IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.301
Volume 3, Issue 1, December 2023

A Review on Formulation and Evaluation of Sunscreen by Using Natural Sources

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Abstract: *Sunscreen is a chemical compound that helps shield the skin from ultraviolet light. Sunburn is caused by UVB radiation, but UVA radiation may cause more skin damage. A sunscreen that blocks both wavebands is ideal. The aim of this study was to use medicinal herbs and specific fixed oils to create a topical herbal sunscreen composition. The goal of this project is to create and evaluate a cosmetic (herbal sunscreen) that shields skin from the sun. Natural ingredients with a range of uses, such as emollient, moisturiser, base, anti-acne, and anti-sweating, include hibiscus and aloevera .Rose water, almond oil, vitamin E capsules, hibiscus flowers, etc. Actinic keratosis, squamous cell carcinoma, and melanoma can all be avoided with regular sunscreen use. Chemicals, either organic or inorganic, may be present in sunscreen. Sunscreen cream is another term for sunscreen. The object either absorbs or reflects solar radiation. UV radiation and provides skin defence. The use of screening materials that have been successful in lowering the indication has increased as a result of the rising incidence of skin cancers and the effects of UV radiation-induced photo damage.*

Keywords: Herbal, sunscreen, skin, sunburn

I. INTRODUCTION

The use of sunscreen as photo protecting agents for UV protection is becoming very popular. A sunscreen preparation is defined as a formulation which, when applied topically, protects the treated area from sunburn. Sunscreens are used to aid the body's natural defense mechanisms to protect against harmful UV radiation from the sun. Its function is based on its ability to absorb, reflect or scatter the sun's rays. The Sun protection factor (SPF) of a sunscreen is calculated by comparing the amount of time needed to produce sunburn on sunscreen protected skin to the amount of time needed to cause sunburn on unprotected skin [1]. Efficacy of sunscreens depends on ability to protect against UV-induced sunburns, and their chemo preventive activity [2]. The ideal sunscreen compound has to meet a wide variety of specification.

- It must absorb or filter out the rays causing sunburn which are those in the region from 2900 to 3300 Angstroms.
- It should be stable in the presence of light, air, and moisture, or if it is decomposed under these conditions, the decomposition products should have comparable absorption to the original compound in the 2900 to 3300Angstrom region.
- It should have very slight or no absorption for the long ultraviolet rays beyond 3400 Angstroms which are thought to produce tanning without appreciable erythema.
- The compound and decomposition products which may be produced under conditions of use should be nontoxic and nonirritating.
- It should be nearly neutral so untoward effects are not produced by the presence of acid or base on the skin.
- It should have good solubility in the ointment base or vehicle in which it is to be formulated and should have low water solubility to prevent rapid removal by perspiration.
- It should be relatively nonvolatile so it will not evaporate under conditions of use.
- It should not be rapidly absorbed through the skin [3].

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1.1 Natural Sunscreens

1.1.1 Aloe vera

Fig- Aloe vera (Source- Stocki)

The leaves of Aloe vera and A. barbadensisare the source of aloe vera gel. Aloe vera gel is widely used in cosmetics and toiletries for its moisturizing and revitalizingaction. It blocks both UVA and UVB rays and maintain skin‟s natural moisture balance. The enzyme bradykinase in aloes stops the sunburns and stimulate immune system intervention. Acemannan which is D-isomer mucopolysaccharidespeeds up the repair phase and the increased production of fibroblasts and collagen. Aloe extracts and aloin from the plant have spectrophotometric peaks at about 297 nm and hence can act as a sunscreen for skin as well as hair [4, 5, 6]. The study was carried out to determine the photo protective activity of Aloe vera juice on Asian hair namely Black, grey which are chemically colored. Tryptophan content of hair treated with aloe vera juice before and after exposure to UV radiation. The tryptophan content measurements revealed that hair which was untreated and exposed showed higher degree of chemical damage while treated with Aloe vera juice offered protection from UV damage [7].

1.1.2 Tomato

Fig- Tomato (Source Ugaao)

Tomato (Lycopersiconesculentum) fruit is the major source of lycopene and studied for its antioxidant activity incosmetic and pharmaceutical field. Tomato is rich in lycopene, a widely studied powerful antioxidant and anti-carcinogenic carotenoid with strong reducing ability. Lycopene is a carotenoid, which gives red color to the tomatoes. It is not merely a pigment but a powerful antioxidant, neutralizes free radicals especially those derived from oxygen, present under the lipid membrane and skin cover. Lycopene scavenges lipid radicals, reduces lipid peroxidation, and prevents erythema caused by UV radiation on the skin. Lycopene may reduce the damaging effect which UV light can have on the skin and can boost protection against both the short term (sunburn) and cumulative effects of sun exposure (cancer) [8, 9, 10].

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1.1.3 Pomegranate

Fig- Pomegranate (Source- Nurserylive)

Pomegrante (Punicagranatum) is having principle antioxidant polyphones in its juice include the ellagitanninsandanthocyanins. Weerakkody P et al 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. They evaluated effectiveness of three commercial sunscreen treatments Parasol1 (Crop Care, Australia), Surround1 (Ag Nova Tech., Australia) and Anti-stress-5001 (EnviroShield Products Co., USA) For preventing sunburndamage of pomegranate, fruit was grown in Condobolin, New South Wales, Australia. The results showed that there was a significant effect of the sunscreen treatments ($p = 0.05$) for the severely sunburn damaged fruit category. Fruit treated with Surround1 (14.7%) andParasol1 (12.8%) had significantly lower numbers of fruit with severe damage compared to the control fruit (25.8%); the effect using the anti-stress 5501 (19%) was not significant [11,12].

1.1.4 Green Tea

Fig- Green tea (Source- Nurserylive)

Green tea is obtained from the fresh leaves of the plant Camellia sinensis. Polyphenols are thought to be the major chemo preventive mediators. Green tea contains four major polyphenols: (-)-epicatechin (EC), (-)-epicatechin-3-gallate (ECG), (-)-epigallocatechin (EGC), and (-)-epigallocatechin-3-gallate (EGCG). It also contains other agents include caffeine, flavonoids, phenolic acids as well as the alkaloids the obromine and theophylline. The first evidence that green tea polyphenols might have a protective role in UVinduced skin cancer came from studies by Wang et al., who showed that green tea administered in the drinking water to SKH-1 hairless mice had a dose-dependent prolongation in the mean time of tumor development when they were subjected to a photo carcinogenesis protocol. Very little absorption by green tea in the UVB or UVA range; it is effective when given systemically; and protection against at least some of the biological effects of ultraviolet radiation occur when green tea is applied immediately after exposure [13,14,15]. Figure 4: Green Tea Topical green tea extract significantly increased the minimal erythema dosage of UV on healthy human skin and reduced signs of UV damage on that skin.(-)-Epigallocatechin-3-gallate (EGCG) and (-)-epicatechin-3-

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gallate (ECG) were reported to be the most active components. In several mouse skin models, topical application as well as oral consumption of green tea has been shown to afford protection against chemical and UVB-induced carcinogenesis and inflammatory responses. Human skin was investigated against topical application of (-) epigallocatechin-3- gallate (EGCG), the major polyphenolic constituent in green tea. It inhibited UVB-induced infiltration of leukocytes (macrophage/neutrophils), a potential source of generation of reactive oxygen species (ROS), and generation of prostaglandin (PG) metabolites. Human were subjected to UVB irradiation on sun-protected skin to four times their minimal erythema dosage (MED) and skin biopsies or keratomes were obtained either 24 h or 48 h later. Study revealed that topical application of EGCG (3 mg/2.5 cm2) before UVB (4 MED) exposure to human skin significantly blocked UVB-induced infiltration of leukocytes and reduced myeloperoxidase activity [16, 17].

1.1.5 Cucumber

Fig – Cucumber (Source - Greenmatters)

Cucumber (Cucumissativus) extract has strong moisturizing abilities as well as mild astringent effects. It also helps remove dead skin cells and tightens skin. Cucumbers soothe skin irritations, prevent water retention and are rich in water, fiber and beneficial minerals. Cucumber also contains ascorbic acid (vitamin C) and caffeic acid, both of which soothe skin irritations. These two acid compounds prevent water retention, which is why cucumbers applied topically are helpful for swollen eyes, burns and dermatitis. Figure 5: Cucumber HogadeMaheshwar et al evaluated the correlation between natural fresh (Cucumber) and marketed cucumber lotion as sun protective agent. Marketed cucumber product was randomly selected and compared with fresh cucumber extracts by making different dilution (100 & 200µg/ml) in ethanol. The absorbance‟s of all aliquots were recorded at different nm with the 5 nm intervals from 250-350 nm. The invitro SPF values were determined at wavelength from 290-320 nm according to the method discussed by Mansur et al and found positive results [18, 19].

1.1.6 Grapes

Fig- Grapes (Source- Nurserylive)

Grapes fruit (Vitisvinifera) are the richest source of polyphenols (60%-70%). The skin and seeds of grapes also contains the polyphenolicphytoalexin namely resveratrol (trans-3, 5, 4‟-trihydroxystilbene). It is an excellent antioxidant with

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strong antiinflammatory and antiproliferative activity [20]. Figure 6: Grapes Indian Beech Tree The sunscreen activity of various solvent (Aq, methanol and acetone) extracts of leaves of Pongamiapinnata was compared with the standard sunscreen drug p-aminobenzoic acid. The absorption spectra of various solvent extracts of this plant were measured using UVvisible spectrophotometer. The aqueous and methanol extracts were found to be highly effective in UVB region and moderately effective in UVA region. Acetone extract was found to greatly absorb exclusively in the UVA region. The extracts of leaves of this plant are showing good absorbance throughout the UV region including UVA region. Hence, P. Pinnata extract can be used to formulate highly effective sunscreen preparations [21].

II. MATERIAL AND METHOD

2.1 Development of Formulation

STEP 1 Melt beeswax and Shea Butter in a china dish after that add Almond Oil, Coconut oil, Rosehip Seed Oil, Carrot Seed Oil, and Olive Oil in measured quantities and heat up to 75℃.

STEP 2 Add Rose Water and Gelatin in another china dish in measured quantity. Heat the mixture up to 75℃.

STEP 3 Mix both the mixture and stir gently until a smooth cream is formed at room temperature.

2.2 Evaluation Parameters

2.2.1 Physical Parameters Appearance, color and homogeneity are determined. 4. Subjective Properties

2.2.2 In Vitro evaluation by UV Spectroscopy 1 gm quantity of formulated cream was weighted, transferred to 100 ml volumetric flask and diluted to volume with nbutyl alcohol. Further, it was kept for ultra-sonication for 5 min and filtered through a cotton filter, discarding the initial 10 ml. Afterwards 5 ml aliquot was transferred to 25 ml volumetric flask and the volume was adjusted with n-propyl alcohol. The absorption spectra of samples were obtained in the range of 290-400 nm using 1 cm quartz cell and nbutyl alcohol as blank solution. The absorption data obtained in the range of 290-320 nm every 5 nm interval. The absorbance values and results of formulation Ⅰ, Ⅱ and Ⅲ are shown in table 3.

2.2.3 Sun Protection Factor Determination SPF of formulated creams were calculated by the application of equation : SPF = CF × ∑EE(λ) × I(λ) × Abs(λ) 320 290 The formulation prepared was scanned under UV Spectrometer and the obtained absorbance for 290 to 320 nm. These values are multiplied with EE × I values and the obtained values are multiplied by the correction factor 10.

2.2.4 Rancidity Rancidification is the process of complete or incomplete oxidation or hydrolysis of fats and oils when exposed to air, light, or moisture or by bacterial action, resulting in an unpleasant taste and odor. Rancidity is performed by using the Phloroglucinol solution. The rancidity is due to the oxidation of the fats and oils; during oxidation free fatty acids are liberated. These free fatty acids react with the Phloroglucinol solution and give pink color indicating the rancidity of the product. 10 ml of cream was taken then added 10 ml of concentrated Hydrochloric acid and 10 ml of Phloroglucinol solution and shaken for one minute. The cream should have passed the test if no pink color develops. 4.4. pH Determination PH denotes “Potential of Hydrogen” and is a scale used to specify the acidity or basicity of an aqueous solution. Acidic solutions are measured to have lower pH values than basic or alkaline solutions. The cream in general has a pH of 6 to 9

2.2.5 Procedure All the formulations were water in oil emulsion. The pH of the cream is measured by making a 10% dilution of the cream and the pH is measured by the pH meter. The electrode must be washed and free from any residue of acid and alkali to ensure an accurate reading.

2.2.6 Viscosity Viscosity is an important parameter in the evaluation of the cream. Viscosity governs many properties of the cream such as spreadability, pouring ability of the cream from the container, etc. The viscosity of formulation was determined by using Brookfield Viscometer and Viscosity was found to be in the range of 28000-32000 cp. The Viscosity is determined by using the following formula: Viscosity = Dial Reading × Factor. For LV-4 at 6 RPM Factor is 1M (1000

III. CONCLUSION

From long back, the use of chemicals in sunscreens as photoprotective agent in the formulation isa common practice. Owing to their harmful effects, they are becoming less popular now a day. The use of Natural sunscreen has been gaining significant attention of researchers due to their safety, multiple biological actions on the skin and cost

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effectiveness. The additive properties exerted by the phytoconstituents of plant make them as the most suitable ingredient for sunscreen formulations. The plant actives are preferred over the chemical sunscreens due to the broad spectrum of UV absorption, protective effect against oxidative stress, inflammation and cancer

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