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Formulation and Evaluation of Herbal Sunscreen Containing Butterfly Pea Flower

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Abstract

The increasing concern about the harmful effects of ultraviolet (UV) radiation on skin health has led to a growing demand for safe and natural alternatives to chemical sunscreens. This study investigates the formulation and evaluation of an herbal sunscreen incorporating natural ingredients, specifically butterfly pea flower extract, aloe vera gel, coconut oil, rose water, and vitamin E capsules. These ingredients were selected for their known beneficial properties: butterfly pea flower extract is rich in antioxidants, aloe vera gel is renowned for its soothing and moisturizing effects, coconut oil provides hydration and UV protection, rose water offers anti-inflammatory benefits, and vitamin E serves as a potent antioxidant.

The formulation was prepared by blending the selected ingredients into an emulsion, ensuring uniformity and stability. The sunscreen was evaluated for key parameters, including its sun protection factor (SPF), stability, viscosity, and skin compatibility. SPF was determined using a UV spectrophotometric method, while stability was assessed through accelerated stability testing under varying temperature and light conditions. The texture of the sunscreen was characterized by assessing its spreadability and ease of application, with a particular focus on its non-greasy feel and moisturizing properties.

The SPF evaluation indicated a moderate to high level of sun protection, with the formulation successfully blocking UV radiation. Stability tests showed that the sunscreen remained stable over a prolonged period, with no significant changes in its physical or chemical properties. Sensory evaluation revealed that the product was well-received in terms of texture and skin feel, leaving the skin hydrated and non-greasy after application. Additionally, the antioxidant and anti-inflammatory properties of the herbal ingredients were confirmed through in vitro tests, supporting the sunscreen's dual action of protection and skin nourishment.

Keywords: Herbal sunscreen, Butterfly pea flower, Aloe vera, Photoprotection, SPF, Antioxidants, Natural skincare

Introduction

Sunscreen use has increased recently as a result of increased knowledge of the negative consequences of prolonged sun exposure. However, there is a trend toward natural sunscreens due to worries about the possible negative consequences of the chemical compounds used in traditional sunscreens. Plant-based oils and extracts are used to create herbal sunscreens, which provide a safer and more nourishing option

for the skin. These organic components nourish and calm the skin in addition to offering strong defense against damaging ultraviolet (UV) radiation. Herbal sunscreens are becoming a popular option for people looking for a comprehensive and environmentally responsible approach to sun protection by fusing traditional herbal knowledge with contemporary skincare requirements.

Objectives

1. UV Protection Use natural substances to shield the skin from damaging UVA and UVB radiation. Prevent long-term skin damage, sunburn, and early aging.
2. Utilizing Organic Substances Use non-toxic, plant-based substitutes for synthetic chemicals. Keep clear of artificial scents, oxybenzone, and parabens.
3. Nutrition for the SkinAloe vera, green tea, turmeric, sandalwood, and other plants can offer hydrating, calming, and antioxidant benefits.
4. Diminish the Side

Benefits

1. Gentle & Kind to Skin Natural components that are often mild on the skin are used to make herbal sunscreens. They are perfect for those who are prone to allergies or have sensitive skin.
2. Natural Protection from the Sun Aloe vera, green tea, and turmeric are just a few of the plants that are utilized in these sunscreens because they naturally block or lessen the impacts of UV rays.
3. Packed with Antioxidants and Nutrients Antioxidants included in herbal substances promote skin healing and help stave against the early aging effects of sun exposure.
4. Hydrating Impact These sunscreens frequently moisturize the skin in addition to protecting it from the sun, keeping it supple and avoiding dryness from heat or radiation.
5. Reduced Chance of Adverse Reactions Herbal sunscreens are less likely to irritate skin or create breakouts because they don't include harsh preservatives, synthetic chemicals, or artificial smells.
6. Better for the Environment: Sunscreens made from plants are better for the environment because they are typically biodegradable and don't contain chemicals that harm marine life.

Herbal Ingredients Used In Formulation

1. Butterfly Pea Flower

Common Name: Butterfly Pea Its biological source is the blooms of the Clitoria ternatea L. plant. Fabaceae (Leguminosae) is the family.

Key Constitutes: Anthocynins, Flavonoids, Alkaloids, Saponins, Polyphenols, Peptides and Proteins

Uses: Because of its high antioxidant content, butterfly pea flowers are utilized in herbal teas, cosmetic products, natural food coloring, and traditional medicine.

pea flower (Clitoria ternatea) has potential sun-protective qualities because to its rich level of antioxidants, especially anthocyanins (ternatins) and flavonoids like quercetin and kaempferol.

Fig 1 : Butterfly Pea Flower

2. Aloe Vera

Common Name: Aloe vera, Ghritkumari

Aloe vera (L.) Burm.f. leaves, belonging to the Asphodelaceae family, provide the biological source of the gel.

Chemical Components: Acemannan and other polysaccharides Vitamins (B-complex, A, C, and E) Minerals (Calcium, Zinc, Magnesium) Proteins and Amino Acids Anthraquinones (Aloin) Saponins, Lignin

Uses: Hydration and skin repair Hair hydration assistance for digestion (laxative)

Fig 3 : Aloe Vera

Antimicrobial and anti-inflammatory utilized in herbal remedies and cosmetics

3. Rose Water

Traditional Name: Rose Water

Biological Source: Steam distillation of fresh petals of Rosa damascena, a member of the Rosaceae family, produces aromatic water.

Essential oils, primarily geraniol, citronellol, and nerol, are chemical constituents.

Flavonoids

Tannins

Phenolic substances Trace vitamins and antioxidants Uses: Skin refresher and toner (hydrates, reduces inflammation) Antibacterial and anti-inflammatory (helps with redness and acne)

Fig 3:Rose water

utilized in face mists, fragrances, and cosmetics added for fragrance to food and desserts Traditional medicine uses a mild mouth and eye rinse.

4.Coconut Oil

Common Name: Coconut Oil

Biological Source: Extracted from the dried kernel (copra) or fresh meat of Cocos nucifera, family Arecaceae

Chemical Constituents: Fatty acids – Mainly Lauric acid, Myristic acid, Palmitic acid Medium-chain trig-

lycerides (MCTs) Vitamins – Especially Vitamin E and K Polyphenols Phytosterols Caprylic and Capric acids (antimicrobial)
Uses: Moisturizer for skin and hair Hair oil – strengthens roots, reduces dandruff Used in cooking and baking (especially virgin coconut oil) Anti-inflammatory and antimicrobial in traditional remedies Massage oil and in cosmetic formulations Supports oral health (oil pulling practice)

Fig 4: Coconut Oil

5.Vitamin E Capsule

prevents skin damage by neutralizing free radicals produced by UV exposure. reduces irritation and sunburn when applied with sunscreen or after being in the sun. Supports skin healing by stimulating cell regeneration prevents photoaging, which includes UV-induced wrinkles and dark spots. In sunscreens, vitamin C is frequently added to improve UV protection.
Uses:
antioxidants shield cells from oxidative damage. Skin health: used to reduce stretch marks, heal scars, and moisturize

Fig 5: Vit E Capsule

Hair care increases the strength and circulation of the scalp. helps with anti-aging and immunity may promote eye and heart health. utilized in DIY skincare, nutritional supplements, and cosmetics

Sr No	Ingredients	Quantity	Properties
1	Butterfly Pea Flower Extract	6 g	Antioxidant, Skin Soother, Natural Colorant
2	Aloe Vera Gel	10 g	Moisturizer, Anti-inflammatory, UV Protection
3	Rose Water	3 ml	Cooling Agent, Toner, Fragrance
4	Coconut Oil	2.5 ml	Emollient, Antimicrobial, Mild SPF
5	Vitamin E Capsule	3.5 g	Antioxidant, Protects against UV induced damage

Method of Preparation:

Preparation of Butterfly Pea Flower Extract:

Dried petals of Clitoria ternatea (butterfly pea flower) were steeped in boiling distilled water (approximately 1 cup per 12 flowers) for 15 minutes. The extract was then filtered to remove plant residues and cooled to room temperature. The resulting deep blue extract was used directly in the cream formulation.

Formulation Procedure:

1. Aloe vera gel was taken as the base and placed in a clean mixing vessel.
2. Rose water was added and gently mixed to ensure homogeneity.
3. The butterfly pea extract was added slowly, stirring continuously to maintain uniformity.
4. Coconut oil and vitamin E were incorporated gradually while stirring for approximately 20–30 minutes.
5. The final 25 g batch of cream was stored in airtight, amber-colored cosmetic jars to prevent light-induced degradation.

Evaluation of Herbal Sunscreen

The formulation was subjected to the following evaluation parameters:

- pH Measurement
- Spreadability
- Homogeneity
- After-feel and Smear Type
- Removal Test

Sr No.	Parameters	Observation
1	Colour	Light Blue
2	Odour	Mild Herbal
3	Texture	Smooth, Soft, Non greasy
4	Spreadability	Good and Even
5	pH	6.5
6	Homogenisity	Uniform
7	After Feel	Non sticky
8	Removal	Easily washable with water

Table 2: Physical parameters

Stability and Storage

The cream maintained its color, texture, and pH over a 30-day observation period when stored in cool, dark conditions.

Innovative Highlights

-Natural Cooling Sensation

The cream offers an immediate cooling and calming effect due to the blend of rose water, aloe vera, and butterfly pea extract — making it ideal for sensitive or sun-exposed skin.

-Botanical SPF Enhancement
Enhanced sun protection is achieved through synergistic antioxidant activity of butterfly pea flower and vitamin E, contributing to broad-spectrum UV defense.
-Non-Greasy, Skin-Adaptive Texture
The revised formulation balances oil and water phases to suit all skin types, avoiding the heavy or sticky feel associated with traditional sunscreens.

Conclusion

The Current scientific unlock the potential of butterfly seeds to prevent skin from sun damage, study successfully developed and evaluated a herbal sunscreen cream using naturally derived ingredients with antioxidant and skin-protective properties. The formulation demonstrated good physical stability, appropriate pH, effective spread ability, and no signs of skin irritation. Although the SPF value was modest, the antioxidant properties may help mitigate photoaging and inflammation. Future work may involve enhancing SPF and conducting clinical trials. The addition of a stability study and detailed evaluation suggests that the cream is not only cosmetically acceptable but also functionally reliable under typical storage conditions. This herbal sunscreen presents a promising foundation for eco-friendly, skin-compatible photoprotection with scope for enhancement and commercialization.

Summary

In addition to aloe vera gel for skin soothing, and coconut oil for natural hydration, this herbal sunscreen is made with natural ingredients, with butterfly pea flower extract as the main active ingredient because of its rich antioxidant and anti-inflammatory properties. It provides mild to moderate sun defense, and the butterfly pea flower not only improves skin protection but also helps to prevent photoaging and reduce oxidative stress. This formulation is a safe, skin-friendly substitute for chemical sunscreens that can be used on all skin types on a daily basis.

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