

REVIEW ON VARIOUS POSSIBLE PHYTOPHARMACOLOGICAL ACTIVITIES OF PSIDIUM GUAJAVA LINN

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ABSTRACT

Psidium guajava is an important food crop and medicinal plant available in tropical and subtropical countries, widely used in food and folk medicines around the world. The photochemical and pharmacological investigations carried out on *P. guajava* validate the immense potential of this plant in the treatment of numerous diseases. Many pharmacological studies have demonstrated the ability of this plant to exhibit antimicrobial, antidiabetic, anti-inflammatory, cardioprotective, neuroprotective, hepatoprotective, antioxidant and anticancer activities and it supports the traditional uses. This is a comprehensive of the phytoconstituents and pharmacological benefits.

KEYWORD: *Psidium guajava*, Antimicrobial, Antidiabetic, Antioxidant, Hepatoprotective, Anticancer.

INTRODUCTION

Psidium guajava Linn. is commonly called guave, goyave in French; guave, guavenbaum, in German; banjiro in Japanese; goiaba, in Portugal; arac, guaiaba in Brazil; and guava in English.^[1,2]

Psidium guajava (common name-guava) is well known tropic tree which is abundantly grown for fruit. It belongs to phylum Magnoliophyta, class Magnoliopsida and Myrtaceae family.^[3] *P. guajava* used as an important food as well as a medicinal plant in tropical and subtropical countries, therefore its nickname as the poor man's apple. The scientific evidences of the medicinal uses of *P. guajava* began in 1940's and reports, maintain a tradition of repeating the data each decade. The plant is well known by a common name "Guava" in English, guayabo in Spanish, goyaveandgoyavier in French, guyabaorgoejaab in Dutch, goiaba and goaibeira in Portuguese and jambubatu in Malaya. Pichi, posh and enandi are the names commonly used in Mexico and America.^[4]

Many people habitually take *P. guajava* leaf decoction for its antispasmodic and antimicrobial properties for the treatment of dysentery and diarrhea.^[5] Therefore, the efficacy and safety of *P. guajava* leaves have empirically been confirmed.^[6] *P. guajava* leaf contains plenty of phenolic compounds which inhibit the peroxidation reaction in the body, and so it can be expected to prevent various chronic diseases such as diabetes, cardiovascular disease and cancer. Furthermore, decreasing of free radicals in the body, means that the polyphenols in the leaf

of *P. guajava* can prevent atherosclerosis, cataract and also inhibits biological aging of the body and skin.^[7] The plant has a wide spreading network of branches. Mostly its branches are curved which display opposite leaves with the small petioles of about 3 to 16 cm. The leaves are wide and clear green in color and have clear and prominent veins.^[8,9] Guava contains a large number of antioxidants and phytochemicals including essential oils, polysaccharides, minerals, vitamins, enzymes, and triterpenoid acid alkaloids, steroids, glycosides, tannins, flavonoids and saponins.^[10] Guava contains a higher content of vitamin C and vitamin A. Guava is also a very good source of the pectin which is an important dietary fiber. It has high content of flavonoids,^[11] fructose sugar and carotenoids. Keeping in view the historical background, important ingredients and common uses of *Psidium guajava* (guava), current studies focus on the phytochemistry and medicinal value of this useful plant.



Figure 1: Whole plant of *Psidium guajava* L.

Antimicrobial Activity

P. guajava leaf extract (2 and 5 g/kg) reduced the occurrence of cough induced by capsaicin aerosol by 35 and 54%, respectively, within 10 min after injection of the extract. The growth of *Staphylococcus aureus* and beta-streptococcus group A, is inhibited by aqueous, methanol and chloroform extract of dry *P. guajava* leaves. Therefore *P. guajava* leaf extract may be recommended for cough.^{12, 13} have reported the antibacterial effect of *P. guajava* leaves extracts and found that they inhibited the growth of the *S. aureus*. The methanolic plant leaf extracts of *P. guajava* and barks of this plant have antimicrobial activity. The organism inhibited is *Salmonella* species, *Bacillus* species, and the concentrations vary according to the organisms.¹⁴ The microbicidal activity of *P. guajava* is attributable to guajaverine and to psydolic acid. The active flavonoid compound guajaverin extracted from the leaves of the same plant is reported to have high potential antiplaque activity.¹⁵

Anti-Inflammatory Activity

Ethyl acetate extract of *P. guajava* suppressed the interferon gamma (IFN- γ)/TNF- α -co-induced production of thymus and activation-regulated chemokine protein and mRNA in HaCaT cells. It also inhibited the TNF- α /IFN- γ -co-induced activation of STAT1 and NF- κ B as well as increased the expression of mRNA and heme oxygenase-1 protein. This demonstrates that *P. guajava* inhibits expression of chemokine in keratinocytes by inducing heme oxygenase-1 expression and it highlight the therapeutic uses of *P. guajava* in atopic dermatitis and inflammatory skin diseases.¹⁶ Ethanol extract of *P. guajava* leaf significantly inhibited lipopolysaccharide induced production of nitric oxide and prostaglandin E2 in a concentration-dependent manner. *P. guajava* extract suppressed the expression and activity of inducible nitric oxide synthase and cyclooxygenase-2 through the downregulation of ERK1/2 activation in RAW264.7 macrophages. It also exhibited significant anti-inflammatory activity in 2 different animal models.¹⁷

Antidiabetic Activity

Treatment with guava juice (1 g/kg) produced a noticeable hypoglycemic action in normal and alloxan-induced diabetic mice.¹⁸ Aqueous leaf extract of *P. guajava* (250 mg/kg), showed statistically significant hypoglycemic activity.¹⁹ Intraperitoneal injection of *P. guajava* leaf extract (10 mg/kg) exhibited a significant inhibitory effect on protein tyrosine phosphatase 1B in 1- and 3-month-old Lepr(db)/Lepr(db) mice. The butanol-soluble fraction significantly decrease the number of lipid droplets.⁶⁶ Ethanol extract of stem bark of *P. guajava* exhibited significant hypoglycaemic activity in alloxan-induced hyperglycaemic rats.²⁰

The aqueous leaf extract of *P. guajava* have the potential effect of inhibition of the alpha-glucosidase activity from the small intestinal mucosa of diabetic mouse.²¹ *P. guajava* bud extract has significant insulin-mimetic and

potentiating activity. Noni leaf, noni, fruit commercial noni juice and mangrove bean have insulin-like activity with minimum effect on insulin action. Habitual intake of *P. guajava* and noni is proposed to offer better protection against type 2 diabetes mellitus.²²

Hepatoprotective Activity

Aqueous leaf extracts of *P. guajava* at 250 mg/kg and 500 mg/kg, significantly reduced the levels of aspartate transaminase (AST), alanine transaminase (ALT), alkaline phosphatase (ALP) and bilirubin. The higher dose of *P. guajava* extract guarded the increase in liver weight, whereas the lower dose of *P. guajava* extract is ineffective except in the paracetamol induced liver damage. In the chronic liver injury induced by CCl₄, the higher dose of *P. guajava* leaf extract is found to be more effective than the lower dose.²³ In the acute liver damage induced by different hepatotoxins, methanolic, ethyl acetate and aqueous leaf extract of *P. guajava* (200 mg/kg, p.o.) significantly reduced the elevated serum levels of AST, ALT, ALP and bilirubin in CCl₄ and paracetamol induced hepatotoxicity. Methanolic extract of leaves of *P. guajava* possesses better hepatoprotective activity compared to other extracts. Histological examinations of liver tissues also support the hepatoprotection.²⁴

Cardioprotective and Hypotensive Activity

Aqueous-alcohol extract of *P. guajava* dry leaves depress the atrial contractility of guinea pig, in a dose-dependent fashion. The compound is concentrated using glacial acetic acid after removing the less polar fractions (acetone, chloroform, hexane, ethanol and methanol). The acetic acid fraction (10-800 mg/l) of *P. guajava* reduced myocardial force, increased the atrial relaxation time measured, abolished the positive staircase effect in a dose-dependent fashion suggesting a decrease of the cellular inward calcium current and its inotropic effect is abolished by cholinergic receptor blockade, indicating a cholinergic involvement in the mechanism of action of the extract. These data support that the extract of *P. guajava* leaves depress myocardial inotropism.²⁵ Aqueous leaf extract of *P. guajava* produced dose-dependent (0.25-2 mg/ml) contracted aorta rings. The effect is then assessed in the presence of phentolamine and nifedipine. The sensitivity of the aortic rings to collective doses of *P. guajava* is significantly improved in the presence of phentolamine. These data suggest that the effect of *P. guajava* is either by activation of alpha-adrenoceptor or acting *via* a calcium ion channel.²⁶

Anticancer Activity

Research based on anticancer drug from natural compounds enabled the discovery of several drugs presently used in cancer therapy. *P. guajava* extracts modified the balance of Th1/Th2 to a dominant status of Th1 by directly reducing regulatory activity T cell. In pretreated mice exhibited retarded growth of s.c. inoculated B16 melanoma cells.²⁷ *P. guajava* leaf oil showed the highest anti-proliferative activity with (4.37

times more potent than vincristine) than other 16 Thai medicinal plants in P388 cell line.^[28] The aqueous extract of *P. guajava* inhibited the cancer cell DU-145 in a dose- and time-dependent manner. TUNEL assay and flow cytometric analysis confirmed the cell cycle arrests at G0/G1 phase. Additionally, suppression of the matrix metalloproteinases-2 (MMP-2) and matrix metalloproteinases-9 (MMP-9), and the upregulation of active caspase-3 in DU-145 are also effected in a dose-dependent manner, implicating a potent anti-metastasis power of *P. guajava*.^[29]

Nephroprotective Activity

The aqueous extract of *P. guajava* fruits have more quercetin, myricetin, and caffeic acid and ethanolic extract have more ferulic acids, cinnamic acids, and coumaric acid. Aqueous and ethanolic extract intake at 2 %, significantly reduced glucose, blood urea nitrogen levels, and increased insulin level in plasma of diabetic mice. Both extracts, dose-dependently reserved glutathione content, retained activity of CAT and GPx, and decreased ROS, IL-6, TNF- α and interleukin-1 β (IL-1 β) levels in the kidney. It also significantly declined renal N (ϵ)-(carboxymethyl)lysine, pentosidine and fructose levels, and suppressed renal activity of aldose reductase. These findings support that guava fruit could protect the kidney against diabetic progression.^[30]

CONCLUSION

Many researches on the medicinal use of plant extract are must in the modern era as many chemically synthesized drugs are highly effective in causing many adverse effects in the humans. *Psidium guajava* (guava) is well known tropic tree grown in tropic areas for fruit. It is found to be effective in diarrhea, dysentery, gastroenteritis, hypertension, diabetes, caries, pain relief, cough, oral ulcers and to improve locomotors coordination and liver damage inflammation. The photochemical and pharmacological investigations carried out on *P. guajava* validate the immense potential of this plant in the treatment of numerous diseases. Additional researches are needed for the compound isolation and identification for the product development from *P. guajava* for the future generations. Every medicinal property of many medicinal plants are also to be determined.

CONFLICTS OF INTEREST

No funding source and there is no conflict of interest.

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