Original Article

Pharmacological Review Of Chemical Agents Used In Sunscreen Preparations

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Abstract

Prolonged exposure toUV radiation has been shown to cause skin disorders like sunburn and skin ageing etc. Sunscreens have been shown to be beneficial effects on lowering the prevalence of skin disorders (sunburn, skin aging, and immunosuppression) because of their chemical properties to absorb, reflect, and scatter UV radiation.A ton of commercial products have hit the marketin the last two decades, made from traditional organic and inorganic UV filters. These products, in particular, have been enhanced with a number of superior properties that protect against the harmful effects of ultraviolet radiation.Sunscreen is defined as a substance that shields the skin from the sun's ultraviolet radiation. Because of their ability to prevent UV-induced sunburns (the sun protection factor -SPF), sunscreen is frequently recommended for sun protection.It aids in the prevention of sunburn and the reduction of sun-related ill effects such as premature skin ageing and skin cancer. They are routinely tested in humans and given a sun protection factor (SPF) that reflects their ability to prevent sunburn.The following review discusses the pharmacology of various chemical agents used in sunscreen preparations for sun protection. Physical and chemical sunscreen agents are the two types of agents. Physical agents that block sunlight and chemical agents that absorb sunlight are listed and explained. The sun protection factor(SPF) is the calculated as the efficacy of the sunscreen formulation. Understanding the pharmacology and chemical properties of various sunscreen agents is essential to develop a better formulation. Shifting paradigm towards the herbal ingredient to reduce the side effects of chemical agents can be a promising future aspect.

INTRODUCTION

When it comes to protecting your skin from the sun's harmful UV radiations, sunscreen is a must. Damage to the DNA of keratinocytes may lead to malignancy, edoema, hyperpigmentation, photoaging and immunodeficiency. Melanoma can also result from overexposure to UV light. [1] Due to their capacity to prevent UV-induced sunburns, sunscreen agents are advised as a kind of sun protection. Using this product may help prevent sunburn and other sun-related skin damage, such as premature skin ageing and cancer. In 1978, the US Food and Drug Administration (FDA) approved the use of the sun protection factor (SPF) as a measure of sunscreen effectiveness. Health Canada has given the green light to and oversees the use of sunscreens in Canada. In 2016, a National Consensus on Sun Safety Messaging was formed to ensure that public health messages throughout Canada are consistent. [2] In addition, in the past five years, the FDA and Health Canada have revised their sunscreen labelling. Research efforts should be directed toward the development of multifunctional substances or combinations that demonstrate the aforementioned biological functions. So studies of in vitro SPF values of herbal extracts and compounds are more informative when accompanied with reports of other beneficial biological activities that are as significant in the prevention of UV-related skin issues. [3]. Sunscreen functions as a barrier to protect the skin from harmful UV radiations. It is possible to protect oneself from UV-induced sunburn using sunscreen. Skin cancer and premature skin ageing may be prevented by applying sunscreen to the skin. A sunscreen's sun protection factor (SPF) is a measurement of how well it protects against sunburn when tested on animals and people. A variety of sunscreen formulations are available, including lip balms, lotions, gels, sticks, and sprays[4]. In order to guard against the sun's damaging UV radiation, sunscreens are employed to enhance the body's natural defensive systems. UV light may be absorbed and scattered by sunscreen agents[5]. Studies show that more Americans die from skin cancer each year than from all other types of cancer combined. Skin cancer affects one in five Americans before they reach the age of 70[6]. UV exposure is responsible for 90% of non-melanoma skin malignancies. Because of UV radiation[7] from the sun, skin cancer is a leading cause of death in the United States. For this investigation, experts in both UV radiation impacts and innovative therapies were involved. A novel formulation with broad-spectrum photostable UV light has just been developed[8].

SKIN

The skin is the biggest organ in the body. It is a one-of-a-kind organ that controls the body's heat and water loss and guards it from bacteria and toxins. Our skin has a surface area of 1.7 square metres. The skin-applied therapeutic substance has both a local and a systemic effect. As a physical barrier, the skin's epidermis is considered. Drugs are mostly transported via the skin's pores. However, if any immunological response change is seen in the In-vitro investigations, it

should be avoided[9]. For a prolonged amount of time, prolonged exposure to damaging UVR may damage the skin by generating free radicals, causing DNA breakage and other elements to cause skin damage, culminating in skin cancer[10-12], ageing and immunological suppression.

Structure of skin

Transdermal medication administration is carried out via the human skin, which is a more complicated organ. Subcutaneous fat or hypodermis, dermis, viable epidermis, and stratum corneum (nonviable epidermis) are the four primary layers of skin (figure1).

UV-induced skin damage is one of the most frequent issues in the world today. There's no denying that UVA rays may cause premature ageing of the skin, as well as dryness, photosensitivity, and even skin cancer. Mutations may be formed in mammalian cells[13,14,15] due to the creation of reactive oxygen species (ROS) that induce oxidative DNA base alterations and strand breakage. Photoprotectors, particularly sunscreen, have been shown to have a significant effect in lowering the occurrence of human skin problems (pigment symptoms and skin ageing) generated by UV radiation [16]. By absorbing, reflecting, or dispersing solar energy, it provides a photoprotective effect. [17,18].

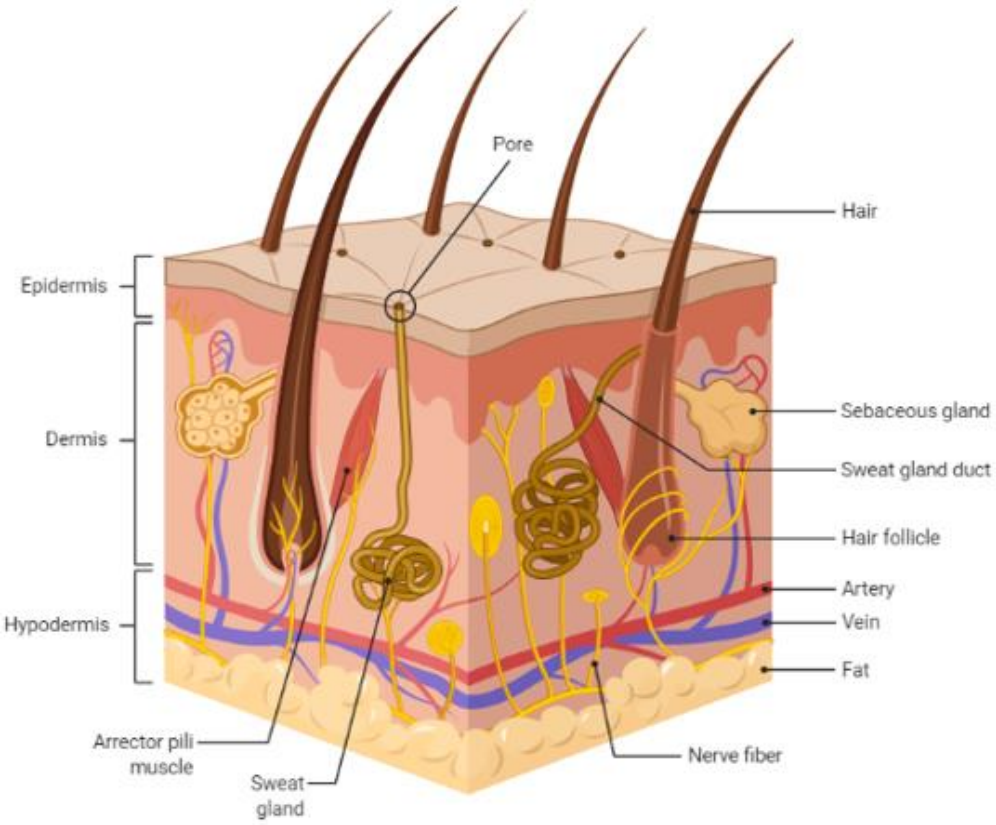


Figure 1: Anatomy of skin.

Mechanism of action and composition of sunscreen agents:

Both inorganic and organic UV filters have distinct mechanisms of action when exposed to the sun's ultraviolet rays (figure 2). Inorganic agents reflect and scatter light, while synthetic compound blockers absorb high-energy UV radiation[19,20]. Anthranilates, dibenzoyl methane (DBM), and benzophenones (also known as benzophenones) are organic UVA and UVB blockers, respectively, and play an essential role in sunscreen absorption[21]. SPF values may be enhanced while still providing broad-spectrum absorption by including them into sunscreen formulations that follow FDA-permitted limits[22]. This is why sunscreen manufacturers have recently limited or even abolished their usage of these chemical components to safeguard their customers from any negative side effects. Use of the two most prevalent organic filters, ethylhexylmethoxycinnamate and oxybenzone, which have recently been outlawed in Hawaii owing to their detrimental impact on coral reefs, demonstrates the obvious deleterious effect of sunscreens. [23].

The broad spectrum range of UV rays is reflected or scattered by inorganic blocks, providing sunscreen action and protecting human skin from direct sunlight exposure [24]. The use of micro-size TiO2 and ZnO in sunscreen, for example, has replaced nano-size TiO2 and ZnO, reducing undesired opaqueness and boosting the SPF values [25].

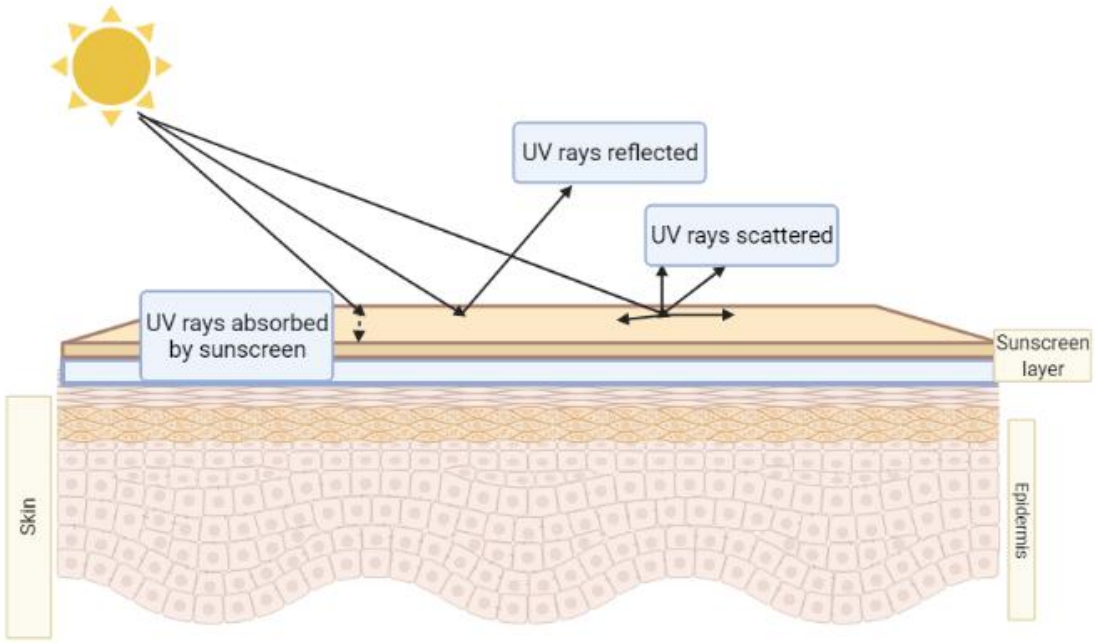


Figure 2: Mechanism of action of sunscreen preparation. They either absorb,scatter or reflect the UV radiation and thereby protect the skin.

CHEMICAL INGREDIENTSUSED AS SUNSCREEN AGENTS:

1. Benzophenone

UV rays are absorbed by benzophenone, a component in sunscreens. Benzophenone is a natural product. When it comes to sunscreen, you'll see the substituted benzophenonesoxybenzone and dioxybenzone among the active ingredients.

Chemical Formula: $C_{13}H_{10}O$

Pharmacology:
Indication: Cosmetic products that include sunscreen ingredients.

Mechanism of action: Inactive in the laboratory, it becomes active when exposed to UV light or sunshine, creating a favourable response in the damaged tissue it is intended to help heal. Psoriasis, different neoplasms, and as a sunscreen agent have all benefited from its usage, which may be done either topically or systemically.

Toxicity: In rats, the LD50 is reported to be 1,900 mg/kg oral.

2. Bemotrizinol:

Bemotrizinol is a sunscreen component that protects against both UVA and UVB rays. As the name suggests, bemotrizinol is an organic UV filter that is often included in sunscreens sold over the counter. Ultraviolet A radiation (UV-A) is the main kind that is absorbed by this material. This chemical agent, in comparison to prior broad-spectrum compounds, is more lipid-soluble and hence more effective and active over a broader range of conditions [50]. When applied to the skin, it is said to be photo-stable, increasing its commencement of action and effectiveness in protecting the skin from UV-radiation[50,51]. Tinosorb S and Escalol S are generally referred to as Bemotrizinol, respectively.

Chemical Formula: $C_{38}H_{49}N_3O_5$

Pharmacology:
Indication: Listed as a sunscreen ingredient that is effective.

Pharmacodynamics: A competitive binding experiment on immature rat uterotrophic cells suggests that bemotrizinol does not have intrinsic estrogenic, antiestrogenic, androgenic and antiandrogenic action [49]. Bemotrizinol reduces erythema and protects the skin's antioxidant defence system against oxidative stress [50]. Treatment with bemotrinizol prevented the emergence of polymorphic light eruption (PLE) in a study of persons who had previously had PLE [52].

Mechanism of action: Bemotrizinol protects against the production of free radicals caused by UV radiation by absorbing UV-A and UV-B light ranging from 280 to 400nm [50].

Toxicity: Oral LD50 in rats is > 2000 mg/kg and dermal LD50 in rabbits is > 2000 mg/kg, respectively.

3. Bisoctrizole:

UVA and UVB radiation absorption Bisoctrizole is used as sunscreen. Both UVA and UVB rays may be blocked by this benzotriazole-based chemical molecule. Only at a 10% concentration in sunscreens, childcare products, and skin lightening treatments has Bisoctrizole been authorised by the FDA for use as a UV filter [46].

Chemical Formula: $C_{41}H_{50}N_6O_2$

Pharmacology:

Indication: Cosmetic items that have sunscreen ingredients.

Pharmacodynamics: Bisoctrizole showed no intrinsic androgenic, estrogenic, or uterotrophic action in an in vitro androgen competitive binding experiment [46].

Mechanism of action: One of the most effective organic UV-A filters is bisoctrizole [46].

Absorption: It was shown that only around 0.01 percent and 0.06 percent of the administered dosage penetrated the skin membrane of rats and humans, respectively, in an in vitro examination of dermal penetration [46]. A possible bioaccumulation following repeated skin applications cannot be ruled out, despite the limited dermal absorption [46].

Toxicity: Oral and dermal LD50 values in rats were both more than or equal to > 2000 mg/kg. At the high dosage of 1000 mg/kg BW/day, bisoctrizole was shown to have no impact on the mother or her offspring throughout the course of an animal development investigation. Bisoctrizole seems to have no phytotoxic impact on animals [46].

4. Drometrizoletrisiloxane

The sunscreen ingredient drometrizoletrisiloxane absorbs UV rays to shield the skin from harmful rays. Drosometrizoletrisiloxane may be used as a UVA and UVB light filter[34,36,37,38,39,41] because of its photostability. There are comparatively few reports of adverse reactions from other countries, but the FDA maintains that the available scientific evidence does not support its use as an over-the-counter sunscreen ingredient that is widely regarded as safe and effective [41,43].

Chemical Formula: $C_{24}H_{39}N_3O_3Si_3$

Pharmacology:

Indication: As an active component in several sunscreens, Drometrizoletrisiloxane blocks damaging UV radiation emitted by the sun. [34,36,37,38,39,42,43].

Pharmacodynamics: Dermatozoletrisiloxane is an ingredient in sunscreen products that is applied directly to the skin and serves as a chemical sunscreen layer that also absorbs UV rays .There will be little systemic exposure and pharmacokinetics with drometrizoletrisiloxane because of the compound's low skin absorption [34,36,37,38,39,42].

Mechanism of action: The sun's unseen energy is ultraviolet radiation, which has three distinct wavelength ranges:
(a) UVA is long-wave UV light with a wavelength range of 320-400nm. While UVA is not as powerful as UVB, it may still reach the dermis. Some skin malignancies may be caused by UVA radiation, which can induce quick tanning, premature ageing, and even skin cancer development. The Earth's ozone layer absorbs 95 percent of the sun's UVA rays.
(b) UVB radiation has a wavelength between 280 and 320 nanometers (nm). When the skin's outer protective layer is penetrated, it causes delayed tanning, sunburn and most skin malignancies. Ozone absorbs more than half of the UVB that hits the Earth's surface, allowing just 5% to reach us.
(c) It has wavelengths between 100 and 280nm and is quite powerful. Regardless of how short the exposure may be, it poses a significant threat to all living things. The ozone layer, on the other hand, largely prevents UVC radiation from ever reaching Earth[40]. Shorter UV radiation is less able to enter the skin than longer wavelength light[40].
Because of this, drometrizoletrisiloxane is a chemical sunscreen with wide UVA/UVB absorption spectrum that is derived from lipophilic benzotriazolederivatives[34–42]. Unlike other UV filters, such as the popular UVA absorber avobenzone, which degrades in the presence of sunshine, this one does not. To guarantee that the combined product covers or protects against as wide a range of UV radiation as feasible, drometrizoletrisiloxane is often coupled with additional active sunscreen ingredients such as titanium dioxide, avobenzone, and others [39].

Absorption: No skin absorption of dromizoletrisiloxane has been documented [36,39]. As a result of these investigations, it is probable that the most regularly used sunscreens have components that penetrate deep into the skin, although the level of penetration is still restricted. Few cases of harmful effects have been reported despite the extensive usage of sunscreen products across the globe.

Toxicity: There is no concern about Drometrizoletrisiloxane's safety due to the fact that it is approved for use in sunscreens by most national health organisations, and the results of their toxicity tests show that there is also low chance of bad effects.[34,36,37,38,39,42].

5. Ecamsule

UV-absorbing sunscreen agent ecamsule may be found in a variety of sunscreens. UVA radiation may be blocked by an organic component included in many sunscreens. Because of its strong photostability, this benzylidene camphor derivative is well-known. Only a few L'Oreal products and a particular concentration of Ecamsule have been authorised in the United States since 2006. A new medication application method was used by the corporation to approve the items.

Chemical Formula: $C_{28}H_{34}O_8S_2$

Pharmacology:

Indication: UVA rays are blocked when a skin-applied filter is used.

Pharmacodynamics: Reversible photoisomerization and photoexcitation occur in the ecamsule when it is exposed to UV light. Rather of damaging the skin, the absorbed UV is converted to heat energy and expelled from the lungs or other organs.

Mechanism of action: UV Radiation may be prevented with Ecamsule, which protects against a range of wavelengths, having the most effective protection at 345nm. Reduces generation of UV-induced pyrimidine dimers and delays the development of skin cancer in animal experiments. Ecamsule has been proven in vitro to successfully protect against UV damage.

Absorption: Ecamsule should not be ingested since it is a topical medication. Human systemic exposure to Ecamsule under actual exposure settings is less than 0.1 percent and provides no health risk.

Toxicity: The most frequent responses were dermatitis, dry skin, acne, itching, redness, and skin irritation.

6. Ensulizole

Sunscreens include the UVB-absorbing chemical ensulizole. As the name suggests, ensulizole, also known as 2-phenylbenzimidazole-5-sulfonic acid, acts as a water-soluble sunscreen. Due to its low UV-A protection, it is often used in cosmetics and sunscreen formulations in conjunction with other UV filter compounds. Ensulizole is widely utilised in products designed to feel light and less greasy because of its water solubility. After UV-A or UV-B exposure, investigations have shown that the treatment with ensulizole protects against cyclobutane pyrimidine dimers and photosensitizes the development of oxidised guanine bases. In commercial sunscreen products, ensulizole may be found in quantities between 74 to 148 mM, which is below the FDA's maximum permitted concentration of 148 mM.

Chemical Formula: $C_{13}H_{10}N_2O_3S$

Pharmacology:

Indication: It is approved for use in sunscreen compositions as a UV-B-absorbing molecule.

Pharmacodynamics: As a UV-B selective filter, ensulizole exhibits very little action when exposed to UV-A rays. As a result of UV-B photoexcitation, Ensulizoleoxidises guanine bases in vitro and may induce cellular photodamage.

Mechanism of action: Ensulizole is a powerful absorber of UV-B wavelengths. It prevents the formation of cyclobutane pyrimidine dimers when exposed to UV-B light. Ensulizole produces DNA strand breaks and photosensitizes the development of oxidised guanine following UV-A or UV-B irradiation, according to in vitro and cellulo investigations. Ensulizole creates reactive oxygen species, such as singlet oxygen, when it is photoexcited.

Toxicity: Dermal LD50 in rats is > 3000 mg/kg and oral LD50 in rats is > 16000 mg/kg.

7. Meradimate

Sunscreens include the UV-absorbing chemical meradimate. [55] Meradimate, which was formerly known as methyl anthranilate, is employed as a UV filter at a maximum concentration of 5% in various goods. Meradimate was the sole name allowed under FDA standards for all over-the-counter medicines. The FDA and Health Canada have given their approval for the use of meradimate as an ingredient in sunblock products[57,58].

Chemical Formula: $C_{17}H_{25}NO_2$

Pharmacology:

Indication: Different products use meradimate as an active component or sunblock element. It falls into the group of absorbents with a wide range of action[53]. UV light may be absorbed or reflected depending on the qualities of the constituents. In addition, it's critical to understand what kinds of radiation these filters block. Ultraviolet A rays are

responsible for solar damage that penetrates into the skin's deeper layers, whereas UVB rays may only produce sunburn on the surface. Broad-spectrum agents are capable of working in both UVA and UVB wavelengths. [59].

Pharmacodynamics: As a low-level, broad-spectrum protectant, meradimate has an advantage[55].

Mechanism of action: Because Meradimate absorbs both UVA and UVB radiation, this chemical has a wide range of applications, including lip balms, lipsticks, and moisturizers[59]. Because it barely reaches 336 nm[54], it does not provide good protection against all forms of UVA radiation. Even though meradimate has a potential protection range of 200-380 nm, this has been proved. [55] Meradimate is an ortho-disubstitutedaminobenzoate, and its function is connected to its structure. Electron delocalization is made simple by this structure, which also causes a shift in the absorption maxima.

Absorption: A person cannot take Meradimate through skin absorption [59].

Toxicity: Meradimate has been demonstrated in certain investigations to enhance the generation of reactive oxygen species[56], however this has not been conclusively proven.

8. Octocrylene:

Octocrylene is a sunscreen ingredient that absorbs UV rays and is often found in sunscreens. The emollient characteristics of octocrylene make it a popular sunscreen ingredient because of its ability to keep skin moisturised. It is an efficient sunscreen because of its capacity to neutralise UV radiation emitted by sunshine and to reduce skin damage as a result of extended exposure to the sun. For its efficacy, octocrylene has been allowed for use in cosmetics and skin care products worldwide, however the concentrations of this component are normally restricted to 10% or 12% of the product. In addition to sunscreen for the face and arms, this ingredient is used in a range of other products, including hairspray, tan oil and BB and CC creams. Contact and photocontact allergies are possible side effects of octacrylene[64].

Chemical Formula: $C_{24}H_{27}NO_2$

Pharmacology:

Indication: The Food and Drug Administration (FDA) in the United States has analysedoctocrylene and determined that a concentration of up to 10% is safe. European Union regulations allow 10% of the formula, but Health Canada permits a maximum of 12%.

Mechanism of action: The oil-soluble liquid UVB filter octocrylene works well. Crystalline UV filters dissolve easily in this solution. It is utilised as a picture stabiliser because of its excellent photostability. UVB and short-wave UVA (ultraviolet) light with wavelengths between 280 and 320 nm are absorbed by the conjugated acrylate component, protecting the skin from direct DNA damage. Because of its hydrophobicity, ethylhexanol acts as an emollient in skin care products.

Absorption: When ecamsule is applied to the skin, it is not digested or absorbed.

Toxicity: This chemical, Octocrylene, may be absorbed into the skin, and some studies have indicated that it may enhance the creation of potentially dangerous free radicals when exposed to light. There is fear that free radicals, which may damage DNA, may have contributed to an increased incidence of melanoma among sunscreen users compared to those who do not use sunscreen.

9. Octinoxate:

The sunscreen ingredient octinoxate absorbs ultraviolet rays. One of the most often used ingredients in sunscreens and other skin care products to protect against DNA oxidation is octinoxate. As a UV-B filter, it was first created in the 1950s as an organic compound. If the liposomes are water-resistant, they may be coupled with nanoparticles or other lipids to boost epidermal absorption and lower the danger of percutaneous absorption. There is FDA approval for its usage in pharmaceutical and cosmetic compositions.

Chemical Formula: $C_{18}H_{26}O_3$

Pharmacology:

Indication: For use in sunscreen and lip balms as an active component Protects from the harmful effects of the sun's rays.

Pharmacodynamics: Protects the skin from the harmful effects of natural light's ultraviolet (UV) radiation by acting as a photoprotective agent. Damage to DNA, cell cycle halt, immunosuppression, necrosis, and transcriptional alterations are among the biological impacts of UV exposure. [67].

Mechanism of action: Accumulates in the outermost layer of the epidermis, absorbing UV-B (predominantly) and UV-A light. Optinoxate is an effective photoprotective agent because it inhibits UV-induced cell damage and raises the skin's tolerance to UV radiation [67–69].

Absorption: As well as being present in the deeper stratum corneum layers, urin, plasma, and breast milk [64], it may be absorbed systemically following skin application. There was an average plasma concentration of 7ng/mL in women and 16ng/mL in males following application of 2mg/cm2 sunscreen[66].

Metabolism: When ingested in a systematic manner, hepatic metabolism may occur. Hydrolysis of esters may be accomplished by lipases in the stratum corneum [64]. When exposed to sunshine, they degrade into photoproducts, which reduces UV absorption[66].

Toxicity: Hazardous to health if ingested, inhaled, or comes into touch with the skin or eyes. [68] Octinoxate may cause the formation of reactive singlet oxygen species, which may have anti-estrogenic effects. Cellular functions in humans may be disrupted or damaged by UV-induced molecular breakdown of octinoxate [66]. The Wistar rat NOAEL (no observed adverse effect level) for fertility and reproductive performance in systemic, parental, and developmental toxicity is 450 mg/kg BW/day [65].

10. Padimate O

Padimate O is a sunscreen component that absorbs UV rays. In cosmetics and OTC sunscreens, Padimate O may be found in concentrations of up to 8%, as mandated by the FDA. To protect against photodamage, it is a structurally similar chemical to Aminobenzoic acid. Toxicological effects on yeast and human skin have been seen [60] once it enters the skin and causes non-ligatable strand breaks on DNA in vitro.

Chemical Formula: $C_{17}H_{27}NO_2$

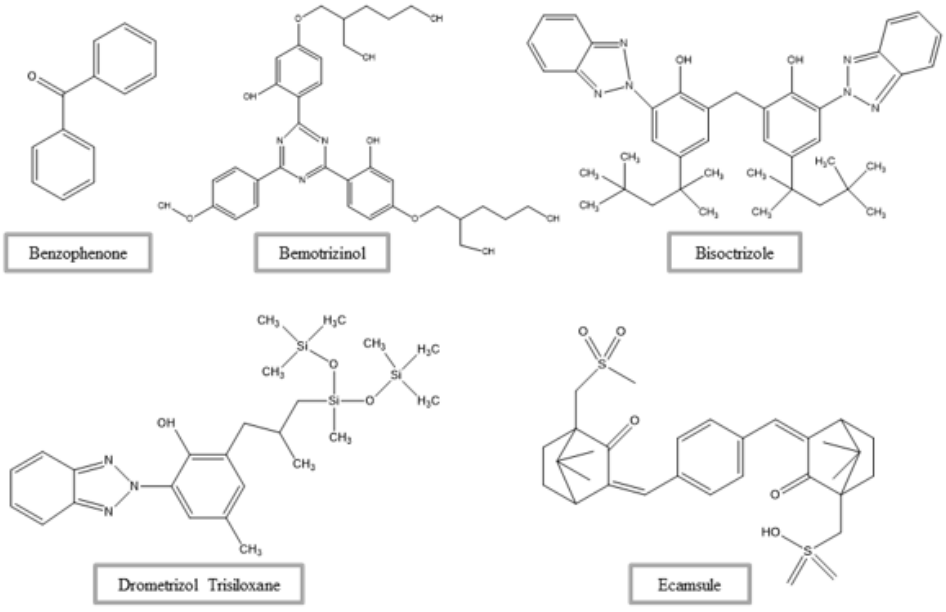
Pharmacology:

Pharmacodynamics: In human keratinocytes, padimate O absorbs UV-B light and may cause DNA damage. DNA strand breaks are more common when padimate O is administered, although the therapy also reduces the production of UV-endonuclease-sensitive sites [60,61].

Mechanism of action: Padimate O and keratinocytes may promote epidermal diffusion if they are in touch simultaneously. Padimate O produces singlet oxygen and carbon-centered free radicals when it is exposed to light. UV-induced cellular damage can be mitigated by padimate O, although it may also cause more difficult-to-repair chemical damage.[60].

Absorption: Padimate O is able to penetrate the skin of humans[60].

Toxicity: Cells under the epidermis are damaged by Padimate O in vitro [60]. There was no LD50 value given (fig. 3).



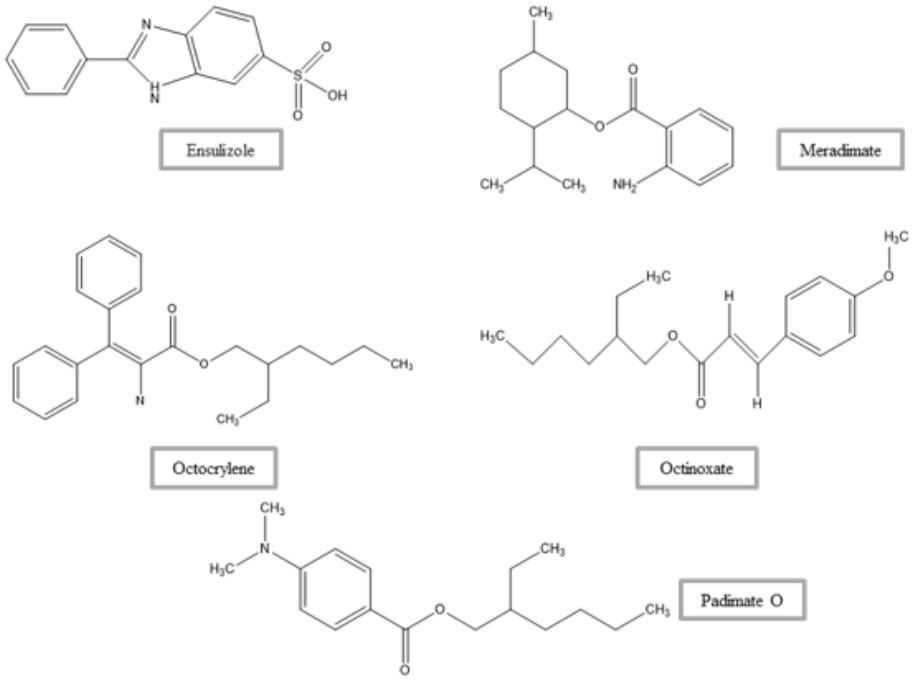


Figure 3: Chemical structures of the discussed sunscreen agents

DISCUSSION:

Further developments

Aesthetics, effectiveness, and safety are all being improved in the development of sunscreens. Sunscreen products may benefit from newer technology, such as adding nonabsorbing elements to boost SPF coating and changing inorganic sunscreens, adding antioxidants, encapsulation of UV absorbers[69-72], and microfine organic particles. Unlike traditional sunscreens, sunspheres (Rohm and Haas) are SPF-enhancing vehicles. Water-filled styrene/acrylate copolymers that do not absorb UVR are used in their construction. SunSPHERE's hollow capsule scatters the incident light, improving the product's effective SPF by 50 to 70 percent [73]. It has been revealed that some newer compounds have photoprotective characteristics, and many of them are currently being explored, such as 2-furildioxime (FDO), calcitriol, caffeic acid, ferulic acid, a polypodiumleucotomos extract.

Analyze the Risk-Benefit Relationship:

Are There Compound/Ingredient Risks in Sunscreen? As a result of a lot of media attention, sunscreen's possible negative health consequences have been widely discussed. The FDA has recently updated its sunscreen monograph and made revisions to the labelling of chemicals deemed to be "generally recognised as safe and effective." (GRASE) (GRASE). Organic (chemical) sunscreen chemicals such as cinoxate, dioxybenzone, ensulizole, homosalate, meradimate, octinoxate, octinoxate-octisalate, octocrylene, padimate O, sulisobenzone, oxybenzone, and avobenzone require further research on their safety and effectiveness before they can be designated as safe. These chemicals, although being considered safe, are regarded to warrant more investigation. Aside from PABA and trolamine salicylate, inorganic (physical) sunscreen filters titanium dioxide and zinc oxide are GRASE at the moment. Studies indicating a lack of absorption through the stratum corneum, as discussed in the inorganic vs. organic section [71,72], have allayed fears concerning systemic absorption of nanoparticles present in physical sunscreen formulations. Photoallergenic contact dermatitis has been associated to chemical sunscreen components such as benzophenone-3, octylmethoxycinnamate, and octocrylene[73,74]. Also, although sunscreen allergy is uncommon, it is a prevalent cause of photoallergy, according to a review[75]. Contrary to popular belief, a meta-analysis of exaggerated-use studies found that the risk of skin sensitivity or irritation with sunscreens containing 1 percent to 6 percent oxybenzone is actually overestimated in the scientific literature. Other issues with UVR filters have been connected to estrogenic and antiandrogenic action by benzophenone UVR filters. Researchers found that male exposure to UV filters (BP-2 and 4-hydroxybenzophenone) may impair couples' fertility, resulting in an increase in the use of benzophenone-based sunscreens.[76] It's not yet clear if oxybenzone, which has been found in sunscreens and many other items, poses a direct danger to corals, even though it has been shown to be hazardous in laboratory studies.

A decent sunscreen should have the following properties:

Inertness, non-irritability, photostability, and compatibility with other substances are only a few of the desired chemical qualities. Physical features include low viscosity, aesthetic appeal, tiny particle size, waterproof ability, suitable solubility, and non-odorous. The capacity to offer protection across a broad range of wavelengths, as well as a restricted systemic absorption via the skin, are all factors that contribute to the product's effectiveness. It is also essential that the items be simple to get your hands on, affordable, and devoid of harmful toxins (77).

Sunscreen Chemicals' Hormonal Effects:

We need to evaluate the evidence to understand why people are so worried about chemicals in sunscreens. Camphor compounds, such as 4-methylbenzylidene camphor or 3-benzylidene camphor, as well as cinnamate derivatives such as isopentyl-4-methoxycinnamate, are the three primary types of chemicals that are raising concerns. octocycline is also a problem. Many investigations have revealed that benzophenone has both oestrogen and androgen disruptive effects. Benzophenone residues were identified not only in wastewater, but also in human urine and breast milk [78]. Benzophenone-like UV filters have been shown to be very harmful to fish and rats in laboratory investigations. Benzophenones altered normal testosterone levels throughout male development in mice and rats by preventing the conversion of androstenedione to testosterone, and this lowered androgenic activity remained even after metabolism mediated by rat and human liver microsomes. ' The thyroid hypothalamus axis is also affected by benzophenones, which block or inactivate thyroid peroxidase function, disrupting thyroid hormone production.

CONCLUSION:

Skin cancer is one of the disorders that may result from exposure to damaging radiation. The best sunscreen should be affordable, effective, and safe, and it should be able to block UV rays. Other harmful consequences, such as contact allergy and other forms of endocrine disruption, photoallergies and cancer, may be caused by the usage of radiation-protection compounds such as the oxybenzone, octinoxate and other synthetic chemicals, such as nanoparticles, aminobenzoic acid and oxylisadimate. Sunscreens are a must-have for everyone who wants to stay safe from the sun's harmful ultraviolet radiation. Sunscreen sales have risen as a result of growing knowledge of the hazards of long-term sun exposure and its relation to cancer. Many health organisations throughout the globe are promoting adequate sunscreen usage, which has been found to reduce skin ageing, tanning, and the risk of developing skin cancer. As new scientific understanding emerges, regulators all around the globe are working to adopt laws that will better monitor the production of high-quality sunscreen products. The use of synthetic organic sunscreens as a kind of photoprotection is a frequent practise. However, there have been a number of drawbacks as a result of their use.

CONSENT FOR PUBLICATION

Not applicable.

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CONFLICT OF INTEREST

The author declares no conflict of interest, financial or otherwise.

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