

## A Review on the Medicinal Plant- Psidium Guajava Linn.

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### ABSTRACT:

Psidium guajava L. commonly known as Guava is a medicinal plant belonging to the family Myrtaceae. P. It is an important food crop and medicinal plant available in tropical and subtropical countries, widely used in food and folk medicines around the world. It is widely distributed throughout India. It contains important phytoconstituents such as tannins, triterpenes, and flavonoid: quercetin, pentacyclic triterpenoid: guajanoic acid, saponins, carotenoids, lectins, leucocyanidin, ellagic acid, amritoside, beta-sitosterol, uvaol, oleanolic acid and ursolic acid. In view of the immense medicinal importance of the plant, this review is an effort to compile all the information reported on its ethanobotanical, phytochemical and pharmacological activities. The present work attempts to generate interest among the masses regarding its potential in preventing and treating several common diseases. Many pharmacological studies have demonstrated the ability of this plant to exhibit antioxidant, hepatoprotective, anti-allergy, antimicrobial, antigenotoxic, antiplasmodial, cytotoxic, antispasmodic, cardioactive, anticough, antidiabetic, antiinflammatory and antinociceptive activities, supporting its traditional uses. Suggesting a wide range of clinical applications for the treatment of infantile rotaviral enteritis, diarrhoea and diabetes.

**KEYWORDS:**ethanobotany, myrtaceae, nutritional value, pharmacology, physicochemical, phytochemical, Psidium guajava.

### I. INTRODUCTION

Psidium guajava L. known as Guava is a medicinal plant belonging to the family Myrtaceae. P. guajava is a well-known traditional medicinal plant used in various indigenous systems of medicine. It is widely distributed throughout India [1]. The leaves and bark of P. Guajava tree have long history of medicinal uses that is still employed today. It is a native of Central America but is now widely cultivated, distributed and the fruits enrich the diets of millions of people in the tropics of the world [2], [3]. It is a genus of about 133 genera and more than 3,800 species of tropical shrubs and a small tree of about 10m high with spreading branches that thrives on all kinds of soils. The common types of guava include apple guava, yellow fruited cherry guava, strawberry guava, and red apple guava. It is mostly eaten raw (ripe or semi-ripe) or consumed in the form of juice, jams, and jellies. The common guava has a fruit with a yellow skin and white, yellow, or pink flesh. Guavas are known for their sweet and tangy flavor and many uses, but there's much more to this fruit than meets the eye. Many consider it a "magical" fruit because of its array of nutrients and medicinal uses. P. guajava has a rich ethno-medicinal history. Different parts of the plant are used in various indigenous systems of medicine, primarily for the treatment of gastrointestinal disorders. Some of the ethno-medicinal uses includes the crushing of the leaves and the application of the liquids coming out from them on wounds, cuts, ulcers, boils, skin and soft tissue infectious site, rheumatic places. [4]

**Common Names** [5], [6]

Guava is known as various names in various regions of the world.

The common names of Psidium guajava include in following Table.

Table No.1:- Common names of *Psidium guajava*

Arabic	guwâfah
Bengali	Piara
Brazil	araca
Cambodia	trapaeksruk
Chinese	fan shiliu
English	apple guava
French	gouyave
Germany	Guavenbaum
India	amarood; jamba
Portuguese	goiaba
Spanish	guayaba
Thailand	farang
Philippines	bayabas

## II. ORIGIN DISTRIBUTION AND MORPHOLOGY



(Figure 1:- Various Parts of Guava Plant.)

Guava (*Psidium guajava* Linn.) is a large tropical evergreen shrub or small shade tree. It is native to and widely distributed in Mexico and Central America. However, the plant is cultivated today from the west coast of Africa to the Pacific region, including India and China, with varieties originally introduced over the past 300 years from the United States. Generally, guava plant has spread widely throughout the tropics because it thrives in a variety of soils, propagates easily, and bears fruit relatively quickly. The guava berry is an important tropical fruit that is mostly consumed fresh. The fruit contains several small seeds and consists of a fleshy pericarp and seed cavity with pulp

It is now cultivated in Southern Florida, Bermuda, and throughout the West Indies from the Bahamas and Cuba to Trinidad, and south to Brazil [7].

In Mexico guava is one of very important crop which is cultivated over 36,447 acres and production is about 192,850 tons. According to records the first money-making guava planting was reputable around 1912 in Florida at Palma Sola [4].

*P. guajava* is a large dicotyledonous shrub or small evergreen tree, generally 3-10 m high with many branches [8]. The stems are crooked and the bark is light to reddish brown, thin, smooth and continuously flaking. Root system is generally superficial and very extensive, frequently extending well beyond the canopy. Each has some deep roots but no distinct taproot [9]. The leaves are opposite and simple; stipules are absent, petiole short, 3-10 mm long; blade oblong to elliptic, veins prominent, gland dotted. The flowers are white, incurved petals, 2 or 3 in the leaf axils; they are fragrant, with four to six petals and yellow anthers. The fruit is small, 3 to 6 cm long, pear-shaped, reddish-yellow when ripe. The fruit contains several small seeds and consists of a fleshy pericarp and seed cavity with pulp [10], [11], [12].

The guava fruits are either eaten fresh, or made into drinks, ice cream, and preserves. Guava fruit is still enjoyed as a sweet treat by indigenous peoples throughout the rainforest, and the leaves and bark of the guava tree have a long history of medicinal uses that are still employed today.

### III. TAXONOMY [13]

KINGDOM:-	PLANTAE
Order:-	Myrtales
Family:-	Myrtaceae
Subfamily:-	Myrtoideae
Genus:-	Psidium
Species:-	Guajava
Binomial name:-	Psidium guajava Linn

### IV. VARIOUS SPECIES [14]

Guava belongs to genus Psidium and various species are

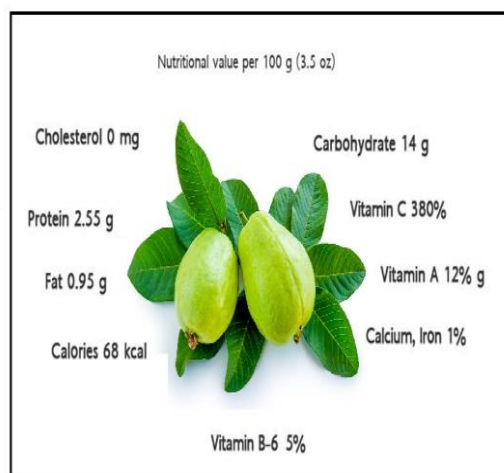
Table No-3: Various species of Psidium

Psidium amplexicaule	Psidium guajava	Psidium pedicellatum
Psidium friedrichsthali um	Psidium australeCamb ess	Psidium sintenisii
Psidium incanescens	Psidium guineense	Psidium spathulatum
Psidium araoRaddi	Psidium robustum	Psidium firmum
Psidium galapageium	Psidium cinereum	Psidium sartorianum
Psidium montanum	Psidium harrisianum	Psidium havanense
Psidium aracaRaddi	Psidium rostratum	Psidium dumetorum

### V. NUTRITIONAL VALUE

Guavas are often included among super fruits, being rich in dietary fiber, vitamins A and C, folic acid, and the dietary minerals, potassium, copper and manganese. Having a generally broad, low-calorie

profile of essential nutrients, a single common guava (*P. guajava*) fruit contains about four times the amount of vitamin C as an orange [15].



The food value and contents of guava fruit is listed in the Table 3. However, nutrient content varies across guava cultivars.

Nutrient value of guava fruit [13]

Table No-4: Nutrient value of guava fruit.

NUTRIENTS	CONTENT
Moisture	2.8-5.5g
Crude fiber	0.9-1.0g
Protein	0.1-0.5mg
Fat	0.43-0.7mg
Ash	9.5-10mg
Carbohydrate	9.1-17mg
Calcium	17.8-30mg
Phosphorous	0.30-0.70mg
Iron	200-400 I.U
Carotene(Vitamin A)	0.046mg
Thiamin	0.03-0.04mg
Riboflavin	0.6-1.068mg
Niacin	40 I.U.
Vitamin	36-50mg

Guavas are rich in dietary fiber and vitamin C, with moderate levels of folic acid. Having a generally broad, low-calorie profile of essential nutrients, a single common guava (*P. guajava*) fruit contains about four times the amount of vitamin C as an orange.

However, nutrient content varies across guava cultivars. Although the strawberry guava (*P. littorale* var. *cattleianum*) has about 25% of the amount found in more common varieties, its total vitamin C content in one serving (90 mg) still provides 100% of the Dietary Reference Intake.

### VI. ETHANOBOTANY

*P. guajava* has a long history of traditional use, a good proportion of which have been validated by scientific research [16]. The ethno-medicinal uses include the crushing of the leaves and the

application of the extract on wounds, boils, and skin and soft tissue infectious site [17]. Stem, bark and root-bark are astringent. Unripe fruit is indigestible, causes vomiting and feverish. Fruit is laxative, leaves are astringent [18]. Locally, decoction of the leaves is with much benefit to the prolapsusani of children [18] ache upsets and for vertigo [7]. *P. Guajava* leaf is a phytotherapeutic used to treat gastrointestinal and respiratory disturbances and is used as anti-inflammatory medicine. Its anti-amoebic and antimalarial effects have also been documented [19,20]. Guava fruit paste and cheese are popular dishes in Florida, the West Indies and parts of South America [21]. The plant *P. guajava* Linn. has an ethnomedicinal history as it has various activities especially functionally against the hyperglycemia.

Table 2 [22] Worldwide Ethnomedicinal uses of Guava

Table No-4: Ethnomedicinal uses of Guava.

COUNTRY	USAGE
Amazonia	For diarrhea, dysentery, menstrual disorders, stomach ache, vertigo.
Brazil	for anorexia, cholera, diarrhea, digestive problems, dysentery, gastric insufficiency, inflamed mucous membranes, laryngitis, mouth (swelling), skin problems, sore throat, ulcers, vaginal

	discharge.
Cuba	for cold, dysentery, dyspepsia coughs, diarrhea, dysentery, toothache
Ghana	coughs, diarrhea, dysentery, toothache.
Haiti	for dysentery, diarrhea, epilepsy, itch, piles, scabies, skin sores, sore throat, stomachache, wounds and as an antiseptic and astringent.
India	for anorexia, cerebral ailments, childbirth, chorea, convulsions, epilepsy, nephritis.
Malaya	for dermatosis, diarrhea, epilepsy, hysteria, menstrual disorders
Mexico	for deafness, diarrhea, itch, scabies, stomachache, swelling, ulcer, worms, wounds.
Peru	for conjunctivitis, cough, diarrhea, digestive problems, dysentery, edema, gout, hemorrhages, gastroenteritis, gastritis, lung problems, PMS, shock, vaginal discharge, vertigo, vomiting, worms.
Philippines	for sores, wounds and as an astringent.
Trinidad	fordiarrhea, dysentery, menstrual disorders, stomach ache, vertigo.
Elsewhere	for anorexia, aches, bacterial infections, boils, bowel disorders, bronchitis, catarrh, cholera, chorea, colds, colic, convulsions, coughs, diarrhea, dysentery, dyspepsia, edema, epilepsy, fever, gingivitis, hemorrhoids, itch, jaundice, menstrual problems, nausea, nephritis, respiratory problems, rheumatism, scabies, sore throat, spasms, sprains, stomach problems, swelling, tonic, toothache, ulcers, worms, wounds and as an antiseptic and astringent.

**VII. VARIOUS PARTS OF THE PLANT HAS BEEN USED IN TRADITIONAL MEDICINE**

Psidium guajava fruit (Guava) is anethnomedicine. It has special importance in the traditional system of medicine. In Ayurveda, it is

considered as an important herbal medicine for dysentery and diarrhea. In Traditional Chinese Medicine system, it is used to treat many diseases. It has been used since ages to improve the health of humans.

Table No-5: Ethnomedical uses of Guava and its part of plant.

Plant part	Compound	Ethnomedicinal Use	
leaves	Phenolic compounds, isoflavonoids, gallic acid, catechin, epicatechin, rutin, naringenin, kaempferol	Hepatoprotection, antioxidant, anti-inflammatory, anti-spasmodic, anti-cancer, antimicrobial anti hyperglycemic, analgesic activity	[23- 28]
Pulp	Ascorbic acid, carotecoids (lycopene, $\beta$ -carotene, $\beta$ -cryptoxanthin)	Antioxidant, anti-hyperglycemic, Anti-neoplastic	[29- 32]
Seed	Glycosids, Carotenoids, phenolic compounds	Antimicrobial activity	[33- 34]
Skin	Phenolic compounds	Improvement of food absorption	[35- 36]
Bark	Phenolic compounds	Strong antibacterial activity, stomachache and anti-diarrhoeal activity	[23, 37]

Leaves: The decoction or infusion of the leaves is used as febrifuge, antispasmodic and for rheumatism in India[6] The leaves are used in USA as an antibiotic in the form of poultice or decoction for wounds, ulcers and tooth ache [38],[39]. Bronchitis, asthma attacks, cough, pulmonary diseases could be also treated with guava teas [40], [41].

Bark: The bark in the form of decoction and poultice is used as an astringent in the treatment of ulcers wounds and diarrhea in Philippines while in Panama, Bolivia and Venezuela, the bark is used in treatment of dysentery and skin ailments. In the form of decoction and poultice, it is used to expel the placenta after childbirth and in infections of the skin, vaginal hemorrhage wounds, fever, dehydration and respiratory disturbances [9]

Root: The root is used in West Africa as a decoction to relieve diarrhoea, coughs, stomach ache, dysentery, toothaches, indigestion and

constipation; while in Philippines, Fiji and South Africa, the roots are used in the form of decoction and poultice as an astringent in ulcers wounds and in treatment of diarrhea [9].

Whole plant: In general, the whole plant or its shoots are used in the form of infusion, decoction and paste as skin tonic in Tahiti and Samoa and as analgesia in painful menstruation, miscarriages, uterine bleeding, premature labor and wounds [9].

**CHEMICAL CONSTITUENTS:-**

Leaves –Leaves contains essential oils such as isopropyl alcohol, menthol,  $\alpha$ -pinene, terpenyl acetate, limonene,  $\beta$ -pinene, caryophyllene, longicyclene and  $\beta$ -bisabolene. Oleanolic acid is also found in the guava leaves [42], [43].Leaves have high content of limonene about 42.1% and caryophyllene about 21.3%.8, 18 Leaves of guava have a lot of volatile compounds [42], [44], [45].

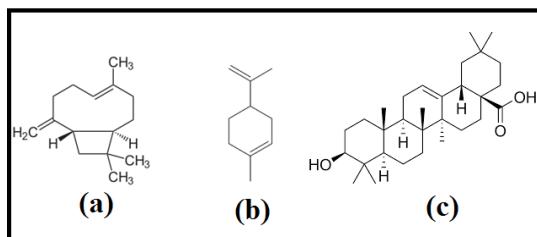


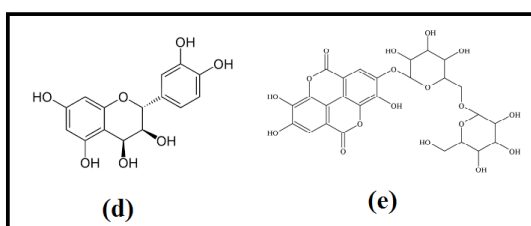
Figure 2(a) Chemical Structure of Caryophyllene., 2(b) Chemical Structure of Limonene, 2(c) Chemical Structure of Oleanolic acid)

Bark: - The bark includes - 12–30% of tannin and one of the sources declares that it includes tannin 27.4%, or polyphenols, resin and the crystals of calcium oxalate.

Tannin is also present in roots. Leucocyanidins, gallic acid and sterols are also present in roots. Carbohydrates with salts are present in abundance. Tannic acid is also its part. [42]

The bark of guava tree contains considerable amounts of tannins (11-27%), and hence is used for tanning and dyeing purposes. Leucocyanidin, luectic

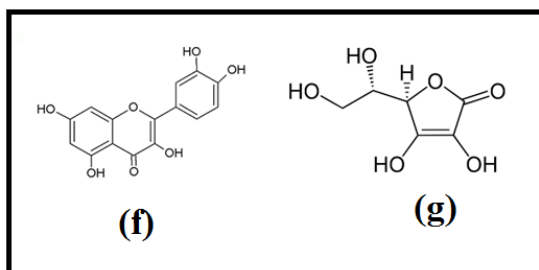
acid, ellagic acid and amritoside have been isolated from the stem bark. Five constituents, including one new pentacyclic triterpenoid: guajanoic acid and four known compounds beta-sitosterol, uvaol, oleanolic acid and ursolic acid, have been recently isolated from the leaves of *P. guajava* by Begum et al [43]. The essential oil contains alpha pinene, caryophyllene, cineol, D-limonene, eugenol, and myrcene. The major constituents of the volatile acids include (E)-cinnamic acid and (Z)-3-hexenoic acid [46].



(Figure 2(d) Chemical Structure of Leucocyanidin, 2(e) Chemical Structure of Amritoside.

The guava fruit - The guava fruit has high water content with lesser amounts of carbohydrates, proteins and fats. The fruit also contains iron, vitamins A and C, thiamine, riboflavin, niacin and manganese. It also contains phosphorus, iron and calcium. It contains more vitamin C than that of orange. The fruit contains saponin, oleanolic acid,

lyxopyranoside, arabopyranoside, guaijavarin, quercetin and flavonoids.[42], [48-49] Citric acid and acetic acid are the major ingredients of guava that play major role in antimutagenic activity.[42], [50] The chemical structures of quercetin and ascorbic acid are given below.



(Figure 2(f) Chemical Structure of Quercetin, 2(g) Chemical Structure of Ascorbic acid.

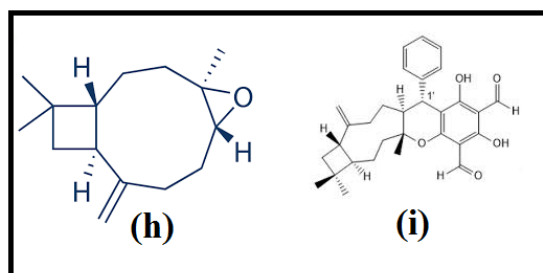
The characteristic fruit odor is attributed to carbonyl compounds. Unripe fruits are high in tannins. Active factors of *P. Guajava* fruits involve

ursolic acid, oleanolic acid, arjunolic acid and glucuronic acid [34].

The skin of fruit - contains ascorbic acid in very

high amount; however, it may be destroyed by heat. Carbonyl compounds credits strong pleasant smell. [42],[50] Guava fruit contains terpenes, caryophyllene oxide and p-selinene in large quantity which produce relaxation effects.[42], [51] The methanolic extract of guava contains high content of

flavonoids.[42], [52] There are 41 hydrocarbons 25 esters, 13 alcohols and 9 aromatic compounds in guava.[42], [53] Titratable acidity and the total soluble solids are present in fruit. Guajadial is also present in guava. [42], [54]



(Figure 2(d) Chemical Structure Caryophyllene oxide, 2(e) Chemical Structure of Guajadial.

Thus, it is clear that *P. Guajava* contains many components reported to display efficacy against various diseases.

## PHARMACOLOGY

### PHARMACOLOGY OF EXTRACTS:

The aqueous extract of *P. Guajava* leaves exhibited good antibacterial activity against various test cultures. Report says that flavanoids extracted from guava leaves believed to be responsible for antibacterial activity [55]. The microbicidal activity of *P. guajava* is also attributable to guajaverine and to psydolic acid [56]. Joseph et al reported that guava leaf essential oil contains more terpenoids and that can strongly inhibit human cervical cancer cells. The leaf extract was found to possess anticestodal[57]., analgesic, anti-inflammatory properties [58]., antimicrobial [59], and antioxidant activities[60]. In addition, the leaf extract is used in many pharmaceutical preparations as a cough sedative [61]. It has demonstrated antibacterial and anti-diarrheal effects and is able to relax the intestinal smooth muscle and inhibit bowel contractions. Guava has antioxidant properties attributed to polyphenols found in its leaves. The presence of the metabolites such as cardiac glycosides, saponins, tannins, alkaloids in *P. guajavamayis* responsible for its potential use as a drug against pathogenic bacteria [62],[63]. Alkaloid, flavonoids are phenolics structure containing one carbonyl group complexes with extracellular and soluble protein and with bacterial cell wall [64]., thus exhibits antibacterial activity through these complexes. In the pharmacological action guava leaf extracts have also been indicated to inhibit disturbances of the central nervous system:

insomnia, convulsions and epilepsy [65], [66]. In addition, anti-rotavirus activity has also been reported to exist in these extracts [67]. Bark and leaf extracts were shown to have in vitro toxic action against numerous bacteria. Water and chloroform extracts of guava were effective in activating the mutagenicity of *Salmonella typhimurium*[68]. It was shown that *P. guajava* leaf extracts might be beneficial in treating acne especially those that have anti-inflammatory activities [69]. In several studies, guava showed significant antibacterial activity against common diarrhea causing bacteria such as *Staphylococcus*, *Shigella*, *Salmonella*, *Bacillus*, *E. coli*, *Clostridium* and *Pseudomonas*, which was concluded that guava has good curative effect on infantile rotaviral enteritis [70]. In a study carried out with leaf extract of the plant, inhibition of gastrointestinal release of acetylcholine by quercetin present in extract was suggested as a possible mode of action in the treatment of acute diarrheal disease [65]. Guava fruit and leaf showed antioxidant and free radical scavenging capacity [60]. Its leaf extract possess anticough activity by reducing the frequency of cough induced by capsaicin aerosol [71]. Leaf extract of guava had inotropic effect on guinea pig atrium [72]. Another study investigated that the hypoglycemic and hypotensive effects of *P. Guajava* leaf aqueous extract in rats showed hypoglycemic activity. The hypoglycemic effect of plant extract was examined in normal and diabetic rats, using streptozotocin (STZ) induced diabetes mellitus model[73]. In the study, i.p. treatment with 1 g/kg guava juice produced a remarkable hypoglycemic action in normal and alloxan-treated diabetic mice[73]. The anti-stress and adaptogenic activity exhibited by ethanol



extract of *P. guajava* possess anti-stress property. It may be useful in the treatment of several disorders caused by stress by its immunostimulating, immunomodulating properties and also by enhancing the homeostatic mechanisms. Aqueous extract of *P. Guajava* budding leaves has been shown to possess anti-prostate cancer activity in a cell line model. Guava leaf essential oil has been shown to possess cytotoxic effect on human cervical cancer cell lines[74],[75].

The leaf extract has an excellent capacity to form coloured complex with iron. Iron chelation therapy has been shown to be anti-parasitic especially in African trypanosomiasis. Furthermore, decreasing of free-radicals has antioxidant effect in the body, meaning that polyphenols can prevent arterial sclerosis, thrombosis, and cataract and inhibit senescence of the body and skin[76]. In other animal studies, guava leaf extracts have shown central nervous system (CNS) depressant activity [77]. It can also be used as antihypertensive and anti-diarrhoeal agents in traditional medicine, by inhibiting intracellular calcium release[78]. *P. guajava* is reputed for its medicinal use in hyperactive gut disorders[79]. In a recent study with guinea pigs Brazilian researchers reported that guava leaf extracts have numerous effects on the cardiovascular system which might be beneficial in treating irregular beat (arrhythmia). Previous research indicated guava leaf provided antioxidant effects beneficial to the heart, heart protective properties, and improved myocardial function. Guava leaf extracts decreased spasms associated with induced diarrhea in rodents. The *P. guajava* infusion at the higher concentration caused a statistically significant inhibition of cellular division in the onion root-tip cells[80]. During various episodes of screening of medicinal plants, extract from *P. guajava* leaves exhibited significant inhibitory effect on the protein tyrosine phosphatase 1B (PTP1B). In a study including 17 Thai medicinal plants on anti-proliferative effects on human mouth epidermal carcinoma and murine leukemia cells using MIT assay, guava leaf showed anti-proliferative activity, which was 4.37 times more than vincristine[81].

#### PHARMACOLOGY OF PURE COMPOUNDS:

Gallocatechin isolated from the methanol extract of guava leaf showed antimutagenic activity against *E. coli*[82]. The active flavonoid compound quercetin-3-O- $\alpha$ -L-arabinopyranoside (guajaverin) extracted from leaves has high potential antiplaque activity by inhibiting the growth

of *Streptococcus mutans*[83]. Lectin chemicals in guava were shown to bind to *E. coli*, preventing its adhesion to the intestinal wall and thus preventing infection and resulting diarrhea[84]. Quercetin has several pharmacologic actions; it inhibits the intestinal movement, reduces capillary permeability in the abdominal cavity[85] and possesses dose-dependent antioxidant properties[86].

1. Antioxidant activity: The extracts from distilled water, 65% ethanol and 95% ethanol respectively showed effects on scavenging hydroxyl radicals and inhibiting lipid peroxidation in the dose-dependent manner, had 50% effective concentration (EC<sub>50</sub>) on scavenging hydroxyl radicals of 0.63, 0.47 and 0.58g/L, had EC<sub>50</sub> on inhibiting lipid peroxidation of 0.20, 0.035, 0.18g/L. [87]

2. Treatment of cough: The water extract of the plant at doses of 2 and 5 g/kg, p.o. decreased the frequency of cough induced by capsaicin aerosol by 35 and 54%, respectively, as compared to the control, within 10 min after injection of the extract, ( $P < 0.01$ ) [88]

3. Anti-diabetic activity: The ethanolic stem bark extract exhibited statistically significant hypoglycaemic activity in alloxan-induced hyperglycaemic rats but was devoid of significant hypoglycaemic effect in normal and normal glucose loaded rats (OGTT) 38. In both acute and sub-acute tests, the water extract, at an oral dose of 250 mg/kg, showed statistically significant hypoglycemic activity [89,90]

4. Antimicrobial activity: *Psidium guajava* aqueous bark and methanolic extracts were found to possess anti-bacterial activity [91]

Four antibacterial compounds were isolated from leaves of guava were identified. The minimum inhibition concentration of morin-3-O- $\alpha$ -L-lyxopyranoside and morin-3-O- $\alpha$ -L-arabopyranoside was 200 microg/ml for each against *Salmonella enteritidis*, and 250 microg/ml and 300 microg/ml against *Bacillus cereus*, respectively [92]

5. Hepatoprotective activity: *P. Guajava* aqueous leaf extracts (250 and 500mg/kg, po) possesses good hepatoprotective activity [25]

6. Antidiarrhoeal activity: *Psidium guajava* leaf aqueous extract (PGE) (50-400 mg/kg p.o.) produced dose-dependent and significant protection of rats and mice against castor oil-induced diarrhoea, inhibited intestinal transit, and delayed gastric emptying. Like atropine (1 mg/kg, p.o.), PGE produced dose-dependent and significant antimotility effect, and caused dose-related inhibition of castor oil-induced enteropooling in the

animals. Like loperamide (10 mg/kg, p.o.), PGE dose-dependently and significantly delayed the onset of castor oil-induced diarrhoea, decreased the frequency of defaecation, and reduced the severity of diarrhoea in the rodents [93]

7. Treatment of plaque: The active flavonoid compound, quercetin-3-O- $\alpha$ -l-rhamnopyranoside (guaijaverin) isolated from *Psidium guajava* demonstrated high potential antiplaque agent by inhibiting the growth of the *Strep. mutans* [94].

PHARMACOLOGICAL EFFECT	DETAILS	REFERENCE
Antioxidant activity	The extracts from distilled water, 65% ethanol and 95% ethanol respectively showed effects on scavenging hydroxyl radicals and inhibiting lipid peroxidation in the dose-dependent manner, had 50% effective concentration (EC <sub>50</sub> ) on scavenging hydroxyl radicals of 0.63, 0.47 and 0.58g/L, had EC <sub>50</sub> on inhibiting lipid peroxidation of 0.20, 0.035, 0.18g/L.	87
Treatment of cough	The water extract of the plant at doses of 2 and 5 g/kg, p.o. decreased the frequency of cough induced by capsaicin aerosol by 35 and 54%, respectively, as compared to the control, within 10 min after injection of the extract, (P < 0.01).	88
Anti-diabetic activity	The ethanolic stem bark extract exhibited statistically significant hypoglycaemic activity in alloxan-induced hyperglycaemic rats but was devoid of significant hypoglycaemic effect in normal and normal glucose loaded rats (OGTT). In both acute and sub-acute tests, the water extract, at an oral dose of 250mg/kg, showed statistically significant hypoglycaemic activity.	89, 90
Antimicrobial activity	<i>Psidium guajava</i> aqueous bark and methanolic extracts were found to possess anti-bacterial activity. Four antibacterial compounds were isolated from leaves of guava were identified. The minimum inhibition concentration of morin-3-O- $\alpha$ -l-rhamnopyranoside and morin-3-O- $\alpha$ -l-rhamnopyranoside was 200 microg/ml for each against <i>Salmonella enteritidis</i> , and 250 microg/ml and 300 microg/ml against <i>Bacillus cereus</i> , respectively. The hot water extract and the methanol extract of <i>Psidium guajava</i> showed high activity against <i>Arthrrium sacchari</i> and <i>Chaetomium funicola</i> strains.	91,92

Hepatoprotective	P. guajava aqueous leaf extracts (250 and 500mg/kg, po) possesses good hepatoprotective activity.	25
Antidiarrhoeal activity	Psidium guajava leaf aqueous extract (PGE) (50-400 mg/kg p.o.) produced dose-dependent and significant protection of rats and mice against castor oil-induced diarrhoea, inhibited intestinal transit, and delayed gastric emptying. Like atropine (1 mg/kg, p.o.), PGE produced dose-dependent and significant antiperistalsis effect, and caused dose-related inhibition of castor oil-induced enteropooling in the animals. Like loperamide (10 mg/kg, p.o.), PGE dose-dependently and significantly delayed the onset of castor oil-induced diarrhoea, decreased the frequency of defaecation, and reduced the severity of diarrhoea in the rodents.	93
Treatment of plaque	The active flavonoid compound, quercetin-3-O-alpha-l-arabinopyranoside (guajaverin) isolated from Psidium guajava demonstrated high potential antiplaque agent by inhibiting the growth of the Strep. Mutans.	94
Spermatoprotective activity	The extracts of the leaves of Psidium guajava Linn. Possess beneficial effects on sperm production and quality, and may thus improve the sperm parameters of infertile males with oligospermia and non obstructive azoospermia.	95
Antimutagenic activity	The water extract of P. guajava was effective in inactivating the mutagenicity of direct acting mutagens	49
Inotropic effect	The extract from P. guajava leaves depress myocardial inotropism.	96
Spasmolytic effect	The spasmolytic activity of the Psidium guajava leaf remedy is mainly due to the aglycone quercetin, present in the leaf and in the extract mainly in the form of five flavonols, and whose effect is produced when these products are hydrolyzed by gastrointestinal fluid.	97
Treatment of infantile rotaviral enteritis	Psidium guajava showed good curative effect on infantile rotaviral enteritis	70
Anti- cancer activity	Aqueous extract of Psidium guajava L.	39

	budding leaves has been shown to possess antiprostate cancer activity in a cell line model. Treatment with Psidium guajava L. budding leaves (1.5 mg/mouse/day) significantly diminished both the prostate specific antigen (PSA) serum levels and tumor size in a xenograft mouse tumor model.	
Antifungal activity	The hot water extract and the methanol extract of Psidium guajava showed high activity against Arthrimum sacchari and Chaetomium funicola strains.	98
Analgesic & anti-inflammatory activity	The aqueous extract of P. guajava leaves possesses analgesic and antiinflammatory properties. The hexane, ethyl acetate and methanol extracts of Psidium guajava leaves (20,100,500 and 1250 mg/kg) exhibited mostly dose-dependent antinociceptive effects in chemical and thermal tests of analgesia.	77,26
Immunomodulatory activity	Extracts derived from Psidium guajava revealed immunomodulatory activities.	99
Treatment of acne	Psidium guajava leaf extracts are used in treatment of acne.	69
Antiproliferative activity	Guava leaf extract has antiproliferatve activity caused by inhibition of the catalytic activity of Prostaglandin endoperoxide H synthase (PGHS) isoforms.	100
Antipyretic	The methanol extract of the leaves of Psidium guajava exhibited an antipyretic effect. 54	101
Contractile effect	Aqueous leaves extract of Psidium guajava significantly and dose-dependently (0.25-2 mg/ml) contracted aorta rings. The effect of P. guajava was to a large extent mediated by activation of alpha-adrenoceptor and to a lesser extent by acting via calcium ion channel	102
Hypotensive	P. guajava leaf aqueous extract (PGE, 50-800 mg/kg i.v.) produced dose-dependent, significant reductions in systemic arterial blood pressures and heart rates of hypertensive, Dahl salt-sensitive rats. The extract causes hypotension in the mammalian experimental animal model used via cholinergic mechanisms.	103
Malaria	The leaves are used as an ingredient in the preparation of fever “teas”. They are also used as a part of the pot herb used in steam treatment for malaria. The stem bark extract contained anthraquinones, flavonoids, seccoirridoids and terpenoids and was found to be effective for the treatment and/or prophylaxis	58

	of malaria.	
Oral care	In southern Nigeria the twigs are used as chew sticks and the presence of bioactive compounds comprised of saponins, tannins, flavonoids, alkaloids is responsible for their effectiveness. Chewing sticks when used without toothpaste are very efficient, effective, and reliable for cleaning teeth. The teeth of chewing sticks users are usually strong, clean, fresh, and devoid of dental plaques carries.	104
CNS Activity	The leaves of the guava tree in decoction are used for spasms, epiand even for cerebral affections.	105
Conjunctivitis	Flowers are also used as a poultice for conjunctivitis	106
Vaginal Disorders	The leaves of the guava tree in decoction are recommended fouterine haemorrhage. The same decoction is used as a wash for vaginal and uterine problems, and especially where an astringent remedy is needed.	105
Rheumatism	The pounded leaves in India are used for rheumatism.	106

8. Spermatoprotective activity: The extracts of the leaves of *Psidium guajava* Linn. Possess beneficial effects on sperm production and quality, and may thus improve the sperm parameters of infertile males with oligospermia and nonobstructive azoospermia [95]

9. Antimutagenic activity: The water extract of *P.guajava* was effective in inactivating the mutagenicity of direct-acting mutagens 4910. Inotropic effect: The extract from *P. Guajava* leaves depress myocardial inotropism [96]

11. Spasmolytic effect: The spasmolytic activity of the *Psidium guajava* leaf remedy is mainly due to the aglycone quercetin, present in the leaf and in the extract mainly in the form of five flavonols, and whose effect is produced when these products are hydrolyzed by gastrointestinal fluid [97]

12. Treatment of infantile rotaviral enteritis: *Psidium guajava* showed good curative effect on infantile rotaviral enteritis [70]

13. Anti- cancer activity: Aqueous extract of *Psidium guajava* L. budding leaves has been shown to possess anti-prostate cancer activity in a cell line model. Treatment with *Psidium guajava* L. budding

leaves (1.5 mg/mouse/day) significantly diminished both the prostate specific antigen (PSA) serum levels and tumor size in a xenograft mouse tumor model [29].

14. Antifungal activity: The hot water extract and the methanol extract of *Psidium guajava* showed high activity against *Arthrinium sacchari* and *Chaetomium funicola* strains [98].

15. Analgesic & anti-inflammatory activity: The aqueous extract of *P. guajava* leaves possesses analgesic and anti-inflammatory properties 49. The hexane, ethyl acetate and methanol extracts of *Psidium guajava* leaves (20,100,500 and 1250 mg/kg) exhibited mostly dose-dependent antinociceptive effects in chemical and thermal tests of analgesia [77, 26].

16. Immunomodulatory activity: Extracts derived from *Psidium guajava* revealed immunomodulatory activities [99].

17. Treatment of acne: *Psidium guajava* leaf extracts are used in treatment of acne [69].

18. Antiproliferative activity: *Guava* leaf extract has antiproliferatve activity caused by inhibition of the catalytic activity of Prostaglandin endoperoxide H synthase (PGHS) isoforms [100].

19. Antipyretic: The methanol extract of the leaves of *Psidium guajava* exhibited an antipyretic effect [101].

20. Contractile effect: Aqueous leaves extract of *Psidium guajava* significantly and dose dependently (0.25-2 mg/ml) contracted aorta rings. The effect of *P. guajava* was to a large extent mediated by activation of alphaadrenoceptor and to a lesser extent by acting via calcium ion channel [102].

21. Hypotensive: *P. guajava* leaf aqueous extract (PGE, 50-800 mg/kg i. v.) produced dose dependent, significant reductions in systemic arterial blood pressures and heart rates of hypertensive, Dahl salt-sensitive rats. The extract causes hypotension in the mammalian experimental animal model used via cholinergic mechanisms [103].

22. Malaria: The leaves are used as an ingredient in the preparation of fever "teas". They are also used as a part of the pot herb used in steam treatment for malaria. The stem bark extract contained anthraquinones, flavonoids, secoirridoids and terpenoids and was found to be effective for the treatment and/or prophylaxis of malaria[58]

23. Oral care: In southern Nigeria the twigs are used as chew sticks and the presence of bioactive compounds comprised of saponins, tannins, flavonoids, alkaloids is responsible for their effectiveness. Chewing sticks when used without toothpaste are very efficient, effective, and reliable for cleaning teeth. The teeth of chewing sticks users are usually strong, clean, fresh, and devoid of dental plaques carries [104]

24. CNS Activity: The leaves of the guava tree in decoction are used for spasms, epiand even for cerebral affections [105].

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26. Vaginal Disorders: The leaves of the guava tree in decoction are recommended fouterine haemorrhage. The same decoction is used as a wash for vaginal and uterine problems, and especially where an astringent remedy is needed [105].

27. Rheumatism: The pounded leaves in India are used for rheumatism[106]

## CONCLUSION

*Psidium guajava* (Linn.) is popularly called 'poor man's apple of the tropics'.

This plant's entire fruit is edible. It is possible to eat the fruit raw or even cooked. For salads or desserts, fruits are sliced and used.

Beverages from the pulp of the fruit are also prepared. The fruit produces many varieties of delicacies, such as jam, guavapaste, and guava cheese. The leaves are also edible and have properties that are medicinal. To meet the nutritional requirements at cheaper value, these essential fruits should be cultivated more.

The fruit and its juice square measure freely consumed attributable to their nice style and nutritionary benefits.

Scientific analysis has confirmed the plurality of standard uses.

In mice and different animal models, toxicity tests, still as controlled human studies indicate that every one leaves and fruit square measure healthy while not aspect effects.

In terms of the medicine action of its main parts, the plant has been totally analysed and also the findings counsel sturdy anti-diarrheal, medication, hepatoprotective, inhibitor, antimicrobial, symptom and anti-mutagenic behaviours.

A number of plant-derived chemicals like quercetin, guaijaverin, flavonoids and galactose-specific lecithins have incontestible positive effectualness in several human trials.

In recent years, analysis has focused on victimization standard medication that have a protracted and established history of treating completely different diseases. Rather a substantial quantity of labor has been performed on the medicine and biological perform of the whole plant and also the potential application of chemical compounds. Therefore, thorough study is needed on its pharmacodynamics, kinetics, and correct standardisation and clinical trials to maximise their therapeutic utility to battle completely different diseases.

The key drive of the pharmaceutical business as a full is to formulate and grow novel innovative/indigenous plant-based drugss by work leads from the normal medicine system

In recent years, a lot of attention has been paid to ethno-botanical and traditional uses of natural compounds particularly of plant origin, as {they square measure}{they're} well studied for his or her efficiency and are wide thought-about to be safe for human use. within the seek new lead molecules for the treatment of various diseases, this can be the safest classical technique.

The fact that it's a standard remedy for the cure of ailments among the varied ethnic teams, vaidhyas, hakims and Ayurvedic practitioners was an in depth screening of literature on the market on

guava. This plant continues to be studied terribly extensively and also the healthful worth of this plant is being explored by researchers.

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