

A complete overview on sunscreen creams

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Abstract

Due to climatic changes, depletion of ozone layer, global warming, melting of ice polar berg, the world is experiencing a gradual increase in temperature and UV radiation exposure hence topical formulations for the skin have become helpful and daily products of use.

Skin conditions such as, wrinkles, acnes, pimples, photo-dermatoses, and pre-aging which is a result of destruction of skin melamine containing cells that naturally protect the skin from UV radiations had resulted into discovery of various formulations such ointment, gels, lotions and creams with Sun protection factor which is abbreviated as SPF which is a common criteria to measure effectiveness, efficacy, quality and safety of a sun protection ability for the formulation.

Due to instability problems, high cost, photodegradation and carcinogenicity some formulation had been banned and restricted from both pharmaceutical and cosmetic market.

This article gives a clear understanding about sunscreen creams by discuss aspects about sunscreen such as ideal characteristics, ingredients, advantages and disadvantages of sunscreen creams formulations.

Emulsion types of formulations that meant for external applications that are prepared by combining aqueous phase and oil phase with ingredients responsible to protect, block or reflect UV radiations are referred to as sunscreen cream.

This article also gives a briefly description about sunscreen creams on aspects such methods of evaluation, various applications but also enumerate various benefits regarding awareness, advancement in sunscreen creams production & formulation technology and challenges to be encountered with possible solutions.

Keywords

SPF⁺ sunscreen Creams, Sun, skin, Sunlight, UV filters and UV radiations.

1. Introduction

Skin, UV radiation, and SPF

The heaviest and the largest single organ of the body is known as the skin, it is consisting of 3 consecutive layers of the skin: epidermis, dermis, and hypodermis respectively. Its smoothness is lost as a result of ageing, pressure and abrasion, UV radiations and sometimes as a result of infections& inflammations.

Epidermis is the outer layer that is in direct contact with environment hence it regulates the internal balance relative to external (homeostasis), protection and also transdermal drug delivery systems are formulated in a such way they can cross this layer, it is composed of horny layer, germinativum layer, granular layer, stratum lucidum and prickle cell layer.

Dermis is layer between epidermis and hypodermis, it plays a major role in wound healing, support, nourishment and protection with epidermis both deeper reticular dermis and superficial papillary dermis are layers of dermis.[1]

Hypodermis is a naturally insulator of the skin that rises below the previous epidermis and dermis hence it is a thermoregulator.

The more the melamine in the skin, the less UV rays experienced vice versa hence melamine is measure a skin UV sensitivity, skin complexion and pigmentation of human eyes and hair.[2]

A 4.6 billion years old luminous natural source of light and energy called the sun which is located at the center of solar system whose sunlight rays wavelength ranges from (100-1000) nm has several various benefits for humans, such as the production of vitamin D, induction of β -endorphin expression, source of energy, killing bacteria and harmful microorganisms, reduce cancer risks, phototherapy, mood enhancing effect , blood pressure, source of various food materials and a source of bones strength.

UV radiations are one of wave radiations founds on electromagnetic spectrum whose range is (40-400nm which mainly consist of

UVA radiations ranging (320-400) nm that are responsible for long-term effects such as carcinogenesis, DNA damage and ageing.

UVB radiations ranging (290-320) nm which are responsible for short term effects such as skin redness, skin burns and erythemat skin reactions and UVC radiations ranging (100-290) nm which are less taken into consideration compared to UVA and UVB.

Sunlight avoidance to decrease production of skin pigmentation and use of bleaching product such as hydroquinone containing product, kojic acid containing products, Monobenzyl ethers containing compounds or use of skin bleaching machine such practices of skin lightening were reported lately commonly among Africans and Asians.

But also, Caucasian people undergoes processes of skin color darkening to stimulate melamine production in their skins which is also known as tanning as follows: An abbreviation IPD stand

for Immediate pigment darkening, an abbreviation PPD stand for Persistent pigment darkening while Delayed tanning is often abbreviated as DT respectively.

After few minutes of exposure to UVA, IPD is experienced but it fades away few hours after exposure, PPD is often experienced after few hours of exposure to high dose of UVA and doesn't not fade away in period less than one week while DT is a result of a week exposure with UVB and remains being experienced for weeks.[3] a diagram of layers of the skin is shown in the fig.1.

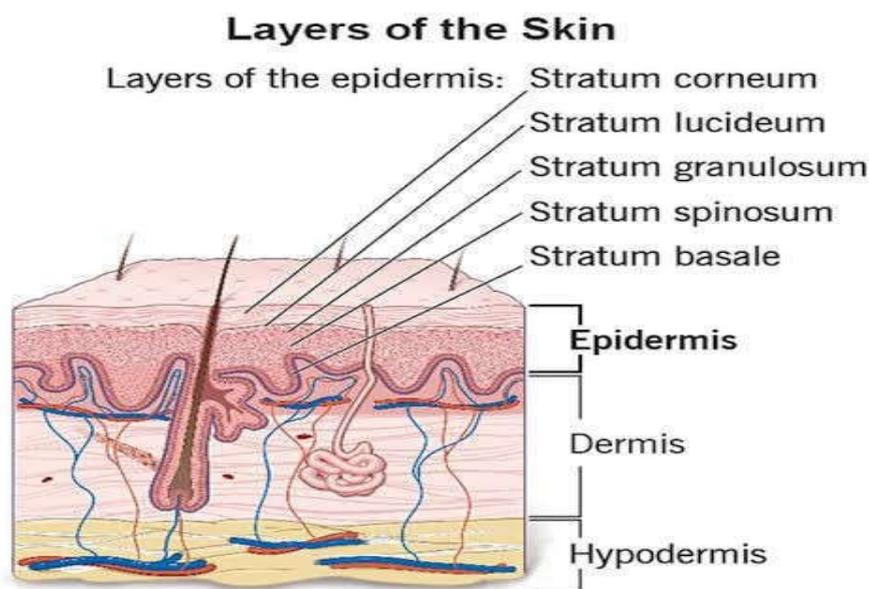


Fig. 1. Diagrammatic representation of the parts of the skin and their respective functions.

SPF sunscreen creams are one typical example of cosmetics used for cleansing, emollients, humectants, barrier and protection against the sunburn & UV radiations and today pharmaceutical and cosmetic industry are able to formulate self-preserving skin care products in which multifunctional cosmetic ingredients replaces traditional preservatives.

These formulations are commonly semi-solid formulations used to enhance skin appearance, longevity complexion and protect the skin from UV radiations, either when small amount of oil droplets continuously dispersed in water phase and it is called o/w and vice-versa is w/o type of formulation.[4]

It was Swiss chemist named Franz Greater after experiencing sun burn in 1946, developed a concept of sun protection factor (SPF^+) which is a ratio relationship between how long it takes for sun exposed skin to become red after applying SPF^+ sunscreen product to unprotected skin.

since currently no product can offer 100% sun protection SPF 100 is an ideal product but for example SPF 50 means that a skin is 50 times more protected from UVB radiations that unprotected skin.

It is a measure of ability a particular sunscreen product (cream) possesses to protect skin from UV radiation when applied.

SPF is the ratio of time taken for erythema to appear on protected skin to time taken for erythema to appear on unprotected skin.

Formulation as such their mechanism of action involves absorption of sun radiant energy erythema portion or incident light scattering and they called sunscreen preparations.

Persistent pigment darkening which is abbreviated as PPD protection factor is also used as a measure of protection against UVA by sunscreen product creams.[5]

By reflection, refraction and scattering UV filters sun screening containing creams like talc, titanium dioxide, zinc oxide, kaolin and calamine are able to minimize UV radiation that could affect the skin by formation of a protective layer.[6]

Ideal characteristics of SPF⁺ sunscreen creams

1. It should be non-toxic and non-irritant to the skin.
2. It should improve the complexion; appearance and it should protect the skin.
3. It should be to deal with light wavelength above 380 nm or in range of (280-320) nm.
4. It should be stable or get better in presence of light, heat or se regions of the skin.
5. It should be compatible with API and other excipient or exhibiting a synergic effect.
6. It should not be photodegradable.
7. Its effects should be enhanced with extracts from various sources.
8. It should be biodegradable.
9. It should be non-comedogenic
10. It should be non-carcinogenic.
11. It should be effective with all skin types.
12. It should be both therapeutic and protective.
13. It should be easily spreadable and feels good on the skin after application.
14. It should not be reactive with skin natural secretions.
15. It should be effective for a prolonged period of time at least 24 hours after application.
16. It should be economically affordable.
17. It should be hypoallergenic.
18. It should possess a broad spectrum of action.
19. It should be elegant cosmetically when applied.
20. Its most of raw material ingredients for formulation should be natural.[7]

2. Sunscreen cream ingredients

1. Emollients

Agents that do not only hydrate the skin but also soothes and moisturize the skin by covering it with a film protective layer hence possess photo protective action are called Emollients.

1. Isopropyl myristate, octyl octanoate and cyclomethycaine exhibit astringent emollient activity.
2. Isopropyl isostearate and diisopropyl dilinoleate exhibit protective emollient activity.
3. Propylene glycol, octyl stearate, jojoba oil, castor oil and glyceryl stearate exhibit fatty emollient activity.
4. Isostearyl alcohol, isopropyl palmitate, decyl oleate exhibit dry emollient activity.[8]

2. Waterproof enhancing agents and polymers

Waterproof enhancing agents

Agents that used to induce resistance of water penetration in a formulation by forming a repellent polymeric film layer on skin are known as water proofing agents. they more effective particularly for sweaty, sensitive type of skins and before swimming. Waxes, silicone oils and resins are examples of waterproof enhancing agents used in formulation.[9]

Polymers

When monomers combine together, the result is called a polymer. Collagen, chitosan, ulvan, gelatin, xanthan Gum and alginic acid are various examples of natural polymers that are used in formulation to enhance stability, polymeric layer film formation for enhanced sun protection activity and antimicrobial activity.

Other polymers such as silicon, polyether, vinyl acetate, polyamide, poloxamer and cellulose (derivatives, nitrate and acetates) are synthetic and semi-synthetic respectively.[10]

3. Agents used for tanning effect.

Naturally formation and presence of melanin pigment which is also the reason why skin darkens are responsible from natural protection of UV radiations, artificially dihydroxy acetone reactions with amino acid of superficial skin result into dark colored melanoids after condensation and polymerization are used to induce tanning while when Riboflavin is used to oxidize tyrosine which result into formation of melanin, this process is known as accelerated tanning process or melanin precursors activity.[11]

4. UV filters

A substance that is capable to hinders the passage of UV radiations is referred to as a UV filter,

UV filters are essential component in formulation an SPF sunscreen cream, they can be used singly or used combination to produce a synergistic sun protection effect.

Zinc oxide and titanium dioxide are capable to reflect UV radiations therefore they are referred to as physical filters or organic filters.

While avobenzene, ecamsule, terephthalylidene dicamphor sulfonic acid, cinoxate, dioxybenzone, homosalate, aminobenzoic acid, ensulizole and butyl methoxy-dibenzoyl methane are referred to as chemical filters or organic filters due to their ability to convert absorbed UV radiation energy into thermal energy.[12] a graphical representation of classes of sunscreen UV filters is shown below in fig. 2.

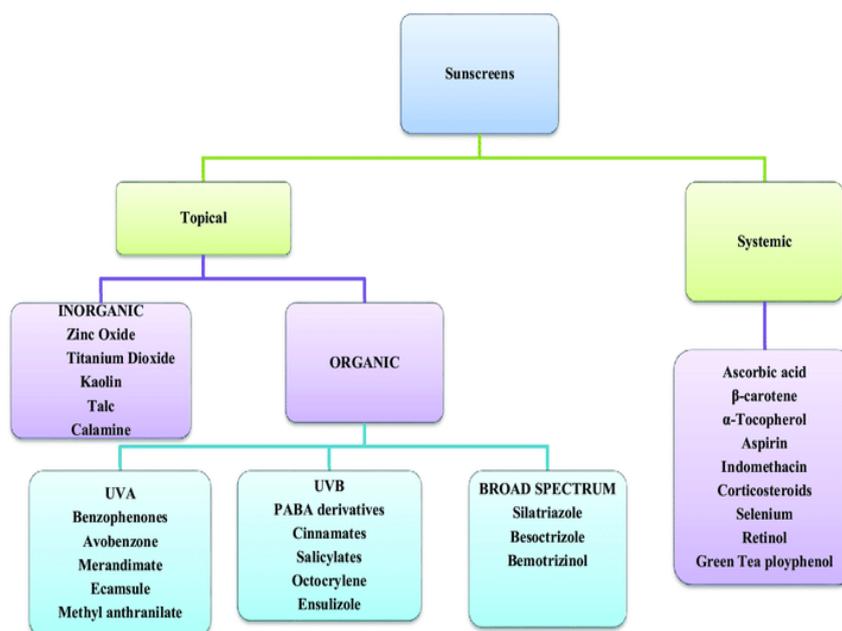


Fig. 2. Classifications of sunscreens UV filters

Even though, they are effective and important in formulation their high skin permeability causes human toxicity, compound such as oxybenzone and avobenzone containing products are banned and restricted in some countries because they are suspected to be carcinogenic and benzophenone compounds, camphor derivatives and cinnamate that are used as UV filters are often marked as compounds possessing Endocrine-disrupting effect such as androgenic disrupting effects, estrogenic disrupting effect and nuclear receptors disrupting effect. Some formulations contain cooling agents such as menthol, humectants such as glycerol and sorbitol that overcome moisture loss, wound healers and soothing effect and agents such as vitamin A, vitamin E, aloe vera, calamine and antioxidants that overcome aging such as vitamins C & vitamin E and to overcome pain some preparations are prepared containing xylocaine. [13,14]

3. Approaches to be taken for preparation of Sunscreen cream

Simulative preparation, palliative and sunscreen preparation are approaches used in preparation of SPF sunscreen creams based on purpose.

With aid of erythema radiation index, a Simulative preparation serve as a suntan to darkens skin color and protection of damage of the skin is achieved, many years ago henna, olive oil and cudbear were used as skin stains.[15] but today systemically 8-methoxypsoralen is administered orally and some chemical stain preparation such as erythulose, juglone and dihydroxyacetone are used as skin staining stimulators.[16]

In case of irritations caused by exposure to excess UV sun radiations which often result into sunburns, antiseptic formulation that are also known as Palliative preparation are used, they contain glycerin, calamine, zinc (oxide, hydroxide or carbonate) and phenol as single ingredient or a combination.[17]

Either by scattering or absorption of absorption portion of erythema sun radiant energy sunscreen preparations are mostly known to offer protection to the skin from sun and its UV harmful radiations and they are often consisting of different types of UV filters such as octocrylene and meradimate.[18]

4. Application of Sunscreen creams

1. Improved skin complexion, pigmentation and health of skin.
2. Relief and treatment of sunburn and offers protection from sunburns.
3. Some creams incorporate with sun to activates 7- hydroxycholesterol which result in vitamin D synthesis in the body.
4. Prevention of skin cancer by protection of the skin from harmful UV radiations.
5. Treatment of skin conditions and disorders such as acnes, pimples and sun spots.
6. Helpful for swimmers and mountain climbers.
7. Some sunscreen possesses anti-ageing activity.
8. Sunscreen are protective against pollutants, thermal infrared rays and blue light. [19,20]

5. Analytical evaluation techniques of Sunscreen creams

Organoleptic characteristics test of the product includes observation of color, physical stability of product in terms of appearance, odor of the product, packaging and labeling of the product examination with a naked eye.

Commonly, abdomen of rabbit is applied with the product and the area is exposed to UV radiation relative to unprotected control site comparison is made based on the effects observed after experiment, this animal pharmacology testing of the product is referred to as *In Vivo* skin testing.

Protection ability of UV induced immunosuppression which is a major cause of cancer by the product is via examination of inhibitory ability of sunscreen by delayed hypersensitivity reactions to allergens or heavy metals like nickel and dinitrochlorobenzene or stimulation of contact arm and this is referred to as determination of immune protection factor.

In vitro spectrophotometric evaluation for determination of SPF is done by using dilute solution transmission or absorption of UV radiation measurement by sunscreen UV film are made in bio membranes or quartz plates and by using known concentration, absorbance, maximum wavelength or molar extinction coefficient of standard substance of test sample and various parameters are estimated. Absence of liquefaction in SPF Sunscreen creams proves that the product is high stable, phase separation, color change or change in smell will not take place and this is known as stability tests.

Skin product should have optimum pH 6 to pH 7 values hence using a digital PH meter over time, pH is determined based on how after storage and repeated test of formulation, if there is occurrence of chemical reaction then there are variational changes in pH which indicates quality of overall product and this referred to as over time pH determination test.

Ratio of minimal dose required to induce pigmentation in a protected skin to that of unprotected skin, this is the measure of ability to protect the user from UVA radiation and it is referred to as persistent pigment darkening test for determination of UVA protection factor.[21]

6. Various benefits regarding awareness, advancement in sunscreen creams formulation production technology and challenges to be encountered with possible solutions.

Oxybenzone exhibit endocrine disrupting effect (disturbance in hormones) both antiandrogenic and estrogenic in animals as demonstrated by studies, research have been initiated for not only replacement of better filters better than oxybenzone but also raw materials that are natural that can be used as UV filters.

Octinoxate, oxybenzone and octocrylene have been restricted and banned in different countries because they are suspected to be environment pollutants after they been identified and estimated in water but also bleaching of coral reef was found to had taken place due to oxybenzone which also play major role in photo allergy.

Some sunscreen product possesses inhibition action of vitamin D production hence research and experiment for development of product that does not only block sunlight but also use a certain proportion of UV radiation to benefit the skin must be taken into consideration. With developing novel formulations.

It is important to regulate globally pollution, which is among one the causes of climatic change condition such as global warming, melting of Polar ice berg and depletion of ozone layer which result in increased UV radiation and temperature, practice such as plant trees, industrial waste management, limitation of fossil fuel usage in vehicles and overpopulation control are measure to be taken, discussed and educated to improve awareness from individual level to a global level.

It is advisable to never use sunscreen creams on infants of 6 months or less but it is recommended to use sun protective clothing and research are still going on to develop a suitable sunscreen product.

Any clothes material or fabric made of safeguard material such as woven or UV inhibitors that are added to protect UV radiation from the skin are called Sun protective clothing therefore Use of sun protective clothing is advisable hence various approaches and modes have been adopted by weaving industry and mostly Sun protective clothing are tight, dark colored fabrics that are able to protect us from UV radiation when worn.

Advance in technology and research is necessary to minimize the cost of topical SPF sunscreen creams and to find more natural formula that can even be homemade that will change society perceptive that these formulations are complex and industrially produced only.

With aid of technology to draw novel drug delivery system with better UV protection effect or dosage forms such as roll-on sunscreen, sunscreen spray and nano sunscreen that are easy to use but also affordable regarding treatment skin conditions particularly those resulting from UV radiations and skin cancer.

Proper application is a challenge that deliberately reduce effectiveness of a product therefore seminar regarding the topic is effective solution but also a brief Counselling about how to use the product properly after buying the product is necessary.

Development of a formulation or technology with sun UV protection effect that mimics natural mechanisms of the skin to deal with the sun UV radiation to enhance skin ability and potential because it had been reported recently that use of sunscreen product block UVB which is responsible for stimulation of production of vitamin D and hence with aid of researches that are going on in terms nanosized particle , microencapsulation and sun spheres for sunscreen formulation, there is a hope that in future better quality and potential products will be discovered.

By using education, children at school must be taught and equipped with behaviors, attitude, practices and prevention measure against UV radiations and advocate to society through seminars and patient counseling.[22]

Strict market control, regulation, inspection, and requisite policies for SPF sunscreen product available on market are necessary to overcome adulteration and also exemplary punishments and penalties with aid of strict rules and regulations for malpractices.

It is advisable to apply sunscreen more than twice, at first one must apply before exposure and after 20 minutes to a half an hour, one should apply a sunscreen once again for better effectiveness of the product hence researches are going on to overcome this drawback of reapplication, amount of sunscreen applied and Spread ability of the product on skin.

7. Conclusion

The relationship between skin cancer and continuous exposure to UV radiation had increased sunscreen creams usage hence daily optimum quality and performance sunscreen cream with adequate sun protection factor is required before one exposure to UV radiations.

Therefore safe, effective, affordable sunscreen cream products with quality are highly on demanded on the market.

Although most of ingredients used in sunscreen cream preparation with SPF are often semi synthetic, researches are going on to figure out natural ingredients that can be used to enhance product quality and safety but also to reduce contact sensitivity, reactivity and irritation to the skin.

Apart from topical application sunscreen creams with suitable SPF, sun protective clothing, sun glasses, skin tanning and wearing hat are practices that are effective to protect from UV sun radiation harmful effects.

Eventually a continuous regulation of sales and research to advanced technologies and discovery of sunscreen creams with optimum SPF not only for prevention purposes but also treatment of UV radiation effects with better quality is very important for better health of the skin and overall well-being of consumer.

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