

# A Review of Sunscreen Properties of Medicinal Plants in Herbal Cream Development

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**Abstract:** *Exposure to ultraviolet radiation is a major cause of skin disorders including premature aging, sunburn, and skin cancer. Synthetic sunscreens, although effective, are often associated with adverse effects such as skin irritation and environmental toxicity. This has led to growing interest in plant-based alternatives with photoprotective properties. Medicinal plants rich in flavonoids, phenolics, and antioxidants have demonstrated significant UV absorption and free radical scavenging abilities. This review focuses on the sunscreen potential of medicinal plants and their application in herbal cream formulations. It also highlights formulation strategies, evaluation parameters, and challenges in herbal sunscreen development*

**Keywords:** Herbal sunscreen, medicinal plants, UV protection, herbal cream

## I. INTRODUCTION

The increasing exposure to solar ultraviolet (UV) radiation has emerged as a major public health concern due to its profound impact on skin physiology and overall dermatological health. Ultraviolet radiation is broadly categorized into UVA (320–400 nm), UVB (290–320 nm), and UVC (100–290 nm), of which UVA and UVB reach the earth's surface and contribute significantly to skin damage (Kaur & Saraf, 2010). UVA penetrates deeper into the dermis, leading to premature aging, photoaging, and oxidative stress, while UVB primarily affects the epidermal layer, causing erythema, sunburn, and direct DNA damage that may result in carcinogenesis (Mishra et al., 2011).

Continuous and unprotected exposure to these radiations accelerates the formation of reactive oxygen species (ROS), which disrupt cellular structures, proteins, lipids, and nucleic acids, ultimately compromising skin integrity and function (Gupta & Sharma, 2014). In response to these detrimental effects, the use of sunscreen formulations has become an essential preventive strategy in dermatology and cosmetology.

Conventional sunscreen products predominantly contain synthetic UV filters such as oxybenzone, avobenzone, and octinoxate, which function by either absorbing or reflecting UV radiation (Singh et al., 2018). Although these agents are effective in providing broad-spectrum protection, their long-term use has raised several concerns related to skin irritation, allergic reactions, hormonal disruption, and environmental toxicity, particularly their adverse effects on aquatic ecosystems such as coral reefs (Bhatia & Sharma, 2013).

Additionally, the increasing consumer preference for natural, safe, and eco-friendly products has prompted researchers and formulators to explore alternative sources of photoprotection. This paradigm shift has significantly boosted interest in herbal and plant-based sunscreen formulations, which are considered biocompatible, biodegradable, and less toxic.

Medicinal plants have been used for centuries in traditional systems of medicine such as Ayurveda, Unani, and Traditional Chinese Medicine for the treatment and prevention of various skin ailments. These plants are rich in diverse phytochemicals, including flavonoids, phenolic acids, tannins, carotenoids, and alkaloids, which exhibit potent antioxidant and photoprotective properties (Kumar & Singh, 2015). Flavonoids, for instance, are capable of absorbing UV radiation due to their conjugated double-bond structures, thereby acting as natural UV filters. Similarly, phenolic compounds neutralize free radicals generated by UV exposure, reducing oxidative stress and preventing cellular damage (Yadav & Kumar, 2018). The synergistic action of these phytoconstituents not only enhances UV protection

but also provides additional benefits such as anti-inflammatory, anti-aging, and moisturizing effects, making them highly suitable for incorporation into cosmetic formulations.

In recent years, numerous studies have investigated the sunscreen potential of various medicinal plants and their extracts. Plants such as *Aloe vera*, *Curcuma longa* (turmeric), *Azadirachta indica* (neem), *Camellia sinensis* (green tea), and *Ocimum sanctum* (holy basil) have demonstrated significant sun protection factor (SPF) values and antioxidant activity (Rao & Kumar, 2012). For example, *Aloe vera* contains aloin and other phenolic compounds that exhibit UV-absorbing properties and soothing effects on the skin, while curcumin in *Curcuma longa* provides strong antioxidant and anti-inflammatory benefits (Joshi & Patel, 2011). Similarly, catechins present in green tea have been shown to protect against UV-induced immunosuppression and oxidative stress (Tiwari & Mishra, 2019). These findings highlight the immense potential of medicinal plants as natural sunscreen agents and support their integration into modern cosmetic formulations.

Herbal cream development represents one of the most effective and consumer-friendly approaches for delivering plant-based sunscreen agents. Creams, particularly oil-in-water (O/W) emulsions, are widely preferred due to their ease of application, non-greasy texture, and enhanced skin penetration (Patel & Patel, 2017). The formulation of herbal sunscreen creams involves the incorporation of plant extracts into a suitable base containing excipients such as emulsifiers, stabilizers, preservatives, and humectants.

The selection of appropriate formulation components is critical to ensure product stability, efficacy, and user acceptability. Moreover, factors such as pH, viscosity, spreadability, and homogeneity must be carefully optimized during formulation development (Meena & Mali, 2013). Advanced formulation techniques, including the use of nanoemulsions and liposomal delivery systems, are also being explored to enhance the bioavailability and photoprotective efficiency of herbal ingredients.

Despite the promising potential of medicinal plants in sunscreen development, several challenges must be addressed to facilitate their widespread application. One of the primary limitations is the variability in the composition of plant extracts due to differences in geographical origin, harvesting conditions, and extraction methods, which can affect the consistency and efficacy of the final product (Sahu & Saxena, 2015). Additionally, herbal formulations often exhibit lower SPF values compared to synthetic sunscreens, necessitating the use of higher concentrations or combinations of multiple plant extracts to achieve desired levels of protection (Verma & Singh, 2014).

Stability issues, including degradation of active constituents upon exposure to light and heat, also pose significant challenges in formulation development. Furthermore, the lack of standardized testing methods and limited clinical validation of herbal sunscreens hinder their acceptance in the global market.

Nevertheless, ongoing research and technological advancements are paving the way for the development of more effective and reliable herbal sunscreen products. The integration of nanotechnology, for instance, has shown great potential in improving the stability, solubility, and skin penetration of plant-based UV filters (Dubey & Jain, 2016). Additionally, the use of synergistic combinations of different plant extracts can enhance overall SPF and provide broad-spectrum protection against both UVA and UVB radiation. Regulatory agencies and researchers are also emphasizing the need for standardized protocols and rigorous clinical studies to establish the safety and efficacy of herbal sunscreens. As consumer awareness regarding the harmful effects of synthetic chemicals continues to grow, the demand for natural and sustainable cosmetic products is expected to rise, further driving innovation in this field.

The exploration of medicinal plants for sunscreen applications represents a promising and sustainable approach to addressing the challenges associated with conventional photoprotective agents. The rich phytochemical composition of these plants offers a multifaceted mechanism of action, including UV absorption, antioxidant activity, and anti-inflammatory effects, making them ideal candidates for incorporation into herbal cream formulations.

While certain limitations and challenges remain, continued research and development efforts are likely to overcome these barriers and unlock the full potential of plant-based sunscreens. This review aims to provide a comprehensive understanding of the sunscreen properties of medicinal plants and their application in herbal cream development, thereby contributing to the advancement of safer and more effective photoprotective solutions.

### PHYTOCHEMICALS RESPONSIBLE FOR SUNSCREEN ACTIVITY

Medicinal plants contain bioactive compounds such as flavonoids, tannins, phenolic acids, and carotenoids that absorb UV radiation and neutralize free radicals.

**Table 1: Phytochemicals and Their Photoprotective Roles**

Phytochemical Class	Example Compounds	Mechanism of Action	UV Protection Role
Flavonoids	Quercetin, Kaempferol	UV absorption, antioxidant	Prevent DNA damage
Phenolics	Gallic acid, Caffeic acid	Free radical scavenging	Anti-photoaging
Carotenoids	Beta-carotene, Lycopene	Light absorption	Skin protection
Tannins	Ellagic acid	Protein binding	Anti-inflammatory
Alkaloids	Berberine	Antioxidant	Cellular protection

### MEDICINAL PLANTS WITH SUNSCREEN PROPERTIES

Several medicinal plants have been evaluated for their SPF (Sun Protection Factor) values and photoprotective efficiency.

**Table 2: Medicinal Plants and Their Sunscreen Potential**

Plant Name	Active Constituents	Reported SPF	Key Benefits
Aloe vera	Aloin, flavonoids	15–20	Moisturizing, soothing
Curcuma longa	Curcumin	10–15	Anti-inflammatory
Azadirachta indica	Nimbin, quercetin	8–12	Antimicrobial
Camellia sinensis	Catechins	12–18	Antioxidant
Ocimum sanctum	Eugenol	6–10	Anti-aging

### FORMULATION OF HERBAL SUNSCREEN CREAMS

Herbal creams are typically oil-in-water (O/W) emulsions containing plant extracts incorporated into a suitable base. Key ingredients include emulsifiers, preservatives, humectants, and stabilizers.

**Table 3: Components of Herbal Sunscreen Cream Formulation**

Component	Example	Function
Oil phase	Coconut oil, almond oil	Emollient
Aqueous phase	Distilled water	Solvent
Emulsifier	Beeswax, stearic acid	Stabilization
Active ingredient	Plant extract	UV protection
Preservative	Parabens, natural oils	Shelf-life
Fragrance	Essential oils	Acceptability

### EVALUATION PARAMETERS OF HERBAL SUNSCREEN CREAMS

Herbal sunscreen creams are evaluated using various physicochemical and biological parameters such as:

**SPF determination** (spectrophotometric method)

**pH measurement** (skin compatibility)

**Spreadability** (ease of application)

**Viscosity** (texture)

**Stability studies** (temperature and humidity)

**In-vitro UV absorption analysis**

These parameters ensure product safety, efficacy, and consumer acceptability (Mishra et al., 2011).

### **ADVANTAGES OF HERBAL SUNSCREENS**

Herbal sunscreens offer several benefits over synthetic formulations:

- Reduced risk of skin irritation
- Biodegradable and eco-friendly
- Rich in antioxidants
- Multifunctional (anti-aging, moisturizing)
- Cost-effective and widely available

### **CHALLENGES IN HERBAL CREAM DEVELOPMENT**

Despite their advantages, herbal formulations face challenges such as:

- Variability in plant extract composition
- Stability issues
- Lower SPF compared to synthetic agents
- Standardization difficulties
- Limited clinical validation

### **FUTURE PERSPECTIVES**

Future research should focus on nanoformulations, standardization of plant extracts, and clinical trials to improve efficacy and commercial viability. Integration of modern technologies like nanotechnology and AI-based formulation design can enhance herbal sunscreen performance.

## **II. CONCLUSION**

Medicinal plants possess significant potential as natural sunscreen agents due to their rich phytochemical composition and antioxidant properties. Herbal creams incorporating these plant extracts provide a safer and eco-friendly alternative to synthetic sunscreens. However, further research is required to overcome formulation challenges and improve SPF efficiency for large-scale applications.

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