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Research Article

Formulation and Evaluation of Sunscreen Cream Using Natural Herbs

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ABSTRACT

Sunscreen is a chemical compound that help protect you from UV-rays sunburn is caused by UV-B radiation, but UV-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. Regular use of sunscreen reduces the development of actinic keratosis, squamous cell carcinoma and melanoma. Sunscreen may have organic or inorganic chemicals. Sunscreen is also known as sunblock cream. It is the product that absorbs or reflect the sun's UV radiation and protect the skin. The increasing incidence of skin cancers and photo damaging effects caused by UV-radiation has increased the use of Sun screening agents, which have shown beneficial effects in reducing the symptoms. Sun screening agents should be safe chemically inert, non-irritating, non-toxic, photo stable and able to provide complete protection to the skin against damage from solar radiation. The formulation F1, F2, F3, F4, & F5 were prepared. The study showed that formulation F1 having all three extract of sesame oil, almond oil, walnut oil was found to be of highest SPF value.

INTRODUCTION

Herbal medicines are the medicines in which active ingredients are made from plant parts like leaves, roots, and flowers. Creams are semi-solid dosage form containing more than 20% water or volume components and typically less than 50% hydrocarbons, waxes or polyols as vehicles. Cosmetics are defined as “an item with mild action on human body for the purpose of cleaning, beautifying, and adding to the attractiveness, altering the appearance and keeping or promoting

the skin or hair in good condition.” Functional cosmetics can be defined as” an item fulfilling specific conditions like skin whitening, minimizing the appearance of lines in the face and body, protecting from the sun and sun-tanning.” The product sunscreen is also known as sunblock or suntan lotion. It is a photo-protective topical product for the skin that absorbs or reflect some of the UV radiations, help protect against sunburn and most importantly prevent skin cancer. Sunscreen is available in the form of lotion, spray,

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gels, foams (expanded foam lotion or whipped lotion), sticks, powders, and other such products. Many natural ingredients like sandalwood, sesame seed oil, sunflower oil, shea butter, jojoba oil, coconut oil, saffron, vitamin E etc. have properties

for protection against sun. Herbal sunscreen is a lotion, spray or a topical product which contains herbal ingredients for protection against UV radiations of the sun by lowering the risk of skin cancer [1]

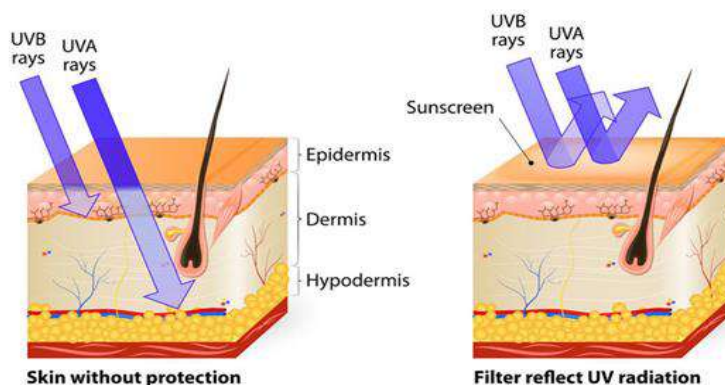


Figure 1: UV penetration in the skin

➤ **Classification of sunscreen: [2]**

1. Natural/ Systemic: Natural chemicals like polyphenols (flavonoids, tannins), carotenoids, anthocyanidins, few vitamins, triglyceride oils, volatile oils from vegetables, fruits, medicinal plant parts (leaves, flowers, fruits, berries), algae and lichens are more effective over synthetic chemicals which is due to their long-term beneficial effects especially against free radical generated skin damages along with UV-rays blocking. These are sunscreens that are absorbed into the body and accumulate in the skin affording protection from the UV-rays.

2. Organic: These sunscreens work by absorbing into skin and converting UV-rays into heat. Organic UV-filters such as benzophenones absorb UV radiation with excitation to a higher energy state. These are generally aromatic compounds linked with a carbonyl group. They are classified into 3 categories based on the range of protection; UV-B (290-320 nm), UV-A (320-400 nm) and broad-spectrum sunscreens that cover the entire spectrum (290-400 nm). Particularly, some organic filters (PABA, PABA derivatives and benzophenones) show considerable negative

effects including eczematous dermatitis, burning sensation and increased risk of skin cancer.

3. Inorganic: These are particles that scatter and reflect UV-rays back to the environment. They act as physical barriers to incident UV-light and ultraviolet. The two primary inorganic UV-filters are Zinc oxide (ZnO) and Titanium oxide (TiO₂) white particles which are used in the cosmetic and pharmaceutical industries. The current agents are ZnO, TiO₂, calamine, ichthammol, talc and red veterinary petroleum. Although, they are generally less toxic, more stable and safer for human than those of organic ingredients, they are visible due to white pigment residues left on the skin.

➤ **Advantages of Sunscreen:**

- Easily available
- cost-effective
- No side effects.
- Don't provoke allergy.
- Easy to manufacture.
- Non-toxic & Non-irritant
- Neutral
- and stable to heat

➤ Benefits of sunscreen:

- Reduce risk of skin cancer
- Protect against sunburns.
- Avoid inflammation.
- Avoid hyperpigmentation.
- Avoid early onset of wrinkles.
- Maintain the look & texture of skin.
- Delay premature signs of ageing.
- Reflects harmful
- UV-A and UV-B rays.

➤ Ideal characteristics of sunscreen: [3]

- Absorb the light preferentially over the range of 280 nm-320 nm.

- Absorb a broad range of UV rays causing sunburn.
- Non-toxic, non-irritant, and non-sensitizing.
- Safe, effective, and chemically inert at low concentration.
- Capable of retaining sunscreen property for several hours.
- Provide complete protection to the skin.
- Not be easily washed away by water (Water-resistant)
- Stable in presence of sunlight.

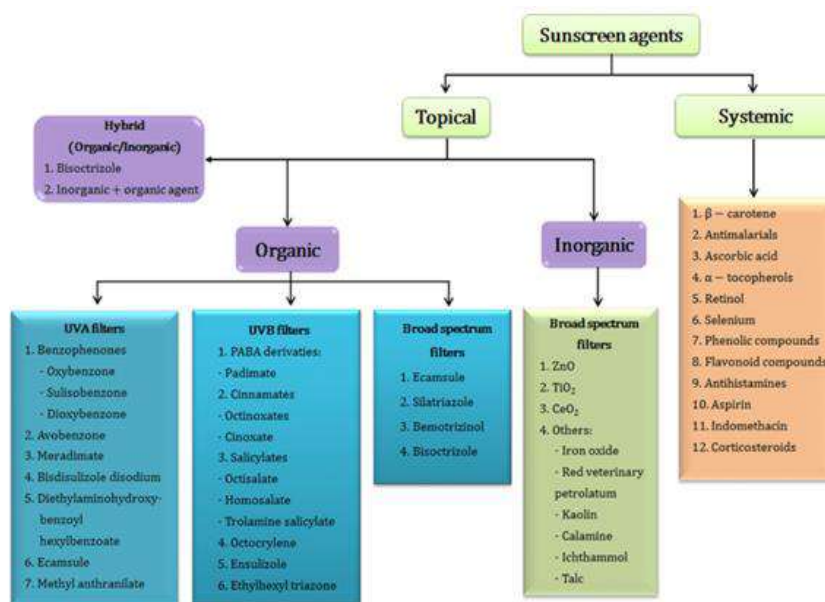


Figure 2: Types of sunscreen

MATERIAL AND METHODS

AIM: The aim was to study the formulation and evaluation of herbal sunscreen using natural herbs. It comprehends to develop sunscreen formulation using herbal ingredients. Moreover, it also focuses to achieve maximum UV-protecting effects & maximum stability of the formulation.

Work Schedule:

- To collect the marketed Almond oil, Sesame seed oil and walnut oil.
- Cream base preparation
- Formulation of herbal sunscreen cream (incorporate natural oils)

- Determination of SPF Value
- Evaluation of prepared creams on the basis of various parameters.

Materials:

Stearic Acid (Research Lab-fine Chem Industries, Mumbai), Cetyl alcohol (Burgoyne Burbidge's &Co), NaOH (Pallav Chemicals & Solvents Pvt. Ltd.), Glycerin (Burgoyne Burbidge's &Co), Triethanolamine (S d Fine – Chem Limited), Almond oil (Hamdard Laboratories, India), Sesame oil (P.P. Oil Pvt. Ltd.), Walnut oil (Essentia Extracts), Methyl Paraben (Research Lab-fine Chem Industries, Mumbai),



Vitamin-E capsule (Procter & Gamble Health Chloroform LR (S d Fine – Chem Limited Ltd.), Distilled Water (College Laboratory), ,SDFCL).



Figure 3: Oils used in preparation of herbal sunscreen

METHOD OF PREPARATION: [4]

Step I: Aqueous phase

- Water-soluble components like methyl paraben and NaOH pellets were added in desired amount of water.
- Stir well until they are completely dissolved in water.

Step II: Oil phase

- Glycerin and triethanolamine were taken in a beaker.
- Oil phase was prepared by heating stearic acid and cetyl alcohol at suitable temperature.

- Natural oils and Vitamin-E capsules were added.

Step III: Emulsion

- Oil phase was added to aqueous phase at 80 °C with continuous stirring.
- It was homogenized till uniform emulsion is formed.
- The finished product was poured into the wide mouth container.
- The container was well-labelled and stored at room temperature.

Formulation:

Sr. No	Ingredients	Uses	F1	F2	F3	F4	F5
1	Stearic acid (g)	Emollient	3	3	3	3	3
2	Cetyl alcohol (g)	Thickener	2	2	2	2	2
3	NaOH (g)	Maintain pH level	0.5	0.5	0.5	0.5	0.5
4	Glycerine (ml)	Moisturizer	0.5	0.5	0.5	0.5	0.5
5	Triethanolamine (ml)	Reduce acidity	0.5	0.5	0.5	0.5	0.5
6	Methyl paraben (g)	Preservative	0.002	0.002	0.002	0.002	0.002
7	Sesame seed oil (ml)	Complexion, protection form UV-rays	2	2.5	3	3.5	4
8	Walnut oil (ml)	Hydration, protection from UV-rays	2	2.5	3	3.5	4
9	Almond oil (ml)	Emollient, protection from UV-rays	2	2.4	3	3.5	4
10	Water (ml)	Vehicle	q.s.	q.s.	q.s.	q.s.	q.s.
11	Vitamin-E capsules (ml)	UV-B protectant	1	1	1	1	1
Total			25 g	25 g	25 g	25 g	25 g



Figure 4: Formulated sunscreen cream

Evaluation: ^[5]

- **Organoleptic characteristics:** Parameters like Appearance, Color, Odor, Homogeneity, Consistency and Texture were evaluated by visual interpretation.
- **Spread ability:** Excess of sample was placed between two glass slides. 100 g of weight was placed on the glass slide for 5 min to compress the sample to a uniform thickness. The time required to separate the two slides was taken as a measure of spread ability. The results were recorded. Spread ability is calculated by using formula- $S = M \times L / T$, where S=spread ability, M=weight tied to the slide, T=time, L=length of glass slide.
- **Washability:** It was determined by rubbing the little amount of cream on hand which was later washed under the running tap water.
- **pH:** For evaluation, all the formulations were oil in water semi-solid emulsions. As pH of the cream cannot be directly measured, 10% dilutions were made with distilled water and the pH was determined by using digital pH meter.
- **Rancidity:** For evaluation, 10 ml of melted cream wax taken and added to 10 ml of concentrated hydrochloric acid along with 10 ml Phloroglucinol solution. The mixture was shaken well for one minute. The material shall be taken to have passed the test if no pink color is developed.
- **Viscosity:** Viscosity of the cream was determined by Brookfield viscometer. The correct spindle was selected (spindle no.4) for the given product and the operating conditions

were set up. Then, the viscosity was directly measured at 6 rpm speed by keeping the torque constant. The mean was obtained. The viscosity is determined by the formula-

Viscosity=Dial Reading $\times$ Factor (for LV-4 at 6 rpm, factor is 1M)

- **Loss on drying:** 1 g of formulated cream was taken in a porcelain dish, allowed to dry in hot air oven at 100 °C for 30 minutes. Two consecutive values after drying at the interval of 30 min were recorded and kept in desiccator for 15 min and LOD was determined.

In-vitro SPF Determination: ^[6]

- **Sample Preparation-** 1 g of sample was weighed, transferred to 100 ml volumetric flask, diluted to volume with ethanol followed by ultra-sonication for 5 min and then filtered through cotton, rejecting the first 10 ml. A 5 ml aliquot was transferred to a 50 ml volumetric flask and diluted to volume with ethanol. Then, 5 ml aliquot was transferred to 25 ml volumetric flask and the volume was completed with ethanol. Thereafter, absorbance values of each aliquot prepared was determined from 290-320 nm at 5 nm interval, taking the ethanol as a blank. The measurements were taken thrice, and the determinations were made at each point, followed by application of Mansur equation as- $SPF_{(spectrophotometric)} = CF \times \sum EE(\lambda) \times I(\lambda) \times Abs(\lambda)$

Where, CF=correction factor (10), $EE(\lambda)$ = Erythrogenic effect of radiation with wavelength λ , $Abs(\lambda)$ = spectrophotometric absorbance values at wavelength λ . The values of $EE \times I$ are constant, they were determined by Sayre et al.

SPF Determination- The aliquots prepared were scanned between 290-320 nm and the obtained absorbance values were multiplied with the respective $EE(\lambda)$ values. Then, their summation was taken and multiplied with the correction factor (10). Data was expressed as mean $\pm$ S.E.M.

		F1		F2		F3		F4	
Wave length (λ)	EE (λ) $\times$ I (λ)	Abs (λ)	EE (λ) $\times$ I (λ) $\times$ Abs(λ)	Abs (λ)	EE (λ) $\times$ I (λ) $\times$ Abs(λ)	Abs (λ)	EE (λ) $\times$ I (λ) $\times$ Abs(λ)	Abs (λ)	EE (λ) $\times$ I (λ) $\times$ Abs(λ)
290	0.015	1.123	0.01685	1.389	0.02084	1.186	0.01779	0.298	0.00447
295	0.0817	1.276	0.10425	1.475	0.12051	1.248	0.10196	1.247	0.10188
300	0.2874	1.395	0.40092	0.863	0.24803	1.365	0.39230	1.362	0.39144
305	0.3278	1.189	0.38975	0.773	0.25339	1.166	0.38221	0.753	0.24683
310	0.1864	0.886	0.16515	0.849	0.15825	0.893	0.16646	0.649	0.12097
315	0.0837	0.915	0.07659	1.295	0.10839	0.765	0.06403	0.795	0.06654
320	0.018	0.864	0.01555	0.942	0.01696	0.589	0.01060	0.295	0.00531
Total		1.16906		0.92636		1.13536		0.93745	
SPF		11.69		9.26		11.35		9.37	

RESULTS

Determination of Evaluation parameters of prepared sunscreen cream:

Parameters	F1	F2	F3	F4	F5
Appearance	Cream like	Cream like	Cream like	Cream like	Oily
Color	Bright white	Slightly white	Slightly white	Yellowish white	Yellowish white
Odor	Characteristic	Characteristic	Characteristic	Characteristic	Characteristic
Homogeneity	Uniform and homogenous	Uniform and homogenous	Uniform and homogenous	Uniform and homogenous	Non-uniform and non-homogenous
Consistency	Good	Good	Good	Good	Poor
Texture	Smooth	Smooth	Smooth	Smooth	Smooth
Irritation	No	No	No	No	No
Spread ability	23.23	20.91	22.38	21.86	20.08
Wash ability	Good	Good	Good	Good	Good
pH	8.40	8.07	9.08	8.97	9.16
Rancidity	No pink color, no rancidity	No pink color, no rancidity	No pink color, no rancidity	No pink color, no rancidity	No pink color, no rancidity
Viscosity	46900	42648	44652	42879	44915
SPF	0.64	0.08	1.36	0.78	ND
LOD	11.7%	11%	11.3%	4.4%	3.4%

CONCLUSION

It can be concluded that there is great market potential for sunscreen chemicals either synthetic/natural or in combination due to awareness of protection from hazardous UV-A as well as UV-B rays. Photo stable, uniform UV-A/UV-B protective sunscreen product with high SPF can be minimum ideal requirement but natural chemicals like poly phenols (flavonoids, tannins), carotenoids, anthocyanidines, few vitamins, fixed oils and volatile from vegetables, fruits, medicinal

plant parts, algae and lichens are more effective due to their long-term beneficial effects especially against free radical generated skin damaging along with UV-rays blocking. These natural oils incorporated sunscreens might provide cost effective, truly broad-spectrum sunscreen products with skin protective effects.

The study aimed to formulate and develop herbal sunscreen cream using walnut oil, almond oil, and Sesame oil in combination. The formulation F1, F2, F3, F4, & F5 were prepared by varying the



composition & evaluated for their physicochemical properties and SPF. The study shows that formulation F1 having all three extract of sesame oil, almond oil, walnut oil was found to be of highest SPF value.

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