IJPSM

Ajit Wagatkar *et al*, Int. Journal of Pharmaceutical Sciences and Medicine (IJPSM),
Vol.8 Issue. 5, May- 2023, pg. 58-73

ISSN: 2519-9889
Impact Factor: 5.9

Review on Phytochemicals, Ethnobotanical and Pharmacological Activities of *Psidium Guajava*

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DOI: 10.47760/ijpsm.2023.v08i05.009

Abstract

Ethnoveterinary medicine include people's indigenous knowledge, skills, methods, practises, and beliefs about caring for themselves. The use of medicinal plants to cure illnesses is an established practise in underdeveloped nations where traditional medicine is used to preserve human health. Guava (Psidium guajava Linn.) is well-known for its culinary and dietary benefits all over the world. Traditional systems of medicine are also aware of the therapeutic benefits of guava fruit, leaf, and other plant components. A range of plant-derived compounds, including quercetin, guaijaverin, isoflavonoids, gallic acid, catechin, epicathechin, rutin, naringenin, kaempferol flavonoids, and galactose-specific lecithins, have demonstrated potential action. Since the guava tree has economic value in every area, it is cultivated on a large scale. Guava fruit is referred to as the "poor man's apple of the tropics" because of the biological activity and therapeutic applications of the guava plant. Parts of the guava plant are utilised to create a range of commercial and medicinal goods. The nutritional value of guava fruit and the therapeutic characteristics of its many components have been examined in this study to give a comprehensive overview of its diverse commercial values.

***Keywords**:* Guava leaves, Psidium Guajava, Pharmacological activity, Secondary metabolites. Ethnomedicine.

Introduction

The fruit guava (*Psidium guajava L.*), which is indigenous to the American tropics, is also referred to locally as guayabo, guara, arrayana, and luma (Gutiérrez,et al.,2008). It can be grown anywhere between Mexico and Peru, but due to its adaptability, it is also grown in tropical and subtropical regions of Europe, Africa, and Asia (Gutiérrez et al.,2008, Kafle et al.,2018). Guava, or *Psidium guajava*, is endowed by nature with a variety of crucial nutrients. Guava is thought to have been introduced to India by the Portuguese after being commercially grown in South Africa. Guava is a fruit that is very common in Asian nations, but it is more common in western nations due primarily to its medicinal qualities. It is a small tree from the Myrtaceae family (Kafle et al.,2018). Depending on the species, guava fruits can range in size from 4 to 12 centimetres (1.6 to 4.7 in) long and can be

ISSN: 2519-9889
Impact Factor: 5.9

round or oval. The fruit initially has a green colour before turning yellow as it ripens (Kafle et al.,2018, Chen And Yen,2007).Apple, cherry, and strawberry guavas are among the varieties of guava that are most popular worldwide. primarily consumed raw in its ripened or semi-ripened form or as juices. The most commonly available guava in the market is apple guava (Kafle et al.,2018).

Table 1: shows the botanical classification of *Psidium guajava*.

Botanical Classification	
Kingdom	Plantae – Plants
Subkingdom	Tracheobionta Vascular Plants
Super division	Spermatophyta Seed Plants
Division	Magnoliophyta Flower Plants
Class	Magnoliopsida Dicotyledonous
Subclass	Rosidae
Order	Myrtales
Family	Myrtaceae
Subfamily	Myrtoideae
Tribe	Myrteae
Gender	Psidium
Species	*Psidium guajava*

Guava fruits are rich in nutrients and have a sweet aroma and flavour. Guavas have four times the amount of vitamin C than oranges (Correa and Couto,2016). Guava fruits have been used to make juices, beverages, nectars, etc. due to their high vitamin C content (Kocher,2011). Guava leaves can be used to make tea, and the resulting decoction works as a vermifuge to treat stomach ailments (El-Saadony et al.,2021). Additionally, in traditional Chinese medicine, the guava has been used to treat diabetes, diarrhoea, and mellitus (Gutiérrez,et al.,2008). Whereas the decoction of guava leaves is used as an anti-bacterial in Nigeria and as a gargle for mouth ulcers in Southeast Asia (Morais-Braga et al.,2016). Guava also has some unique applications for the treatment of skin conditions and wounds. For example, guava poultice is used by people in Mexico, Brazil, the Philippines, and Nigeria to treat skin conditions and wound infections (Gutiérrez,et al.,2008).

ISSN: 2519-9889
Impact Factor: 5.9

Guava leaves, in addition to the fruit, may have health benefits as well. To name a few, they may help prevent cancer, control blood pressure, treat diarrhoea, and resolve bowel issues. Additionally, it aids in weight loss, enhances skin tonicity, and cures scurvy, dysentery, constipation, cough, and colds (Kafle et al.,2018).

There are more than 150 species of Psidium in the world, but only a small number of those species are the primary carriers. *P. guajava* and *P. cattleyanum* are currently the two species that are most frequently found on the market. *P. guajava* has seen the development of numerous cultivars that have been chosen for qualities like sweetness, aroma, colour, and seedlessness. Outside of its growing region, *P. cattleyanum's* edible yellow or red fruits are rarely eaten. Additionally, *P. cattleyanum var. cattleyanum,* commonly known as purple guava, red cattley guava, red strawberry guava, or red cherry guava, fructifies red fruits, while *P. littorale*, also known as lemon guava, yellow cherry guava, or yellow strawberry guava, fructifies yellow fruits (Zou and Liu,2023).

1. Morphology

The height of the *Psidium guajava*, an evergreen shrub-like tree, ranges from 6 to 25 feet. Figure 1 shows the leaves, flowers, fruit, seeds, and bark of a plant, among other plant parts.

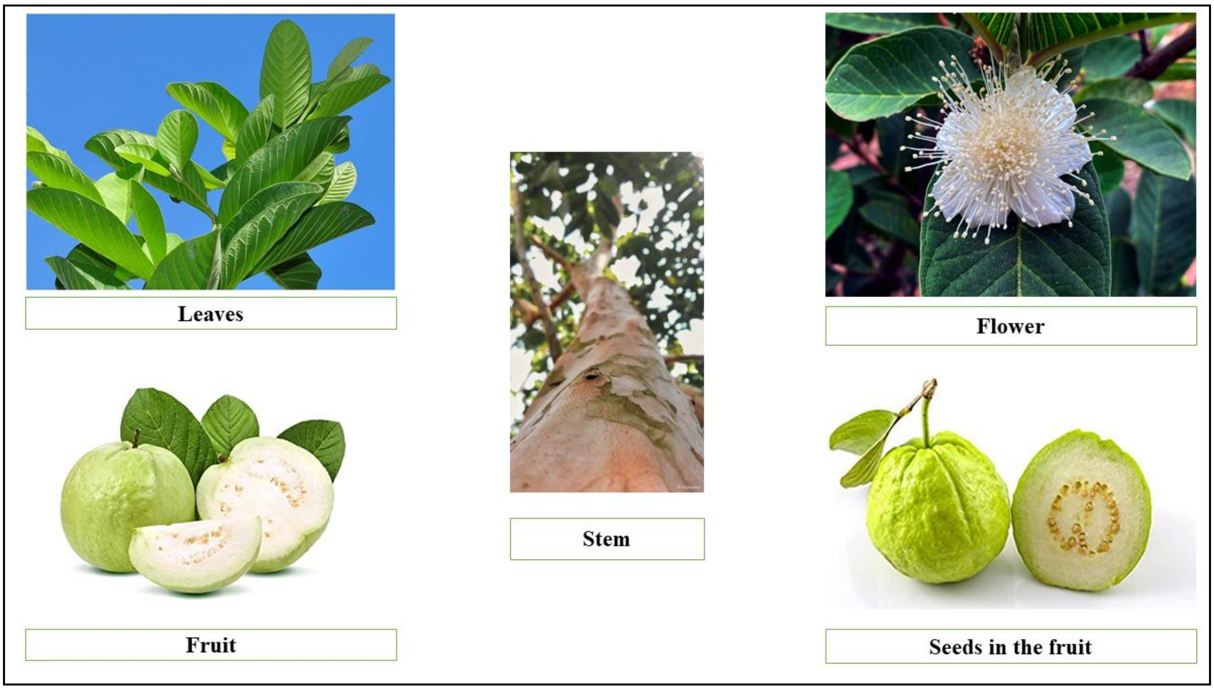


Fig. 1: Morphology of *Psidium guajava*

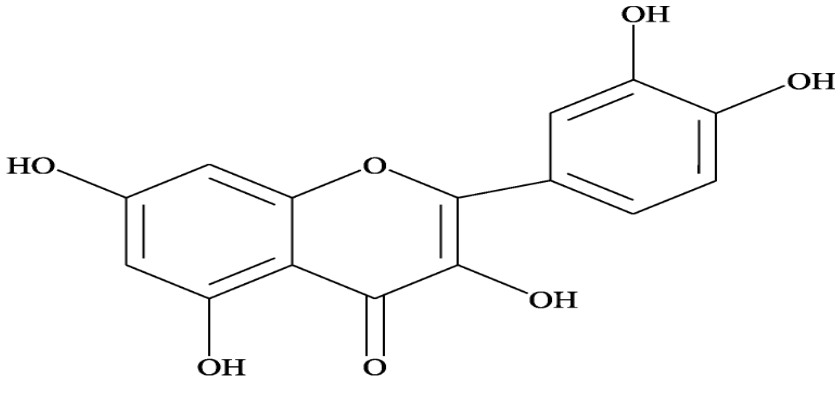
The plant's extensive network of branches spreads out widely.. Most of its branches are curved, and the opposite leaves have small, 3 to 16 cm long petioles. The leaves have wide, prominent veins and a wide, clear green colour (Rouseff et al.,2008). The plant produces fragrant white flowers with incurved petals. Flowers have four to six petals, yellow anthers, and insects are used for pollination. Guava fruits range in size from small to medium, measuring 3 to 6 cm. It has a pear-like shape and is yellow when ripe (Das,2011). Its slightly darker-

ISSN: 2519-9889
Impact Factor: 5.9

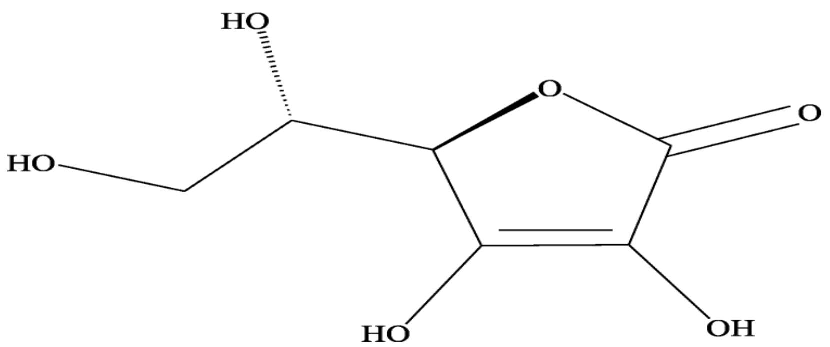
colored pulp contains slightly yellowish-colored seeds. Seeds are very small and are palatable when chewed. They range in number from 112 to 535 and are arranged in regular patterns(Kumar et al.,2011).The guava bark is thin and has green coloured spots. Long straps make removal very simple. It contains a significant amount of antibacterial and antimicrobial substances. Stem ethanolic extracts exhibit strong anti-diabetic properties. Essential oils, polysaccharides, minerals, vitamins, enzymes, triterpenoid acid alkaloids, steroids, glycosides, tannins, flavonoids, and saponins are just a few of the phytochemicals and antioxidants found in guava. Guava has greater levels of vitamin C and A. Pectin, an essential dietary fibre, is also abundant in guavas (Naseer et al., 2018).

2. Chemical Composition of Guava

The guava fruit contains iron, calcium, phosphorus, iron, and vitamin C. Compared to an orange, it has more vitamin C. The fruit contains flavonoids, guaijavarin, quercetin, lyxopyranoside, arabopyranoside, oleanolic acid, and saponin. Guava's main components, ascorbic acid and citric acid, are crucial for its anti-mutagenic activity (Naseer et al.,2018). Fig. 1 depicts the chemical makeup of quercetin and ascorbic acid.



(a)



(b)

Fig-2: (a) Chemical structure of quercetin (b) Chemical structure of ascorbic acid **[10]**

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Impact Factor: 5.9

Fruit skin has a very high concentration of ascorbic acid, but heat can destroy it. The carbonyl chemicals are thought to be responsible for the fruit's potently pleasant aroma (Omayio et al., 2019). Guava fruit contains significant amounts of terpenes, caryophyllene oxide, and p-selinene, all of which have calming effects (Sarkar et al.,2011). The flavonoid content is higher in the methanolic extract of the guava (Chassagne et al.,2021). It contains 41 hydrocarbons. Guava contains 9 aromatic compounds, 25 esters, and 13 alcohols (Guzmán and Lucia, 2021). Fruit contains total soluble solids and titratable acidity(Paul et al.,2012). Guava also contains guajadial (Hetzler et al.,2022).

ß-pinene, ß-limonene, ß-pinene, isopropyl alcohol, menthol, terpenyl acetate, caryophyllene, longicyclene, and -bisabolene are all constituents of essential oil found in leaves. Oleanolic acid is also found in the guava leaves(Tangjitman et al.,2015). Leaves have high content of limonene about 42.1% and caryophyllene about 21.3% (Rakmai et al.,2018). Leaves of guava have a lot of volatile compounds (Silva et al.,2021).

The tannin content of the bark ranges from 12 to 30%, and according to one source, it also contains resin, calcium oxalate crystals, and tannin 27.4%, or polyphenols. Roots also contain tannin. Roots also contain sterols, gallic acid, and leukocyanidins. Salt-containing carbohydrates are prevalent in large amounts. Tannic acid is also its part (Naseer et al.,2018).

2.1 Phenolic Compounds

Due to their antihyperglycemic effects, GLs are widely used as a traditional medicine source in Asian nations. They consist of the superior bioactive polysaccharides, proteins, lipids, vital fatty acids, vitamins, and minerals covered in the earlier sections. Phosphoric acids, flavonoids, triterpenoids, sesquiterpenes, glycosides, alkaloids, and saponins are among the secondary metabolites found in GLs. Phenolic compounds (PCs) are important bioactive compounds that give GLs their anti-inflammatory and hypoglycemic properties. These PCs typically play a significant part in controlling various physiological and metabolic processes in the human body. About 72 different phenolic compounds in GLs have been discovered using high-performance liquid chromatography, a diode array detector, and quadrupole time-of-flight tandem mass spectrometry (Daz-de-Cerio et al., 2016).In general, GLs contain five different quercetin glycosides. One quercetin galloyl glycoside (guavinoside C) and two new benzophenone galloyl glycosides (guavinosides A and B) were also reported (Matsuzaki et al.,2010).Additionally, it has been reported that GLs contain thirty flavonoids, nineteen sesquiterpenoids, and seventeen triterpenoids (Jiang et al.,2013). GLs also included diphenylmethane (Shu et al.,2012), sesquiterpenoid-diphenylmethane meroterpenoids (psiguadials A and B) (Shao et al.,2010), and psiguanins A-D (1-4) (Shao et al.,2012). Polyphenolic compounds have been shown in epidemiological studies to protect against chronic diseases like diabetes, cancer, neurodegenerative diseases, and cardiovascular diseases (Rasouli et al.,2017). To fight against chronic pathologies, phenolic compounds alter a variety of physiological functions like cell division, enzymatic activity, cellular redox potential, and signal transduction pathways (Luca et al.,2020). Various phenolics structures can be seen in figure 3.

ISSN: 2519-9889
Impact Factor: 5.9

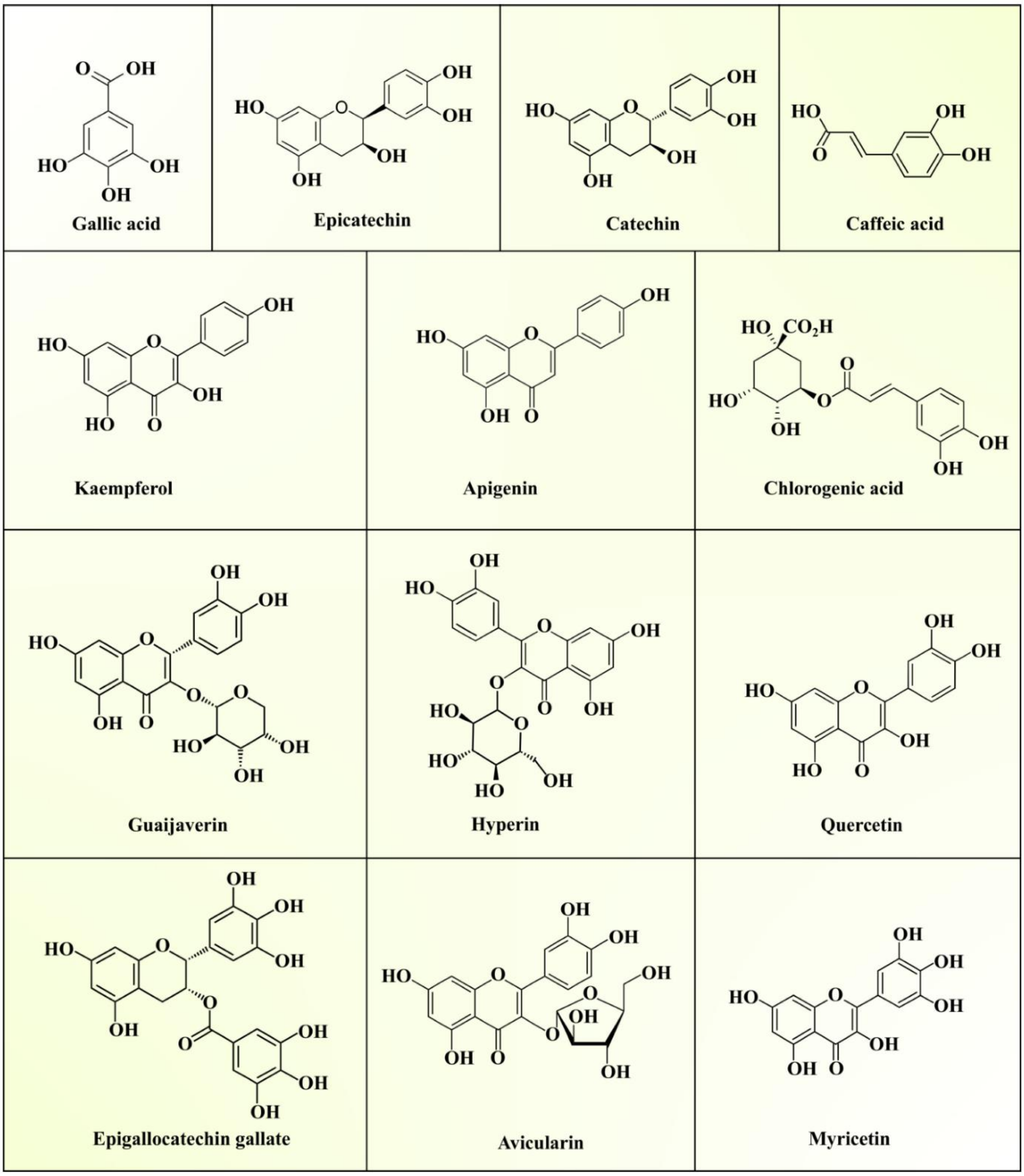

Fig-3: Structures of Phenolic compound present in Guava extract **[9]**

ISSN: 2519-9889
Impact Factor: 5.9

3. Medicinal Importance of Guava

Due to its pharmacologic properties, *Psidium guajava* L. is used as both a food and a traditional medicine in subtropical regions all over the world_(Deguchi, and Miyazaki.,2010). Almost everywhere in the world, medicinal plants play a significant role in the health care system. These observations are reflected from traditional knowledge. It is well known that guava is frequently used throughout the world as a treatment for a wide range of illnesses, including diarrhoea, fever reduction, dysentery, gastroenteritis, hypertension, diabetes, caries, and the treatment of wounds and pain. Guava is also widely used in nations like Mexico, Africa, Asia, and Central America that have a long history of using medicinal plants. Along with its medicinal uses, it is also used to prepare food products and as food. In addition, it is employed in the manufacture of toys and houses. Guava has a high concentration of organic and inorganic substances, including secondary metabolites like polyphenols, antioxidants, antiviral substances, and anti-inflammatory substances. Numerous compounds in guava have anti-cancer properties. It contains more vitamins and minerals. In the guava, phenolic substances like flavonoids play a significant role. Lycopene and flavonoids are important antioxidants. They aid in the treatment of cancerous cells and help to delay premature skin ageing (Anand et al.,2016). Guava may have an impact on myocardial inotropism. After a 21-day course of treatment, guava skin extract can lower blood sugar levels (Rai et al.,2015).

4. Biological Activities of Guava Leaf Extracts

Guava leaf extracts contain compounds with a variety of biological properties, including antioxidant, hypoglycemic, anticancer, and other biological activities. Additionally, sulfated GLP has been found to have stronger biological activities, such as antioxidant, antibacterial, and antitumor effects, than its unsulfated counterpart. The following subsections provide information on the GL extract's beneficial bioactivities (Kumar et al.,2021).

4.1 Anticancer/ Antitumour Activity

Cancer is a complex health condition that can be recognised by an increase in cell proliferation or a decrease that results in apoptosis (Toyokuni,2016). Several exogenous and endogenous factors that contribute to the excessive production of reactive oxygen species can cause it (ROS). This may lead to DNA or RNA single- or double-strand breaks, base mutations, chromosomal breaks and reorganisations, DNA cross-linkage, nucleic acid degradation, lipid peroxidation damage to cell membrane integrity, and the development of tumours (Gonzalez et al.,2028). According to Jiang et al. (2020), GLs include significant levels of triterpenoids, sesquiterpenes, tannins, psiguadials, volatile oils, flavonoids, benzophenone glycosides, and different quinones. Psiguadial D and C inhibit human hepatoma cells (HepG2) and protein tyrosine phosphatase 1B (PTP1B).Terpenoids and flavonoids found in GLs have antitumor effects by controlling the immune system, inhibiting tumour angiogenesis and cell proliferation, and suppressing signal transfer and tumour cell adhesion

ISSN: 2519-9889
Impact Factor: 5.9

(Biswas et al.,2019).According to studies, these leaves have a strong inhibitory effect on a variety of cancer cell lines, including MDA-MB-231 and Michigan Cancer Foundation-7 (MCF-7) for breast cancer, HeLa for cervical cancer, KB for nasopharyngeal cancer, LNCaP, DU 145, and prostate cancer-3 (PC-3) for prostate cancer, and colorectal 320 double minutes (COLO320DM) for colon cancer (Correa and Couto, 2016). Angiogenesis, which is the process by which new blood vessels develop from pre-existing ones, is primarily responsible for the growth of colorectal tumours. Long-term angiogenesis is essential for the development of tumours into malignancies because the blood vessels effectively supply the developing tumour cells with vital metabolites and oxygen while also serving as a reliable mechanism for the removal of cellular waste. The anticancer and antiangiogenic potential of GL extracts against angiogenesis-dependent colorectal cancer was examined in a study (Lok et al.,2020). Apigenin, a flavonoid, and ß-caryophyllene-rich extract from guava leaves showed significant antiproliferative activity against the human colon carcinoma cell lines Caco-2, HT-29, and SW480. The interaction between ß-caryophyllene and the transcription factor HIF-1, which controls the biological processes involved in hypoxia, tumour metastasis, and tumor-mediated angiogenesis, is responsible for the substance's antiangiogenic effects. In the presence of ß-caryophyllene, HIF-1 also mediates the transcription of vascular endothelial growth factor (VEGF), which accounts for the antiangiogenic and anticolorectal cancer properties of guava leaf extract.

The antiproliferative and antiestrogenic effects of guajadial, a caryophyllene-based meroterpenoid from GLs, were examined against the human breast cancer cell lines MCF-7 BUS and MCF-7 (Bazioli et al., 2020).According to the scientists, guajadial exhibits anticancer potential via acting on estrogenic receptors, inducing apoptosis by limiting DNA synthesis, and inhibiting the cell cycle during the G1 phase (Huang et al.,2019). According to a similar study, three benzophenones—Guavinoside B, Guavinoside E, and 3,5-dihydroxy-2,4-dimethyl-1-O-(6′-O-galloyl—D-glucopyranosyl)-benzophenone—isolated from guava leaves—inhibited the growth of HCT116 human colon cancer cells (Zhu et al.,2019). Extracellular signal-related kinases (p-ERK1/2), p53, c-Jun NH2-terminal kinases (p-JNK), and cleaved caspases 8 and 9 are important proteins involved in apoptotic signalling and cell proliferation. These substances strongly induced cancer cell apoptosis and modulated their expression. Another study found that guava leaf extracts had an inhibitory effect on lung cancer genes, particularly those primarily involved in signalling pathways like PI3K-Akt (Jiang et al.,2020).The researchers reported that the leaf extract's components, including daidzein, ursolic acid, apigenin, genistein, and quercetin, strongly inhibited the proteins cyclin-dependent kinase 2,6 (CDK2,6), vitamin D3 receptor (VDR), hepatocyte growth factor receptor (MET), Progesterone receptor (PGR), epidermal growth factor receptor (EGFR), and peroxisome proliferator-activated receptor (PPAR).

4.2 Antidiabetic Activity

About 10% of the world's population has a blood glucose metabolic disorder called hyperglycemia, which is primarily characterised by diabetes, a serious chronic disease. Type 1 diabetes is characterised by either insufficient insulin secretion from pancreatic islet -cells or by the inability of cells to respond to the secreted

ISSN: 2519-9889
Impact Factor: 5.9

insulin (type 2 diabetes) (Mazumdar et al.,2015, Punia and Kumar,2021). According to the International Diabetes Federation (IDF), 5 million people died from diabetes mellitus in 2017, which affected 451 million people worldwide. By 2045, 693 million people are expected to have diabetes worldwide (Cho et al.,2017). Long-term hyperglycemia increases the production of ROS and dyslipidemia, which results in serious cellular damage and complications (Hu et al.,2018). GLs have been widely used as ethnomedicine for diabetes management (Luo et al.,2019). Numerous studies have noted the potential antidiabetic properties of GL flavonoids and polysaccharides. In diabetic mice, guaijaverin and avicularin flavonoids of GL extract significantly improved the function of ß-cells of pancreatic islets and hepatocyte morphology (Zhu et al.,2020). The blood glucose homeostasis enzyme dipeptidyl-peptidase IV was inhibited by guaijaverin (Eidenberger et al., 2013), whereas avicularin prevented intracellular lipid aggregation by preventing glucose uptake through GLUT-4 in vitro and showed no obvious toxicity for 3T3-L1 adipose cells. In conjunction with a high-fat diet, Luo et al. (Shabbir et al., 2020) isolated GL polysaccharides (GLPs) and investigated their antidiabetic effects on streptozotocin-induced diabetic mice.The researchers found that GLP significantly increased total superoxide dismutase and total antioxidant capacity enzyme activity in vivo and significantly decreased total cholesterol, triglycerides, glycated serum protein, creatinine, fasting blood glucose, and malonaldehyde content. Elevated postprandial glucose concentrations may result from poor glycemic control. According to Nair et al. (Shabbir et al.,2020, Nair et al.,2013), the inhibitors of the enzymes α-amylase and α-glucosidase can reduce postprandial glucose absorption and are therefore potential targets for managing diabetes. With the help of ultrasound, the polysaccharides were removed from the GLs, and their antiglycation activity was investigated (Luo et al.,2018). The researchers discovered that GLP significantly inhibited α-glucosidase with a 99.54% inhibition rate at a concentration of 100 g/mL and significantly inhibited α-amylase with a 14.06% inhibition rate at a dose concentration of 1 mg/mL. According to the research, GL bioactive compounds may be useful in lowering the risk of developing diabetes.

4.3 Antioxidant Activity

Since it serves as a terminal electron acceptor during the respiration process, which is the main source of energy production, oxygen is a crucial element for aerobes. However, the body's inflammatory diseases, ischemic diseases, neurological disorders, hemochromatosis, emphysema, acquired immunodeficiency syndrome, and many other illnesses are caused by free radicals produced during metabolic processes (Kumar et al.,2021).The antioxidant functions of GLs are due to the presence of phenolic compounds like gallic acid, pyrocatechol, taxifolin, ellagic acid, ferulic acid, and several others (Chen and Yen,2007, Farag et al.,2020). Seven major flavonoids, including quercetin, hesperetin, kaempferol, quercitrin, rutin, catchin, and apigenin, were found in GL extracts after high-performance liquid chromatography analysis. Kaempfertin, isoquinoline, and corilaginoline alkaloids were a few more bioactive compounds that were discovered(Taha et al., 2019).These are the main substances in charge of giving GLs their antioxidant capabilities. Numerous studies have demonstrated the importance of antioxidant compounds from GLs in reducing the harmful effects of free radicals. A DPPH

ISSN: 2519-9889
Impact Factor: 5.9

assay revealed that the essential oils extracted from GLs act as moderate antioxidants with an IC50 value of ~460.37 ± 1.33 g/mL **(**Kim et al.,2016)**.** Other such analyses on GL extract showed the reduction of linoleic acid oxidation and the scavenging effect on peroxyl radicals. The study also showed a linear relationship between the amount of phenols in GL extract, the strength of the antioxidant, and its ability to scavenge free radicals (Chen and Yen, 2007). Zebrafish were used to research GL polysaccharide's protective effects. The authors found that GL polysaccharides prevented the production of reactive oxygen species (ROS), decreased lipid peroxidation, and prevented cell death in response to oxidative stress brought on by hydrogen peroxide (Kim et al.,2016). Another study found that GL extracts at 4000 ppm or more can stop the oxidation of fresh pork sausages, pointing to the potential use of this substance as a functional food ingredient (Tran et al.,2020). It was shown that fermentation improved the antioxidant activity of soluble guava leaf polyphenols when GLs were co-fermented with yeast and bacterial strains to liberate insoluble bound polyphenol components (Wang et al., 2017a). In an advanced study, crude polysaccharides of GLs were used to create silver nanoparticles, which demonstrated strong DPPH radical- and ABTS radical cation-scavenging activity (Wang et al.,2017b). The results clearly show that GL extracts can be a valuable antioxidant substance in the food preservation and cosmetic industries.

4.4 Antimicrobial Activity

Current major concerns include the emergence of novel disease-causing strains and microbial resistance to conventional antibiotics. The prevalence of systemic microbial infections, which include septicemia, urinary tract infections, meningitis, pneumonia, and gastritis, affects the entire body and is a major cause of mortality worldwide. Pathogens like *Staphylococcus, Shigella, Salmonella, Bacillus, Escherichia coli, Clostridium*, and *Pseudomonas* are primarily to blame for food-borne illnesses (Ullah et al.,2020).Bioactive substances derived from plants are potential sources of antimicrobials. These substances work by inhibiting the growth, disruption, and lysis of microbial cell walls, preventing the formation of biofilms, suppressing DNA replication and transcription, preventing the production of adenosine triphosphate (ATP), squelching the production of bacterial toxins, and producing reactive oxygen species (ROS) **(**Mickymaray,2019) GLs are known to have antimicrobial properties due to the presence of various organic and inorganic antioxidants and anti-inflammatory compounds **(**Naseer et al.,2028). GL essential oils display strong antimicrobial properties against *Pseudomonas aeruginosa, Escherichia coli, Streptococcus faecalis, Staphylococcus aureus,* and *Bacillus subtilis* (Soliman et al.,2016). Their antiproliferative and antioxidant properties have also been demonstrated by studies. The presence of phenolic acids, flavonoids, terpenoids, glycosides, and saponins, whose presence is positively correlated with antimicrobial activity, was discovered through qualitative analysis of aqueous and organic extracts of guava leaves. Gallic acid, chlorogenic acid, rutin, isoquercitrin, avicularin, quercitrin, kaempferol, morin, and quercetin were all detected in fermented GLs by HPLC-TOF-ESI/MS analysis. Ergosterol, a component of fungal cell membranes, and glucosamine, a marker of fungal cell growth, are both inhibited by these substances. Similar to this, the water-soluble tannins in GLs act as bacteriostatic agents through mechanisms like restraining

ISSN: 2519-9889
Impact Factor: 5.9

substrate, impeding oxidative phosphorylation, and inhibiting extracellular enzymes. They have been shown to have an inhibitory effect on clinical isolates of *Staphylococcus aureus* that are resistant to antibiotics (Das and Goswami,2019). Quercetin was identified as one of the most prevalent flavonoids of GLs with the highest pharmacological activity in a different study by Hirudkar et al (Hirudkar et al.,2020). Triterpenoids like betulinic acid and lupeol have also been linked to activity against bacterial and fungal pathogens (Ghosh et al.,2010). With a minimum inhibitory concentration (MIC) of 0.79 µg/mL against E. coli, a minimum bactericidal concentration of 51 µg/mL, and a reasonable antifungal activity with a minimum inhibitory concentration of 12.6 µg/mL, a methanolic GL extract demonstrated antibacterial activity (Dhiman et al.,2011). A decoction of GLs showed an inhibitory effect on bacterial colonisation and binding of bacterial enterotoxins on epithelial cells at different concentrations (1%, 5%, and 10%), which changed the inflammatory response. The antioxidant enzymes peroxidase, catalase, and polyphenol oxidase were more active in guava extract (Almulaiky et al.,2018). Due to their high antiradical activity against DPPH radicals and ABTS radical cations, silver nanoparticles (40 nm in size) made by biological means using GL extract exhibited antibacterial activity against *Pseudomonas aeruginosa* (Bose and Chatterjee,2016).It has been extensively researched how the cytokine interleukin-7 (IL-7) helps the immune system fight off microbial infections. The action of GL extracts on intestinal mucosal cells is thought to help with the upregulation of IL-7 synthesis and the development of B and T cells (Comber and Bamezai,2012), The use of GL extract in the treatment of microbial infections, diseases linked to oxidative stress, and the discovery of additional preventative compounds from GLs is encouraged by ongoing research on the antimicrobial activity of plant bioactive compounds.

4.5 Anti-inflammatory Activity

Thymus production and germ infection can both be stopped by guava extract in ethyl acetate. It has antiviral properties. It can enhance the mRNA expression. The heme oxygenase-1 protein's function can be changed by guava. And for this reason, it can be used as a skin anti-inflammatory. Guava extract in ethanol prevents the production of nitric oxide by lipopolysaccharide. It prevents E2 from expressing itself. It functions as an anti-inflammatory agent in this way (Jang et al.,2014).

The antigen can be reduced by extract in ethyl acetate It is capable of preventing the release of -hexosaminidase combined with histamine into RBL-2H3 cells. This causes a stop in the mRNA expression of TNF- and IL-4. In this manner, the antigen is inhibited and IκB-α is spoiled. Among the significant substances present in guava are flavonoids and benzophenone. These substances cause the production of nitric acid and the inhibition of histamine (Matsuzakiet al.,2010).

Guava extract also show anti-nociceptive activity. Producing acetic acid was the mechanism. Guava contains phenol, a crucial substance that is responsible for the fruit's anti-allergic and anti-inflammatory activities (Denny et al.,2013). Guava extracts are effective at producing serum and reducing liver inflammation and damage (Díaz-de-Cerio et al.,2017).

Ajit Wagatkar *et al*, Int. Journal of Pharmaceutical Sciences and Medicine (IJPSM),
Vol.8 Issue. 5, May- 2023, pg. 58-73

ISSN: 2519-9889
Impact Factor: 5.9

4.6 Antihypertensive and hypolipidemic

Heart disease, high cholesterol, and hypertension can all be effectively treated with guava. Additionally, it has a small amount of potassium, which helps to lower blood pressure by relaxing blood vessels. A daily intake of guava fruit has been found to significantly lower blood lipids and blood pressure due to the fruit's higher potassium and fibre content. Additionally, guava has a high concentration of pectin, which delays food absorption and significantly lowers blood lipids, lowering the risk of cardiovascular diseases (Perez and Chang,2014).Many authors had postulated that the gallic acid, catechins, epicatechins, rutin, naringenin, and kaempferol found in the leaves are what inhibit the pancreatic cholesterol esterase, lowering blood cholesterol levels. Catechins play a crucial role in the prevention of hypercholesterolemia (Deguchi and Miyazaki,2010). Quercetin has been linked to a reduction in heart disease mortality and a reduction in the frequency of stroke linked to hypertension and hyperlipidaemia (Omayio et al.,2019). Guava's moderate potassium content is responsible for its beneficial effects on cardiovascular health, stroke prevention, and cholesterol lowering (Kafle et al., 2018).

Conclusion

The traditional use of *Psidium guajava* (Linn.), also referred to as the "poor man's apple of the tropics," for a variety of ailments dates back many years. The fruit's delicious flavour and nutritional advantages encourage free consumption of both the fruit and its juice. Scientific research has validated several of the traditional uses. Both the leaf and the fruit are safe and have no negative side effects, according to controlled human trials as well as toxicology tests on mice and other animal models. Numerous plant-derived substances, including flavonoids, galactose-specific lecithins, guaiaverin, and quercetin, have demonstrated promise effectiveness. The plant's principal constituents have been thoroughly investigated for their pharmacological action, and the findings point to the presence of potent anti-diarrheal, anti-hypertensive, hepatoprotective, antioxidant, antibacterial, hypoglycemic, and anti-mutagenic properties. In recent years, traditional medicines that have a long history of successfully treating a variety of disorders have received more attention from researchers. The pharmacological, biological, and potential applications of chemical components from the entire plant have been the subject of a sizable amount of research. Therefore, thorough research into their pharmacodynamics, kinetics, appropriate standardisation, and clinical trials are required to maximise their therapeutic value in treating a variety of disorders.

ISSN: 2519-9889
Impact Factor: 5.9

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