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Bioactive compounds present in different parts of Guava and their significance: A review

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Abstract
Guava (*Psidium guajava* L.) is a tropical and subtropical fruit crop that is commonly used in food and traditional medicine all over the world. It is a member of the Myrtaceae family. Tannins, flavonoid: quercetin, pentacyclic triterpenoid: guajanoic acid, saponins, carotenoids, lectins, leucocyanidin, uvaol, amritoside, betasitosterol, ellagic acid, oleanolic acid, triterpenes, and ursolic acid are some of the essential phytoconstituents. Guava can be eaten raw or refined into juice, pulp, jam, jelly, nectar, powder, tea, and other items. The guava plant parts are utilized for the improvement of variety industrial and medicinal products. Antiviral, anti-inflammatory, antidiabetic and anti-mutagenic factors are all found in guava. Guava extract has antinociceptive properties and can help with liver inflammation and serum development.

Keywords: Guava, bioactive compounds, antioxidants

Introduction
Guava (*Psidium guajava*) is an evergreen bush or little tree in the family Myrtaceae developed for its consumable natural products. Guava (*Psidium guajava* Linn.) is a fruit that is well-known for its culinary and nutritious qualities all over the world (Etim *et al*, 2020) [1]. The fruit is also as "The fruit of the poor guy" or "Tropical apple". Guava is commonly grown in common tropical and subtropical regions (Adhau and Salvi, 2014) [2]. Guava (Psidium guajava Linn.) is a tropical American fruit that was first introduced to India in the early seventeenth century. Guava is grown in India, Mexico, Brazil, Cuba, Venezuela, Australia, South Africa, Thailand, Malaysia, Indonesia, China, Sri Lanka, the Philippines, Bangladesh, Myanmar, the Dominican Republic, the United States, and Haiti (Mitra *et al*, 2012) [3]. Guava stands fifth in production among India's most important fruit crops and can be grown throughout the country. Important guava growing states in the country are Uttar Pradesh, Madhya Pradesh, Maharashtra and Bihar, Allahabad district of Uttar Pradesh is very popular for growing the excellent quality of guava fruits in the world(Jolhe *et al*, 2020) [4]. Guava is grown accros the country which is (0.25 million hectares) with an annual yield of 4.08 million tons respectively. Depending on the species, guava fruits are typically 4 to 12 centimetres (1.6 to 4.7 in) long, round or oval. The fruit is initially green in color, but as it ripens, it turns yellow (Kafle *et al*, 2018) [5]. The fruit contains approximately 80 percent moisture and 20 percent dry matter including 1 percent ash, 0.7 per cent fat and 1.5 percent protein (Upadhyay *et al*, 2019) [6].
Guava fruit is commonly eaten fresh as a dessert fruit or processed as puree, juice, concentrate, jam, jelly, cheese, toffee, fruit flakes, squash, syrup, nectar, powder, wine, vinegar, ready-to-eat snacks, beverages, and dehydrated canned products (Sinha and Mishra, 2017) [7]. The root, bark, leaves, and fruit of the plant have been reported to have pharmacological properties (Seshadri *et al*, 2020) [8] and are used to cure a variety of ailments. malaria, gastroenteritis, spewing, looseness of the bowels, diarrhea, wounds, ulcers, toothache, sore throat, swollen gums, and a host of other symptoms have also been handled with various sections of the plants throughout herbal medicine (Biswas *et al*, 2013) [9]. This plant has also been used to treat life-threatening illnesses including diabetes, hypertension, and obesity. Guava fruit comes in two varieties of white and pink interior Interspersed with little hard seeds. White guava has a sweeter flavor and is more widely cultivated, while pink guava is considered a delicacy. The fruits are circular to ovoid, fleshy, yellow, and around 5cm in diameter, with a pink or white edible mesocarp containing small round seeds.

Guava seeds make up between 6-12 percent of the total weight of the fruit. The seeds are round in shape and pale yellowish brown in color, with 16 percent oil, 7.6 percent protein, and 61.4 percent crude fiber content. Guava seeds, have the ability to become a source of oil that can be used in food products and as a dietary supplement (Raihana *et al*, 2015) [10]. The leaves are opposite, oblong, three to seven inches long, and have prominent veins on the underside. Guava leaf is widely used to treat diarrhea, gastroenteritis, and other digestive issues, while the fruit of the guava has been used to raise platelets in dengue fever patients (Laily *et al*, 2015) [11]. The guava bark is thin and has green patches on it. It is incredibly easy to dispense with it in long straps. It contains a significant volume of antimicrobial and antibacterial substances (Rahim *et al*, 2010) [12].

Guava is a very rich source of ascorbic acid (vitamin C) and contains other nutraceutical components, including vitamin A (beta-carotene), vitamin B1 (thiamine), (B2) riboflavin, niacin and pantothenic acid (Vijaya Anand *et al*, 2020) [13]. Moreover, it additionally contains a considerable measure of phosphorous, calcium, iron, potassium, and sodium. The major ingredients of guava are citric acid and acetic acid (Palachum *et al*, 2020) [14]. Guava's dietary importance is enhanced by the presence of antioxidant pigments such as carotenoids and polyphenols. These various bioactive nutrients play a significant role in traditional therapies for various lifestyle problems, such as diabetes (type 2) and obesity (Upadhyay *et al*, 2019) [15]. α-pinene, β-pinene, limonene, menthol, β-sitosterol, cineol, quercetin are bioactive compounds with different pharmacological activity (Ngbolua, 2018) [16].

Cultivation of guava

Guava is raised in both tropical and subtropical regions up to 1500 m. above mean sea level. It tolerates high temperatures and drought conditions in northern India during the summers (Dinesh and Reddy, 2012) [17]. Guava is primarily grown in the tropics and can withstand temperatures of 15–45 °C (59–113°F) (Singh, 2011) [18]. Guava grows optimally between 23 and 28°C (73–82°F) but established trees can tolerate short periods at-3 to-2°C (27-28°F) although temperatures below 15°C (60°F) may cause the tree to stop producing fruit. It is, however, vulnerable to heavy frost, which can destroy young plants. During the rainy season (July - September), an annual rainfall of about 100 cm is adequate. The quality of the fruits is harmed by rain during the harvesting season. Guava can grow in a variety of soils, including sandy and rocky soils, as well as loams, preferring a pH of 4.5–7 but tolerating alkaline soils up to pH 8.5. (Birdi *et al*, 2020) [19]. Guava is more drought tolerant than most tropical fruits, and it can survive long periods of drought by ceasing vegetative development before the weather improves. Guavas of high quality are grown in river basins. Water logging is a problem for the crop (Sehrawat *et al*, 2014) [20]. During the rainy season, planting takes place. The months of June and July are suitable for planting the layers and seedlings. India is the top producer of guava in the world and approximately 200640 hectare agricultural land has been used for Guava cultivation. Different cultivars of guava has been grown across the country and reported productivity of 15.3 MT/Ha respectively. UP is leading in guava production having 928.44 tonnes of produce in 2017- 2018. Top ten guava producing states and varieties grown therein have been shown in Table no 1.

Taxonomy of guava

The guava plant (Psidium guajava L.) belongs to the Myrtaceae family. Psidium guajava is the most important fruit of the genus Psidium, which contains around 150 species. Guava is thought to have originated from an area extending from southern Mexico to or through Central America. Singh, 2011) [21]. Guava is widely known and cultivated throughout the world (Paull and Duarte, 2012) [22].

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

Nutritional value of guava

This popular fruit is a source of nutrients. The fruit is a good source of carbohydrates, proteins, fats, minerals, and other nutrients, and thus may help reduce the risk of malnutrition (Youssef and Ibrahim, 2016) [23]. According to the USDA's Food Data Central, guava is a strong source of protein (2.3%), carbohydrates (12.16%), and dietary fiber (4.8%), among other popular fruits. Guava has been stated to be a good source of calcium, with 17.63 mg per 100 g. In addition, Guava is an excellent source of ascorbic acid, i.e. 241,86 mg/100 g, which, together with various fruits, makes it a promising source of discovery and added value in food products (Bogha *et al*, 2020) [24]. Lutein, zeaxanthine, and lycopene are abundant in guava. It is rich in flavonoids, fructose sugar, and carotenoids (Das, 2011) [25]. Minerals such as calcium, phosphorus, iron, and vitamins like niacin, pantothenic acid, thiamin, riboflavin, vitamin A, and vitamin E are abundant in fruit (Reddy, 2017) [26]. Guava contains both polyphenolic compounds and carotenoids, which provide the fruit with antioxidant pigments, making it one of the most antioxidant-rich fruits (Omayio *et al*, 2019) [27]. Essential oils, phenols, triterpenes, saponins, flavonoids, lectins, fiber, and pectin, as well as fatty acids, are all present in guavas. Caffeic, coumaric, ferulic, cinnamic, ellagic, and rosmarinic acids are among the polyphenol and glycoside esters found in guava fruit. (Medina and Herrero, 2016) [28]. Flavonoids such as myricetin, naringenin, epicatechin, quercetin, rutin and apigenin have been found. (Vijaya Anand *et al*, 2020) [29]. The major components in fruit are α-Pinene, β-caryophyllene, (Z)-3-hexenal, and α-humulene. Carbonyls and esters such as 3-hydroxy-2butanone, benzaldehyde, ethyl hexanoate, (Z)-3-hexenyl acetate, hexyl butanoate, and ethyl octanoate are only contained throughout the fruit (Lee *et al*, 2011) [30]. Guava leaves contain variety of chemical components for example, α-pinene, β-pinene, limonene, menthol, caryophyllene, β-bisabolene, farnesene, humulene, selinene, cardinene and curcumene, mallic acids, β-copanene, β-sitosterol, cineol, quercetin, tannin, guajavolide and guavenoic acid, resin, triterpernes, such as oleanolic acid, triterpenoids, prenol, dihydrobenzophenanthridine, and cryptonine. flavonone-2, 2′-ene (Thome *et al*, 2019) [31]. In Guava seed Presence of bioactive components such as polyphenols, tocopherols and phytosterols in these fruit seed oils makes them highly desirable due to their beneficial effects on human body. Guava seeds had a protein content of 9.73 percent dry matter, with 15 amino acids, 67 percent of which were arginine, glutamic acid, aspartic acid, glycine, and leucine. The main

fatty acids were linoleic (60.0 percent), palmitic (14.8 percent), oleic (12.5 percent), stearic (9.08 percent), and arachidic (1.31 percent). Being a rich source of linoleic acid, it can be used to supplement food products deficient in omega-6 essential fatty acid. guava seed oil is a good source of palmitic acid and stearic acid and apart from that siginificant amount of mono unsaturated fatty acid(MUFA) and poly unsaturated fatty acid (PUFA) (Kapoor *et al,* 2020) [32]. Proteins, oils, phenolic, flavonol glycoside, starch, flavonoid compounds, quercetin-3-O—D-(2''-Ogalloyglucoside)-4'-O-vinylpropionate are all contained in guava seed (Molla and Azene, 2011) [33]. *Psidium guajava* twigs contain calcium, magnesium, phosphorus, potassium and sodium. Concentrations of fluoride, copper, iron, zinc, manganese, lead and also contains flavonoid, sesquiterpene alcohols and triterpene acids (Ngbolua, 2018) [34]. The bark contains 12–30 per cent tannin and one of the sources states that it contains 27.4 per cent tannin or polyphenols, resin and calcium oxalate crystals. Tannin can be found in roots as well. Roots also include leukocyanidins, gallic acid, and sterols (Naseer *et al,* 2018) [35].

Utilization of different part of guava

Guava is used to make a variety of processed items, including drinks, syrup, ice cream, jams, jellies, toffee, juice, and dehydrated and canned products. Additionally different parts of guava being utilized for different pharmacological applications.

Food utilization

The guava has incredible potential for broad business use because of its simplicity of development, high nutrient content, and processing in a variety of consumer products (Kocher, 2011) [36]. There are a variety of products that can be made from guava processing including guava jam, juice, pulp, jellies, chocolate, wine and guava powder (generally utilized in the preparing of yogurt) and spray soluble guava extracts containing high antioxidants concentrations (Kadam *et al,* 2012) [37].

Guava Jams and Jellies: Jam is a semi-solid mixture obtained by cooking a fruit soft tissue with sugar. Jam is an in-between moisture food prepared by boiling fruit pulp with sugar (sucrose), pectin, acid and other ingredients (additive, coloring and flavoring materials) to a rationally thick evenness, firm enough to hold the fruit tissues in position (Rahman *et al,* 2018) [38]. The jam could be between 65 and 68 degree Brix after which it is hot filled into cleaned and disinfected glass containers.

Guava jelly is made from slightly ripe guava fruits. Jelly is a semi-solid product that is prepared by boiling clear strained fruit extracts free of pulp after adding the required amount of sugar, citric acid and pectin. It should have a total soluble solids content of at least 65 percent and a fruit portion of at least 45 percent (Jolhe *et al,* 2020) [39]. The fruit is sliced into little pieces and cooked for around 45 minutes at low temperatures with utilizing similar measure of water and the juice extricated by filtration utilizing sifters or muslin cloth (Kuchi *et al,* 2014) [40]. Sugars are added to the extracted juice until it is boiled to 105 °C or a layer is formed by cooling a little segment in a spoon. The measure of sugar utilized differs relying upon the pectin content of the extracted juices, going from 0.5 kg sugar/kg juice to 0.75 kg sugar/kg juice for pectin rich juice and low-pectin juice respectively. After that, hot filling into clean and sterlized containers (SWER *et al,* 2019) [41].

Guava leathers: Guava leather is prepared by dehydrating the purée of fruit into a leather sheet. Leathers can be eaten as a confection or cooked to make a sauce. In the tropics, there is a scarcity of knowledge on the chemical and organoleptic properties of guava leathers. Guava leather has a higher protein and fat content. This was also noted in ash content with pawpaw leather (2.67 per cent) and guava leather (2.87 percent) (Kanwal *et al,* 2016) [42].

Guava Shrikhand: The current consumer preference for reduced or low-fat products that help to reduce the risk of chronic degenerative diseases has prompted the production of probiotic low-fat foods such as shrikhand, a semisolid light, sweetish sour fermented dairy product. In Gujarat, Maharashtra, and Karnataka, it is a famous delicacy. The procedure for making shrikhand began with heating skim milk, cooling it at 30 °C in a batch pasteurizer, adding lactic acid bacteria (LAB) starter culture, and thoroughly mixing it with a mixer. The temperature of the pre-sterilized storage vat was kept at 37 °C during the incubation period, which lasted between 8 to 12 hours. After the curd was properly set, the contents were transferred to another vessel through a clean, moist muslin cloth. Sugar and guava powder have been added to this chakka and have been thoroughly mixed either manually or mechanically to a homogeneous consistency. It is usually packaged in polystyrene cups and stored under refrigerated conditions (Kumar, 2011) [43].

Guava Juice and Nectars: The Fresh fruits or the pulp of the guava are used to produce guava juice. Juice is separated by squeezing the guava fruit with hydraulic filterl press or from the pulp after dilution with water and resulting filtration. The juice is generally not clear and requires the use of pectic enzymes to make it smoother and easier to clean. Studies by Imungi showed that the ideal conditions for removing guava juice utilizing proteolytic enzymes from Kenyan guava were 400 ppm compound at a temperature of 45-50 degree C for an hour and a half (90 minutes).

Nectars- Water is added to guava pulp or fresh juice to produce nectar. Allowed added substances or sweetners, just as sugar could conceivably be added yet the items should have at least 8.5° Brix, 25.0 percent of the guava puree or juice and acidity 0.15 percent at a pH of 3.4 – 4.8 (Omayio *et al,* 2019) [44].

Guava wine: The wine made from guava (*Psidium guajava* L.) is the result of anaerobic yeast fermentation, in which the sugars are converted to alcohol and carbon dioxide (Sevda and Rodrigues, 2011) [45].

Guava leaf tea: The leaf of *Psidium guajava* was extracted with hot water and yielded 14 percent guava leaf extract. In a summary, 100 g of dried leaves were mixed with 2 L of distilled water (DW) and decocted at 80 ^{0}C for 30 minutes. The extracted solution was freeze dried after filtering through four layers of gauze to remove leaves (Kaneko *et al,* 2013) [46].

Guava leaf powder: The guava leaves were collected and manually shredded into small pieces. Subsequently, the biomaterial was washed a few times using ordinary tap water

followed by a single wash with pure distilled water to make it free from dust and undesired soluble contaminants. The wet material was allowed to sit in a clean and dry place to allow free water to evaporate from the surface and thereafter was placed in an electric oven at 50 °C for 24 h. The dried guava biomass was kept in desiccator while cooling, crushed into powdered form and stored in moisture-free conditions until further use in experimentations (Ponnuchamy *et al,* 2019) [47].

Guava seed powder: Firstly collection of seeds and seeds were dried in an air circulation oven (Tecnal, model TE-394 /L) at 60°C for approximately 16 hours. After dehydration, the seeds were crushed using a domestic blender (Walita) and the powder obtained. The powder was packaged in lidded polyethylene containers (Uchôa-thomaz *et al,* 2014) [48].

Guava seed powder fortified biscuits (GSPFB)

With the help of response surface methodology (RSM), the level of guava seed powder, wheat flour and sugar was optimized. 17.65 g of guava seed powder, 62 g of wheat flour and 20 g of sugar were mixed. Butter (25 g), baking powder (1 g) and vanilla flavour (2 ml) were also used. The oven was pre-heated to 180 °C. The dough was then rolled on a platform and cut into round shape. Cut biscuit dough were then lined upon food grade steel mesh on an oven tray and baked in the oven at 180 °C for 25 min and cooled for 30 min at ambient temperature. Control samples were prepared without any addition of Guava seed powder. Biscuits of each formulation were made in triplicate. The process adopted for biscuit manufacture was as per the method elaborated by the AACC (2000). The biscuits were cooled for 30 min and then packed in Low density polyethylene pouches and sealed until further analysis (MAURYA and PANDEY) [49].

Guava pomace: Guava pomace is a representation of preparing waste delivered after the production process, and it can represent up to 15% of the first natural fruit (Denny *et al*, 2013) 50. To get juice, Guava fruits were utilized. A cabinet tray dryer was utilized for drying guava pomace, which could correctly control the ideal drying temperature somewhere in the range of 20 and 150 °C. The guava pomace, high in moisture content, ana dry at a temperature of 65°C as proposed by previous studies for drying carrot pomace. (Tangirala *et al,* 2012) [51].

Pharmacological utilization

The use of guava in restorative practices was considered to be a few different Specialists in various diseases and has demonstrated the potential for the treatment of most diseases worldwide. Guava has been shown to be effective in the treatment of these diseases in ethno pharmacological assessments, research centres, and clinical preliminary studies. In addition, harmful quality evaluations of the roots, bark, leaves, natural items, blossoms and seeds of the plant have been viewed as safe for therapeutic purposes, both for oral and effective use, at whatever point controlled in blends and improvement structures (Gupta *et al,* 2020) [52].

Antioxidant activity

Recent findings have shown that *Psidium guajava* is an important source of phytochemical antioxidants. Guava is a very good antioxidant and a rich source of vitamin C. Guava has antioxidant properties that are attributed to the polyphenols found in its leaves Guava leaf extracts and essential oil from the stem and bark will scavenge free hydrogen peroxide, superoxide anion radicals, and inhibit the development of hydroxyl radicals (Fasola *et al,* 2011) [53]: (Vyas *et a.,* 2010) [54]. The antioxidant properties of guava can be due to quercetin, carotenoids, vitamin C, and polyphenols (Dakappa *et al,* 2013) [55].

Quercetin, quercetin-3-O-glucopyranoside and morin may be extracted from the leaves. Antioxidant activity can be seen in these compounds. Quercetin has anti-oxidant properties. It is thought to be the most active and powerful antioxidant found in guava leaves (Soman *et al,* 2010) [56]; (Nantitanon *et al,* 2012) [57].

Anti-diabetic

Blood glucose levels have been found to *Psidium guajava*. Guava fruit extract has been shown to help diabetes patients lose weight and control their blood sugar levels. Guava fruit extract was given at portions of 125 and 250 mg/kg to STZ-incited diabetics. Guava Fruit Extract reduces the depletion of insulin-positive beta cells and insulin release by protecting pancreatic tissues, including islet beta cells, from oxidation. (Huang *et al,* 2011) [58]. Quercetin, kaempferol, myricetin had inhibitory effects on sucrose, maltase, and α-amylase (Wang *et al,* 2010) [59].

Anti-inflammatory activity

Germ contamination and thymus production have been shown to be blocked by guava extract in ethyl acetate. It has the potential to serve as an antiviral agent. It has the ability to improve mRNA expression. Guava may alter the work of the heme oxygenase-1 protein. Because of this, it can be used as an anti-inflammatory agent for the skin. The lipopolysaccharide that develops nitric oxide is inhibited by guava extract in ethanol. The outflow of E2 is inhibited. In this way, it serves as an anti-inflammatory agent (Jang *et al,* 2014) [60].

Anticancer effect

A few examinations have shown that therapeutic plants of *Psidium guajava* effectsly affect human epidermal carcinoma and murine leukemia cells. The decrease measure, the LDH discharge examine, and the colony forming assay all revealed that the GBA was extremely cytotoxic. The concentrate showed inhibited of HT-29 cell development at 250 µg/ml. branch extract displayed apoptotic impacts in HT-29 cells, including chromatin condensation and sharking. It causes cytotoxicity and raises the sub-G1 phase of HT-29 cells. (Lee and Park, 2010) [61].

Antiviral Activity

Antiviral movement of guava extracts was resolved against development of A/Narita/1/2009 (amantadine-safe pandemic strain 2009) with an IC50 of 0.05 percent and development of A/Yamaguchi/20/06 (touchy strain) and A/Kitakyushu/10/06 (oseltamivir-safe strain). The development of these strains has been firmly hindered by guava extracts. Guava tea has been shown to be effective against flu infection and has additionally been appeared to build up viral tolerance in the body (Sriwilaijaroen *et al,* 2012) [62].

Antidiarrhoeal effect

Quercetin and quercetin-3-arabinoside, obtained from the buds and leaves of Psidium guajava L. at concen. of 1.6 µg/ml, showed a morphine-like hindrance of the arrival of

acetylcholine in the coxially prompted ileum followed by an underlying ascent in muscle tone followed by a consistent decline. Methanol extract from leaves (8 µg/ml) of Psidium guajava showed activity against simian (SA-11) rotavirus by 93.8 percent hindrance. Furthermore, guava galactose- lectin has been appeared to tie to Escherichia coli (a natural cause of diarrhea), hinder its bond to the intestinal wall, and accordingly avoid diarrheal inflammation. (Gupta *et al.* 2011) [63].

Immunomodulatory activity

Psidium guajava leaf extract showed immunomodulatory actitvity. Decoction of guava leaves has been shown to activate macrophages to destroy E. coli strain (heat stable toxin producer) using murine monocyte cell line, J774 (Birdi *et al*, 2014) [64]. Ethyl acetate fraction of guava leaves has been shown to suppress COX2 expression, cytokine secretion, degranulation, and FceRI-mediated signaling in antigen-stimulated mast cells. A flavonoid fraction of guava leaf extract has been shown to control the activation of the nuclear factor KB in the *in-vitro* model system using Labeo rohita head renal macrophages (Daswani *et al*, 2017) [65].

Antiparasitic Activity

Antiparasitic drug are utilized to treat irresistible infections brought about by ectoparasites, protozoa, parasitic fungi, and helminths, among other things. Guava leaf essential oil worked well in an *in vitro* antiparasitic experiment as a host for Toxoplasma gondii. Guava leaf essential oil's conceivable restorative activity may have prompted the *in vitro* reduction of free extremists associated with toxoplasmosis pathology (Lee *et al*, 2013) [66].

Wound healer

The gingival, periodontal ligament fibers are composed of collagen. Fibroblasts are the most common cell type found in periodontium connective tissue. Vitamin C is required to maintain the periodontium's overall integrity (Ravi and Divyashree, 2014) [67]. Guava is rich in vitamin C (ascorbic acid). Ascorbic acid can regulate the statement of procollagen gene prompting collagen arrangement, changing the fibroblast separation through its consequences for extracellular matrix. The decoction of root bark is prescribed as a mouthwash for sore gums, and the decoction of leaves as an efficient gargle for swollen, bleeding gums (mittal *et al*, 2010) [68].

Antibacterial

Guava extracts show antibacterial action against both Gram-positive and Gram- negative bacteria. *In vitro* testing revealed that an aqueous mixture and a water-soluble methanol extract from guava leaves and bark had strong antibacterial efficacy against multidrug-resistant Vibrio cholera (Shu *et al*, 2011) [69].

Guava for Cold and Cough

Guava leaves have been shown to be beneficial in the treatment of colds and coughs. Guava is high in ascorbic acid and iron, which helps to relieve lung inflammation and mucous production while also keeping the respiratory tract free of pathogens. Fruit, especially raw fruit, or a decoction made from tender immature leaves, is extremely beneficial in the treatment of colds and coughs. Because of its astringent properties, it acts by disintegrating mucus polymers, loosening cough and reducing more mucus intake, keeping the respiratory tract, mouth, and lungs free of bacteria, and inhibiting current microbial behavior. Guava has a high concentration of vitamin C, and has been shown to be very helpful in treating colds and coughs caused by bacteria or viruses. In many Indian villages, roasted ripe guava is used as a home remedy for severe cases of cough, cold, and congestion. Another study found that a hydro extract of *Psidium guajava* leaves significantly reduced coughing frequency caused by capsaicin aerosol within 15 minutes of administration when compared to a control (Kafle *et al*, 2018) [70].

Hematological activity

The methanolic extract of Psidium guajava bark can be used as a blood booster in anemic patients or as a prophylactic purpose. As a result, it is suggested that a concentration of 200mg/kg could be sufficient to stimulate the necessary haemopoiesis. While the exact process by which the extract facilitated the rise in these hematological indices was not determined in this research, it is concluded that this behavior was a direct result of the extract on the haematopoietic systems (Fasola *et al*, 2012) [71].

Table 1: Indian States according to decreasing order of guava production and varieties cultivated therein (APEDA2017)

Sr. no.	States	Production (tonnes)	Varieties grown
1	Uttar Pradesh	928.44	L-49, Allahabad Safeda, Lucknow Safeda, Apple Colour, Chittidar, Red Fleshed, Allahabad Surkha, Sardar, Mirzapuri Seedless, CISH-G-1, CISH-G-2, CISH-G-3
2	Madhya Pradesh	686.70	L-49, Allahabad safeda, Gwalior-27, Hafshi, Seedless Chittidar
3	Bihar	427.61	Allahabad Safeda, Apple Colour, Chittidar, Hafshi, Harijha, Sardar, Selection-8
4	Andhra Pradesh	229.78	Allahabad safeda, Lucknow 49, Anakapalli, Banarasi, Chittidar, Hafshi, Sardar, Smooth Green, Safed Jam, Arka Mridula
5	West Bengal	215.20	L-49, Allahabad Safeda, Dudhe Khaja, Gole Khaja, Kabli, Baruipur, Chittidar, Harijha, Sardar
6	Chattisgarh	197.18	Lucknow 49', 'Allahabadi Safeda' and 'lalit'
7	Punjab	195.60	Punjab Pink, Allahbad Safeda, Arka Amulya, Sardar, Punjab Safeda, Punjab Kiran, Shweta, Nigiski, Punjab Soft, Allahabad Surkha, Apple guava, Chittidar
8	Gujarat	169.57	Nagpur seedless, Dharwar, Dholka, Kothrud, L-24, L-49, Nasik, Sindh
9	Tamil Nadu	155.06	Anakapalli, Banarasi, Bangalore, Chittidar, Hafshi, Nagpur Seedless, Smooth Green
10	Karnataka	140.23	Allahabad Safeda, L-49, Araka Mridula, Araka Amulya, Bangalore, Dharwar

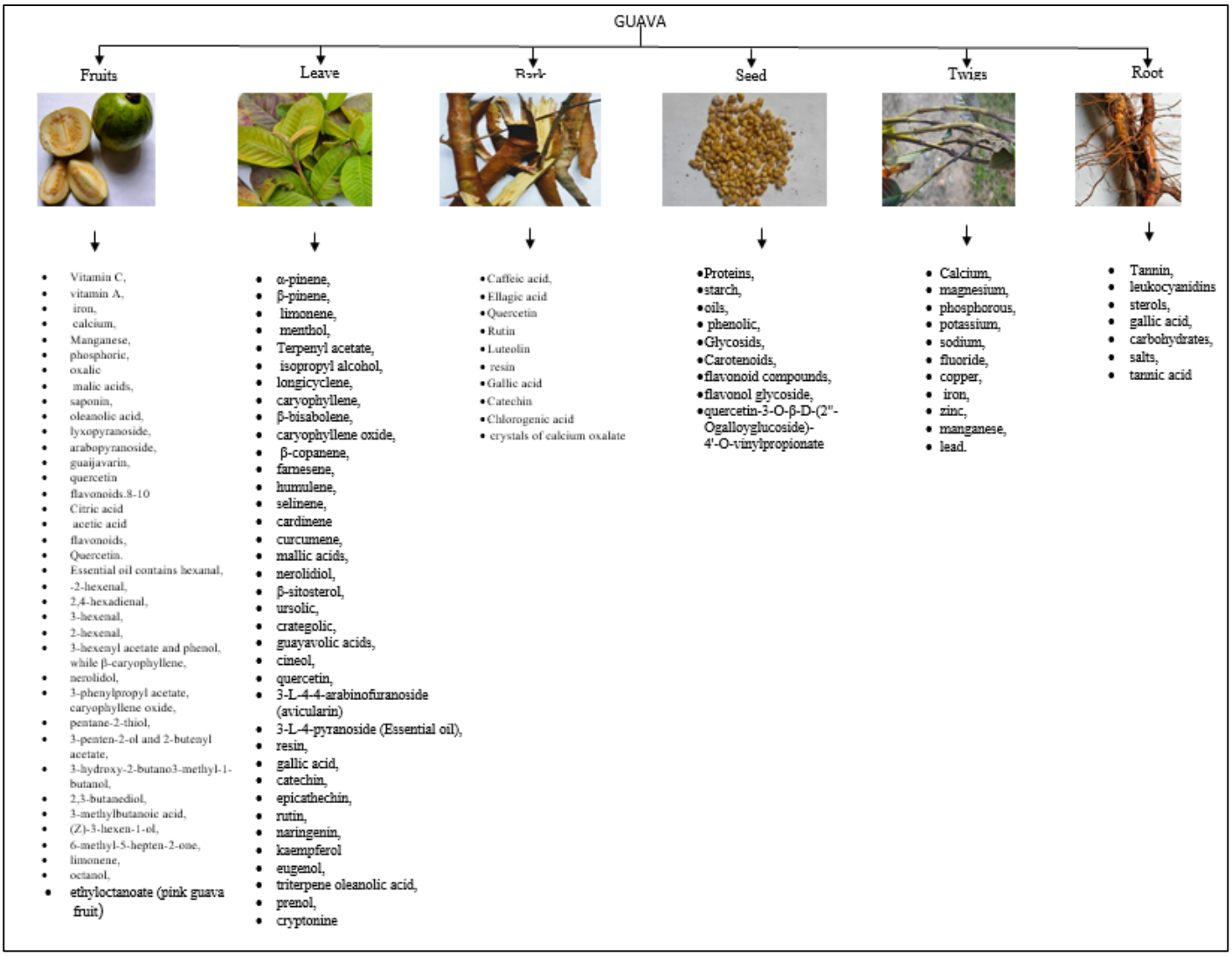
Table 2: food utilization of different parts of guava

Sr. no	Parts of guava	Utilization	refernces
1	Fruit	Jam	Rahman *et al*, 2018 [38]
2	Fruit	Jellies	Jolhe *et al*, 2020; Kuchi *et al*, 2014; SWER *et al*, 2019 [39-41]

3	Fruit	Wine	Sevda and Rodrigues, 2011 [45]
4	Fruit	Leathers	Kanwal *et al*, 2016 [42]
5	Leaf	Tea	Kaneko *et al*, 2013 [46]
6	Leaf	Powder	Ponnuchamy *et al*, 2019 [47]
7	Seed	Powder	Uchôa-thomaz *et al*, 2014 [48]
8	Guava Seed Powder Fortified Biscuits (GSPFB)	Powder	MAURYA and PANDEY [49]
9	Fruit	Juice	Omayio *et al*, 2019 [44]
10	Fruit	Nectars	Omayio *et al*, 2019 [44]
11	Guava pomace		Tangirala *et al*, 2012 [51]

Table 3: pharmacological utilization of different parts of guava

Sr. no	Parts of guava	utilization	refernces
1	Leaf Leaf	Antioxidant activity	Fasola,*et al*, 2011); (Vyas *et al*, 2010 [53; 54] Soman *et al*, 2010); (Nantitanon *et al*, 2012 [56; 57]
2	Fruit	Anti-diabetic	Huang *et al*, 2011[58]
3	Guava skin	Anti-inflammatory activity	Jang *et al*, 2014 [60, 59]
4	buds	Antidiarrhoeal Effect	Gupta *et al*, 2011 [63]
5	Leaf	Immunomodulatory activity	Birdi *et al*, 2014; Daswani *et al*, 2017 [64, 65]
6	Leaf	Antiparasitic Activity	Lee *et al*, 2013 [66]
7	Root bark	Wound healer	Mittal *et al*, 2010 [68]
8	Leaf and bark	Antibacterial	Shu *et al*, 2011 [69]
9	Leaf and fruits	Cold and Cough	Kafle *et al*, 2018 [70]
10	Bark	Hematological activity	Fasola *et al*, 2012 [71]



Conclusion

Guava (Psidium guajava Linn.) is well known for its food and nutritional qualities all over the world. Guavas were also included in the list of super fruits because they were high in folic acid, dietary fiber, potassium, and dietary minerals. In guava plant various bioactive compound are available like araban, arabinose, ascorbigen, destructive, guajavanoic destructive, linoleic destructive, myristic destructive, guajiverine, tannins, polyphenols, quercetin, quercitrin, ursolic destructive and terpenes. The medicinal properties of

guava fruit, leaves, and other plant parts are also well-known in traditional medicine. Since any aspect of the guava tree has economic importance, it is grown on a commercial scale. The guava plant has gone through a critical stage as far as biological action and remedial use, and the fruit is viewed as the tropics' poor man's apple. Plant parts from the guava plant are used in a variety of consumer and medicinal products. The plant has been commonly considered for its pharmacological actions, and numerous studies as well as published literature specify its powerful anti-diarrheal, antimutagenic, hepatoprotective, antihypertensive, antioxidant, hypoglycemic, and antimicrobial properties.

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