# AN ANALYSIS OF THE PROTECTIVE IMPACT AND EFFECT OF PHYTOCHEMICAL, THERAPEUTIC, AND SCIENTIFIC ANTI-DIABETIC STUDIES ON PSIDIUM GUAJAVA

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**Abstract**

In terms of global health, diabetes mellitus (DM) is a significant issue. Complications, malfunctioning beta cells, and elevated blood glucose levels are the hallmarks of DM, the most common chronic illness. The oral hypoglycaemic drugs that are currently on the market have a risk of liver dysfunction, weight gain, and gastrointestinal discomfort. Using herbal plants with anti-diabetic qualities is quite prevalent throughout the world. The aim of the review study is to find out the effect of Psidium guajava on diabetics. In tropical and subtropical nations, Psidium guajava is a significant food crop and medicinal plant that is widely used as food and in folk medicine all over the world. It is a member of the Myrtaceae family, which has about 133 genera and 3800 species worldwide. Several metabolites in good yield and some of them have been found to have beneficial biological properties; these metabolites primarily belong to the phenolic, flavonoid, carotenoid, terpenoid, and triterpene families. This plant's extracts and metabolites, especially those from the leaves and fruits, have beneficial pharmacological properties. Anti-diabetic is one of the major pharmacological activity that shows by the plant. The plant's principal components have undergone comprehensive pharmacological testing, and the results indicate that they have anti-inflammatory, hypotensive, antifungal, antipyretic, and antioxidant effects.

**Key words:**Diabetes mellitus, Psidium guajava, Anti-diabetic, Pharmacological properties

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## Introduction

A serious problem in terms of world health is diabetes mellitus (DM). The most prevalent chronic condition, DM is characterised by complications, dysfunctional beta cells, and high blood glucose levels. Overproduction of reactive oxygen species is brought on by persistently high blood pressure. One of the primary processes for the development of diabetes is oxidative stress, which causes cellular damage prior to the appearance of diabetic problems. By 2030,552 million people would likely have been diagnosed with DM, according to one estimate. [1] Hyperglycaemia, a hallmark of DM, is brought on by impairments in insulin secretion. Especially, 91–96 % of cases of diagnosed diabetes are non-insulin dependent, that has a strong correlation with being overweight, acting inappropriately, and eating poorly. Insulin is a crucial anabolic hormone that regulates glycaemic balance and facilitates glucose transfer. It is well recognised that both insulin resistance and non-insulin-dependent diabetes carry a high risk. Diabetes affects how carbohydrates, proteins, and fats are metabolised. Around the world, using herbal plants that have anti-diabetic properties is fairly common. [1,2,15]

The market-available oral hypoglycaemic medications might cause gastrointestinal distress, weight gain, and liver dysfunction. Therefore, the search for novel, potentially effective DM prevention and treatment therapies is urgent. There is widespread knowledge that plants have tremendous medicinal potential and a wide range of pharmacological effects. A widespread fruit tree with a tropical or subtropical climate is called Psidium guajava Linn. Due to their low toxicity and effective medicinal properties, guava plant have served as a very long period of time as a traditional remedy or herbal tea in Mexico, India, China, Pakistan, and Bangladesh to cure diabetes. Psidium guajava is a member of the Myrtaceae family and it is one of the most important economic fruits in tropical climes. In oriental nations, guava leaves and fruit have long been used as a treatment for diabetic patients. It is believed to contain a variety of bioactive substances, like polyphenols, quercetin, tannins, triterpenoids, which may control hyperglycaemia. [1] In fact, through modifying insulin-related signalling, extracts of guava leaves can enhance glucose intolerance and glucose metabolism in the diabetic rats' skeletal muscles. P. guajava leaf includes a lot of phenolic chemicals that limit the body's natural process of oxidation, which makes it likely to prevent a number of chronic illnesses like diabetes, heart disease, and cancer. Additionally, the polyphenols in Pisidium guajava leaf can avoid atherosclerosis, cataracts, biological ageing of the skin and body by reducing free radicals in the body. The presence of essential oil can be detected in leaves that have high concentrations of caryophyllene, longicyclene, limonene, pinene, isopropyl alcohol, menthol, and bisabolene. Guava leaves also contain oleanolic acid. A large percentage of limonene (42. 1%) and caryophyllene (21. 3%) can be found in leaves. Guava leaves contain a large number of volatile chemicals. [3,12]

The existence or absence of numerous bioactive substances in guava plant, such as flavonoids, tannins, phenolics, saponins, glycosides, alkaloids, and carbohydrates, was determined by preliminary examination of the plant's phytochemical in various solvent extracts. Quantity of phyto-compounds in each extract varied, and a comparison of the quantities revealed that the extracts made fromacetone, ethanol, methanol, and aqueous decoction technique contained the highest concentrations of phyto-compounds. Ethyl acetate extract and N-hexane was reported to contain the fewest bioactive chemicals. Alkaloids, glycosides, flavonoids, polyphenols, reducing agents, saponins have all been found in various solvent ofP. guajava leaf extracts, according to several investigations. [4,17]

**Fig. No. 1:** Psidium Guajava Linn plant, leaves and fruit

**Taxonomical Classification**[7,8]

Over 150 varieties of guavas are grown around the world (Abreu et al. , 2012). Guava can be either sour or sweet depending on the fruit's flavour. Fresh, completely ripe sweet guava is consumed. Guavas that are small and sour can be discovered in the wild and are typically processed. Furthermore, Red Indian, Redland, Ruby, Webber and Blitch, Hart, are among the guava cultivars that are sold all over the world. Allahabad, Seedless, Safeda, Red Flesh, Karcla, and apple colour are commercial types grown in India. Depending on the fruit's colour, guava can also be categorised as white guava or red guava.

**Table No. 1**: Taxonomical Classification of Psidium guajava

| Botanical name | Psidium guajava |
|---|---|
| Kingdom | Planate |
| Division | Magnoliophyta |
| Class | Magnoliopsida |
| Order | Myrtales |
| Family | Myrtaceae |
| Subfamily | Myrtoideae |
| Genus | Psidium |
| Species | Guajava |
| English name | Guava |

**Vernacular Name**[7]

There are several names for guava used around the world. There are several common names for Psidium guajava.

**Table No. 2:** Vernacular Names of Psidium Guajava

| | |
|---|---|
| **Germany** | Guavenbaum |
| **Bengali** | Piara |
| **English** | Apple guava |
| **French** | Gouyave |
| **Portuguese** | Goiaba |
| **Spanish** | Gouyave |
| **India** | Amarood |
| **Brazil** | Araca |
| **Cambodia** | Trapaeksruk |
| **Chinese** | Fan shiliu |

**Geographical Distribution**[7,8]

The guava fruit is consumed widely throughout the world due to its tasty flavour and a variety of health advantages. Brazil, Mexico, India, United States, Pakistan, Bangladesh, Thailand, and there are several other nations have Psidium guajava trees flourishing there. A record of 2017 and 2018 shows that Pakistan, Thailand, Mexico, India, Indonesia, Brazil, Bangladesh, and Nigeria were the best guava producersin the global. Pakistan produces 0. 55 million tons of guava fruit annually, ranking it fourth among all nations. Guava fruit has a great nutritional content, is very tasty, is inexpensive, and trees produce fruit all year long.

One of the friendliest fruits, guava is well-liked all across the world. Unknown is the fruit's true origin. Nonetheless, guavas are thought to be indigenous to the Caribbean and tropical America, where they are also known as "sand plums. " The history of guava dates back to the sixteenth century. Guava is now grown commercially in several nations, including Egypt, India, Mexico, Hawaii, and Mexico. Tropical and subtropical climates with dry summers and brief winters are optimum for guava tree growth. Winter-exposed trees are reported to produce more fruit than their tropical counterparts. Although immature crops are vulnerable toboth dryness and extreme cold, it can endure in both extreme humidity and drought circumstances. The guava tree is also less cold resistant. Guava trees are grown at sea level to a height of 1500m. Some cultivars, though, may even flourish at 2500 m. Guava trees grow successfully on a variety of soils, including heavy clay, gravel, and even limestone. Nevertheless, guava tree cultivation is best suited to fertile, drained ground with a pH range of 4. 5 to 9. 4. Additionally, the soil needs to have a high water table and high salt concentration. Guava trees are typically propagated from seed through cuttings, air layering and grafting. In India, marching andair layering were two prominent plantation techniques used, but budding and grafting techniques have since taken their place because trees planted using the previous technique only survive for two to three years.

**Botanical Description**[7]

The height of the Psidium guajava shrub or small tree can occasionally reach 10 m, but it typically grows to a height of 1-6 m. An aged stem's pale reddish-brown bark, smooth that flakes of is covered with this colour. Because newly exposed bark is a bitthe colour greenish-brown, it can occasionally givethe trunks seem mottled. Earlier stems have pubescence, somewhat four-angled, and have a greenish hue.

Simple leaves are produced on 4- to 10-mm-long short stalks and are positioned in opposition along the stems. The ovate-elliptic or oblong-elliptic leaf blades are relatively oval in shape (7. 1–14. 2 cm long and 2. 4 – 6. 4 cm wide), having rounded or pointy ends, and rounded (obtuse) bases. They are typically drab green in colour and have pubescent undersides that are hairy. Each leaf contains a central vein that stands out prominently and 9 to 19 pairs of side veins that are also fairly noticeable.

Further up the leaf forks, the flowers are typically borne individually (axils). These flowers have a diameter of around 24 mm and are carried on a pubescent peduncle, which is a 1 to 2. 6 cm long hairy stalk. Each flower features 4-5 white petals and 4-5 green sepals that are joined together at the base (10-20 mm long). Additionally, they feature numerous (6–10) little white stamens that are 200–250 in number, as well as a stigma-topped style (5. 8 –11 mm long).

Fruit is circular, oval and as it ripens, it changes from green to a yellowish colour. These berries (2. 4 to 10 cm long) feature a luscious pink, white, or yellowish pulp that is packed with many seeds. The berries are crowned with the remnants of the persistent sepals. The kidney-shaped seeds are yellow in colour. Fruit from both cultivated and untamed trees is utilised to disseminate them.

**Morphological Characteristics[6]**

The guava tree is a tiny tree or shrub that grows 2–7 metres tall and has numerous branches. The tree has copper-colored, smooth yet thin, and shedding bark. Underneath the horizon, is the greenish skin that becomes visible once the top layer has been removed.

When the tree is completely grown, the trunk has a 25 cm diameter. The tree's twigs are bent downward and have a quadrangular shape. The short-petioled, leathery, evergreen leaves are arranged opposite one another. The dimensions of leaves are 6 –14 cm long and 2. 4 to 5. 4 cm wide, with an irregular shape that ranges from oval to elliptical. The leaves are made up of parallel lines that branch out from the centre and migrate outward. Flowers with 3. 5 - 4. 5 white petals and 248 stamens are produced in groups on the axes of leaves and range in size from 1. 8 to 5. 1 cm. With relation to the cultivar, the fruit is round, pear-shaped, measuring 5–10 cm across and weighing 50–200 g. The exocarp, or outer layer of the fruit, is a thin layer that is a light yellow colour with a trace of pink. The fruit's fleshy mesocarp is located right next to the exocarp. The flesh is granular, thick, and ranges in colour from white to yellowish or dark pink, and it can be 2 –11 mm long. Mesocarp is flavorful, juicy andacidic. The middle pulp is above the granular meat (endocarp). The juicy, slightly darker-toned endocarp contains rocky yellowish seeds. The pulp has a 5mm diameter and 112 to 535 seeds are present. The endocarp of the berry is made up of two different types of cell wall tissues: parenchyma cells and stone cells. The characteristic grittier feel of the fruit is caused by stone cells, which are made of lignified woody material and are resistant to enzymatic digestion. Guava fruit's span of time at room temperature is only approximately three to five days because of its rapidrespiration and rapid metabolism.

**Fig. No. 1**: Some Plant parts of Psidium Guajava

**Phytoconstitute Presents in different parts of the Guava Plant**

In contrast to the essential oil of the guava fruit, which containscaryophyllene oxide,3-phenylpropyl acetateand nerolidol, guava fruit oil also contains(E,E)-2,4-hexadienal,(Z)-3-hexenal, butyrolactone. In guava fruit, glycogen, protein, and saccharose were described in the literature. Fruit skin primarily consists of ascorbic acid. Guava fruit possesses significant therapeutic qualities such asanti-bacterial, spasmolitic, anti-inflammatory, antipyretic and analgesic actions. [3,5,13,14]

The guajava leaves include a number of minerals and other nutrients that benefit the body nutritionally and aid in supplying it with the nourishment it needs. The leaves also meet nutritional needs and offer a number of health benefits. The existence or non-existence of several bioactive substances such flavonoids, tannins, alkaloids, saponins, glycosides, and carbohydrates were investigated using conventional methods for preliminary analysis of phytochemicals of the various solvent extracts. All of the extracts had different amounts of phytocompounds, and a comparison of those amounts revealed that the extracts made from ethanol, acetone, methanol, and aqueous decoction contained the highest concentrations. The extract of n-hexane and ethyl acetate was found to contain the fewest bioactive substances. In the various solvent extracts of Pisidium guajava leaves, flavonoids, glycosides, alkaloids, polyphenols, reducing chemicals, saponins, and tannins have all been found in investigations. By squelching the effects of free radicals, bioactive chemicals found in plants have been shown to lessen the problems associated with diabetes mellitus (DM). Alkaloids, carotenoids, triterpenes, anthocyanins, vitamin C, flavonoids, quercetin, essential oils, and aldehydes were discovered in the phytochemical investigation of the leaves. [8,9,18,19]

**Phytoconstitute present in various solvent**

**Table No. 3-** Phytoconstitute present in various solvent. [3,5,8,9]

| Phytochemical Constituents | Name of the Test | Aqueous | Ethanol | Chloroform | Petroleum Ether |
|---|---|---|---|---|---|
| Carbohydrate | Molish Test | + | + | + | + |
| Tannin | Lead acetate test | + | + | + | - |
| Alkaloids | Mayer's test | - | + | - | + |
| Terpenoids | Noller test | - | + | + | - |
| Quinones | H2SO4 test | + | + | - | + |
| Saponin glycosides | H2SO4 test | - | + | - | - |
| Flavonoids | Schioda's test | + | + | + | - |
| Phenols | FeCl | - | + | - | - |
| Fixed Oil | Spot test | - | + | - | - |
| Anthraquinone | Borntrager's test | - | + | - | + |

*+ = Present; - = Absent

**Chemical Present in Various Part of the Plant [79]**

**Fruits: -** These are distinguished by having a lot of water (84. 7%), a low quantity of carbs (12. 1%), lipids (0. 65%), and proteins (0. 91%), and a high content of proteins (Medina and Pagano, 2003). Calories per 100g are 35 –50 kcal, moisture is 77–85 g, crude fibre is 2. 9–5. 6g, ash is 0. 41–0. 8g, phosphorus is 17. 5–32mg, iron is 0. 3–0. 7 mg, vitamin A is 200–400 I. U., thiamine is 0. 045 mg, riboflavin is 0. 02-0. 05 mg, niacin is 0. 7–1. 065 mg, ascorbic acid is the plant also contains manganese, along with the acids phosphoric, oxalic, and malic. Unripe fruit is inedible, induces vomiting, and raises body temperature. It undergoes chemical modifications, hydrolytic enzyme activity changes (-amylase and -amylase activities dramatically decreased with ripening), and carotenoid content decreases while chlorophyll, cellulose, hemicellulose, and lignin contents increase. Unripe fruit contains a lot of tannins, is astringent, and tends to promote constipation, however it is occasionally used to treat diarrhoea.

**Fruit peels: -** The main component of the skin is ascorbic acid, which is also present in the firm in a substantial quantity meat and central pulp (between 56 and 600 mg in ripe fruit and between 345 and 445 mg in almost ripe fruit). About 50% of the ascorbic acid is destroyed during heat processing or canning. The fruit's pungent aroma is a result of its carbonyl compounds.

**Leaves: -** The primary constituents of the essential oil found in leaves are limonene, pinene, menthol, isopropyl alcohol, terpenyl acetate, longicyclene, caryophyllene, -bisabolene, cineol, caryophyllene

oxide, copanene, selinene, farnesene, humulene, curcumen, and cardinene. The leaves have been shown to contain oleanolic acid, flavonoids, and saponins. Additionally identified compounds include nerolidiol, sitosterol, ursolic, crategolic, and guayavolic acids. The leaves also contain triterpenic acids and flavonoids, as well as avicularin and its 3-l-4-pyranoside, which has potent antibacterial properties, fixed oil at a concentration of 6%, resin at a concentration of 3. 15 percent, tannin at a concentration of 8. 5%, and various other fixed substances, including fat, cellulose, chlorophyll, tannin and mineral salts. Additionally, guavacoumaric acid, guavavanoic acid, 2-hydroxyursolic acid, jacoumaric acid, isoneriucoumaric acid, asiatic acid, ilelatifol d, and -sitosterol-3-O-dglucopyranoside have been extracted from the leaves of Psidium guajava . The highest levels of flavonoids were discovered in mature leaves in quercetin (2882. 11mg kg1), luteolin (52. 1mg kg1), and kaempferol (98. 23mg kg1) are some examples of these compounds.

**Bark:** It contains resin, calcium oxalate crystals, and 12–30% tannin.

**Roots:** These substances include salts, leukocyanidins, sterols, gallic acid, and tannins. Tannic acid is present in high concentrations in the root, stem-bark, and all leaves.

**Seeds:** They have 15% oil by dry weight, 16% proteins, 13% starch, and phenolic andflavonoid components such quercetin-3-O-d-(2-O-galloyl-glucoside)-4-Ovinylpropionate. Certain isolated substances are cytotoxic.

**Floral Buds:** The largest amounts of myricetin (254 mg kg1), quercetin (3603 mg kg1), luteolin (227 mg kg1), kaempferol (228 mg kg1), and apigenin (250 mg kg1) are found in the buds of flowers.

**Twigs:**-Consists of sodium (0. 03-0. 20%), potassium (0. 21-0. 39%), phosphorous (0. 10-0. 38%), magnesium (0. 06-0. 30%), calcium (0. 30-0. 100%), and magnesium (0. 06-0. 30%). Copper (0. 01 to 0. 12 ppm), iron (2. 66 to 5. 34 ppm), zinc (0. 32-0. 58 ppm), manganese (0. 01-0. 25 ppm), and lead (0. 01-0. 12 ppm) were also present. Fluoride concentrations ranged from 0. 02 ppm to 0. 12 ppm. Contains triterpenoids, sesqui-terpenes, alcohols, and flavonoids.

**Table No. 4:** Chemical Present in Various Part of the Plant

| Parts of the Plant | Chemical Constitutent Present | Reference |
|---|---|---|
| Fruits | Water, carbs (13. 2%), lipids (0. 53%), and proteins (0. 88%), crude fibre is 2. 8–5. 5 g, ash is 0. 43–0. 7 g, phosphorus(17. 5–32mg), iron is 0. 3-0. 6mg, vitamin A is 200-400 I. U. , thiamine is 0. 045 mg, riboflavin is 0. 03-0. 05 mg, niacin is 0. 6–1. 065mg, | 7,8,9 |
| Fruit peels | Ascorbic acid | 7,8,9 |
| Leaves | limonene, caryophyllene oxide menthol, terpenyl acetate, selinene, mineral salts. longicyclene, caryophyllene, bisabolene, cineol, cellulose, pinene, caryophyllene oxide, copanene, farnesene, isopropyl alcohol, cardinene, curcumen, triterpenic acids ,flavonoids, fat, humulene, tannin, chlorophyll, and longicyclene. | 7,8,9 |
| Bark | Resin, calcium oxalate crystals, and 15–32% tannin | 7,8,9 |
| Roots | Salts, leukocyanidins, sterols, gallic acid, and tannins. | 7,8,9 |
| Seeds | 15% oil by dry weight, 14% proteins, 12% starch, and phenolic and flavonoid | 7,8,9 |
| Floral Buds | apigenin (255mg kg1), luteolin (22 mg kg1), quercetin (3608mg kg1), kaempferol (225mg kg1), andmyricetin (255 mg kg1). | 7,8,9 |
| Twigs | sodium (0. 03-0. 20%), potassium (0. 21-0. 39%), phosphorous (0. 10-0. 38%), magnesium (0. 06-0. 30%), calcium (0. 30-0. 100%), magnesium (0. 06-0. 30%), copper (0. 03-0. 13ppm), iron(2. 85-5. 12 ppm) manganese (0. 00-0. 26 ppm), lead (0. 00-0. 11 ppm) and zinc (0. 31-0. 55 ppm). | 7,8,9 |

**Nutrient Profile of the Plant**[7,11,19,20]

Due to its higher concentration of a number of nutrients, the guava fruit is frequently referred to as the "Queen of Fruits. " It is a fruit that is high in fibre, protein, and lacks cholesterol. Guavas are aconcentrated vitamin and mineral source, just as other fruits. Fruits include four times as much vitamin C as oranges and 7-8 times as much as other citrus fruits, three times as much protein, and four times as much fibre as pineapples. Fruit also contains twice as much lycopene as tomatoes do. Even potassium is slightly higher in the fruit than in bananas. The leaves include specific minerals and other nutrients that are beneficial to the body's nutrition and assist in providing the nutrients the body needs. The leaves also meet nutritional needs and offer a number of health benefits.

**Carbohydrates:-**Guava contains 14. 3 g of total carbohydrates and has a 5% dietary value. Guava has the lowest GI of any berry with a score of 34. About 8 g of sugars, including glucose (35. 6%), sucrose (6. 2%), and fructose (57. 8%), are present in the fruit. The fruit's main sweetener is fructose.

**Protein:-** Guava, which is a fruit, has a reasonably high protein content of 2. 4 g/100 g of fresh fruit, making it one of the more protein-rich fruits. High-quality protein is provided by guavas. Leucine and glutamic acid are the two main amino acids found in fruit.

**Consumable Fiber:-** Guavas are high in fibre, having 5. 3 g of total dietary fibre with a nutritional value of 21%. Berries contain 7. 2g/100 g of insoluble dietary fibre and 1. 7g/100 g of soluble dietary fibre, respectively. Dietary fibre with a high ratio of soluble to insoluble components is beneficial to human health.

**Vitamins: -** With the exception of vitamin D, guavas provide a nearly complete source of vitamins. Fruit only contains 375mg of ascorbic acid per 100 g. However, the fruit is a superior source of vitamin C due to its high nutritional value of vitamin C, which is on the order of 622%. In addition to vitamin C, vitamin A (1030 IU) is also widely distributed and has a 21% dietary value. Guava also provides other B complex vitamins, vitamin E, folate, and choline.

**Minerals: -** Ash content is around 1. 4 g of the fresh fruit weight (100 g). Guavas are low in sodium and high in potassium, like all fruits. Guava also contains high levels of iron, phosphorus, copper, calcium, and magnesium. Guava also offers minor elements including selenium, zinc, and others.

**Table No. 5:-**The following table displays the food value of 100g of guava. The Food value of guava[7]

| Name of the Nutrient | Amount present |
|---|---|
| **Fat** | 0. 42-0. 8mg |
| **Protein** | 0. 1-0. 5mg |
| **Calories** | 75-82g |
| **Miosture** | 2. 5-5. 4g |
| **Crude fiber** | 0. 8-1. 1g |
| **Ash** | 9. 5-10mg |
| **Iron** | 202-402 I. U |
| **Thiamine** | 0. 04-0. 05mg |
| **Vitamin B3** | 36 I. U |
| **Carbohydrate** | 9. 2-18mg |
| **Carotene** | 0. 046mg |
| **Vitamin G4** | 35-52mg |
| **Niacin** | 45 I. U. |
| **Phosphorous** | 0. 32-0. 71mg |
| **Riboflavin** | 0. 5-1. 065mg |
| **Calcium** | 17. 5-32mg |

**Traditional Medical Uses of the Plant** [5,7,20-23]

In subtropical regions worldwide, Psidium guajava Linn. is used both as food and traditional medicine due to its pharmacologic properties. Almost everywhere in the globe, the health care system heavily relies on medicinal herbs. These observations are based on conventional wisdom. It is commonly known that guava is regularly used around the world to treat a wide range of illnesses, including diarrhoea, fever reduction, gastroenteritis, hypertension, diabetes, caries, and pain relief from wounds. Guava has a high concentration of organic and inorganic substances, including secondary metabolites such polyphenols, antioxidants, antiviral substances, and anti-inflammatory substances. Numerous chemicals in guava have anti-cancer properties. It has more vitamins and minerals. In the guava, phenolic substances like flavonoids play a significant role. Important antioxidants include flavonoids and lycopene. They aid in the treatment of malignant cells and aid in delaying the onset of skin ageing. The fruit and leaves of Psidium guajava have reportedly been used to treat and prevent cancer. The leaves, barks, roots, and immature fruits of Psidium guajava have been used to treat diarrhoea, gastroenteritis, and dysentery. Psidium guajava leaves have reportedly been used to treat toothaches, sores, ulcers, and rheumatic discomfort. Additionally, Psidium guajava leaves lower blood glucose levels. Guavas have been used to treat a number of ailments because they offer therapeutic qualities. Because all portions of this plant are utilised to treat various illness problems, it is known as the medicine tree. The guava has qualities that are antibacterial, anti-inflammatory, anti-diabetic, anti-allergic, anti-hypertensive, and similar. Its bark, roots, fruit, and leaves are all healthy and relieve nausea and diarrhoea. Additionally to their usage in the treatment of hypertension, leaves also have anti-diabetic and anti-gastrointestinal properties. Guava is typically eaten raw, favoured as a dessert, or used in salads. To get rid of the pungent smell, the fruit is occasionally fried. Guava powder is also used to flavour a variety of goods, including ice cream, candies, and fruit drinks. Additionally, the fruit is processed to create juices, marmalades, preserves, jam, and other products. Guavas are also used to make a variety of breakfast cereals and snacks. Green fruit that is still immature is a good source of pectin and can be used as the starting point for its extraction. [20-23]

**Table No. 6 :** Ethnomedicinal uses of Guava plant[7]

| Parts of Plant | Chemical Compound Present | Usage in Ethnomedicine |
|---|---|---|
| **leaves** | Isoflavonoids, gallic acid, catechin, epicathechin, rutin, Phenolic compounds, naringenin, kaempferol | Anti-inflammatory, anti-spasmodic, hyperglycemic, analgesic activity, anti hepatoprotection, antioxidant, Anti- cancer, antimicrobial. |
| **Bark** | The Phenolic compounds | It has antibacterial activityand anti-diarrhoeal activity. |
| **Seed** | Carotenoids,phenolic compounds, Glycosids, | It shows Antimicrobial activity. |
| **Pulp** | Ascorbic acid, carotecoids | Anti-hyperglycemic, anti-neoplasic and antioxidant. |
| **Skin** | The Phenolic compounds | Helps in improvement of food absorption. |

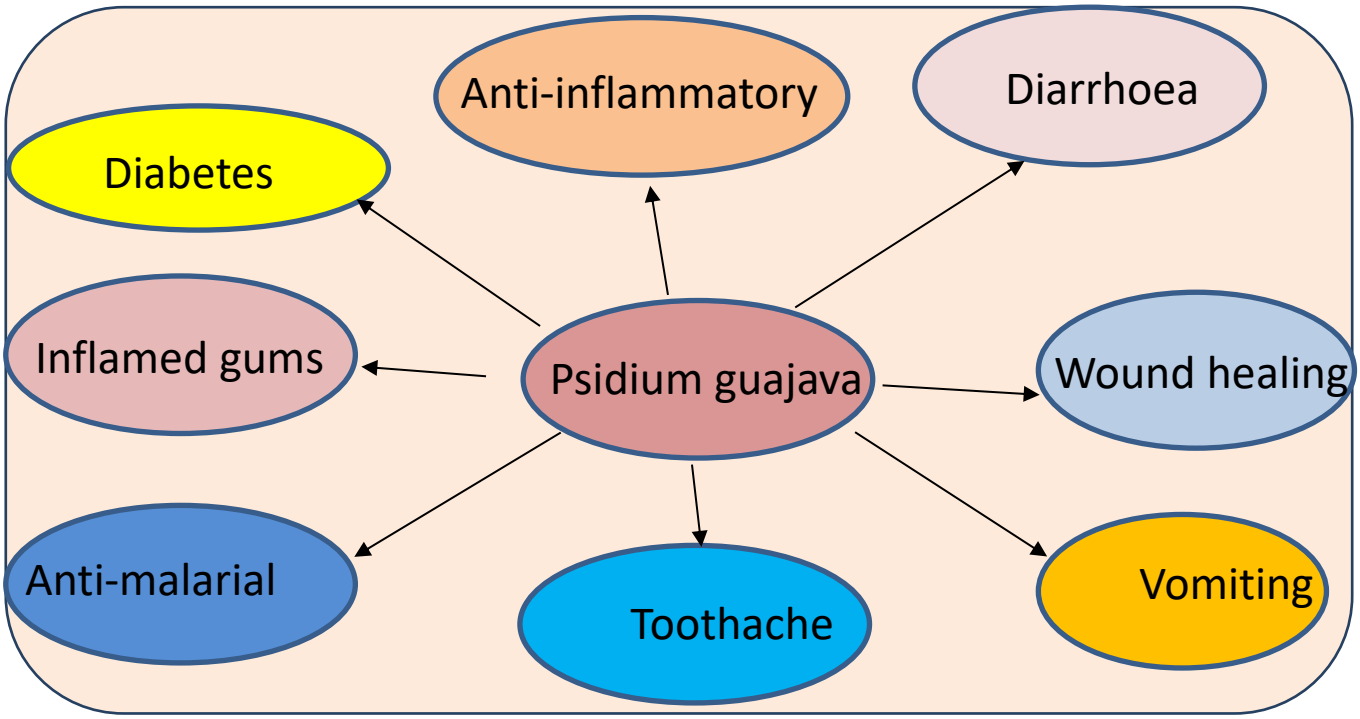


**Fig. No. 3 :** Traditional uses of Psidium uajava

**Pharmacological evaluation**[6,7]

Multiple diseases brought on by microbial infections have been demonstrated to be improved by extracts and phytochemicals derived from Psidium guajava leaves. The plant portion that is used in decoctions the most frequently is its leaves. The majority of pharmacological and chemical research has been done on the leaf, which illustrates the relationship between therapeutic plants and cultural beliefs. Along with triterpenoids, flavonoids and volatile oil, guava leaves also contain tannins. Treatment of gastrointestinal diseases is the primary traditional application (diarrhoea, stomach pain, gastroenteritis, indigestion, and dysentery). Psidium guajava leaves have a high concentration of polyphenols and isoflavonoids in their aqueous extract. It can therefore be employed as a chemo preventive antitumor agent. The induction of apoptosis and differentiation is observed to be intimately correlated with the antitumor effects of guava extract. Psidium guajava extracts work to limit tumour growth by lowering Tr cells and causing them to switch to Th1 cells. One of the main risk factors for heart disorders is high blood pressure. Other important bodily organs and ocular health are both impacted by blood pressure. Globally, about 1. 15 billion people have high blood pressure. Furthermore, high blood pressure contributes to 7. 5 million deaths annually, or 12. 8% of all fatalities. When a person's systolic and diastolic blood pressure are both above 120, they are considered to have high blood pressure. Guavas are also known as lower LDL cholesterol levels by triggering their oxidation, limiting their build up on artery walls and consequently producing an increase in high blood pressure. Guavas are beneficial to vision. Guava consumption not only delays vision

deterioration but also enhances it. Macular degeneration and cataracts can both be treated with guava. A cataract is the presence of a cloudy or opaque region inside normally clear lines, causing vision to become blurry. Guava has this impact because it contains a lot of vitamin A, particularly lycopene and beta-carotene. The guava is advantageous for diabetes people because of its low GI score and high fibre content. Low GI scores lessen the likelihood of an unexpected sugar spike. Dietary fibre that is soluble increases insulin sensitivity, which lowers blood glucose levels and stimulates the body's consumption of carbohydrates. Additionally, eating soluble fibre significantly lowers levels of total cholesterol and low-density lipoprotein. When dietary soluble fibre interacts with an aqueous solution, it produces viscous gels and delays the absorption of glucose. The effects of gastric emptying or preventing the passage of glucose into the intestine are two potential mechanisms of action. However, the rate of enzymatic action on food in the colon is also affected by dietary soluble fibre. [25-29]

**Table No. 7-** Guava's potential for use in medicine

| **Pharmacological Effect** | **Extract** | **Pharmacological Activity** |
|---|---|---|
| Anti-diabetic activity | Water & Methanol | There was a dose-dependent increase in percentage inhibitory activity against alpha- amylase enzyme. |
| Antibacterial activity | Water &75% Methanol | It shows antibacterial activity against S. suis, P. multocida, E. coli and S. typhimurium. |
| Antioxidant activity | Water & 95% Ethanol | It shows effects on scavenging hydroxyl radicals and inhibiting lipid peroxidation. |
| Anti-diarrhoeal Activity | Water | It shows significant delayed the onset of castor oil-induced diarrhoea. |
| Anticancer activity | Water,75% Methanol, Essential oil | The Psidium guajava leaf has been shown to possess anti prostate cancer activity. |
| Anti-hypotensive effect | Water | It reduces systemic arterial blood pressures and heart rates. |
| Treatment of cough | Water | It decreased frequency of cough by 35% and 54%, as compared to the control, within 10 min after injection of the extract. |
| Antipyretic activity | Water | The extract and aspirin produced comparable antipyretic effects up to 60 min. |
| Anti-malarial activity | Water | The stem bark extract contained anthraquinones, flavonoids, seccoirridoids and terpenoids and those are effective for the treatment of malaria |
| Antifungal activity | Hexane, Acetone | It showed the best antifungal activity against Trichophyton rubrum, Sporotrix schenckii, Trichophyton tonsurans, Microsporum canis, Candida parapsilosis, Cryptococcus neoformans. |

## Conclusion

The results of the pharmacological research on Psidium guajava by the scientists point to the enormous potential of this plant in the treatment of diseases like cancer, liver disorders, rheumatoid arthritis, menstrual pain, diabetes, allergies, wounds, acne, dental plaque, malaria, allergies, diarrhoea, gastroenteritis, and other inflammatory diseases, as well as diabetes, heart disease, and degenerative muscular diseases. Many pharmacological and phytochemical investigations on Psidium guajava suggest that due to its abundance of bioactive ingredients, this plant has high anti-diabetic potential. The fruit can be consumed either raw or cooked. Fruits are cut into slices and served as sweets or salads. The fruit's pulp can also be used to make drinks. The fruit is used to make a wide range of delicacies, including jam, guava paste, and guava cheese. In addition to being edible, the leaves are also therapeutic. To meet dietary needs at a lower cost, this essential fruit should be grown more. Given the low toxicity of guava extracts and the phytochemicals they produce, their usage as nutraceutical and therapeutic agents, and the proven effectiveness of both conventional formulations. Also, it's important to determine each therapeutic trait of many medicinal herbs.

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