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# REVIEW ON NUTRITIONAL, MEDICINAL AND PHARMACOLOGICAL PROPERTIES OF GUAVA (*PSIDIUM GUAJAVA* LINN.)

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## ABSTRACT

Guava (*Psidium guajava* Linn.) commonly known for its food and nutritional values throughout the world. The medicinal properties of guava fruit, leaf and other parts of the plant are also well known in traditional system of medicine. Since, each part of guava tree possesses economic value; it is grown on commercial scale. Guava plant is considerable process has been achieved regarding the biological activity and medicinal application of guava and the fruit considered as poor man apple of tropics. The guava plant parts are used for the development of various industrial and pharmaceutical products. In the present review, nutritional value of guava fruit and medicinal properties its various parts have been discussed to provide collective information on its multi purpose commercial values.

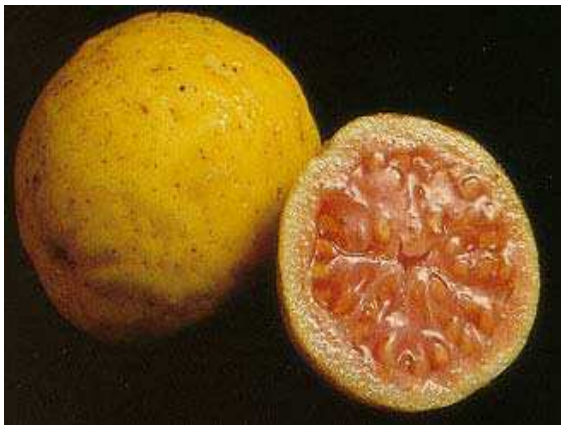
## KEYWORDS

Guava, *Psidium guajava*, Medicinal Plant, Poor man apple, Pharmacological properties.

## INTRODUCTION

Guava is a small tropical tree that grows up to 35 feet tall; it is widely grown for its fruit in tropics. It is a member of the Myrtaceae family, with about 133 genera and more than 3,800 species. The leaves and bark of *P. guajava* tree have a long history of medicinal uses that are still employed today (Nwinyi *et al.,* 2008). In the view of the immense medicinal importance of *P. guajava* plant evidenced in the various studies mentioned above and also corroborated in a recent review article by Kamath *et al.* (2008), there is a strong incentive for further research into the pharmacological activities of *P. guajava* plant extract against common infectious diseases considering the fact that the plant is readily available in the tropics and within the reach of the local populace.

Guava contains broad spectrum of phytochemicals including polysaccharides, vitamins, essential oils (Smith and Siwatibau, 1975, Macleod and Troconis, 1975), minerals, enzymes, proteins (Deo and Shastri, 2003), sesquiterpenoid alcohols and triterpenoid acids (Smith *et al,* 1975; Wilson111 and Shaw, 1978; Begum *et al.,* 2002), alkaloids, glycosides, steroids, flavanoids, tannins, saponins (Cho *et al.,* 2003; Narayana *et al.,* 2001; Geidam *et al.,* 2007) (Table 1). *Psidium guajava* or guava is very rich in antioxidants and vitamins and also high in lutein, zeaxanthine and lycopene (Tee *et al.,* 1997; Hobert and Tietze, 1998).



Guava is rich in tannins, phenols, triterpenes, flavonoids, essential oils, saponins, carotenoids, lectins, vitamins, fiber and fatty acids. Guava fruit is higher in vitamin C than citrus (80 mg of vitamin C in 100 g of fruit) and contains appreciable amounts of vitamin A as well. Guava fruits are also a good source of pectin - a dietary fiber. The leaves of guava are rich in flavonoids, in particular, quercetin. Much of guava's therapeutic activity is attributed to these flavonoids. The flavonoids have demonstrated antibacterial activity. Quercetin is thought to contribute to the anti-diarrhea effect of guava; it is able to relax intestinal smooth muscle and inhibit bowel contractions. In addition, other flavonoids and triterpenes in guava leaves

show antispasmodic activity. Guava also has antioxidant properties which are attributed to the polyphenols found in the leaves.

Guava's main plant chemicals include: alanine, alpha-humulene, alpha-hydroxyursolic acid, alpha-linolenic acid, alpha-selinene, amritoside, araban, arabinose, arabopyranosides, arjunolic acid, aromadendrene, ascorbic acid, ascorbigen, asiatic acid, aspartic acid, avicularin, benzaldehyde, butanal, carotenoids, caryophyllene, catechol-tannins, crataegolic acid, D-galactose, D-galacturonic acid, ellagic acid, ethyl octanoate, essential oils, flavonoids, gallic acid, glutamic acid, goreishic acid, guafine, guavacoumaric acid, guaijavarin, guajiverine, guajivolic acid, guajavolide, guavenoic acid, guajavanoic acid, histidine, hyperin, ilelatifol D, isoneriucoumaric acid, isoquercetin, jacoumaric acid, lectins, leucocyanidins, limonene, linoleic acid, linolenic acid, lysine, mecocyanin, myricetin, myristic acid, nerolidiol, obtusinin, octanol, oleanolic acid, oleic acid, oxalic acid, palmitic acid, palmitoleic acid, pectin, polyphenols, psidiolic acid, quercetin, quercitrin, serine, sesquiguavene, tannins, terpenes, ursolic acid and some other compounds listed (Table 1). 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. The present paper deals with origin and distribution, brief morphological characters, nutritive values, and results of reported research findings on its medicinal properties.

***Origin Distribution and Morphology***

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 (Lapík *et al.,* 2005; Jimenez-Escrig *et al.,* 2001; Lozoya *et al.,* 2002). The tree is easily identified by its distinctive thin, smooth, copper-colored bark that flakes off, showing a greenish layer beneath. It is the hardiest among tropical fruit trees and excels most of the other fruit crops in productivity and adaptability. Moreover, guava scores over other fruits in ascorbic acid, pectin and other mineral contents. Guava cultivars however, display a greater diversity in tree size, bearing habit and yield, as well as in fruit size, shape, quality and ripening season. The existence of a very large number of rootstocks, cultivars and clones, maintained by vegetative propagation, rein forces the need of a reliable verification of cultivars identifications for nurserymen and growers.

*Psidium guajava* (Linn.) is a low evergreen tree or shrub 6 to 25 feet high, with wide spreading branches and square, downy twigs, is a native of tropical America. It is a common vegetation cover by roads and in waste places in Hawaii. Guava is a tropical and semitropical plant. It is well known in the islands for its edible fruit. It is common in the backyards. The branches are crooked, bringing opposite leaves. 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.

**Table 1**
***Chemical composition of various parts of Guava (Psidium guajava Linn.)***

| Parts | Constituents | Reference |
|---|---|---|
| **Fruit** | Vitamin C, vitamin A, iron, calcium, Manganese, phosphoric, oxalic and malic acids, saponin combined with oleanolic acid. Morin-3-O-α-L-lyxopyranoside and morin-3-O-α-L-arabopyranoside, flavonoids, guaijavarin, Quercetin. Essential oil contains hexanal , -2-hexenal , 2,4-hexadienal, 3-hexenal, 2-hexenal, 3-hexenyl acetate and phenol, while β-caryophyllene, nerolidol , 3-phenylpropyl acetate, caryophyllene oxide, pentane-2-thiol, 3-penten-2-ol and 2-butenyl acetate, 3-hydroxy-2-butano3-methyl-1-butanol, 2,3-butanediol, 3-methylbutanoic acid, (Z)-3-hexen-1-ol, 6-methyl-5-hepten-2-one, limonene, octanol, ethyl octanoate(pink guava fruit). | Hernandez *et al.,* 1971; Iwu, 1993; Burkill, 1997; Nadkarni and Nadkarni, 1999; Bassols, Demole, 1994; Paniandy *et al.,* 2000. |
| **Leaves** | α-pinene, β-pinene, limonene, menthol, terpenyl acetate, isopropyl alcohol, longicyclene, caryophyllene, β-bisabolene, caryophyllene oxide, β-copanene, farnesene, humulene, selinene, cardinene and curcumene, mallic acids, nerolidiol, β-sitosterol, ursolic, crategolic, and guayavolic acids, cineol, quercetin, 3-L-4-4-arabinofuranoside (avicularin) and its 3-L-4-pyranoside (Essential oil), resin, tannin, eugenol, caryophyllene (1a α-, 4a α-, 7 α-, 7a β-, 7b α-)]-decahydro-1H-cycloprop[e] azulene, Guajavolide (2 α-,3 β-,6 β-,23-tetrahydroxyurs-12-en-28,20 β-olide; 1) and guavenoic acid (2 α-,3 β-,6 β-,23-tetrahydroxyurs-12,20(30)-dien-28-oic acid, triterpene oleanolic acid, triterpenoids, flavinone-2 2'-ene, prenol, dihydrobenzophenanthridine and cryptonine. | Zakaria *et al.,* 1994, Iwu 1993, Nadkarni and Nadkarni, 1999; Oliver-Bever, 1986; Begum *et al.,* 2002; Wyk *et al.,* 1997, Joseph *et al.,* 2010 |
| **Bark** | polyphenols, resin and crystals of calcium oxalate | Burkill, 1997; Nadkarni and Nadkarni, 1999 |
| **Root** | Tannin, leukocyanidins, sterols, gallic acid, carbohydrates, salts, tannic acid. | Iwu 1993, Quisumbing, 1978 |
| **Seed** | Proteins, starch, oils, phenolic, flavonoid compounds, flavonol glycoside, quercetin-3-O-β-D-(2"-O-galloyglucoside)-4'-O-vinylpropionate | Michel *et al.,* 2002; Burkill, 1997 |
| **Twigs** | Calcium, magnesium, phosphorous, potassium, sodium, fluoride, copper, iron, zinc, manganese, and lead. | Okwu and Ekeke, 2003 |

***Nutritional value***

Guavas are often included among superfruits, 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 (Hassimotto *et al.,*2005). The food value and contents of guava fruit is listed in the Table 2. However, nutrient content varies across guava cultivars. Although the strawberry guava (*P. littorale* var. *cattleianum*), notably containing 90 mg of vitamin C per serving, has about 25% of the amount found in more common varieties, its total vitamin C content in one serving still provides 100% of the Dietary Reference Intake for adult males (Healthaliciousness, 2008). Guavas contain both carotenoids and polyphenols – the major classes of antioxidant pigments – giving them relatively high potential antioxidant value among plant foods (Jimenez-Escrig *et al.,* 2001). As these pigments produce the fruit skin and flesh color, guavas that are red-orange have more pigment content as polyphenol, carotenoid and pro-vitamin A, retinoid sources than yellow-green ones (Linda *et al.,* 2004).

**Table 2**
***Food value of Guava fruit (Kamanth et al., 2008)***

| | |
|---|---|
| Calories | 77-86g |
| Moisture | 2.8-5.5g |
| Crude fiber | 0.9-1.0g |
| Protein | 0.1-0.5 |
| Fat | 0.43-0.7 |
| Ash | 9.5-10 |
| 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 B3 | 35 I.U. |
| Vitamin G4 | 36-50mg |

***Medicinal and Pharmacological properties***

The long history of guava use has led modern-day researchers to study guava extracts (Table 3). This paper explains the Evidence-based information regarding the phytochemistry and pharmacological activity of this plant (Table 4).

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). The microbicidal activity of *Psidium guajava* is attributable to guajaverine and to psydiolic acid (Bérdy *et al.,* 1981). The leaves of guava contain large amounts of tannin, triterpernoids (crategolics, guaijavolic, oleanolics and ursolic acids) and essential oils containing ß sitosterol, ß-bisabolene, ßcariophyllene, aromadendrene, ß-salinene, guaijaverine, nerolidiol and sel-11-en-4_-ol (Morton,1981). Gnan & Demello (1999) also reported a complete inhibition of *S. epidermitis* and *Salmonella typhimurium* when it was used extract of the guava leaves. Direkbusarakom *et al.* (1997) tested guava (*Psidium guajava)* extract for antiviral activity against the fish pathogenic viruses, infectious, haematopoietic necrosis virus (IHNV) infectious pancreatic necrosis virus (IPNV) and *Oncorhynchus masou* virus (OMV) using plaque reduction in CHSE-214 cell lines. Antiviral tests against the shrimp pathogenic virus, yellow-head virus (YHV), they tested the efficacy of guava extract using MIC of the extract against 24 strains of pathogenic bacteria including *Vibrio harveyi* (9 strains), *V. splendidus (*7 strains), *V. parahaemolyticus* (2 strains) and 1 strain of each *V. mimicus*, *V. vulnificus*, *V. fluvialis*, *V. cholerae*, *V. alginolitycus* and *Aeromonas hydrophila*. The extract of guava demonstrated antiviral activity against IHNV, OMV and YHV but was not effective for IPNV. The MIC of the extract ranged from 625-5,000_g/mL against all pathogenic bacterial strains tested. According to the authors it might be possible to use guava extract for prevention of bacterial diseases in fish.

The decoction of *P. guajava* showed antibacterial activity towards *S. flexneri* and *Vibrio cholerae*. It decreased production of both LT and CT and their binding to GM1. However, it had no effect on production and action of ST. The decoction also inhibited the adherence of EPEC and invasion by both EIEC and *S. flexneri* to HEp-2 cells. Quercetin, on the other hand, had no antibacterial activity at the concentrations used nor did it affect any of the enterotoxins. Although it did not affect adherence of EPEC, it inhibited the invasion of both EIEC and *S.*

*flexneri* to HEp-2 cells (Birdi *et al.,* 2010). Guava leaf extracts and fruit juice has 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). Joseph *et al,* (2010) reported guava leaf essential oil contains more terpenoids and that have strongly inhibited human cervical cancer cells. 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.*, 1994, 1990; Tona *et al.*, 2000).

**Table 3**
***Worldwide Ethnomedical uses of Guava (Kamanth et al., 2008).***

| 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 and dysentery |

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

In the pharmacological actions and the medicinal uses of a guava leaves extracts have also been indicated to cause disturbances of the central nervous system: insomnia, convulsions and epilepsy (Lutterodt and Maleque, 1988; Meckes *et al.,* 1996). Bronchitis, asthma attacks, cough, pulmonary diseases could be also treated with guava teas (Batick, 1984; Khan and Ahmad, 1985) and could also be useful as anti-inflammatory and hemostatic agent (Liu, 1988). Moreover, aqueous extracts of guava leaves were described to be effective against a number of microbial strains: *Aeromonas hydrophila*, *Shigella* spp. and *Vibrio* spp. (Chulasiri *et al.,* 1986), *Staphylococus aureus* and *β-streptococcus* group A (Jaiarj *et al.,* 1999), *Escherichia coli*, *Pseudomonas aeruginosa*, *Bacillus subtilis* (Abdelrahim *et al.,* 2002). In addition, anti-rotavirus activity has also been reported to exist in these extracts (Goncalves *et al.,* 2005).

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 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).

Another study investigated that 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). The aqueous extract of *Psidium guajava* budding leaves (PE) bears an extremely high content of polyphenolic and isoflavonoids. It could be used as an anti-tumor chemopreventive in view of anti-angiogenesis and anti-migration, indicated that the $IC_{50}$ of PE for DU145 cells was ~0.57 mg $ml^{-1}$. In addition, PE effectively inhibited the expressions of VEGF, IL-6 and IL-8 cytokines, and MMP-2 and MMP-9, and simultaneously activated TIMP-2 and suppressed the cell migration and the angiogenesis. PE potentially possesses a strong anti-DU145 effect. Thus, clinically it owns the potential to be used as an effective adjuvant anti-cancer chemopreventive (Peng *et al.,* 2010).

The Anti-stress and Adaptogenic activity exhibited by ethanol extract of *Psidium guajava* possess anti-stress property. It may useful in the treatment of several disorders caused by stress by its immunostimulating, immunomodulating properties and also by enhancing the homeostatic mechanisms (Lakshmi, Sudhakar, 2009). Lee and Park (2010) demonstrated that acetone extracts of

guava branch (GBA) had cytotoxic effects on HT-29 cells**.** It significantly induces cytotoxicity and an increase in the sub-G1 phase of HT-29 cells. So that GBA may be a potential candidate for a novel therapeutic agent in the field of anticancer drug discovery.

## CONCLUSION

*Psidium guajava* (Linn.) is popularly known 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 anti-mutagenic activities. In recent years, emphasis of research has been on utilizing traditional medicines that have a long and proven history of treating various ailments. Quite a significant amount of work has been done on the pharmacological and biological activity and possible application of chemical compounds from whole part of the plant. Hence extensive investigation on its pharmacodynamics, kinetics, and proper standardization and clinical trials is needed to exploit their therapeutic utility to combat various diseases.

**Table 4**
***Pharmacological effect of Guava (Mittal et al., 2010).***

| 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 (EC50) on scavenging hydroxyl radicals of 0.63, 0.47 and 0.58g/L, had EC50 on inhibiting lipid peroxidation of 0.20, 0.035, 0.18g/L. | Wang *et al.,* 2007 |
| 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, ($P < 0.01$). | Chulasiri *et al.,* 1986 |
| 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 | Mukhtar *et al.,* 2006; 2004 |

| | | |
|---|---|---|
| | extract, at an oral dose of 250 mg/kg, showed statistically significant hypoglycemic activity. | |
| Antimicrobial activity | *Psidium guajava* 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-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. The hot water extract and the methanol extract of *Psidium guajava* showed high activity against *Arthrinium sacchari* and *Chaetomium funicola* strains. | Abdelrahim *et al.,* 2002; Arima and Danno, 2002; Sato *et al.,* 2000. |
| Hepatoprotective activity | *P. guajava* aqueous leaf extracts (250 and 500mg/kg, po) possesses good hepatoprotective activity. | Roy *et al.,* 2006 |
| 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. | Ojewole *et al.,* 2008 |
| Treatment of plaque | The active flavonoid compound, quercetin-3-O-alpha-l-arabinopyranoside (guaijaverin) isolated from *Psidium guajava* demonstrated high potential antiplaque agent by inhibiting the growth of the Strep. Mutans. | Prabu *et al.,* 2006 |
| 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. | Akinola *et al.,* 2007 |
| Antimutagenic activity | The water extract of *P.guajava* was effective in inactivating the mutagenicity of direct-acting mutagens. | Grover and Bala, 1993 |
| Inotropic effect | The extract from P. guajava leaves depress myocardial inotropism. | Garcia *et al.,* 2003 |
| Spasmolytic effect | The spasmolytic activity of the *Psidium guajava* leaf remedy is mainly due to the aglycone quercetin, present in the leaf and | Lozoya *et al.,* 1994 |

| | | |
|---|---|---|
| | in the extract mainly in the form of five flavonols, and whose effect is produced when these products are hydrolyzed by gastrointestinal fluid. | |
| Treatment of infantile rotaviral enteritis. | *Psidium guajava* showed good curative effect on infantile rotaviral enteritis. | Wei *et al.,* 2000 |
| 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. Guava leaf essential oil has been shown to possess cytotoxic effect on Human cervical cancer cell lines. | Chen *et al.,* 2010**;** Joseph *et al.,* 2010 |
| 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. | Ojewole, 2006; Shaheen *et al.,* 2000 |
| Immunomodulatory activity | Extracts derived from *Psidium guajava* revealed immunomodulatory activities. | Kaileh *et al.,* 2007 |
| Treatment of acne | *Psidium guajava* leaf extracts are used in treatment of acne. | Qadan *et al.,* 2005 |
| Antiproliferative activity | Guava leaf extract has antiproliferatve activity caused by inhibition of the catalytic activity of Prostaglandin endoperoxide H synthase (PGHS) isoforms. | Kawakami *et al.,* 2009 |
| Antipyretic | The methanol extract of the leaves of *Psidium guajava* exhibited an antipyretic effect. | Olajide *et al.,* 1999 |
| 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 | Olatunji-Bello *et al.,* 2007 |
| 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. | Ojewole, 2005 |

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| 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 of malaria. | Nundkumar and Ojewole, 2002 |
| 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. | Okwu and Ekeke, 2003 |
| CNS Activity | The leaves of the guava tree in decoction are used for spasms, epiand even for cerebral affections. | Ticzon and Romeo, 1997 |
| Conjunctivitis | Flowers are also used as a poultice for conjunctivitis. | Ayensu, 1978 |
| 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. | Ticzon and Romeo, 1997 |
| Rheumatism | The pounded leaves in India are used for rheumatism. | Ayensu, 1978 |

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