
A Review: Preparation and Evaluation of Sunscreen

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Abstract

Currently, herbal sunscreens are widely utilized globally to protect against UV radiation from sunlight. Sunscreen is a topical substance which helps in protecting the skin from the ultraviolet radiations by reflecting or absorbing some of the sun's rays. Herbal remedies offer fewer adverse effects and a higher level of safety. This project aims to formulate and evaluate herbal sunscreen lotions with anti-UV and anti-inflammatory characteristics. Screening agents have shown effective in lowering symptoms of skin cancer and photo-damage induced by UV exposure. Creams were made from plant extracts, including *Theobroma cacao*, *Rubus idaeus*, *Aloe*, *Cocos Nucifera*, *Rosa Rubiginosa*, *Olea europaea*. *Rubus idaeus* and *Cocos Nucifera* have high polyphenol and flavonoid content.

Herbal sunscreen lotions were evaluated for organoleptic characteristics, pH, rancidity, spread ability, and drug content. Sun Protection Factor (SPF) was used to measure product effectiveness. These products demonstrated excellent spread ability, regularity, normality, admire, intended pH, easy for removing, and shows no indications of phase differentiation. Sunscreens need to be comfortable, chemically stable, gentle on the skin, non-hazardous, resistant to degradation from sunlight, and effective at shielding the skin from the sun damage. Sunscreen creams are great for mending, softening, and renewing the skin.

Keywords - UV radiation, raspberry seed oil, skin cancer, sunburn, sun protection, SPF.

INTRODUCTION

A substance that protects the layers of skin against the harmful effects of the sun. Sunscreen guards the skin from UVA and UVB rays through reflection, absorption, and dispersing. Using sunscreen-containing lotions, creams, or gels can prevent premature skin ageing and damage, which can lead to skin cancer. Sun-block formulas should address sunburn, tan, skin cancer, and premature lines, folds and wrinkles, while also improving SPF. Sunscreen is commonly utilised to prevent the skin from and dangerous UV rays and minimize the incidence of skin problems. Sunscreens with a wide range of spectrum have been studied to mitigate for a long-time consequence of intense ultraviolet exposure. Sunscreens use as a photo protectant had changed dramatically in recent decades. As people become more aware of sunscreen's benefits for preventing sun damage, skin ageing, and cancer, the need for sunscreen formulas will rise. Pharmaceutical industries can meet the demand by producing high-standard, effective, secure, and visually attractive sunscreens. Sunscreen lotion defends against damaging the sun's UV radiations, which has been classified in

UVA

The longest spectrum, 320–400 nm, damages the dermis and inner skin cells, resulting in instantaneous sunburn and tanning.

UVB

Medium spectrum, 290–320 nm; affects epidermal cells, causes sun damage, inflammation, and premature tanning.

UVC

The shortest spectrum, 100 to 290 nm, causes infections, wounds, and inflammation by harming the skin's uppermost cells.

Sunscreens come in various forms, including creams, gels, sprays, ointments, and lotions. Sunscreens are applied topically to block UV rays from entering the skin. Sunscreen product design and development incorporate regulatory considerations. Creams come either in O/W or W/O emulsions, depending on the manufacturer's desire.^[1]

Classification of Sunscreen**Based on application****Topical**

They shield the skin from harmful radiation by bouncing or soaking rays.

Oral

They can be taken by oral route to prevent skin injury. For example, flavonoids.

Topical sunscreens are classified in 2 categories depending on the method of prevention-

Organic sunscreen

Inorganic sunscreen

Organic Sunscreen

This sunscreen absorbs UV rays and converts them into heat. The thin consistency makes it suitable for daily usage and allows for easy addition of skincare components. It activates chemically carbon-based compounds. It comprises non-mineral function ingredients.

Inorganic sunscreen

Inorganic sunscreen scatters and reflects ultraviolet radiations back into the environment, creating a physiological obstacle against ultraviolet radiation. Inorganic sunscreen is also known as sunblock.^[2]

Ideal Properties of Sunscreen

Should soak in a wide range of ultraviolet radiation that causes sun damage.

Steady in direct light.

Provides full skin protection

Must be secure and efficient.

Shouldn't induce inflammation, exposure, or harmful effects.

Shouldn't stain.

Effectiveness towards ultraviolet A & B rays

Antioxidant and oxygen species-responsive reducing abilities.

Anti-mutagenic properties.

Cancer prevention abilities.

Enhance impacts.

Reliability and sustainability of active components.^[3]

Advantages of Sunscreen Lotion

- Avoids sun damage and early ageing.
- Provides immediate sun protection after application.
- Serves better in harsh ultraviolet exposure.
- Suitable for people with light-sensitive skin.
- Protects against ultraviolet A & B radiation.

Disadvantages of Sunscreen Lotion

- The product is pricey.
- Forms an obstructive coating, resulting in sweat.
- Could be less effective if not implemented correctly and freely.
- May produce white drip to appear on your skin while sweating.
- Sunscreen might create adhesiveness in particular skin area.^[4]

Benefits of Sunscreen Lotion

- Reduce risk of cancer of the skin
- Prevent burns from the sun.
- Steer clear of inflammation.
- Prevent excessive pigmentation.
- Prevent wrinkles from appearing too soon.
- Preserve the skin's appearance and texture.
- Postpone premature ageing symptoms.
- Refracts damaging UV-A and UV-B radiation.^[5]

Importance of Sunscreen

Ultraviolet light is vital to physical healthcare of human because it facilitates the synthesis of vitamin D₃, the intestinal absorption of calcium, and phosphorus. However, these radiations also negatively impact human health through direct interactions with proteins, lipids, DNA, and RNA, which may have cancerous consequences. Using any energetic compound with Ultraviolet absorbing or UV-reflecting qualities topically is most effective technique to shield skin from damaging UV rays. Because of this, using sunscreen has become more crucial in the current situation. One of the most effective and simple ways to protect the health and appearance of one's skin at every stage of life is to apply sunscreen. When employed constantly, sunscreen helps protect against sun damage, skin melanoma, and immature ageing. To assist in incorporating sunscreen into your everyday schedule.^[6]

Mechanism Of Photoprotection

Sunscreen works by protecting the skin from UV radiation. They employ two distinct mechanisms to function: Mineral-based, inorganic sunscreens operate on this mechanism by scattering and reflecting ultraviolet (UV) rays from the skin's surface, thereby shielding the skin from harmful UV rays. This technique is used by organic sunscreen to lower the detrimental impacts of ultraviolet rays and its penetration depth into the skin by absorbing the radiation and transforming it into heat energy. Sunscreen Protection Factor - Sunscreen is commonly defined in respect to Sunscreen Protection Factor (SPF), which is the amount of ultraviolet (UV) radiation required to create low inflammation dosage in covered skin to exposed skin. It is simple, fast, and accurate to test the substance's absorption ranging in 290 and 320 nm at the time period of 5 nm.^[7]

Material And Methods

Plant materials

Cocoa butter

Cocoa butter, is also known as the theobroma oil. Cocoa butter is a pale-yellow lipid derived from the cocoa bean *Theobroma cacao*. It melts at a temperature marginally lower than that of the human body. Cocoa butter includes phytochemicals and fatty acids, which may help protect against UV rays and enhance blood flow to the skin. The fat in cocoa butter creates a protective layer over the skin to keep moisture in and reduce the ageing process of your skin by shielding it from UV radiation from the sun. It has been utilised as antioxidant and includes vitamins such as A & E, each of these promote skin cell rejuvenation.^[8]

Raspberry seed oil

Raspberry seed oil is a fixed oil derived from raspberry seeds that contains lipids and good quantities of vitamins A & E, which are highly valued in the beauty products and pharmaceutical companies. It has good level of antioxidants, as well as anti-ageing, anti-inflammatory, and anti-carcinogenic properties, make it an excellent conditioner and soothing which helps to lower oxidative damages in the skin. It can be used in beauty products formulation for ultraviolet (UV) prevention. It helps to prevent cells from oxidative destruction while also maintains the integrity of collagen. It moisturizes one's face lacking clogging pores and is therefore harmless. It contains sun-preventive capabilities and also made useful for individuals looking for moderate, non-itchiness lotion.^{[9],[10]}

Aloe vera gel

Aloe vera belongs to the family Aloe and is a type of succulent plant. Aloe vera contains several highly beneficial compounds such as vitamins, enzymes, minerals, carbohydrates, saponins, lignin, salicylic acids, and amino acids. Vitamins contains antioxidant vitamins A, C, & E. Aloe vera contains significant amount of Vitamin C & E, and β -carotene, which can help in prevent dry skin and boost collagen production, reducing the likelihood of fine lines and wrinkles. Aloe vera in sunscreens can help to protect your skin and body from dryness and the hazards of sun radiation.^{[11],[12]}

Coconut oil

The coconut tree is a member of the palm species (Arecaceae) and is the only remaining species of the family *Cocos*. Coconut oil can be used in natural sunscreens or mixed with other natural sunscreens. Natural lipids present in coconut oil profoundly moisturize and nourish the skin. Coconut oil for the skin is popular because it is highly moisturizing and helps reduce inflammation, combat free radical damage, prevent infection and protects from harmful sun radiation.^{[13],[14]}

Rose oil

Rose oil is a valuable oil derived from the petals of the rose flower of the family *Rosaceae*. Rose oil is occasionally utilized in sunscreens to nourish the skin from sun damage and prevent premature ageing. Rose oil includes antioxidants and other elements that can aid with sun protection. Additionally, rose oil helps lessen skin inflammation, reduce some sun-induced ageing effects.^{[15],[16]}

Olive oil

Olive oil is extracted through the olive's berries of the species *Oleaceae*, found traditionally in the Mediterranean Basin. Olive oil's ability to reflect light might fasten the tanning process and protects the skin from sun radiations. Olive oil is composed of triglycerols, fatty acids, glycerols, oleic acid which helps the skin to protect from sun burn from harmful UV radiations.^{[17],[18]}

Preparation of Sunscreen Lotion

| Ingredients | Quantity |
|--------------------|------------|
| Cocoa butter | 10g |
| Raspberry seed oil | 6ml |
| Aloe vera gel | 8g |
| Coconut oil | 4ml |
| Rose oil | 4ml |
| Olive oil | 5ml |
| Stearic acid | 2ml |
| Glycerin | 5ml |
| Methyl paraben | 0.5g |
| Vitamin E | 2 capsules |
| Propylene glycol | 2g |
| Trimethylamine | 1g |
| Triethanolamine | 0.5ml |
| Cetyl alcohol | 0.5ml |
| Zinc oxide | 1g |
| Avobenzone | 1ml |
| TOTAL | 50ml |

Table 1: Ingredients and their quantities ^[19]

Preparation Method

Melt cocoa butter in a porcelain and then add Raspberry seed oil, Coconut oil, Rose oil and Olive oil in given determined amount and then heat up to 60° C.

Then add aloe vera gel in above mixture and let it heat.

Make a fine powder of propylene glycol, trimethylamine and zinc oxide in mortar and pestle separately.

Weight accurately given quantities of stearic acid, glycerine, propylene glycol, trimethylamine, Triethanolamine, cetyl alcohol, zinc oxide and Avobenzone and add to above mixture and heat up to 60°C.

Pour the above mixture into the suitable air tight plastic bottle and label it correctly.^[20]

Evaluation of Sunscreen Lotion

Physical parameters

Colour: The color of the lotion preparation was physically examined and noticed.

Odour: The smell or odour of the preparation was tested by placing the formulation to the skin of the hand and feeling the scent.

Appearances: Visual inspection of the formulation's appearance was conducted.^[21]

Spread ability

The spreading ability of the sunscreens affects their medicinal efficacy. Place a small amount of sunscreen on a flat surface of skin. Use a finger to spread it gently. Note how easily it spreads and if it feels smooth or clumpy.

The formula for the spreadability is

$$S = M \times L / t$$

Determination of pH

The pH of the preparation is measured using a potentiometric pH meter. The pH 8s determined by dissolving 2 gm of preparation in 50 ml of freshly produced in the distilled water for about 3 hours.

The goal of this test is to ensure the pH of manufactured sunscreens was comparable to the pH level of the dermis after 1 day of use. The conclusions were checked three times and the standard deviation were recorded.^[22]

Determination of Viscosity

Viscosity is tested by utilizing the Brookfield viscometer, attach the spindle and immerse in lotion. Then set the speed and measure at different rpm each time. Record the viscosity value.

Wash ability

To do this test, just rinse the sunscreen cream with water.

Homogeneity

The uniformity of the formulation was evaluated using touch and appearance.^[23]

Irritancy Test

On the dorsal surface of the left hand, mark an area of one square centimeter. Time was recorded while the lotion was administered to the designated region. Any irritability, erythema, or oedema was monitored for up to 24 hours at regular intervals and reported.

Rancidity

Rancidification refers to the process of deterioration or degradation of lipids and oil caused by atmosphere, sunlight, water, or bacteria, leading in an uncomfortable texture and smell. Phloroglucinol solution is used to perform rancidity tests. Rancidity occurs when lipid oxidise, releasing free fatty acids. The reaction of lipid derivatives with the Phloroglucinol solution results in a pink colour, suggesting product rancidity. 20 ml of lotion was mixed with 20 ml of strong HCl and 20 ml of Phloroglucinol solution, then agitated for two minutes. If no pink colour develops, the lotion has passed the test.^[24]

Stability Testing

Stability testing of the produced mixture is performed at normal temperature and monitored up to 8 days. The formulation was examined at $44^{\circ}\text{C} \pm 2^{\circ}\text{C}$ for 25 days. The preparation was stored at normal and raised temperature and checked on the first, fifth, tenth, fifteenth, and twentieth days for all the test parameters.^[25]

| | |
|--------------------------|-------------------|
| Appearances | Smooth |
| Colour | Pale yellow |
| State | Semi solid |
| Consistency | Good |
| Texture | Smooth |
| Irritation | Non |
| Spreadability | Good |
| pH | 7.3 |
| Rancidity | No pink colour |
| Wash ability | Washable |
| Homogeneity | Homogeneous |
| Thermal stability | No oil separation |

Table 2: Physical Evaluations

Determination of SPF

An Ultraviolet Visible spectrophotometer has been utilised to test the effectiveness of herbal sunscreens in vitro. A 0.10 % (w/v) solution of formulation lotion in ethanol was prepared by mixing 0.050 g in 50.0 ml of ethanol. A portion of every formulation are examined at 5 nm breaks

from 290 to 320 nm. SPF is computed using the following equation. Each sample underwent three analyses.^[26]

$$\text{SPF} = \text{CF} \times \text{EE} \times \text{I}(\lambda) \times \text{abs}(\lambda)$$

| Wavelength (nm) | Absorbance | SPF |
|-----------------|------------|---------|
| 290 | 1.472 | 0.32454 |
| 295 | 1.395 | 0.45493 |
| 300 | 1.326 | 0.23465 |
| 305 | 1.254 | 0.15464 |
| 310 | 1.176 | 0.35484 |
| 315 | 1.064 | 0.55164 |
| 320 | 0.983 | 0.16646 |
| | Total | 11.54 |

Table 3: Determination of SPF

Chemical evaluations

Active Ingredient Analysis

HPLC

Determines active chemicals (such as avobenzene, octocrylene) to ensure that the concentration matches the label claims.

Ultraviolet absorption spectrum

Determines the active component's absorption characteristics across ultraviolet wavelengths.

Preservative Efficiency Tests

Evaluates the ability of preservatives to suppress microbiological development.^[27]

Emulsification Tests

Determines the durability of emulsions in the preparation (oil-in-water or water-in-oil).

Fourier Transform Infrared Spectroscopy (FTIR)

Identifies functional groups and characterizes the chemical structure of active ingredients.^[28]

Detection of the moisture content

Take 1.5ml of the formulation and place it on a petri dish. Dry at 100°C or 105°C until there is a weight difference between two consecutive observations. The dehydrators have a maximum difference of 0.5 g. Usually, reduction in weight is recorded as moisture.^[29]

Antimicrobial activity

Antimicrobial activity is shown by the existence of a region of restriction and the diameter of the discs. The conclusions of antimicrobial activity utilizing *Candida albicans* are shown. This helps pick a more effective composition.^[30]

CONCLUSION

This research aimed to create sunscreen lotion from collection of Raspberry seed oil, Aloe vera, Coconut oil, Rose oil, Olive oil and tested its effectiveness in preventing sunburn. The new work may result in advancements in the management of sun damage caused by ultraviolet rays exposure. Additionally, the research shows that ultraviolet Spectroscopy is the most effective, palatable, and reproducible method for assessing herbal sunscreens' effectiveness. The formulation was created

by adjusting the composition, and its SPF and physical-chemical characteristics were assessed. The study indicated that the formulation was more stable and had a higher SPF value, resulting in a superior sunscreen cream. Sunscreen is crucial for effective sun protection. Regular and adequate use reduces the incidence of radiation-induced skin complications and malignancies. Patients should be urged to use more than just sunscreen. Sunscreen chemicals, whether synthetic, natural, or combined, have a significant commercial potential due to increased awareness of UVA and UVB ray protection.

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