Sustainability, Agri, Food and Environmental Research, (ISSN: 0719-3726), 11(X), 2023:
http://dx.doi.org/ 10.7770/safer-V11N1-art2385

Phytochemical properties of guava plants (*Psidium guajava)*: a review.

Propiedades fitoquímicas de las plantas de guayaba. (*Psidium guajava*): una revisión.

Ravinder Singh[1], Anumita Bhadra[2], Rattan Deep Singh[1*]

1- Department of Biotechnology, Chandigarh University, Gharuan, Mohali 140413, Punjab, India.

2- School of Bioengineering and Biosciences, Lovely professional university, Phagwara, India.

* Author for correspondence: drattandeep@gmail.com

ABSTRACT

The traditional practice of medicine has been a core of cultures everywhere in the world. In this aspect, scientists and researchers have been looking for natural sources such as plants to study their benefits to mankind. In recent years guava is getting popular due to the enormous benefits rendered by it in the international trade. It deserving rises due to its nutritious significance, besides having various pharmacological applications, including its leaf's antimicrobial effect, the use of fruit and juice from its leaves to treat diarrhea dysentery, diabetes mellitus, and many others. The use of its seeds and bark is also known. However, due to presence of rich constituents, the guava also is a potential source of antioxidants which can be used in cosmetic and/or dermatological industry for generating new formulations. In review also suggests the antifungal and antibacterial property of guava which was estimated against a number of bacterial strains. Methanolic and aqueous extracts from *Psidium guajava*, were analyzed for the existence of phytochemicals and tested for their antioxidant and antimicrobial activity in this study. The phytochemical investigation has shown that guava leaves' extract is abundant in various secondary metabolites, such as polyphenols. Guava leaves have also been shown to be high in flavonoids, phenols and tannins, while components

such as flavonoids, alkaloids, saponins and triterpenes are present in relatively lower concentrations.

Keywords: Pharmacological uses, antioxidant, antimicrobial

RESUMEN

La práctica tradicional de la medicina ha sido un núcleo de culturas en todo el mundo. En este aspecto, los científicos e investigadores han estado buscando fuentes naturales como las plantas para estudiar sus beneficios para la humanidad. En los últimos años la guayaba se está popularizando debido a los enormes beneficios que brinda en el comercio internacional. Merece subidas por su importancia nutritiva, además de tener diversas aplicaciones farmacológicas, entre las que destacan el efecto antimicrobiano de sus hojas, el uso de frutos y jugos de sus hojas para tratar la disentería diarreica, diabetes mellitus y muchas otras. También se conoce el uso de sus semillas y corteza. Sin embargo, debido a la presencia de componentes ricos, la guayaba también es una fuente potencial de antioxidantes que pueden usarse en la industria cosmética y / o dermatológica para generar nuevas formulaciones. En la revisión también se sugiere la propiedad antifúngica y antibacteriana de la guayaba que se estimó frente a una serie de cepas bacterianas. Los extractos metanólicos y acuosos de Psidium guajava se analizaron para determinar la existencia de fitoquímicos y se analizaron en este estudio para determinar su actividad antioxidante y antimicrobiana. La investigación fitoquímica ha demostrado que el extracto de hojas de guayaba es abundante en varios metabolitos secundarios, como los polifenoles. También se ha demostrado que las hojas de guayaba tienen un alto contenido de flavonoides, fenoles y taninos, mientras que componentes como flavonoides, alcaloides, saponinas y triterpenos están presentes en concentraciones relativamente más bajas.

Palabras clave: Usos farmacológicos, antioxidante, antimicrobiano.

INTRODUCTION

The Guava, Scientifically known as *Psidium guajava* had a place with the group of Myrtaceae (Morton JF. Products of Warm Climates, 1987). Guava is viewed as one of the amazingly wonderful, sensitive, high dietary and significant profitable yield. Guava organic products are utilized for both eating straightforwardly just as additionally preparing it. It is additionally covered with entering smell, accordingly turning into the most scrumptious and

the most intriguing natural product for shoppers, having a high efficiency, strength, flexibility and its Vitamin "C" substance. Other than its high nutritive worth, it yields a weighty harvest each year in this manner giving high benefits with less speculation. It is effectively accessible with sensible value hence named as "Apple of Tropics" and "Super Fruit" for its rich nutraceutical values (Nimisha S, 2013). This had provoked a few Indian ranchers to take up Guava Cultivation on a business scale. Its development isn't influenced by the boundaries of temperature, hot breezes, sparse precipitation, saline and helpless soil, water logging condition or more all, the non-accessibility of water, composts and such different sources of info. Guava Trees were not hard to develop and could get by in a scope of soil and climatic conditions. Notwithstanding, an exact administration is expected to create an exceptionally productive harvest (development practices of guava and the financial qualities of the example respondents).

In India, the Total region under Guava Cultivation was around 219.70 thousand hectares with an expected yearly creation of 2,572 lakh tons (Indian Horticulture Data Base, 2009-10). Allahabad safeda and Taiwan Guava natural products are superb assortments filled in India particularly in conditions of Karnataka, Madhya Pradesh, Maharashtra, Nagaland, Orissa, Pondicherry, Punjab, Rajasthan, Sikkim, Tamil Nadu, Tripura, Uttar Pradesh, Jharkhand and West Bengal, HDP innovation brings about augmentation of unit zone yield and accessibility of the natural products in the market early which bring better cost. It is realized that there are three blooming periods of this yield, unmistakably spring (Ambe Bahar), stormy (Mrig Bahar) and fall (Hasta Bahar).

Dietary benefit: Vitamin An and nutrient C are lavishly present in Guava. Some different constituents incorporate riboflavin and minerals like iron, calcium and phosphorus. Guava contains 4-5 times higher Vitamin C substance when contrasted with other citrus natural products. When age, guava contains 82% water, 2.45% corrosive, 4.45% decreasing sugar, 5.23% on lessening sugar, 9.73% TSS, 0.48% debris and 260 mg Vitamin C/100 g of organic product.

Soil and atmosphere: Guava is a product of tropical and sub-heat and humidity thus can be developed effectively up to an elevation of 1000-1500 m mol. Dry moderate winter and summer combined with a yearly precipitation of 1000 mm is ideal for its development and advancement. It can fill well in a wide range of soil since it is a tough harvest. The pH should be kept up at 6.5-8.5. Guava has high resilience to salt, while it is touchy to water logging condition.

Harvest Regulation: There might be different adversaries to the development of this yield in particular bug assaults and common catastrophes including windy breezes, twisters, floods and substantial precipitation. These common foes could make enormous harm and misfortune the ranchers. So ranchers go for crop protection and yield turn. In any case, another difficult that emerges is that ranchers don't have much earlier information on harvest protection.

Additionally the stormy season harvest of guava is unpleasant, characterless, poor in quality, less nutritive and is assaulted by a few bug nuisances and illnesses (Radha T., 2007). The colder time of year season is considerably more profitable for the plants as natural products developed are unrivaled in quality, liberated from different kinds of irritations and illnesses and bringing significant yields from the market (Nautiyal P., 2016). So crop guideline is the solitary choice left with them. Harvest guideline is done to control the regular blooming and fruiting of the guava plant in the ideal period of the year adding to a better return of organic products, better quality, more benefits and better maintainability of the climate by decreasing the utilization of pesticides. In hot and sticky atmosphere of India, where normal yearly precipitation is 1400mm branch bowing of shoots is performed. Branch bowing was finished by holding 10-15 sets of leaves at summit and eliminating all the leaves, blossoms and creating organic products physically (Fig. 1). Branches were bowed sunrise by applying pressure steadily from proximal to distal finish of branch. They were kept at twisted situation by binds the tip of branches to the wooden stakes fixed on the ground with the assistance of rope till flushing finishes, for 40-45 days. All the plants were exposed to comparative social practices (Deepa Samant, 2016).

Psidium guajava has been for some time known for its restorative worth, both in India and abroad (Deguchi Y., 2010). This plant discovers applications for the treatment of the runs, diarrhea, Gastroenteritis, hypertension, diabetes, caries and help with discomfort and for development in locomotors coordination. Its leaf's concentrate is being utilized as a medication in hack, the runs, and oral ulcers and in some swollen gums wound.

It contains high substance of natural and inorganic mixes like optional metabolites for example cell reinforcements, polyphenols, antiviral mixes, mitigating mixes. The phenolic aggravates present in the constituents of the guava plant are useful in battling malignant growth and furthermore has hostile to maturing properties.

With regards to portrayal of Guava tree, it is an always green tropical tree with a stature of around 20 to 30 feet. This tree stem is thick and develops into numerous branches. The Guava blossoms have enormous stalks going from 1 to 2 cm length with white petals

ordinarily pollinated by honey bees. By and large Guava trees are known to be regenerative and bear organic products for around 15 years while they can make due till around 30-40 years. The leaf petioles are around 3-16 cm, having an unmistakable green tone and conspicuously obvious veins. The blossoms have 4-6 petals, are white in shading with lovely scent and yellow anthers. Guava organic product has a pear like appearance, 3-6 cm long, green when unripen and yellowish when in age state. The inward mash locale has yellowish seeds and its tone shifts in various assortments of the plant. The seeds are minuscule in estimate and can be effortlessly burned-through alongside the mash. The guava bark is slender and has greenish shaded spots which can be eliminated effectively (Sumra Naseer, 2018). Another seedless assortment of this plant are found as of late which has a high yielding limit. The organic product contains saponin, oleanolic corrosive, lyxopyranoside, arabopyranoside, guaijavarin, quercetin and flavonoids (Arima H., 2002) (A.J., 2011) (A.C., 1987). Two significant substance segments of guava are citrus and ascorbic acids having against mutagenic exercises (Grover I.S., 1993). The covering of the natural product contains high measure of ascorbic corrosive which can be obliterated by heat. Turpentine present in the natural product gives loosening up impacts (Meckes M, 1996), while the solid fragrance is credited to the presence of carbonyl mixes.

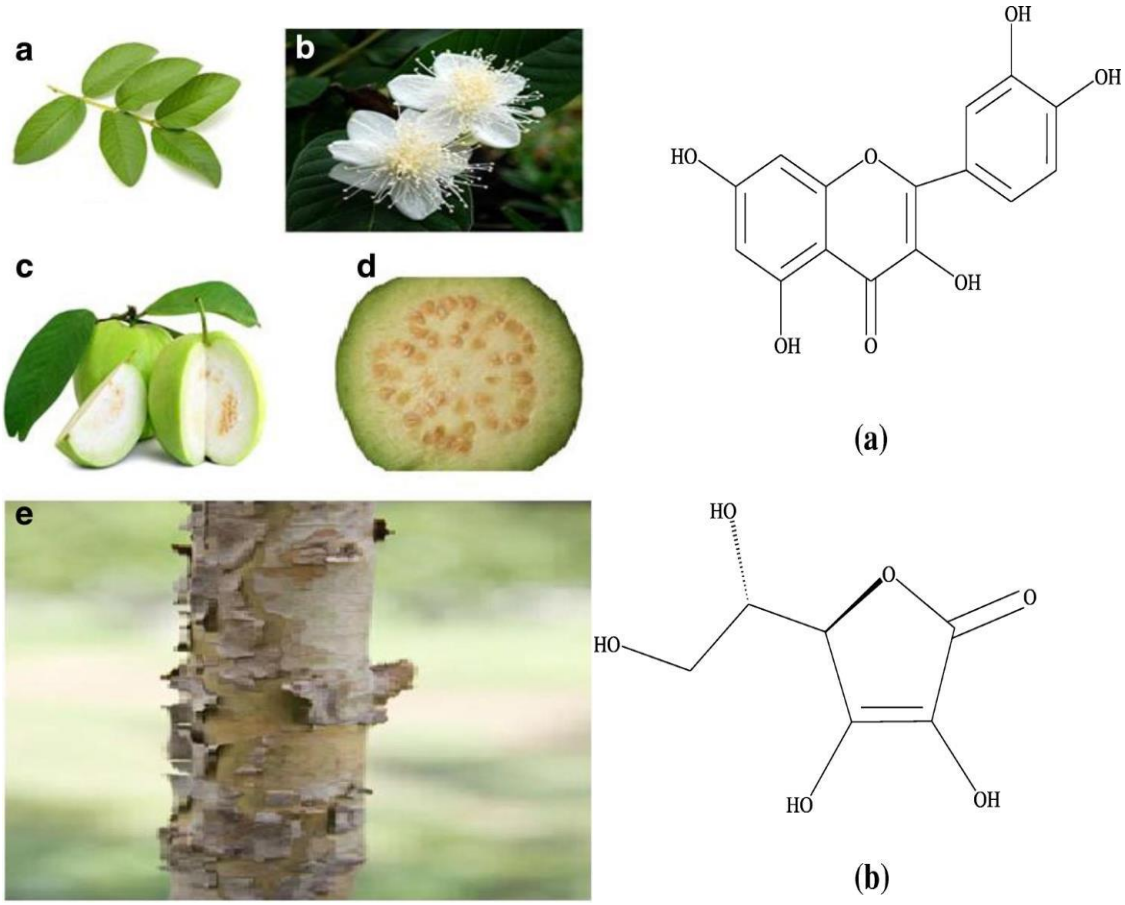

Fig.1: (i) Various parts of guava (a-e) leaves, flowers, fruits, seeds in the fruit, bark respectively. (ii) Chemical composition of guava (a) quercetine, (b) ascorbic acid. Source: (Sumra Naseer, 2018).

Therapeutic plants are a fundamental part of different clinical frameworks of the world. Guava plant have been considered and discovered to be supplied with numerous restorative and phytochemical properties, treatment of various illnesses, for example as a calming, utilized in the treatment of gastroenteritis, loose bowels, diarrhea, diabetes, hypertension, caries, wounds, relief from discomfort and diminishing fever alongside having against microbial and hostile to oxidant properties. Natural and inorganic mixes like auxiliary metabolites are in high amounts acquired in guava trees for example cell reinforcement, polyphenols, antiviral mixes and calming mixes. Hostile to harmful exercises are a property of these guava trees. It has a higher number of nutrients and minerals. Phenolic aggravates like flavonoids likewise locate a significant spot in the guava. Lycopene and flavonoids are significant models cell reinforcements got from guava. They help in the fix of carcinogenic cells and help to forestall pre-adult maturing (Anand V., 2016). Guava can influence the myocardium inotropism (Conde Garcia EA., 2003). Guava skin concentrate can control level

of diabetes preceding its treatment (Rai PK, 2010).

Antimicrobial movement: Guava's leaves extricate has the limit of diminishing hack issues alongside being profoundly antimicrobial in nature. Some different advantages being anticipation from jungle fever, gastroenteritis, heaving, the runs, loose bowels, wounds, ulcers, toothache, hacks, sore throat, kindled gums, and various other condition (Abdelrahim SI., 2002). It was accounted for that the antibacterial impact of guava leaves separates repressed the development of the *Staphylococcus aureus*. The methanolic plant leaf concentrates and barks of *Psidium guajava* plant have antimicrobial movement. The restraint of microorganisms, for example, Salmonella species, Bacillus species was noted and the groupings of hindrance shifts as per the creatures (Abdelrahim SI. A. A., 2002). *Trichophyton tonsurans* and *Candida albicans* (Abdul Jabbar Shah, 2011). (Sanchez RJ, 2005) were inspected for the property of antibacterial action of microscopic organisms against Gram positive and negative microbes by testing the ethanol to water proportion of the concentrate from *Psidium guajava* leaves, stem bark and root, and fluid concentrate against *Staphylococcus aureus* and it was seen that the presence of a certain ethanol: water in the concentrate was a lot of advantageous than that without the equivalent and simply comprising of aqueous arrangement. The leaf remove indicated certain protein debasing movement which is thought to be the primary driver of the in vitro antibacterial impact against *Staphylococcus aureus* (Francis Borgio J., 2011). (Pérez-Martínez X., 2008)

The microbicidial action of guava plants can be credited to the presence of guajaverine and to psydiolic corrosive. Alkaloids present in guava plants are one more compound dependable to show some antimicrobial (particularly antiviral) action. Alkaloids are nitrogenous mixes fundamentally separated into three kinds relying upon their antecedents and structure. One such illustration of alkaloids is nicotine. A benzylisoquinoline alkaloid, papaverine was appeared to have inhibitory impact on a few infections and indoquinoline alkaloids from *Cryptolepsis sanguinolenta* showed action against various gram negative microorganisms and yeast (Silva, 1996). One surprising impact of the plant extricate is its guard instrument against malarial parasite because of the presence of quinine (an alkaloid) as appeared in (Iwu, 1999). Another enormous and usefully gathering of optional metabolites are terpenes. They incorporate sterols and triterpenes, shaped when 2,3-oxidosqualene solidifies. Sterols and triterpenes can amass as forms of glycoside in guava plants. These glycosides, which incorporate steroidal glycoalkaloids, are ordinarily alluded to as saponins. Studies on guava have demonstrated saponins to effectsly affect protozoa.

Antioxidant property: One of the by-products of our own metabolism are the free radicals. The molecules create havoc within our body by attacking the cells and tearing

through cellular membranes thereby destructing the nucleic acids, proteins, and enzymes. These actions of the free radicals, also known as oxidative stress, results in losing the structure and function of the cells, thereby destroying them gradually. Free radicals plays an essential role in causing diseases in the body and therefore it is of great concern to us to acquire the knowledge associated with its mechanism before they could be treated with the antioxidant to cure the physiological disorders.

These cell reinforcement properties of the guava plants can be credited to the presence of certain phenolic mixes, for example, protocatechuic corrosive, ferulic corrosive, quercetin and guavin B (Maria Mozarina BeserraAlmeida, 2011), quercetin, ascorbic corrosive, gallic corrosive and caffeic corrosive (Javier Jiménez, 2001). The cancer prevention agent property of guava leaves was likewise portrayed through a correlation explore between ethanol establishing guava leaves and water comprising guava leaves with ethanol guava leaves indicating possibly a lot higher cell reinforcement movement (Qian He, 2004) with roughly 70% (vol.) ethanol (Chiari-Andréo, 2017) . Indeed, even products of guava plants shows cancer prevention agent potential, henceforth guava has been broadly refered to by numerous specialists in their diaries. Some other phytochemical properties have likewise been accounted for in the event of guava, for example, a germicide impact, the treatment of looseness of the bowels, diarrhea, diabetes mellitus, and others (Gutiérrez RM, 2008). It has discovered use in agro-based enterprises and their items as a food added substance invested with cell reinforcement exercises forestalling cooking and lipid oxidation and as practical food fixings (Ayala-Zavala, 2011), in any case, its utilization in corrective businesses as a potential cancer prevention agent is yet to be investigated. As for the ethno pharmacological property of plants, it is affirmed that there is countless plant types of guava developed in Brazil and numerous different nations have not yet been phytochemically or organically investigated to its fullest, and in this manner, the analysts propose the investigation of the constituents of guava.

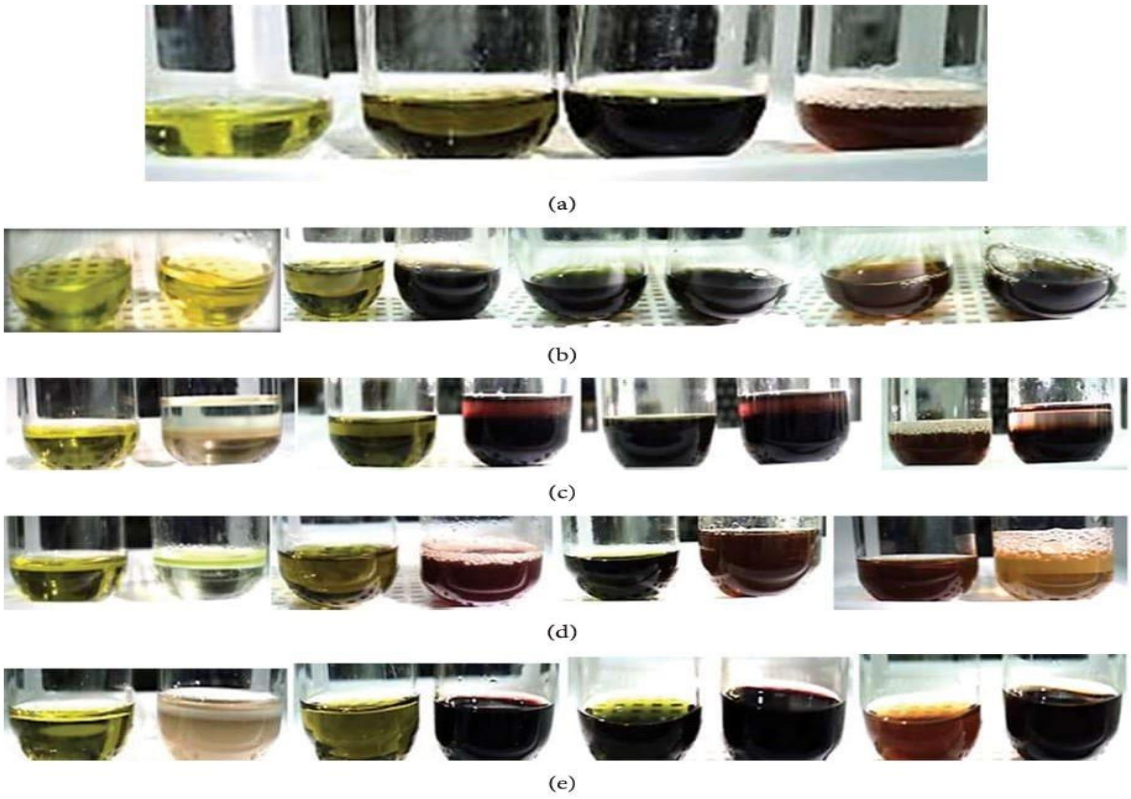

Fig. 2: (a) Existence of saponin tests. (b) Existence of phenols and tannins tests. (c) Existence of terpenoids tests. (d) Existence of flavonoids tests. (e) Existence of glycosides tests. Source: (Bipul Biswas, 2013).

Antigenotoxic and antimutagenic impacts: Genotoxity is the potential or capacity of various specialists to make a genuine harm the hereditary material and such specialists which causes these sorts of poisonousness are supposed to be genotoxins thus the specialists restricting the impacts of these genotoxins are alluded to as antigenotoxic. Additionally, the specialists which makes any kind of change the hereditary materials are supposed to be mutagenic and antimutagens meddles with the mutagenicity of a substance. Guava has been accounted for to show both these impacts.

In carcinogenesis, the DNA harm denotes the start of absolute first stage. Various examines are available which can effectively distinguish the presence of genotoxic specialists in the climate or can even research when there is an introduction to such genotoxic specialists or mixes in the climate or word related settings. While ethanol guava leaf remove had demonstrated more cancer prevention agent property, therapy with fluid leaf concentrate of guava affirmed assurance against mutagens and genotoxins accordingly indicating antigenotoxic movement. For models, as against mitomycin C, nalidixic corrosive and H2O2 (three instances of genotoxins) (Mital Kaneria, 2011). In pathogenicity causing strain of Salmonella typhimurium, the virulity altogether diminished by treating them before with watery leaf separate was reflected in another investigation.

ANTICANCER/ANTITUMOR IMPACTS

Today world is confronting a difficult issue of an appalling illness like disease whose overall death rate gauges increments shockingly every year. It is assessed that by 2030, the worldwide ascent in cases is relied upon to develop to 21.4 million and death pace of 13.2 million essentially because of the development and maturing of the populace and the different sorts of malignancy caused to be specific cellular breakdown in the lungs, bosom malignancy, and colorectal disease being the most repulsive of all tumors, though decreases in youth mortality and passings from other irresistible infections particularly in agricultural nations (Jacques Ferlay, 2010). The watery concentrate so utilized decidedly hindered the development of the disease cell line and given in various fixations each time according to prerequisite. It was seen that at an underlying convergence of 1.0 mg/ml, the concentrate diminished the feasibility of PCa DU-145 (the androgen autonomous PCa cells) to 36.1% and 3.6%, separately when hatched for 48 h and 72 h (Barbalho, 2012). Another significant utilization of guava plant is the fundamental oil removed from its leaves which are exceptionally viable in lessening the development of human mouth epidermal carcinoma (KB) and murine leukemia (P388) cell lines. These oils were provided in various focuses going from 0.019 mg/ml to 4.962 mg/ml when discovered to be viable.

The basic oils got from guava leaves shows the most elevated effectiveness against malignancy causing proliferative cells with an IC50 estimation of 0.0579 mg/ml on P389 cell lines (Manosroi J, 2006); an impact generally credited to the sesqueterpenes present in the fundamental oil (Green, 2009). When analyzed by accepting a benchmark group, improved

outcomes were found in creature cells with a diminishing pattern of malignant growth (Rani Pallavi, 2012). These explores suitably recommend that extraction of acqueous arrangement from Psidium guajava are exceptionally strong for the anticipation of tumor advancement (Seo, 2005). Another compound related with indicating hostile to tumorogenic impact is jacoumaric corrosive (separated from guava seeds); it decreased tumor altogether as depicted in (Sourabh, 2016). Phytochemical investigations of CH3)2CO from the concentrate of guava seeds has prompted the disconnection of phenyl-ethanoid glycosides chemically known as 1-O-3, 4-dimethoxyphenylethyl-4-O-3,4-dimethoxycinnamoyl-6-O-cinnamoyl-beta-D-glucopyranose and O-3,dimethoxyphenylethyl which indicated significant levels of poisonous against certain phone lines (Neve, 2006). These discoveries portray the likely utilization of *Psidium guajava* removes against tumors cells and their part as chemotherapeutic specialists to restrict the development and spread of tumors and malignant growths.

As conclusion, *Psidium guajava* commonly known as guava is seen to have enormous usefulness, the most important being the phytochemical properties rendered by it. These properties are highly beneficial, potentially a great number of these secondary metabolites including some of the vitamins, terpenoids, flavonoids, phenolics, minerals, etc. can be used in controlling post-harvest physiological disorders or microbial pathogen injuries. It also finds use in curing wounds and burns. Further, they are safe and highly economical to use too.

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Received: 08th March 2021; Accepted: 12th May 2021; First distribution:06th September 2021.