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# A REVIEW ON SUNSCREENS

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## ABSTACT

Sunscreen, also known as Sun-block or Sun creams, is a photo protective topical product for the skin that helps to protect against sunburn and prevents skin cancer. The purpose of sunscreen preparations is to minimize the harmful effects of sunburn. The materials that are used for the above purpose are known as sun tanning agents and sun burn preventive agents respectively. The relative effectiveness of sunscreen agents to protect the skin is determined by Sun Protection Factor (SPF). It offers protection against both UVA and UVB rays. In the market, it is available as creams, gels, lotions, sprays, sticks etc. The review describes the importance of sunscreen in the current scenario.

**KEYWORDS**: Sunscreen, Sunscreen index, Sun Protection Factor.

## 1.1 INTRODUCTION

Sunscreen, also known as Sun-block or Sun creams, is a photo protective topical product for the skin that helps protect against sunburn and most importantly prevent skin cancer. Skin is the largest and outer part of body, which is directly exposed to sunlight. Sunlight is vital for all living beings; it is required for formation of vitamin D,

circulation of blood, formation of haemoglobin,etc. exposure of sunlight on human body may exhibit beneficial and harmful effects depending upon length and frequency of exposure. The purpose of sunscreens (anti-sunburn and suntan) preparations is to assist the skin painful effects and purpose of the anti-burn preparations is to minimize the harmful effects of sunburn. The materials which are used for the above purpose are known as sun tanning agents and sun burn preventive agents respectively. In combination these are known as sunscreens (also known as sun-block, suntan lotions).

Sunrays reaching to the surface of the earth contains visible ray, ultraviolet rays with shorter wavelength and infrared rays with longer wavelength. Ultraviolet rays particularly below 320nmare responsible for most of the therapeutic as well as most of the detrimental effects of sunrayson human body that depends on length and frequency of exposure, intensity of the sunlight and individual sensitivity also concerned.[1]

UV radiation has broad spectrum, ranging from 40 to 400 nm, which is divided into vacuum (40- 190nm), far UV (190-220nm), UVC (220-290), UVB (290-320nm), and UVA (320-400nm), of which the latter two are medically important. There are two distinct subtypes of UVA radiation. Short wave UVA (320-340nm), and long-wave UVA (340-400nm), the latter constituting most of UV radiation. Effects of UVA manifest usually after a long duration of exposure, even if doses are low. It has been postulated that UVA up regulates the formation of matrix metalloproteinase (MMPs), enzyme that degrade the matrix protein's elastin and collagen, which, if not prevented, can result in marked reduction in skin elasticity and increased wrinkling. UVA radiation damages skin by penetrating into layers of skin and producing reactive oxygen resulting in acute and chronic changes. UVA radiation can induce polymorphous light eruptions (PMLE) in sensitive skin, but in some it has also shown reduce PMLE. UVA can also cause exacerbation of cutaneous lupus erythematosus, whereas solar urticaria can be cause by both UVA and UVB radiation. With the increased incidence in skin cancer cases, such as squamous and basal cell carcinomas reported worldwide, use of photoprotective agents has increased over years. There has been symptomatic improvement and inhibition of reoccurrence of these conditions when photoprotective agents are used either therapeutically or prophylactically, indicating the need to promote and regularize their application.[2]

Sunscreen was first commercialized in the United States in 1928 and has been expanded worldwide as an integral part of the photoprotection strategy. Over the decades of

development, sunscreen have been improved step-by-step, accompanying the innovation of photoprotective agents. The utilization of sunscreens (also referred to as sun protectants) for protection against the harmful effects of the sunrays has been increasing over the last few decades. This may have resulted from the increased awareness about the potentially harmful effects that arise from repeated exposure to the sun. Repeated sun exposure increases the risk of three types of cancer: melanoma, basal cell carcinoma, and squamous cell carcinoma with melanomas causing higher mortality while the non-melanoma skin cancers are associated with higher morbidity and aesthetic skin damage. People with black skin are much less susceptible to sunburn than white- skinned individuals. A significant benefit from regular sunscreen use has not yet been demonstrated for primary prevention of basal cell carcinoma and melanoma. Some organic UV filters (PABA derivatives, cinnamates, benzophenones and octocrylene) have been described to cause photo allergy.

The formulation and science of sunscreens have also evolved along with improvements in the scientific knowledge and technologies to improve the formulation characteristics in both efficacy, safety, and aesthetic appeal. Increased incidence of skin melanomas has attracted regulatory concerns on the quality of sunscreens resulting in higher demands from authorities regarding the quality of sunscreen products. The development of sunblock began with the discovery of negative health effects of prolonged exposure to UV rays.[3]

Photoprotective agents protect the skin by preventing and minimizing the damaging effects of ultraviolet (UV) rays of natural light. It has been observed that sunscreens increase skin'stolerability to UV rays. Sunscreens contain chemical (organic) or physical (inorganic) compounds that act to block ultraviolet radiation.

### 1.2 INDICATIONS FOR THE USE OF SUNSCREEN

The common indications for the use of sunscreen in dermatology are in the prevention and management of:

- Sunburn.
- Freckling, discoloration.
- Photoaging.
- Skin cancer.
- Phototoxic / photoallergic reactions.
- Photosensitivity diseases.

- Polymorphous light eruption (290 - 365nm).
- Solar urticaria (290 - 515nm).
- Chronic actinic dermatitis (290 - visible).
- Persistent light reaction (290 - 400nm).
- Lupus erythematosus (290 - 330nm).
- Xeroderma pigmentosum (290 - 340nm).
- Albinism.

- Photo aggravated dermatoses.
- Post – inflammatory hyperpigmentation (post- procedure).

### 1.3 IDEAL CHARACTERISTICS OF SUNSCREENS

In order to ensure optimal patient compliance, an ideal sunscreen would be:

- Cosmetically elegant.
- Non- comedogenic. Non- irritant.
- Hypoallergenic. Substantive.
- Economical.
- Capable of retaining sun- screening property for several hours. Should be easily washed out away with water.
- Must be stable in the presence of sunlight.[4]

### 1.4 ADVANTAGES

- Offers protection against both UVA and UVB rays and is naturally broad spectrum.
- Protect from sun as soon as it is applied.
- Last longer when in direct UV light.
- Less likely to cause stinging irritation on the skin, making it better for sensitive skin.
- Better for those with heat-activated skin since it deflects the heat and energy given off by the sun away from skin.
- Less likely to be pore-clogging, making it ideal for blemish-prone skin type.
- Less is needed to protect the skin because there is no risk of no spaces between the sunscreen molecules after applied.
- Tends to be thinner and, therefore, spreads more easily on the skin, making it more wearable for daily use.

### 1.5 DISADVANTAGES

- It can be rubbed off, sweat off and rinsed off easily means more frequent reapplication when outdoors is needed.
- May leave a whitish cast on the skin, making some formulas incompatible for medium to dark skin tones.
- It is too chalky and opaque for daily use under makeup.
- It can be thicker, which will require more effort to rub in.
- It may show white drips on skin when sweats.
- Create an occlusive film, which result in increased perspiration during physical activities and therefore causes it to wear off more quickly.
- Cause brown spots and discoloration due to higher internal skin temperature.
- It requires 20 min after application before it begins to work.
- Increased chance of irritation and stinging due to multiple ingredients combined in order to achieve broad spectrum UVA and UVB protection.

### 2.1 CLASSIFICATION OF SUNSCREENS

The last FDA sunscreen monograph was issued in 1999, with a list of 16 approved sunscreen agents. It recommends that sunscreen be classified as organic and inorganic, replacing the previously used terms ‘chemical’ and ‘physical’ respectively. There are three commonly used nomenclatures for sunscreen agents in the world. These are the International Nomenclature Ingredients (INCI) Name, United States Adopted Name (USAN) & Trade name.[5]

| |
|---|
| **1. Inorganic Sunscreen** |
| **2. Organic Sunscreen** |

#### 2.1.1 INORGANIC SUNSCREEN OR PHYSICAL SUNSCREEN

Opaque formulation containing:

- Mineral components such as zinc oxide /titanium dioxide (and also talc, kaolin, ferricchloride, icthyol, red petroleum) sits on skin surface and reflects the UV rays.
- Immediate protection, no need to wait.
- Naturally broad spectrum. Provides protection against UVA &UVB rays.
- Also known as inorganic UV filters.
- Both the zinc oxide and titanium dioxide are white powders that are insoluble in the productbase therefore are suspended in such products.

**MECHANISM**

✓ Scatters and reflects UV radiation due to large particle size.

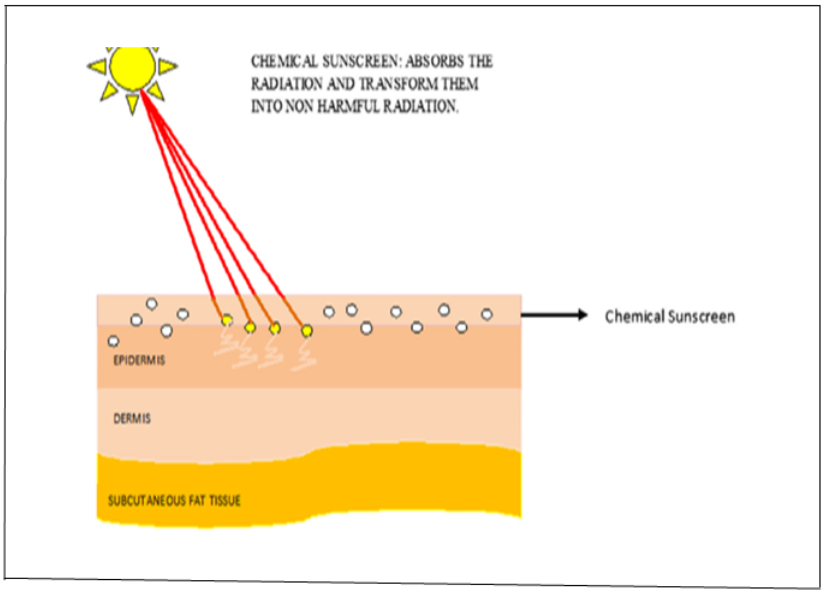



**Figure 1: Mechanism of Inorganic sunscreen.**

**ADVANTAGES**

- They can only penetrate the outer layer of the skin therefore they have an excellentsafety.
- They are photostable, independent of the sunscreen base and other ingredients.
- Provide a broad-spectrum protection since they reflect and scatter both UVA and UVB radiations.
- Titanium oxide provide UVA and UVB II protection.
- Zinc oxide provides protection against UVB, UVA II, and UVA I radiations.

**DISADVANTAGES**

- They reflect and scatter UV radiation into visible spectrum (>400nm), which provide a whiteappearance on the skin after application and therefore cosmetically less appealing.
- Sunscreen products contain nanoparticles no longer reflect visible light and therefore, do notappear white but transparent on the skin.
- Today, $TiO_2$ and ZnO are commonly used in micronized (1-100µm) and nanonized (1-100µm) forms for an aesthetically more appealing cosmetic look.

**2.1.1. ORGANIC SUNSCREEN OR CHEMICAL SUNSCREEN**

It is also known as organic filters. They are active ingredients that absorb UV radiations within a particular wavelength, depending on their chemical structure. Once the UV filter

absorbs energy, it moves from a low-energy ground state to a high-energy excited state. Form this excited state, any of the following three processes may occur, depending on the ability of the filter to process the energy it has absorbed:

**i.** Photostable filter: This type of filter dissipates its absorbed energy to the environment as heat energy, and return to the ground state. It is subsequently fully capable of absorbing UVenergy again.

**ii.** Photo unstable filters: The filter undergoes a change in its chemical structure, or is degradedafter absorbing UV energy. It is not capable of absorbing UV energy again.

**iii.** Photo reactive filter: In its excited state, the filter interacts with surrounding molecule, including other.

Formulation contains one or more:

- PABA, PABA esters
- Benzophenones
- Cinnamates
- Salicylates
- Digalloyl trioleate
- Anthranilates.
- It reacts with skin to absorb and convert UV rays into energy before they can cause any harm.
- Chemical reaction produces heat on outer skin. Not suitable for sensitive skin condition.
- Their molecular structure is responsible for absorbing UV energy.

Organic sunscreen is further classified into 3 types namely,

- UVB Filters.
- UVA Filters.
- New Generation Broad Spectrum (UVA + UVB).

**Table 1: Types of Organic sunscreens.**

| UVB FILTERS | UVA FILTERS | NEW GENERATION BROAD SPECTRUM (UVA + UVB) FILTERS |
|---|---|---|
| 1. PABA derivatives – padimate O.<br>2. Cinnamates – octinoxate, cinoxate. | 1. Benzophenones (UVB & UVA2 absorber) - oxybenzones, sulisobenzone, dioxybenzone.<br>2. Avobenzone or parsol (UVA1 | 1. Ecamsule.<br>2. Silatriazole.<br>3. Bemotrizinol. |

| | | |
|---|---|---|
| 3. Salicylates – octisalate, homosalate, trolamine salicylate.<br>4. Octocrylene.<br>5. Ensulizole. | absorber).<br>3. Meradimate (UVA2 absorber). | 4. Bisoctrizole. |

**MECHANISM**

- ✓ Absorbs UV radiations, which produce excitation of the sunscreen chemical to a higher energy state. Then, they return to the ground state and convert the absorbed energy into longer, lower energy wavelengths(heat).[6]

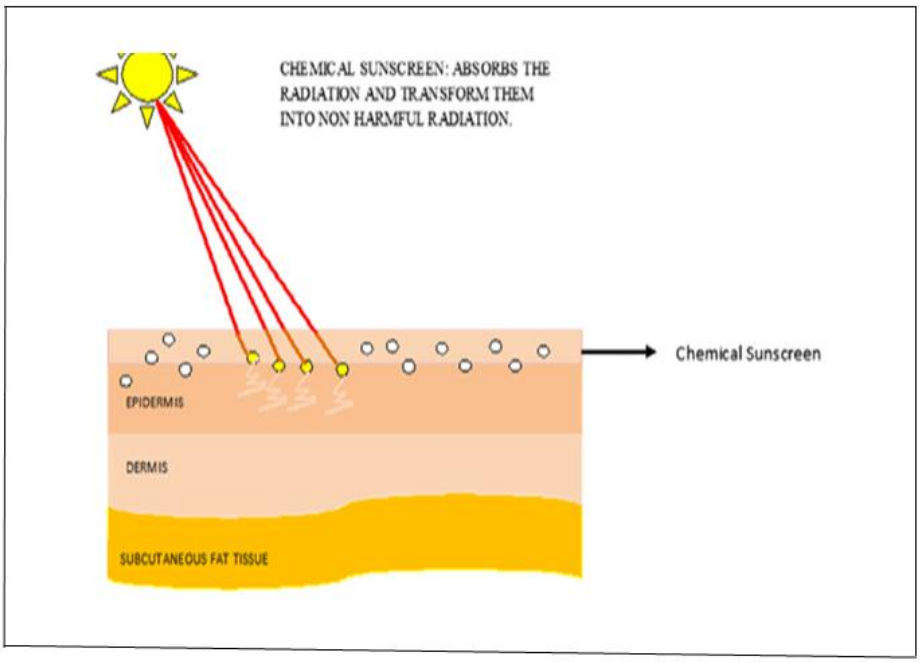



**Figure 2: Mechanism of Organic sunscreen.**

**ADVANTAGES**

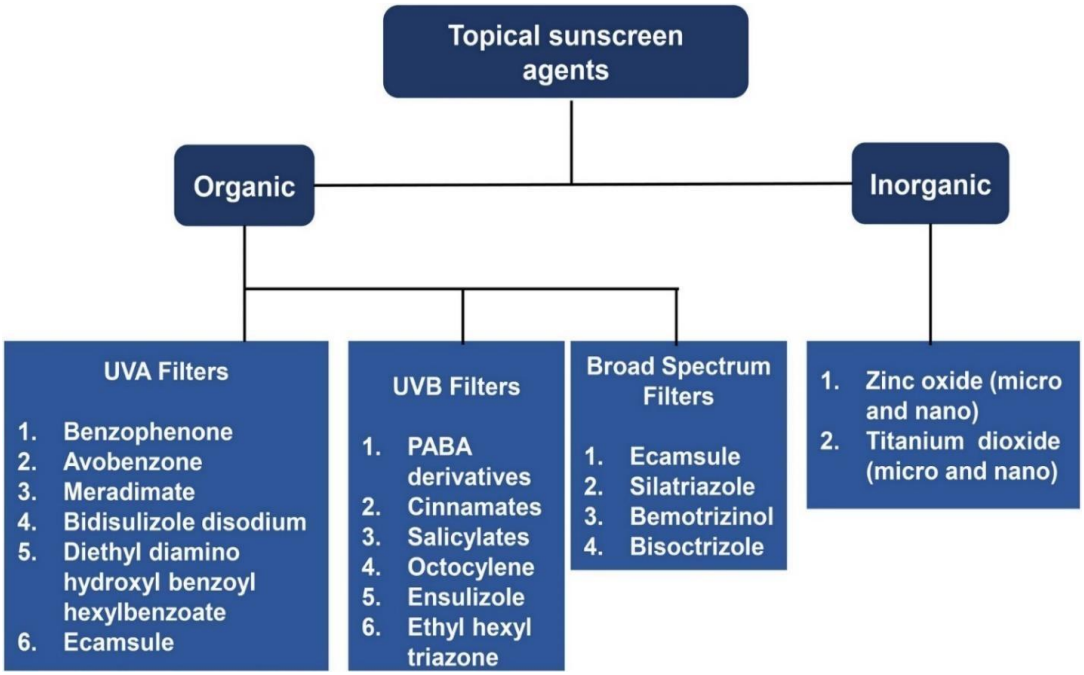
- Organic filters (e.g.: padimate O, oxybenzone) often combined with one another to achievethe desired broad-spectrum protection.
- It contains photo stabilizers, that help to prevent UV filters from losing their effectivenessin sunlight.

**DISADVANTAGES**

- Organic sunscreens can penetrate the skin due to their lipophilic nature, which may causesafety issues.

- Issues with photostability. Upon exposure to UV radiation, the structure of UV filters maybe negatively affected and/ or destructed.
- They lose their absorption capacity.

## 2.2 CLASSIFICATION OF SUNSCREENING AGENTS




## 3.1 SUNSCREEN RELATED INDICES

Patients complaining of worsening pigmentation or recurrent polymorphous light eruption in-spite of using sunscreens with 'good sun protection factor (SPF)' or "SPF > 50". In fact, in 2007, the FDA has proposed that the expansion of SPF be changed to 'sunburn protection factor' to indicate that it is only an index of protection against sunburn or UVB – induced erythema, and hence does not necessarily imply UVA or broad spectrum.

Various indices have been formulated by in vitro and in vivo methods to assess the efficacy of sunscreens with respect to specific components of the UV spectrum. These are as follows:

### 3.1.1 UVB SUNBURN PROTECTION FACTOR (SPF)

This term is defined by Plough Corporation to determine the relative effectiveness of sun screen agents to protect the skin. USFDA also recommended SPF as a means of numerically identifyingthe effects of products and guide customers about suitability of their type of skin. This is the ratiobetween UV exposure required to produce a minimally perceptible erythema on protected skin and the exposure that will produce the same erythema for unprotected skin.

The larger the SPF the greater is the sun protection. SPF rating number are in the range of 2-8. Sensitive individuals should use products of ultra protection category, i.e SPF of 15.

The UV -dose /time is used to calculate the SPF using:

| SPF = MED PROTECTED SKIN ÷ MED UNPROTECTED SKIN |
|---|

Where,

MED → Minimal Erythema Dose.[7]

**Table 2: Grading systems for SPF.**

| GRADE | SPF |
|---|---|
| Low | 2 – 15 |
| Medium | 15 -30 |
| High | 30 – 50 |
| Highest | >50 |

### 3.1.2 UVA PROTECTION FACTORS

**i. Japanese Standard (Minimal Persistent Pigment Darkening; *in vivo* method)**

| PFA = MPPD of Protected Skin / MPPD of Unprotected Skin. |
|---|

Where, PFA ⟶ Photoprotection Factor of UVA.

MPPD ⟶ Minimal Persistent Pigment Darkening.

**Photoprotection grades according to Japanese cosmetic industry association guideline.**

**Table 3: Photoprotection grades according to Japanese Cosmetic Industry Association Guidelines.**

| Photo Protection Factor of UVA Value | Protection Grade of UVA (PA) | Protection Level |
|---|---|---|
| 2 or more, but less than 4 | PA+ | **Low** |
| 4 or more, but less than 8 | **PA++** | **Moderate** |
| 8 or more | **PA+++** | **High** |

**ii. Australian / New Zealand Standard (*in vitro* method)**

- 8-µm layer of the product should not transmit more than 10% of radiation of 320 – 360 nm.
- 20-µm layer of the product should not transmit more than 1% of radiation of 320 – 360 nm.[8]

**iii. European Union Guidelines**

- UVA protection factor (persistent pigment darkening method) = 1/3 of SPF and Critical wavelength = 370 nm.

### 3.1.3 IMMUNE PROTECTION FACTOR (IPF)

Ability of sunscreen products to prevent UV induced immunosuppression. IPF is assessed by complex methods such as the ability of a sunscreen to inhibit either the sensitization or elicitationarm of contact or delayed type hypersensitivity reactions to allergens, nickel etc.[9]

### 3.2 TYPES OF SUNSCREEN FORMULATIONS

1. Emulsion formulation.
2. Gel based formulation.
3. Aerosol formulation.
4. Sun stick formulation.
5. Powder formulation.

### 3.2.1 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. It is normally produced from two unmixable liquid phases, namely “water-in-oil” emulsion. These possess the ability to spread more easily on the skin and disperse from bottle. 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.

E.g. Sunrider Oi- lin natural emulsion sunscreen SPF 30.


**Figure 3: Emulsified sunscreen formulation.**

### 3.2.2 GEL SUNSCREEN FORMULATION

It 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. The aqueous gel must be composed of water and solubilizer. 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. The hydro alcoholic gels are formulated by alcohol in conjugation 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. 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. However, they are not widely sold because they are difficult to produce and quite expensive.

E.g. Neutrogena Hydro boost ultra gel lotion sunscreen broad spectrum SPF 50.


**Figure 4: Gel sunscreen formulation.**

### 3.2.3 AEROSOL SUNSCREEN FORMULATION

In addition to lotions and creams, 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. However, this application may result in the uneven spreading of sunscreen agents corresponding to some high coverage areas with an excessive amount of sunscreen and other areas with little coverage to protect the skin satisfactorily. Nevertheless, the aerosol products have not

become as popular as other sunscreens due to some critical negative aspects. First, they are typically oil based, making them quite expensive and often reducing their effectiveness. In addition, it is hard observed where the sunscreen has been applied. Caution must be taken to avoid accidently spraying sunscreen into eyes.

E.g. Nivea Sun Protect & Moisture, Moisturizing spray SPF 50+.


**Figure 5: Aerosol sunscreen formulation.**

### 3.2.4 SUN STICK FORMULATION

It 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 petroleum and waxes. This form is subdivided into three categories, namely transparent, semi-transparent, and matte sunscreen. 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.

E.g., Dot & Key Skincare Strawberry Dew Sunscreen Stick SPF 50 / PA+ + + Broad Spectrum.


**Figure 6: Sun stick sunscreen formulation.**

### 3.2.5 POWDER SUNSCREEN FORMULATIONS

Powder sunscreen is a convenient and easy-to-apply sunscreen that mimics the texture of setting powder. It is lightweight, mattifies the skin, and is easy to use over makeup. However, it should be used as a reapplication or touch-up method every two hours after first applying a traditional, liquid sunscreen. To select the powdered sunscreen that's right for you, look for a formulation that is broad-spectrum, meaning it protects against both UVA and UVB rays and is at least SPF 30+ 1. E.g., Brush on Block SPF 30 Mineral Sunscreen.[10]


**Figure 7: Powder sunscreen formulation.**

### 4.1 FORMULATION

- Suitable sunscreen agents are used.
- Suitable base used to make a final product of an aqueous or alcoholic lotion, a fatty cream,oil or emulsion.
- Vehicle contributes to its effectiveness. E g. Deionized water.
- Emulsifiers used to keep formulation stable. E g. Cetosteryl alcohol.
- Glycerin can be used as moisturizer in some sunscreens
- Thickening agent to enhance consistency. E g cross polymer
- Certain natural oils that have high absorption ability of UV light are used. E g coconut oil,olive oil etc.
- An antioxidant is used to prevent rancidity by natural oils.
- Preservatives are also used. E g Sodium methyl paraben, Sodium propyl paraben.
- Perfumes.

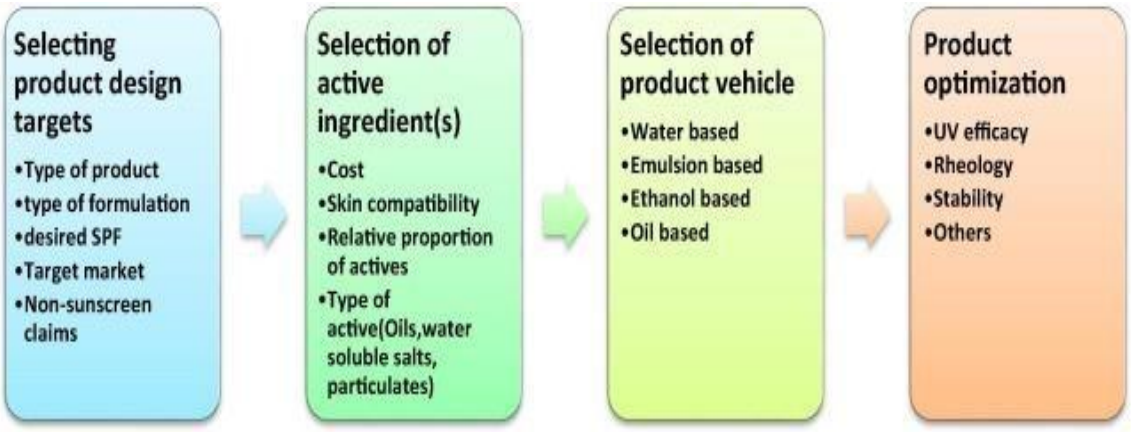



**Figure 8: Schematic representation of Formulation process.**

### 4.2 EVALUATION METHODS

1) Spectrophotometric Evaluation.
2) Sensitivity Test.
3) Sunscreen Index
4) Erythemal Dosage.

### METHODS

#### 4.2.1 Spectrophotometric Evaluation

This is to evaluate the UV radiation absorption ability of the sunscreen preparations with UV spectrophotometer. Other parameters can be calculated like concentration of the substance in the preparation, molar extinction coefficient or absorbency and compared with other substances.[11]

The intensity (I) of radiation of a given wavelength through a layer of absorbing material of thickness(t) and concentration (c) depends upon the intensity of incident radiation(I). This relationship is known as the Bouguer-Beer's Law, is given by the equation;

$$I = I_0 \, v^{-kte} \qquad \text{——————} \quad 1$$

Where *k* is a constant which depends upon the intensity of absorbing material. In logarithmic form, equation may be written as:

$$\ln I\text{-}/I_0 = -kte \qquad \text{——————} \quad 2$$

Where e is the optical density. The optical density of a film 1 cm thick (t=1) and containing

1gmore of absorber per 1000 ml (c=1) is the standard vale of the absorption coefficient *k*.

The ratio $-\frac{I-}{Io}$ give the fraction of incident relation transmitted through the film of absorber.

Equation (3) is more conveniently used with Briggsian logarithm, and becomes-

$$2.303\ e = \log I_0 / I = (2.303k)\ tc$$

$$A = \log I_0 / I = etc \qquad \text{——————————} \quad 3$$

Where A is the molar absorbency and E is the molar extinction coefficient. The molar extinction coefficient is a characteristic, intensive property of a pure compound and may be used to identifyan unknown screen in a sunscreen preparation.

### 4.2.2 Sensitivity Test

This test is performed directly on the rabbit's backside or abdomen. Sunscreen preparations are directly applied on these sites because these are very sensitive sites and these are kept for exposure to radiation along with control unprotected site for specific period of time. The effects are observed at the end of the period. Several factors or variables like radiation source, site of thetest field etc. to be taken care during the test as they may influence the results.

### 4.2.3 Sunscreen Index

Kumler proposed a method for evaluating the relative screening activity of sunscreen compounds. He proposes to compute $E^0_{o.1}$ cm 3080 Å. to obtain a figure of merit he calls the sunscreen index or S.I. This particular wavelength was chosen as the peak of the sunburn curve, and the S.I at this wavelength is taken to indicate the total efficacy of the sunscreen.

### 4.2.4 Erythemal Dosage

Primary interest of the cosmetic chemist is the estimation of erythemal effective radiation, or E – vitons /$cm^2$, transmitted by a sunscreen preparation. The erythemal energy is the product of the solar energy transmitted through the film and the effective factor at that wavelength. This can be computed by the relationship:

$$u\ W/cm^2 = I_S = I_{S0} \times I / I_0$$

$I_{S0}$ →fraction of wavelength

The summation of the u/W $cm^2$ for 50 Å wide bands centered from 2925 to 3375 Å gives theerythemal energy transmitted by the preparation.

$$E\text{ - vitons} / cm^2 = 0.1\ (u\ W/cm^2)_2 = 0.1$$

And the erythemal dosage for a given solar exposure would be given by:

$$E - \text{vitons} / cm^2 \times \text{sec exposure}$$

The physiological effects that should be observed with such a dosage, provides a first approximation of the effectiveness of the screen. However, it must be remembered that many other factors enter into the operation of the screen; stability, film thickness, film continuity, percutaneous absorption, and the effects of the skin milieu on the transmittance of the screen all can contribute to the variations in the actual behavior of the preparation. For comparative purposes, the term provides a preliminary figure of merits for different sunscreens preparations, the highest protection is afforded by the preparation with a minimum.

**DISCUSSION**

Sunscreen, also known as Sun-block or Sun creams, is a photo protective topical product for the skin that helps protect against sunburn and most importantly prevent skin cancer. The perception of sunscreen use has shifted from purely protecting against UV-induced erythema to broad- spectrum protection against not only erythema but also photoaging, dyspigmentation, DNAdamage, and photo carcinogenesis. The impact of visible light and IR light in photoaging is still being explored, but better methods of protection against these wavelengths are needed. Sunscreens continue to be adapted to provide the broadest coverage while being cosmetically appealing**.**

The application of an adequate amount of sunscreen with an appropriate sun protection factor is imperative, and must be in accordance to skin type and exposure pattern of an individual.[12] The advantages of sunscreen is that, it offers protection against both UVA and UVB rays and is naturally broad spectrum. It also protect from sun as soon as it is applied. The disadvantage includes, it can be rubbed off, sweat off and rinsed off easily means more frequent reapplication when outdoors is needed and may leave a whitish cast on the skin, making some formulas incompatible for medium to dark skin tones.

The approach used to establish sunscreen efficacy, sun protection factor (SPF), is a useful assessment of primarily UVB (290-320 nm) filters. The SPF test, however, does not adequately assess the complete photoprotective profile of sunscreens specifically against long wavelength UVA (340-400 nm). Moreover, to date, there is no singular, agreed upon method for evaluating UVA efficacy despite the immediate and seemingly urgent consumer need to develop sunscreen products that provide broad-spectrum UVB and UVA photoprotection. With regard to the safety of UVB and UVA filters, the current list of commonly used organic and inorganic sunscreens hasfavorable toxicological profiles based on acute, sub chronic and chronic animal or humanstudies.

## CONCLUSION

Thus, it can be concluded that there is a great market potential for sunscreen chemicals either synthetic or natural or in combination due to awareness of protection from hazardous UVA and UVB rays.[13] Exposure to ultraviolet radiation is directly harmful and has been associated with the development of skin cancers. High-quality evidence has shown that sunscreen reduces the risk of developing both melanoma and nonmelanoma skin cancer. Therefore, physicians should counsel patients on photoprotection strategies, including avoiding midday sun, seeking shade and wearing protective clothing, as well as using sunscreen if sun exposure cannot be avoided. Presently, the use of a broad-spectrum sunscreen with an SPF of at least 30, for people is recommended for photoprotection.[14] Research on the safety and efficacy of established sunscreens is ongoing.

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