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**Research Article**

# Formulation of a Polyherbal Sunscreen Cream

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## ABSTRACT

The present study focuses on the development and evaluation of a herbal sunscreen formulation prepared using plant-derived bioactive ingredients such as Green tea (Camellia sinensis), Licorice (Glycyrrhiza glabra), Aloe vera (Aloe barbadensis), Carrot seed oil, and Raspberry seed oil. In recent years, growing awareness regarding the adverse effects and environmental impact of synthetic sunscreen agents has encouraged researchers to explore safer herbal alternatives. In this work, an oil-in-water emulsion-based sunscreen cream was formulated and evaluated for its physicochemical characteristics, stability, antioxidant potential, phytochemical composition, and in-vitro sun protection factor (SPF) using UV spectrophotometric analysis. The results indicated that the formulation exhibited moderate SPF values ranging approximately between 10 and 18, along with good physical stability and enhanced antioxidant activity due to the synergistic effect of the incorporated plant extracts and oils. The study concludes that polyherbal sunscreen formulations can serve as effective, safe, and eco-friendly alternatives or adjuncts to conventional chemical-based sunscreens.

## INTRODUCTION

India has a rich traditional heritage in herbal medicine, where plants have long been used for treating various skin disorders and improving complexion. Ancient Ayurvedic texts such as Charaka Samhita describe numerous medicinal plants that were traditionally used for enhancing

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skin glow and treating dermatological conditions.[1-2] In modern times, plant-derived extracts, oils, and powders have found extensive applications in cosmetic and skincare formulations either as active ingredients or supportive excipients. Herbal ingredients are increasingly gaining attention because they contain a wide range of bioactive phytochemicals that can improve skin health naturally without significant side effects.[3] Human skin is continuously exposed to ultraviolet (UV) radiation from sunlight, which can lead to several harmful effects such as premature aging, sunburn, pigmentation, and even DNA damage. Among UV radiations, UVB rays (280–320 nm) are particularly responsible for erythema and skin burning. Plants, being naturally exposed to sunlight, have developed protective mechanisms against UV-induced damage, mainly through the synthesis of phenolic compounds and antioxidants. These natural defense systems have inspired the development of herbal sunscreen formulations that can help protect human skin from harmful UV radiation.[4-6]

**Various Plants Having Sunscreen Activities**

**Licorice (Glycyrrhiza Glabra)**[7]

Licorice (Glycyrrhiza glabra) is well known for its strong skin-protective properties due to the presence of active constituents such as glycyrrhizin and glycyrrhetinic acid. These compounds exhibit anti-inflammatory, antioxidant, and depigmenting effects, making licorice effective in reducing UV-induced skin damage, pigmentation, and irritation. It also helps in inhibiting melanin synthesis, thereby reducing dark spots and uneven skin tone. [8-11].

**Green Tea (Thea viridis)** [12]

Green tea (Camellia sinensis) is another powerful herbal ingredient widely recognized for its antioxidant properties. It contains epigallocatechin gallate (EGCG), which provides significant protection against UV-induced oxidative stress, DNA damage, and inflammation. Regular topical application of green tea extracts has been reported to reduce photoaging effects and may also help in preventing UV-induced skin cancers by neutralizing free radicals generated during sun exposure. [13-16]

**Aloe Vera (Aloe barbadensis )** [17]

Aloe vera (Aloe barbadensis) is widely used in skincare formulations due to its soothing, moisturizing, and healing properties. It contains various bioactive compounds such as aloin,

barbaloin, and emodin. The gel extracted from Aloe vera leaves is commonly used to treat burns, inflammation, and skin irritation. It also helps in hydrating the skin and supporting the repair of damaged skin tissues, making it an ideal base for sunscreen formulations. [18-19]

**Carrot Seed Oil (Daucus carota)[20]**

Carrot seed oil (Daucus carota) is rich in beta-carotene, a precursor of vitamin A, which provides strong antioxidant activity. It helps in protecting the skin from oxidative stress caused by UV radiation and supports skin regeneration. It is also known to improve skin tone and provide mild natural photoprotection, making it a useful ingredient in herbal sunscreen preparations.[21]

**Raspberry Seed Oil (Rubus Idaeus L)[22]**

Raspberry seed oil (Rubus idaeus) contains essential fatty acids such as omega-3 and omega-6, along with vitamin E, carotenoids, and phytosterols. These components contribute to its antioxidant, anti-inflammatory, and moisturizing properties. Although it may offer slight UV absorption, its primary role in sunscreen formulations is to enhance skin hydration, improve barrier function, and support overall skin protection rather than acting as a primary UV filter..[23-24]

**Table no. 01- Plants used for sunscreen.**

| Sr. No. | Plant | Botanical name | Part Used | Active Chemical Constituent |
|---|---|---|---|---|
| 1. | Liquorice | Glycyrrhiza Glabra | Root | Glycyrrhizin & Glycyrrhetinic acid |
| 2. | Green tea | Thea viridis | Leaves | Epigallocatechin3O gallate(EGCG) |
| 3. | Aloe Vera | Aloe barbadensis | Leaves | Barbaloin, isobarbaloin & anthraquinones |
| 4. | Carrot Seed Oil | Daucus carota | Seeds | BetaCarotene |
| 5. | Raspberry Seed Oil | Rubus Idaeus L | Seeds | Linoleic acid, Alpha-Linolenic acid & Oleic acid |

**Review of Literature**

**1. Katiyar SK et al.[14,27]** reviewed the photoprotective effects of green tea polyphenols on the skin. Green tea contains catechins, particularly epigallocatechin gallate (EGCG), which exhibit strong antioxidant and anti-inflammatory activities. The study reported that green tea polyphenols reduce UV-induced oxidative stress, erythema, collagen degradation, and DNA damage, thereby providing significant protection against photoaging and skin cancer. Current Drug Targets - Immune, Endocrine & Metabolic Disorders. 2003;3(3):234-242.

**2. Yusuf N et al.**[26,40] investigated the photoprotective effects of green tea polyphenols against ultraviolet radiation. Their findings demonstrated that green tea extracts effectively neutralize reactive oxygen species (ROS) generated during UV exposure and reduce inflammatory responses in skin tissues. The study highlighted the potential use of green tea as a natural sunscreen ingredient. Photodermatology, Photoimmunology & Photomedicine. 2007;23(1):48-56.

**3.Ahmad N and Mukhtar H**[29,41] reviewed the role of green tea in cutaneous photochemoprotection. The authors concluded that topical application of green tea extract helps prevent UV-induced skin damage through antioxidant mechanisms and supports skin repair processes. Green tea was suggested as a promising herbal ingredient for sunscreen formulations. Skin Pharmacology and Applied Skin Physiology. 2001;14(2):69-76.

**4. Korac RR and Khambholja KM**[49] reviewed the potential of herbal ingredients in skin protection against ultraviolet radiation. The authors reported that plant-derived compounds such as flavonoids, polyphenols, carotenoids, and vitamins provide antioxidant and photoprotective effects. Herbal formulations were found to be safer alternatives to synthetic sunscreens with reduced adverse effects. Pharmacognosy Reviews. 2011;5(10):164-173.

**5. Saewan N and Jimtaisong A**[45] reviewed various natural products used for photoprotection. The study highlighted the importance of herbal antioxidants in preventing UV-induced oxidative damage and inflammation. The authors suggested that natural extracts can enhance sunscreen efficacy when incorporated into topical formulations. Journal of Cosmetic Dermatology. 2015;14(1):47-63.

**6. Nichols JA and Katiyar SK**[44] discussed the mechanisms of skin photoprotection by natural polyphenols. The review explained that polyphenolic compounds provide anti-inflammatory, antioxidant, and DNA repair activities, thereby reducing the harmful effects of UV radiation. The study supported the use of plant-based ingredients in sunscreen preparations. Archives of Dermatological Research. 2010;302(2):71-83.

**7. Ghosh D and Dhandha MM**[23] investigated the Sun Protection Factor (SPF) of raspberry seed oil in combination with niacinamide and zinc oxide. The study demonstrated that raspberry seed oil contributes antioxidant activity and enhances overall photoprotection when combined with other sunscreen agents. SKIN Journal of Cutaneous Medicine. 2024;8(5):1807-1814.

**8. Oomah BD et al.**[24] evaluated the characteristics of raspberry seed oil and reported that it contains essential fatty acids, tocopherols, carotenoids, and polyphenols. These bioactive compounds provide antioxidant activity, improve skin hydration, and support skin barrier protection, making raspberry seed oil a useful ingredient in cosmetic formulations. Food Chemistry. 2000;69(2):187-193.

## Aim and Objectives

The aim of this study is to formulate and evaluate a herbal sunscreen cream using natural plant extracts such as Green tea, Licorice, Aloe vera, Carrot seed oil, and Raspberry seed oil.

## Objectives

- The main objective is to assess the physicochemical properties, stability, and photoprotective activity of the developed formulation.

- The study also aims to prepare herbal extracts from selected plants and incorporate them into an oil-in-water emulsion system.
- Further objectives include evaluating parameters such as color, odor, pH, spreadability, and texture, as well as determining the in-vitro SPF using UV spectrophotometric methods.
- Additionally, the study focuses on analyzing the contribution of natural oils in enhancing antioxidant and photoprotective activity, performing stability studies under different conditions, and comparing the formulation with existing herbal sunscreen systems.
- Ultimately, the goal is to evaluate the potential of the formulation as a safer and more natural alternative to synthetic sunscreen products.

**Materials and Methods**

**Herbal ingredients :**

- Green tea leaves (dried)
- Licorice root powder
- Fresh Aloe vera leaves
- Carrot seed oil
- Raspberry seed oil

**Chemical / Excipients**

- Stearic acid
- Cetyl alcohol
- Beewax
- Liquid paraffin
- Glycerin
- Potassium hydroxide
- Methyl paraben
- Propyl paraben
- Distilled water

**Equipments**

- Beakers
- Hot plate or water bath
- Mechanical stirrer / magnetic stirrer
- Thermometer
- Mortar & pestle
- pH meter
- Weighing balance
- Muslin cloth
- Glass rods

**Extractions**

**Licorice extraction (hydroalcoholic method)**

The extraction of Licorice was carried out using a hydroalcoholic maceration method, where powdered root was soaked in 70% ethanol for 24–48 hours, followed by filtration and concentration..[32-33]

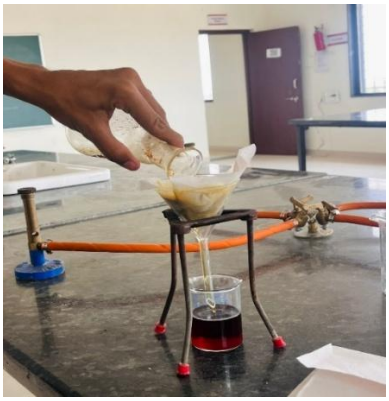

**Fig. no.06: Licorice extraction**

## Green tea extraction (ethanolic method)

Green tea extract was prepared by macerating powdered leaves in ethanol solution for 24 hours, followed by filtration and evaporation at low temperature. [34-35]

**Fig. no.07: Green Tea Extraction**

## Aloe vera extraction (fresh gel method)

Aloe vera gel was obtained by collecting fresh inner gel from leaves, followed by blending and filtration to obtain a uniform gel..[36]

**Fig. no.08: Aloe vera Extraction**

## Material Required

**Table no.02: Final Formula Table**

| Sr.no. | Ingredient | Quantity | Function |
|---|---|---|---|
| 1. | Licorice extract | 5ml | Anti-pigmentation |
| 2. | Green tea extract | 10ml | Antioxidant |
| 3. | Aloe vera gel | 25ml | Moisturizer / Base |
| 4. | Raspberry seed oil | 5ml | Photoprotection |
| 5. | Carrot seed oil | 3ml | Skin Repair |
| 6. | Stearic Acid | 6g | Thickener |
| 7. | Cetyl Alcohol | 3g | Emollient |
| 8. | Beeswax | 4g | Stabilizer |
| 9. | Liquid paraffin | 8ml | Oil Phase |
| 10. | Glycerin | 4ml | Humectant |
| 11. | Potassium Hydroxide | 0.25g | pH Adjustment |
| 12. | Methyl Paraben | 0.2g | Preservative |
| 13. | Propyl Paraben | 0.1g | Preservative |
| 14. | Vitamin E | 1ml | Preservative |
| 15. | Distilled Water | q.s. to 100g | Vehicle |

**Method of Preparation**

**Oil Phase**

The oil phase consisting of stearic acid, cetyl alcohol, beeswax, liquid paraffin, carrot seed oil, and raspberry seed oil was heated until a uniform melt was obtained..[37-40]

**Liquid Phase**

The aqueous phase containing distilled water, Aloe vera gel, herbal extracts, glycerin, and preservatives was prepared separately under controlled heating with continuous stirring. The oil phase was then slowly added to the aqueous phase with constant stirring to form an oil-in-water emulsion.[41-45]

**Storage**

Potassium hydroxide solution was added to adjust the pH, and the formulation was allowed to cool gradually with continuous stirring to obtain a smooth cream. The final product was stored in airtight containers under cool conditions for further evaluation..[46-50]

**Observation**

| Sr. no. | Evaluation Parameters | Standard Range | Observation |
|---|---|---|---|
| 1. | Physical appearance | Smooth, homogenous semisolid without phase separation | Smooth homogenous semisolid cream obtained |
| 2. | Color | Light green to pale cream color | Light caramel cream obtained |
| 3. | Odor | Mild pleasant herbal odor | Mild pleasant, pungent and woody odor |
| 4. | pH | 5.5- 6.5 ( Skin compatible range ) | pH found 5.92 |
| 5. | Texture | Smooth and non gritty | Smooth and non gritty texture obtained |
| 6. | Spreadability | Easily spreadable with good film formation | Good spreadability with uniform application |
| 7. | SPF value | Minimum SPF 10-15 for moderate herbal photoprotection | Estimated SPF was observed in range of 13 -14 |
| 8. | UV absorbance | Significant absorbance in UV-B region | Good absorbance observed between 290-320nm |
| 9. | Stability | No phase separation, color change, or odor change during storage | Stable under room and refrigerated condiions |
| 10. | Phase Separation | No visible separation | No phase separation observed |
| 11. | Irritation test | No redness or irritation on applied | No irritation observed |
| 12. | Homogeneity | Unform distribution of ingredients | Formulation showed good homogeneity |
| 13. | Storage stability | Stable for at least 1-3 months | Stable for approximately 2-3 months under proper stoerge |


**Fig.no.09:- Final Product**

## RESULT

The prepared herbal sunscreen cream exhibited a smooth, homogeneous, and stable semisolid appearance with a light caramel color and mild herbal odor. The pH of the formulation was found to be around 5.9, which lies within the skin-compatible range. The cream showed good spreadability and uniform application on the skin without any gritty texture or phase separation. UV spectrophotometric analysis indicated significant absorbance in the UV-B region (290–320 nm), with an estimated SPF value ranging between 13 and 14, indicating moderate photoprotective ability. Stability studies revealed that the formulation remained physically stable under both room temperature and refrigerated conditions without any noticeable changes in color, odor, or consistency. No signs of skin irritation or adverse reactions were observed during testing, indicating that the formulation is safe for topical application.

## CONCLUSION

The present study successfully demonstrated the formulation of a stable and effective polyherbal sunscreen cream using natural plant-based ingredients. The combination of Green tea, Licorice, Aloe vera, Carrot seed oil, and Raspberry seed oil provided synergistic antioxidant, moisturizing, and photoprotective effects. The developed formulation showed acceptable physicochemical properties, good skin compatibility, and moderate SPF activity, suggesting its potential as a natural alternative to synthetic sunscreen products. Overall, this work supports the growing interest in herbal cosmetics and highlights the feasibility of developing safe, eco-friendly, and effective sunscreen formulations from plant-derived materials.

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