IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 5, Issue 1, January 2025

A Review on Formulation And Evaluation Of Herbal Sunscreen

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Abstract: *The modern, fast-paced lifestyle adversely impacts our health, particularly through exposure to pollution and harsh synthetic chemicals. Nature, however, provides timeless and valuable herbal remedies. One significant concern is UV radiation, a primary cause of sunburn and a risk factor for serious skin cancers. Sunscreen, a topical product designed to reflect or absorb UV radiation, can prevent sunburn and mitigate other harmful effects of sun exposure, such as skin cancer and premature aging. This study discusses the formulation and evaluation of topical photoprotective products that incorporate additional photo-protective polyphenols. These products offer antioxidant, anti-malignant, antifungal, anti-aging, and moisturizing benefits, along with properties conducive to wound healing. UV radiation has been linked to skin issues like sunburn and symptoms resulting from prolonged exposure. The ability to prevent sunburn and diminish the adverse effects of the sun, including premature aging and skin cancer, is significant. The present research outlines the formulation and evaluation of topical photoprotective. These formulations incorporate antioxidant, anti-malignant, wound healing, antifungal, anti-aging, moisturizing, anti-inflammatory, antiproliferative, and other photo-protective polyphenols. This research delivers a stable, natural photoprotective product boasting antioxidant properties, high SPF, and essential homogeneous UVA/UVB protection. This review study aimed to identify natural extracted ingredients for sunscreen. Some natural ingredients such as: Jojoba oil, Tomato (Lycopene), Soya oil, Aloe-Vera,. etc.*

Keywords: natural sunscreen; herbal sunscreen; SPF; skin care; antioxidant; UV protection

I. INTRODUCTION

Cream is a type of topical preparation that is commonly used in medicine and skincare. It is a semi-solid emulsion made up of a mixture of water and oil, with emulsifying agents that allow the two to blend together. Creams are designed for external application to the skin or mucous membranes.[1]

The key characteristic of cream is its emulsified structure, which gives it a consistency that is thicker than lotions but lighter and less greasy than ointments. Creams are generally used to deliver active ingredients (such as medications) to the skin, moisturize, or treat a variety of dermatological conditions.[2]

Types of Creams:

Water-in-Oil (W/O) Creams:

- These creams contain a higher proportion of oil compared to water, making them thicker and greasier.
- They are less likely to evaporate, making them ideal for dry or cracked skin.
- Example uses: Emollient creams for dry skin, barrier creams, or moisturizers for sensitive or irritated skin.

Oil-in-Water (O/W) Creams:

- These creams have a higher water content and are less greasy than water-in-oil creams.
- They are often used for moisturization and are easily absorbed by the skin.
- Example uses: Hydrating creams, topical treatments for rashes, and antiinflammatory creams (like hydrocortisone creams).[3]

Sunscreen is a topical product designed to **protect the skin from harmful effects of ultraviolet**

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(UV) radiation from the sun. UV radiation is known to cause sunburn, premature aging (wrinkles, fine lines), and increase the risk of skin cancer. Sunscreens work by either **absorbing** or **reflecting** UV rays, preventing them from penetrating the skin.

Sun Protection Factor (SPF): SPF is a measure of how effectively a sunscreen protects the skin from **UVB** radiation. The higher the SPF, the greater the level of protection:

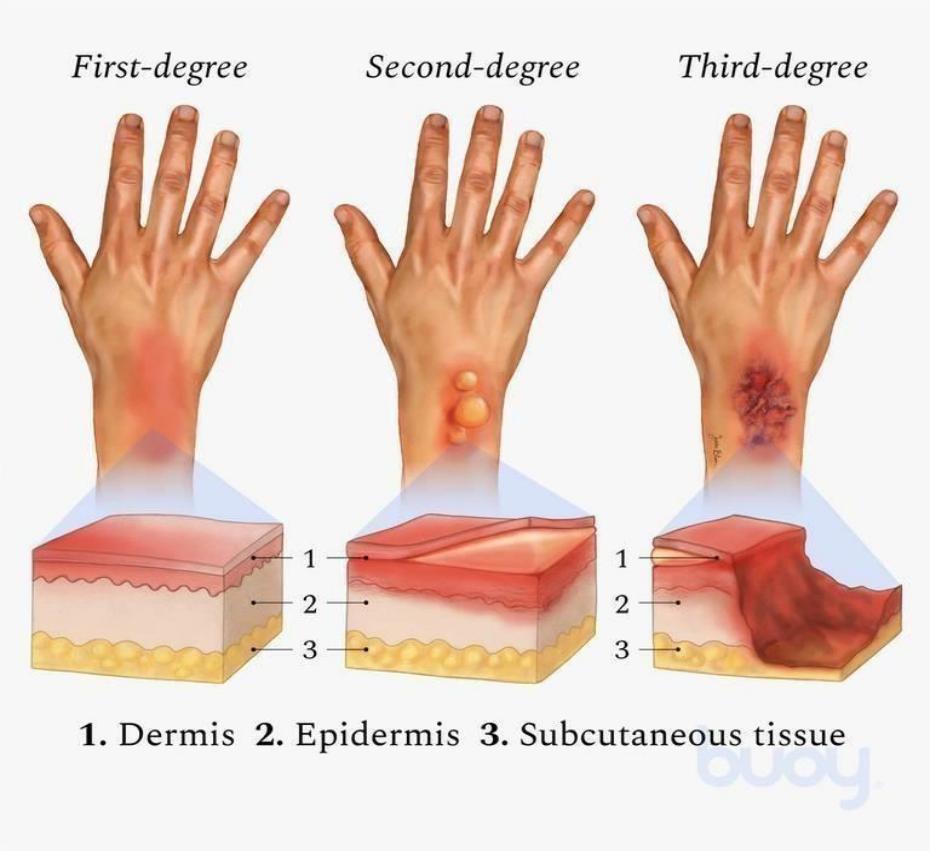
- **SPF 15**: Blocks about 93% of UVB rays
- **SPF 30**: Blocks about 97% of UVB rays.
- **SPF 50**: Blocks about 98% of UVB rays.

While higher SPF values offer more protection, they do not guarantee 100% protection. Reapplication is necessary for maintaining effective sun protection.[4]

Sun exposure and sunburn

Sunburn is a type of radiation burn that affects the skin due to overexposure to solar ultraviolet radiation (UVR). It is characterized by erythema, a well-known acute skin response to UVR, resulting from an inflammatory reaction in the skin. The severity of erythema is correlated with the extent of DNA damage caused by UVR. Sunburn poses a risk at any age, although it is more common in people with lighter skin tones who have a greater likelihood of sunburn. Additionally, younger children and older adults tend to be more sensitive to sunlight.

Research suggests that exercise is one of the most common risk factors for sunburn while sunbathing is less frequently associated with recent sunburn occurrences. In multivariate analyses, factors such as younger age, non-Hispanic white ethnicity, higher income, and excellent self-reported health are linked to a higher likelihood of experiencing sunburn. Conversely, those with poorer self-reported health show a reduced likelihood of sunburn. Symptoms of sunburn can include pain, general fatigue, and mild dizziness



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UVB rays, which have a shorter wavelength than UVA rays, primarily induce erythema by reaching the epidermal layer of the skin more effectively. Exposure to UVR also causes a rapid increase in melanin levels, the photoprotective pigment, which serves as a natural defense against UVR induced erythema. On a cellular level, sunburn triggers DNA damage and the destruction of keratinocytes.[5]

UVA Protection

UVA protection lacks a numerical rating system, but the phrase "broad spectrum" assures protection against both UVA and UVB rays. Adequate sunscreen application is crucial for effective UVA defense.

UVB Protection

UVB protection is measured using the Sun Protection Factor (SPF) system. SPF indicates the duration of protection offered by a sunscreen. It's essential to apply the recommended amount to ensure optimal protection.

HOW TO USE

Stick SPOT to Skin

- Lift the tab and apply the SPOT sticker to skin exposed to the sun.
- Remove the tab and press the SPOT firmly in place.

Cover SPOT & Skin with Sunscreen

- Apply sunscreen over both the SPOT and your skin.
- Wait 30 seconds for the sunscreen to absorb, gently rubbing it in. Cover all exposed skin with a generous amount of sunscreen**.**

Expose to Sun

- Face the SPOT toward direct sunlight. After about one minute or more in direct sunlight, the SPOT will turn clear.

Watch for Purple & Reapply

- Enjoy the sun Keep an eye on the SPOT – when it turns purple, it’s time to reapply your sunscreen.[6]

Uses of sunscreen

Prevents sunburns

- Sunscreen blocks or absorbs UV radiation before it can damage the skin, preventing redness, pain, and peeling.

Reduces skin cancer risk

- Regular use of sunscreen can reduce the risk of developing skin cancers and skin precancers.

Improves skin texture

- Regular use of sunscreen can help improve your skin's texture, making it smoother and more even.

Boosts moisture

- Some sunscreens contain a moisture boost formula that hydrates the skin while protecting

Acts as a barrier against pollution

- Some sunscreens can act as a barrier against pollution while providing protection against free radicals from UV rays.

Prevents DNA Damage in Skin Cells

- Sunscreen helps protect the DNA within skin cells from UV-induced damage, which can otherwise lead to cellular mutations, premature aging, and skin cancer.

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Helps Reduce Tanning

- While some people enjoy a tan, repeated tanning can cause long-term skin damage. Sunscreen reduces tanning by limiting the amount of UV radiation that penetrates the skin, keeping your natural skin tone consistent.

Keeps Skin Tone Even

- Consistent sunscreen use prevents blotchiness, dark patches, and discoloration, helping you maintain an even and healthy complexion over time.

Protects Around Sensitive Areas Like Eyes and Lips

- Skin around the eyes and lips is thin and more sensitive to UV rays. Sunscreen offers an extra layer of protection to these areas, minimizing the risk of early wrinkling and fine lines.[7]

Formulation:

The cream bases were prepped by emulsification process. As oil phase containing lipophilic subject and aqueous phase. Containing hydrophilic subject were separately heated in water bath for 75◦-80◦*c*. After that add aqueous phase in oil phase with constantly stirring unital the mix was congealed at the room temperate.[8]

Development of Formulation:

As compared to lotion or any other dosage form, creams are more efficient due to good stability, spread ability, exclusivity, penetration power and cost effectiveness. Long contact time and hydrophobic active drug solubility in oil phase keeps cream dosage forms always a choice of manufacturers. Cream formulations of varying Phyto chemicals composition were developed. All studied concentrations were in the legislated range.[9]

Step I: Aqueous Phase Preparation: take bees wax, shea butter, gelatine and other ingredients weighed accurately and dissolved in rose water and heated up to 80°C

Step II: Oil Phase Preparation: jojoba oil, tomato (lycopene), soya oil, aloe-vera, coconut oil, rose oil, squlane (from sunflower or soya oil) and other ingredients weighed accurately and mixed and heated at 80°C.

Step III: Mixing Phase: Oil phase was added to aqueous phase at 80°C with continuous stirring for 20-25 min and then it was homogenized till uniform emulsion formed. It was then poured into the wide mouth container and stored at temperature not exceeding 37°C.[10]

Formula for making sunscreen:

No.	Ingredients	For (50gm)	Role
1.	Jojoba Oil	6ml	Spreadability enhancer
2.	Tomato (Lycopene)	6ml	UV protector
3.	Soya oil	5ml	Enhances Texture
4.	Aloe vera	6ml	Soothing agent
5.	Coconut oil	5ml	Moisturizer
6.	Rose water	5ml	Hydrating agent
7.	Gelatine	4ml	Emulsifier
8.	Squalane	6ml	Skin brightening
9.	Bees wax	2.5gm	Thickener
10.	Shea butter	2.5gm	Antioxidant
11.	Rose oil	2ml	Perfume

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Ingredients in Herbal Sunscreens:

Jojoba oil:

Is a popular natural oil derived from the seeds of the **Simmonds chinensis** plant, which is native to the southwestern United States and northern Mexico. Despite being called an oil, **jojoba oil** is technically a **liquid wax ester**, which gives it a unique chemical structure and skin compatibility.[11]

Tomatoes:

Tomato (Lycopersiconesculentum) fruit is the major source of lycopene and studied for its antioxidant activity in cosmetic and pharmaceutical field. Tomato is rich in lycopene, a widely studied powerful antioxidant and anti-carcinogenic carotenoid with strong reducing ability. Lycopene is a carotenoid, which gives red colour to the tomatoes. It is not merely a pigment but a powerful antioxidant, neutralizes free radicals especially those derived from oxygen, present under the lipid membrane and skin cover. Lycopene scavenges lipid radicals, reduces lipid peroxidation, and prevents erythema caused by UV radiation on the skin. Lycopene may reduce the damaging effect which UV light can have on the skin and can boost protection against both the short term (sunburn) and cumulative effects of sun exposure (cancer).[12]

Extraction from Tomato (*Solanum Lycopersicon*):

The extract is produced by crushing tomatoes into crude tomato juice that is then separated into serum and pulp**.** The tomato pulp is then extracted with ethyl acetate. The final product is obtained after solvent removal by evaporation water bathat 40-60°C.[13]

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Soya oil:

Soy (or **soya**) is a highly nutritious legume, often associated with plant-based diets due to its protein content. However, **soy** has a wide range of skincare benefits, especially in natural and herbal beauty products. The active compounds in soybeans, including **proteins**, **isoflavones**, and **vitamins**, are used for their hydrating, anti-aging, and skin-soothing properties. Below, I'll cover the various benefits of **soy** for skin health.[14]

Aloe vera:

It is a widely used plant in pharmacy and healthcare, known for its numerous therapeutic properties. The gel and juice extracted from the **Aloe vera** plant (scientifically known as *Aloe barbadensis miller*) are utilized in a variety of **topical** and **oral** formulations due to their **soothing**, **anti-inflammatory**, and **moisturizing** effects.[15]

Extraction from Aloe-vera (*Aloe barbadensis*) : Aloe vera Leaf Gel Extract: The gel (400 g = 2.5 g dry matter) was homogenized in a Waring blender, then diluted with an equal volume of PBS and homogenized for second time. The extract was kept at 4 °C overnight, then filtered through cloth. The clear filtrate was kept at 20 °C.[16]

Coconut oil:

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oconut oil is a popular ingredient in sunscreen due to its natural moisturizing properties and its ability to offer some sun protection. Known for its high content of antioxidants, particularly vitamin E, coconut oil can help reduce damage from free radicals produced by UV exposure. It provides a soothing layer that can nourish the skin, keeping it hydrated and preventing dryness caused by prolonged sun exposure. While coconut oil alone isn't sufficient as a broad-spectrum sunscreen, it is often blended with other sun-blocking agents to enhance its protective properties. Its natural aroma and texture also make it a desirable ingredient in sunscreens for a tropical, skinfriendly feel.[17]

Rose water:

Rose water is a popular ingredient in skincare and cosmetic formulations, known for its **soothing**, **hydrating**, and **anti-inflammatory** properties. While it doesn't offer **direct UV protection** like **zinc oxide** or **avobenzone**, it can be an excellent complementary ingredient in sunscreen products for its various skin benefits.[18]

1. Soothing and Calming:

Rose water has mild **anti-inflammatory** properties, which makes it an ideal ingredient for **calming irritated skin** caused by **sun exposure**. After spending time in the sun, skin can become red, irritated, or inflamed. The inclusion of rose water in sunscreens can help **reduce redness** and **soothe** the skin, making it feel more comfortable after UV exposure.

2. **Hydration:**

Rose water is known for its hydrating properties, which can help maintain the skin's moisture balance. Sun exposure can lead to dehydrated skin, and rose water helps lock in moisture, keeping the skin feeling soft and supple. It also works well in combination with other moisturizing ingredients like glycerin or hyaluronic acid in sunscreens.[19]

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Determination of SPF:

- Correction Factor: This is used to adjust the measured SPF value to account for variations in experimental conditions. It ensures that the SPF value is accurate and consistent with standard conditions.
- Erythemogenic Effect: This refers to the ability of UV radiation to cause erythema (skin redness). The erythemogenic effect is wavelength-dependent, with UVB (290-320 nm) being the most erythemogenic. The SPF calculation considers the erythemogenic effect of different wavelengths to determine the overall protection.
- Intensity of Solar Light of Wavelength: The intensity of solar light varies with wavelength. The SPF determination involves measuring the intensity of UV radiation at different wavelengths and how effectively the sunscreen absorbs or blocks this radiation.
- Absorbance: Absorbance is measured using UV spectrophotometry. A thin film of the sunscreen is applied to a substrate, and its absorbance of UV radiation is measured across the relevant wavelengths (usually 290-400 nm). The absorbance data is used to calculate the SPF.[20]

Calculation Process:

- Measure Absorbance: Apply the sunscreen to a substrate and measure its absorbance using a UV spectrophotometer across the UVB and UVA range.
- Calculate Erythemogenic Effect: Use the erythemogenic action spectrum, which indicates the relative effectiveness of different wavelengths in causing erythema, to weight the absorbance values.
- Apply Correction Factor: Adjust the weighted absorbance values using a correction factor to account for experimental variations.
- Determine SPF: Integrate the corrected, weighted absorbance values over the UV spectrum to calculate the SPF. The formula for SPF can be expressed as.[21]

The formula for SPF can be expressed as:

$$SPF = CF \sum_{290}^{320} EE(\lambda) \times I(\lambda) \times A(\lambda)$$

Whereas,
CF= Correction factor;
EE= Erythemogenic effect;
I= Intensity of solar light of wavelength;
A= Absorbance

Evaluation:

Physical Parameter:

- Appearance, consistency, Texture, Oduor, Color, etc.…

Determination of pH

- The pH of the cream is measure by making a 10% dilution of the cream and the pH is measured by the pH meter. (cream formulation is water in oil emulsion)
- The electrode must be washed and free from any residue of acid and alkali to ensure the accurate reading.
- The cream is general has a pH of 6 to 9.[22]

Spread ability:

- Take two glass slide, place 1g of the sample (cream) in between the glass slides.
- Put a 100gm of weight on the glass slides, for 5min. to compressed the cream and spread.
- Measured the time takes for spread and also measure the length of spread sample or cream. [23]

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$$S = M \times \frac{l}{t}$$

Where,
S= spread ability. M= weight of cream. L= length.
T= time.

Grittiness:

- The product was checked for the present of any gritty particles.

Viscosity:

- Viscosity of cream is in the range of 28,000 to 32,000 cp
- The viscosity is determined by using "Brookfield Viscometer".
- Viscosity is an important parameter in the evaluation of the cream.

Rancidity

Rancidification is the process of complete or incomplete oxidation or hydrolysis of fats and oils when exposed to air, light, or moisture or by bacterial action, resulting in an unpleasant taste and odor. Rancidity is performed by using the Phloroglucinol solution. The rancidity is due to the oxidation of the fats and oils; during oxidation free fatty acids are liberated. These free fatty acids react with the Phloroglucinol solution and give pink color indicating the rancidity of the product. 10 ml of cream was taken then added 10 ml of concentrated Hydrochloric acid and 10 ml of Phloroglucinol solution and shaken for one minute. The cream should have passed the test if no pink color develops.[24]

Extrudability

The extrudability of herbal sunscreens was determined in this study by calculating the percentage of formulation extruded from the collapsible tube based on the weight in grams necessary to extrude at least 0.5 cm of gel ribbon in 10 seconds [16]. After that, the extrudability was estimated using the formula:[25]

$$Extrudability = \frac{Applied\ weight\ to\ extrude\ gel\ from\ tube\ (gm)}{Area\ (cm2)}$$

II. CONCLUSION

UV radiation poses significant risks to the skin, leading to a range of harmful effects such as skin cancer, hyperpigmentation, premature aging (photo-aging), sunburn, and skin irritation. In response to these concerns, herbal cosmetics have emerged as a natural alternative to protect the skin from the damaging effects of UV rays. These herbal products are often preferred for their gentle, non-comedogenic properties and minimal side effects.

This review highlights the scientific evidence supporting the use of herbal ingredients in cosmetics. Active compounds derived from various herbs have shown promising UV-protective properties. Furthermore, herbs are considered more environmentally friendly and sustainable compared to synthetic alternatives, offering broad compatibility with different skin types and needs.

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