



A Review on Formulation and Evaluation of Herbal Sunscreen Cream

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ABSTRACT

Sunscreen is a chemical compound that help protect you from UV rays sunburn is caused by ultraviolet B radiation but ultraviolet a may be more damaging to the skin. Sunscreen should ideally block both wavebands. The aim of this study was to develop herbal topical sunscreen formulation based on some fixed oils, in combination with some medical plants. The objective of this work is to formulate and evaluate a cosmetic (Herbal sunscreen) for protection of skin from the natural ingredients which have different properties such as emollient, moisturizer, base, anti-acne, anti sweating in the ingredients such as Aloe vera, Butterfly pea flower, Coconut oil, Rose water, Vitamin E Capsule etc. A modest investment in prevention produced substantial savings in illness-related costs. The FDA recently released its final orders concerning the labelling of sunscreen. The final monograph updates the tentative final monograph regarding over the counter (OTC) sunscreen products. Among the labelling standards are removals of the term "sun block" inclusion of a statement detailing the importance of sunscreen to prevent harmful effects of the sun, three sun protection categories: minimum, moderate, high, a new SPF category of 30+ for products with SPF values greater than 30, uniform, and streamlined labelling for all sunscreens.

Keywords: Herbal, Sunscreen, SPF, Skin

Introduction

Cosmetics are defined as "The items with mild action on human body for the purpose of cleaning, beautifying, adding to the attractiveness, altering the appearance, or keeping or promoting the skin or hair in good condition" while functional cosmetics even after falling the cosmetics definition are designated as "Items fulfilling specific conditions like skin whitening, minimizing the appearance of lines in the face and body, protecting from the sun and sun tanning"[1]. Sunscreen also known as sunblock or suntan lotion, is a photoprotective topical product for the skin that absorbs or reflects some of the sun's ultraviolet (UV) radiation and thus helps protect against sunburn and most importantly prevent skin cancer [2]. Sunscreen come as lotion, spray, gels, foams (such as an expanded foam lotion or whipped lotion), sticks, powders and other topical products [3]. Sunscreen are common supplements to clothing, particularly sunglasses, sunhats and special sun protective clothing, and other form of protection (eg. umbrellas, etc.) [4].

Many natural ingredients have properties that protect you from sun. sandalwood is one of them. There are others like seed oil, sunflower oil, sesameoil, sheabutter, jojoba oil coconut oil, saffron and vitamin E oil. These are commonly called indoor tanning lotions when designed for use with tanning bed and just suntan lotion if designed for outdoor use may not have special protection in them [5].

Herbal sunscreen (also known as herbal sunblock, suntan lotion) is a lotion, spray or topical product containing herbal ingredients which helps to protect from the UV radiations of the sun and hence lowering the risk of skin cancer [6].

Herbal sunscreen also known as herbal sunblock. Herbal suntan lotion is a lotion, spray or other topical product that helps protect the skin from the sun's UV radiation and which reduce sunburn and other skin damage Sunscreen can be classified into two types sunscreen [7].

- 1) Physical sunscreen
- 2) Chemical sunscreen

➤ **Physical sunscreen**

Those that reflect the sunlight. Physical sunscreen Contain inert mineral particles that reflect UV rays like a mirror. The most common type used is ultra fine titanium dioxide (TiO₂), made up of minute particles only 20-30 nm³ in size. These products have advantages over chemical sunscreens in that they are inert substances that do not break down over time. They are far less liable to cause skin irritation, since they are in the form of insoluble particles that are not absorbed through the skin. Because of the small size of the particles, modern physical sunscreens reflect radiation in the UVB and short UVA regions better than earlier products [5].

➤ **Chemical sunscreen**

Those that absorb the uv light Sunscreen agents are for external use only .the use of sunscreen as photo protecting agents for uv protection. The sunscreen formulations which when applied topically protect the treated area from sunburn sunscreen depends on ability to protect against uv induced sunburn and their chemopreventive activity. Excessivesolar ultraviolet radiationare responsible for various skin damages such as sunburn, skin pigmentation premature aging and photo carcinogenesis. The main mechanism of skin damage by UV radiations is formation of Reactive Oxygen Species (ROS) that interact with proteins lipids and subsequently alter them. UVB and to a lesser extent UVA are responsible for inducing skin damages [9]. Sunscreen should contain antioxidant agent in addition to sunblock agent to be effective in prevention of photoaging and skin cancer .plants due to their antioxidant potential are known as attractive option to be used in Sunscreen formulation for prevention of skin damage due to solar radiation .sunscreen is topical product that protects the skin against harmful effects of the sun [10].

❖ **Classification of sunscreen**

Sunscreen are classified as either topical or systemic based on the route of administration topical sunscreen are divided into two classes on their mechanism of protection.

1. Organic sunscreen
2. Inorganic sunscreen

➤ **Organic Sunscreen**

Organic sunscreen works by absorbing into skin and converting UV rays into heat. It is thin and ideal for everyday use allow for skincare ingredients to be added easily. Organic sunscreen actives chemical carbon based compound. It containsnon mineral active ingredient [11].

➤ **Inorganic sunscreen**

These are particles that scatter and reflect uvrays back to the environment they act as physical barrier to indent ultraviolet and uvlight .they are considered broad spectrum as they cover entire ultraviolet spectrum .the Inorganic sunscreen are also referredto as sunblock [12].

❖ **Selection of sunscreen based on skin types**

Wash your face with the help of a gentle cleanser. This will ensure that the makeup, pollutants and other dirt are removed. Wait for an hour and make sure that you do not touch your face. Your skin should return to its natural state which will help determine the type of your skin. Take a tissue paper and dab your face. The area consisting of your forehead and nose must be the place where you concentrate. This is where you should wipe with the help of a tissue. So, what's your skin type?

There are 4 types of skin explained below.

Normal Skin:

If your skin shows no oil or no flaking and it feels smooth and supple, then hooray! You have a normal skin type.

Oily Skin:

If there is lots of grease on the tissue paper, then you have an oily skin type. It is common that you might have a shine and large pores.

Dry Skin:

If the tissue paper is accompanied by lots of flakes and dead skin, then your skin is dry. You need to consider moisturizing your skin.

Combination:

Any combination of the abovementioned skin types is a combination skin type. This is very common and most of you might as well have this skin type. Your skin is generally oily in the forehead and nose area and dry elsewhere [13].

ADVANTAGES OF HERBAL SUNSCREEN.

- Easily available.
- Do not provoke allergy.
- Easy to manufacture.
- Cheap in cost.
- Effective with small quantity.
- No side effect.
- No special equipment needed for preparation.
- Renewable resources.

- Botanical ingredients are easily available
- They are inexpensive
- Ingredients are easily available
- Be non toxic and non irritant
- Be neutral
- Be stable to heat
- Easy to manufacture [14].

DISADVANTAGES

- They are difficult to hide taste and odour
- Manufacturing process are time consuming and complicated
- Herbal drug have slow effects as compare to allopathic dosage form it also requires long term therapy [15].

APPLICATIONS

- The dose used in FDA sunscreen testing is 2 mg/cm² of exposed skin [16].
- The actual amount of sunscreen applied has been shown to be about 20–50% of the amount needed to achieve the labelled SPF.
- Diary registrations of the skin area with sunscreen application made it possible to roughly calculate the median amount of sunscreen applied, which was 0.39 and 0.79 mg/cm² respectively.
- Some studies have shown that people commonly apply only 1/4 to 1/2 of the amount recommended for achieving the rated sun protection factor (SPF), and in consequence the effective SPF should be downgraded to a 4th root or a square root of the advertised value, respectively [17].
- A later study found a significant exponential relation between SPF and the amount of sunscreen applied and the results are closer to linearity than expected by theory [18].
- A simple method used to determine application thickness has been to divide the amount (grams) of sunscreen used by the sunscreen treated skin area (cm²) [12].

ADVANCES IN SUNSCREENS

- Nano sunscreen
- Sun sport
- Sunscreen sprays
- Roll-on sunscreen
- Sunscreen for children [12].

2. AIM AND OBJECTIVE

AIM : To study the Formulation and Evaluation of herbal Sunceeam.

OBJECTIVE :

1. Sunscreens inhibit the transmission of ultraviolet (UV) radiation into the skin by reflecting, absorbing or scattering such radiation.
2. Consequently, sunscreens have been recommended as a form of protection against sunlight, with protection increasing with higher sun protection factor.
3. To develop sunscreen formulation using herbal ingredients.
4. To develop various formulations.
5. To perform physicochemical characterization.
6. To achieve maximum stability of formulations.
7. To achieve maximum UV protecting effects [19].

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
- Delays premature signs of aging
- Reflects UVA and UVB rays
- Works immediately when applied on the skin [20].

AN IDEAL HERBAL SUNSCREEN AGENT SHOULD HAVE FOLLOWING CHARACTERISTICS

- Absorb light preferentially over the range of 280nm – 320nm
- Be stable to heat, light and perspiration
- Be non-toxic, non-irritant and non-sensitizing
- Not be rapidly absorbed
- Be rapid soluble in suitable vehicle
- Be neutral
- Must absorb a broad range of UV rays causing sunburn
- Must be stable in the presence of sunlight
- Should be able to provide complete protection for skin
- Should not be easily washed away with water
- Should be safe, effective, chemically inert at low concentration
- Should not cause irritation, sensitization and toxicity
- Capable of retaining Sunscreening property for several hours
- Resistance to water
- Preferably odorless, if mild odor, accepted by user.
- Capable of retaining sunscreening property for several hours.
- Stable under condition of use.
- Non-stain [21].

3. MATERIALS AND METHOD**Aloe vera**

Aloe vera is a good active ingredient to reach in Sunscreen arsenal. It has been proven to both treat and prevent burns on your skin. The leaves of aloe vera and *A. Barbadosis* are the source of aloe vera gel. Aloe vera gel is used in cosmetics lotion for its moisturizing and revitalization. It blocks UVA and UVB rays and maintains skin natural moisture balance. It stops the sunburn and stimulates immune system intervention. Aloe vera gel can be used

to help with the healing process of sunburn it help relieve pain and redness by reducing inflammation. The gel also stimulate the production of collagen which help the healing process [22].



Figure No. 1 : Aloe vera

Butterfly pea flower

Packed with antioxidant:

Butterfly pea flower contain many antioxidant such as flavonoids anthocyanin and polyphenols.your skin need antioxidant to improve general health and elasticity.antioxidant help to minimize fine line and improve your skin and appearance.

Soothes minor skin irritation:

Butterfly pea flower it helped calm itching and general irritation. The butterfly pea flower used for use in rejuvenating the skin.

Reduce redness:

Because of butterfly pea flowers ability to soothe irritated skin, it also minimize redness caused by acne. Dryness and general irritation. These nourishing properties are further enhanced when combined with other nutrients that benefit skin health.

Improve moisture retention:

This helps increase skin turnover to naturally restore itself moisture retention helps stop dryness and promote lipid balance.

Improve the skin barrier:

Because butterfly pea flower contain plant based antioxidants and antioxidants vitamin such as vitamins, it help improve skin barrier

Suitable for all skin type:

Butterfly pea flower is a hidden skin ncarerockstar. It is gentle enough for use on all skin types, no matter what time of year it is [23].



Figure No. :Butterfly pea flower

Coconut oil

Coconut oil keeps the skin soft and smooth while preventing premature ageing of the skin. Coconut oil for skin use as a moisturizer, remove dead skin cells. Coconut oil moisturizing dry skin including in people with condition such as eczema. Promoting wound healing it have antibacterial, antifungal

and antiviral properties which prevents free radicals from causing damage to the skin. Coconut oil has anti-inflammatory properties which reduce redness on skin this can be helpful for both dry and oily skin conditions by reducing inflammation of the skin [24].



Figure No. 3 : Coconut oil

Rose water

Rose water contains vitamin B, which is often used in sunscreen and sun products. It helps to bolster the effectiveness of SPF. Rose water can be used to lighten skin pigmentation. Rose water can remove oils and dirt from your skin by unclogging your pores. It helps maintain the pH level of your skin. It is a hydrating and nourishing agent for skin and protects skin against harmful environmental aggressors. Gulabjal has antioxidant levels that tackle free radicals and keep skin healthy and glowing [25].



Figure No. 4: Rose water

Vitamin E Capsule

Vitamin E provides extra protection against acute UVB damage and protects against cell mutation caused by sun and pollution exposure. Vitamin E helps cleanse your skin and remove impurities from it and help improve skin elasticity. Vitamin E combination with lemon juice helps to whiten the skin. It is most commonly known for its benefits of skin health and appearance. It has antioxidant and anti-inflammatory properties [26].



Figure No. 5: Vitamin E Capsule

4. SUNSCREEN FORMULATIONS

1. EMULSION FORMULATION
2. GEL FORMULATION
3. AEROSAL FORMULATION
4. SUN STICK FORMULATION

1. Emulsion formulation

An emulsion is termed a lotion or creams depending on its viscosity, respectively, below 50,000 and in the range of 150,000–500,000 centipoises, providing almost unlimited versatility [27]. It is normally produced from two unmixable liquid phases, namely “water-in oil” and “oil-in-water” emulsions. These formulations possess the ability to spread more easily on the skin and disperse from bottles [28]. Emulsion sunscreens also provide an elegant medium that can give the skin a smooth and silky feeling without greasy shine. However, these are extremely difficult to stabilize, especially at high temperatures [27].

2. Gel sunscreen

Sunscreen gel seems to represent an ideal vehicle from an aesthetic perspective due to its purity and elegance. It is categorized into four main forms, namely aqueous, hydro alcoholic, micro emulsion, and oil anhydrous formulations [27]. The aqueous gel must be composed of water and solubilizers. e.g., nonionic surfactants, organic agents, and phosphate esters at sufficient proportions to ensure the gel will be transparent at all temperature. Therefore, it is easily washed away when exposed to water or sweat [29]. The hydro alcoholic gels are formulated by alcohol (ethanol) in conjunction with water, which are important in reducing additional solutes because most lipophilic ingredients are readily miscible in alcohol. The micro emulsion gels are composed of small particles, allowing them to appear smooth, thick, and evenly on the skin, thus delivering an elegant feel and high SPF [30]. The oil anhydrous formula possesses many attributes similar to ointments. However, oil anhydrous products are clear, while the ointments are translucent. These products can be produced as a gel by combining mineral oil and special silica [31]. However, they are not widely sold because they are difficult to produce and quite expensive.

3. Aerosol sunscreen

Aerosol sunscreens are topically applied to protect skin disorders from harmful sunlight. These products can be easily spread onto the surface of skin and distribute active ingredients to form a thin film on the skin [32].

4. Sun stick

The sun stick is undoubtedly one of the most convenient products due to its small size and light weight. The sun stick is produced by two main emulsion components, namely oil and oil soluble components, through the incorporation of petrolatum and waxes [27]. This form is subdivided into three categories, namely transparent, semi-transparent and matte sunscreen [33]. The transparent formula contains only chemical UV filters, while semi-transparent is formulated mainly by chemical and mineral substances and matte is composed of only mineral sunscreen ingredients [33].

HERBAL SUNSCREEN PREPARATION

The regular, daily use of modern cosmetic products can potentially be very important for the long-term health of the skin. Among the most useful ingredients are sunscreens, which block ultraviolet radiation absorption by the skin, either wholly or in part. (Clothing, hats and sunglasses can all act as effective sunscreens.). The many formulations that are on sale include lotions, creams, pastes and gels, and rely on either chemical or physical agents for their protective action.

These are the most important group of preparation herbal sunscreen should either scatter the incident light effectively or they adsorb the erythral portion of the suns radiant energy various other then the duration of exposure are also to be taken into account. Opaque powder material either used in dry state or in a vehicle [34].

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.[35]

Butterfly pea flower contain

<i>Content</i>	<i>Weight</i>
<i>Soluble minerals</i>	8.94mg
<i>Ash</i>	0.9mg

<i>Crude protein</i>	41.27mg
<i>Soluble carbohydrates</i>	29.18mg

Formulation of sunscreen cream was prepared by following procedure

I have to take butterfly pea flower extract. then I have take aloe vera gel because it has proven to both treat and prevent burns on skin. Then added rose water in mixture rose water provide cooling effect. then gradually add coconut oil and vitamin E. all the ingredients were mixed vigorously using spatula for about 20-30min and placed.[36]

List of ingredients used in formulation

<i>Name of ingredients</i>	<i>Weight</i>
<i>Aloe vera</i>	5mg
<i>Rose water</i>	2ml
<i>Butterfly pea flower Extract</i>	4gm
<i>vitamin E.</i>	2gm
<i>coconut oil</i>	2ml
<i>Beewax</i>	0.5gm

Table no 1: Formulation table

5. RESULT AND DISCUSSION.

Organoleptic Properties.

The appearance and colour are included in the organoleptic property. The pH is measured and was found to be 6.2 by dilution of cream in water. Viscosity was measured by using Brookfield viscometer. Cream spreadability was measured with prepublished methods.[37]

Sun Protection Factor.

Sun protection factor (SPF) was measured with a UV-2000S transmittance analyser. The cream was placed on the polymethylmethacrylate plates were tested. Cream base without UV- absorbing agents was used for blank scan. Three samples plates were prepared was kept in dark for 15 minutes for curing. Then the plates were scanned at three different locations and the SPF value was recorded.[38]

Chromatographic evaluation.

The contents of cosmetics products can be determined and confirmed by chromatography like TLC, HPTLC, HPLC, Gas chromatography.[39]

Stability studies.

It is carried out at elevated temperature, relative humidity and pH a period of 6 months and all above parameters are evaluated periodically to confirm changes in product.[40]

Centrifugation and the freeze-thaw method were used to test the stability of each herbal sunscreen. For 10 minutes, the centrifugation was carried out at 10000 rpm with 500 rpm intervals, and phase separation was observed. All herbal sunscreens were stored at 20°C and 40°C in freeze-thaw research, and phase separation was noted. All of the tests were done three times [41].

Microbial Test.

As herbal products are sensitive to microbial growth, microbial assay was carried out by agar well diffusion method or turbidometric method.[42]

Physical Parameters

Appearance, color, and homogeneity were determined.

Determination of Viscosity

The Brookfield viscometer (RVDV-II+PRO) was used to test viscosity, with the proper number of spindles selected. A 50 ml beaker was used to hold 50 g of preparation until the spindle groove was dipped and the rpm was set. Herbal sunscreen viscosity was measured at 5, 10, 20, 50, and 100 rpm. The viscosity was computed using the factor obtained from the reading.

Determination of pH

The pH of herbal sunscreens was determined using a digital pH meter. pH was measured after 1 g of the formulation was dissolved in 100 ml of newly

prepared distilled water for 2 hours. The purpose of this study was to guarantee that the pH of the produced herbal sunscreens is similar to the pH of the skin after 24 hours of use. The results were triple-checked, and S.D. was recorded.

Extrudability Study

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.[43] After that, the extrudability was estimated using the formula:

$$\text{Extrudability} = \frac{\text{Applied weight to extrude gel from tube (gm)}}{\text{Area (cm}^2\text{)}}$$

Spreadability

The spreadability of herbal sunscreens determined their therapeutic efficiency. The appropriate amount of herbal sunscreen was applied between two slides, and under specified load directions, and the two sides took the time in seconds to slide off. Spreadability was defined as the amount of time it took to separate two slides in less time.[43]

The formula for calculating it is:

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

Where M = weight tied to upper slide

L = length of glass slide

T = time taken to separate the slides

Thermal Stability

The oil separation from herbal sunscreens was evaluated in a humidity chamber at 60-70 % RH and 37±1°C. A 20 mm wide and 5 mm thick stripe of herbal sunscreens was applied to the internal wall of a 100 ml capacity chamber in its whole heights. The beaker was stored in a humidity chamber for 8 hours at 60-70 % relative humidity and 37°C. There should be no oil separation in the herbal sunscreen to pass the test.[44]

Skin Irritation

Study Three healthy rat groups (1273/PO/Re/S/09/CPCSEA), each with six rats of either sex, were used in the skin irritation investigation. The animals were fed conventional animal feed and had unlimited access to water. Hair was shaved from the backs of the rats on one of the study days, and 5 cm² of the area was marked on both sides, with one side serving as a control and the other being tested. No reaction, slight patchy erythema, slight but confluent or moderate but patchy erythema, and severe erythema with or without edema were graded as 0, 1, 2, 3 for no reaction, slight patchy erythema, slight but confluent or moderate but patchy erythema, and severe erythema with or without edema, respectively.[45]

What is SPF?

SPF stands for Sun Protection Factor and is the system used worldwide to determine how much protection a sunscreen provides, applied to the skin at a thickness of 2 mg/cm². The test works out how much UV radiation (mostly UVB) it takes to cause barely detectable sunburn on a given person with and without sunscreen applied. For example, if it takes 10 minutes to burn without a sunscreen and 100 minutes to burn with a sunscreen, then the SPF of that sunscreen is 10 (100/10).[8]

A sunscreen with a SPF of 15 provides >93% protection against UVB. Protection against UVB is increased to 97% with SPF of 30+. The difference between a SPF 15 and a SPF 30 sunscreen may not have a noticeable difference in actual use as the effectiveness of a sunscreen has more to do with how much of it is applied, how often it is applied, whether the person is sweating heavily or being exposed to water. Hence a sunscreen with SPF 15+ should provide adequate protection as long as it is being used correctly.[8]

Determination of SPF

A UV Visible spectrophotometer was used to examine the in-vitro efficacy of herbal sunscreens. A 0.10 percent solution (w/v) of herbal sunscreen lotions in ethanol was made by dissolving 0.050 g of herbal sunscreen lotions in 50.0 ml of ethanol. Between 290 and 320 nm, aliquots of each herbal sunscreen were scanned at 5 nm intervals. SPF was calculated using the equation below. Three times each sample was analysed.[46]

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

Whereas, CF= Correction factor;

EE= Erythemogenic effect;

I= Intensity of solar light of wavelength;

A= Absorbance

Safety Evaluation by Mutagenicity Assay

Salmonella typhimurium strain TA 100 without the S9 mix was employed in the investigation. Sodium azide (CAS Number: 26628-22-8) was used as a positive control for TA 100: 5 g/plate. As a negative control, sterile distilled water was used. Before the start of each experiment, fresh solutions of the reference mutagen were created. The samples were dissolved in dimethyl sulfoxide (DMSO) and preincubated in phosphate buffer with the test strain for 20 minutes at 37°C. The plates were incubated at 37°C for 48 hours after the test samples (herbal sunscreens) were added. The mutagenic reactions of the sunscreen compounds were assessed using a triplicate assay for each sample [45,41,49]

6. RESULT

To be effective in preventing sunburn and other skin damage, a sunscreen product should have a wide range of absorbance. During the storage and handling of cosmetic formulation, spreadability and viscosity are the prime parameters which affect the formulation acceptability. The formulated cream exhibited no redness, inflammation and irritation. When the formulation was kept for long time, it was found that there was no change in the color of the cream. The cream was easily removed by washing with tap water.

7. CONCLUSION

Days with sunscreen correlated not with days without risk behavior, but with days "sunbathing with the intention to tan," indicating that sunscreens were used as tanning aids to avoid sunburn.

The current study aimed to create a stable herbal sunscreen with a suitable SPF. Coconut oil-based sunscreens (F5 and F6) were found to be stable, have good antioxidant activity, and have high SPF values of 33.43 and 33.50, respectively. These herbal sunscreens have also been shown to be non-mutagenic. It can be stated that the current study will hopefully lead to improvements in the treatment of sunburns produced by UV radiation exposure. The study also demonstrates that UV Spectroscopy is the most efficient, acceptable, and repeatable approach for determining the performance of herbal sunscreens. As a result, the findings of this study can help regulatory agencies, scientific organizations, and manufacturers set standardized standards for herbal sunscreens. The study attempted to develop herbal sunscreen cream using extract of butterfly pea flower and examined their efficacy for preventing sunburn.

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