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Content

Psidium guajava L: A review

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Psidium guajava L, belonging to the Myrtacea family, has been reported to have anti-diarrheal, hepatoprotective, hypoglycemic, lipid lowering, antibacterial and antioxidant activities. It contains important phytoconstituents such as tannins, triterpenes, 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 phytochemical and pharmacological activities. The present review is an attempt to generate interest among the masses regarding its immense potential in preventing and treating several common diseases.

Key words: *Psidium guajava* L, Myrtaceae, quercetin, guajanoic acid

INTRODUCTION

Psidium guajava L is a fruit-bearing tree commonly known as guava, which belongs to the family Myrtaceae. The French call it *goyave* or *goyavier*; the Dutch, *guyaba*, *goeajaaba*; the Surinamese, *guave* or *goejaba*; and the Portuguese, *goiaba* or *goaibeira.* Hawaiians call it guava or *kuawa*. In Guam, it is *abas*. In Malaya, it is generally known either as guava or *jambu batu* (Morton, 1987). Guava grows nearly throughout India up to 1500 m in height and is cultivated commercially in almost all states, the total estimated area being 50,000 hectares. The important guava-growing states in India are Uttar Pradesh, Bihar, Maharashtra, Assam, West Bengal and Andhra Pradesh. Cultivated varieties grow about 10 m in height and produce fruits within 4 years. Wild trees grow up to 20 m high and are well branched. The tree can be easily identified by its distinctive thin, smooth, copper-colored bark that flakes off, showing a greenish layer beneath. Guava trees have spread widely throughout the tropics because they thrive in a variety of soils, propagate easily and bear fruits quickly. The fruits are enjoyed by birds and monkeys, which disperse guava seeds and cause spontaneous dumps of guava saplings to grow throughout the rainforest (Wealth of India, 2003).

The leaves and bark of guava tree have a long history of medicinal uses. In India, decoction of the leaves and bark of guava is used to cure diarrhea, dysentery, vomiting and sore throats, and to regulate menstrual cycles. The tribes of the Amazon use leaf decoction for mouth sores, bleeding gums, as douche for vaginal discharge and to tighten and tone up vaginal walls after labor. Guava is cultivated throughout the tropics. Commercially, the fruit is consumed raw or used in making jams, jellies, pastes and juice. Guava leaves are official in Dutch Pharmacopoeia. Guavas are free from fat and cholesterol. They are also an excellent source of fiber, potassium and vitamin A.

Phytochemistry

Guava is rich in tannins, phenols, triterpenes, flavonoids, essential oils, saponins, carotenoids, lectins, vitamins, fibre and fatty acids. Guava fruit is higher in vitamin C than citrus fruits (80 mg of vitamin C in 100g of fruit) and contains appreciable amounts of Vitamin A as well (Table 1). Guava fruits are also a good source of pectin (Sunttornusk L, 2005).

The leaves of guava are rich in flavonoids, particularly quercetin. It has demonstrated antibacterial and anti-diarrheal effects and is able to relax the intestinal smooth

Table 1: Food value of *Psidium guajava* fruit

Vitamin G4	36-50
Calories	77-86 g
Moisture	2.8-5.5 g
Crude fiber	0.9-1.0 g
Protein	0.1-0.5 g
Fat	0.43-0.7 g
Ash	9.5-10 g
Carbohydrates	9.1-17 mg
Calcium	17.8-30 mg
Phosphorus	0.30-0.70 mg
Iron	200-400 I.U.
Carotene (vitamin A)	0.046 mg
Thiamine	0.03-0.04 mg
Riboflavin	0.6-1.068 mg
Niacin	40 I.U.
Vitamin B3	35 I.U.

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muscle and inhibit bowel contractions. Guava has antioxidant properties attributed to polyphenols found in its leaves. 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* (Begum *et al*., 2004).

Biological Activity and Clinical Research

The long history of guava use has led modern-day researchers to study guava extracts (Table 2). Its traditional use against diarrhea, gastroenteritis and other digestive complaints has been validated in numerous clinical studies. 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 (Manosroi *et al*., 2006). Bark and leaf extracts were shown to have *in vitro* toxic action against numerous bacteria. Gallocatechin isolated from the methanol extract of guava leaf showed antimutagenic activity against *E. coli* (Matsuo *et al*., 1996). Water and chloroform extracts of guava were effective in activating the mutagenecity of *Salmonella typhimurium* (Grover *et al*., 1993). The antimicrobial activities of *P. guajava* and leaf extracts, determined by disk diffusion method (zone of inhibition), were compared to tea tree oil (TTO), doxycycline and clindamycin antibiotics. It was shown that *P. guajava* leaf extracts might be beneficial in treating acne especially those that have anti-inflammatory activities (Qadan *et al*., 2005). The active flavonoid compound - quercetin-3-O-alpha-l-arabinopyranoside (guaijaverin) - extracted from leaves has high potential antiplaque activity by inhibiting the growth of *Streptococcus mutans* (Limsong *et al*., 2004). Guava leaf extract inhibited the growth of *Streptococcus aureus* in a study carried out by disc diffusion method (Abdelrahim *et al*., 2002). In several studies, guava showed significant antibacterial activity against common diarrhea-causing bacteria such as *Staphylococcus*, *Shigella*, *Salmonella*, *Bacillus*, *E. coli*, *Clostridium* and *Pseudomonas*. A double-blind clinical study of the effects of a Phytodrug (QG-5) developed from guava leaf showed a decrease in duration of abdominal pain, which is attributed to antispasmodic effect of quercetin present in leaf extract (Xavier Lozoya *et al*., 2002). Guava leaf extracts and fruit juice have also been clinically studied for infantile diarrhea. In a clinical study with 62 infants with infantile rotaviral enteritis, the recovery rate was 3 days (87.1%) in those treated with guava, and diarrhea ceased in a shorter period than controls. It was concluded in the study that guava has 'good curative effect on infantile rotaviral enteritis' (Wei *et al*., 2000). Lectin chemicals in guava were shown to bind to *E. coli* (a common diarrhea-causing organism), preventing its adhesion to the intestinal wall and thus preventing infection and resulting diarrhea (Rodriguez *et al*., 2001). Guava leaf extract has also shown to have tranquilizing effect on intestinal smooth muscle, inhibit chemical processes found in diarrhea and aid in the re-absorption of water in intestines. In other research, an alcoholic leaf extract was reported to have a morphine-like effect, by inhibiting the gastrointestinal release of chemicals in acute diarrheal disease. This morphine-like effect was thought to be related to a chemical, quercetin. The effective use of guava in diarrhea, dysentery and gastroenteritis can also be related to guava's documented antibacterial properties (Lozoya *et al*., 1995, 1990; Tona *et al*., 2000).

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 (Lutterodt, 1989, 1992; Lin *et al*, 2002). Guava fruit and leaf showed antioxidant and free radical scavenging capacity (Hui-Yin Chen *et al*., 2007). Guava leaf extract showed anticough activity by reducing the frequency of cough induced by capsaicin aerosol (Jaiarj *et al*., 1999). Leaf extract

Table 2: Worldwide ethnomedical uses of guava plant

Country	Usage
Amazonia	For diarrhea, dysentery, menstrual disorders, stomachache, 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 colds, dysentery, dyspepsia
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, jaundice
Malaya	For dermatitis, 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	For bacterial infections, blood cleansing, diarrhea, dysentery

of guava had ionotropic effect on guinea pig atrium (Conde Garcia *et al.*, 2003).

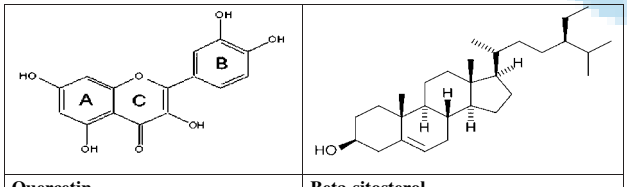
In a study of aqueous extract of *P. guajava* in acute experimental liver injury induced by carbon tetrachloride, paracetamol and thioacetamide, it showed hepatoprotective activity. The effects observed were compared with a known hepatoprotective agent, silymarin. Histological examination of the liver tissues supported hepatoprotection (Roy *et al.*, 2006).

During various episodes of screening of medicinal plants, extract from *P. guajava* leaves exhibited significant inhibitory effect on the protein tyrosine phosphatase1B (PTP1B). Significant blood glucose lowering effects of the extract were observed after intraperitoneal injection of the extract at a dose of 10 mg/kg in both 1- and 3-month-old Lepr(db)/Lepr(db) mice (Oh *et al.*, 2005).

In a study undertaken to investigate the hypoglycemic and hypotensive effects of *P. guajava* leaf aqueous extract in rats, it showed hypoglycemic activity. The hypoglycemic effect of plant extract was examined in normal and diabetic rats, using streptozotocin (STZ)-induced diabetes mellitus model (Ojewole, 2005).

In a study, i.p. treatment with 1 g/kg guava juice produced a marked hypoglycemic action in normal and alloxan-treated diabetic mice (Cheng *et al.*, 1983).

Important Chemical Constituents of *P. guajava*



Quercetin	Beta-sitosterol

In two randomized human studies, the consumption of guava fruit for 12 weeks was shown to reduce blood pressure by an average 8%, decrease total cholesterol level by 9%, decrease triglycerides by almost 8% and increase HDL cholesterol by 8%. The effects were attributed to the high potassium and soluble fiber content of the fruit. A randomized, single-blind, controlled trial was conducted to examine the effects of guava fruit intake on blood pressure and blood lipids in patients with essential hypertension. It is possible that an increased consumption of guava fruit can cause a substantial reduction in blood pressure and blood lipids without decreasing HDL-cholesterol level (Singh *et al.*, 1992, 1993).

In other animal studies, guava leaf extracts have shown central nervous system (CNS) depressant activity (Shaheen, 2000).

CONCLUSION

Extensive literature survey revealed that guava, acclaimed as 'poor man's apple of the tropics', has a long history of traditional use for a wide range of diseases. The fruit as well as its juice is freely consumed for its great taste and nutritional benefits. Much of the traditional uses have been validated by scientific research. Toxicity studies in mice and other animal models as well as controlled human studies show both leaf and fruit are safe without any side effects. A number of chemicals isolated from plants like quercetin, guaijaverin, flavonoids and galactose-specific lecithins have shown promising activity in many human trials. The plant has been extensively studied in terms of pharmacological activity of its major components, and the results indicate potent anti-diarrheal, antihypertensive, hepatoprotective, antioxidant, antimicrobial, hypoglycemic and antimutagenic activities. In recent years, emphasis of research has been on utilizing traditional medicines that have a long and proven history of treating various ailments. In this regard, further studies need to be carried out to explore *P. guajava* L for its potential in preventing and treating diseases.

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