WORLD JOURNAL OF PHARMACEUTICAL RESEARCH
SJIF Impact Factor 8.084
Volume 12, Issue 15, 142-151. Review Article ISSN 2277– 7105

THE REVIEW ON FORMULATION AND EVALUATION OF SUNSCREEN CREAM

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Article Received on
06 July 2023,

Revised on 26 July 2023,
Accepted on 16 August 2023

DOI: 10.20959/wjpr202315-29400

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ABSTRACT

UV radiation from the sun causes skin cancer, sunburn, skin irritation, hyperpigmentation, and photo-aging. To prevent from these diseases sunscreen has been used, which provide protection from the UV radiation. The sunscreen cream can be synthetic, natural or combined. The sunscreen cream is formulated and evaluated by using different parameters such as appearance, color**,** odor, P^H, viscosity, spreadability, solubility, hygroscopicity, rancidity, skin irritation test, in vitro evaluation by UV spectroscopy, and sun protection factor (SPF). The SPF is the major evolutionary test for the sunscreen cream, which is used to determine the efficiency of the cream to provide barrier against the UV radiation. In this review paper the different types of preparation for the cream was discussed, procedures to perform the various evaluation tests, ingredients such as oil phase, water phase, and additives used for the preparation of the cream. We provide information about effects of UV radiation and formulation and evaluation of sunscreen cream for the protection from the UV radiation.

KEYWORDS: Sunscreen cream, UV radiation, SPF, Protective.

INTRODUCTION

Sunscreen is a cosmetic preparation that is used to actively reflect (Physical blocker) or absorb (Chemical absorber) sunlight, especially in areas with ultraviolet wave emission, so that it can prevent skin disorders due to UV.[11] The skin is the primary defensive barrier of our body thatprevents the invasion of external environmental pollutants, including UV radiation and environmental chemicals. Oxidative stress is the primary cause of extrinsic aging or photoaging, caused mainly by UV radiation. The principal effects of UV radiation in the skin are DNA damage, oxidative stress, deleterious impact on the extracellular matrix, inflammation, and immunosuppression. Therefore, to prevent UV-induced damage, the treatment of the skin with products containing functional antioxidant ingredients may be one of the useful strategies. Furthermore, the use of formulation containing both sunscreen chemicals and naturally occurringantioxidants may be the most instructive for more effective protection of skin photodamage.[12] Sunlight is composed of wavelengths ranging from ultraviolet light to visible light. Ultraviolet (UV) is divided into UVA (320-400nm), UVB (290-320nm) and UVC (100-290nm). Exposure tosolar radiation has negative effects on the human skin.[18] Many studies are currently being conducted on plant chemicals that have the potential to be used as active ingredients since they are safer and easier to accept by the general public.[11] Compared to artificial sunscreens, natural sunscreens with strong UV absorptive capacities are largely limited by low specific extinction value and by their inability to spread in large scale sunscreens cosmetic application. Sunscreens are best alternative safeguards against UV irritation.[20] The choice of sunscreen as a cream dosageform is because the cream has advantages besides being easy apply, more comfortable to use on the skin, not sticky, and easy to wash with water, especially oil-in-water types of cream.[11]

Advantages

- Sunscreen cream shields from harmful UV rays.
- It prevents premature aging.
- It decreases the risk of skin cancer.
- It prevents sunburn.
- Prevents tanning induced by UVB.[29]

Disadvantages

- PABA in sunscreen can cause a high rate of allergic reaction. It can make Acne worse. It may cause pain in hairy areas. Sometimes cause pus in the hair follicle.[28]

MATERIALS

The chemicals used were oil phases such as emulgide,[10] stearic acid,[10] cetyl alcohol,[10] liquid paraffin,[10] coco butter,[9] shea butter,[9] sweet almond oil,[9] tea tree oil,[4] grape seed oil,[4] coconut oil,[4] tween 80,[9] bees wax[4] etc. The water phases such as glycerin,[9] triethanolamine,[10] deionized water,[9] distilled water, rose water.[4] Additives such as methyl paraben,[10] sea wood extracts,[10] moringa powder.[10]

Methods of preparation

1. **Trituration**

- ✓ This method is used for finely divided insoluble powder particles or liquids insoluble powder are added by geometric dilutions liquids are added by making well in center.
- ✓ Air pocket formation avoided. Involved the use of glass slab when small quantities are used mortar and pestle used when we have large quantities.

2. **Levigation**

- ✓ Incorporation of insoluble coarse particles. Also known as “wet grinding”. Insoluble coarse powder is rubbed with molten base or liquid or a semi solid base.
- ✓ Considerable shearing force is applied to avoid grittiness.

3. **Fusion method**

- ✓ The fusion method is followed when the drugs and other solids are soluble in the cream base. The base is liquefied, and the soluble components are dissolved in the molten base.
- ✓ The congeal mixture is then speculated or triturated to obtain a smooth texture. Care is taken to avoid thermal degradation of the base or other components during the fusion process

4. **Mechanical method**

- ✓ Water-removable creams are basically hydrophilic type emulsions.
- ✓ Hydrophilic emulsifying agent is included in the aqueous phase in order to obtain stable oil-in-water dispersion.

Evaluation of cream

1. **Colour**

To determine the color of the compound, 0.2 g of the material was placed against white background in diffuse day light, viewed by eye and its color should be determined accordingly.[9]

2. Odour

To determine the odor of the compound, 0.4 g of the material was placed in a 5cm diameter watch glass, left for 15 minutes and there after the air above the sample was inhaledslowly and repeatedly. The strength of the odor was determined by classifying it as either non- existent, weak, distinct or strong and the odour sensation described as either aromatic, fruity, musky, mouldy or rancid.[9]

3. Solubility

The solubility of the material was described using the common descriptive phrasesof solubility and the corresponding quantitative solubility ranges given in the BP 2013 and expressed in the terms of "parts", which represented the number of milliliters (ml) of the solvent,in which 1g of solid was soluble. (Table 1)[9]

Table 1

Descriptive phrase	Approximate quantities ofsolvent by volume for 1 part of solute by weight
Very soluble	Less than 1 part
Freely soluble	From 1 to 10 parts
Soluble	From 10 to 30 parts
Sparingly soluble	From 30 to 100 parts
Slightly soluble	From 100 to 1000 parts
Very slightly soluble	From 1000 to 10000 parts
Partially soluble	More than 10000 parts

4. Hygroscopicity

To determine the hygroscopicity, first weigh the empty China dish and weigh the China dish with sample. Place the sample in electric oven and maintain the temperature for 24 hours, again weigh the dry sample. (Table 2).[9]

$$Hygroscopicity = \frac{Weight\ of\ the\ sample\ (in\ atmosphere) - Oven\ dry\ weight}{Oven\ dry\ weight}$$

Table 2

Classification	% water uptake at 25 c % rh[w/w]
Non hydroscopic	0-0.12
Slightly hydroscopic	0.2-2
Moderately hydroscopic	2.0-15.0
Very hydroscopic	>15.0

5. Spreadability

The spreadability of the sunscreen determined their therapeutic efficacy. The appropriate amount of sample was applied between two slides, and under specified load direction,and the two sides took the time in seconds to slide off. Spread ability was defined as the amount of time to take separate two slides in less time.

$$S = M \times \frac{L}{t}$$

Where, M = weight tied to upper slide

L = length of glass slide

T = time taken to separate the slides.[8]

6. Determination of viscosity

The Brookfield viscometer (RVD-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 rpm was set. Herbal sunscreen cream's viscosity was measured at 5,10,20,50, and 100 rpm. The viscosity was computed using the factor obtained from the reading.[8]

7. Determination of P^H

The P^H of sunscreen was determined using a digital P^H meter. P^H was measured after 1gof the formulation was dissolved in 100 ml of newly prepared distilled water for two hours. The purpose of this study was to guarantee that the P^H of the produced sunscreen is similar to the P^H ofthe skin (5.4-5.9) after 24 hours of use.[8]

8. Rancidity

Rancidification is the process of complete or incomplete oxidation or hydrolysis of fats and oils when exposed to air, light or moisture or by bacterial action, resulting in an unpleasant taste and odor. Rancidity is performed by using the phloroglucinol solution. The rancidity is due to the oxidation of the fats and oils; during oxidation free fatty acids are liberated. These free fattyacids react with phloroglucinol solution and give pink color indicating the rancidity of the product. 10 ml of cream was taken then added 10 ml of concentrated Hydrochloric acid and 10 ml of phloroglucinol solution and shaken for one minute. The cream should have passed the test if no pink color develops.[4]

9. Skin irritation test

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 back of the rats on one of the study days, and 5cm^2 of the area was marked on both sides, with one side serving as a control and the other side being tested.[8]

10. In vitro evaluation by uv spectroscopy

1 gm quantity of formulated cream was weighed, transferred to 100 ml of volumetric flask and diluted to volume with n-butyl alcohol. Further, it was kept for ultra-sonication for 5 minutes and filtered through a cotton filter, discarding the initial 10 ml. Afterwards 5 ml aliquot was transferred to 25 ml of volumetric flask and the volume was adjusted with n-propyl alcohol. The absorption spectra of samples should be in the range between 290-400nm using 1cm quarts cell and n-butyl alcohol as blank solution.[4]

11. Determination of sun protection factor (SPF)

The efficacy of a sunscreen is usually expressed by the sun protection factor (SPF), which is defined as the UV energy required to produce a minimal erythema dose (MED) on protected skin, divided by the UV energy required to produce a MED on unprotected skin.

$$SPF = \frac{minimal\ erythema\ dose\ in\ sunscreen-protected\ skin}{minimal\ erythema\ dose\ in\ nonsunscreen-protected\ by\ skin}$$

The minimal erythemal dose (MED) is defined as the lowest time interval or dosage of UV light irradiation sufficient to produce a minimal, perceptible erythema on unprotected skin (wood et al., 2000; wolf et al., 2001)

The higher the SPF, the more effective is the product in preventing sunburn.

Nevertheless, it is necessary to standardize method to determine the SPF of the products.

The photoprotection offered by topical sunscreen against solar ultra violet radiation exposure can be determined in vitro or in vivo, and it is ideally determined by photo testing in human volunteers. This type determination has been used for many years and although useful and precise, is a time consuming process, complex and expensive, particularly information concerning to the protection against long wavelength (UVA) is required (Azevedo et al.,

1999; Gasparoo et al., 1998). As a consequence, much effort has been devoted to the development of in vitro techniques for assessing the photoprotection of sunscreen compounds.

The methods in vitro are two types. Methods which involve the measurement pf absorption or transmission of UV radiation through sunscreen product films in quartz plates or bio-membranes, and methods in which the absorption characteristics of the sunscreen agents are determined based on the spectrophotometric analysis of dilute solutions (Fourneron et al., 1999; Gordon et al., 1993; Mansur et al., 1986; Pissavini, M et al., 2003; Walters et al., 1997).

Mansur et al., (1979)), developed a very simple mathematical equation which substitutes the in vitro method proposed by Sayre et al., (1979), utilizing UV spectrophotometry and the following equation;

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

Where;

EE - Erythemal effect spectrum,

I - Solar intensity spectrum,

Abs - Absorbance of sunscreen product,

CF - Correction factor (=10)

The values of EE×I are constants. They were determined by Sayre et al.,(1979), and shown in the table:3[19]

Table 3

Wavelength (λ nm)	EE×I (normalized)
290	0.0150
295	0.0817
300	0.2874
305	0.3278
310	0.1864
315	0.0839
320	0.0180

CONCLUSION

Due to increased knowledge of the need for protection of skin from the sun, it can be stated that the market for sunscreen chemicals, whether synthetic, natural, or combined, has a large potentials.[7] UV radiation causes various damaging effect on the skin. It causes skin cancer, hyperpigmentation, photo-aging, sunburn and skin irritation. Herbs are eco-friendly and compatible compared to the synthetic ones.[4] The use of natural sunscreen has been gaining significant attention of researches due to their safety, multiple biological actions on the skin and cost effectiveness. We have concluded that a good sunscreen cream should passes the abovementioned mentioned evaluation parameters, for the safety of the patients.

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