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Research Article

FORMULATION AND EVALUATION OF HERBAL SUNSCREEN CREAM FOR THE PREVENTION OF SUNBURNS

M. Bhaskar, C. Bhavesh Reddy, G. Vinay, Khanees Fathima, K. Mani Varun,
Maheen Banu

Smt. Sarojini Ramulamma College of Pharmacy, Seshadri Nagar, Mahabubnagar-509001,
Telangana, India.

Abstract:

The present study focuses on the formulation and evaluation of an herbal sunscreen using natural ingredients with photo protective properties. Exposure to ultraviolet (UV) radiation, particularly UVA and UVB rays, is known to cause harmful effects on the skin such as sunburn, premature aging, and increased risk of skin cancer. Conventional sunscreens, though effective, may produce adverse effects including skin irritation and long-term toxicity, which has led to growing interest in herbal alternatives.

This study aims to develop a safe and effective herbal sunscreen formulation incorporating natural ingredients such as aloe vera, neem, coconut oil, rose water, and vitamin E. These ingredients are selected based on their antioxidant, anti-inflammatory, moisturizing, and UV-protective properties. The formulation is designed to provide broad-spectrum protection against UV radiation while enhancing skin health and minimizing side effects.

The prepared herbal sunscreen was evaluated using various physicochemical parameters including pH, homogeneity, spread ability, skin irritation, and organoleptic properties such as colour, odor, and texture. The results indicated that the formulation is stable, non-irritant, and suitable for topical application. The presence of natural antioxidants helps in neutralizing free radicals and reducing photo-oxidative damage.

In conclusion, the developed herbal sunscreen demonstrates potential as a safer alternative to synthetic sunscreens, offering effective protection against UV radiation along with additional skin benefits. This study supports the increasing demand for herbal cosmetic formulations with improved safety and efficacy profiles.

Keywords: Ultraviolet-A (UVA), Ultraviolet-B (UVB), Herbal sunscreen, Aloe vera, Neem extract, Emulsion, Sunburn prevention, Moisturizing agents, Herbal formulation.

Corresponding author:

Mr. Bhaskar, M.Pharm, (Ph.D),
Pharmaceutical Analysis,
Smt. Sarojini Ramulamma College of Pharmacy,
Seshadri Nagar, Mahabubnagar-509001,
Telangana, India.

Email-bhaskarssrcp@gmail.com,

Mobile-+919392992419.

QR CODE



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INTRODUCTION:

Sunlight is a major source of energy for life, but it also contains ultraviolet (UV) radiation that can cause harmful effects on the skin. UV radiation is divided into UVA, UVB, and UVC rays, among which UVA and UVB are mainly responsible for skin damage such as sunburn, pigmentation, premature aging, and even skin cancer. Continuous exposure to these radiations leads to oxidative stress and cellular damage in the skin.⁽¹⁾

Sunscreens are topical preparations designed to protect the skin from the harmful effects of UV radiation by either absorbing, reflecting, or scattering the rays. However, synthetic sunscreens may sometimes cause adverse effects like skin irritation, allergies, and long-term toxicity, which has led to increased interest in natural alternatives.⁽¹⁾

Herbal sunscreens have gained importance due to their safety, effectiveness, and additional skin benefits. They are formulated using plant-based ingredients such as aloe vera, neem, coconut oil, rose water, and vitamin E, which possess antioxidant, anti-inflammatory, moisturizing, and photoprotective properties. These natural compounds not only protect the skin from UV damage but also help in maintaining skin health.

The present study focuses on the formulation and evaluation of a herbal sunscreen that provides effective protection against UV radiation while being safe and suitable for regular use.⁽³⁾

Sunburn

Sunburn is a type of skin damage caused by excessive exposure to ultraviolet (UV) radiation, mainly from sunlight. It primarily affects the outer layer of the skin (epidermis) and is commonly caused by UVB rays, although UVA rays also contribute to skin damage. When the skin is exposed to UV radiation beyond its protective capacity, it leads to inflammation and damage to skin cells.⁽⁴⁾

Sunburn occurs due to damage to the DNA of skin cells. In response, the body increases blood flow to the affected area, causing redness and inflammation. In severe cases, damaged cells undergo cell death, leading to peeling of the skin during the healing process.

Prevention of sunburn includes limiting sun exposure, wearing protective clothing, and using sunscreen products that provide protection against both UVA and UVB rays.⁽⁵⁾

Activity

The prepared herbal sunscreen formulation exhibits multiple beneficial activities that help in protecting and improving skin health. The primary activity of

the formulation is photoprotection, which helps in shielding the skin from harmful ultraviolet (UV) radiation, thereby preventing sunburn, premature aging, and skin damage.⁽⁶⁾

The presence of natural ingredients such as aloe vera, neem, coconut oil, rose water, and vitamin E contributes to its antioxidant activity by neutralizing free radicals generated due to UV exposure. The formulation also shows anti-inflammatory activity, which helps in reducing redness, irritation, and swelling caused by sun exposure.⁽⁷⁾

Additionally, the herbal sunscreen provides moisturizing activity, maintaining skin hydration and preventing dryness. It also exhibits mild antimicrobial activity due to neem, helping to protect the skin from infections. Overall, the formulation demonstrates combined protective, soothing, and nourishing activities, making it suitable for regular topical application.⁽⁸⁾

Plant Profile⁽⁹⁾

1. Aloe Vera

Biological source: Leaf pulp of *Aloe barbadensis* Miller

Family: Liliaceae

Part used: Leaves

Active constituents: Vitamins (A, C, E, B12), salicylic acid, amino acids

Uses

Moisturizing, soothing, healing of sunburn, UV protection

Role in formulation: Provides hydration and cooling effect, helps repair damaged skin.



Figure Aloe Vera

2. Neem Extract⁽¹⁰⁾

Biological source: Leaves of *Azadirachta indica*

Family: Meliaceae

Part used: Leaves

Active constituents: Azadirachtin, Nimbin, Nimbidin, Quercetin

Properties:

Anti-inflammatory

Antibacterial

Antioxidant

UV-protective

Role in formulation

Acts as a natural protective agent against UV-induced damage

Provides anti-inflammatory effect to soothe sunburn

Enhances overall skin protection and healing



Figure Neem Leaf and Powder

3. Coconut Oil ⁽¹¹⁾

Biological source: Dried fruit of *Cocos nucifera*

Family: Arecaceae

Part used: Fruit (oil)

Active constituents: Lauric acid, capric acid, fatty acids

Uses

Moisturizing, emollient, mild UV protection

Role in formulation: Acts as base, improves spread ability and skin softness.

4. Rose Water ⁽¹²⁾

Biological source: Petals of *Rosa damascena*

Family: Rosaceae

Part used: Flower petals

Active constituents: Citronellol, geraniol, phenyl ethyl alcohol

Uses

Cooling, soothing, antioxidant

Role in formulation: Provides fragrance, hydration, and skin soothing effect.



Figure Container in Rose Water

5. Vitamin E ⁽¹³⁾

Biological source: Natural oils (tocopherols)

Active constituents: Alpha-tocopherol

Uses

Antioxidant, anti-aging, skin repair

Role in formulation: Protects skin from free radical damage and improves stability of formulation.



Figure Strips of Vitamin E Capsules

6. Beeswax ⁽¹⁴⁾

Biological source: Obtained from honeycomb of *Apis mellifera* (honeybee)

Family: Apidae

Part used: Wax from honeycomb

Chemical constituents: Esters (myricyl palmitate), hydrocarbons, free fatty acids, alcohols

Uses

Emulsifying agent, thickening agent, skin protectant

Role in formulation

Acts as a natural emulsifier to stabilize oil and water phases

Provides consistency and thickness to the sunscreen

Forms a protective barrier on the skin

Improves spread ability and texture of the formulation

7. White Soft Paraffin ⁽¹⁵⁾

Chemical name: White Soft Paraffin (Petrolatum)

Source: Purified mixture of semi-solid hydrocarbons obtained from petroleum

Nature: Ointment base (hydrophobic)

Appearance: White, soft, translucent, greasy mass

Odor: Odourless

Chemical constituents: Saturated hydrocarbons (alkanes)

Uses

Emollient

Skin protectant

Role in formulation

Acts as a base material in the formulation

Forms a protective barrier on the skin to prevent moisture loss

Improves texture and consistency of the sunscreen

Enhances spread ability



Figure White Soft Paraffin IP

list of ingredients

Sr.No.	Ingredients	Quantity used (per 25 g)
1	Aloe vera	5 g
2	Neem	1 g
3	Rose water	2.3 mL
4	Coconut oil	2 ml
5	Vitamin E	2 g
6	Bees wax	3.2 g
7	Glycerin	1 mL
8	White Soft Paraffin	9 mL
9	Moringa extract	1 mL

Method of Preparation

The herbal sunscreen was prepared by emulsification method using oil phase and aqueous phase.

Preparation of oil Phase

The oil phase was prepared by taking 3.2 g of beeswax and 2mL of coconut oil in a clean beaker. The mixture was heated using a water bath until the beeswax melted completely. Then 9 mL of white soft paraffin was added and mixed thoroughly to obtain a uniform oily mixture. After complete melting and mixing, the oil phase was kept warm. Finally, vitamin E (2 g) was added and mixed well.

Preparation of Aqueous Phase

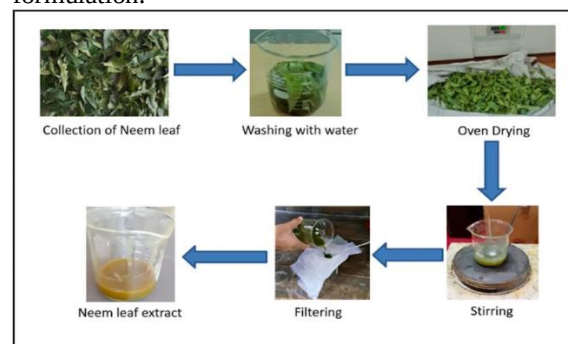
Preparation of Neem Extract

Fresh neem leaves were collected and washed thoroughly with distilled water to remove dust and impurities. The cleaned leaves were then shade dried for several days until completely free from moisture. The dried leaves were powdered using a grinder to obtain a coarse powder.

About 100 g of neem leaf powder was taken and mixed with 250 ml of distilled water (or ethanol, depending on requirement) in a beaker. The mixture was heated gently on a water bath for 30–45 minutes with continuous stirring to extract the active constituents. After heating, the mixture was allowed to cool at room temperature.

The extract was then filtered using muslin cloth or Whatman filter paper to remove solid residues. The filtrate obtained is the neem extract, which can be used directly or concentrated by further evaporation if required. The prepared extract was stored in a

clean, airtight container for further use in the formulation.



Preparation of Moringa extraction⁽¹⁶⁾

The extraction of Moringa oleifera for use in an herbal sunscreen can be carried out using a simple solvent extraction method to obtain antioxidant-rich compounds from the leaves. Fresh moringa leaves are first washed thoroughly to remove dust and impurities, then shade-dried at room temperature to preserve their bioactive components. Once completely dry, the leaves are ground into a fine powder. This powder is then soaked in a suitable solvent such as distilled water in a ratio of about 1:10 (plant material to solvent) and left for 24–72 hours with occasional stirring to allow proper extraction of phytochemicals. The mixture is then gently heated (without boiling) to enhance extraction efficiency and subsequently filtered using muslin cloth or filter paper to remove solid residues.

The aqueous phase was prepared by taking 5 g of aloe vera gel and 2.3 ml of rose water in another beaker. To this, 1 g of neem extract and 1mL of moringa extract was added gradually and mixed thoroughly to obtain a smooth and uniform solution. The mixture was stirred continuously and maintained at a temperature similar to the oil phase.

Emulsification

The oil phase was slowly added into the aqueous phase with continuous stirring. Stirring was maintained until a smooth, homogeneous cream-like emulsion was formed. Final Preparation:

The prepared herbal sunscreen was allowed to cool and then transferred into a clean, airtight container and stored at room temperature for further evaluation.

Evaluation Tests

The prepared herbal sunscreen formulation was evaluated using the following parameters to ensure its quality, safety, and effectiveness:

1. Organoleptic Evaluation⁽¹⁷⁾

The formulation was observed for colour, Odor, appearance, and texture by visual inspection.

Colour: Light cream

Odor: Pleasant

Appearance: Smooth and uniform

Texture: Soft and non-gritty

2. pH Determination

The pH was measured using a digital pH meter and found within the acceptable skin range (5–7), indicating suitability for topical use.

Observed pH: 6.2

Result: Within acceptable skin range (5–7), suitable for topical application

3. Homogeneity⁽¹⁸⁾

The formulation was checked for uniformity by visual and tactile examination to ensure absence of lumps and even distribution of ingredients.

Result: Uniform and homogeneous, no lumps observed

4. Spreadability

A small amount of formulation was placed between two glass slides and the ease of spreading was evaluated. Good spread ability ensures easy application on the skin.

Result: Good spreadability, spreads easily on the skin

5. Skin Irritation Test⁽¹⁹⁾

The formulation was applied on a small area of skin and observed for redness, itching, or irritation. No irritation indicates safety for use.

Result: No irritation, redness, or itching observed

6. Washability Test⁽²⁰⁾

The ease of removal of the formulation with water was assessed.

Result: Easily washable with water

7. After Feel⁽²⁰⁾

The formulation was applied on the skin and evaluated for smoothness, greasiness, and residual effect.

Result: Smooth, non-greasy, and pleasant feel on skin

8. Type of Smear⁽²⁰⁾

The nature of the film formed after application (oily or non-oily) was observed.

Result: Non-oily and uniform film formed

9. Determination of SPF⁽²⁰⁾

The SPF of the formulation was determined using UV spectrophotometry based on the Mansur equation. SPF was calculated using Mansur equation:

$$SPF = CF \times \sum EE(\lambda) \times I(\lambda) \times Abs(\lambda)$$

Where CF = Correction Factor (10), EE = Erythral effect, I = Solar intensity, Abs = Absorbance.

Results

Herbal sunscreen is one of the most well-known and trustable products for skin care. Herbal sunscreen not only protect the skin from harmful UV radiations from sun and environment but also provide nourishment to the skin. It provides numerous vitamins and nutrients required to the skin for proper functioning and also provide moisturizing effects. The herbal sunscreen was prepared from the ingredients mentioned above and was subjected to many Organoleptic and Physical evaluations to ensure safety of the formulation. The

evaluation parameters were Colour, Odour, skin irritation test Etc.

Parameter	Result
pH	6.2
Spreadability	Good
Irritation	none
Colour	Pale green
Odour	Pleasant

Discussion

The present study focused on the formulation and evaluation of a herbal sunscreen using natural ingredients such as aloe vera, neem extract, coconut oil, beeswax, and vitamin E. The objective was to develop a safe, effective, and eco-friendly alternative to conventional sunscreens. The formulation was successfully prepared using the emulsification method by combining oil and aqueous phases.

The evaluation tests indicated that the prepared sunscreen possessed acceptable physicochemical properties. The pH of the formulation was found to be within the skin-friendly range, suggesting its suitability for topical application. The formulation showed good homogeneity, smooth texture, and satisfactory spreadability, which are important for uniform application on the skin. The absence of irritation during the skin irritation test confirmed that the formulation is safe and non-toxic.

The presence of natural ingredients contributed additional benefits such as moisturizing, soothing, and antioxidant effects. Aloe vera and neem extract played a significant role in protecting the skin from inflammation and oxidative damage caused by UV radiation. Coconut oil and white soft paraffin improved the emollient property, while beeswax acted as a stabilizing and thickening agent.

However, compared to marketed sunscreens, the herbal formulation may have limitations such as lower stability and lack of standardized SPF value. Despite these limitations, the prepared sunscreen offers a safer and more natural alternative with minimal side effects.

Overall, the study demonstrates that herbal sunscreen can be effectively formulated with desirable properties and can serve as a promising option for skin protection with added therapeutic benefits.

Comparison with Marketed Sunscreen

Parameter	Herbal sunscreen	Marketed sunscreen
SPF	18.5	30+
Safety	High (Natural)	Moderate
Skin Irritation	None	Possible
Cost	Low	High
Side Effects	Minimal	Possible

CONCLUSION:

Overall, the formulated herbal sunscreen provides protection to the skin from the harmful UV rays and also many more skin benefits which enhance the skin naturally.

Coconut oil and vitamin E also provides some extra benefits to the skin.

The finished product passes all the evaluation tests. In conclusion, Herbal sunscreen is beneficial to protect skin from problems like sunburn and skin cancer. Herbal sunscreen is an alternative source from hazardous chemical products. Sunscreen protects the skin from harmful UVA and UVB rays, which can damage DNA and lead to skin cancer. Regular use of sunscreen helps reduce the risk of cancers like Melanoma, Basal Cell Carcinoma, and Squamous Cell Carcinoma. It works by absorbing or reflecting UV radiation, thereby preventing sunburn and long-term skin damage.

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