



**INTERNATIONAL JOURNAL OF
PHARMACEUTICAL SCIENCES**
[ISSN: 0975-4725; CODEN(USA): IJPS00]
Journal Homepage: <https://www.ijpsjournal.com>



Research Article

Formulation and Evaluation of Herbal Gel Based Sunscreen

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ARTICLE INFO

Published: 23 June 2025

Keywords:

Herbal gel, Herbal
sunscreen gel, sun
protection factors (SPF), UV
protection

DOI:

10.5281/zenodo.15719905

ABSTRACT

Herbal cosmetics in a tremendous demand in the market due to their unique properties and minimal side effects. The popularity of herbal cosmetics is mainly due to the effect produced by herbal cosmetics is mainly due to the effort produce by herbal extract used and its inherent suitability of routine used in daily life. Herbal cosmetics also avoid adverse effect compared to synthetic product. Herbal extract shows remarkable photo protection owing to their ability to absorb ultraviolet (UV) rays and antioxidant, anti-inflammatory, and antimodulatory properties. Moreover, herbal cosmetics after the mean of less costly product compared to synthesis ones. Therefore, aim of the present study was to formulate and evaluate cost effective herbal sunscreen gel containing latex of leaves aloe Barbadensis, Family-Liliaceae, Curcuma longa root, Family-Zingiberaceae, sunflower oil and rose water. Sunscreen is a short of product against the sun harmful by containing ultraviolet radiation (UV) rays which divided into two types. Ultraviolet radiation A(UVA) And ultraviolet radiation B(UVB). Neutral substance extracted from plant have recently considered as potential sunscreen resources owing to high ultraviolet ray absorption and anti-oxidant activity. The decrease in the intensity of UV radiation reaching the skin through sunscreen may reduce the risk of sun induced skin cancer.

INTRODUCTION

Herbal sunscreen (also known as herbal sunscreen blocks) is a lotion spray or other topical product that help protect the skin from the sun ultraviolet radiation and which reduced sun burn and other skin damage with the goal of lowering the risk of

the skin cancer with help of herbs. Sunscreen are used to protect the skin from harmful effects of the sun including the appearance of erythema in the short term and actinic photo-ageing and skin cancer is long term. The efficacy of sunscreen is usually expressed by the sun protection factors (SPF) which defined as UV energy required for producing a minimal erythema dose to protect

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Relevant conflicts of interest/financial disclosures: 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.



skin. Divided by the UV energy required for producing on unprotected skin. SPF – Minimal erythema dose in sunscreen protected skin by minimum erythema dose in non – sunscreen protected skin. Photo protection Sunscreen alone may provide insufficient protection from UV sunscreen function best to prevent sunburn from UV radiation and then poorly sun avoidance remains the most desirable from of sun protection. SPF- Sun protection factors is used for UV sun protection and its system is used worldwide to determine how much protection a sunscreen provide applied to the skin at a thickness of 2mg/cm² SPF with sunscreen. Due to Sunscreen has deep cell penetration it has recently become multiple skin health advantage of the most personal care product an addition being sold separately sunscreen can also found in other item including those for the seasonal care of lips, and skin. And energy The Sun May also Damage our skin Sunlight Ultraviolet (uv) rays can the Result in Sunburn skin Cancer, And Early Ageing of the Skin. Sunscreen Shield the Skin from These UV rays Negative from Consequences By preventing, reaching. It Include natural Component Can regenerate. The skin and give enough protection against Pollution and Climate change in the Atmosphere. The Most Often Used herbs its Natural Sunscreen Include Aloe Vera, Turmeric and Sunflower oil. Aloe Vera is Well known and Ancient Liliaceae medicine plant. Aloe Vera Extract include lot Them of polyphenol component and chemical in Aloe Vera contains is potentially active, Element include vitamin supplement mineral and amino acid. It was successfully treated Sunburn including both first and Enzymes Treated Second degree burn: Turmeric extract Anti - flatulent and Anti - inflammatory, anti-fungal, Anti-cancer properties. It contains vitamin E & Antioxidant and Sunflower Fat -soluble, Photo protective capabilities. The Sun Protection Efficacy Was

Assessed in Term of SPF. SUNSCREEN GEL FOR SKIN ANATOMY –As the body's largest organ, skin protects against germs, regulates body temperature and enables touch (tactile) sensations. The skin's Main layers include the epidermis, dermis and hypodermis and is prone to many problems, including skin cancer, acne, wrinkles and Rashes. The outer layer of the skin has cells that contain the pigment melanin. Melanin protects skin from the sun's ultraviolet rays. These can Burn the skin and reduce its elasticity, leading to premature aging. People tan because sunlight causes the skin to produce more melanin and darken.

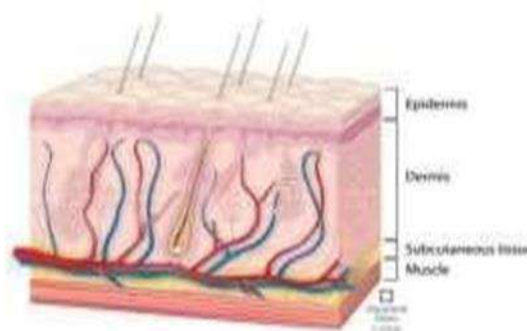


Figure: 1. Anatomy of Skin

Three layers of tissue make up the skin:

1. Epidermis top layer
2. Dermis Middle layer
3. Hypodermis, the bottom or fatty layer.

Acts as a protective barrier: The epidermis keeps bacteria and germs from entering your body and bloodstream and causing infections. It also protects against rain, sun and other environmental factors.

Make new skin: The epidermis continually make new skin cells. These new cells replace the approximately 40,000 old skin cells that your body

sheds every day. One can have new skin every 30 days.

- **Protects your body:** Langerhans cells in the epidermis are part of the body's immune system. They help fight off germs and infections.

Importance And Advantages Of Sunscreen *

Photo stability and Toxicity

- Photo stability refers to the ability of a molecule to remain intact under irradiation. It can be a concern for all UV filters because they are specifically chosen as UVR-absorbing molecules. This issue has been particularly noted with avobenzone, as photolysis has been demonstrated, especially in in vitro systems that simultaneously irradiate and measure transmittance in situ. This effect may also degrade other sunscreens in a formulation. Similar changes have been observed with octyl methoxycinnamate and octyl dimethyl PABA, while oxybenzone has been shown to be relatively stable. Higher SPF sunscreen products often use combinations of multiple sunscreen agents at maximum concentrations, which may interact with one another. The photo stability of these molecules also depends on the solvent or vehicle used. Certain ingredients, such as

Photoprotection

Sunscreens alone may provide insufficient protection from UVR. While sunscreens are most effective at preventing sunburn caused by UV-B radiation, they offer more limited protection against UV-A radiation. Relying solely on sunscreens can have the unintended consequence of increasing outdoor exposure times, which may lead to higher overall UVR exposure. Particularly in individuals who burn easily and poorly, sun avoidance remains the most effective form of sun protection.

Importance of Photoprotection

Exposure to UV radiation can lead to:

Photoaging: Manifested as wrinkles, sagging, and loss of skin elasticity.

Photo carcinogenesis: DNA damage that increases the risk of skin cancers.

Sunburn: An acute inflammatory response to excessive UV exposure.

Sun Protection

Protecting your skin and eyes from the damaging effects of the sun is essential, as exposure to ultraviolet radiation contributes to skin aging and is the primary cause of skin cancer. Some individuals may need to take extra precautions due to photosensitivity. Additionally, it's important to protect your skin when at high altitudes in any season, particularly in snowy conditions, as snow reflects additional ultraviolet radiation onto your skin.

Advantages of Herbal Sunscreens

- Easily available
- No side effect
- No special equipment needed for preparation
- Renewable resources.
- Botanical ingredients are easily available.
- Made up with natural ingredients.

MATERIAL

Turmeric Extract - Turmeric sunscreen is a perfect natural remedy which protect your skin from the bacteria caused by excess sweat in summer months. Turmeric extract, primarily containing curcumin, is widely used in herbal gel-based sunscreens due to its multiple therapeutic properties. It provides mild natural UV protection



by absorbing some UVA and UVB rays, contributing to photoprotection alongside other ingredients.

Aloe Vera - Aloe Vera is widely acknowledged to possess the anti-inflammatory, anti-microbial, and wound healing effects. A great moisturizer may cause burning skin. Aloe Vera can lead in the defense of the skin against the damaging ultraviolet uv radiation of the sun by absorbing some of the radiation. Aloe vera is a key ingredient in herbal gel-based sunscreens due to its numerous skin benefits. Known for its soothing and moisturizing properties, aloe vera helps to calm sun-exposed skin, reducing inflammation and redness. It also contains antioxidants, enzymes, and vitamins that promote skin healing and repair, making it ideal for after-sun care.

Triethanolamine - It is stabilizer and surface-active agent. Thickener. When viscous Trimethylamine is added to a product, it adds body and density to the formula's feel.

Zinc Oxide - Must be applied to skin surface where it all reflect, scatter and absorb ultraviolet ray. Sunscreen with zinc oxide can lid in preventing skin cancer because uv radiation is the primary cause of the disease.

Methyl Paraben- Used as preservative in the sunscreen gel. Effective at preventing microbial growth and bacterial.

Rose Water - It used in the sunscreen. And after sun product, as it helps to boost the effectiveness of the SPFx.

Glycerin - It can be found in some sunscreen as natural moisturizer and to help make sunscreen more spreadable

Carbopol 940 - It is a gelling agent. Carbopol is made use of in some sunscreen products to help its

product stay on the skin and provide even coverage. It also can help to improve the product's water.

METHOD

Making Of Aloe vera Gel -

- The gel base is prepared by dispersing carbomer 940 in distilled water at 80 degrees Celsius. With constant stirring and PH was adjusted to 6-7 using triethanolamine. Clear mucilaginous gel was scooped with spoon.
- Extract was mixed uniformly with magnetic stirrer and extract filter with filter paper, finally transferred into sterilized glass stored in refrigerator.
- Gel extract adds into gel base using aloe extract was prepared.

Preparation:

Prepared Sunscreen with Carbopol 934 Base

- Herbal sunscreen was prepared by combining several herbs with Carbopol 934 as a foundation.
- One gm of Carbopol was soaked with distilled water.
- Additionally, component such as aloe Vera gel, turmeric, triethanolamine, rose water, glycerin, was add and mixed continuously.
- For one hour before adding the preservative.

Prepared Sunscreen with The Sunflower Oil Base

- In a water bath required amount of sunflower oil, turmeric extract.



- Heated for 1hour.
- The oil phase at room temperature other ingredients are aloe Vera, rose water, glycerin adding with stirring constant until homogenous mixture. Then preservatives added to combinations
- Stored in cool place and evaluation.



Figure.2 Formulation

Formulation Table

Sr. No.	Ingredients	F1	F2	F3	F4
1	Carbopol	1.8gm	1.6gm	1.5gm	1.5gm
2	Zinc Oxide	2gm	1.8gm	1.6gm	1.5gm
3	Methyl Paraben	1gm	1.2gm	1gm	1g m
4	Triethanolamine	0.6ml	0.5ml	0.5ml	0.4ml
5	Turmeric Extract	0.3ml	0.2ml	0.15ml	0.1ml
6	Rose Water	4 drops	3drops	4drops	4drops
7	Aloe Vera	8ml	7ml	7.5ml	7ml
8	Glycerin	2.5ml	3ml	3ml	2.8ml
9	Distilled Water	Q.S.	Q.S.	Q.S.	Q.S.

Evaluation Test

1) Flocculation test: A flocculation test for herbal gel-based sunscreen assesses the tendency of particles within the gel to clump together, forming

larger aggregates, which can affect the product's appearance, texture, and stability. This test is important because it helps ensure the gel remains homogeneous and does not separate over time.



Figure.3 Formulation F1, F2, F3, F4

2) Temperature Stability-Temperature stability tests for herbal gel-based sunscreens aim to assess their durability and effectiveness over a range of temperatures, ensuring they remain functional and effective even under varying conditions. These tests typically involve observing changes in the gel's physical appearance, color, and texture, as

well as checking for chemical alterations like pH or viscosity, according to ICH guidelines [2,6]. The goal is to determine the gel's stability over time and under different temperature conditions.

At 0°C

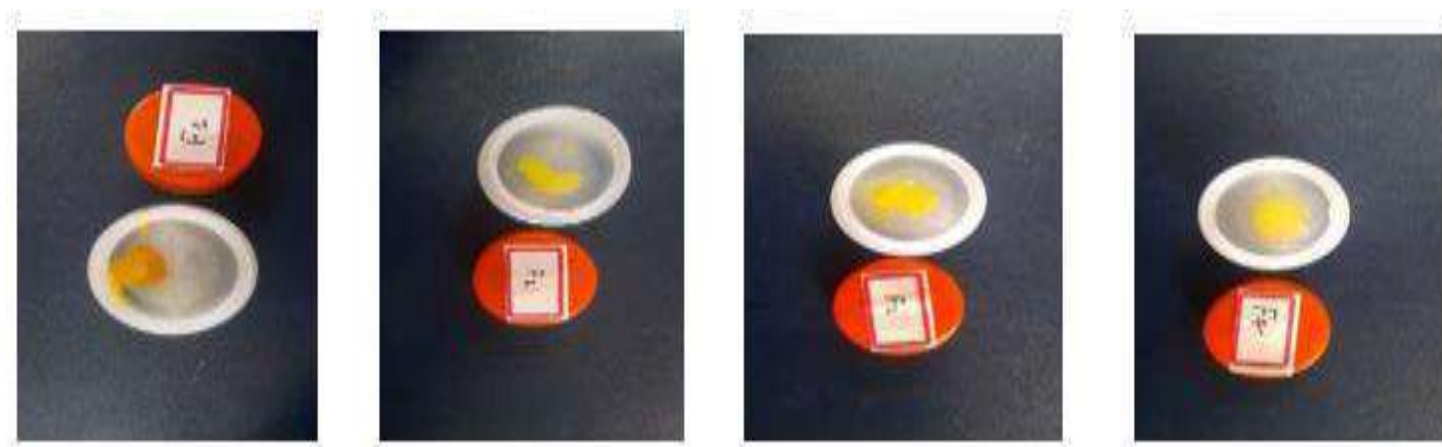


Figure 4.1 Formulations at 0°C

At 10 ° C

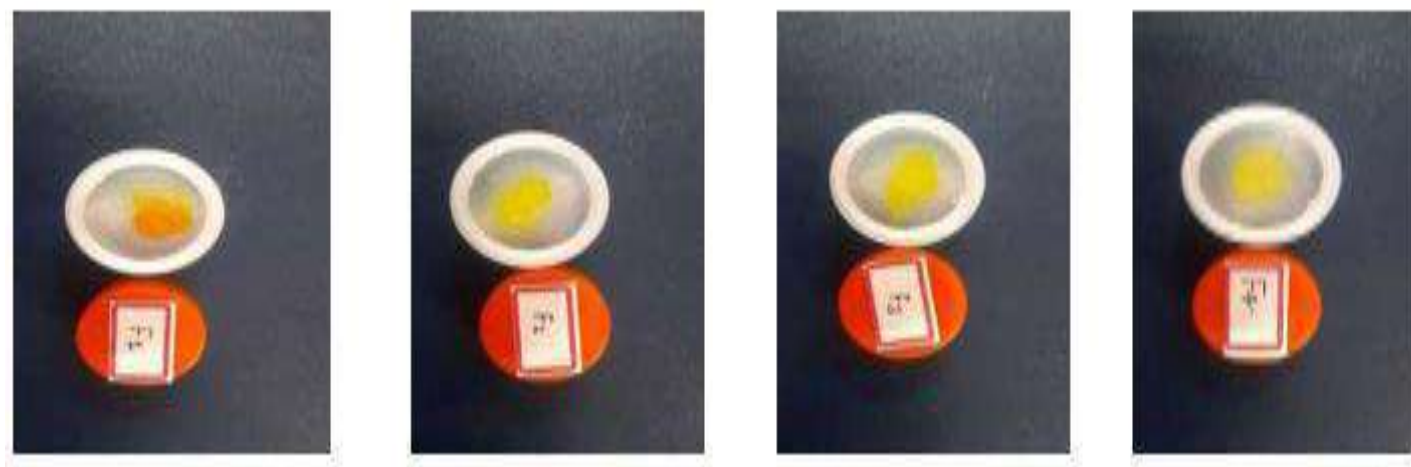


Figure 4.2 Formulations at 10°C

At 20° C

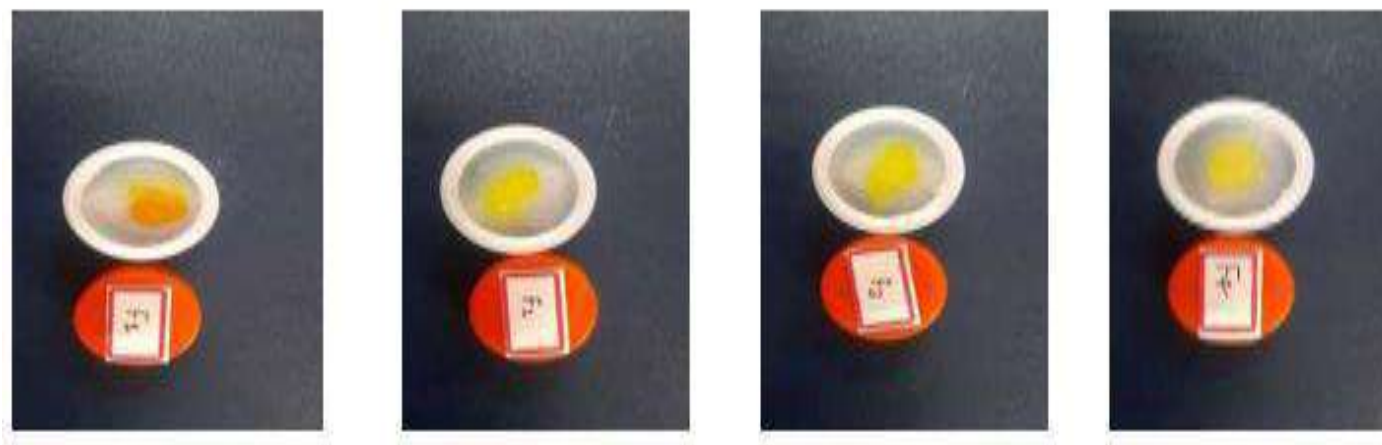


Figure 4.3 Formations at 20°C

3) Spreadability test:

To assess the Spreadability of a sunscreen gel using a texture analyzer, a specialized fixture with a cone-shaped probe and a matching receptacle is used. The probe is lowered into the sample, and the

force required to penetrate the gel's surface is measured. This force translates into the product's Spreadability. The probe subsequently goes downward at a predetermined speed to compress. The probe quantifies the amount of force required to penetrate the gel's surface as it moves into the sample holder.



Figure 5.1 Texture Analyzer Apparatus

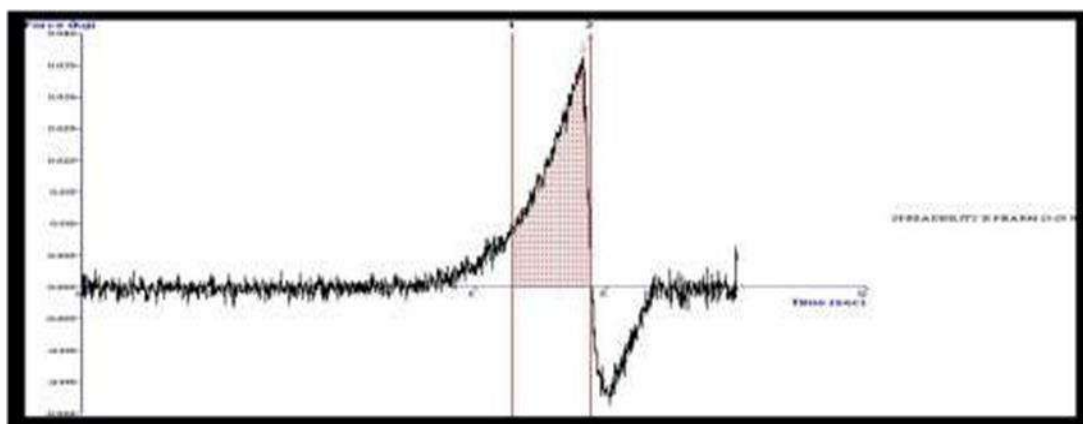


Figure 5.2 Graph Generated Using Texture Analyzer

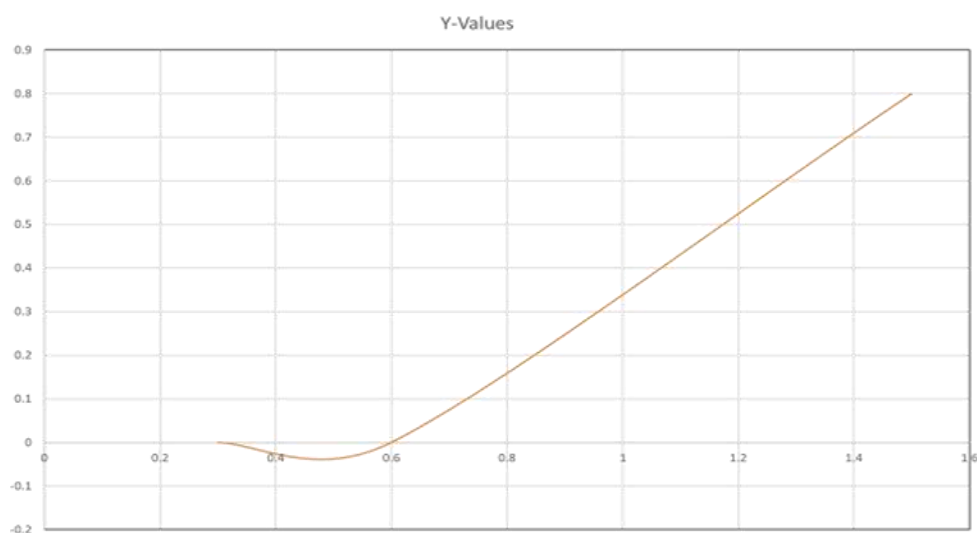


Figure 5.3 Graph of Spreadability Test

4) Viscosity Test

Viscosity of an herbal gel-based sunscreen can be determined using a Brookfield viscometer. The gel sample is placed in a beaker, and a spindle is

lowered into it. The viscometer rotates the spindle at a specific speed, and the resistance to movement is measured, indicating the viscosity. Measurements can be taken at different speeds to assess the gel's viscosity profile.

rpm	Torque Reading
0.3	57*10M
0.6	68*20M
1.5	82*4M

5) Determination sun protecting factor

Calculating the sun protection factors (SPF) may be used to determine how effective a sunscreen product is. It is sometimes referred to as difference

between UV energy required to create minimum erythema dose (MED) on sunscreen applied human skin and the UV energy required to produce a unprotected skin.

SPF = Minimal Erythema Dose for Protected Skin
by Minimal Erythema Dose for Unprotected Skin

$$\text{Formula SPF} = \text{CF} \times \text{EE} \times \text{I} (\lambda) \times \text{abs} (\lambda)$$

Where: The SPF value can be calculated by multiplying the correction factor (CF), the erythema effect spectrum (EE), the intensity spectrum from the sun (I), and also the absorbance (Abs) of the gel sample.

6) Stability:

Thermal stability testing of herbal gel-based sunscreens involves evaluating their resistance to changes in properties when exposed to elevated temperatures or humidity. This is crucial to ensure the sunscreen remains effective and stable during storage and application

7) Skin Irritation Test:

Skin irritation tests for herbal gel-based sunscreens typically involve applying the gel to a designated skin area and monitoring for signs of irritation like redness, edema, or inflammation. These tests are crucial to ensure the sunscreen is safe and suitable for use. Ensure the sunscreen does not cause irritation or allergic reactions.

8) Patch Test:

A patch test for an herbal gel-based sunscreen helps determine if you're sensitive or allergic to the product before applying it to your entire body. It involves applying a small amount of the sunscreen to a small area of skin, typically the inner wrist or behind the ear, and observing for any reactions

over a 24–48-hour period. Test on a small area of skin to check for any adverse reactions.

9) PH Test:

The pH of the herbal gel-based sunscreen was measured immediately after formulation and again after 30 days of storage at room temperature to assess both initial compatibility with skin and formulation stability. Across three independent batches, the freshly prepared gels exhibited a mean pH of 5.8 ± 0.1 , which falls well within the skin's natural pH range (4.5–6.5) and is unlikely to disrupt the acid mantle or provoke irritation. After 30 days, the pH shifted only marginally to 5.7 ± 0.1 , indicating excellent buffering capacity and physicochemical stability of the herbal extracts and gel base.

CONCLUSION

The current study aimed to create a stable herbal sunscreen with a suitable SPF. Titanium dioxide-based sunscreen (984) was found to be stable have good antioxidant activity. These herbal sunscreens have also been shown to be non-mutagenic. It can be stated that the current study will hopefully lead to improvements in the treatment of sunburns produced by UV radiation exposure. The study also demonstrate that UV spectroscopy is the most, efficient acceptable and repeatable approach for determining the performance of herbal sunscreen. Herbal sunscreen gel is containing aloe Vera, turmeric and sunflower oil is safe and effective way to protect your skin from harmful uv rays of the sun. Aloe has great-anti-inflammatory and anti – oxidant properties. That can help to protect the skin. While sunscreen is sunflower oil is rich source of vitamin E Which also has antioxidant and anti-ageing property. Days with sunscreen correlated not with days without risk behavior, but with days "sunbathing with the intention to tan," indicating that sunscreens were used as tanning



aids to avoid sunburn. The study also demonstrates that UV Spectroscopy is the most efficient, acceptable, and repeatable approach for determining the performance of herbal sunscreens. As a result, the findings of this study can help regulatory agencies, scientific organizations, and manufacturers set standardized standards for herbal sunscreens. The study attempted to develop herbal sunscreen cream using extract of butterfly pea flower and examined their efficacy for preventing sun burn.

REFERENCES

1. Boyd As. Naylor M. Cameron GS. Etal. The effects of chromic sunscreen use on the histologic changes of dermatophilosis. *J. Am Acad Dermatol.* Dec. 1995;33(6):941-6.
2. DE Buys HV. Levy SB. Murray JC, et, al, modern approaches to photo protection. *Dermatol clin.* Oct 2000: 18(4): 577-90
3. Supriya s. Design and Evaluation of polyherbal formulation for Malaria *Int J pharma phytopharmacol Res.* 2021; 11(3): 1-5, Doi: 10. 518471/R4UUOZG8X.
4. Shahrzad K, Seyyed MJM, Meisam A, Esmaeil K, Nasrin MA, Hossein M, the effects of curcuma longa Rhizome extract on blood cells of Mice: An Animal Trial, *Pharmacophore*, 2017; 8 (3): 19-23.
5. Gasparro FP, Mitch nick M and Nash JF, A review of sunscreen safety and efficacy photochemical photobiol. Sep. 1998: 68 (3): 243-56.
6. Dromgoole SH and Maibach HI, sunscreen agent intolerance: *Dermatol oct.* 1995: 33 (4): 597-602.
7. Mithal BM and Saha RNA, *Hand Book of cosmetics*, first edition. Reprint – 2007. Vallabh Prakashan. Delhi 122- 124.
8. Saifee M, Atre M, Toshniwal R. Formulation and In- vitro Evaluation of Ethosomal Gel of Repaglinide for Transdermal.
9. Kaur, C. D., & Saraf, S. (2010). In vitro sun protection factor determination of herbal oils used in cosmetics. *Pharmacognosy Research*, 2(1), 22–25.
10. Ngoc, L. T., Tran, V. V., Moon, J. Y., Chae, M., Park, D., & Lee, Y. C. (2019). Recent trends of sunscreen cosmetic: An update review. *Cosmetics*, 6(4), 64
11. Dalvi, S. S., and R. M. Satpute. “Herbal Sunscreen: An Overview.” *Journal of Pharmaceutical Sciences and Research*, vol. 6, no. 6, 2014, pp. 228–231. Patel, D., Vora, N., and Shah, D. “Herbal Sunscreens: A Review.” *Journal of Pharmacognosy and Phytochemistry*, vol. 8, no. 1, 2019, pp. 2585–2589.
12. Chauhan, R. (2021). A review on natural photo protectant for sunscreen. *World Journal of Pharmaceutical Research*, 10, October, ISSN: 2277-7105.
13. Donglikar, M. M. (2017). Development and evaluation of herbal sunscreen. *Pharma cogan*, 9, 83–97.
14. Wag mode, M. V. (2021). Formulation and evaluation of herbal sunscreen cream. *International Journal of Creative Research Thoughts*, 9, 742. ISSN: 2320-2882.
15. Sayre, R. M., Agin, P. P., LeVee, G. J., and Marlowe, E. “A Comparison of in Vivo and in Vitro Testing of Sun screening Formulas.” *Photochemistry and Photobiology*, vol. 29, no. 3, 1979, pp. 559– 566.
16. Pandey P. Novel researched herbal sunscreen cream SPF determination by in-vitro model. *Asian J Pharm Res Dev.* 2023 Apr:84.
17. Banswal, L. K. (2023). A review on formulation and evaluation of herbal sunscreen cream. *International Journal of Research Publication and Reviews*, 4, 3742. ISSN: 2582-7421.
18. M. D. Gianeti, L. R. Gaspar, F. Bueno de Camargo Jr., and P. M. B. G. M. Campos,



- “Benefits of combinations of vitamin A, C and e Derivatives in the stability of cosmetic formulations,” *Molecules*, Vol. 17, no. 2, pp. 2219–2230, 2012
19. T. Guaratini, M. D. Gianeti, and P. M. B. G. M. Campos, “Stability of cosmetic formulations containing esters of Vitamins E And A: chemical and physical aspects,” *International Journal of Pharmaceutics*, vol. 327, no. 1-2, pp. 12–16, 2006.
 20. G. Baek and C. Kim, “Rheological properties of Carbopol Containing nanoparticles,” *Journal of Rheology*, vol. 55, no. 2, pp. 313–330, 2011
 21. E. B. Manaia, R. C. K. Kaminski, C. P. Soares et al., “Liquid crystalline formulations containing modified surface TiO₂ Nanoparticles obtained by sol–gel process,” *Journal of Sol-Gel Science and Technology*, vol. 63, no. 2, pp. 251–257, 2012
 22. E. B. Manaia, R. C. Kaminski, A. G. de Oliveira, M. A. Correa, and L. A. Chiavacci, “Multifunction hexagonal liquid- ^Crystal containing modified surface TiO₂ nanoparticles and Terpinen-4-ol for controlled release,” *International Journal of Nanomedicine*, vol. 10, pp. 811–819, 2015.
 23. H. Yang, S. Zhu, and N. Pan, “Studying the mechanisms of Titanium dioxide as ultraviolet-blocking additive for films and Fabrics by an improved scheme,” *Journal of Applied Polymer Science*, vol. 92, no. 5, pp. 3201–3210, 2004.
 24. B. L. Diffey, P. R. Tanner, P. J. Matts, and J. F. Nash, “In Vitro assessment of the broad-spectrum ultraviolet protection Of sunscreen products,” *Journal of the American Academy of Dermatology*, vol. 43, no. 6, pp. 1024–1035, 2000.
 25. B. L. Diffey, “A method for broad spectrum classification of Sunscreens,” *International Journal of Cosmetic Science*, vol. 16, No. 2, pp. 47–52, 1994.
 26. D. Nesseem, “Formulation of sunscreens with enhancement sun Protection factor response based on solid lipid nanoparticles,” *International Journal of Cosmetic Science*, vol. 33, no. 1, pp. 70–79, 2011.
 27. N. S. Allen, M. Edge, A. Ortega, C. M. Liauw, J. Stratton, and R. B. McIntyre, “Behaviour of nanoparticle (ultrafine) titanium Dioxide pigments and stabilisers on the photooxidative stability Of water based acrylic and isocyanate based acrylic coatings,” *Polymer Degradation and Stability*, vol. 78, no. 3, pp. 467–478, 2002.

HOW TO CITE: Prathmesh Patidar, Triveni Bijore, Jaypal Singh Jadon, Lakeesha Sunaiya, Madhuri Solanki*, Formulation and Evaluation of Herbal Gel Based Sunscreen, *Int. J. of Pharm. Sci.*, 2025, Vol 3, Issue 6, 3560-3570. <https://doi.org/10.5281/zenodo.15719905>

