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Review Article

Formulation and Evaluation of Sunscreen Cream

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Abstract

Creating sunscreen cream formulations with a high sun protection factor (SPF) and desirable properties was the aim of this study. Zinc oxide, an organic UV filter, and titanium dioxide, an inorganic UV filter, were the active ingredients. Through the use of an emulsification technique, two ideal cream bases were created from a number of trial formulations and combined with both active ingredients at the permitted concentrations. The samples' physical characteristics, pH, viscosity, and in vitro SPF were measured. Additionally, the SPF of the sunscreen creams was compared to that of their equivalents that included titanium dioxide or zinc oxide at the same concentrations. The stability under freeze-thaw conditions was investigated. The findings showed that the combination of sunscreens' synergistic efficacy on SPF was validated. The SPF was impacted by the inherent characteristics of cream bases, particularly viscosity in the final product. Costs associated with disease were significantly reduced with a small investment in prevention. The final orders from the FDA regarding sunscreen labeling were just made public. Regarding over-the-counter (OTC) sunscreen products, the final monograph revises the tentative final monograph. The term "sun block" will no longer be used, and a statement regarding the need of sunscreen to prevent sun damage will be included in the labeling standards. There will also be three categories for sun protection: minimum, moderate, and high.

Keywords: Sunscreen; SPF; UV Filter

Introduction

The wavelengths of sunlight range from ultraviolet to visible light. UVA (320–400 nm), UVB (290–320 nm), and UVC (100–290 nm) are the three categories of ultraviolet (UV) light [1]. The skin of humans is adversely affected by sun exposure. UV is the most damaging to skin of all; prolonged exposure can result in skin cancer and sunburns. Sunlight exposure can cause a variety of biological reactions, such as sunburn, erythema, and skin cancer. The synthetic sunscreen formulas on the market have a number of negative side effects. As a result, in the cosmetics sector, developing a suitable sunscreen and assessing its level of UV protection is crucial. Sunscreen has a bright future because to advancements in UV-filter technology, an increased focus on environmentally friendly compositions, and a deeper understanding of skin protection. Enhanced UV spectrum coverage, improved texturing, and longer-lasting protection are a few examples of advances. Customized formulae based on specific skin needs might also become more popular. As awareness of the importance of sun protection grows, we should anticipate continued breakthroughs in sunscreen formulas and application methods [2].

Ideal properties of Sunscreen Cream

- It must block off a broad range of UV rays that might cause skin burns.
- Must maintain stability in the presence of sunlight.
- It must have the ability to shield the entire skin.
- It should be challenging to get rid of with water.

- It should be nontoxic, chemically inert, and low concentration.
- It must not be toxic, irritable, or sensitizing.
- It should be able to keep up its ability to block the sun for several hours [3].

Advantages

Sunscreen cream provides UV radiation protection.

- It stops aging too soon.
- It lowers the chance of developing skin cancer.
- It shields against sunburn.
- It stops UVB-induced tanning [4].

Disadvantages

Sunscreen with PABA has a high potential for allergic reactions.

- It might exacerbate acne.
- In places with hair, it could hurt and lead to pus in the hair follicle occasionally [5].

Requirements of vitamin E

Vitamin E is a fat-soluble vitamin that is essential to human health. The most physiologically active form of vitamin E is alpha-tocopherol, though there are other varieties as well. This material protects the body's cells from free radical damage by acting as a potent antioxidant [6]. Vitamin E is found in a wide range of foods, including almonds, seeds, leafy green vegetables, and vegetable oils. When administered topically, vitamin E has a number of benefits for the skin. Its emollient properties help to keep moisture in the skin, which can help to enhance skin hydration. Because well-hydrated skin is softer, smoother, and more elastic, wrinkles and fine lines can be less noticeable. In addition to its hydrating properties, Vitamin E is a strong antioxidant that can help reduce signs of aging. Free radicals can harm skin and hasten the aging process. Vitamin E helps neutralize them and prevent this from happening [7]. This can minimize the appearance of fine lines and wrinkles while improving the skin's overall tone and texture. Furthermore, vitamin E has anti-inflammatory properties, suggesting that it may help reduce skin inflammation and redness. This could be especially beneficial for people with sensitive skin, rosacea, or eczema. Vitamin E reduces inflammation, which can help to improve the skin's overall health and appearance. In addition to its antioxidant, emollient, and anti-inflammatory properties, vitamin E is engaged in a wide range of other vital physiological activities. It thins the blood, which helps prevent blood clots and is essential for the immune system to function correctly [8]. Furthermore, research has shown that vitamin E reduces the oxidation of low-density lipoprotein (LDL) cholesterol, which can lead to the buildup of plaque in the arteries and increase the risk of heart disease. All things considered, vitamin E is a versatile substance that benefits the body and skin in a number of ways. When applied topically or taken orally, vitamin E can help reduce inflammation, diminish the appearance of aging, improve skin hydration, and prevent harm to the body's cells [9]. When added to sunscreens, vitamin E can boost the effectiveness of UV protection and provide additional benefits to the skin, making it a fantastic choice for anybody looking to protect and enhance the health of their skin [10].

Benefits of Vitamin E in sunscreen

Adding Vitamin E to a topical treatment like sunscreen has several advantages for the skin. Some of the primary benefits of sunscreen containing vitamin E include the following.

Enhanced sun protection

UV radiation from the sun can cause sunburn, premature aging, and skin cancer, among other skin problems [11]. It has been shown that vitamin E provides additional UV protection and boosts the effectiveness of sunscreens. Vitamin E can reduce the risk of sunburn and other sun-related skin disorders when combined with other sun blocking substances like zinc oxide or titanium dioxide.

Increased skin hydration

Vitamin E's emollient properties help the skin hold onto moisture, which can help to enhance skin hydration [12].

Diminished signs of aging

Vitamin E is a strong antioxidant that can help reduce the signs of aging by scavenging free radicals. Free radicals are unstable substances that have the capacity to damage skin tissue and speed up the aging process. Vitamin E can assist to neutralize these chemicals and stop their harmful effects [13]. This can minimize the appearance of fine lines and wrinkles while improving the skin's overall tone and texture.

Reduced inflammation

Vitamin E may be helpful to reduce skin irritation and redness because of its anti-inflammatory properties. This could be especially beneficial for people with sensitive skin, rosacea, or eczema

[14]. Vitamin E reduces inflammation, which can help to improve the skin's overall health and appearance.

Material and Methods

Preparation of emulsions

The emulsions were prepared by heating the oil phase and aqueous phase at the same temperature. Following that, a mechanical stirrer was used to add the initial aqueous phase to the oil phase while continuously stirring at 2000 rpm for 15 minutes, or until the aqueous phase was added completely [15]. Subsequently, the (W/O) phase was gradually included into the second phase. Ultimately, the emulsion was allowed to settle to ambient temperature before the stirrer's speed was reduced to 1000 rpm for homogeneity.

Physical analysis

Phase separation and creaming were two physical and organoleptic (color, appearance, feel, and thickness) studies performed on the produced emulsions.

Stability tests

Emulsion stability tests were conducted under various settings to investigate the impact of these factors on emulsion storage [16]. The samples maintained at 8 °C ± 2 °C, 25 °C ± 2 °C, and 40 °C ± 2 °C underwent these tests. Throughout a 28-day period, different time intervals were used to observe the emulsions' color, phase separation, and liquefaction.

Centrifugation tests

For emulsions, centrifugal tests were carried out right after preparation. After one, seven, fourteen, twenty-one, and twenty-eight days of storage, those tests were conducted again. They were run at a speed of 5,000 rpm.

pH determination

With a digital pH meter, the pH values of several emulsions kept under diverse circumstances were found. After one, three, seven, fourteen, twenty-one, and thirty-eight days of storage, the pH tests were conducted again for each of the emulsions.

Table 1: List of the ingredients [17].

Sl. No.	Ingredients
1	Vitamin E
	Zinc Oxide
	Stearic Acid
	Glyceryl Monostearate
	Sodium Lauryl sulphate
	Triethanolamine
	Glycerine
	Methyl Paraben
	Propyl Paraben
	Wool fat
	Bentonite

Table 2: Description of the ingredients[18].

Sl. No.	Ingredients	Properties
1	Vitamin E	Photo protection
2	Zinc Oxide	Broad spectrum blocker
3	Stearic Acid	Softening skin
4	Glyceryl Monostearate	Prevent dehydration
5	Sodium Lauryl sulphate	Cleansing agent
6	Triethanolamine	Balance pH
7	Glycerine	Moisturizer
8	Methyl Paraben	Prevent the growth of bacteria
9	Propyl Paraben	Extend the shelf life
10	Wool fat	Waterproofing and texturing
11	Bentonite	For effectiveness

Preparation of sunscreen cream

Adequate sunscreen ingredients are applied.

⇩

A suitable base can be utilized to create an oil, emulsion, fatty cream, or watery lotion as the finished product.

⇩

Emulsifiers are employed in formulation to maintain stability.

⇩

Certain sunscreens contain glycerin as a moisturizer.

⇩

The purpose of the thickening agents is to improve consistency.[19]

⇩

A number of natural oils, including olive, peanut, and coconut oil, can absorb UV rays quite well.

⇩

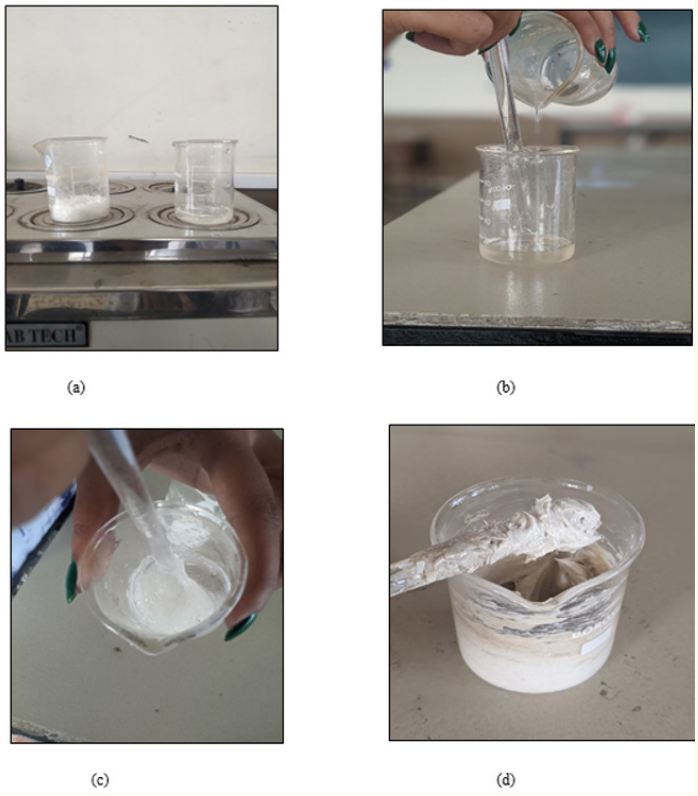
If a natural oil is being utilized, then an antioxidant should be added to stop rancidity.

⇩

Preservatives such as Sodium propyl paraben and Sodium methyl paraben are utilized.

⇩

Finally, a perfume was applied.[20]



(a) (b) (c) (d)

Figure 1

Evaluation

As in any other preparation identification quantitative determination of various ingredients are essential for evaluation and quality control point of view [21]. Apart from this routine tests some special tests are necessary for this type of product.

- **Appearance** - Thick and give white shade on the skin or leave the so-called white cast was evaluated.
- **Oduor** - The smell is mainly due to the lack of chemicals than to an additional substance [22].
- **Spreadability** - Spread ability values showed that the creams possessed good and uniform spread ability property.
- **pH** - Sunscreens not only shield skin from UV rays but also delay the appearance of fine lines, wrinkles, and other indications of aging [23]. The pH assessment was done with the help of pH meter.
- **Viscosity** - Viscosity of prepared sunscreen cream was evaluated using a viscometer for 5 minutes approximately.
- **Patch test for irritancy** - Applied a small amount of the product to a small tender area of skin such as the bend of arm for several days in a row. Examined the area each day and no reaction occurred [24].

Results

Table 3: Result of evaluation.

S. No.	Parameters	Observation
1	Appearance	Creamish white
2	Odour	Characteristics
3	pH	5.9
4	Viscosity (cps)	3401
5	Spreadiability	Good and uniform
6	Patch test for irritancy	No irritation reaction persists

Conclusion

The current study set out to create a sunscreen cream with the right amount of stability and UV protection. The results of the study showed that sunscreens with vitamin E had high SPF values of 33.43 and 33.50, respectively, stability, and good antioxidant activity. Furthermore, it has been shown that these sunscreens do not result in mutations. One could argue that the current research will hopefully lead to improved treatments for sunburns caused by UV radiation exposure. The study also demonstrates that UV spectroscopy is the most efficient, dependable, and reproducible technique for determining sunscreen efficacy. As a result, sunscreen cream makers, scientific societies, and regulatory agencies can use the study's findings to create consistent guidelines.

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