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Review of *Psidium guajava* Leaves as a Natural Resource in Cosmetic Science

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Abstract:- Guava leaves (Psidium guajava) offer great potential as a natural resource for both cosmetics and traditional remedies. Herbal formulations are now widely utilized for their therapeutic benefits, as medicinal plants and their active compounds are generally less toxic and cause minimal side effects. This review focuses on the bioactive compounds found in guava leaves, including flavonoids, tannins, saponins, and triterpenoids, which contribute to their antioxidant, anti-inflammatory, and antimicrobial properties. These attributes support therapeutic activities such as wound healing, eczema treatment, and hair care. Cosmeceutical formulations incorporating guava leaves offer a natural and effective alternative to synthetic agents, enhancing product safety, efficacy, and sustainability. Guava leaf extracts are effective in promoting hydration, anti-aging, and skin-brightening benefits for both skin and hair. Guava leaves' special therapeutic and cosmetic qualities are used in products like cleansers, moisturizers, and serums that appeal to diverse skin types. Specific benefits, including antioxidant richness, cost-effectiveness, and targeted therapeutic effects, further strengthen the case for their sustainability. Additionally, combining guava leaves with synthetic ingredients in cosmetics can amplify their benefits. This review also discusses the ways that guava leaves support skin health, reduce oxidative stress, and inhibit microbial growth, offering valuable insights for future product development and clinical applications.

Keywords:- *Psidium guajava; Extract; Bioactive Components; Cosmeceutical Formulations.*

I. INTRODUCTION

Cosmetics or cosmeceuticals, are defined as products or substances that are applied to the human body, like skin, hair, nails, lips, teeth, etc., to alter, beautify, or enhance the look. Cosmetics are often external medications that are applied to the body's surface. They include many different products such as hair dyes, lipsticks, fragrances, nail polishes, and skincare (lotions, sunscreens, toners, and powders). Cosmetics are primarily used for beautification, cleansing, and protection; they serve as a moisturizing, cleaning, and beautifying agent, aid in changing the body's appearance while maintaining its functionality, and also increase the attractiveness of the body and assist in curing skin infections. Sunscreen creams aid in both sunburn treatment and UV protection. Natural plant sources have long been used to produce herbal medicines, which are an important part of global healthcare and a key component of traditional healing practices [1].

- *Biological Source and Morphological Features of Psidium guajava Leaves*

Psidium guajava L., usually called guava, is a small tropical tree from the Myrtaceae family, originally discovered in places ranging from southern Mexico to northern South America [2]. Today, guava is cultivated widely in regions with tropical and subtropical climates, making it an internationally grown fruit. *Psidium guajava* leaves have an elliptical or oblong shape, with tips that may either be rounded or pointed and bases that are similarly rounded. The typical length of the leaf ranges from 7 to 15 cm, while their width is about 3 to 5 cm. The leaves' lower surface has a slightly softer texture than their smooth upper surface, especially in younger leaves. Prominent veins are visible on the lower surface, contributing to the leaf's distinct appearance. Guava leaves grow in pairs directly opposite one another on the stem, a pattern known as opposite phyllotaxy. The leaf margins are entire, meaning they have smooth edges without teeth, further defining their shape.

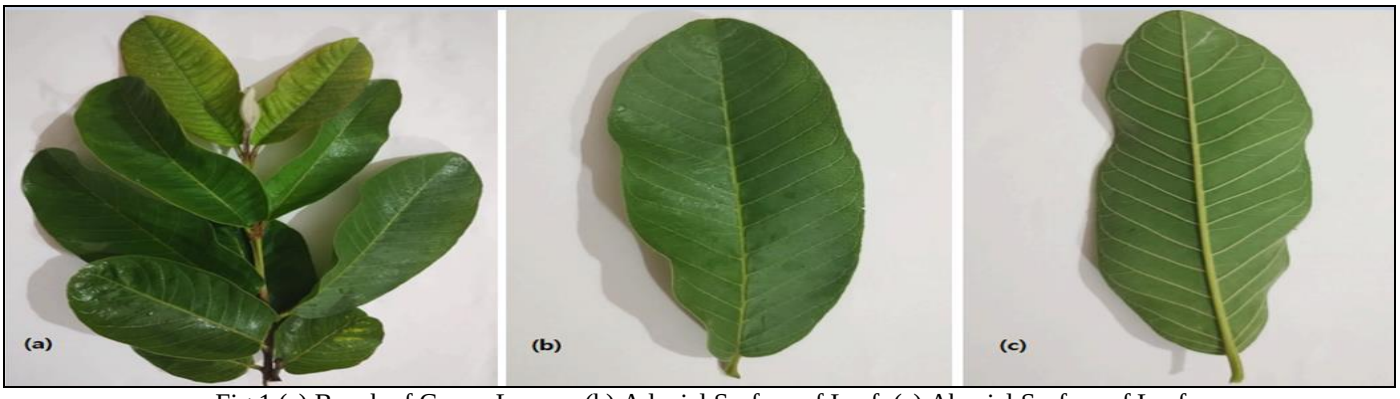

Fig 1 (a) Bunch of Guava Leaves, (b) Adaxial Surface of Leaf, (c) Abaxial Surface of Leaf

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II. THERAPEUTIC POTENTIAL OF GUAVA LEAVES IN TRADITIONAL AND MODERN MEDICINE

The use of guava leaves in traditional medicine is remarkable, primarily valued for their anti-diarrheal properties [3]. Guava leaf infusions are commonly used to manage diarrhea because they contain antioxidants that can help fight harmful free radicals in the body, which may improve health and lower the chance of long-term diseases [3][4][5]. The leaves and bark of guava trees have been used for medicine for a long time. A boiled mixture of these parts is used to treat diarrhea, dysentery, vomiting, sore throats, and help with menstrual cycles. In Africa, people use the leaf mixture for mouth sores, bleeding gums, to clean vaginal discharge, and to strengthen the vaginal walls after childbirth. [6].

Antioxidant, antibacterial, and antiproliferative properties are present in GL essential oil. Numerous bioactive substances, such as alkaloids, steroids, flavonoids, tannins, and saponins, have been found in guava leaf extract. Guava leaves contain various plant compounds, like quercetin, avicularin, apigenin, guaijaverin, kaempferol, hyperin, and myricetin. They also contain gallic acid, catechin, epicatechin, chlorogenic acid, epigallocatechin gallate, caffeic acid, cratogolic acid, malic acid, and oleanolic acid. These compounds contribute to the many health benefits of guava leaves [7][8].

Studies have revealed a range of therapeutic benefits from guava leaves, highlighting their antimicrobial, anti-inflammatory, anti-diarrheal, anti-diabetic, antioxidant, anti-allergic, and anti-aging effects. Furthermore, guava leaves aid in wound healing, when crushed or made into an extract, they can be applied to cuts and wounds to speed up recovery [9].

These leaves are a significant source of vitamin C, B, antioxidants, and tannins. In addition to traditional uses, guava leaves are consumed as tea, available in capsule form, ground into pastes, extracted as essential oils, and incorporated into cosmetics for their skin-benefiting properties. The leaves extract is also used for treatment of hypertension, pain relief, rheumatism, lung diseases, and ulcers [10][11].

Phenolic compounds influence various physiological functions, including cell growth, enzyme activity, redox balance, and signalling pathways, contributing to the defense against chronic diseases [12]. Phenolic compounds are important for strengthening the immune system and helping control chronic diseases like diabetes, cancer, and problems with the digestive system, brain (neurodegenerative diseases), and heart [13], and these phenolics are responsible for cosmetic improvement. The leaves' antibacterial qualities can lessen the development of tooth plaque and fight oral infections [14]. Extracts from guava leaves have been used to treat respiratory ailments like bronchitis and coughing. Compounds with expectorant qualities found in the leaves may aid in cleaning the respiratory tract [15].

Flavonoids and terpenoids that are found in guava leaf extract have anticancer properties that regulate the immune system, signal transmission, and tumour cell adhesion inhibition, and obstruction of tumour angiogenesis and cell proliferation [15][16]. Apigenin (a type of flavonoid), vitamin E, and β-caryophyllene in GLEs have been found to strongly stop the growth of human colon cancer cells. Caco-2, SW480, and HT-29 (Lok et al., 2020) [17]. Three benzophenones, guavinoside E, guavinoside B, and 3,5-dihydroxy-2,4-dimethyl-1-O-(6′-O-galloyl-β-D glucopyrano syl)-benzophenone, derived from guava leaves, were identified in a related work by Zhu et al. (2019) as preventing the growth of HCT116 human colon cancer cells [18].

III. DIFFERENT METHODS OF EXTRACTION OF PHYTOCHEMICAL COMPONENTS

- *Maceration, Infusion, Percolation, and Decoction*

In maceration, coarse or powdered guava leaves were soaked in a solvent in a sealed container and let to remain at room temperature for at least three days while being constantly stirred. Infusion and decoction, just like maceration, involve soaking plant material in either cold or boiling water. The sample is heated in a specified quantity of solvent for a certain duration of time for decoction, and the maceration period for infusion is shorter. Compared to maceration and infusion, decoction typically yields more oil-soluble chemicals and is only appropriate for extracting heat-stable compounds and hard plant materials such as roots and barks. In the percolation technique, a device known as a percolator is used; dried samples are placed in the percolator along with solvent, and the mixture is allowed to macerate in the closed percolator for 24 h. The extract is then obtained by opening the percolator's output and letting the liquid within drain gradually [19][20].

- *Soxhlet Extraction or Hot Continuous Extraction*

In this technique, dried powdered guava leaves are placed in a bag known as a thimble in its chamber of the apparatus. Methanol or ethanol is placed into it and heated in a round-bottom flask; vapors enter the sample thimble and condense in the condenser. The procedure goes on upon the liquid content having reached the siphon arm and poured into the bottom flask. Strengths and drawbacks: In comparison to maceration, this process uses less solvent, and more yield can be obtained. Yet, there are drawbacks to Soxhlet extraction, including the possibility of harmful emissions during extraction and exposure to dangerous and combustible liquid organic solvents. High-purity solvents are required in the extraction system, which could raise costs [19][20].

- *Microwave-Assisted Extraction*

MAE helps analytes separate from the sample matrix into the solvent by using microwave energy. Microwaves interact with samples and solvents, causing cell wall rupture, thereby promoting compound release into a solvent. Benefits and limitations: rapid and efficient, The MAE method showed improved analyte recoveries and repeatability; tannins and anthocyanins might not be appropriate for MAE because they easily degrade.

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➢ *Ultrasound-Assisted Extraction (UAE) or Sonication Extraction*

Process: This method involves the usage of ultrasound frequency ranging from 20 kHz to 2000 kHz [20]. These waves increase surface contact time with samples, causing disrupting cell walls in guava leaves, thereby enhancing the release of phytochemical components into a solvent. Benefits and limitations: reduces the extraction time and solvent consumption and increases the yield. costlier than simple methods [21].

➢ *Supercritical CO2 Extraction*

CO_2 is used as a supercritical fluid, which has the physical characteristics of both gas and liquid at its critical temperature. CO_2 is used at high pressures and low temperatures (7380 kPa and 31.1°C) to dissolve guava leaf compounds, which are then extracted. Benefits and limitations: environmentally friendly, non-toxic, suitable for heat-sensitive compounds [20]. High-cost equipment and expertise are required and less accessible for small scale [22].

➢ *Extraction Procedure of Psidium guajava Leaves Using Methanol as a Solvent (Maceration):*

The leaves of *Psidium guajava* are collected, cleaned to remove dirt and foreign particles, and then dried. After drying, the leaves are coarsely powdered using a blender. To extract the bioactive components, the maceration technique is employed. For this, 25 grams of the coarsely ground, air-dried leaves are soaked in 100 ml of 70% methanol in a closed flask for 7 days. The mixture should be stirred daily to ensure effective extraction. Once the extraction is complete, the solution is stored in an airtight container under cool conditions to maintain its potency [23].

IV. ROLE OF GUAVA LEAVES EXTRACT IN COSMETICS

Guava leaves (*P. guajava*) have a variety of health benefits, including anti-inflammatory, antibacterial, anti-allergic, antimicrobial, and antioxidant [24][25].

Table 1 Guava Leaves Extract as Natural Ingredient in Cosmetic Formulations

S.no	Application	Extraction Solvent	Key compounds	Primary benefits	references
1	Body wash/ exfoliating scrub	Methanol	Essential oils, flavonoids, propylene glycol, glycerine.	Antioxidant, humectants.	26, 27
2	Toners	Ethanol	Phenolic acids, flavonoids, alkaloids, saponins, and tannins.	Antioxidant, astringent property.	27, 28
3	Lotions	Ethanol	Flavonoids and phenolic acids (gallic acid, leucocyanidin, and quercetin).	Antioxidant (free radical scavenger).	29
4	Sunscreens	Methanol	Carotenoids and polyphenols (gallocatechin, leucocyanidin), flavonoid (quercetin) and leaf oils (pinene, 1,8-cineole, and caryophyllene).	Photoprotective, anti-ageing, protection against UV rays.	30, 31, 32, 33
5	Deodorant	Ethanol	Tannin, flavonoids, saponins.	Antibacterial.	34
6	Anti-acne emulgel	Diethyl ether	Tannins, triterpenoids, glycosides, and flavonoids.	Anti-inflammatory.	35, 36
7	Shampoo	Methanol	Flavonoids, tannins, saponins, vitamin c, phenolics, essential oils, gallic acid, carotenoids.	Anti-inflammatory, antimicrobial, antifungal, dandruff control, stimulates scalp health.	37
8	Toothpaste	Methanol	Flavonoids, tannins, and triterpenes.	antibacterial, anti-inflammatory, and antioxidant, tighten gums and lessen bleeding.	38, 39

➢ *Guava Leaf Extract in Oral Care Formulations*

It has been discovered that the leaves and bark of *Psidium guajava* contain various bioactive components, like cineol, triterpenes, eugenol, tannins, flavonoids, kaempferol, and other compounds such as malic acid, gallic acid, chlorophyll, and mineral salts [38]. Seo et al. (2014) highlighted the versatility of guava in yielding valuable compounds through different extraction methods. Water extracts were found to have the highest concentration of phenolic compounds, renowned for their potent antioxidant properties. Meanwhile, ethyl acetate extracts exhibited a rich profile of sesquiterpenes and fatty acids [39]. Sesquiterpenes, such as cubenol and other complex hydrocarbons, are particularly notable for their use as flavoring and fragrance agents, enhancing guava's applications in the cosmetic and food industries.

Additionally, incorporating guava leaf powder into formulations provides an effective balance between cleaning efficiency and enamel protection. Its natural abrasiveness ensures the thorough removal of debris and stains while minimizing the risk of enamel damage. This makes guava leaf powder an excellent ingredient for oral care products, promoting a clean and polished finish without compromising dental health [38].

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Furthermore, it is beneficial for both conventional and herbal therapies due to its antibacterial, anti-inflammatory, and antioxidant properties. Guava leaf extract is a valuable addition to toothpaste because of these qualities, which support gum health, dental health, and overall oral hygiene. G.L. extract contains tannins with mild astringent properties that help tighten gums and reduce bleeding.

- *Guava Leaf Extract in Body Scrubs*

Guava leaves are rich in compounds like saponins and essential oils, and they exhibit antimutagenic and antioxidant properties, making them effective in neutralizing free radicals and suitable for various cosmetic applications. [40]

Dead skin cells can be removed by using body scrub, a cosmetic product made with slightly abrasive (scrub) ingredients. One of the natural components that may be used as a scrub is guava leaf (*P. guajava*) [41]. According to Lestari et al. (2022), in their review of scrub preparation, it was concluded that the preparation had an extract concentration of 10%, 15%, & 20% and showed that soft cream with scrub granules that were homogeneous, easy to apply to the skin, had a soft texture and felt cool when applied, was easy to wash, and had a unique scent from the guava leaf extract along with extra fragrance. From the three extract concentrations, Lestari et al., 2022, concluded that 15% shows good and stable preparation according to the assessment tests conducted in terms of texture, aroma, and color.

- *Guava Leaf Extract in Toners*

Toner is a cosmetic preparation that cleanses and refreshes skin before applying skincare products. G.L. extract, known for its rich content of tannins [42][43] (Biswas et al. 2013; Mailoa et al. 2014), demonstrates remarkable properties that can regulate perspiration. Tannins, with their astringent nature, may contribute to reduced sweat secretion by denaturing superficial proteins in the skin's stratum corneum and partially blocking sweat pores [44]. Additionally, glycerin, a humectant present in guava leaf extract formulations, claimed to hydrate the skin and perspiration control by drawing moisture from deeper epidermal layers to the stratum corneum [45]. Glycerine enhances skin hydration and forms a protective film that minimizes sweat evaporation [46][47]. This synergistic mechanism underscores the potential of guava leaf extract-based treatments in effectively managing perspiration.

- *Guava Leaf Extract in Skincare Lotions*

The lotion is a cosmetic preparation in the form of a liquid emulsion that is used on the hands and body to moisturize and soften the skin. G.L. has potential phytochemicals like natural flavonoids and phenolics. Flavonoids and phenolics primarily function as antioxidants that are gallic acid, leucocyanidin, and quercetin that can be used as free radical scavengers. various concentrations of ethanol extract of guava leaves (*P. guajava*).

- *Guava Leaf Extract in Sunscreen Formulations*

Sunscreens, also known as sun-blocking agents, are in the form of creams or lotions that are applied to the skin to protect from sun rays. Ethanol extract from guava leaves contains various phytochemicals: carotenoids and polyphenols such as gallocatechin, leucocyanidin, and flavonoids, namely quercetin. and leaf oil contains caryophyllene, 1,8-cineole, and pinene. The leaves are noted to have antioxidant properties. Since antioxidants may counteract free radicals, stop oxidative stress, and act as anti-aging agents. Photoprotective compounds that are extracted from guava leaves are added as antioxidants in sun care products. Polyphenols are a special class of compounds that have earned a reputation as potent anti-aging agents with potent antioxidant properties. Because they are less expensive and have ease of availability, they are safer than synthetic chemicals. The utilization of plants as sources of herbal compounds in sunscreen compositions.

Compounds like lutein and zeaxanthin play a crucial role in shielding the retina from oxidative damage caused by UV rays. In previous studies, the usage of guava leaf extracts in sunscreens has shown that it helps in the prevention of UV-A and UV-B sun rays. Antioxidants reduce the damage caused by free radicals and oxygen to cells. Guava contains significant phytochemicals, particularly polyphenols, which help prevent pigmentation.

According to a study by Puspaningtyas (2012), red guava fruit extract has the ability to block the tyrosinase enzyme, which lowers the formation of melanin96. An essential enzyme for the formation of melanin is tyrosinase. By reducing melanogenesis, inhibiting this enzyme can subsequently help to lessen hyperpigmentation and improve the skin's brightness [48].

- *Guava Leaf Extract in Anti-Acne Formulations*

Acne vulgaris is a chronic inflammatory disease that typically occurs on the skin and is a significant issue for teenagers, especially during puberty. It is a condition that affects the skin surface and can cause both inflammatory and non-inflammatory lesions [49].

Afifi et al. demonstrated the potential of guava leaf extracts, rich in bioactive compounds such as tannins, triterpenoids, glycosides, and flavonoids, in combating *Propionibacterium acnes*, leveraging their antimicrobial and anti-inflammatory properties to inhibit bacterial growth and reduce inflammation in sebaceous glands.

- *Guava Leaf Extract in Shampoo:*

Guava leaf extract is used in shampoo formulation due to its rich nutrient profile and potential positive effects on hair health. Known for its high content of flavonoids, tannins, saponins, vitamin C, B, phenolic compounds, essential oils, gallic acid, carotenoids, and anti-inflammatory compounds, guava leaf extract can help protect the scalp and hair from environmental damage, reduce dandruff, and combat oxidative stress, which contributes to hair aging. When incorporated into shampoos, guava leaf extract helps cleanse the scalp effectively while stimulating blood circulation, potentially encouraging healthier hair growth. Additionally, its antimicrobial properties aid in keeping the scalp balanced and free from harmful bacteria, making it an ideal ingredient

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for shampoos aimed at maintaining scalp hygiene and promoting thicker, shinier hair. The natural scent and soothing qualities of guava leaves add to the sensory appeal, making guava leaf extract a multifaceted ingredient in modern hair care formulations.

V. CONCLUSION

Guava leaves have proven to be a versatile and valuable natural resource for cosmetic and health care products. Their rich composition of antioxidants, anti-inflammatory agents, and antibacterial compounds makes them highly effective in addressing various skincare, dental, and haircare needs. This review concludes that guava leaf is capable of being used as an excipient in cosmetics.

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