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Herbal Lip Balm Containing Guava Leaf (*Psidium Guajava*) Extract With SPF: A Review

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Abstract

The increasing demand for herbal cosmetic products has encouraged the development of plant-based lip care formulations. Lips are highly sensitive anatomical structures that lack sebaceous glands and possess minimal melanin content, making them more susceptible to dryness, cracking, and ultraviolet (UV) radiation-induced damage. Conventional lip balms often contain synthetic chemicals and artificial sunscreens that may cause irritation or allergic reactions. Therefore, herbal lip balms enriched with natural extracts have gained popularity due to their safety and therapeutic benefits.

Psidium guajava leaves are rich in flavonoids, tannins, phenolic compounds, and antioxidants that exhibit antimicrobial, anti-inflammatory, wound-healing, and photoprotective properties. These phytoconstituents may enhance the sun protection potential when incorporated into topical formulations. The present review discusses the phytochemical profile of guava leaves, methods of extraction, formulation strategies for herbal lip balm preparation, evaluation parameters, SPF determination methods, stability studies, advantages, limitations, and future scope. The integration of guava leaf extract into lip balm formulations may provide a safe, cost-effective, and multifunctional natural cosmetic product. [1,3]

"This review highlights the potential of guava leaf extract as a safe and effective natural ingredient in lip balm formulation with SPF."

Keywords: Herbal lip balm, *Psidium guajava*, SPF, phytoconstituents, natural cosmetics.

Introduction:

Lips are one of the most delicate and exposed parts of the human body. Structurally, the lip epithelium is thinner than normal skin and lacks sebaceous and sweat glands, which makes it highly susceptible to dehydration, cracking, and environmental damage. Unlike other areas of the skin, the vermilion border of the lips contains very low levels of melanin, reducing its natural protection against ultraviolet (UV) radiation. Continuous exposure to sunlight, pollution, dry weather, and harsh cosmetic products can lead to dryness, hyperpigmentation, inflammation, and even precancerous conditions such as actinic cheilitis. Therefore, the regular use of protective lip care formulations is essential not only for cosmetic purposes but also for maintaining lip health and preventing long-term damage. [1,2]

In recent years, there has been a growing preference for herbal and plant-based cosmetic formulations due to increasing awareness about the adverse effects of synthetic ingredients. Herbal lip balms are considered safer, biocompatible, and environmentally friendly alternatives to conventional products that often contain artificial fragrances, preservatives, and chemical sunscreens. Among various medicinal plants, Psidium guajava leaves have gained attention because of their rich phytochemical composition, including flavonoids, tannins, and phenolic compounds with antioxidant and antimicrobial properties. These bioactive constituents not only support wound healing and moisturization but may also contribute to photoprotective effects when incorporated into topical formulations. Hence, the development of a herbal lip balm containing guava leaf extract with added Sun Protection Factor (SPF) represents a promising approach toward achieving both therapeutic and protective benefits in a single natural cosmetic preparation. [3,4]

History of Lip Balm:

Lip balm has a rich historical evolution that dates back thousands of years to early civilization such as Ancient Egypt, Ancient Greece, and Ancient Rome, where cosmetic and therapeutic preparation were widely used for personal care. In ancient Egypt, natural ingredients such as beeswax, animal fats, honey and plant oils were blended to prepare protective ointments that prevented lip dryness caused by desert climates and sun exposure. Similarly, Greek and Roman societies used herbal salves containing waxes and botanical extracts to soothe cracked and inflamed lips, reflecting the early integration of herbal medicine into cosmetic practices. During the medieval period, the preparation of lips salves was mainly carried out by herbalists and apothecaries, who focused on medicinal healing rather than beautification, using ingredients such as lanolin, butter, and plant-based oils to treat chapped lips and minor infections. [5]
The development of modern lip balm began in the late nineteenth century when American physicians Charies Browne Fleet introduced one of the earliest commercially available lip protection products, which later gained popularity under the brand name **ChapStick**. Initially hand-wrapped and candle-like in appearance, these products gradually evolved into convenient retractable tubes that improved hygiene and portability. During the twentieth century, rapid advancements in cosmetic chemistry enabled the incorporation of petroleum jelly, mineral oils, antioxidants, vitamins, flavouring agents, and sunscreen filters, transforming lip balm from a simple protective salve into a multifunctional cosmetic product. In recent decades, growing awareness regarding the adverse effects of synthetic chemicals and increasing demand for eco friendly products have encouraged the development of herbal and natural lip balms. Plant extracts such as aloe vera, guava leaves, green tea and other medicinal herbs are now widely explored for their antioxidants, antimicrobial, anti-inflammatory, and photoprotective properties. Consequently, modern herbal lip balms not only moisturize and repair lips but also provide therapeutic benefits and sun protection, making them an important area of research in pharmaceutical and cosmeceutical formulation developments. [6]

Anatomy and Physiology of Lips:

Introduction:

The lips are specialized structures forming the anterior boundary of the oral cavity. They play essential roles in speech, facial expression, food intake, and sensory perception. Anatomically, the lips are unique because their skin is thinner than other facial areas and lacks sebaceous(oil) glands and sweat glands, making them more prone to dryness and environmental damage.

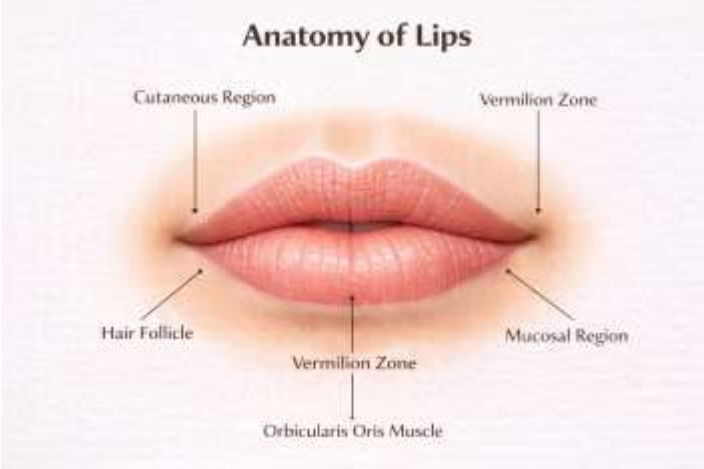

Fig- Anatomy of Lips

Anatomy of Lips:

Anatomically, the lips can be divided into three distinct regions. Each region differs in structure and functions.

1. Cutaneous region
2. Vermilion zone

3. Mucosal region

1. Cutaneous Region (Outer Skin Surface)

The cutaneous region is the outermost portion of the lips and resembles normal facial skin. It is covered by keratinized stratified squamous epithelium and contains appendages such as hair follicles sebaceous glands, and sweat glands. The presence of sebaceous glands allows limited production of sebum, which helps maintain moisture and barrier function. This region provides mechanical protection against environmental stress such as wind, dust, and microorganisms.
The outer surface also contains melanocytes that produce melanin, offering some degree of protection against ultraviolet (UV) radiation. However, compared to other areas of facial skin, the lip skin is thinner and therefore relatively less protective.

2. Vermilion Zone

The vermilion zone is the visible red portion of the lips and represents a transitional area between the skin and oral mucosa. This region is covered by a thin keratinized stratified squamous epithelium. The thinness of the epithelial layer allows the underlying capillary blood vessels to be visible, which gives the lips their characteristics red or pink colour.
Unlike the cutaneous region, the vermilion zone lacks sebaceous glands and sweat glands. It also contains a very thin stratum corneum (outermost keratin layer), which significantly reduces its barrier function. Due to this structural limitation, the vermilion zone experiences high trans epidermal water loss (TEWL), making it prone to dehydration, dryness, and fissuring.
Additionally, the vermilion zone contains fewer melanocytes compared to surrounding facial skin, which makes it more sensitive to UV radiation and more prone to sunburn and hyperpigmentation. This anatomical features justified the inclusion of SPF agents in lip balm formulations.

3. Mucosal Region

The mucosal region lines the inner surface of the lips and faces the oral cavity. It is composed of non-keratinized stratified squamous epithelium, which remains moist due to the presence of minor salivary glands located in the submucosa. This region plays a crucial role in lubrication, facilitating speech, mastication, and swallowing. The mucosal surface is softer and more flexible compared to the outer lip surface. Because it is constantly exposed to saliva, it maintains hydration more effectively than the vermilion zone. [8]

Types of Lip Balm:

Lip balms are widely used cosmetic and therapeutic products designed to protect and moisturize the lips. Depending on their composition, purpose, and functional properties, lip balms can be classified into several types. Each type is formulated to meet specific needs such as hydration, treatment of lip disorders, sun protection, or cosmetic enhancement.

1. Medicated Lip Balm

Medicated lip balms are specially formulated to treat or prevent lip condition such as dryness, cracking, inflammation, or infections. These lip balms contain active medicinal ingredients that provide therapeutic effects. Common ingredients used in medicated lip balms include menthol, camphor, phenol, and sometimes mild antiseptic agents. These substances help soothe irritation, relieve pain, and promote healing of chapped or damaged lips. Medicated lip balms are often recommended during extreme weather conditions when lips become severely dry or cracked.

2. Moisturizing Lip Balm

Moisturizing lip balms are the most commonly used type and are designed primarily to hydrate and soften the lips. They contain ingredients such as natural oils, butters, and waxes that help retain moisture and prevent dehydration. Common moisturizing ingredients include coconut oil, almond oil, shea butter, cocoa butter, and beeswax. These lip balms form a protective barrier over the lips that reduces moisture loss and keeps the lips smooth, soft, and healthy.

3. Tinted Lip Balm

Tinted lip balms combine lip care with cosmetic enhancement. These lip balms contain mild coloring agents or pigments that provide a light tint to the lips while also delivering moisturizing benefits. They are popular among individuals who prefer a natural look while maintaining lip hydration. Tinted lip balms usually contain natural or synthetic pigments along with moisturizing agents, making them both decorative and protective.

4. SPF Lip Balm

SPF lip balms formulated to protect the lips from harmful ultraviolet (UV) radiation. The lips contain very little melanin, making them more vulnerable to sun damage compared to other parts of the skin. SPF lip balms contain sunscreen agents such as zinc oxide, titanium dioxide, or certain chemical UV filters. These ingredients help absorb or reflect UV rays, thereby preventing sunburn, dryness, and long-term damage caused by sun exposure.

5. Herbal or Natural Lip Balm

Herbal lip balms are prepared using natural plant-based ingredients instead of synthetic chemicals. These lip balms often contain herbal extracts, essential oils, natural waxes, and plant oils. Common ingredients used include aloe vera, coconut oil beeswax, shea butter, and plant extracts such as guava leaves. Herbal lip balms are gaining popularity due to their minimal side effects, natural origin, and additional therapeutic benefits such as antioxidant and anti-inflammatory properties.

6. Flavored Lip Balm

Flavored lip balms are formulated with pleasant flavors such as fruit, mint, vanilla, or chocolate to enhance user experience. Although their main function is still moisturization and protection, the addition of flavoring agents makes them more appealing, especially to younger users. These lip balms usually contain safe food-grade flavoring agents along with moisturizing ingredients. [9,10]

Guava Leaves (*Psidium Guajava*)

Guava leaves are obtained from the plant *Psidium guajava*, which belongs to the family Myrtaceae. Guava is widely cultivated in tropical and subtropical regions of the world, including India, Southeast Asia, and South America. Traditionally, different parts of the guava plant such as leaves, fruits, bark, and roots have been used in herbal medicine for the treatment of various health conditions. Among these, guava leaves are considered highly valuable due to their rich content of bioactive compounds.

Fig- Guava leaves

Guava leaves are oval-shaped, green in color, and possess a characteristic aromatic odor. They contain several important phytochemicals such as flavonoids, tannins, saponins, alkaloids, and phenolic compounds, which are responsible for their therapeutic properties. These bioactive constituents exhibit various pharmacological activities including antioxidant, antimicrobial, anti-inflammatory, and wound healing effects.

In traditional medicine, guava leaves have been widely used for treating ailments such as diarrhea, infections, inflammation, and skin disorders. The presence of polyphenols and flavonoids in guava leaves helps in neutralizing free radicals and protecting cells from oxidative damage. Due to these beneficial properties, guava leaves are increasingly used in cosmetic and pharmaceutical formulations.

In cosmetic applications, guava leaf extract is used as an active ingredient in various herbal products including creams, lotions, and lip balms. The antioxidant and antimicrobial properties of guava leaves help protect the delicate skin of the lips from environmental damage, microbial infections, and oxidative stress. Additionally, the anti-inflammatory properties help in soothing irritated lips and promoting the healing of cracked or damaged lip skin.

Furthermore, guava leaves also contain vitamin C and other essential nutrients that support skin health and improve the overall appearance of lips. Because of these beneficial properties, guava leaf extract is considered a promising natural ingredient for the formulation of herbal lip balm containing sun protection factor (SPF). The combination of moisturizing agents with guava leaf extract provides nourishment, protection, and long-lasting hydration to the lips. [11,12]

Phytoconstituents of Guava leaves

Guava leaves (*Psidium guajava*) are a rich source of various bioactive phytoconstituents that contribute to their medicinal and therapeutic properties. Phytoconstituents are naturally occurring chemical compounds present in plants that play an important role in providing pharmacological and biological activities. The presence of these compounds makes guava leaves highly valuable for use in pharmaceutical as well as cosmetic formulations.

One of the major groups of phytoconstituents present in guava leaves is **flavonoids**. Flavonoids are polyphenolic compounds known for their strong antioxidant properties. These compounds help in neutralizing free radicals produced due to environmental stress such as ultraviolet radiation and pollution. By reducing oxidative stress, flavonoids help protect the delicate lip skin from damage and premature aging. Some common flavonoids found in guava leaves include quercetin, kaempferol, and catechin.

Another important class of phytochemicals found in guava leaves is **tannins**. Tannins are polyphenolic compounds that possess astringent and antimicrobial properties. They help in tightening the skin tissues and preventing microbial growth. In lip care formulations, tannins contribute to the healing of cracked or damaged lips and protect the lip surface from bacterial infections.

Guava leaves also contain **saponins**, which are glycosidic compounds known for their antimicrobial and cleansing properties. These compounds help in inhibiting the growth of harmful microorganisms on the skin surface. In herbal cosmetic formulations, saponins play a role in maintaining skin hygiene and preventing infections.

In addition to these compounds, guava leaves also contain **alkaloids**, which are nitrogen-containing compounds known for their biological activities. Alkaloids exhibit anti-inflammatory and antimicrobial properties that help reduce irritation and inflammation of the skin. These properties are particularly beneficial in soothing dry or chapped lips.

Another important group of phytoconstituents present in guava leaves is **phenolic compounds**. Phenolic compounds are known for their antioxidant activity and their ability to protect cells from oxidative damage. These compounds help in maintaining skin health and improving the overall appearance of the lips.

Guava leaves are also rich in **vitamins and essential nutrients**, particularly vitamin C. Vitamin C plays an important role in collagen synthesis and skin repair. It helps in maintaining the elasticity and health of lip skin. The presence of vitamin C also enhances the antioxidant capacity of guava leaf extract, which further protects the lips from environmental damage.

Due to the presence of these diverse phytoconstituents, guava leaves exhibit multiple pharmacological properties such as antioxidant, antimicrobial, anti-inflammatory, and wound healing activities. These beneficial properties make guava leaf extract a suitable natural ingredient for the formulation of herbal lip balm. When incorporated into lip balm formulations, guava leaf extract helps protect the lips from dryness, microbial infections, and harmful ultraviolet radiation, thereby improving lip health and appearance. [13,14]

Medicinal Properties of Guava Leaves

Guava leaves (*Psidium guajava*) have been widely used in traditional medicine due to their numerous therapeutic properties. The medicinal potential of guava leaves is mainly attributed to the presence of various bioactive phytochemicals such as flavonoids, tannins, saponins, phenolic compounds, and essential vitamins. These compounds exhibit a wide range of pharmacological activities that are beneficial for maintaining skin health as well as treating several health disorders.

One of the most important medicinal properties of guava leaves is their antioxidant activity. Guava leaves contain a high concentration of flavonoids and polyphenols, which help neutralize harmful free radicals present in the body. Free radicals are unstable molecules that can cause oxidative stress and damage skin cells. The antioxidant compounds present in guava leaves help protect skin tissues from oxidative damage and maintain the natural health of the skin. In lip care formulations, this antioxidant property helps prevent dryness, aging, and damage to the delicate skin of the lips. [15]

Guava leaves also possess significant antimicrobial properties. The presence of tannins, flavonoids, and other phenolic compounds enables guava leaves to inhibit the growth of various bacteria, fungi, and other microorganisms. This antimicrobial activity helps prevent infections that may occur due to cracked or damaged lips. Therefore, guava leaf extract can act as a natural protective agent in lip balm formulations. [16]

Another important medicinal property of guava leaves is their anti-inflammatory activity. Inflammation of the skin may occur due to environmental factors such as sunlight, wind, pollution, or dryness. The bioactive compounds present in guava leaves help reduce inflammation and soothe irritated skin. When used in lip balm formulations, guava leaf extract helps calm irritated lips and promotes faster healing of chapped lips.

Guava leaves also exhibit wound healing properties. The presence of tannins and vitamin C promotes tissue repair and regeneration. These compounds help accelerate the healing process of damaged skin and restore the normal structure of the skin tissues. This property is particularly beneficial in treating cracked or injured lips. [17]

In addition to these properties, guava leaves are also known for their astringent activity. Astringent compounds help tighten skin tissues and reduce excess moisture loss from the skin surface. This property helps maintain the natural moisture balance of the lips and prevents dryness and cracking.

Furthermore, guava leaves contain vitamin C and other essential nutrients that contribute to healthy skin. Vitamin C plays an important role in collagen synthesis and skin repair. It helps maintain skin elasticity and improves the overall appearance of the lips. The presence of these nutrients enhances the protective and nourishing effects of guava leaf extract in cosmetic formulations.

Due to these multiple medicinal properties such as antioxidant, antimicrobial, anti-inflammatory, and wound healing activities, guava leaves have gained considerable attention in the field of herbal cosmetics. The incorporation of guava leaf extract in herbal lip balm formulations helps protect the lips from environmental damage, improves lip hydration, and promotes overall lip health. Therefore, guava leaves are considered a valuable natural ingredient for the preparation of herbal lip balm containing sun protection factor (SPF).

Lip Balm and Its Importance

Lip balm is a semi-solid cosmetic preparation specifically designed to protect and moisturize the delicate skin of the lips. The skin of the lips is thinner and more sensitive compared to other parts of the body and lacks sebaceous glands, which are responsible for producing natural oils. Due to this reason, lips are more prone to dryness, cracking, and damage caused by environmental factors such as sunlight, wind, cold weather, and pollution. Lip balm helps in maintaining the moisture balance of the lips and provides a protective barrier against these harmful external factors.

Lip balms are commonly formulated using a combination of waxes, oils, emollients, and active ingredients that help in moisturizing and nourishing the lips. Ingredients such as beeswax, cocoa butter, shea butter, and various natural oils are widely used in lip balm formulations because of their ability to soften and hydrate the lip skin. These ingredients form a thin protective layer over the lips which helps reduce transepidermal water loss and keeps the lips smooth and supple. (18)

In addition to moisturization, lip balms also play an important role in protecting the lips from ultraviolet (UV) radiation. Prolonged exposure to sunlight can lead to dryness, pigmentation, and premature aging of the lips. Therefore, many lip balm formulations include sun protection factors (SPF) or natural ingredients with UV-protective properties. These components help protect the lips from harmful ultraviolet rays and maintain the natural color and health of the lips.

Lip balms are also beneficial in the treatment of chapped, cracked, or irritated lips. The emollient and soothing properties of lip balm ingredients help relieve dryness and promote healing of damaged lip skin. Regular application of lip balm helps restore moisture, reduce irritation, and improve the overall appearance of the lips.

In recent years, there has been increasing interest in the use of herbal ingredients in cosmetic formulations, including lip balms. Herbal lip balms are prepared using plant-based extracts and natural ingredients that provide additional therapeutic benefits. These products are generally considered safer and less harmful compared to synthetic cosmetic products. Herbal ingredients such as aloe vera, honey, coconut oil, and guava leaf extract are commonly used in lip balm formulations because of their antioxidant, antimicrobial, and skin-nourishing properties.

Furthermore, herbal lip balms containing plant extracts can provide additional protective effects against environmental stress and microbial infections. The incorporation of natural extracts enhances the therapeutic value of lip balms and improves their effectiveness in maintaining lip health. Among these herbal ingredients, guava leaf extract has gained attention due to its antioxidant and antimicrobial properties, which help protect the lips from oxidative damage and infections.

Therefore, lip balm plays an essential role in maintaining the health, hydration, and protection of lips. The use of herbal ingredients such as guava leaf extract in lip balm formulations not only enhances the moisturizing effect but also provides additional therapeutic benefits, making it a promising approach for the development of herbal lip balm containing sun protection factor (SPF). (19)

Role of Herbal Extract in Lip Care

Herbal extracts have gained significant importance in cosmetic and pharmaceutical formulations due to their natural origin and therapeutic benefits. In recent years, there has been a growing preference for herbal cosmetic products because they are considered safer and more compatible with the skin compared to synthetic products. Herbal extracts are obtained from different parts of plants such as leaves, roots, flowers, fruits, and seeds, which contain a variety of bioactive compounds responsible for their medicinal properties.

In lip care products, herbal extracts play an essential role in maintaining the health and appearance of the lips. The skin of the lips is delicate and highly sensitive to environmental factors such as sunlight, wind, dryness, and pollution. Continuous exposure to these factors may cause dryness, cracking, irritation, and loss of natural moisture from the lips. Herbal extracts help protect the lips from these harmful conditions by providing moisturizing, soothing, and protective effects.

One of the major benefits of herbal extracts in lip care is their moisturizing property. Many plant-derived ingredients contain natural oils, fatty acids, and vitamins that help retain moisture in the lip skin. These components form a protective barrier on the surface of the lips, preventing excessive water loss and keeping the lips soft and smooth. Ingredients such as coconut oil, aloe vera, and shea butter are commonly used in herbal lip care formulations for their excellent moisturizing properties.

Herbal extracts are also known for their antioxidant activity. Many plants contain natural antioxidants such as flavonoids, polyphenols, and vitamin C. These compounds help neutralize free radicals generated due to exposure to ultraviolet radiation and environmental pollutants. By reducing oxidative stress, herbal extracts help protect the delicate skin of the lips from damage and premature aging. [20]

Another important role of herbal extracts in lip care is their anti-inflammatory and soothing properties. Environmental factors such as extreme weather conditions, dehydration, and sunlight exposure can cause irritation and inflammation of the lips. Herbal ingredients help reduce redness, swelling, and irritation, thereby providing a soothing effect to the lips. These properties make herbal extracts highly beneficial in treating dry and chapped lips.

In addition to these benefits, herbal extracts also possess antimicrobial properties. Certain plant compounds such as tannins, flavonoids, and essential oils can inhibit the growth of microorganisms. This helps protect the lips from bacterial or fungal infections that may occur due to cracks or wounds on the lip surface.

Among various herbal ingredients used in cosmetic formulations, guava leaf extract has gained attention due to its rich content of bioactive compounds. Guava leaves contain flavonoids, tannins, and phenolic compounds that exhibit antioxidant, antimicrobial, and anti-inflammatory activities. These properties make guava leaf extract a valuable natural ingredient in lip balm formulations.

The incorporation of herbal extracts in lip care products not only enhances the therapeutic value of the formulation but also improves its safety and effectiveness. Herbal lip balms prepared with natural plant extracts provide hydration, protection, and nourishment to the lips without causing harmful side effects. Therefore, the use of herbal extracts represents an effective and promising approach in the development of lip care products, particularly in the formulation of herbal lip balm containing guava leaf extract with sun protection factor (SPF). [21]

Sun Protection Factor (SPF)

Sun Protection Factor (SPF) is a measure used to determine the effectiveness of a sunscreen product in protecting the skin from harmful ultraviolet (UV) radiation emitted by the sun. Ultraviolet radiation is mainly divided into two types, namely UVA and UVB rays, both of which can cause damage to the skin. UVB rays are primarily responsible for sunburn, while UVA rays penetrate deeper into the skin and contribute to premature aging and skin damage. Continuous exposure to these rays can lead to various skin problems including dryness, pigmentation, inflammation, and even skin cancer. [22]

The skin of the lips is extremely delicate and more vulnerable to sun damage compared to other parts of the body. Unlike the skin on other areas, the lips lack melanin and sebaceous glands, which normally help protect and moisturize the skin. Due to this reason, lips are more susceptible to dryness, sunburn, cracking, and discoloration when exposed to sunlight for prolonged periods. Therefore, the inclusion of sun protection factors in lip care products is considered highly important.

SPF value indicates how effectively a product can protect the skin from UVB radiation. For example, a lip balm with SPF 15 means that it can protect the lips from sunburn approximately fifteen times longer than unprotected skin under similar conditions. Higher SPF values generally provide greater protection against UV radiation. Lip balms containing SPF are specifically designed to create a protective layer on the lip surface that helps block or absorb harmful ultraviolet rays.

In cosmetic formulations, SPF can be achieved by using chemical or physical sunscreen agents. Chemical sunscreen agents absorb UV radiation and convert it into less harmful energy, whereas physical sunscreen agents such as zinc oxide and titanium dioxide reflect or scatter UV rays away from the skin. In recent years, there has been increasing interest in the use of natural ingredients with photoprotective properties to enhance SPF in cosmetic formulations.

Herbal extracts are known to contain various bioactive compounds such as flavonoids, phenolic compounds, and carotenoids that exhibit natural UV-absorbing properties. These compounds can help protect the skin from ultraviolet radiation by reducing oxidative stress and preventing cellular damage. Therefore, herbal ingredients are increasingly incorporated into cosmetic products to enhance their sun protection capability.

Among various herbal ingredients, guava leaf extract has shown promising antioxidant and protective properties due to the presence of polyphenols and flavonoids. These compounds help neutralize free radicals generated by UV radiation and protect skin cells from oxidative damage. When incorporated into lip balm formulations, guava leaf extract may contribute to improving the protective effect of the product against environmental stress and sunlight exposure.

The incorporation of SPF in lip balm formulations not only protects the lips from harmful UV radiation but also helps maintain their natural color, texture, and health. Regular use of lip balm containing SPF can prevent dryness, sunburn, and premature aging of the lips. Therefore, lip balms formulated with herbal extracts and sun protection factors represent an effective approach for maintaining lip health and providing protection against environmental damage. [23]

Mechanism of Action of Herbal Lip Balm Containing Guava Leaf Extract with SPF

Herbal lip balm containing guava leaf extract with sun protection factor (SPF) acts through multiple mechanisms to protect, nourish, and maintain the health of the lips. The lips are highly sensitive and lack sebaceous glands, which makes them more susceptible to dryness, cracking, and damage caused by environmental factors such as sunlight, wind, cold weather, and pollution. The combination of moisturizing agents, herbal extracts, and sun protection components in the formulation works synergistically to provide protection and therapeutic benefits to the lips.

One of the primary mechanisms of action of lip balm is **moisturization and hydration**. Lip balm formulations usually contain emollients and occlusive agents such as waxes, oils, and butters. These ingredients form a protective layer on the surface of the lips that helps reduce transepidermal water loss (TEWL). By preventing excessive moisture loss, lip balm keeps the lips soft, smooth, and well hydrated. [24]

Fig- mechanism of action of Lip Balm

Another important mechanism is the **antioxidant activity of guava leaf extract**. Guava leaves contain various bioactive compounds such as flavonoids, tannins, and phenolic compounds that possess strong antioxidant properties. These compounds help neutralize harmful free radicals generated due to exposure to ultraviolet radiation and environmental pollutants. By reducing oxidative stress, guava leaf extract protects lip cells from damage and helps maintain healthy lip tissue.

Herbal lip balm containing guava leaf extract also exhibits **anti-inflammatory and soothing effects**. Environmental factors such as sun exposure, dryness, and pollution can cause irritation and inflammation of the lips. The phytochemicals present in guava leaves help reduce redness, swelling, and irritation, thereby providing a soothing effect to damaged lip skin.

In addition to these effects, guava leaf extract also shows **antimicrobial activity**. The presence of tannins and other phenolic compounds helps inhibit the growth of bacteria and fungi on the lip surface. This antimicrobial property helps prevent infections that may occur due to cracked or injured lips.

Another important mechanism involved in the action of herbal lip balm is **sun protection**. The SPF present in the formulation helps protect the lips from harmful ultraviolet radiation. Sunscreen agents present in the lip balm either absorb or reflect UV rays, thereby reducing their penetration into the skin. This protective effect helps prevent sunburn, pigmentation, and premature aging of the lips.

Furthermore, the combined action of moisturizing agents, herbal extracts, and SPF provides **comprehensive protection and nourishment** to the lips. The moisturizing ingredients maintain hydration, the herbal extract provides therapeutic benefits, and the SPF protects the lips from sunlight. This synergistic action enhances the overall effectiveness of the lip balm formulation.

Therefore, herbal lip balm containing guava leaf extract with SPF provides multiple benefits such as moisturization, antioxidant protection, antimicrobial activity, anti-inflammatory effects, and sun protection. These combined mechanisms make the formulation highly effective in maintaining lip health, preventing dryness and cracking, and protecting the lips from environmental damage. [25]

Ingredients Used in Lip Balm Formulation

The preparation of herbal lip balm requires the use of various ingredients that perform different functions such as moisturizing, protection, stabilization, and enhancement of the overall quality of the formulation. These ingredients include waxes, oils, herbal extracts, antioxidants, and other additives that contribute to the effectiveness and stability of the lip balm.

Waxes are one of the most important components used in lip balm formulations. They provide firmness and structural stability to the product. Beeswax is commonly used in herbal lip balm because it forms a protective barrier on the lips and helps prevent moisture loss. In addition, beeswax also improves the texture and consistency of the lip balm.

Natural oils are also essential ingredients in lip balm formulations. Oils such as coconut oil, castor oil, and almond oil are widely used due to their excellent moisturizing and nourishing properties. These oils help maintain hydration of the lips and provide a smooth and glossy appearance. They also improve the spreadability of the lip balm during application.

Herbal extracts are included as active ingredients in herbal lip balm formulations. In this formulation, guava leaf extract is used because of its antioxidant, antimicrobial, and anti-inflammatory properties. These properties help protect the lips from environmental damage, microbial infections, and dryness.

Butters such as shea butter or cocoa butter are also used in lip balm formulations. These ingredients contain natural fatty acids and vitamins that help nourish and soften the lips. They provide deep moisturization and improve the overall texture of the formulation.

Antioxidants such as vitamin E are often incorporated into lip balm formulations to prevent oxidation of oils and improve the stability and shelf life of the product. Vitamin E also provides additional skin benefits by protecting the lips from oxidative damage.

In addition to these ingredients, flavoring agents and coloring agents may be added to enhance the sensory characteristics of the lip balm. Flavoring agents provide a pleasant taste and aroma, while coloring agents improve the appearance of the product and make it more attractive to consumers. [26,27]

Table: Ingredients Used in Herbal Lip Balm and Their Roles:

Ingredient	Category	Function in Lip Balm
Guava Leaf Extract	Herbal active ingredient	Provides antioxidant and antimicrobial activity
Beeswax	Wax / Base	Gives structure and firmness
Coconut Oil	Emollient	Moisturizes and softens lips
Shea Butter	Moisturizing agent	Nourishes and prevents dryness
Vitamin E	Antioxidant	Protects from oxidative damage
Zinc oxide	SPF agent	Protects lips from UV radiation
Flavoring Agent	Additive	Improves taste and aroma

Table – Ingredients Used

Evaluation Parameters of Herbal Lip Balm

1. **Appearance**

The prepared lip balm is visually examined to evaluate its color, texture, uniformity, and overall appearance. A good

quality lip balm should possess a smooth texture and uniform consistency without the presence of any lumps or foreign particles. The appearance of the lip balm also plays an important role in determining its consumer acceptability.

2. pH Determination

The pH of the lip balm formulation is determined using a digital pH meter. The pH value should be compatible with the natural pH of the skin to avoid irritation or discomfort during application. Maintaining an appropriate pH ensures that the lip balm is safe and suitable for regular use.

3. Melting Point Test

The melting point of the lip balm is determined to evaluate its thermal stability. This test indicates the temperature at which the lip balm begins to soften or melt. An ideal lip balm should remain solid at room temperature but melt slightly upon application to allow easy spreading on the lips.

4. Spreadability Test

Spreadability is an important parameter used to determine the ease with which the lip balm can be applied on the lips. A small quantity of lip balm is placed between two glass slides and the extent of spreading is observed. Good spreadability ensures uniform application and improves the overall user experience.

5. Hardness Test

The hardness of the lip balm is measured to determine its firmness and resistance to deformation. This test helps ensure that the lip balm maintains its structural integrity during storage, handling, and application. An appropriate level of hardness is necessary to prevent breakage of the product.

6. Stability Study

Stability studies are carried out to determine the physical and chemical stability of the lip balm over a certain period of time. The prepared formulation is stored under different temperature conditions and observed for any changes in color, odor, texture, and consistency. Stability testing helps evaluate the shelf life and overall quality of the product.

7. Skin Irritation Test

The skin irritation test is performed to evaluate the safety of the lip balm formulation. A small amount of the lip balm is applied to a specific area of the skin and observed for any signs of irritation, redness, itching, or allergic reactions. This test ensures that the product is safe for topical application.

8. SPF Determination

The Sun Protection Factor (SPF) of the lip balm is determined to evaluate its ability to protect the lips from harmful ultraviolet radiation. The SPF value indicates the effectiveness of the formulation in preventing sunburn and protecting the delicate lip skin from UV damage. [28]

Table: Evaluation Parameters of Herbal Lip Balm:

Evaluation Parameter	Method	Purpose
Appearance	Visual inspection	To check color, texture and uniformity
pH	pH meter	To ensure compatibility with lip skin
Melting Point	Capillary tube method	To determine temperature stability
Spreadability	Glass slide method	To evaluate ease of application
Hardness	Penetrometer test	To check firmness of lip balm
Stability Study	Storage at different temperatures	To check product stability
Skin Irritation Test	Patch test on skin	To ensure safety
SPF Determination	Spectrophotometric method	To evaluate sun protection ability

Table : Comparison Between Herbal Lip Balm and Conventional Lip Balm: [29]

Parameter	Herbal Lip Balm	Conventional Lip Balm
Source of Ingredients	Prepared using natural plant extracts, waxes, and oils.	Prepared mainly using synthetic chemicals and petroleum-based ingredients.
Safety	Generally safe and less harmful due to the use of natural ingredients.	May cause irritation or allergic reactions in some individuals.
Moisturizing Effect	Provides deep moisturization due to natural oils and butters.	Provides temporary moisturization only.
Antioxidant Properties	Contains natural antioxidants such as flavonoids and polyphenols.	Usually lacks natural antioxidant compounds.
Healing Properties	Herbal extracts help in healing cracked or damaged lips.	Limited healing properties.
Environmental Impact	Eco-friendly and biodegradable due to natural ingredients.	May contain chemicals that are not environmentally friendly.
Side Effects	Minimal side effects and suitable for sensitive skin.	Higher chances of irritation or adverse effects.
Additional Benefits	Provides therapeutic benefits such as antimicrobial and anti-inflammatory effects.	Mainly provides cosmetic benefits only.

Table – Comparison table

Advantages of Herbal Lip Balm:

1. Use of Natural Ingredients

Herbal lip balms are prepared using natural plant-based ingredients such as herbal extracts, natural oils, and waxes. These ingredients are generally considered safe and gentle on the skin compared to synthetic chemicals used in conventional cosmetic products.

2. Reduced Risk of Side Effects

Since herbal lip balms contain natural ingredients, they are less likely to cause irritation, allergic reactions, or other harmful side effects. This makes them suitable for regular use and for individuals with sensitive skin.

3. Moisturizing and Nourishing Properties

Herbal lip balms contain natural oils and butters such as coconut oil, almond oil, and shea butter which provide deep moisturization to the lips. These ingredients help prevent dryness and keep the lips soft, smooth, and well hydrated.

4. Healing Properties

Herbal extracts possess therapeutic properties such as anti-inflammatory, antimicrobial, and wound healing effects. These properties help in repairing damaged lip tissues and promote faster healing of cracked or chapped lips.

5. Protection Against Environmental Damage

Herbal lip balms provide protection against environmental factors such as sunlight, wind, pollution, and cold weather. The natural ingredients present in the formulation help form a protective barrier on the lip surface and reduce moisture loss. [30]

Limitations of Conventional Lip Balm

1. Use of Synthetic Ingredients

Conventional lip balms are commonly formulated using synthetic chemicals, artificial fragrances, and petroleum-based products such as mineral oil and paraffin. These ingredients may not be suitable for long-term use and can sometimes have adverse effects on sensitive skin.

2. Temporary Moisturizing Effect

Most conventional lip balms provide only short-term relief from dryness. They form a superficial layer on the lips without deeply nourishing or repairing the lip tissue, leading to frequent reapplication.

3. Risk of Allergic Reactions

The presence of artificial colors, flavors, and preservatives in conventional lip balms can cause allergic reactions such as irritation, redness, or itching, especially in individuals with sensitive skin.

4. Lack of Therapeutic Benefits

Conventional lip balms primarily focus on providing basic moisturization and cosmetic appeal. They generally lack additional therapeutic properties such as antioxidant, antimicrobial, or anti-inflammatory effects.

5. Environmental Concerns

Conventional lip balms often use non-biodegradable ingredients and plastic packaging, which contribute to environmental pollution and are not eco-friendly. [31]

Conclusion

Herbal lip balm containing guava leaf extract with sun protection factor (SPF) represents a promising and effective approach in modern lip care formulations. The increasing demand for natural and safe cosmetic products has led to the growing interest in the use of herbal ingredients in lip balm preparation. Guava leaves are rich in various bioactive phytoconstituents such as flavonoids, tannins, and phenolic compounds, which exhibit antioxidant, antimicrobial, and anti-inflammatory properties. These properties play a significant role in protecting and maintaining the health of the lips. (32)

The formulation of herbal lip balm using natural ingredients such as waxes, oils, and herbal extracts provides multiple benefits including moisturization, nourishment, and protection against environmental damage. The incorporation of SPF in lip balm formulations further enhances their protective effect by safeguarding the lips from harmful ultraviolet radiation, which is a major cause of dryness, pigmentation, and premature aging. (33)

Various evaluation parameters such as appearance, pH, melting point, spreadability, and stability studies are essential to ensure the quality, safety, and effectiveness of the formulation. The comparison between herbal and conventional lip balms clearly indicates that herbal lip balms offer additional therapeutic benefits with minimal side effects, making them a better alternative for regular use. (34)

"Further research and clinical studies are required to validate its long-term effectiveness."

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