, preventing the sharp rise in blood sugar levels that occurs shortly after eating. In one study, participants who drank guava tea after consuming white rice saw significantly lower blood sugar spikes than those who drank plain water as a control [23]. Guava (fruit and leaves) also appears to reduce fasting sugar levels. According to a study, individuals with Type 2 diabetes who consumed guava leaf decoction with each meal for three months had lower fasting blood glucose levels than they did prior to the experiment [24].

2.3. Antioxidant Activity:

Since it serves as a terminal electron acceptor during the respiration process, which is the main source of energy production, oxygen is a crucial ingredient for aerobes. However, the body's inflammatory diseases, ischemic diseases, neurological disorders, hemochromatosis, emphysema, acquired immunodeficiency syndrome, and many other illnesses are caused by free radicals created during metabolic processes [25]. Numerous studies have demonstrated the importance of antioxidant molecules from GLs in reducing

the negative effects of free radicals. A DPPH experiment showed that essential oils isolated from GLs perform as mild antioxidants with an IC50 value of 460.37 1.33 g/mL [26]. Other similar investigations on GL extract showed the reduction of linoleic acid oxidation and the scavenging impact on peroxyl radicals. The research also revealed a linear relationship between the phenolic content of GL extract, the antioxidant's effectiveness, and its capacity to scavenge free radicals [27]. GLs were co-fermented with yeast and bacterial strains to liberate insoluble bound polyphenol components, and it was found that fermentation improved the antioxidant activity of soluble guava leaf polyphenols [28]. In a recent work, crude polysaccharides of GLs were used to create silver nanoparticles, which displayed high DPPH radical- and ABTS radical cation-scavenging activity [29]. The results clearly show that GL extracts can be a valuable antioxidant substance in the food preservation and cosmetic industries.

2.4. Antidiarrheal Activity:

It has been observed that boiling 6–10 new, tender guava leaves in a pot of warm water and drinking the mixture while it is still warm, on an empty stomach, is a very effective way to reduce diarrhoea. According to research, P. guajava leaves exhibit a broad spectrum antibacterial action (as antigiardial and antirotaviral activity) that may be utilised to successfully treat diarrhoea of a pathogenic origin. The presence of high flavonoid content in guava leaves is responsible for the antidiarrheal activity [30]. Due to its astringent qualities, guava barks are often used to cure diarrhoea in children. A cup of warm water and guava extract can be used to make a tea that will assist you quickly empty your bowels. In an article published in the Journal of Smooth Muscle Research in 2008, researchers examined the impact of guava leaves on the peristalsis of rat bowels. They discovered that the extract of guava leaves could delay the onset of castor oil-induced diarrhoea, reduce the frequency of faeces, and lessen the severity of diarrhoea in the rats [31].

2.5. Antimicrobial Activity:

Current major concerns include the emergence of novel disease-causing strains and microbial resistance to conventional antibiotics. The prevalence of systemic microbial infections, which include septicemia, uti, meningitis, pneumonia, and gastritis, affects the entire body and is a major cause of mortality worldwide. Pathogens such Staphylococcus, Shigella, Salmonella, Bacillus, Escherichia coli, Clostridium, and Pseudomonas are the main culprits behind food-borne illnesses [32]. Bioactive substances originating from plants are potential sources of antimicrobials. These substances work by inhibiting the growth, disruption, and lysis of microbial cell walls, preventing the formation of biofilms, suppressing DNA replication and transcription, preventing the production of adenosine triphosphate (ATP), squelching the production of bacterial toxins, and producing reactive oxygen species (ROS) [33]. GLs are known to have antibacterial activities because to the inclusion of many organic and inorganic antioxidants and anti-inflammatory substances [34]. With regard to Pseudomonas aeruginosa, Escherichia coli, Streptococcus faecalis, Staphylococcus aureus, and Bacillus subtilis, GL essential oils exhibit potent antibacterial activities. Studies also point to their antiproliferative and antioxidant properties.

2.6. Wound Healing:

Guava leaves have been used extensively on wounds throughout human history since the dawn of humanity. Ancient inhabitants of India and China ground guava leaves into a paste with a little water or oil, which they then applied to the surface of wounds. When a methanolic extract of guava leaves was administered locally twice a day, tannins and flavonoids demonstrated quicker wound healing. Numerous studies have demonstrated that ointment prepared from guava leaves can heal wounds far more quickly than what the market offers. The leaves are cleaned, crushed, and extracted with oil. To aid in absorption, a vehicle is added to the extract, primarily melted candle wax. The finished combination is then rubbed over the incision twice daily for the following four days [35].

2.7. Anti-Allergy:

Studies on Psidium guajava leaf extracts in methanol and water revealed a significant reduction of mast cell histamine release and prevented IL-10-mediated in vitro activation of T regulatory (Tr) cells from CD4+ splenocytes of C57BL/6 mice. By directly reducing Tr cell activity, the extracts also changed the Th1/Th2 balance to a Th1 dominant state. Guava leaf extracts reduced the allergic response in mice mediated by T cells [36].

Conclusion:

There is evidence that GLs are a source of easily accessible natural chemicals. The high levels of antioxidant, anticancer, hypoglycemic, and other biological activity found in GL extracts have been the subject of much research. The abundance of vitamins, minerals, and proteins in GLs encourages their use as a direct source of nutrients. Many bioactive chemical substances found in GLs have been shown to improve and stabilise a variety of physiological and metabolic processes in the human body. The widespread use of allopathic medications for illness treatment and prevention has sped up the emergence of drug resistance. Drug resistance is a common occurrence during antimicrobial therapy overall. People were urged to switch from allopathic to Ayurvedic therapy because it is extremely rare for resistance to natural or Ayurvedic therapy to develop. However, it is exceedingly challenging for researchers to separate the active element from the raw natural compound, so a more straightforward procedure must be created. Natural therapy is not only safe and freely accessible, but it is also cost-effective in the treatment and prevention of disease. It is crucial to prioritise the development of traditional herbal medicine derived from natural resources because even doctors and practitioners today are searching for alternative medical treatments to cure a variety of disorders.

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