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ORIGINAL RESEARCH

Sun protective activity of natural herbs as emerging trend in dermatology: a review

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One of the major organs in the body is the skin, which shields the body from numerous sorts of external stimuli and harm as well as moisture loss due to constant exposure to sunlight. Ultraviolet B (UV-B) light exposure has a negative impact by causing DNA damage that may ultimately lead to transformation. Although there are several sunscreen chemicals in use, their effectiveness and safety are still up for debate. Effectiveness is assessed using indicators such as the degree of sun protection and the protection factor against chronic pigment darkening. Sunscreen is a substance that protects the skin from excessive UV exposure. Due to their ability to shield skin from sunburns caused by UV radiation, sunscreen use is widely prescribed for sun protection (the sun protection factor or SPF). Sunscreens can be found in a variety of forms, including cream, lotion, gel, sticks, sprays, and lip balms. They can only be used externally. A review of organic sunscreen ingredients has been made.

Keywords: sunscreen, radiation, herbs

1. Introduction

Sunscreens substances that block, scatter, or absorb UV rays (1). They prevent harmful consequences such as accelerated aging, which can cause drooping, wrinkles, and hyperplasia linked to UV radiation (2011). Based on their chemical composition and mode of action, the active chemicals employed in sunscreen manufacturing are separated into filters such as organic and inorganic (2). While inorganic filters shield skin by diffusing and reflecting UV radiation, biological filters absorb UV rays (3). In addition to being sold straight by physicians in the United States, clinics in Italy, cancer non-profit organizations, and cancer prevention organizations in Australia, these chemicals are also sold as over-the-counter medications in pharmacies and supermarkets (4). The skin, which comprises about 15% of an adult's total body mass, is the biggest organ in the body (5). The Latin word integeer is the source of the English word "integument," which refers to the skin's outer layer (6). The epidermis, dermis, and hypodermis, the three main layers of the skin, are each home to sweat glands, sebaceous glands, and hair follicles (7). Sunscreens are substances that block, absorb, or scatter UV rays. It regulates harmful consequences such as premature aging, which can cause sagging, wrinkles, and hyperplasia linked to UV radiation. The active ingredients used in sunscreen production are divided into chemical and artificial filters based on their method of effect and chemical composition. While organic filters absorb UV rays, inorganic screens shield skin by dispersing and reflecting UV light (1).

1.1. Skin as a protective barrier

The skin, which comprises 15% of an adult's total body mass, is the body's biggest organ. The Latin word integeer refers to the outer layer of skin or integument. The skin's color, texture, and thickness, as well as adrenal glands such as the perspiration and oil glands and the hair follicles, differ from person to person and are also influenced by the environment. There are primarily three layers that comprise the skin structure: the epidermis, dermis, and hypodermis. Each layer has a particular purpose. It primarily serves as a barrier against viruses, and injuries because of its

structure, which is made up of a complicated network. It also regulates the temperature and releases water into the external environment.

1.2. UV radiation and exposure

The electromagnetic energy that makes up sunlight has three main wavelengths: UV, visible light, and infrared. UV-A, UV-B, and UV-C are all three subranges of UV radiation. UV-C has the smallest wavelength and highest energy, while UV-A has the greatest wavelength and least energy, with a range of 320–400 nm, and UV-B is in the middle. As it produces reactive oxygen species (8), UV-A can reach deeper layers of the dermis and damage DNA by an indirect photosensitizing reaction. After hitting the genetic material in the epidermal layer, UV-B causes reorganizations of molecules that result in the creation of photons like cyclobutene, which is a dimer and pyrimidine photoproduct. UV-C is absorbed by the ozone layer in the earth's stratosphere. Due to the anatomic placement of the skin on the outside of the body, UV radiation is a major cause of age-related alterations like the abnormal growth of skin cells. Sunscreen agents are used to address this problem. The majority of the beneficial and harmful effects that we associate with sunlight are caused by UV rays, especially those with a wavelength below 320 μ m (8).

The ozone layer now prevents very high energy radiation (UV-C). The damage caused by high-energy radiation (UV-B) occurs more quickly. However, lower energy radiation (UV-A) might damage the skin permanently by penetrating deeper into the skin.

1.2.1. Principle of effectiveness of sunscreens

i Sunscreens provide a protective coating to the skin that blocks UV rays from penetrating it by reflecting or absorbing them. Zinc oxide and titanium dioxide both have such a tendency. UV-reflecting substances are highly effective and often utilized.

ii Sunscreens include ingredients in formulations that absorb medium-range UV photons (280 m–320 μm) while permitting higher-wavelength rays to pass (9).

iii Without reducing tanning, biologically beneficial chemicals can be utilized to successfully reduce inflammatory symptoms. Histamine in the tissues is released by sunlight; antihistaminic medications prevent inflammation. While HCs and FCs can be helpful in curing sunburns, they are not suggested for applying a sun tan (10).

iv Skin tanning-inducing or -accelerating substances can be used. Dioxyacetone tans skin by combining with the corneal layer's keratin to generate a brown complex. 8-Methoxypsoralene enhances tanning and prevents sunburn when taken internally at doses of 10–20 mg 2 h before exposure to the sun.

1.2.1.1. Classification of sunscreen components. The categorization of sunscreen components relies on their chemical composition and way of action, as well as according to their skin type and SPF to be used (11).

1.2.1.2. Ideal properties of sunscreen products.

- Sunscreen should block a wide spectrum of UV radiation to protect skin from sun damage.
- There should be no chemical breakdown that might lead to an increase in toxicity or irritation from byproducts or a decrease in efficacy.
- It should have the correct characteristics when formulated with a cosmetic base and should readily permeate the skin.
- Neither water nor perspiration should be able to remove it.
- For best results, frequent reapplication of sunscreen is not required. Low concentrations appear to be effective.
- Sunscreen should block broad-spectrum UV radiation to shield skin from sun damage.
- There should not be any chemical breakdown that could raise byproduct toxicity or irritation or reduce efficacy.
- It should rapidly penetrate the skin and have suitable properties when made on a cosmetic basis; neither water nor perspiration should be able to wash it off.
- For best results, sunscreen should not need to be reapplied regularly.
- At low quantities, it appears to function.

1.2.1.3. Problems with the usage of synthetic material.

- As organic filters absorb UV rays, as a result, photodegradation occurs, and free radicals are produced, causing skin damage.
- Amino benzoic acid causes the skin to react in photosensitive and photoallergic ways.
- As a result of titanium dioxide exposure, human brain cells and fibroblasts may experience cell death.
- The harmful effect of zinc oxide nanoparticles on neural stem cells is related to the structure rather than the preparation's particle size, according to a study.
- The nanoparticles of TiO_2 with a particle diameter of 153.5 nm that get through cell membranes impair the function of cutaneous fibroblast cultures (12).

1.2.1.4. Merits of natural sunscreen over synthetic sunscreen.

- Natural sunscreen is preferred over synthetic sunscreen in the Hawaiian Islands, Key West, Florida, and the United States Virgin Islands, such as oxybenzone and octinoxate, because the latter causes coral reefs to bleach.

- While natural antioxidants such as ascorbic acid, flavones, and alpha-carotene have the ability to donate electrons and stop the chain reaction of free radicals, synthetic sunscreens harm human skin by causing reactive oxygen species.
- Natural sunscreen preserves the skin's youthfulness and smoothness by preventing early skin aging.
- Natural sunscreen is more affordable and widely accessible than synthetic sunscreen.
- They are compatible with all skin types.

1.2.2. Herbs are used as the sunscreen agent

Herbs or plant-based products have been utilized for many years in the past. Since humans have recognized the benefits of plants and their phytoconstituents, they have been using plant-based goods in their daily lives for decades. Today, people are becoming more knowledgeable about these products and how they may be used in daily life. The use of organic radicals in professional skin care products is increasing daily as a result of investigations into the antioxidant properties derived from plant products in the hunt for efficient topical UV protection agents. To identify a substance and pharmacological components that may be liable for these effects, researchers are now examining the chemical composition of herbal treatments. Tocopherols, flavonoids, phenolic acids, nitrogen-containing substances, and monoterpenes are strong natural antioxidants that are widely employed in conventional medicine. As topical antioxidant supplementation has been shown to influence the skin's antioxidant network, using antioxidant-rich aromatherapy compositions offers intriguing study options. The next step was to research various conventional treatments.

1.2.2.1. Tomato (Solanum lycopersicum). Tomatoes are frequently utilized in Indian families and are mostly used to treat a variety of skin issues. Ketchup, for instance, has 9.9–13.44 mg of lycopene/100 g, but fresh tomatoes provide 0.88–77.74 mg/100 g of wet weight. More than 4,000 publications (scientific and non-scientific) have been written about lycopene. Lycopene has been extensively studied for more than 70 years. Long-term tomato consumption may reduce sunburn caused by UV light through unknown processes. Although additional phytochemicals may possibly be involved, it is thought that carotenoids from the food provided to the skin will safeguard the skin against UV-induced damage (13).

1.2.2.2. Basil. Basil, also known as *Ocimum basilicum*, is a member of the family sensu lato in the herbaceous groups: Lamiaceae and Nepetoideae. Sweet basil, garden basil, munjariki, basilikumkraut, and common basil are some of the names that people commonly call the plant. The Lamiaceae family of plants is native to the subtropics, especially the Mediterranean area. We can find basil throughout most of India. *O. basilicum* Linn. is widely used in India as it is used to cure a number of ailments in both Ayurveda and Unani medicines (14).

According to published research, basil essential oil has anti-inflammatory, antimicrobial, antifungal, antiphagocytic, antioxidant, chemo-modulatory, and insecticidal properties. An alcohol-based leaf extract possesses hypolipemic, larvicidal, anti-HIV-1, and cardiac stimulant qualities, while a water-based extract has vasorelaxant and antiplatelet aggregation qualities. Basil essential oil has various applications (15).

1.2.2.3. Carrot. Carrot seed oil is one natural sunscreen component that can lessen this impact. Carotol, the most prevalent essential oil, also includes fatty acids, a significant amount of -carotene, slightly in the way of -carotene, and carotenoid that undergoes partial conversion to vitamin A. With a high vitamin A concentration, carrot seed oil is a potent anti-inflammatory, antiseptic, antifungal, and antioxidant. Topical application of a product with active components made from natural ingredients provides wide-spectrum sun protection and antiaging effects for the skin, with the impact of sunscreen on UV radiation and as a powerful antioxidant potentially helping to reduce the reasons for aging caused by oxygen species that are reactive. In the modern world, it is highly advantageous and practical to use cosmetics that contain active ingredients that provide sun protection as well as antiaging properties (16).

1.2.2.4. Green tea. Green tea is produced from freshly picked *Camellia sinensis* plant leaves. It is hypothesized that polyphenols are the primary chemo-preventive mediators. Green tea contains four primary polyphenols: epicatechin, epigallocatechin-3-gallate, and (-)-epigallocatechin (EGC). It also contains caffeine, flavonoids, and phenolic acids, as well as alkaloids such as theophylline and theobromine. According to Wang et al.'s findings, when light carcinogenesis was performed on SKH-1 hairless mice, the average time for tumor formation was delayed in a dose-dependent way. This study provided the first evidence that polyphenols found in green tea may prevent skin cancer caused by UV exposure. Very less UV-B or UV-A radiation is absorbed by green tea (17).

1.2.2.5. Amla. The amla plant, *Phyllanthus emblica*, produces fruits that are high in polyphenols such as flavonoids, phenolic glycosides, and tannins. Terpenes, sterols, necessary trace elements, vitamins (primarily vitamin C), and amino acids are also present. Amla extract is well known for its strong antioxidant properties that shield skin fibroblasts from oxidative damage. Additionally, it promotes fibroblast growth, regulates collagen metabolism, and stimulates procollagen synthesis. The primary component of amla, gallic acid, is a potent antioxidant, a depigmenting agent, and an inhibitor of UV-induced immunosuppression.

Because polyphenols only penetrate a small portion of the skin, topical administration is ineffective. As a result, it calls for the usage of formulation bases or penetrations enhancers. Vitamin C has been shown a great potential in sun protection herbs.

Due to their surfactant and lipophilic properties, phospholipids enable greater adherence of the complex to the skin's surface and enhanced topical absorption. Additionally, it enhances collagen structure and hydration. As a result, applying phospholipid complexes topically to bioactive chemicals improves local action and boosts activity by enhancing absorption and distribution to tissues (13).

1.2.2.6. Turmeric. The herb *Curcuma longa* L. is a perennial rhizomatous plant that can reach a height of 1 m. It is the Curcuma species and Zingiberaceae family member that is used the most. The genus has about 100 species, of which about 40 are of Indian origin. The Arabic term "Kourkoum," which implies saffron, is where the Latin word "Curcuma" originates from. It thrives in warm, muggy weather and needs a lot of water. It has big, oblong leaves and a short pseudostem. The underground rhizome consists of a parent, or mother, rhizome and numerous subsidiary, branching rhizomes. It does not produce fruit and has delicate yellow blossoms. The multiple health benefits of the polyphenol curcumin have been supported by evidence that it targets a wide range of signaling molecules and also exhibits activity at the cellular level (14). It has been demonstrated that curcumin reduces oxidative stress-related systemic indicators. Recent research on the effects of purified curcuminoids supplementation on oxidative stress parameters such as catalase and plasma SOD and activities as well as serum concentrations of lipid peroxides and glutathione peroxidase showed that curcuminoids had a significant impact on all examined oxidative stress parameters. Using turmeric as a sunscreen ingredient, the formulation also reveals the antioxidant activity and UV protection properties of sunscreen (18).

1.2.2.7. Grape pomace. Anthocyanins and proanthocyanins account for 90% of the antioxidant capabilities of *V. vinifera* fruit skin, whereas flavonols, flavanols, and phenolic acids account for 10%. Scientific research has shown greater results as to be in sunscreen agents as polyphenols have strong sun protection activity. Studies on grape seeds *in vivo* and *in vitro* ascribe the antioxidant effect of flavonoids. As winemaking waste preserves significant amounts of polyphenolics and this grape species is the one used most frequently in winemaking, it may be useful in multifunctional cosmetics (19).

2. Future perspective

To protect the skin from the harmful effects of UV radiation, sunscreen should be used. The upcoming years will see the development of revolutionary technology for the production of sunscreen. New advancements in sun protection include UV skin patches that contain a sensitive blue pigment that alters color when subjected to UV light. It is conceivable to create an ingestible sunscreen that works similarly to the chemical known as gadusol that zebrafish and other animals produce to protect themselves from UV rays by expressing the right gene into yeast. The ultimate goal of researchers is to safeguard the body by exposing a top layer of DNA to harm as UV rays cause DNA damage. It was discovered that cyanobacteria are a more secure substitute for the synthetic products that are now utilized in sun protection. Phytosomes are lipophilic vesicles that have been shown to improve topical absorption and deliver better drug content when used (20).

3. Conclusion

Sunscreen can be a lotion, spray, or gel that deflects or absorbs some of the UV rays from the sun to help prevent sunburn. Numerous cosmetic items contain ingredients that could help to protect the skin. All sunscreen products have SPF values. SPF is the quantity of UVB radiation to which we can be exposed without burning. Skin can be exposed to the sun for 15 times longer while using an SPF of 15 before it starts to burn. A carrier takes one or several of the bioactive components of sunscreen. These sunscreen products block solar sunlight (UV) radiation when utilized on the skin, reducing skin damage. Sunscreen formulations, despite being fundamentally basic, are incredibly complicated and demand careful consideration when choosing to control a range of efficiency and in-use characteristics using sunscreen active and carrier substances. This leads us to the conclusion that sunscreen formulas made with natural chemicals are preferable to those made with synthetic ones. Sunburn is a skin condition caused by exposure to UV rays that inhibits skin function. Sunscreen lotions are used to cure sunburn. The top layer of the skin is impacted by UV-B. Although synthetic compounds employed in formulations have undesirable side effects such as genotoxicity, cytotoxicity, and endometriosis, they are nevertheless beneficial. To address this problem, natural sunscreens are used because they are safer and as effective as synthetic sunscreens.

Author contributions

PP devised the topic, the main conceptual ideas, and the proof outline. RP and DM wrote the manuscript. All authors provided critical feedback and helped shape the research, analysis, and manuscript.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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