Review literature on sunscreen

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Abstract:

The objective of this study was to develop sunscreen cream formulations with high sun protection factor (SPF) and satisfied characteristics. The sun-and-skin interactions have controversial sides. The topical application of sunscreens (and the avoidance of extreme exposure to sun rays) is worldwide recognized as the best strategy to avoid sunburn and oedema. The sunscreen is prepared using water phase that includes distilled water as a main solvent, glycerine as a moisturizer, Arabic gum as a thickener, and citric acid as a preservative. The sunscreen lotions were prepared using three different compositions F1, F2 andF3 and evaluated for their stability, safety and SPF. Results showed that the sunscreen lotions were non-mutagenic, non-irritant, stable and possess SPF for normal skin. This review article sought to expound the scientific basis of sunscreen use, the classification, formulation, quality control and Evaluation.

Keywords- SPF, Sun protection, ultraviolet rays, UV filter.

Introduction:

Sunscreen is a cream or liquid applied on the skin to protect it from the harmful effects of the sun and prevent sunburn. However, in the United States, the term suntan lotion usually means the opposite of sunscreen, and instead refers to lotion designed to moisturize and maximize UV exposure and tanning rather than block it[(1)]. Sunscreen is also known as sun-cream, sun block or suntan lotion, is a lotion, spray, gel, foam stick or other topical product that absorbs or reflects some of the sun's ultraviolet (UV) radiation and thus helps protect against sunburn. Now-a-days one cosmetic product category sunscreen have gain wide popularity due to additional health benefits apart from beautification[(2)]. Skin aging has become a critical factor as an indicator of beauty and of health in all over the world. The UVA radiation is the main concomitant cause of skin photosensitization and phototoxicity[(3)]. The biologically active components of ultraviolet (UV) radiation include UVA and UVB radiation. The sun protection factor or SPF, stated on the sunscreen bar it refer mainly to the ability to block UVB, the rays that cause sunburns. Some of the newer sun blocks protect against UVA as well [(4)].

Fig: Sunscreen cream

Advantage:

1. Sunscreen protects your skin and reduces your risk of developing skin cancer and skin pre-cancers.
2. Sunscreen protects every skin type.
3. If you have a darker complexion, the melanin in your skin offers some protection from sunburns, but you still need to protect your skin from those harmful ultraviolet rays.
4. No special equipment needed for preparation.
5. Renewable resources.
6. Botanical ingredients are easily available[5,6,7].

History:

Early synthetic sunscreens were first used in 1928. The first major commercial product was brought to market in 1936, introduced by the founder of L'Oreal, French chemist Eugène Schueller. The earliest form of sunscreen was created by Franz Greiter in 1938 and then Benjamin Green in 1944 who used a mixture of cocoa butter and red veterinary petroleum to protect his skin from the sun. Shortly afterwards, Franz Greiter branded his formula Piz Buin while Mr. Green marketed his as Coppertone Suntan Cream. In the United States, one of the first sunscreen products to become popular was invented for the military by Florida airman and pharmacist Benjamin Green in 1944. This came about because of the hazards of sun overexposure to soldiers in the Pacific tropics at the height of World War II[4,8].

Franz Grieter also credited with the term "Sun Protection Factor," better known as "SPF." Greiter was climbing an Appalachian mountain range when he was burnt to a crisp by the brutal UV rays[9]. Subsequently, the relationship between UV light and skin ageing as well as skin cancer was investigated in more detail; for instance, through the development of a photoageing concept by Albert Kligman in 1986, or the relationship between tanning and development of skin cancer reported by the WHO in 2007.Clothing, scarves, and shade were early methods of protecting skin from the sun[3]. However, applying products to the skin for additional protection also started thousands of years ago. Early civilizations used a variety of plant products to help protect the skin from sun damage. Health experts advise everyone, regardless of skin color, to use sunscreen with an SPF of at least 30. Although dark-skinned people won't get sunburned as quickly, they will still burn and are still susceptible to sun-induced damage—such as sun spots and wrinkles—and cancer[10]
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Classification:

A. Inorganic (physical blockers)

These are particles that scatter and reflect UV rays back to the environment. They act as a physical barrier to indent ultraviolet and UV light. The two primary inorganic UV filters are Zinc oxide (ZnO) and titanium dioxide (TiO_2) white particles which used in the cosmetic and pharmaceutical industries. The current agents are ZnO, TiO_2, calamine, ichthammol, talc, and red veterinary petrolatum. 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 and can stain clothes[6,11].

B. Organic (chemical absorbers)

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 broadly classified into three categories based on the range of protection; UVB (290–320 nm) and UVA (320–400 nm) and broad-spectrum sunscreens that cover the entirespectrum (290–400 nm)[12]. Particularly, some organic filters (e.g., PABA, PABA derivatives, and benzophenones) show considerable negative effects, including eczematous dermatitis, burning sensation, and increased risk of skin cancer[13,14].

C. Natural / Systemic (chemical absorbers)

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[9]. These are sunscreens that are absorbed into the body and accumulate in the skin affording protection from the UV rays[15].

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[8]. 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[16].

Formulation of sunscreen cream:

Initial stock solution was prepared by taking 1% v/v of oil in ethanol and water solution (40:60). Then from 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%[7,14].

SPF:

SPF stands for Sun Protection Factor, and the number beside it indicates how well the sunscreen protects skin against sunburn. Under ideal conditions (like in a laboratory), a sunscreen with higher SPF protection and broad-spectrum coverage offers more protection against sunburn, UVA damage and DNA damage than comparable products with lower SPF values[17].

Preparation of sunscreen sample for SPF measurements-

200mg of each sample was weighed, transferred to a 100 mL volumetric flask, diluted to volume with 50% hexane in ethanol and followed by vigorous vortexing. Then, it is filtered through filter paper, rejecting the first 10 mL. A 5.0 mL aliquot was transferred to 50 mL volumetric flask and diluted to volume with 50% hexane in ethanol. Then a 5.0 mL aliquot was transferred to a 50 mL volumetric flask and the volume completed with 50% hexane in ethanol[15,18]. The final concentration of each diluted sample is 20 ppm in 50% hexane in ethanol[3].

Mean SPF Calculation-

The efficacy of a sunscreen compound, expressed by the sun protection factor (SPF), is defined as the energy from UV required producing a minimal erythema dose (MED) on protected skin, divided by the UV energy required to produce a MED on unprotected skin[19].

SPF =

Minimal erythema dose in protected skin

Minimal erythema dose in unprotected skin

Physical characterization of screen cream:

Physical sunscreens are important in individuals who are unusually sensitive to UVA and visible light such as those with photosensitizing diseases. Chemical sunscreens are more cosmetically appealing and can selectively absorb UVB and/or UVA[20]. Appearance and texture of the creams was optically observed. Viscosity values at 25°C of the creams were measured in triplicate using a Brookfield DV-III Ultra rheometer fitted with a LV spindle Number 4 at 10 rpm. Brookfield Rheocalc operating software was used to control the rheometer. The samples were determined for pH values at 25°C by a pH meter[16,21].

Evaluation:

In 1978, the North-American regulatory agency (FDA) proposed the first normatization to determine the Sun Protection Factor (SPF). Following are newly accepted and followed methods of evaluation of sunscreens[22]:

In vivo Evaluation of Sunscreens-

The SPF listed on sunscreen products is intended to communicate the amount of erythemal UVR attenuation. More particularly, numerical SPF theoretically tells the user that he or she is protected X times better than without sunscreen where X is the labelled SPF. SPF is calculated by dividing the minimal erythemal dose (MED) of protected skin for the MED dose of unprotected skin. MED is a measure of the amount of energy per unit area ($J \cdot cm^{-2}$) required to cause minimal erythema[20,22].

Procedure

Human volunteers are irradiated with a UVA light source (320÷400 nm) and skin changes, yielding in a immediate or persistent pigment darkening or eryhema or tanning are observed after desired time following irradiation has been stopped[23].

In Vitro Evaluation of Sunscreens-

An *in vitro* SPF test method would be advantageous if it could generate results faster and cheaper. Furthermore, it could avoid the ethical concerns associated with *in vivo* testing. Several *in vitro* techniques have been developed, but at present there is no broadly accepted method[24]. *In vitro* approaches generally consist of a film of sunscreen applied to an artificial test substrate and a spectrophotometer which analyzes the amount of UVR passing through the film of product. In the case of transmission spectroscopy, sunscreen is generally applied to a substrate and its spectral transmission measured prior to and after exposure to a UV source[25].

Procedure

There are two objectives in a sample preparation method. The first is to simulate the application conditions used for in-vivo testing, both the applied quantity and sub-strate interaction[26]. This would produce a reliable in-vitro SPF value that would positively predict the result of a subsequent in-vivo test. The second objective is

for the method to be consistent enough to generate reproducible results sample-to-sample for the same sunscreen formulation. The spectral transmittance of a sunscreen in the ultraviolet spectral range can be used to predict an in-vitro SPF value based on standard erythema and solar data[27].

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 rays.

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