

A review on Sunscreen / Sun protection

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ABSTRACT: The exposure of skin to ultraviolet B (UVB) radiation has a destructive effect on keratinocytes by causing DNA damage that can subsequently lead to malignant transformation. Have not suffered irreversible damage, they will survive. In the absence of appropriate repair, keratinocytes undergo Apoptosis, producing characteristic „sunburn cells“. Sunscreen is defined as substance that protects the skin from Excessive exposure to the ultraviolet radiation of the sun. Sunscreen use is often proposed for sun protection because of Their ability to block UV-induced sunburns (the sun protection factor –SPF). It helps to prevent sunburn and reduce the Harmful effects of the sun such as premature skin aging and skin cancer. They are routinely tested in humans and can be Assigned a sun protection factor (SPF) which reflects their ability to prevent sunburn. Sunscreens are found in cream, Lotion, gel, stick, spray, and lip balm type’s forms. They are for external use only.

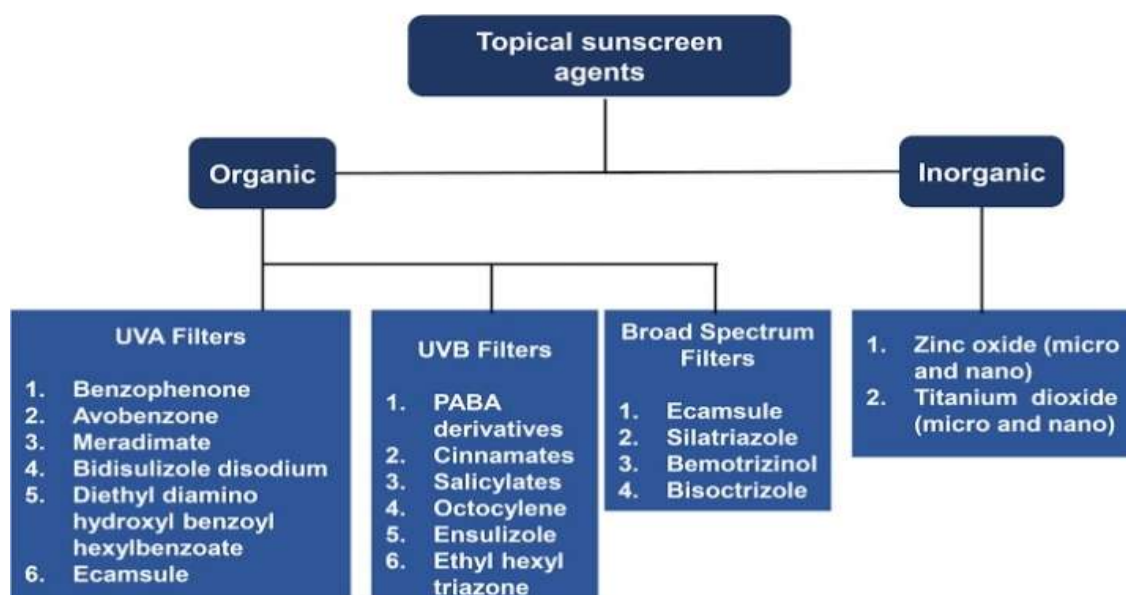
An attempt has been made to review natural sunscreen agents.

Keywords: sunscreen, polyphenols, sun protection factor, sunburn

I. INTRODUCTION:

Ions are becoming increasingly popular. By sun protection we mean a preparation that, when applied locally, protects the treated area from sunburn. Sunscreen supports the body’s natural defense mechanisms and protects it from the sun’s harmful UV rays. Its function is based on the ability to absorb, reflect and scatter sunlight. The sun protection factor (SPF) of a sunscreen is calculated by comparing the time it takes to cause sunburn on skin protected with a Sunscreen to the time it takes to cause sunburn on unprotected skin cause. The effectiveness of sunscreens depends on their ability to protect against UV rays from sunburn and their chemoprophylaxis.(1)

Classification:



1) 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 contains chemical carbon-based compounds. It contains non-mineral active ingredients (e.g., PABA, PABA Derivatives, and benzophenones) show considerable negative effects, including eczematous dermatitis, burning sensation, and increased risk of skin cancer.

i) UVA filters:

Benzophenones (UVB and UVA2 absorbers)-Oxybenzone, Sulisobenzene, Dioxybenzone Avobenzone or Parsol 1789 (UVA1 absorber) Meradimate (UVA2 absorber)

ii) UVB filters:

PABA derivatives-Padimate O Cinnamates-Octinoxate, Cinoxate Salicylates-Octisalate, Homosalate, Trolamine salicylate Octocrylene, Ensulizole

iii) Broad spectrum (UVA+UVB) filter :

Ecamsule (Mexoryl SX), Silatriazole (Mexoryl XL), Bemotrizinol (Tinosorb S), Bisotrizole (Tinosorb M)

2) Inorganic sunscreen:

These are particles that scatter and reflect UV rays back to the environment. They act as a physical barrier to prevent ultraviolet and UV light. They are considered broad spectrum as they cover the entire ultraviolet spectrum. Inorganic sunscreens are also referred to as sunblock. Two primary inorganic UV filters are Zinc oxide (ZnO) and titanium dioxide (TiO₂) white particles which are used in the cosmetic and pharmaceutical industries. The current agents are ZnO, TiO₂, calamine, ichthammol, talc, and red veterinary petrolatum. Although they are generally less toxic, more stable, and safer for humans than those of organic ingredients, they are visible due to white pigment residues left on the skin and can stain clothes.

D) Zinc oxide: micro and Nano

Eg. calcium carbonate, and Magnesium oxide

II) Titanium dioxide : micro and Nano

Eg. kaolin, talc, (4)

Properties of Ideal Sunscreen:

- It should be non-volatile so that it will not evaporate in the required conditions
- Considering nature, it should be neutral approximately, so that any outward.
- It should not soak up quickly into the skin.
- It must soak up or refine the rays causing harmful effects that are in the range (2900-3300) Angstroms.
- Under useful conditions, if any decomposition product or any compound is formed, then it should be harmless hypoallergenic.
- It should have a minute or absolutely no absorption for UV rays after 3400 Angstroms which are responsible for tanning

Ultra-Violet radiations and human skin⁸⁻⁹:

Ultraviolet (UV) radiation is defined as that portion of the electromagnetic radiation lies between X-rays and visible light which is from 200 to 400 nm. This ultraviolet radiation comprises 3 categories Wavelength as follows:

UV-A Radiation: This radiation ranges between 320 to 400 nm. UV-A is most responsible radiation for immediate tanning or darkening of the skin due to excess production of melanin in the epidermis, premature photo ageing, suppression of immunologic functions, and even necrosis of endothelial cells and damage of dermal blood vessels.

UV-B Radiation: This radiation ranges between 280 to 320 nm. UV-B radiations are known as burning rays as they are 1000 times more capable of causing sunburn than UV-A. UV-B rays act mainly on the epidermal basal cell layer of the skin but more genotoxic than UV-A radiations. Ultraviolet B (UVB) rays vary with time and season are major cause of sunburn. Sunburned skin is a leading risk factor for melanoma and non-melanoma skin cancer.

UV-C Radiation: This radiation ranges between 200 to 280 nm. UV-C radiations are filtered by stratospheric ozone layers so less effective and hazardous. The human skin is the largest organ of the body of surface area of approximately 1.5–2.0 m². Skin acts as an effective barrier against the harmful effects of environmental and xenobiotic agents.⁹⁻¹⁰⁽²⁾

Mechanism of photoprotection

Sunscreens act by preventing and minimizing the damaging effects of the ultraviolet

sun rays following exposure to the sun. Sunscreens have been demonstrated to increase the tolerance of the skin to UV exposure. They primarily work through two mechanisms as detailed below. Fig. 3 gives a pictorial perspective of the mechanisms of action stated.

a) Scattering and reflection of UV energy from the skin surface. Mineral based (Inorganic sunscreens

work primarily through this mechanism. They provide a coating that blocks sun rays from penetrating through the skin .

b) Absorption of the UV energy by converting it to heat energy thus reducing its harmful effects and reduce the depth through which it can penetrate the skin. Organic sunscreens work primarily through this mechanism .(7) (8)

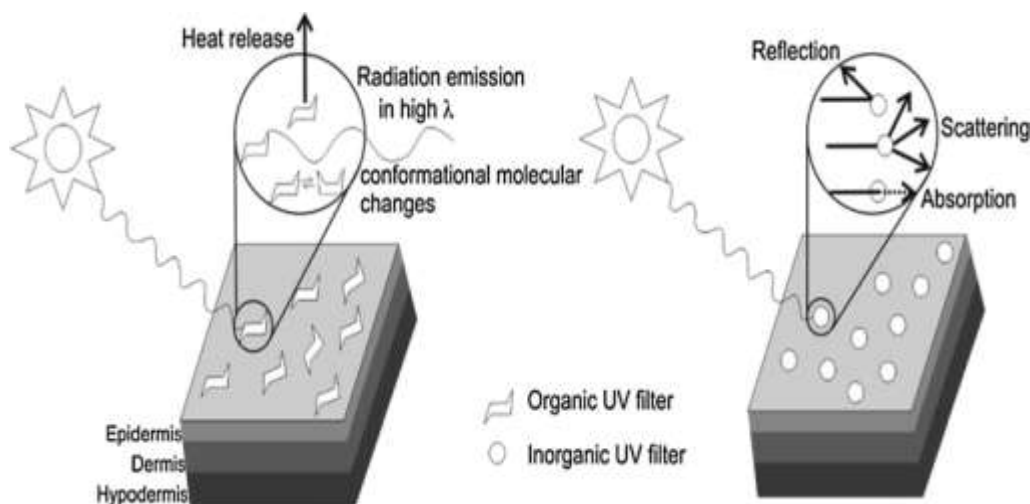


Fig : Mechanism of action of organic and inorganic sunscreens.

Limitations of Sunscreens:

- 1) Sunscreen technology has made great advancements in accessibility, consumer acceptability, and overall safety and efficacy over the years.
- 2) In the evaluation of sunscreens available for US consumers today, FDA regulations, safety in humans, and safety for the environment must be carefully considered.
- 3) In the 2019 FDA-proposed rule, two ingredients, para-aminobenzoic acid (PABA) and trolamine salicylate, were classified as category II and banned from products marketed in the USA given their safety concerns.
- 4) PABA has been linked to cases of allergic and photoallergic dermatitis and is a cross-sensitizer to sulfonamide antibiotics, thiazide diuretics, local anesthetics, and dyes.
- 5) The benzophenones include dioxybenzone, sulisobenzone, oxybenzone, and avobenzone, with oxybenzone the most commonly used agent in the group.(9)

Material & Method:

Material:

An isotriazine was given as a gift from The Sun Chemical, Thailand. Titanium dioxide was purchased from S. Tong Chemicals, Thailand, respectively. Paraffin oil was purchased from Carlo Erba Reagents, Spain. Beeswax Foundation was purchased from Madybees, Egypt. Ethanol and hexane were purchased from BDH. Glycerine Was bought from Flukachemika. The solubility of oils was determined in different ratios of ethanol and distilled Water. It is reported that maximum of 50% of ethanol could be used in cosmetics. Hence solubility of oils Was detected taking 10% to 50% of ethanol in distilled water. The maximum solubility was observed in 40% Ethanol and 60% distilled water solution.(10)

Formulation of sunscreen cream:

Initial stock solution was prepared by taking 1% v/v of oil in ethanol and water solution (40:60). Then form this Stock solution, 0.1% was prepared. Thereafter, absorbance values of each aliquot prepared were determined From 290 to 320 nm, at 5-nm intervals, taking 40% ethanol and 60% distilled water solution as blank, using Shimadzu

UV-Visible spectrophotometer(7). Briefly, an oil phase containing lipophilic substances and an Aqueous phase containing hydrophilic substances were separately heated in a water bath to 80°C. Anisotriazine was investigated at the concentrations of 4, 6 or 8% while titanium dioxide was investigated At the concentrations of 8 or 12%.(10)

NATURAL SUNSCREENS:

Aloe vera

The leaves of Aloe vera and A. barbadensis are the source of aloe vera gel. Aloe vera gel is widely used in cosmetics and toiletries for its moisturizing and Revitalizing action. It blocks both UVA and UVB rays and maintains skin's natural moisture balance. The Enzyme bradykinase in aloe stops the sunburns and Stimulate immune system intervention. Acemannan which is D-isomer mucopolysaccharides speeds up the repair phase and the increased production of fibroblasts and collagen. (11)



Pomegranate

Pomegranate (*Punica granatum*) is having Principle antioxidant polyphenols in its juice include The Ellagitannins and anthocyanins. Explained the effect of applying sunscreen treatments to Pomegranate fruit on the degree of sunburn damage and The effect of maturity and sunburn on the internal Antioxidant concentration of the juice.(12)



Almond

Almond is commercially known as almonds. Seeds are rich in polyphenolic compounds especially Flavonoids and phenolic acids. The UVB protective Property of this plant's skin extract was tested. The Mice was exposed to UVB radiation and analyzed for Changes in lipid peroxidation and gperoxidation and increased levels of glutathione. The results showed that topical application of cream formulation has significant antioxidant and anti-photo aging properties. The results showed that topical application of cream formulation has significant antioxidant and anti-photo aging properties.(13) (14) (15)



Soybean Oil

Soybeans (*Glycine Max*) are a nutritious and Cost-effective addition to sunscreen. Soybeans Originally come from China and are a rich source of Essential fatty acids, protein, lecithin, iron and calcium In the diet. When used topically on the skin, soybean oil Is a cost-effective moisturizer compared to other oils And has a natural SPF of 10.(16)



Cucumber

Cucumber extract (*Cucumis sativus*) has strong moisturizing properties and a slightly astringent effect. It also helps remove dead skin cells and tightens the skin. Cucumbers relieve skin irritations, prevent water retention and are rich in water, fiber and useful minerals. Cucumbers also contain ascorbic acid (vitamin C) and caffeic acid, which relieve skin irritations. These two acid compounds prevent water retention, which is why externally used cucumbers are helpful for eye swelling, sunburn and skin inflammation.(17)



Grapeseed oil (*Vitis vinifera*)

It is the most important source of polyphenols (60-70%). It has antioxidant properties and strong anti-inflammatory and antiproliferative effects. The polyphenol phytoalexin, i.e. resveratrol (trans-3,5,4'-trihydroxystilbene), is contained in both the shell and the seeds. It has an antioxidant effect and exhibits strong anti-inflammatory and antiproliferative effects.(18)



Evaluation of Sunscreen formulation:

1) Sun Protection Factor (SPF) determination:

The sunscreen formulation's efficacy can be identified by calculating the sun protection factor (SPF), which is defined as the UV energy required to produce a Minimal Erythema Dose (MED) in protected skin, divided by the UV energy Required to produce a MED in unprotected skin:

$$SPF = \frac{\text{Minimal erythema dose in sunscreen protected skin}}{\text{Minimal erythema dose in non sunscreen protected skin}}$$

The minimal erythema dose (MED) is defined as the lowest time interval or dosage of UV light irradiation sufficient to produce minimal, perceptible erythema on the unprotected layer of skin.

In Vitro SPF values of oily formulations containing vegetable oils and/or organic UV filters were calculated Spectrophotometrically and observed absorbance values at 5 nm intervals (290-320 nm) were calculated Spectrophotometrically by using the formula:

$$SPF = CF \times \sum EE(\lambda) \times I(\lambda) \times Abs(\lambda)$$

Where,

CF = Correction Factor (10)

EE(λ) = Erythema Effect Spectrum

I(λ) = Solar Intensity of Radiation with wavelength λ

Abs(λ) = Absorbance of the sunscreen product at wavelength λ

EE × I = Constant Value

2) Homogeneity

The formulation were tested for homogeneity by visual appearance and by touch.

3) 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 reduced.

4) Viscosity

The brookfield or oswald viscometer at 100 RPM, using spindle No. 7 at temp 25oC. The determinations were carried out in triplicate and the average of three reading was Recorded. 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.

5) Accelerated stability testing

Accelerated stability testing of prepared lotion was conducted for 2 most stable formulations at room temp, Studied for 7 days. The formulations were placed at 40oC + 1oC for 20 days. Both formulations were kept at room temp and elevated temp and observed on th o, 5th, 10th, 15th and 20th day for any change in color, phase separation.

6) Spreadability

Two glass slides of standard dimensions (20 × 5cm) were selected. The formulation was over one of the slide. The other slide placed on the top of the lotion such a that the formulation sandwiched between the two slides in An area occupied by a distance of 7.5 cm, alongside 100 gm weight was placed uniformly to form a thin layer. The weight was removed and the excess of lotion adhering to the slides was scrapped off. The two slides in a Position were fixed to stand (45° angle) without slightest disturbance and in such a way that only the lower slide Held firmly by the opposite fangs of the clamps allowing the upper slide to slip off freely by the force of weight Tied to it. 60 gm of weight was tied to the upper slide carefully. The time required for the top cursor to travel 5 cm was recorded and separated from the bottom cursor

under weight direction. Experiment Was repeated three times and three of these dimensions were averaged. Results recorded. The diffusion capacity is calculated using the formula:

$$S = m \times l/t$$

Where

S = diffusion capacity,

L = length of the slide,

M = weight attached to the upper slide and

T = time

II. 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 parameter which Affects the formulation Acceptability.the formulated cream exhibited no redness, Inflammation and irritation .when Formulation were kept for long time ,it found that no change in colour of cream .The cream Was easily removed by washing With tap water .

III. CONCLUSION:

The use of sunscreens is an important component to sunprotection. Regular and appropriate use is associated With a decreased risk of various skin complications and cancers as a result of UV radiation exposure. In Addition, patients need to be reminded not to solely rely on the use of sunscreen. Thus it can be concluded that there is great market potential for sunscreen chemicals either synthetic or natural or in combination due to awareness of protection from hazardous UVA as well as UVB.

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