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A DETAILED REVIEW ON PHARMACOGNOSY, PHYTOCHEMISTRY AND MEDICINAL PROPERTIS OF GUAVA OIL

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Abstract

Psidium guajava L., commonly known as guava, is a tropical evergreen plant of the Myrtaceae family, traditionally valued for its nutritional and medicinal properties. Native to Central America and Mexico, guava has spread across tropical and subtropical regions due to its adaptability and health benefits. Various parts of the plant-including leaves, seeds, bark, and fruit-are rich in bioactive compounds such as flavonoids, terpenoids, tannins, and phenolic acids, which contribute to its pharmacological potential. Guava essential oil, primarily extracted from leaves and seeds, exhibits diverse therapeutic activities including antimicrobial, anti-inflammatory, antioxidant, wound healing, antidiabetic, hepatoprotective, and cardioprotective effects. Extraction methods such as steam distillation, cold pressing, solvent extraction, and supercritical CO_2 extraction influence oil yield, composition, and quality. Recent advancements in green chemistry approaches-ultrasound-, microwave-, and enzyme-assisted extraction—enhance oil recovery while maintaining ecological sustainability. Phytochemical analyses using GC-MS and HPLC have identified key constituents including β-caryophyllene, limonene, nerolidol, and eucalyptol, responsible for the oils, aroma and biological efficacy. Guava oil finds applications in pharmaceuticals, nutraceuticals, cosmetics, and traditional medicine, supporting digestive health, metabolic balance, skin regeneration, and management of chronic diseases. The rich ethnomedicinal history combined with modern scientific validation underscores guava oil as a multifunctional natural product with considerable therapeutic and industrial significance.

Introduction

Psidium guajava, commonly known as the guava, is an evergreen plant belonging to the myrtaceous family. These are native to regions in Mexico and central America. Since from the ancient days, this guava has held an important place in the traditional medicine. Over centuries, guava has spread to the tropical and subtropical regions worldwide,adapting to the varied environmental conditions. Guava is widely regarded as a nutritional furit and packed with the essential vitamins and minerals. The fruit is particularly rich in vitamin C. Guava leaves contains potent phytochemicals like tannins, flavonoids and phenolic compounds. Which areintegral to the traditional use in treatinig conditions such as a skin infections, respiratory ailments, gastrointestainal disorders, and metabolic diseases. The therapeutic properties of guava are concentrated in the extraction of essesntial oils that are extracted from its leaves, which is known as guava oil [1].

Essential oils have remained a popular herbal remedy for various chronic diseases since from ages, but most of them are lacked for the clinical evidence for therapeutic uses, one such valuable oil is guava oil. This plant is used for many various applications in the treatment of different diseases like high blood pressure, diabetes, and tooth decay and pain relief. The medicinal properties of these plants are mainly extracted from the, leaf which is used in the treatment of the cough, diarrhea, oral ulcers and swollen gums. Guava is a tropical plant which belongs to

the American. It is now grown across various regions with the indigenous medicinal practices, different parts of the guava plant are utilized to treat a range of human aliments including wounds, ulcers, bowel issues and cholera [2].

Beyond its culinary significance, guava has long been recognized for its therapeutic properties, particularly in traditional folk medicine, primarily observed in central parts of America. Guava leaves has been studied in pharmaceuticals for their antimicrobial, anti-inflammatory, anti-diarrheal, anti-diabetic and antioxidant properties. guava leaves are also useful for promoting wound healing. The crushed guava leaves or their extract may be applied topically to cuts and abrasions for fast healing. Infusion made from guava leaves have been used to alleviate diarrhea as they contain compounds with anti-diarrhea effects which helps to reduce the symptoms3.

1. Botanical Source and Chemical Compositions

Psidium guava is a tropical plant which is grown in a tropical area which is abundantly grown for fruit. It belongs to phylum mangoliophyta, class, Mangoliopsida and myrtaceae family. It has about 133 genera and more than 3,800 species.These plant is mainly grown in a tropical regions because of available of big range of soils. In Mexico, it is one of the very Important crop, which is cultivated over 36,447 acres and production is about 192, 850 tons. It is an evergreen shrub like tree which reaches to height till 6 to 25 fts [4]. Guava is rich in minerals, including vitamin A and C, which are present in amounts that are 36 times higher than those found inorgans of the same sample weight [5].

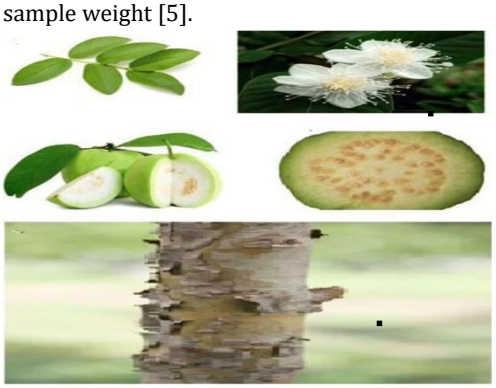

Fig 01: Guava

Table 01: Botanical Classification

Kingdom	Plantae-Plants
Subkingdom	Tracheobionata Vasucular plants
Divison	Mangoliophyta flower plants.
Class	Mangoliopsida Dicotyledonous
Subclass	Rosidae
Order	Myrtales
Family	Myrtaceae
Subfamily	Myrtoideae
Gender	Psidium
Species	Psidium guajava

The present review was conducted in order to obtain update information about the phytochemistry and pharmacology of p. guajava L., auseful medicinal plant species of pharmaceutical relevance which could be developed as medicine for managing various ailments including sickle cell anaemia [6].

2. Types of guava

The common types of guava include apple guava, yellow fruited cherry guava, strawberry guava, and red apple guava. The common guava has a fruit with a yellow skin and white, yellow, or pink flesh.Guavas are known for their sweet and tangy flavor and many uses, but there's much more to this fruit than meets the eye. Many consider it a "magical" fruit because of its array of nutrients and medicinal uses.P. guajava has a rich ethno-medicinal history. Different parts of the plant are used in various indigenous systems of medicine, primarily for the treatment of gastrointestinal disorders [7].

Fig 02: Apple guava

Fig 03: Yellow fruited cherry guava

Fig 04: red apple guava

Fig 05: strawberry guava

3. Parts Used For Oil Extraction

The fruit processing, parts such as leaves, seeds sections of the peel and pulp fraction not separated in the physical depulping process. Thesediscard part holdimportant health properties. In ethno traditional medicine , extract of the root, bark and leaves of P guajava [8].

Table 02: Parts used in Guava oil

lent Part	Type of oil extracted	Major constituents	Common uses
Seeds	Fixed (non – volatile) oil	Linoleic acid, oleic acid, stearic acid	Cosmetic, skin care, pharmaceutics
Leaves	Essential (volatile oil) oil	Caryophyllene, limonene	Aromatherapy, antimicrobial agents
Fruit peel / pulp	Aroma oil	Esters, aldehydes, alcohols	Flavouring perfumery
Bark / roots	Medicinal extracts	Tannins, triterpenes	Traditional medicine

This important tropical fruit is famous for worldwide, and these are widespread cultivation india, Syria, Pakistan, Bangladesh Indonesia and south America. These plants each part are also used as the folkloric herbal medicines, offering numerous therapeutic applications. This guava consists of the antioxidative properties and phytoconstituents are also present, including the essential oils, polysaccharides, minerals, steroids, glycosides, vitamins, titerpenoids, tannins, flavonoids and at last saponins. They also consist of the anti-cancer properties and also antimicrobial potency [9].

Macroscopic Features

Guava oil (from Psidium guajava leaves or seeds) is a pale yellow to light green liquid with a pleasant fruity aroma. It has low viscosity, specific gravity less than 1, and a refractive index of 1.40–1.50. The oil is insoluble in water but soluble in organic solvents like ethanol and hexane. It remains clear and stable under normal storage conditions [10].

Microscopic Features

Microscopic or molecular studies using GC–MS show that guava oil mainly contains limonene, eucalyptol, caryophyllene, and nerolidol. FTIR analysis confirms C–H, C=C, and carbonyl functional groups typical of terpenoids. In nanoemulsion forms, TEM images show uniform spherical droplets. Guava seed oil also contains phenolic compounds and phytosterols that contribute to its antioxidant activity [11].

Geographical Distribution and Cultivation Practices

1. Geographical Distribution

Guava is an originated in Central America and Mexico and is now widely grown in tropical and subtropical regions. Major producers include India, Brazil, Mexico, Thailand, and the Philippines. In India, it is mainly cultivated in Uttar Pradesh, Bihar, Maharashtra, and Tamil Nadu. The crop thrives in warm climates (20–30°C) with moderate rainfall (1000–2000 mm) and well-drained loamy soils [12].

2. Cultivation Practices

- **Propagation:** By seeds or vegetative methods (air layering, grafting).
- **Planting:** Spacing of 5×5 m or 6×6 m; planted in monsoon or spring.
- **Soil & Nutrients:** Prefers loamy soil; organic manure and balanced NPK fertilizers enhance yield.
- **Irrigation & Pruning:** Regular watering and pruning improve leaf and fruit quality for oil extraction [13].

3. Extraction and Processing Methods

Guava oil is primarily obtained from the seeds, leaves, and fruits of *Psidium guajava L.* using various extraction techniques. The choice of method depends on the desired oil quality, yield, and application [14].

4. Extraction Methods

a. Steam Distillation

This is the most common technique for extracting essential oils from guava leaves and fruits. Plant material is subjected to steam, which releases volatile compounds. The vapor is condensed and separated to obtain pure guava essential oil. This method preserves the aromatic and therapeutic properties of the oil [15].

b. Cold Pressing

Used mainly for guava seeds, this mechanical process involves pressing the seeds at low temperatures to extract oil without using heat or solvents. It retains natural antioxidants and nutrients, making it ideal for cosmetic and nutraceutical applications [16].

c. Solvent Extraction

Organic solvents such as ethanol or hexane are used to dissolve oil components from dried guava leaves or seeds. The solvent is later evaporated to obtain concentrated oil. Although this method yields more oil, traces of solvents may affect purity [17].

d. Supercritical CO_2 Extraction

An advanced and eco-friendly technique that uses carbon dioxide under high pressure and temperature to extract oil. It offers high purity, better yield, and minimal thermal degradation of active compounds like flavonoids and terpenes [18].

Processing and Purification

After extraction, the crude guava oil undergoes the following processing steps:

- **Filtration:** Removes plant residues and impurities.
- **Dehydration:** Eliminates moisture to prevent microbial growth and rancidity.
- **Centrifugation:** Separates the oil layer from aqueous or solid phases.
- **Storage:** The purified oil is stored in amber glass containers under cool, dark conditions to preserve its stability and fragrance [19].

Quality Evaluation

The final oil is analyzed for:

- **Physicochemical Properties:** Color, odor, specific gravity, and refractive index.
- **Chemical Composition:** Using GC-MS to identify major constituents like limonene, caryophyllene, and guajavolene.
- **Purity Tests:** To ensure the absence of residual solvents or contaminants [20].

Green Chemistry Approaches for Essential Oil Isolation

Green chemistry emphasizes the development of sustainable, energy-efficient, and environmentally friendly methods for essential oil extraction. In the case of *Psidium guajava* L. (guava), these approaches aim to obtain high-quality essential oil rich in bioactive compounds such as terpenes, flavonoids, and phenolics while minimizing the use of toxic solvents and reducing waste generation [21]. Techniques such as supercritical carbon dioxide (CO_2) extraction, ultrasound-assisted extraction, and microwave-assisted hydrodistillation have gained prominence due to their efficiency, selectivity, and low environmental impact. These modern green extraction methods not only preserve thermolabile components but also enhance yield and purity compared to conventional solvent-based processes. Additionally, integrating renewable energy sources and biodegradable solvents aligns guava oil extraction with the principles of sustainable chemistry, promoting safer production practices and supporting the eco-friendly utilization of natural plant resources [22].

Phytochemical Constituents

1. Major Bioactive Compounds

Guava oil derived from *Psidium guajava* L. is rich in diverse bioactive compounds that contribute to its pharmacological and therapeutic properties. The major constituents include terpenoids, flavonoids, and phenolic compounds, which exhibit strong antioxidant, antimicrobial, and anti-inflammatory activities. Key volatile components identified in guava leaf and seed oils include β-caryophyllene, limonene, α-pinene, β-pinene, caryophyllene oxide, and nerolidol, which are responsible for the oil's characteristic aroma and biological efficacy. Additionally, sesquiterpenes such as humulene and germacrene D enhance its antimicrobial potential, while compounds like linalool and eugenol impart antioxidant and soothing effects [23]. The composition and concentration of these bioactives vary depending on the extraction method, plant part, and geographical source. Advanced analytical studies using GC-MS and HPLC have confirmed that guava oil possesses a complex chemical profile, making it a valuable natural product for applications in pharmaceuticals, cosmetics, and food preservation [24].

2. Chemical Composition Analysis

The chemical composition of guava oil (*Psidium guajava* L.) varies widely depending on the plant part, extraction method, and geographical origin. Gas Chromatography–Mass Spectrometry (GC–MS) analysis has revealed that guava oil contains a complex mixture of volatile and non-volatile constituents, primarilycomposed of terpenes, sesquiterpenes, and phenolic compounds25. Major identified components include β-caryophyllene, limonene, α-pinene, β-pinene, eucalyptol, nerolidol, and caryophyllene oxide, which contribute to the oil's aroma and biological activity. Fatty acids such as oleic, linoleic, and palmitic acids are also present, particularly in seed-derived oils, influencing their emollient and antioxidant properties [25]. The relative concentration of these compounds is affected by extraction conditions such as temperature, pressure, and solvent type, with advanced methods like supercritical CO_2 and ultrasound-assisted extraction yielding oils of higher purity and stability. Overall, comprehensive chemical profiling provides insights into the functional quality, therapeutic potential, and standardization of guava oil for industrial and pharmaceutical applications [26].

Medicinal And Pharmacologial Properties

Guava oil possesses diverse medicinal and pharmacological properties, making it a valuable natural therapeutic agent. It exhibits antimicrobial activity against bacteria, fungi, and viruses, largely due to its high content of flavonoids, terpenoids, and phenolic compounds [27]. The oil also demonstrates anti-inflammatory and analgesic effects by inhibiting pro-inflammatory cytokines and enzymes, which can help in managing pain, skin inflammation, and wound healing. Additionally, guava oil has antioxidant properties, neutralizing free radicals and enhancing endogenous antioxidant defenses, thereby protecting cells from oxidative stress and related chronic diseases28. Other pharmacological effects include antidiabetic, hepatoprotective, cardioprotective, and neuroprotective activities, as evidenced by various in vitro and in vivo studies. Itstherapeutic potential extends to cosmetic applications, where it promotesskin regeneration and reduces oxidative damage. Overall, the pharmacological profile of guava oil supports its use in traditional medicine, modern herbal formulations, and nutraceutical products [29].

1. Anti-Inflamatory Andantioxidand Effects

Guava oil (Psidium guajava L.) exhibits significant anti-inflammatory and antioxidant properties, primarily due to its rich content of bioactive compounds such as flavonoids, phenolic acids, terpenoids, and essential fatty acids. These constituents modulate inflammatory pathways by inhibiting pro-inflammatory mediators like TNF-α, IL-1β, and IL-6, as well as enzymes such as COX-2 and ions, thereby reducing inflammation [30]. Additionally, guava oil suppresses NF-κB signaling, which plays a crucial role in cellular inflammatory responses. Its antioxidant activity

is attributed to polyphenols, carotenoids, and vitamins that scavenge free radicals and enhance endogenous antioxidant enzymes, including superoxide dismutase, catalase, and glutathione peroxidase.As a result, guava oil protects cells and tissues from oxidative stress, supporting skin health, wound healing, and potentially mitigating chronic conditions associated with inflammation and oxidative damage. These combined effects highlight its therapeutic potential in natural medicine, nutraceuticals, and cosmetic applications [31].

2. Wound Healing and Skincare Applications

Guava oil (Psidium guajava L.) has shown considerable potential in wound healing and skincare due to its rich composition of bioactive compounds, including flavonoids, terpenoids, and essential fatty acids. These constituents promote tissue regeneration, reduce inflammation, and prevent microbial infections at wound sites, accelerating the healing process [32]. The oil's antioxidant properties help neutralize free radicals, protecting skin cells from oxidative damage and supporting collagen synthesis, which enhances skin elasticity and repair. In skincare, guava oil is used for moisturizing, soothing irritated skin, and reducing signs of aging such as wrinkles and fine lines. Its antimicrobial activity also makes it effective in treating acne and minor skin infections. Overall, guava oil serves as a natural, multifunctional ingredient for both therapeutic wound care and cosmetic skincare applications, combining healing, protective, and rejuvenating effects [33].

3 Digestive and Metabolic Health Benefits

Guava oil (Psidium guajava L.) offers notable benefits for digestive and metabolic health due to its rich profile of bioactive compounds, including flavonoids, terpenoids, and essential fatty acids. The oil aids digestion by reducing gastrointestinal inflammation, regulating bowel movements, and inhibiting harmful gut bacteria, which helps prevent disorders like diarrhoea and indigestion [34]. Its antioxidant and anti-inflammatory properties further protect the digestive tract from oxidative stress and tissue damage. Additionally, guava oil has metabolic benefits, including the potential to regulate blood glucose levels, improve lipid profiles, and support liver function, thereby contributing to the management of diabetes and cardiovascular risk factors. These combined effects highlight guava oil as a natural agent that supports overall digestive efficiency and metabolic balance [35].

6. Traditional and Flok Uses

Guava oil, derived from the seeds, leaves, and fruits of *Psidium guajava* L., has been widely used in traditional and folk medicine for centuries. It is valued for its antimicrobial, anti-inflammatory, and astringent properties, making it effective in treating digestive disorders such as diarrhea and dysentery, as well as alleviating stomach cramps. Topically, guava oil has been applied to minor wounds, burns, and skin infections to promote healing and prevent microbial contamination [36]. In addition, it has been used to relieve joint and muscle pain, improve oral health by reducing gum inflammation and toothache, and manage skin conditions like acne and oily skin. Folk practices also incorporate guava oil in hair care to reduce dandruff and strengthen hair, and in respiratory treatments through steam inhalation or chest application for coughs and congestion. Beyond medicinal uses, it has been traditional massage therapies and ritualistic practices, reflecting its integral role in cultural wellness practices [37].

1. Historical Importance in Traditional Medicine

Guava oil (Psidium guajava L.) has a long-standing history in traditional medicine, particularly in regions where the guava plant is native, such as Central and South America, and later in Asia and Africa. Traditionally, guava leaves, fruits, and seeds were used to prepare oils and extracts for treating a variety of ailments, including diarrhea, wounds, skin infections, inflammation, and respiratory conditions [38]. The oil was valued for its antimicrobial, anti-inflammatory, and digestive properties, and was commonly applied topically to promote wound healing or consumed in small quantities to support gastrointestinal health. Historical records also indicate its use in herbal remedies for fever, pain, and metabolic disorders, highlighting the recognition of its therapeutic potential long before modern pharmacological studies. This traditional knowledge laid the foundation for contemporary research into the medicinal, pharmacological, and cosmetic applications of guava oil [39].

7. Therapeutic Applications and Modern Uses

Guava oil, extracted from the seeds, leaves, and fruits of *Psidium guajava* L., has gained attention in modern therapeutics due to its rich composition of bioactive compounds such as flavonoids, terpenes, and essential fatty acids. Its therapeutic applications include antimicrobial, antioxidant, anti-inflammatory, and wound-healing properties, making it useful in managing skin infections, acne, eczema, and minor burns. Guava oil has also been studied for its potential in digestive health, helping to alleviate diarrhea and dysentery, and in oral care, reducing gum inflammation and combating oral pathogens [40]. In addition, it shows promise in pain management and anti-inflammatory therapies for conditions like arthritis. Modern applications extend beyond medicinal use; guava oil is incorporated into cosmetic formulations, including creams, lotions, soaps, and hair oils, for its moisturizing, anti-aging, and hair-strengthening effects. It is also explored in nutraceuticals, pharmaceuticals, and aromatherapy, reflecting a transition from traditional remedies to scientifically validated products in the health and wellness industry [41].

1. Pharmaceutical Formulation Containing Guava Oil

Guava oil (Psidium guajava L.) has been incorporated into various pharmaceutical formulations due to its therapeutic properties, including antimicrobial, anti-inflammatory, antioxidant, and wound-healing effects. It is commonly formulated into ointments, creams, gels, and lotions for topical application to treat wounds, burns, skin

infections, and inflammatory conditions [42]. Additionally, guava oil can be included in capsules, syrups, or emulsions for oral administration to support digestive health, metabolic balance, and general wellness. Advanced formulations may combine guava oil with other herbal extracts or carrier oils to enhance bioavailability, stability, and efficacy. These formulations leverage the natural bioactive compounds of guava oil, making it a valuable ingredient in both therapeutic and cosmetic pharmaceutical products [43].

2 Potential for Nutraceutical and Funcional Food Industries

Guava oil (Psidium guajava L.) holds significant potential for the nutraceutical and functional food industries due to its rich profile of bioactive compounds, including flavonoids, phenolic acids, essential fatty acids, and vitamins. Its antioxidant, anti-inflammatory, antimicrobial, and metabolic-regulating properties make it a valuable ingredient for developing health-promoting foods and supplements [44]. Guava oil can be incorporated into functional beverages, dietary supplements, health bars, and fortified oils to support digestive health, cardiovascular function, skin wellness, and overall immunity. Moreover, its natural origin and safety profile align with the growing consumer demand for plant-based, clean-label, and preventive health products. The integration of guava oil into nutraceutical formulations offers a promising avenue to enhance health benefits, promote disease prevention, and add value to natural products in the functional food sector [45].

8. Sustainability and Conservation Aspects

The production and utilization of guava oil (*Psidium guajava* L.) increasingly emphasize sustainability and conservation to ensure long-term ecological and economic benefits. Eco-friendly cultivation practices, such as organic farming, minimal use of chemical fertilizers, and integrated pest management, help maintain soil health and reduce environmental pollution. Sustainable harvesting of leaves, seeds, and fruits ensures that the plant population is not overexploited, preserving biodiversity in both wild and cultivated areas. Modern extraction methods, including cold-pressing, supercritical CO_2 extraction, and other green technologies, reduce energy consumption, avoid toxic solvents, and maximize oil yield while maintaining bioactive compound integrity [46]. Additionally, promoting the use of by-products, such as seed cake and leaf residues, for animal feed or biofertilizers supports a circular economy approach. These conservation-focused strategies not only protect natural resources but also enhance the commercial viability of guava oil in the nutraceutical, cosmetic, and pharmaceutical industries, aligning traditional knowledge with contemporary environmental responsibility [47].

1. Role of Guava Oil in Sustainable Herbal Industries

Guava oil (Psidium guajava L.) plays a significant role in promoting sustainability within the herbal and natural product industries. Its versatile therapeutic properties, including anti-inflammatory, antioxidant, antimicrobial, and wound-healing activities, make it a valuable ingredient for pharmaceuticals, nutraceuticals, cosmetics, and functional foods. By utilizing leaves, seeds, and fruit residues, the production of guava oil supports waste valorization and minimizes environmental impact [48]. The oil's natural origin aligns with the growing consumer demand for eco-friendly, plant-based, and sustainable products, fostering responsible sourcing and cultivation practices. Moreover, guava oil encourages the development of small-scale, community-based herbal enterprises, contributing to economic growth while adhering to principles of green chemistry and circular economy, thereby enhancing the sustainability and resilience of the herbal industry [49].

Future Prospects and Research Opportunities

Guava oil (Psidium guajava L.) holds promising future prospects due to its diverse pharmacological properties and potential applications in pharmaceutical, nutraceutical, cosmetic, and functional food industries. Future research can focus on standardizing extraction methods, enhancing yield and bioactive compound content, and developing novel formulations for targeted therapeutic uses [50]. There are opportunities to explore its mechanisms of action at the molecular level, synergistic effects with other natural compounds, and clinical evaluations for human health benefits. Additionally, sustainable production practices, waste utilization, and value-added by-product development offer avenues for eco-friendly industrial growth. Advancements in nanotechnology, encapsulation, and delivery systems could further increase the stability, bioavailability, and efficacy of guava oil, making it a versatile ingredient for next-generation herbal and functional products. Continued scientific exploration will help bridge traditional knowledge with modern applications, positioning guava oil as a key natural resource in health and wellness industries [51].

1. Drug Development and Formulation Potential

Guava oil (Psidium guajava L.) demonstrates significant potential for drug development and pharmaceutical formulations due to its diverse bioactive compounds with anti-inflammatory, antioxidant, antimicrobial, wound-healing, and metabolic-regulating properties [52]. It can be incorporated into topical formulations such as creams, gels, ointments, and transdermal patches for treating skin infections, wounds, burns, and inflammatory conditions. Additionally, oral formulations like capsules, emulsions, and syrups can be developed to support digestive health, metabolic balance, and general wellness. Advanced drug delivery approaches, including nanoemulsions, liposomes, and encapsulation techniques, can enhance the bioavailability, stability, and targeted delivery of guava oil's active constituents. These formulation strategies not only expand its therapeutic applications but also provide

opportunities for creating safe, effective, and standardized herbal medicines, bridging traditional uses with modern pharmacological innovations [53].

2. Integration with Nanotechnology and Green Extraction Methods

The integration of nanotechnology and green extraction methods presents a promising avenue for enhancing the therapeutic and commercial potential of guava oil (Psidium guajava L.). Green extraction techniques, such as supercritical fluid extraction, microwave-assisted extraction, and ultrasound-assisted extraction, enable the efficient, eco-friendly isolation of bioactive compounds without using harmful solvents or generating excessive waste. Coupling these methods with nanotechnology approaches, including nanoemulsions, liposomes, and nanoparticles, can significantly improve the stability, bioavailability, and targeted delivery of guava oil's active constituents [54]. This combination not only maximizes the oil's antioxidant, anti-inflammatory, antimicrobial, and wound-healing properties but also supports the development of advanced herbal formulations, nutraceuticals, and cosmetic products. Such innovations align with sustainable production practices and modern drug delivery systems, bridging traditional herbal knowledge with cutting-edge scientific applications [55-57].

Conclusion

Guava oil (Psidium guajava L.) represents a valuable natural product with significant pharmacognostic, phytochemical, and therapeutic importance. Its diverse bioactive constituents-including flavonoids, terpenoids, tannins, and phenolic compounds-contribute to a wide range of pharmacological activities such as antimicrobial, antioxidant, anti-inflammatory, antidiabetic, and wound-healing effects. The phytochemical richness of guava oil supports its traditional use in folk medicine and underlines its potential in modern drug discovery and formulation development. From a pharmacognostic perspective, proper identification, standardization, and quality assessment of guava oil are essential to ensure therapeutic efficacy and safety.67 Advances in modern analytical techniques have further enabled detailed chemical profiling, enhancing understanding of its biological mechanisms. However, despite promising experimental evidence, comprehensive clinical evaluations, standard extraction optimization, and toxicological studies are still required to validate its therapeutic potential and ensure its integration into evidence-based medicine.

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Conflict of Interest

The authors declare no conflict of interest.

Informed Consent and Ethical Statement

Not Applicable

Author Contribution

All authors are contributed equally.

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