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Formulation & evaluation of herbal sunscreen spray

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Abstract

This study's goal was to create an herbal topical sunscreen solution based on few fixed oils and a few medicinal herbs. Regular application of sunscreen slows the growth of melanoma, squamous cell carcinoma, and actinic keratosis. Organic or inorganic compounds can be found in sunscreen. The product that shields the skin from UV light from the sun by reflecting or absorbing it.

The chemical substances that absorb sunlight and the physical substances that obstruct sunlight are listed and described. Calculation of the sun protection factor is done to determine the formulation's effectiveness. Detailed explanations are provided for the formula used to determine the Sun Protection Factor value. To determine the Sun Protection Factor, the UV spectroscopic approach is used. For calculating Sun Protection Factor values in *in vitro* research, the suggested method is proven to be quick and simple. The herbal formulation has fewer negative effects than the chemical formulation, making it more beneficial. The activity of a few herbal sunscreen ingredients is mentioned and discussed.

Keywords: Herbal sunscreens with aloe vera extract, calendula oil, avocado oil, UV radiations, sunscreen agents, sun protection factor

Introduction

Herbal products are less likely to have skin negative effects than synthetic ones. Since herbal sunscreens are both non-toxic and non-irritating, the new trend towards using herbal products is gaining traction daily in addition to providing the needed sun protection from dangerous UV rays^[1].

Herbal sunblock is another name for herbal sunscreen. A lotion, spray, or other topical preparation that contains herbs can help protect skin from the sun's UV rays and lessen sunburn and other skin damage^[1]. Skin ageing has developed into a significant aspect as an indicator of beauty and health around the world^[2] and is now a common cosmetic product category due to additional health benefits besides aesthetics^[3].

In this study we have deeply discussed about:

- UV radiation
- Need of sunscreen
- Sun screening agents
- Calculation of SPF factor
- Herbal sunscreen formulation

Sunscreen can be classified into two types

Physical sunscreen: contains particles that disperse and reflect UV rays back into the surrounding air. They serve as a physical defence against UV light.

Aloe Vera: This plant is safer for human skin, more stable, and less poisonous. It reflects 85% of UV light.

Avocado Oil: Protects against UV rays that cause wrinkles, other ageing symptoms, and skin cancer.

Chemical sunscreen: Sunlight is being absorbed by it. It demonstrates the damaging effects on skin, including a burning feeling and a higher chance of developing skin cancer.

Effects of ultraviolet radiation to the human skin

Skin Cancer: Based on cell of origin and clinical behaviour, skin cancers are frequently divided into the two main types of melanoma and non-melanoma skin cancers (NMSC). UV exposure and skin pigmentation have a big impact on skin cancer risk^[3].

DNA Damage: Solar UV easily absorbs and damages nucleic acids. Additional proposed processes by which solar UV influences the genome include photodynamic reactions.^[4]

Photo aging: Intrinsic and extrinsic ageing are the two main categories of the complex ageing process of the skin^[5]. Skin ageing is brought on by oxidative damage and UVB light exposure. Genetic factors are the primary cause of the inherent. Extrinsic ageing is mostly brought on by environmental causes like UVB, which result in skin wrinkles and a loss of elasticity^[5].

Advantages of herbal sunscreen

- It serves as a shield and rests on top of skin,
- It absorbs sunlight and forms a barrier that deflects and blocks UV rays before they reach the skin surface,
- There is no need to wait; it provides protection immediately,
- Herbal components are typically better for sensitive skin.
- Easily available, No side effect
- They are inexpensive
- Easy to manufacture
- Non-toxic and non-irritant

Disadvantages of chemical sunscreen

- Including the potential to induce skin cancer,
- The ability to absorb UV rays and convert them into heat that is then emitted by the skin,
- A slow rate of effectiveness, and an increased risk of irritation and pain due to the chemical active ingredient.
- They are difficult to hide taste and odour
- Manufacturing process are time consuming and complicated



Fig 1: Aloe Vera

Plant Profile

Aloe Vera

Plant: *Aloe barbadensis miller*

Family: Liliaceae

Synonym: Aloe Vera mill, etc.

Purpose for choosing aloe vera

- Proteolytic enzymes found in aloe vera help to restore damaged scalp skin. This aloe vera gel is a skin-care wizardry tool^[6].
- It is an excellent active component to have in your arsenal of sunscreen. It has been demonstrated to alleviate and prevent skin burn^[7].
- The gel also promotes collagen formation, which aids in the healing process^[7].

Role of aloe vera

- 85% reflect UV- radiation
- SPF (14 ±16)
- Protect skin from UV- radiation
- Good for brightening the skin
- Moisturizing agent
- Used to decrease pigment melanin found in skin.



Fig 2: Calendula oil

Calendula oil

Plant: *calendula officinalis*

Family: Asteraceae

Synonyms: Calendula aurantiaca, Calendula eriocarpa, etc.

Purpose of choosing calendula oil

- Calendula oil has a well-known effect of reducing irritability, especially for people with sensitive skin.
- Calendula's anti-inflammatory properties and capacity to reduce trans-epidermal water loss, which in turn strengthens the skin's defences against potential irritants, are likely responsible for its skin-soothing effects.
- It has been demonstrated that calendula reduces both the outward signs of skin irritation and discomfort as well as how uncomfortable it feels^[8].

Role of calendula oil

- To protect skin from UV radiation, Maintain natural pigmentation of skin, vit. E.

- SPF (14⁺16), It can restore skin elasticity, Provide smooth and soft texture, it is ideal for sensitive, oily and acne- proven skin.



Fig 3: Avocado oil

Avocado oil

Plant: *Persea americana*

Family: *Lauraceae*

Synonyms: *Persea Americana*, alligator pear oil, etc.

Purpose of choosing avocado oil

- Avocados include components that may help shield your skin from skin cancer, wrinkles, and other symptoms of ageing as well as from sun damage and inflammation.
- It contains vitamins C and E ^[9], which act as antioxidants and anti-inflammatory agents to keep the skin supple, robust, and smooth ^[10].

Role of Avocado oil

- Treat and prevent acne,
- soothe itchy skin,
- replenish dry skin,
- hydrate and moisturize skin,
- protect against skin damage,
- block UV radiation;



Fig 4: Neem oil

Neem oil

Plant: *Azadirachta indica* Juss.

Family: *Meliaceae*

Synonyms: Margosa oil

Purpose of choosing neem oil

- Neem can balance oil production, treat injuries, promote collagen creation, lessen post-acne scarring, and minimise skin inflammation.
- It functions as a natural option to treat skin tissue from the inside out while also minimising scarring and hyperpigmentation.

Role of neem oil

- Contain vitamins E and C,
- Moisturiser for dry skin,
- Anti-itch; antioxidant,
- Used to lessen skin pigmentation,
- Can aid in restoring and repairing the collagen layer under the skin.



Fig 5: Rose water

Rose water

Plant: *Rosa damascena*

Family: *Rosaceae*

Synonyms: Rosanna, Roseanne, Rosemond and Rosamunde

Purpose of choosing rose water

- It is a soothing and aromatic aqueous solution that is created by extracting the essence of rose petals in water, making it a natural treatment for a variety of skin care and health problems.
- Its capacity to reduce skin inflammation and preserve the pH balance of the skin is foremost among these.
- Rose water is delicate and light on the skin, making it appropriate for all skin types and thought to be particularly beneficial as a toner ^[11].

Role of rose water

- Cooling effect, Fragrance
- Maintain PH
- Contain vit. B, vit. E
- Effect on sunburn, Soothing agent



Fig 6: Honey

Honey

Plant: Apis mellifica.

Family: Apidae

Synonyms: Merrifera

Purpose of choosing Honey

- Honey Deeply Moisturizes and Hydrates the Skin, Honey Diminishes the Signs of Premature Aging. It is

an Effective Pore Cleanser and Gentle Exfoliator, Honey Lightens Scars and Hyperpigmentation.

- Honey Fights Acne and Breakouts, Honey Relieves Sunburn.

Role of Honey

- Helps skin protect itself from the sun's damaging UV rays
- Also aids in skin cell rejuvenation

Ingredients	Quantity taken	Role of ingredient
Aloe vera	5ml	85% reflect UV- radiation, SPF (14 ±16)
Calendula oil	5ml	SPF (14 ±16), It can restore skin elasticity
Avocado Oil	4ml	Vit. C – No wrinkles, UV – protecting agent, Shield skin from UV radiation
Neem oil	2ml	Contain vit. E, vit. C, Moisturiser for dry skin
Rose water	12ml	Cooling effect, Maintain PH
Honey	2ml	Preservative, Moisturising agent, Protect from sunburn

List of herbal ingredients used in formulation

Method of sunscreen formulation

Formulation of aloe vera extract

Aloe vera should be cleaned. Gather the aloe vera gel, blend it with an electric mixer, filter the resultant solution, and then store it in a jar.

Formulation of sunscreen cream was prepared by procedure given below: Making an aloe vera extract in liquid form prevents skin blistering by acting as a UV reflector. Before adding avocado oil, add honey to act as a preservative. Give dry skin a boost. The mixture's PH is then maintained by the addition of rose water, which also gives the skin a calming effect.

Following that, gradually incorporate calendula oil, which may help to re-establish skin elasticity. Neem oil can also be added; it is beneficial for dry skin. Over the course of 20 to 30 minutes, all the ingredients were vigorously mixed by using mortar pestle.

Evaluation parameter for sunscreen

Physical parameters: It is determined by – Colour, Odour, Phase separation

Subjective properties

- **Removal:** By rinsing the area where the sunscreen spray had been administered with tap water, the ease of removal was evaluated.
- **Irritancy test:** The time was recorded as the sunscreen was applied to the designated area. Irritation and erythema were monitored for any presence at regular intervals up to 7 to 8 hours and reported.
- **Feel:** Emollience, slipperiness.
- **Spread ability:** Verify by applying on skin. (self-volunteer)
- **Thermal stability:** In this investigation, formulations were kept in stability chambers at various storage temperatures (ranging from 10 to 40°C) for 3–4 days. Observed alterations included colour, liquefaction, and phase separation.
- **PH determination:** A digital pH metre was used to calculate the pH of herbal sunscreens. The goal of this research was to ensure that the pH of commercially available herbal sunscreens is comparable to the pH of the skin after prolonged use. The outcomes were verified three times and noted.

- **Effectiveness of sunscreen:** It is usually expressed by sun protecting factor (SPF),
- **Sun protecting factor:** The effectiveness of herbal sunscreens was evaluated *in vitro* using a UV Visible spectrophotometer.

By mixing 0.1 ml of herbal sunscreen spray with 10.0 ml of ethanol, a 0.10 percent solution (w/v) of the spray was created. A small amount of each herbal sunscreen was scanned between 290 and 320 nm. SPF was determined using the following equation. Each sample performed three separate analyses.

$$SPF = CF \sum_{290}^{320} EE(\lambda) \times I(\lambda) \times A(\lambda)$$

Wavelength detect by UV- spectrophotometer

Result and Discussion

1. **Physical characteristics:** The herbal sunscreen spray's composition was discovered to be milky in colour. Has a scent like roses. Furthermore, no phase separation occurred.
2. **Subjective characteristics:** The herbal sunscreen didn't irritate, and it was simple to remove. It also felt emollient.
3. **Spread-ability:** The final herbal sunscreen spray had good spreading properties.
4. **Thermal stability:** Oil does not separate in the freezer or at normal room temperature.
5. **PH measurement:** The herbal sunscreen spray's PH was determined to be 6.7.
6. **SPF:** Using the formulation given above, the SPF of the created formulation was calculated, and the result was 32.71.

Table 2: Value of absorption at particular wavelength

Wavelength	EE '(λ)x I (λ)	Absorption
290	0.015	0.55
295	0.0817	0.48
300	0.2874	0.33
305	0.3278	0.41
310	0.1864	0.23
315	0.0837	0.1
320	0.0180	0.08

Table 3: Observations

Sr. no	Parameters	Observation
1	Odour	Rose essence
2	PH	6.7
3	Colour	Milky
4	Spread ability	Good
5	Irritancy test	No irritation
6	Feel	Good
7	Thermal stability	No oil separation
8	Effectiveness of sunscreen (SPF)	32.71
9	Viscosity	At 60 rpm 25.4 mPa.s At 80 rpm 16.1 mPa.s At 100 rpm 12.6 mPa.s

Conclusion

The objective of the current inquiry was to create a stable herbal sunscreen spray with a suitable SPF. It was shown that sunscreens derived from coconut oil were stable, had significant antioxidant activity, and had an SPF of 32.71. Additionally, it has been proven that these herbal sunscreens do not cause mutations. One could argue that the findings of the present study should lead to more effective ways to cure sunburns brought on by UV radiation exposure. The study also demonstrates that UV Spectroscopy is the most efficient, dependable, and repeatable technique for determining the efficacy of herbal sunscreens. As a result, the findings of this study can help producers, academic institutions, and regulatory organisations create standardised standards for herbal sunscreens.

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Conflict Of Interest: All authors declare there is no conflict of interest.

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