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A COMPREHENSIVE REVIEW ON *PSIDIUM GUAJAVA* LINN: AS AN HERBAL REMEDY

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ABSTRACT: *Psidium guajava* Linn is an herbal remedy used in Ayurveda as a traditional system of medicine in ethnomedicine. It is a tropical evergreen plant that grows in tropical and subtropical climates. It has a wide variety of nutritional components. The whole plant and various parts of the plants possess different types of therapeutic activity, such as Tannin, phenols, triterpenes, flavonoids, essential oils, saponins, carotenoids, lectins and vitamins, dietary fiber, fatty acids, and other active components of guava plants demonstrate pharmacological activity. The fruits and leaves can be freely consumed for their good taste and various nutritional benefits and can be used in various treatments. The most active constituents, like tannins, flavonoids, terpenoids, etc., are mainly found in leaf parts. Guava has a high nutritional value, as it is high in dietary fiber, vitamins C and A, folic acid, dietary minerals, potassium, copper, and manganese. Guava leaves have phenolic compounds which are reported to possess antibacterial, antistress, antigenotoxic, anti-inflammatory, anti-hyperglycemia, anti-rotavirus, cytotoxic, hepatoprotective, etc. In this review, compile all the knowledge of pharmacogenetic and pharmacological studies to present guava as an herbal drug. Many pharmacological activities have been demonstrated, such as antioxidant, antidiabetic, antihypertensive, laxative, antiallergic, cardiotoxic, etc.

INTRODUCTION: Guava is a tropical plant with vital nutrients and beneficially therapeutic action. In Indian Ayurveda and traditional Chinese medicine, the preparation of leaves has been used as folk medicine¹. Guava is abundantly grown for fruit, obtained from *Psidium guajava* Linn, belonging to phylum Magnoliophyta, class Magnoliopsida and Myrtaceae family.

The plant is known as 'Guava', 'amrud', 'jhampal', 'bayabas' etc. in Sanskrit².

Taxonomy:

Kingdom: Plantae

Order: Myrtales

Family: Myrtaceae

Subfamily: Myrtoideae

Genus: *Psidium*

Species: *Guajava*

Biological name: *Psidium guajava* Linn.

It is widely cultivated and distributed in native America, India, Mexico, etc. tropical and subtropical areas. In India, two varieties of guava found are pyriferum and pomiferum. Guava trees

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are small evergreen shrubs with numerous robust branches. This tree has a smooth bark that flakes off now and again ³.

The study of indigenous medicinal practices is known as ethnomedicine. Traditional medicine commonly uses plant components to treat wounds, ulcers, intestinal problems, chronic diarrhea, diabetes, cough pain, high cholesterol, heart disease, discomfort, and weight reduction, among other ailments ⁴.

Guava has a high nutritional value, as it is high in dietary fiber, vitamins C and A, folic acid, dietary minerals, potassium, copper, and manganese, among others ⁵.

Nutritional Value of Guava Fruit:

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: 36-50m

Plants have various chemical constituents that possess various therapeutic applications for human health and are used as functional food or nutraceuticals ⁶. Guava leaves have phenolic compounds reported to possess antibacterial, antistress, antigenotoxic, anti-inflammatory, anti-hyperglycemia, anti-rotavirus, cytotoxic, hepatoprotective, etc. ⁷.

This review aims to describe pharmacogenetic studies and pharmacological activities examined over the last decade on various parts of *Psidium guajava* Linn *in-vitro* and *in-vivo*.

Distribution: Guava originated from Mexico, northern or central America ⁸. Guava is believed to have originated in South Africa for economic reasons before being brought to India by the Portuguese. Guava is a popular fruit in Asian

countries, but it has expanded its territory in Western countries due to its therapeutic advantages ⁹. It's a one-of-a-kind situation. It belongs to the Myrtaceae family and is a tiny tree. As long as the tree is maintained moist, it may be cultivated in any soil. Climates that are tropical or subtropical predominate. India is currently the world's leading guava producer. China, a neighboring country, came in second ¹⁰.

Cultivation and Collection: Guava seeds remain viable for many months. They often germinate in 2 - 3 weeks but may take as long as 8 weeks. Guava is generally propagated from seeds, but trees vary in plant and fruit characteristics. Guavas require full light and appreciate a frost-free environment. They may grow in various soil conditions, although they prefer rich soils, high in organic matter & well-drained soil with pH ranging from 5 to 7. The tree can withstand short water logging but not salty soils. 3 x 5 m and 5 x 6 m are the most popular tree spacing. The temperature between (15-30°C) significantly impacts growth ¹¹.

Fruit set at 24-28°C is an option. Fertilization is planned based on leaf and soil analyses, as well as the stage of growth. Pruning a bearing tree regularly is required. Because the fruit is produced on fresh growth, pruning the tree and removing water shoots and suckers are required. Trimming of undesirable wood is necessary regularly to preserve a desirable tree shape. Because guava grows fruit on fresh growth from mature wood, it's necessary to maintain a balance between vegetative growth and mature wood to ensure production the following season and fruiting consistency ¹².

Thinning at the early stages of fruit growth boosts the size of the rest fruits, prevents trunk breakage, and encourages regular bearing. The most common procedure for guava is hand thinning because chemical thinning agents have yet to be developed. The common problems for the guava are foliage diseases, root-rot, guava whitefly, guava moth, Caribbean fruit fly, mealy bugs, scale, whiteflies, and fruit flies ¹³. Guavas mature all year in warmer climates. The fruit should be allowed to ripen on the tree for the best flavor, but it can also be harvested green and left to ripen off the tree at room temperature ¹⁴. Guava is a tiny tree that grows to be 3-10 meters tall. Its root system is shallow.

Roots consist of lower-dropping branches. The trunk's diameter is 20 cm, and it is covered with smooth green or red-brown bark. Young twigs are pubescent¹⁵.

The leaves of plants grow in pairs and opposite to each other, elliptic to oblong, 5-15 cm long x 3-7 cm broad. The leaf is pubescent and veined in the lower part and glabrous in the upper part¹⁶.

The flower is white and 3cm in diameter. The fruit is juicy, pyriform, and weighs about 500 gm. The skin color of the fruit is yellowish to orange. The inner part or flesh is white, yellow, or red, sweet to sour in taste. The fruit contains numerous seeds, about 3-5 mm long¹⁷.



FIG. 1: GUAVA TREE LOCATED IN A RURAL AREA OF WEST BENGAL, INDIA

Macroscopic Characteristics of Leaves:

Color: Green

Size: 7-15 centimeters long and 3-5 centimeters wide

Shape: Oblong to oval in shape

Odor: Aromatic when crushed¹⁸.

Microscopic Characteristics: The transverse section of Guajava showed upper and lower epidermis. The epidermis consists of a single layer of cuticle, anomocytic stomata. In below part of the epidermis contain oil glands. The vascular bundle is surrounded by 4-6 layers of the cortex. Xylem is lignified, and phloem is non-lignified¹⁹.

Large Cells Make up the Pith: There were a lot of unicellular trichomes, both blunt and pointed. Calcium oxalate is present in cluster and prismatic types²⁰.

Chemical Constituents: The main components of *Guava aretensis*, phenols, triterpenes, flavonoids, essential oils, saponins, carotenoids, lectins, vitamins, dietary fiber, fatty acids, etc. Guava fruits

are richer in the source of vitamin C (80 mg of vitamin c in 100 gm of fruits) than citrus and also present vitamin A. It is an excellent source of pectin, a type of dietary fiber²¹. Guava leaves mainly contain flavonoids – Quercetin. Due to the presence of Quercetin, guava shows antibacterial activity. It is also contributing to anti-diarrhea effects. Due to the presence of polyphenols, guava acts as an anti-oxidant agent²².

The Active Constituents of Guava Plants are:

> alanine,	> arjanolic acid,	> isoneriucoumaric acid,
> alpha-humulene,	> aromadendrene,	> isoquercetin,
> alpha-hydroxyursolic acid	> ascorbic acid,	> jacoumaric acid,
> alpha-linolenic acid,	> ascorbigen,	> lectins,
> alpha-selinene,	> asiatic acid,	> leucocyanidins,
> amritoside,	> aspartic acid,	> limonene,
> araban,	> avicularin,	> linoleic acid,
> arabinose,	> benzaldehyde,	> linolenic acid,
> arabopyranosides,	> butanal,	> lysine,
	> carotenoids,	> mecocyanin,
	> caryophyllene,	> myricetin,
	> catechol-tannins,	> myristic acid,
	> crataegolic acid,	> nerolidiol,
	> D-galactose,	> obtusinin, octanol,
	> D-galacturonic acid,	> oleanolic acid,
	> ellagic acid,	> oleic acid,
	> ethyl octanoate,	> oxalic acid,
	> essential oils,	> palmitic acid,
	> flavonoids,	> palmitoleic acid,
	> gallic acid,	> pectin, polyphenols,
	> glutamic acid,	> psidolic acid,
	> gorenishic acid,	> quercetin,
	> guaifene,	> quercitrin,
	> guavacoumaric acid,	> serine,
	> guajavarin, guajiverine,	> sesquigavene,
	> guajivolic acid,	> tannins,
	> guajavolide,	> terpenes, ursolic acid and Euginol.
	> guavenoic acid,	
	> guajavanoic acid,	
	> histidine,	

FIG. 2: ACTIVE CONSTITUENTS OF THE GUAVA PLANT

Extraction of Plant Material:

- ❖ The sample of a leaf is washed in water.
- ❖ Then dried and placed into a blender to be blended into a powder.
- ❖ For the extraction process, the maceration procedure is used. Four solvents which are increasing polarity, n-hexane (>95%), methanol (>95%), ethanol (>99.5%), and boiling water, are used.
- ❖ Then the leaf powder was added to each solvent to make a 20% concentration.
- ❖ The mixes were prepared in a sterile 125 ml Erlenmeyer flask coated in aluminum foil to minimize evaporation and kept at room temperature for 3 days.

- ❖ The flasks were then shaken at 70 rpm on a platform shaker.
- ❖ After 3 (Three) days of soaking in the solvent, the mixtures were transferred to 50 mL tubes and centrifuged for 10 min at 4,000 rpm at 25°C.
- ❖ The supernatant was collected and stored at 4°C until needed^{23, 24}.

Phytochemical Studies: Different chemical tests are done to identify active constituents in guava. For each test, 1ml of each solvent extract was used for analysis, except in the saponin test, 3ml of solvent extracts were used²⁵.

Test for Saponin: Extract was placed in a test tube and shaken vigorously. The presence of saponins 26 indicated the formation of stable foam.

Test for Phenols and Tannins: Extracts were mixed with 2ml of 2% solution of FeCl₃. A blue-green or black coloration is formed²⁷.

Test for Terpenoids (Salkowski's test): Extract is mixed with chloroform (2ml). Then add 2ml of concentrated sulfuric acid and shake gently. A reddish-brown color is formed in the interphase to show the presence of terpenoids²⁸.

Test for flavonoids (Shinoda test): add magnesium ribbon fragments and concentrated hydrochloric acid to extract dropwise. Orange, red, pink, or purple color is formed²⁹.

Test for Glycoside: Extract was mixed with 2 mL of glacial acetic acid containing 2 drops of 2% FeCl₃. The mixture was poured into another tube containing 2 mL of concentrated sulfuric acid. A brown ring at the interphase indicates the presence of glycosides³⁰.

Physicochemical Studies: The parameters for physicochemical studies are total ash value, loss on drying, water-soluble ash, acid-insoluble ash, foaming index, saponification value, water-soluble extractive value, etc., were determined as per WHO guidelines³¹.

Loss on Drying: Transfer the sample to the beaker, cover it and accurately weigh the bottle and content

individually; keep for 1 hour at 60°C. Then calculate the final value and % yield of moisture content³².

Ash value: Weigh 3gm of guava leaves in the crucible. Then it is kept in a Muffle furnace for 5 to 6 hours and switched off the instruments. Then after 15 minutes, the crucible was cool and weighed³³.

Water-soluble and Insoluble Ash Value: In a beaker, 0.7 gm leaves mixed with 25ml of water and heated for 5 min. Then filter and warm the filter paper after filtration. Weight the ash of the filter, remaining on filter paper and water-insoluble extract. The filtrate is a water-soluble extract³⁴.

Swelling Index: In a measuring cylinder, 3gm of accurately weighed dry guava is dissolved in 20ml of water and kept for 24 hours with agitating occasionally. After that observe the swelling values o guava leaves and measure the volume occupied by swollen³⁵.

Foaming index: add 1gm of extract to 10ml of water in a beaker. Then shake for a few min and allow to stand. The foaming index is calculated by

$$\text{Foaming index} = 1000 / a$$

a = volume of decoction used for preparing dilution in tube³⁶.

Therapeutic Uses: Various parts of guava plants have pharmacological activity.

Leaf: The decoction or infusion of leaves is used in treating rheumatism in India. It is used as an antibiotic for wounds, ulcers, and toothache in the USA. Guava teas are also treated for bronchitis, asthma, cough, and pulmonary diseases.

Bark: The decoction or infusion of the bark acts as an astringent in treating ulcers, wounds and diarrhea in the Philippines. In Panama, it is used to treat dysentery and skin disorders. It is also helped to expel the placenta after childbirth. It also treats skin infections, vaginal hemorrhage, wounds, fever, dehydration, and respiratory disturbance.

Roots: the decoction form of roots used to treat diarrhea, cough, stomach ache, dysentery, toothaches, indigestion, and constipation in West

Africa. The is acts as an astringent in treating ulcers, wounds and diarrhea in the Philippines.

Whole Plants: The decoction, infusion, or paste form of whole plants acts as a skin tonic in Tahiti and Samoa and acts as an analgesic in painful menstruation, miscarriages, uterine bleeding, premature labor, and wounds^{37, 38}.

Pharmacological Activity:

Laxative: guava leaves and fruits contain dietary fiber, which helps in the treatment of constipation. It contains 36 gm of dietary fiber per 100 gm of fiber in the diet. Guava seeds are also a potent laxative used to treat chronic constipation and intestinal cleansings³⁹.

Antidiabetic Activity: In china, guava leaves are consumed on an empty stomach to treat diabetes. Peeled fruits without skin consumption are lowering blood sugar levels.

The inhibition of intestinal motility effects of leaves on glycosidase to breakthrough related to postprandial hyperglycemia in the treatment for diabetes (type II)². The fiber of guava leaves elevated glucose absorption from the gut⁴⁰.

Anti-diarrhea: Leaf extracts decreased spasms, and induced diarrhea. Reduced defecation, the severity of diarrhea, and intestinal fluid secretion reduction. Quercetin and its derivatives affect smooth muscle fibers with calcium antagonism, inhibit intestinal movement, and reduce capillary permeability in the abdominal cavity⁴¹.

Cardioprotective: The constituents of guava plant, Arjunolic acid acts as a cardioprotective agents⁴².

Hepatoprotective activity: the leaf extracts possess a significant hepatoprotective effect with Asiatic acid. It blocked the lip polysaccharides, D-galactosamine in both serum Aspartate aminotransferase and serum alanine transferase levels. It is also showing improved nuclear condensation and ameliorated proliferation with less lipid deposition⁴³.

Antioxidant Activity: Guava leaf extracts and fruits are potential sources of natural antioxidants. Guava contains copious amounts of phenolic compounds such as protocatechuic acid, ferulic acid, Quercetin, Gauvin ascorbic acid, gallic acid,

and caffeic acid inhibit peroxidation reactions in the human body.

The decrease of free radicals has antioxidizing effect in the body due to the guava leaf polyphenols that prevent arterial sclerosis, thrombosis, cataract and inhibition of senescence in the body and skin⁴⁴.

Antihypertensive Agents: the consumption of guava fruit daily significantly reduces blood pressure levels. Guava contains potassium which helps to relax blood vessels and thus helps in controlling blood pressure⁴⁵.

Anticancer: The aqueous extract of guava inhibits the growth of cancer cell line DU-145 in a dose-dependent manner. Essential oil extraction from leaves effectively reduces the growth of human mouth epidermal carcinoma and murine leukemia. Jacomari acid is obtained from guava seeds having anti-tumor effects. Leaf extracts have the potential effect as chemotherapeutic agents to inhibit the growth of tumors and cancer⁴⁶.

Anti-inflammatory and Analgesic Agents: the decoction of leaf extracts showing anti-inflammatory activity in the treatment of rheumatism. The young leaves and shoots are used for inflammation of the kidney and kidney problems in India⁴⁷.

CNS-related Activity: Quercetin is a flavonoid that is obtained from leaf extracts, induced the reduction in acetylcholine evoked released. The leaf infusion is used in India for cerebral infections. The mechanism of action may be associated with an interaction with presynaptic calcium channels⁴⁸.

Wound Healing Activity: The plant provides astringent activity in treating wound healing activity and skin damage repair properties.

Decoction of the bark, leaf, and flowers is used in formulating eye products for their soothing effects. The solvent extraction of guava shows antiallergic activity. The guava cream has adjunctive therapy in atopic dermatitis^{49, 50}.

CONCLUSION: *Psidium guava* Linn possesses several medicinal properties for multiple health problems. The fruits and leaves can be freely

consumed for their good taste and various nutritional benefits and can be used in various treatments. The most active constituents, like tannins, flavonoids, terpenoids, etc., are mainly found in leaf parts.

From this review, this can be concluded that the whole part of various parts of the plants has a traditional use in the treatment of various diseases such as constipation, diabetes, skin disorder, hypertension, rheumatism, etc., in recent years, further investigation studies on guava, discover its therapeutic activity on cancer.

Hence, a significant amount of investigation is required on its pharmacodynamics, kinetics and proper standardization, and clinical trials are needed to exploit their therapeutic utility to combat various diseases.

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