

Wonderful Effect of *Amrood* (*Psidium guajava* Linn.) Drug of Unani System of Medicine

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1. Introduction

Psidium guajava Linn., is a perennial plant, which belongs to the family Myrtaceae. It is originally from America, but now it is cultivated in all over India. There are two types of guava fruit- 1) White (*Psidium pyriferum* Linn.) 2) Red (*Psidium pomiferum* Linn.)

Origin and Distribution: Widely distributed throughout the Philippines in all islands and provinces. Common in backyards and settled areas. In thickets and secondary forests at low altitudes, ascending to at least 1,500 meters. Introduced from tropical America. Thoroughly naturalized. Pan tropic in distribution.

Botanical Description: Guava tree is a plant reaching a height of 8 meters. Young branches are 4-angled. Leaves are opposite, oblong to elliptic, and 1 to 5 centimeters long, the apex being pointed, and the base usually rounded. Peduncles are 1- to 3-flowered. Flowers are white, 3 to 3.5 centimeters across, with in-curved petals, coming out solitary or two to three in the leaf axils. Numerous stamens form the attractive part of the flower. Inferior ovaries develop into round or obovoid green fruits 4 to 9 centimeters long, turning yellow on ripening and have edible, aromatic, seedy pulp^{1,2,3}.

Taxonomical Classification¹²: Domain: Eukaryota, Kingdom: Plantae, Phylum: Spermatophyta, Subphylum: Angiospermae, Class: Dicotyledonae, Order: Myrtales, Family: Myrtaceae, Genus: *Psidium*, Species: *guajava*.

Vernacular name^{1,2,3}:

Hindi: *Amrood, Safari Aam*
 Arabic: *Gawafa, Guwafah safra*
 Persian: *Amrood-e-Hindi (Tibb-e-Gurba)*
 Latin: *Psidium guajava* Linn.

English: *Guava or Apple Guava*

Botanical name: *Psidium guajava* Linn.

Unani Description of *Psidium guajava* Linn.: It is very famous fruit. There are two types – one is in the season of rain and second is in the season of winter. The winter season guava is better than rainy guava.^{1,2,3,7}

Mizaj (Temperament): It is Hot & Moist in 1st degree.

Muzir Asraat (Side effect): It produces borborygmi and intestinal pain.

Musleh (Antidote): Its side effect's antidotes are Saunth, Kaali Mirch aur Saindha Namak.

Badal (Substitute): Naaspaati and Sev (Apple)

Afaal: Pharmacological Uses according to Unani Medicine: Qabiz wa Habis, Mufareh wa Muqawwi, Munafiz-e-Akhlaath-e-Ghaleezah, Musakkin-e-Tashanujee, Muqawwi-e-Asaab, Musakkin, Mulayien, Mukhrij-e-Balgham, Muqawwi, Kasir-e-Riyah, Dafah-e-Tap^{1,2,3,7,8,9,10}.

Therapeutic Use: Purgative, Cough and Heart tonic.

Miqdar Khuraq (Dose): According to digestion^{1,2,3}.

Edibility / Nutrition: Well known for its edible fruit. Fruit can be eaten raw or processed into beverages, ice cream, syrup, jellies and jams. Ripe fruit is eaten as vegetable and used as seasoning for native dishes, like *sinigang*, etc. Very high in vitamin C (80 mg in 100 gm of fruit) with large amounts of vitamin A.



Table 1: Nutrients with Contents in Amrood¹³:

Nutrients	Content	Nutrients	Content	Nutrients	Content	Nutrients	Content
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	0.3-0.7mg
Iron	200-400 IU	Carotene	0.046mg	Thiamin	0.03-0.04mg	Riboflavin	0.6-1.068mg
Niacin	40 I.U.	Vitamin	36-50mg				

Folkloric: In the Philippines, the astringent, unripe fruit, the leaves, bark cortex, and roots- though more often the leaves only - are used in decoction for washing ulcers and wounds. Fresh leaves used for wounds and toothache. Decoction or infusion of fresh leaves used for wound cleaning to prevent infection and to facilitate healing. Warm decoction of leaves for aromatic baths. Decoction of bark and leaves used for diarrhea. Decoction of root bark also used as mouthwash for swollen gums. Root-bark has been recommended for chronic diarrhea. For toothache, chew 2-3 young leaves and put into the tooth cavity. In India, water decoction of leaves used for treatment of jaundice.

In Mexico, decoction of leaves used for cleaning ulcers. Ground leaves used as poultice. Leaves also used as remedy for itches. Fruit also used as Anthelmintic. In Uruguay, decoction of leaves used as vaginal and uterine wash, especially in leucorrhoea.

In the West Indies, decoction of young leaves and shoots used as febrifuge and for antispasmodic baths. Infusion of leaves used for cerebral affections, nephritis, and cachexia. Pounded leaves used locally for rheumatism; extract used for epilepsy and chorea.

In Costa Rica, decoction of flower buds used for diarrhea and to improve blood flow.

In African folk medicine, leaves used for treatment of diarrhea. For gum swelling, chew leaves or use the leaf decoction as mouthwash 3 times daily; chewed leaves. For skin ulcers, pruritic or infected wounds: Apply decoction of leaves or unripe fruit as wash or the leaf poultice on the wound or use the decoction for wound cleansing. It is also popularly used for the wound healing of circumcision wounds. Guava jelly used as heart tonic; also for constipation. Ripe fruit is used as aperients. Water in which the fruit is soaked used for diabetes.

In Nicaragua, *P. guajava* is a traditional treatment for Giardia-induced diarrhea. For nosebleeds, densely roll the bayabas leaves and place into the nostril cavity. As vaginal wash, warm decoction of leaves as vaginal wash (after childbirth) or douche. Cosmetic Leaf extract used in skin whitening products. Dental Toothbrush au-natural: Bayabas twigs, chewed at the ends until frayed, used as alternative for tooth-brushing with whitening effect^{13,58}.

In Amazonia for diarrhea, dysentery, menstrual disorders, stomach ache, vertigo. In Brazil for anorexia, cholera, diarrhea, digestive problems, dysentery, gastric insufficiency, inflamed mucous membranes, laryngitis, mouth (swelling), skin problems, sore throat, ulcers, vaginal discharge. In Cuba for cold, dysentery, dyspepsia. In India for anorexia, cerebral ailments, childbirth, chorea, convulsions, epilepsy, nephritis. In Malaya for dermatosis,

diarrhea, epilepsy, hysteria, menstrual disorders. In Peru for conjunctivitis, cough, diarrhea, digestive problems, dysentery, edema, gout, hemorrhages, gastroenteritis, gastritis, lung problems, PMS, shock, vaginal discharge, vertigo, vomiting, worms.

Elsewhere for anorexia, aches, bacterial infections, boils, bowel disorders, bronchitis, catarrh, cholera, chorea, colds, colic, convulsions, coughs, diarrhea, dysentery, dyspepsia, edema, epilepsy, fever, gingivitis, hemorrhoids, itch, jaundice, menstrual problems, nausea, nephritis, respiratory problems, rheumatism dyspepsia, edema, epilepsy, fever, gingivitis, hemorrhoids, itch, jaundice, menstrual problems, nausea, nephritis, respiratory problems, rheumatism, scabies, sore throat, spasms, sprains, stomach problems, swelling, tonic, toothache, ulcers, worms¹³.

Phytochemical Findings: Phytochemical screening yielded alkaloids, flavonoids, glycosides, polyphenols, reducing compounds, saponins and tannins. Leaf products have isolated more than 20 compounds, including alkaloids, anthocyanins, carotenoids, essential oils, fatty acids, lectins, phenols, saponins, tannins, triterpenes, and vitamin C. Leaves contain a fixed oil (6%) and volatile oil (0.365%). Fixed oil, 6%; volatile (essential) oil, 0.365%; eugenol; tannin 8-15%; saponins; amygdalin; phenolic acids; malic acid; ash, aldehydes. Fruit contains "glykosen" 4.14 to 4.3%, saccharose 1.62 to 3.4 %, protein 0.3%, etc. Bark contains 12 to 30% tannin. Roots are also rich in tannin. Contains catequinic components and flavonoids. Major constituents of leaves are tannins, β -sitosterol, maslinic acid, essential oils, triterpenoids and flavonoids. Chloroform-methanol extracted lipids of guava seeds was 9.1% on a dry weight basis. Analysis yielded 12 fatty acids, with a pattern similar to cottonseed oil. Protein content of seeds was 9.73% on a dry weight basis³⁸. Phytochemical screening yielded flavonoid, tannin, terpenoids and steroids from the leaves, and saponins, flavonoids, terpenoids and steroids from the bark⁵⁵. Preliminary phytochemical analysis of powdered leaves by four solvent extracts (H₂O/H, EtOH/E, CHCl₃/C, and Benzene/B) yielded flavonoids (CB), terpenoids (HEC), quinones (E), oil and fat (HECB), phenols (HECB), starch (ECB), protein (E), carbohydrate (HECB), cellulose (HECB)⁵⁹. GC-MS analysis of fruit yielded 65 compounds. Major constituents were α -pinene, 1,8-cineole, β -caryophyllene, nerolidol, globulol, C₆ aldehydes, C₆ alcohols, ethyl hexanoate and (Z)-3-hexenyl acetate. Unique fruit flavor was attributed to the presence of C₆ aldehydes, C₆ alcohols, ethyl hexanoate, (Z)-3-hexenyl acetate, terpenes and 1,8-cineole⁶⁹.

Pharmacological Action: Antidiarrheal, Antiseptic, Antispasmodic, Antioxidant Hepatoprotective, Anti-allergy, Antimicrobial, Antigenotoxic, Antiplasmodial, Cardioactive, Anticough, Antidiabetic, Anti-inflammatory,

Antinociceptive. Bark and leaves are Astringent and Vulnerary^{11,13,14}.

2. Studies

• **Assessment of two medicinal plants, *Psidium guajava* L. and *Achillea millefolium* L., in in vitro and in vivo assays:** Study on the cytotoxicity and mutagenicity of the plants provide info on its safety for use as therapeutic agents¹⁴.

• **Antihypertensive / Antidiarrheal:** In the study, *P. guajava* leaf extracts was more active than *D. mespiliformis* in their antagonistic effects on caffeine-induced calcium release from the sarcoplasmic reticulum of rat skeletal muscle. Results might explain their use as antihypertensive and antidiarrheal agents in traditional medicine through an inhibition of intracellular calcium release. Antidiarrheal / Quercetin: Quercetin is a main active constituent. Spasmolytic and antidiarrheal effects are attributed to quercetin-derived, flavonoids and glycosides²⁶.

• **Anticestodal:** Anticestodal efficacy of *P. guajava* against experimental *Hymenolepis diminuta* infection in rats: The study showed anticestodal efficacy and supports folkloric medicinal use in the treatment of intestinal-worm infections in northeast India¹⁸.

• **Hypoglycemic / Hypotensive:** The leaf of *P. guajava* is used extensively in African folk medicine. The study shows that the aqueous leaf extract of *P. guajava* possesses hypoglycemic and hypotensive properties and provides pharmacological credence to the folkloric use of the plant for type-2 diabetes and hypertension in some rural African communities¹⁹.

• **Microbicidal / Antidiarrheal:** Microbicidal effect of medicinal plant extracts (*P. guajava* Linn. and *Carica papaya* Linn.) upon bacteria isolated from fish muscle and known to induce diarrhea in children: Study concludes that guava sprout extracts is a feasible treatment option for diarrhea caused by *E. coli* or *S. aureus*-produced toxins, with quick curative effect, easy availability and low cost²⁶.

• **Antimicrobial / Leaves:** Aqueous extracts of leaves have shown antimicrobial activity against *Shigella* spp., *Vibrio* spp., *S. aureus*, *B. strep*, *E. coli*, *P. aeruginosa* and *B. subtilis*²⁷.

• **Guava Extracts and Radiolabelling:** Study showed aqueous *P. guajava* extract could present antioxidant action and affect membrane structures in ion transport altering radiolabelling of blood constituents with Technitium (Tc99m) and precautions applied to nuclear medicine procedures on patients using guava extracts²⁰.

• **Anti-diabetic:** Study of extract of leaves of *P. guajava* showed to possess anti-diabetic effect in type 2 diabetic mice model, the effect in part, mediated via the inhibition of PTP1B (protein tyrosine phosphatase 1B)²¹.

• **Trypanocidal:** Study showed that *P. guajava* leaf extract possessed trypanocidal properties attributed to broad antimicrobial and iron chelating activity of flavonoids and

tannins. Iron chelation was suggested as a effective way of killing trypanosomes²².

• **Antitumor:** Study showed *P. guajava* extracts to be efficacious in preventing tumor development by depressing Tr cells (regulatory)²³.

• **Radical Scavenging:** Study showed extracts from distilled water, 65% ethanol and 95% ethanol with significant dose-dependent effects on scavenging hydroxyl radicals and inhibiting lipid peroxidation. Flavonoids may be one of the antioxidative components²⁴.

• **Anti-proliferative / Anticancer / Leaf Oil:** A study on the anti-proliferative activity of essential oil from 17 Thai medicinal plants on human mouth epidermal carcinoma (KB) and murine leukemia (P388) cell lines. In the KB cell line, *P. guajava* leaf oil showed the highest anti-proliferative activity, more than 4x more potent than vincristine. The results suggested the potential of Thai medicinal plants for cancer treatment²⁵.

• **Spasmolytic:** A morphine-like spasmolytic action involving the inhibition of acetylcholine release and the transmural transport of electrolytes and water has been reported as possible modes of antidiarrheal action of *P. guajava* leaf extracts. The extract also inhibited the growth of causative agents for enteric fever, food poisoning, dysentery and cholera²⁶.

• **Antispasmodic:** In a study of acute diarrheic disease, a phyto-drug developed from guava leaves, standardized with its quercetin content, exhibited a decrease in the duration of abdominal pain²⁷.

• **Antioxidant / Hypocholesterolemic:** A study done to determine the effects of guava consumption on antioxidant status and lipid profile in normal male youth showed a significant increase in level of total antioxidants and reduced oxidative stress and also increase the level of HDL cholesterol significantly²⁸.

• **Anti-Ulcer:** Study showed rats pretreated with *P. guajava* extract from fresh tender leaves showed antiulcer activity in aspirin-induced gastric ulcer model with a significant reduction of ulcer index, pepsin activity, free and total acidity, volume and mucus content of gastric juice²⁹.

• **Anti-bacterial:** Study evaluated the antibacterial activities of aqueous and ethanol-water extracts from leaves, roots and stem bark of *P. guajava*. The AE of leaves roots and stems were active against gram-positive bacteria *Staphylococcus aureus* and *B. subtilis* and virtually ineffective against *E. coli* and *P. aeruginosa*. The EW showed higher activity than the AE³¹.

• **Leaves Extracts / Differences in Hypoglycemic Potential:** In a mice model, study showed the water soluble, edible alcohol, and edible alcohol-soluble extracts of wild *P. guajava* leaves may have different hypoglycemic potential³².

• **Hepato-protective / Leaves:** Study in male and female rats showed the aqueous extract of *P. guajava* leaves may be

hepato-protective (not hepato-toxic), with hematopoietic potentials³³.

- **Anticancer Activity / Review:** Review of a limited number of studies revealed guava extracts may have anti-cancer activity. One study tested guava fruit extract against a proliferation of cancer cell lines. One study in mice used a combination of bark, leaf, and root extract to inhibit growth of B16 melanoma cells^{35,36}.

- **Corrosion Inhibition / Mild Steel:** Study evaluated the corrosion inhibition behavior of an extract of guava leaves towards mild steel in HCl media. Results showed the extract has good inhibition efficiency (IE) and acts as a mixed-type inhibitor. As extract concentration increases, IE also increases³⁷.

- **Hepatoprotective / Leaves:** Study evaluated the hepatoprotective activity of *P. guajava* in CCl₄-, paracetamol- and thioacetamide-induced liver injury. Results showed significant reduction of liver enzymes and bilirubin. Higher doses prevented increases in liver weight³⁹.

- Study evaluated the hepatoprotective activity of *P. guajava* in acute experimental injury induced by carbon tetrachloride, paracetamol or thioacetamine and chronic liver damage induced by carbon tetrachloride. Results showed the aqueous extract of leaves possess good hepatoprotective activity in both acute and chronic liver injury models⁶⁶.

- **Antihyperglycemic / Unripe Fruit Peel:** Study evaluated the glycemic potential of an aqueous extract of unripe fruit peel in STZ-induced diabetic rats. Results showed normal, mild, and severely diabetic rat models had hypoglycemic and antidiabetic effect⁴⁰.

- **Analgesic / Antipyretic / Dried Leaves:** Study of an ethanol extract produced significant reduction of pyrexia in yeast induced hyperpyrexia and hot plate latency assay. Analgesic activities were observed in early and late phase of formalin induced paw licking tests in rats⁴¹.

- **Anti-Epileptic / Leaves:** Study evaluated the anti epileptic activity of a leaves extract of *P. guajava* in seizure induced by maximal electroshock and pantalon territorialize. Results showed the leaves extract at higher and medium doses produced highly significant and sustained increases in onset of convulsions and decrease in rate of convulsion. Activity may be due to presence of flavonoids and saponins⁴².

- **Effect in Hyperactive Gut Disorders / Diarrhea and Gut Spasm:** Study evaluated the mechanisms responsible for its use in diarrhea and gut spasm. A crude extract showed protection in castor oil-induced diarrhea model, similar to loperamide. In isolated rabbit jejunum preparations, crude extract showed potent effect against high K⁺ than spontaneous pre-contractions, similar to verapamil. Results indicate the crude extract possesses Ca⁺⁺ antagonist-like constituent/s to explain its inhibitory effect on gut motility⁴³.

- **Antibacterial / Leaves and Essential Oil:** Study evaluated essential oils and various leaf extracts of *P.*

guajava for antimicrobial effect. Of the bacteria tested, Staphylococcus aureus strains were most inhibited, with the methanol extract showing greatest bacterial inhibition. Essential oil extract showed inhibitory effect against *S. aureus* and Salmonella spp⁴⁴.

- **Antibacterial / Infectious Diarrhea:** Study evaluated crude decoction and quercetin for antibacterial effect on virulence of common diarrheal pathogens viz. colonization of epithelial cells and production and action of endotoxins. Decoction of *P. guajava* showed antibacterial activity towards *S. flexneri* and *Vibrio cholerae*, with decreased production of *E. coli* labile toxin and cholera toxin. Its spectrum of anti-diarrheal activity is not due to quercetin alone⁴⁵.

- **Antibacterial / Antifungal / Leaves and Bark / Skin Disorders:** Study evaluated the effects of *P. guajava* on organisms responsible for skin disorders. *P. guajava* solutions of leaf and bark extracts were effective in inhibiting growth of Staphylococcus aureus and *S. epidermis*, and fungi Mentagrophytes gypseum and Trichophyton mentagrophytes. Tetracycline as control showed significantly stronger inhibition, which may be due to the fact that it is pure chemical vs the crude extracts of *P. guajava* solutions⁴⁶.

- **Wound Healing Potential / Cytotoxic Effects:** Study evaluated the wound healing potential in vivo and cyto-toxic effects in vitro of *P. guajava* leaf extract and commonly used corticosteroids. In vitro, the extract caused a decrease in cell viability and growth compared to control and corticosteroids. In vivo, the extract caused acceleration of wound healing⁴⁷.

- **Periodontal Disease / Adjunctive Therapy:** Study evaluated the potential of *P. guajava* in the treatment of periodontal disease. Review suggests therapeutic potential of guava as adjunct in treating periodontal disease⁴⁸.

- **Gastroprotective / Ischemia-Reperfusion Injury:** Study evaluated a leaf extract for gastric secretory and protective properties on ischemia-reperfusion (I-R) induced gastric mucosal injury in rats. Results showed gastroprotective properties attributed to stimulation of mucus secretion by the guava extract⁴⁹.

- **Antibacterial / Wound, Skin and Soft Tissue Infections:** Study evaluates crude aqueous extracts of leaves of *P. guajava* against bacteria associated with surgical wound, burns, skin and soft tissue infections. Results showed potent inhibitory activity against growth of pathogenic Proteus mirabilis, Strep pyogenes, E. coli, Staphylococcus aureus⁵⁰.

- **Hepato-toxic and Hepato-protective Disease / Erythromycin Induced Liver Damage:** Study of aqueous extract of leaves of *P. guajava* on erythromycin-induced liver damage in albino rats showed hepato-protective activity at lower dose and hepato-toxic property at higher dose⁵¹.

- **Anti-Trypanosomal Activity / Leaves:** Study evaluated ethanolic extracts of leaves of *P. guajava* for anti-trypanosoma and cyto-toxicity activity in bloodstream

species of *Trypanosoma brucei brucei* (BS427) and HEK293. Results showed inhibition of growth of *T. b. brucei*, with selectivity index comparing favorably with pentamidine and diminazne⁵².

• **Antidiarrheal Activity / Leaves:** Study evaluated an aqueous leaf extract of *P. guajava* for antidiarrheal activity in experimentally induced diarrhea in rodents. PGE (50-400 mg/kg p.o.) produced dose-dependent and significant ($p < 0.05-0.01$) protection of rats and mice against castor oil-induced diarrhea, inhibited intestinal transit, and delayed gastric emptying. Like atropine, it produced dose-dependent and significant ($p < 0.05-0.01$) anti-motility effect and caused inhibition of castor-oil induced enteropooling. Like loperamide, PGE induced dose-dependent and significant ($p < 0.05-0.01$) delay in onset of castor-oil induced diarrhea, decreased frequency of defecation and decreased severity of diarrhea in rodents⁵⁴.

• **Anti-Inflammatory Activity / Leaves and Bark:** Study of leaf and bark tannin fraction of *P. guajava* showed significant anti-inflammatory activity in in-vitro models. The anti-inflammatory activity is probably due to the presence of tannin (gallic acid)⁵⁵.

• **Wound Healing / Tannins / Leaves and Bark:** Study of *P. guajava* leaf and bark tannin fraction showed significant effect on wound healing models. A tannin-rich fraction formulated in ointment form showed significant percentage wound protection at tested concentrations. The wound healing activity was attributed to the presence of tannin (gallic acid)⁵⁶.

• **Cardioprotective in Diabetes / Antiglycative / Leaves:** Study evaluated the antiglycative potential of ethyl acetate fraction of leaves in streptozotocin induced diabetic rats. Results showed a significant decrease in liver alpha 2 macroglobulin, a protein associated with early stages of cardiac hypertrophy. Results suggest the PGEt extract may be beneficial in preventing cardiovascular complications associated with diabetes⁵⁷.

• **Hyperglycemic Effect / Fruit Peels:** Study evaluated the glycemic potential of *P. guajava* fruit peel extract on blood glucose of normal and STZ-induced sub-diabetic female albino Wistar rats. Results showed a hyperglycemic effect from a single oral administration of variable doses of *P. guajava* fruit peel extract. Results suggest diabetic patients should peel off the guava fruit before consumption. On the other hand, the fruit peel could be useful for hypoglycemia induced by excess insulin or other hypoglycemic drugs⁶⁰.

• **Antibacterial Microcapsules for Cotton Fabric / Leaves:** Study prepared antibacterial cotton fabric by using microcapsules containing *P. guajava* leaf extract. Leaf extract was applied to cotton fabric by direct printing with a binder and assessed for antibacterial activity against *E. coli* and *S. aureus*. Results showed cotton fabric finished with microcapsules containing *P. guajava* leaf extract showed antibacterial activity against *S. aureus*, but not against *E. coli*⁶¹.

• **Testosterone Effect / Contraceptive / Hypolipidemic / Leaves:** Study evaluated an aqueous extract of *P. guajava*

leaves on testosterone level and serum lipid parameters in rats. Results showed male fertility regulation with reduction in serum testosterone suggesting significant contraceptive efficacy, together with sizable reduction in weight of organs, i.e., testis, epididymis, prostate and seminal vesicle⁶².

• **Antidiarrheal Activity / Fruits** Study evaluated the antidiarrheal potency of ethanolic fruit extract of *P. guajava* using Wistar albino rats. Results showed significant ($p < 0.05$) antidiarrheal activity evidenced by reduction in rate of defecation (78.33% at 600 mg/kg body weight compared to loperamide at 100%). The activity was attributed to flavonoids and tannins probably through denaturation of proteins and forming protein tannates which minimize intestinal mucosal permeability. LD50 of the crude methanolic extract was 10,715 mg/kg⁶³.

• **Antioxidant / Antibacterial / Antitumor:** Study evaluated the phenolic and flavonoid levels, antioxidant activity, lethality assay, antibacterial and antitumor activities of dried *P. guajava* extract. The guava extract yielded high levels of phenolics (766.08 ± 14.52 mg/g) flavonoids (118.90 ± 5.47 mg/g) and antioxidant activity (87.65%). LD50 was 185.15 μ g/ml. MIC was 250 μ g/ml for *Streptococcus mutans*, *S. mitis*, and *S. oralis*. IC50 in HeLa, RKO and Wi cell lines were 15.6 ± 0.8 μ g/ml, 21.2 ± 1.1 μ g/ml and 68.9 ± 1.5 μ g/ml, respectively. Results suggest the dry extract of leaves has potential as topical application in the oral cavity, the development of antitumor formulation, and, also, as functional food⁶⁴.

• **Amelioration of Arsenic Toxicity:** Study evaluated the effect of *P. guajava* leaf extract on arsenic induced biochemical alterations in Wistar rats. Results suggest kidney damage caused by arsenic can be repaired to some extent by AEPG50⁶⁵.

• **Antioxidant / Leaves:** Study investigated the antioxidant activity of *P. guajava* leaf extract for antioxidant activity by DPPH free radical scavenging method using ascorbic acid as standard. The leaf extract showed strong antioxidant activity. IC50 of the *P. guajava* extract was 45.5 ± 0.044 μ g/mL compared to ascorbic acid standard of 25.8 ± 0.204 μ g/mL⁶⁷.

• **Antiplatelet Activity:** Aqueous extracts of *P. betle* and *P. guajava* showed profound effect on the ultrastructure of selected dental plaque bacteria viz., *Streptococcus sanguinis*, *S. mitis*, and *Actinomyces* sp. Extracts interfered with normal growth cycle and development of bacterial cells slowing down plaque development⁶⁸.

• **Comparative Antidiabetic Activity / Fresh and Dry Leaves:** Study evaluated the comparative anti-hyperglycemic activity of fresh and dry leaves of *P. guajava* against alloxan-induced diabetic rats. The fresh leaf extract showed significant anti-hyperglycemic activity compared to dry leaves, producing nearly equal reduction in blood glucose compared to that of standard glibenclamide 10 mg/kg⁷⁰.

• **Antioxidant / Antimutagenic / Leaves:** Study evaluated various solvent fractions of *P. guajava* leaf for antioxidant

and antimutagenic properties. A methanolic extract showed maximum antioxidant activity comparable to ascorbic acid and BHT as tested by DPPH, FRAP, and CUPRAX reducing ability assays. The methanolic fraction at 80 µg/ml concentration inhibition above 70% mutagenicity. Findings suggest high amount of phenolics responsible for the broad spectrum antimutagenic and antioxidant properties in vitro⁷¹.

• **New Source of Antioxidant Dietary Fiber / Fruit:** Study of pulp and peel fractions showed high dietary fiber (48.55-49.42%) and extractable polyphenols (2.62-7.79%). All fractions showed remarkable antioxidant capacity correlating with total phenolic content. Results showed the peel and pulp can be used to obtain antioxidant dietary fiber, a new product which combines dietary fiber and antioxidant compounds⁷².

• **Analgesic / Dried Leaves:** Study evaluated methanolic and aqueous extracts of dried leaf of *P. guajava* for analgesic property in adult male wistar albino rats using formalin and acetic acid induced writhing and hot plate tests. Results showed analgesic property in the order of methanolic < aqueous < combined methanolic and aqueous⁷³.

• **Hepatoprotective Fruit Polysaccharide Supplementation / Paracetamol Toxicity:** Study evaluated the effect of polysaccharide from guava fruit on paracetamol (PCM)-induced liver injury on Sprague-Dawley rats. Results showed PCM induced alterations (glycogen depletion, vacuolisation, loss of cell membrane, inflammatory cells infiltration, hepatocellular distortions) were attenuated by PPG supplementation⁷⁴.

• **Biocidal Triterpenoids / Betulinic Acid and Lupeol / Leaves:** Study isolated two triterpenoids viz., betulinic acid and lupeol from the leaf extract of *P. guajava*. The two compounds were found active against all tested bacteria and fungi. Compound 1 showed better antimicrobial activity compared to compound 2⁷⁵.

• **Nephroprotective / Doxorubicin Induced Renal Toxicity / Leaves:** Study investigated the protective effect of ethanolic extract of *P. guajava* leaves against doxorubicin-induced nephrotoxicity in rats. Results showed amelioration of doxorubicin-induced toxicity at 100 and 300 mg/kg dose of ethanolic extract⁷⁶.

• **Silver Nanoparticles / Antibacterial / Leaves:** Study reports on a simple, rapid, cost-effective, and environment friendly method for the synthesis of silver nanoparticles using guava leaf extract. The nanoparticles showed antibacterial activity against *Pseudomonas aeruginosa*. Results showed promise as an alternate antibacterial agent in the field of agriculture for large-scale production⁷⁷.

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