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Review

Medicinal and pharmacological potential of Guava leaf powder, A Review

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Abstract

Guava (Psidium guajava) encompasses a broad range of nutritional and therapeutic potential. Depending on the species, the fruits are 4-12 cm long and have a round or oval form. It belongs to the Myrtaceous family and mostly cultivated in tropical and subtropical climates of subcontinent including Pakistan, India and Bangladesh. The most therapeutic value could be traced in pink form of guava. The phytochemicals "quercetin, avicularin, apigenin, guaijaverin, kaempferol, hyperin, myricetin, gallic acid, catechin, epicatechin, chlorogenic acid, epigallocatechin gallate, and caffeic acid" have been investigated in the guava plant leaves for its therapeutic properties. Antidiarrheal, antihypertensive, antilipidemic, anticancer, and other health promoting benefits are associated in both of the fruits and the leaves of guava. The nutritional and phytochemical profiles of guava leaves are presented in detail in current review. Many bioactivities of guava leaf extracts are also critically investigated. Guava leaves might be employed as a component in of nutraceutical and medications due to their phytochemical profile. To prove the efficacy of the guava leaf extracts, further extensive clinical trials are needed.

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History:

Many vital nutrients have been bestowed upon Guava (Psidium guajava) by nature. Guava was originally grown for commercial purposes in South Africa, and the Portuguese carried it to India [1]. Guava is a popular fruit in Asia, although it is more popular in Western nations due to its medical benefits. The tree may be grown in any soil with a tropical or subtropical environment. India is now the world's greatest producer of guava, followed by China [2]. Guava fruits are normally 4 to 12 centimeters (1.6 to 4.7 inches) long, round or oval depending on the species. The fruit is initially green in color, but as it ripens, it turns yellow [3]. Apple guava is the most widely available guava on the market. The skin color of guava is yellowish to orange and color of the flesh can be pink, red, white or yellow and its taste can be sour, aromatic and juicy type [4]. The fruit contains a variable number of seeds and its mesocarp is characterized by the presence of small and hard fibrous structures called stone cells. The botanical classification of Psidium guajava (Guava) is shown in Table 1.

Nutritional Composition of guava:

Guava fruit consists of dietary fiber and is rich in vitamin C four to ten times more than citrus fruit. The fresh firm guava consists of roundabout 56-500mg of ascorbic acid but the highest quantity of ascorbic acid is present in the skin [5]. Approximately 84% moisture is present in guava and fat, protein and carbohydrates. Due to nutrients such as vitamin A and C, folic acid, dietary minerals like manganese, copper and potassium and enriched dietary fiber, guava is considered a super fruit [6]. The nutrient contents of guava vary throughout cultivation. Among the plant foods, guava has relatively high antioxidant potential because major classes of antioxidant components such as polyphenols and carotenoids are present in guava. Guava flesh and skin color are produced due to these pigments, in red-orange type guava varieties presence of carotenoids, polyphenols, provitamin A and retinoids type pigments are more than in yellow-green varieties. The nutritional value of single guava fruit is mentioned below in Table 02 [7]

Utilization of Guava Fruit:

Guava fruit is mostly eaten in raw form and its by-products such as jam, the pulp (puree), jelly, paste, syrup, chutney and jam etc. Multiple products of guava are available in the market such as creams, yogurt, jellies, nectars and ice creams [8]. For manufacturing tools, fences wood of the guava tree is very useful and it can be used as firewood because of its charcoal source. Guava fruits are chopped and passed through a pulper for pulp (puree) production, fibrous tissues and seeds are removed by pulper and then the finisher removes the stone cells. A mixture of stone cells, fibrous tissues and seeds is known as guava waste [9].

Guava leaf:

Chemical composition:

leaves of guava hold essential oil with the presence of core components such as "α-pinene, limonene, isopropyl alcohol, terphenyl acetate, selinene, caryophyllene, β-pinene, longicyclene, β-bisabolene, farnesene, caryophyllene oxide, humulene, β-copanene, cardinene, menthol, and curcumene". Vital oil from leaves of guava has been identified with the presence of guavavolic acids and as well as with the presence of ursolic, nerolidiol, β-sitosterol and crategolic acid [10].

Guava leaves include 0.37 % volatile oil, 6.0 % fixed oil, 3.14 % resin, 8.51 % tannin, and other fixed compounds, as well as resin 3.14 %, tannin 8.51 %, and other fixed substances. guava leaves include fat, mineral salts, resin, chlorophyll, tannin, cellulose, and volatile oil, with eugenol, mallic acid, and tannin ranging from 8-16 % in essential oil. The leaves also contain an vital oil high in cineol, 4 triterpenic acids, and 3 flavonoids: quercetin, its 3-L-4-4 arabinofuranoside (avicularin), and its 3-L-4-pyranoside, all of which have antibacterial properties [5].

When qualitatively and quantitatively constituents of essential oils were investigated through GC-MS round about sixty compounds of essential oils at the rate of 90.55% were identified. The main components were copaene 11.81%, caryophyllene 18.81%, azulene 10.26%, Guajavolide and guavenoic acid and along with it from the fresh leaves of guava, a well-known triterpene oleanolic acid was also isolated[11].

Applications/Utilization of guava leaves:

Globally, from industrial activities millions of tons of waste are generated, causing environmental damage because most of its drained without proper treatments. A small fraction of waste is used as a feed for animals or in the fields[12]. The waste is rich in bioactive compounds and capable of preventing oxidative damage caused by free radicals [13].

Because of its therapeutic potential, waste is of great importance. Therefore, many efforts have been made to develop new food products from waste and the extraction of bioactive compounds [11].

Most widely, leaves of guava are used in tea, in capsules, pastes, and as extracted essential oils. Usually, young leaves are preferred for medicinal benefits, which can be available in many forms in health stores. These leaves are also available in tea stores in dried form and ready for use. To make medicinal tea leaves are dried and then crushed and boiled[14].

Guava fruit, roots and leaves have long been used as private medicines. Especially, the leaves are blended with essential oil, and a large number of other terpenoids, flavonoids and tannin based phenolic compounds and their functionality are highly expected. Quercetin, one of the flavonoids and aglycone a sugar-free compound is known to have gentle action [15]. The tannin component of leaves is effective in improving the function of the pancreas by promoting the metabolism of the cells, thereby promoting insulin secretion and improving insulin function[16].

The leaf and guava fruit have been described to have many pharmacological actions such as anti-cough, antibacterial, antifungal, antidiarrheal, antidiabetic, antioxidant, antimutagenic, antiulcer, anti-inflammatory, fever, cardioprotective effects.

Composition of guava leaf powder:

Physico-chemical studies:

The leaves powder showed little ash and moisture content of 2.81% and 1% respectively. The value of ash shows the number of inorganic plant compounds. So, less value of ash indicates that guava leaves powder consists of more organic compounds[17]. There are also many carbohydrates, which are a rich source of energy and less

amount of protein and fat is present in the powder of leaves [18]. When the analysis of the powdered sample was done for the presence of elements it showed all types of elements were present including zinc, magnesium, calcium, manganese, sodium, potassium and iron. The amount of these metals was at the under tolerable greater intake level and within RDI which is recognized by the Nutritional Reference Intakes for healthy people[19].

For detecting adulteration or poor handling of drugs the physical assessment of drugs is an important factor. When moisture determination of powder sample of leaves of guava was done it showed 8.5% moisture content which is not in very high quantity, so it would discourage the growth of yeast, fungi or bacteria[12]. The ash value determination was done in three different forms: total ash, acid insoluble ash, and water-soluble ash. In assessing the purity of drugs, the total ash is mainly important for detecting foreign inorganic material like metallic salts or silica absence or presence [20]. The quantity of silica present, particularly sand is measured by acid insoluble ash. The water-soluble portion of the total ash is known as water-soluble ash. In crude powder of leaves 7.65% total ash, 1.50% water-soluble ash and 7.5% acid insoluble ash were present. The presence of a low amount of inorganic matter and silica in leaves of guava indicated a low amount of total ash, water-soluble ash and acid-soluble ash[21]. The extraction of crude powder was maximum of 24% in methanol, the minimum was 3.32% in petroleum ether and in water, it was 16.9%. The pH value of extract of acetone was 3.57. In crude powder of leaves and extract of acetone lead, arsenic, mercury, cadmium and chromium were absent.

Phytochemical analysis:

Alkaloids and saponins were present in maximum quantity whereas triterpenes were present in moderate quantity in the extract of acetone. Cardiac glycosides and tannins were present in high quantity in the crude powder [15]. Steroida, cardiac glycosides and phlobatannins were absent in the extract of acetone whereas in crude powder phlobatannins were absent[14].

Medicinal and pharmacological properties:

Anticough action

In Bolivia and Egypt, guava leaf has traditionally been treated for ailments such cough and respiratory issues. The occurrence of cough elicited by capsaicin aerosol was decreased within ten min of intraperitoneal injection of aqueous extract. A lethal dose of guava leaf extract is larger than 5 g/kg[22].

Guava leaf extract has indeed been offered as a cough medication as a case formulation. Meanwhile, a recent study on Egyptian plant discovered that the “alcoholic extract, (4 g/ml) aqueous extract (8 g/ml), ethyl acetate extract (6 g/ml), essential oil (16 g/ml), and quercetin (30 g/ml)” mean a major decline in contractile response of isolated guinea pig trachea treated with histamine (2 g/ml), acetyl choline [23].

The extracts and the essential oil were confirmed to be safe for administration as anti-cough in terms of its influence on the “isolated trachea, Smooth muscle relaxant, and Anti-inflammatory” characteristics in this research. In isolated rabbit hearts, high quantities have been reported to inhibit ventricular contractions. It may also be effective in cough treatment because of the large quantity of vital oil (0.46 percent) and its broad antibacterial activity [24].

Antifungal activity

Leaf extracts of P. guajava L. already have considerable antifungal activity. For the strains of Chaetomium funicola M002 and Arthrinium sacchari M001 extracts of methanol and hot water were used against them due to their antifungal activity[25].

Anticestodal activity

Guava leaves have been demonstrated to have Anticestodal properties. Research supported the use of guava leaf as folk medicine in the northeastern portion of India to treat intestinal illnesses caused by worms[6].

Antioxidant activity

Guava pulp and peel might be utilised to make antioxidant-rich dietary fiber as a by-product, and this product has both antioxidant and dietary fibre qualities. Natural antioxidants are enriched in guava. Because of its polyphenol concentration, the fruit is better as a dietetic supplement for preventing atherosclerosis [26].

Meanwhile, the leaf has been shown to have a high level of antioxidant activity. Because it has strong DPPH, “radical scavenging activity, potent inhibitory activity” of lipid peroxidation, and a strong inhibitory effect against the death of cells, guava could be used to start reducing nutrition loss and waste by delaying the oxidation process and increasing the shelf life of food products[27]. To summarize, a well-balanced diet supplemented with the extract of the guava leaf provides health benefits.

Antimutagenic activity

The leaves of. guavas have anti-mutagenic activity: flavonoids may be present in guava leaves which may cause this activity and the leaves' anti-carcinogenic qualities. (+)Gallocatechin was discovered , bio-antimutagenic molecule against UV-induced mutation in ‘Escherichia coli’ after being extracted from guava leaf methanol extract of guava leaves[28].

Hepatoprotective activity

Hepatoprotective action is found in guava leaves aqueous extract [29].

Anti-bacterial Activity

Guava extracts were shown to have antibacterial action against 21 different foodborne pathogens. “Five Listeria monocytogenes strains, four Staphylococcus aureus strains, six Escherichia coli strains, four Salmonella Enteritidis strains, Vibrio parahaemolyticus strains, and Bacillus cereus strains”, as well as 5 food decay bacteria such as “Pseudomonas aeruginosa, P. putida, Alcaligenes faecalia” and 2 strain In another study, four antibacterial flavonoids were extracted from guava leaves: quercetin-3-O-arabinoside, Morin-3-O-lyxoside, quercetin, and morin-3-O-arabinoside[30].

Furthermore, the antibacterial activity of Psidium guajava leaf extract was stronger against Gram-positive bacterial and fungus strains. Aqueous extract was found to be more effective than organic extracts in preventing the growth of infective organisms such as “E. coli, Proteus mirabilis, Pseudomonas aeruginosa, Streptococcus pyogenes, and Staphylococcus aureus” and it can also be used to prepare oral antibacterial medicines to treat soft tissue, skin, and surgical infections[26].

At a minimal bactericidal dose, a methanolic extract of guava leaf reduced the development of a multidrug-resistant strain (MDR) by 80%. According to a time-kill experiment, methanolic extract (4 mg/mL) eradicated MDR bacteria in 10 hours. Because guava leaf extracts have the strongest antibacterial and antifungal properties, they can be utilised as natural antiseptics to extend cut flowers' life and treat A. hydrophila-related fish infections. Psidium guajava aqueous extracts had antibacterial activity with MIC values ranging from "2.61 to 4.69 mg/mL" and toxic values (LC50, EC50) significantly over hazardous dosages[28].

Guajava contains the different '11.5 ppm' fluoride demonstrated anti-adherence action and decreased the bacteria's cell-surface hydrophobicity, possibly making them less adherent and so reducing plaque[31]. Guajava extracts may function by avoiding and lowering the adherence of primary bacterial colonizers to the tooth surface and limiting or inhibiting the development and explosion of microbes observing the tooth surface, which may intensify their antiplaque effects[32] .

Anti-diarrhoeal Activity

Guava leaf extracts were used to test microorganisms that cause diarrhoea, such as "S. aureus, Salmonella spp , E. coli". The use of methanol extract resulted in the greatest suppression of bacteria. guava leaf and bark crude and aqueous methanolic extracts showed great potential for regulatory waves of cholera V and show[26]. cholera 01, crude and aqueous extract of guava leaf and bark exposed great likely for regulatory epidemics of cholera V and showed Anti-bacterial activity against multidrug-resistant V[4]. cholera 01, guava leaf and bark crude methanol and aqueous extracts A clinical investigation found that guava products helped reduce stomach discomfort in patients with severe diarrhoea. Guava leaf extracts were used to test microorganisms that cause diarrhoea, such as 'S. aureus, Salmonella spp., and E. coli' [26]. The use of methanol extract resulted in the greatest suppression of bacteria. cholera 01, guava leaf and bark crude methanol and aqueous extracts showed strong antibacterial activity against, multidrug-resistant V [19]. cholera 01, guava leaf and bark crude methanol and aqueous extracts A clinical investigation found that guava products helped reduce stomach discomfort in patients with severe diarrhoea.

Gastro Protective Effect

Natural compounds found in plants are the finest alternatives to manufactured drugs to treat stomach ulcers. The methanol extract of guava leaves was used to evaluate three distinct ulcer models in rats, including ethanol, pyloric ligation, and aspirin-induced ulcer [33]. Different dosages of leaves extract, such as 100mg/kg and 200mg/kg, prevent stomach lesions caused by pyloric ligation (65.70 percent), ethanol (70.4 percent), and aspirin (70 percent), and their effectiveness was comparable to that of omeprazole, a conventional medicine[20]. The use of this methanol extract for the treatment of gastric ulcers reduced acid production, secretory volume, and raise pH in the stomach. Guava leaves impacted both healing and gastroprotective characteristics.

Antidiabetic, hypoglycaemic and anti-hyperlipidaemic activities

For many years, guava leaf can be used to treat diabetes mellitus in individuals. a. Lowering postprandial blood glucose levels: In alloxan-induced diabetic rats, 'oral administration of a 50 percent ethanolic extract of the leaves and/or the n-butanol soluble fraction from the ethanolic extract inhibited hyperglycemia'[26]. The tannins isostrictinin, strictinin, and pedunculagin were identified as active principles in the ethanolic and n-butanol extracts. In contrast, the oral dose of the water extract that exposed statistically important hypoglycaemics activity on alloxan-induced diabetic rats in both acute and sub-acute tests was 250 mg/kg [34].

c. Reduction in the symptoms of diabetes, "hyperlipidaemia, hypercholesterolemia, and hypoadiponectinemia". Drinking Guava Leaf Tea with each meal reduces hyperglycemia and 'hypoadiponectinemia, hypercholesterolemia, and hyperlipidaemia' in pre-diabetic and diabetic individuals with and without hyperlipidaemia. In people with hypercholesterolemia or borderline hypercholesterolemia, the successive consumption lowers blood cholesterol [21]. Guava leaf extracts are powerful antiglycation agents that may be useful in the prevention of glycation-related diabetic problems. The leaf extract is also a lipase inhibitor, reducing obesity, heart disease, and atherosclerosis by decreasing carbohydrate absorption. As a result, guava might be used to treat and/or prevent diabetes mellitus[35].

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Table 1. Botanical classification of Psidium guajava (Guava)

Kingdom	Plantae
Order	Myrtales
Family	Myrtaceae
Subfamily	Myrtiodeae
Genus	Psidium
Species	Guajava
Binomial name	*Psidium guajava Linn*

Table 2. Nutritional Composition of guava (per 100g)

Nutrient	Composition
Protein	0.1-0.6 mg
Moisture	2.79-5.5 g
Lipids	0.43-0.71 mg
Crude fibre	0.90-1 g
Carbohydrate	9.1-17.1 mg
Ash	9.6-10 mg
Iron	200-400 I.U.
Calcium	17.9-30 mg
Phosphorous	0.3-0.7 mg
Thiamine	0.03-0.05 mg
Riboflavin	0.6-1.067 mg
Vitamin A	0.047mg
Vitamin C	37-50 mg
Niacin	40.0 I.U.

Fig. 01: Guava fruit and leaves, bunch of guava leaves with dorsal leaves