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FORMULATION AND EVALUATION OF HERBAL SUNSCREEN CREAM

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Abstract

Herbal sunscreens provide a safe, natural, and effective alternative to chemical-based products. This study developed a herbal sunscreen cream using blue pea flowers (*Clitoria ternatea*), coconut oil, rose water, and aloe vera-ingredients known for antioxidant, anti-inflammatory, moisturizing, and healing benefits. These botanicals not only protect against UVA and UVB radiation but also enhance skin defense and repair. *Clitoria ternatea*, with its strong antioxidant and UV-protective properties, served as the key component. The formulation was evaluated for SPF, pH, viscosity, spreadability, stability, and skin irritation, showing favorable results with good stability and no adverse effects. Overall, the study demonstrates that *Clitoria ternatea*-based sunscreen is an effective, skin-friendly, and eco-conscious alternative to synthetic sunscreens.

Keywords: Herbal sunscreen, *Clitoria ternatea* (Blue pea flower), Antioxidant activity, UV protection (SPF), Skin-friendly formulation, Natural alternative to synthetic sunscreen.

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Introduction

Sunscreens are products designed to protect the skin from the harmful effects of sunlight. They play a key role in preventing sunburn, premature skin aging, and reducing the risk of skin cancer. Sunscreens can also help minimize sun sensitivity reactions caused by certain medications such as tetracyclines, sulfa drugs, and phenothiazines like chlorpromazine. The active ingredients in sunscreens work by either absorbing ultraviolet (UV) radiation or reflecting it away from the skin [1].

Mineral sunscreens, also called inorganic or physical sunscreens, form a barrier on the skin's surface to block UV rays. They usually contain zinc oxide or titanium dioxide, which reflect and scatter radiation. Although mineral sunscreens may leave a slight white cast and are sometimes harder to rub in, they are generally safe, photostable, and well-tolerated. Some modern formulations are tinted or even made in fun colors to improve appearance and appeal, especially for children. An advantage of mineral sunscreens is

that they start protecting immediately after application, but they can wash off easily with sweat or water.

Chemical sunscreens, on the other hand, protect the skin by absorbing UVA and UVB rays. Common ingredients include avobenzone, oxybenzone, and octinoxate. These compounds act like sponges, absorbing UV radiation and converting it into harmless heat that is released from the skin. Unlike mineral sunscreens, they penetrate into the outer skin layers, making them invisible after application. However, chemical sunscreens take about 15 to 30 minutes to become effective, so they need to be applied before sun exposure.

Herbal sunblock is another name for herbal sunscreen. Herbal sun protection lotion is a type of lotion, spray, or other topical treatment that helps shield the skin from UV radiation from the sun.

a. physical sunscreen:

Those are in sunlight reflection.

b. Chemical sunscreens:

Those are UV light-absorbing [2].

Sunscreen lotion protects the skin from harmful ultraviolet (UV) rays:

- **UVA (320–400 nm):** Longest wavelength penetrates deeper into the skin (dermis), causing tanning and sunburn.
- **UVB (290–320 nm):** Medium wavelength, affects the top skin layer, leading to delayed tanning, sunburn, and blisters.

- **UVC (100–290 nm):** Shortest wavelength, impacts outer skin cells, causing redness, ulcers, and lesions.

Classification of sunscreen and mechanism of photo-protection

Sunscreens are products used to protect the skin from harmful UV radiation and are classified based on their mode of administration and mechanism of action. Based on administration, they are divided into systemic and topical sunscreens.

- **Systemic sunscreens** are taken orally in the form of tablets, capsules, or dietary supplements. They usually contain antioxidants and photo-protective compounds such as *Polypodium leucotomos* extract, beta-carotene, and lycopene. These agents work from within the body by lowering inflammation and oxidative stress caused by UV exposure, thereby reducing skin sensitivity to sunlight [3,4].
- **Topical sunscreens** on the other hand, are applied directly to the skin and are the most widely used form of sun protection. They are further divided into organic (chemical) and inorganic (mineral) sunscreens [5].
- **Organic sunscreens**
These are carbon-based compounds that absorb UVA and/or UVB rays and convert them into harmless heat released from the skin [6]. They penetrate the outer skin layer and provide protection with a lightweight, transparent feel, making them suitable for daily use. Examples include avobenzone, octinoxate, oxybenzone, and homosalate.
- **Inorganic Sunscreens**
Inorganic sunscreens such as zinc oxide and titanium dioxide work by blocking, scattering, and reflecting UV rays on the skin surface [7]. Unlike organic types, they form a physical barrier without being absorbed. These offer broad-spectrum protection against both UVA and UVB rays and are especially recommended for sensitive skin. Due to their protective mechanism, they are often referred to as sunblocks [8].
- **Importance of Sunscreens**
UV radiation aids in vitamin D3 production and mineral absorption, but excessive exposure damages DNA, proteins, and lipids, leading to issues like cancer. Sunscreens protect the skin by absorbing or reflecting harmful UV rays, making them essential for skin health.

Ideal Properties of Sunscreen Cream

1. Anticancer property
2. Safety stability of the active compound
3. Must absorb a broad range of UV rays causing sunburn
4. Must be stable in presence of sunlight
5. Should be able to provide complete protection of skin
6. Should be safe effective, chemically inert at low concentration
7. Should not stain filtering
8. Activity against UVB and UVA radiation
9. Anti-mutagenic property

10. Booster effect

Benefits of sunscreen

- Reduce risk of skin cancer
- Protect against sunburn
- Avoid inflammation and redness
- Avoid blotchy skin and hyperpigmentation
- Stop DNA damage
- Prevent the early onset of wrinkles and fine lines
- Lower skin cancer risk
- Shields from harmful UV rays
- Maintain the brightness of your natural complexion
- Maintain the look and texture of your skin

Advantages

- Easily available
- may side effects
- No special equipment needed for preparation
- They are expensive
- Ingredients are easily available
- Renewable resources
- Be non-toxic and non-irritant
- Be neutral
- Be stable to heat
- They are difficult to hide taste and odour

Disadvantages

- May cause skin irritation or allergic reactions
- It can clog pores and trigger acne breakouts
- Some chemical sunscreens may disrupt hormones
- Risk of eye irritation if applied to close
- It requires frequent re-application for effectiveness
- It may leave greasy feel or white cast on skin
- Not all provide full UVA and UVB protection
- Effectiveness decreases if not applied properly
- High quality sunscreens can be costly

Materials and Methods

1.Aloe Vera

Aloe vera is a natural and safe plant widely used in cosmetics and medicine due to its minimal side effects. It is versatile, as it can be applied topically or taken in the form of drinks, gels, and supplements. Traditionally valued in Ayurveda and now supported by scientific studies, aloe vera holds both cultural and medical importance. It is also eco-friendly, as it grows well in arid climates with little water [9].

2. Butterfly Pea Flower

Native to Southeast Asia, the butterfly pea flower (*Clitoria ternatea*) is a perennial climbing plant from the Fabaceae family, well known for its vibrant blue blooms. Traditionally, it has been used in herbal teas, natural dyes, Ayurvedic medicine, and folk remedies in countries like Thailand, India, and Malaysia. The flower is rich in bioactive compounds such as tannins, alkaloids, and flavonoids (especially anthocyanins like ternatins), which provide diverse therapeutic benefits [10]. Tannins show antimicrobial and astringent activity, alkaloids affect the nervous system with adaptogenic effects, and flavonoids act as powerful antioxidants. Together, these compounds support antibacterial, anti-inflammatory,

neuroprotective, and antioxidant functions. Because of these properties, butterfly pea is being studied for roles in managing cognitive decline, infections, inflammation, oxidative stress, and diabetes. Today, it is also widely used in nutraceuticals, skincare, and wellness products for promoting overall health.

3. Coconut Oil

Coconut oil prevents premature skin aging while maintaining the skin's softness and smoothness. Use coconut oil on your skin to hydrate and exfoliate dead skin cells. Coconut oil moisturizes dry skin, even in those who have eczema or other skin conditions. Its antimicrobial, antifungal, and antiviral qualities aid in wound healing by preventing skin damage from free radicals [11]. Because of its anti-inflammatory qualities, coconut oil can help with skin conditions that cause redness on the skin, including oily and dry skin [12].

4. Vitamin E Capsule

Extra protection against acute UVB damage and against cell mutations brought on by exposure to the sun and pollution is provided by vitamin E [13]. Vitamin E helps to improve skin elasticity and cleanse the skin by eliminating impurities. When vitamin E and lemon juice are combined, the skin becomes lighter. It is most well-known for improving the appearance and health of skin. It has anti-inflammatory and antioxidant qualities [14].

5. Rose water

Rose water has vitamin B, which is frequently found in sun products and sunscreen. It enhances the efficacy of SPF protection. Rose water is a useful tool for reducing skin pigmentation [15]. Rose water unclogs your pores, which helps remove dirt and oils from your skin. It aids in keeping your skin's pH level stable. The antioxidant levels in free radicals and maintain healthy, radiant skin while also protecting the skin from damaging environmental aggression [16].

Formulation of Sunscreen Cream

Formulation of butterfly pea flower extract:

To make an extract of butterfly pea flower for herbal sunscreen, steep about a dozen fresh or dried flower leaves in a cup of boiling water. After about 15 minutes, strain the liquid and discard the leaves. The deep blue water is then ready to be used in Sunscreen cream.

Table 01: Blue Pea Flower Sunscreen Cream Formulation – 100gm

S.no	Ingredients	Functions	Amount(g)
1	Butterflypea flower	Anti-oxidant Soothing Anti-aging	8.0g
2	Aloe Vera	Moisturizer skin soother	16.0g
3	Coconut oil	Emmollient anti-bacterial	12.8ml
4	Shea butter	Emmollient nourishing agent	11.2g
5	Emulsifying wax	Emulsifier(oil-water phase)	9.6g
6	Vitamin E	Anti-oxidant, preservative booster	1.6g

7	Preservative	Shelf-life stabilizer	1.6g
8	Rose water	Fragrance, solvent, cream base	39.2ml

Formulation of sunscreen cream was prepared by the following procedure

1. I have to take butterfly pea flower extract.
2. Then I have taken aloe vera gel because it has proven to both treat and prevent burns on the skin.
3. Then add rose water in a mixture, to provide a cooling effect.
4. Then gradually add coconut oil and vitamin E.
5. All the ingredients were mixed vigorously using a spatula for about 20-30min and placed.

Evaluation Tests:

- **SPF (Spectrophotometric):** $SPF = CF \times EE(\lambda) \times I(\lambda) \times Abs(\lambda)$
- **Appearance:** Thick consistency, leaves white cast.
- **Odour:** Mild, due to absence of added chemicals.
- **Viscosity:** Measured by Brookfield Viscometer (100 rpm, spindle no. 7).
- **pH:** Determined by dissolving 0.5 g cream in 50 ml distilled water.
- **Homogeneity:** Checked by visual inspection and touch.
- **After-feel:** Tested for emolliency, slipperiness, residue.
- **Smear type:** Nature of film formed after application.
- **Removal:** Tested by washing with tap water.
- **Spreadability:** Evaluated for uniform distribution.
- **Washability:** Checked by rinsing with water.
- **Irritancy test:** Cream applied to 1 cm² skin patch, observed for erythema/edema up to 24 hrs.
- **Cleaning:** Ease of removal of oil phase with water.

Results

Table 02: Properties of Blue Pea Flower

S.no	Parameters	Observation
1	colour	Light blue
2	odour	characteristics
3	Appearance	good
4	washability	washable
5	Texture	smooth
6	State	semisolid
7	PH	65
8	viscosity	1094
9	Spreadability	Good and uniform
10	Irritant effect	No
11	stability	No separation
12	Homogeneity	Homogenous
13	SPF	30

Ideal Storage Conditions for Butterfly Pea Flower Sunscreen Cream

- **Store Cool (15–25°C)** – Avoid heat, cold, and sunlight.
- **Keep Dry** – Don't store in bathrooms; protect from humidity.
- **Seal Tightly** – Always close the cap to prevent oxidation, contamination, and evaporation.
- **Use Clean Tools** – Apply with clean hands or a spatula to avoid germs.
- **Care for Container** – Don't share, and wipe caps/nozzles regularly.

Packaging Recommendations

- **Opaque or Amber Bottles:** Protects from light.
- **Airless Pumps:** Reduces air exposure and prolongs shelf life.
- **Label with Manufacturing Date & Expiry:** Natural products often have **shorter shelf life** (typically 6–12 months).

Discussion

In this work, a sunscreen cream was formulated using an extract obtained from the leaves of the butterfly pea flower (Blue pea flower). The dried leaves were boiled, and the liquid extract was incorporated into the cream. The formulation was evaluated for colour, odour, spreadability, irritability, washability, solubility, and SPF. Herbal-based sunscreens are preferred as they are safer and more effective than synthetic products, which may cause photosensitivity, irritation, penetration into blood vessels, skin tumors, cancer, and persistent white patches. The developed cream showed good spreadability and viscosity, with no redness, inflammation, or irritation during application or storage. Its colour remained stable, and it was easily removed with tap water, unlike synthetic creams that often cause irritation. Thus, herbal cosmetics are safer and more reliable than synthetic alternatives.

Conclusion

This study successfully formulated and evaluated a herbal sunscreen cream using butterfly pea flower extract along with aloe vera, coconut oil, rose water, shea butter, and vitamin E. The cream showed ideal physicochemical properties—pH 6.5, high viscosity, smooth texture, good spreadability, excellent washability—and caused no skin irritation. An SPF of 30 (determined in vitro) confirmed strong UVB protection. The butterfly pea extract, rich in antioxidant and UV-absorbing flavonoids, played a key role in enhancing photoprotection, while other natural ingredients supported skin healing, moisturization, and product stability. Overall, the formulation demonstrates that *Clitoria ternatea* is a safe, effective, and eco-friendly alternative to synthetic sunscreen agents, though further in vivo and long-term stability studies are recommended.

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Conflict of Interest

No Conflict of Interest

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Inform Consent and Ethical Statement

Not Applicable

Author Contribution

All authors are contributed equally.

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