



An Outlook of Pharmaceutically Important Plant - *Psidium Guajava* Linn.

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ABSTRACT

*In this review, an endeavor has been made to study literature of medicinally important plant *Psidium guajava* Linn belonging to family Myrtaceae. This plant is native to American continent but is equally famous throughout the world for its nutritional values. It is widely used as food as well as folk medicine in tropical as well as subtropical countries across the globe. *Psidium guajava* Linn mainly contains quercetin, guaijaverin, isoflavonoids, gallic acid, catechin, epicatechin, rutin, naringenin, kaempferol flavonoids and galactose-specific lecithins in it. All these constituents have different pharmacological activities which are proven by various in vitro and in vivo models. Medicinally important phytoconstituents are found in various plant parts such as leaf, seeds, pulp, skin and fruits of *Psidium guajava* Linn. Thus it can be concluded that wide range of clinical applications are available for flavonoids rich plant *Psidium guajava* Linn.*

Keywords: *Psidium guajava* Linn, Myrtaceae, Nutritional values, Phytoconstituents

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INTRODUCTION

Psidium guajava Linn are trees and shrubs which are widely cultivated in tropical and subtropical regions throughout the world, these fruits can range in various sizes from medium to large. Various cultivars have white, pink, or red flesh, and a few also feature red (instead of green or yellow) skin. The term "guava" has been derived from Arawak guayabo "guava tree", via the Spanish guayaba. Various types of guava such as apple guava, yellow-fruited cherry guava, strawberry guava, and red apple guava are cultivated in various countries. Ripe fruits are often consumed either as such or in the form of juice, jams, and jellies. The fruits of *Psidium guajava* Linn are known for their sweet and tangy flavor and many therapeutic applications. This fruit is magical because of its variety of nutrients and medicinal uses. *Psidium guajava* Linn is used in various indigenous systems of medicine, primarily for the treatment of gastrointestinal and stomach related 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 [1].

GEOGRAPHICAL SOURCE

Guava's believed to have originated from Mexico but available in Asian countries also because of its health benefits and nutritional values. Guava producing countries are India, China, Thailand, Pakistan, Mexico, Indonesia, Brazil, Bangladesh, Philippines, and Nigeria. Globally, India, Pakistan and Brazil are the principal producers of many varieties of Guava [2].

VERNACULAR NAMES IN INDIA

Guava is known by various names in various regions of the India [2]. The common names of *Psidium guajava* Linn are mentioned in Table 1.

Table 1 Vernacular Names of *Psidium guajava* Linn

Language	Vernacular Name
Assamese	Madhuri aam
Bengali	Peyara
Gujarati	Jaamkal, Jamrukh
Hindi	Amrood
Kannada	Perale, Seebi
Malayalam	Pera
Manipuri	Pungton
Marathi	Jam, Peru
Nepali	Bihi
Tamil	Segappu koyyaa
Telugu	Goyyapandu
Urdu	Amrud

SCIENTIFIC CLASSIFICATION OF PLANT AS PER TAXONOMY**Table 2 Taxonomic Classification of *Psidium guajava* Linn**

Kingdom	Plantae
Class	Tracheophytes Angiosperms Eudicots Rosids
Order	Myrtales
Family	Myrtaceae
Genus	<i>Psidium</i>
Species	<i>P. guajava</i>
Botanical name <i>Psidium guajava</i> Linn [3]	

CULTIVATION, COLLECTION AND PROCESSING

With reference to Government reports the area under guava cultivation in India is increased by 64% from 94 thousand hectares in 1991-92 to 155 thousand hectares in 2001-02 whereas the production increased by 55% from 11 lakh tones to 17 lakh tonnes. Major guava producing states are Uttar Pradesh, Bihar, West Bengal, Maharashtra, Chhattisgarh, Tamil Nadu, Karnataka, Madhya Pradesh, Gujarat and Andhra Pradesh. *Psidium guajava* Linn is economically important because the fruit is a good source of vitamin C, pectin, calcium and phosphorus. The fruit is used for the preparation of processed products like jams, jellies and nectar. Guava jelly puree is very popular for its attractive purplish-red colour, pleasant taste and aroma. The puree can be used in juice, cakes, puddings, sauces, ice-cream, jam and jelly. Fruits can be preserved by canning as halves or quarters, with or without seed core (shells). Good quality salad can be prepared from the shell of ripe fruits. Leaves of guava are used for curing diarrhoea and also for dyeing and tanning because of its tannin contents. Guava fruits have very short shelf life making it difficult for distant marketing. For long distance transportation, use of refrigerated transport and also proper packaging and cushioning material is required to enhance the shelf life of fruits. The processing industry for guava needs to be developed in order to lower the marketing costs and reduce wastage and losses in the production chain. Guavas can be dehydrated and powdered. Two types of wine, viz. guava juice wine and guava pulp wine can be manufactured from ripe fruits. Good quality ready-to-serve beverage can be made from guava. The seeds contain 5-13% oil which is rich in essential fatty acid and can be used in salad dressing. Guava is grown in both tropical and sub-tropical regions upto 1,500 m. above m.s.l. It tolerates high temperatures and drought conditions prevalent in north India in summers. However, it is susceptible to severe frost as it can kill the young plants. An annual rainfall of about 100 cm. is sufficient during the rainy season (July-September). Rainfall during the harvesting period deteriorates the quality of fruits. Heavy clay to very light sandy soils having pH between 4.5-8.2 are suitable for cultivation of guava. Good quality guavas are produced in river basins. The crop is sensitive to water-logging [4].

Table 3 State wise Growing Belts for *Psidium guajava* Linn

State	Growing belts
Andhra Pradesh	East Godavari, West Godavari, Guntur, Krishna, Ananthapur, Medak, Ranga Reddy, Mahaboob nagar, Prakasham, Khammam
Madhya Pradesh	Jabalpur, Ujjain, Hoshangabad, Khargone, Badwani, Indore, Shivpuri
Chhattisgarh	Raipur, Durg, Jabalpur
Maharashtra	Satara, Beed, Pune, Ahmed nagar, Aurangabad, Amravati
Gujarat	Bhavnagar, Ahmedabad
Karnataka	Kolar, Shimoga, Dharwar, Raichur, Bangalore (R & U), Belgaum
Tamil Nadu	Madurai, Dindigul, Salem
Jharkhand	Ranchi, Lohardaga, Hazaribagh, Giridih, Dhanbad
West Bengal	South 24 Parganas, North 24 Parganas, Hooghly
Uttar Pradesh	Allahabad, Farukhabad, Aligarh, Badaun

Land is prepared during the summer season by ploughing, harrowing, levelling and removing weeds. Plants are vegetatively propagated by budding, inarching or air layering. Planting is done during the rainy season. June-July is the ideal time for planting the layers and seedling. The plants are usually planted at a distance of 5-8 m. The exact planting distance is decided according to variety, soil fertility and availability of irrigation facilities. Standard spacing is 6 m. x 6 m. accommodating 112 plants/acre. By increasing the plant density, productivity can be increased. In the model scheme, a spacing of 6 m. x 6 m. with a population of 110 plants per acre has been considered which was commonly observed in areas covered during a field study. High density planting causes erect growth of branches making the plant tall, compact and also gives higher yield/unit area in early years of fruiting. Square system of planting is generally adopted. Pits of 1x1x1m. size are dug before the monsoon and filled with a mixture of farmyard manure and soil. Time of fertilizer application depends on the region and crop variety. In north India, fertilizer is applied in the first week of May for rainy season crop and in first week of July for winter season crop. The plants are manured twice a year, first during June-July and second by during October. A fertilizer dose of 600 g. N, 400 g. K in Northern Region, 260 g. N, 320 g. P and 260 g. K in Eastern Region, 900 g. N, 600 g. P and 600 g. K in Southern Region and 600 g. N, 300 g. P and 300g. K/plant /year in Western Region is recommended. Guava is mostly grown under rainfed condition. During winter season, irrigation is provided at an interval of 20-25 days and in the summer months it is provided at an interval of 10-15 days by the ring method. Drip irrigation has proved to be very beneficial for guava. About 60% of the water used for irrigation is saved. Besides substantial increase in size and number of fruits is observed. The plants start bearing at an early age of 2-3 years but they attain full bearing capacity at the age of 8-10 years. The yield of a plant depends on its age, cropping pattern and the cultural practices. A 10 year old plant yields about 100 to 150 kg. of fruits every year. If both rainy and winter season crops are taken, more yields may be obtained in the rainy season. Guavas are harvested throughout the year (except during May and June) in one or the other region of the country. However, peak harvesting periods in north India are August for rainy season crop, November- December for winter season crop and March-April for spring season crop. In the mild climatic conditions of the other parts of the country, the peak harvesting periods are not so distinct. Guava fruits develop best flavour and aroma only when they ripen on tree. In most of the commercial varieties, the stage of fruit ripeness is indicated by the colour development which is usually yellow. For local markets, fully yellow but firm fruits are harvested, whereas half yellow fruits are picked for distant markets. Fruits are harvested selectively by hand along with the stalk and leaves. Fruits are further graded and stored in polybags with proper ventilation [4].

Morphological Characteristics

Psidium guajava Linn is a small tree, up to 33 ft tall, with spreading branches, easily recognized because of its smooth, thin, copper-colored bark that flakes off, showing the greenish layer beneath; and also because of the attractive, "bony" aspect of its trunk which may in time attain a diameter of 10 in. Faintly fragrant white flowers, borne singly or in small clusters in the leaf axils, are 2.5 across, with 4 or 5 white petals which are quickly shed, and a prominent tuft of about very many white stamens tipped with pale-yellow anthers. The fruit, exuding a strong, sweet, musky odor when ripe, may be round, ovoid, or pear-shaped, 5-10 cm long, with 4 or 5 protruding sepals at the top, and thin, light-yellow skin, frequently blushed with pink [5].



Fig. 1 Plant of *Psidium guajava* Linn with Fresh Fruits (Image Source – Google Images)

MICROSCOPIC CHARACTERISTICS OF *PSIDIUM GUAJAVA* Linn LEAVES

The surface preparation of both surfaces of leaves reveals the presence of stomata only on lower surfaces. They are paracytic type and are traversed with unicellular to multicellular uniseriate trichomes and starch grains in between. The transverse section of the leaves is dorsiventral in nature. The broader portion of midrib is covered with vascular bundle in centre surrounded by fibres. Trichomes are present on both surfaces in midrib region. The detailed study shows a layer of both upper and lower epidermis consisting of oval to rectangular shaped cells. The deposition of cuticle is observed on upper epidermis. The layer of upper epidermis is followed by a layer of tooth-shaped cells in lamina portion while 2-5 layered collenchymas cells in midrib region. The mesophyll cells of lamina portion are composed of usually single layered palisade cells (rarely 2-layered) in continuation with spongy parenchyma cells. They are interrupted with vessels and are filled with chlorophyll contents. In midrib region, hypodermis is followed by a wide zone of ground tissue composed of parenchyma cells and is filled with scarce distribution of starch grains at places. The prismatic crystals of calcium oxalate are also seen in ground tissue portion. Schizolysigenous types of secretory cells are observed in ground tissue portion. The vascular bundle was found surrounded by lignified fibres [6].

PHYTOCONSTITUENTS OF *PSIDIUM GUAJAVA* LINN

The plant has been identified as having many medicinally important phytoconstituents. The fruit contains saponin combined with oleanolic acid. Morin-3-O--L-lyxo-pyranoside, morin-3-O--L-arabopyranoside and flavonoids, guaijavarin, pinene, guavicularin and quercetin were identified from leaves. Aroma active volatiles such as (Z)-3-hexenal, 3-sulfanyl-L-hexanol, 4-hydroxy-2,5-dimethyl-3(2H)-fura-none, 3-sulfanylhexyl acetate, hexanal, ethyl butanoate, cinnamyl acetate and methional were also identified. Two triterpenoids, betulinic acid and lupeol, were isolated from the leaf extract of *Psidium guajava* Linn. Two more triterpenoids, 20-acetoxy-2,3-dihydroxyurs-12-en-28-oic acid (guavanoic acid), and 2,3-dihydroxy-24-p-z-coumaroyloxyurs-12-en-28-oic acid (guavacoumaric acid), along with six known compounds (2-hydroxyursolic acid, jacoumaric acid, isoneriu-coumaric acid, asiatic acid, ilelatifol D and Sitosterol-3-O-D-glucopyranoside) have been isolated from the leaves. *Psidium guajava* Linn seed oil is an excellent source of beta carotene, vitamin A, vitamin C, copper, zinc and selenium. The composition of fatty acids in guava seed oil is presented in the following table, showing that the oil is particularly rich in linoleic acid [7,8].

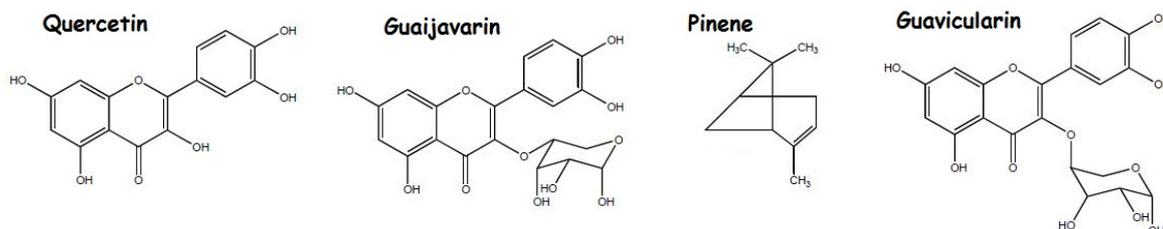


Fig 2 Structures of Phytoconstituents from *Psidium guajava* Linn [1]

Table 4 Chemical Constituents *Psidium guajava* Linn seeds

Chemical Constituent	Percentage
Lauric acid	<1.5%
Myristic acid	<1.0%
Palmitic acid	8-10%
Stearic acid	5-7%
Oleic acid	8-12%
Linoleic acid	65-75%
Saturated fats, total	14%
Unsaturated fats, total	86%

USES

Psidium guajava Linn fruits are edible with a rich source of vitamin C. Seeds yield fatty oil, bark and leaves are used for tanning while bark decoction is used to treat diarrhoea. In folk medicine, root, bark and leaf extracts are used to treat gastroenteritis, vomiting, diarrhoea, dysentery, wounds, ulcers, toothache, coughs, sore throat and inflamed gums. Guavas are free from fat and cholesterol (except seeds). They are also an excellent source of fiber, potassium and vitamin A. Leaves are especially used to treat diabetes mellitus, painful menstruation, hypertension, as an antiseptic, and treatment of coughs and colds. The leaves of guava are used as an astringent. Locally, a decoction of leaves is applied with much benefit to the *prolapsus ani* of children. Indians also employ it to treat sore throats, vomiting, stomach upsets and vertigo. The leaves are used as a health tea. Leaves contain copious amounts of phenolics, which inhibit peroxidation in living bodies and therefore can be expected to prevent various chronic diseases. *Psidium guajava* possesses useful medicinal properties: anti-diarrhoeal, anti-oxidant, hepatoprotective, anti-allergy, anti-microbial, anti-genotoxic, cardioprotective, anti-cough, anti-spasmodic and anti-hyperglycemic properties. Thus, guava fruit possesses a wide range of useful medicinal properties, which can be clinically exploited. The stem, bark and root bark of *P. guajava* are astringent. Unripe fruit is indigestible, causes vomiting and feverishness. The leaves are rich in tannin, and have antiseptic properties. The anti-inflammatory and analgesic activities of *P. guajava* were investigated in rats using the carrageenan-induced hind paw edema model. The leaves are also used for several other ailments, including diabetes. The young leaves and shoots are also used for inflammation of the kidney and kidney problems. Some of the ethnomedicinal uses include the crushing of leaves and the application of liquids from them onto wounds, cuts, ulcers, boils, skin and soft tissue infectious sites and rheumatic places and the chewing of the leaves to relieve toothache, oral ulcers, inflamed gums, throat and chest pains, treatment of leucorrhoea, diarrhea, dysentery, convulsions and epilepsy, as well as the use of decoctions and infusions as a douche for vaginal discharges and to tighten and tone vaginal walls after childbirth [9,10,11].

Allied Varieties of *Psidium guajava* Linn

Along with *Psidium guajava* Linn following varieties are also available and cultivated across the globe. All these differ in the percentage of phytochemical constituents available in them [12].

Table 5 Allied varieties of *Psidium guajava* Linn

<i>Psidium friedrichsthalium</i>	<i>Psidium incanescens</i>	<i>Psidium amplexicaule</i>
<i>Psidium galapageium</i>	<i>Psidium montanum</i>	<i>Psidium arao Raddi</i>
<i>Psidium cambess</i>	<i>Psidium pedicellatum</i>	<i>Psidium araca Raddi</i>
<i>Psidium guineense</i>	<i>Psidium robustum</i>	<i>Psidium australe</i>
<i>Psidium harrisianum</i>	<i>Psidium rostratum</i>	<i>Psidium cinereum</i>
<i>Psidium havanense</i>	<i>Psidium sartorianum</i>	<i>Psidium dumetorum</i>
<i>Psidium spathulatum</i>	<i>Psidium sintenisii</i>	<i>Psidium firmum</i>

DISCUSSION

Psidium guajava Linn fruits are economically important source of medicines specially in traditional systems. These are popularly known as guava and have been used traditionally as a medicinal plant across the globe for a number of ailments. In this review, endeavour has been made to present pharmacognostic account of *Psidium guajava* Linn. It contains a good amount of lycopene which is a carotenoid phytonutrient. Lycopene has anti-tumor properties and protects from prostate cancer. The plant is also rich in dietary fiber, which can reduce the sugar levels in the body and help diabetes patients take control of their health. People suffering from chronic pain can use the fruit and derive benefit from its anti-inflammatory properties. Guavas contain a mineral known as folate. It helps promote fertility in

humans. Guava is rich in magnesium which acts as a nervous relaxant. It helps to relax muscles and nerves of the body. Guava has a capacity to shrink and contract any open tissues in body. This has anti-bacterial properties that can flush out the harmful toxins and bacteria from body of patients. The juice is an effective remedy to treat dengue fever. It is recommended to drink the guava juice at least three times in a day for effective results. Pink guavas contain twice the amount of lycopene present in tomatoes. Lycopene is an antioxidant that protects our skin from being damaged by UV rays and environmental pollution thereby proving its anti-ageing role [13].

CONCLUSION

In conclusion this pharmacognostic outlook of *Psidium guajava* Linn will surely be useful for researchers as well as cultivators throughout the world because this extensive literature survey reveals that guava can be acclaimed as 'poor man's apple of the tropics', has an ethnobotanical history of uses for a wide range of diseases. The fruit as well as juice is freely consumed for its great taste and nutritional benefits. Much of the traditional uses have been validated by scientific research. The plant has been extensively studied in terms of pharmacological activity of its major components. Future endeavors shall also be made to exploit pharmaceutical importance of *Psidium guajava* Linn. This review will provide all the necessary information with regard to guava, and will be useful in carrying out further research specially in the area of ethnomedicines.

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