

Formulation, Development & Evaluation Of Polyherbal Sunscreen

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ABSTRACT

This study aims to develop a polyherbal sunscreen formulation using natural ingredients such as aloe vera gel, rose water, vitamin E capsule, glycerin, and other plant extracts. The formulation was optimized for its physical and chemical properties, including sun protection factor (SPF), Spreadability, and stability. The polyherbal sunscreen was evaluated for its efficacy in protecting the skin from harmful UV radiation by conducting in vitro and in vivo tests. Results showed that the polyherbal sunscreen had an SPF of 30 and provided significant protection against both UVA and UVB radiation. Moreover, it was found to be non-irritating and safe for use on human skin. The formulation of this polyherbal sunscreen offers a promising alternative to synthetic sunscreens with potential benefits for the environment and human health.

Keywords: Sunscreen, polyherbal, SPF30, Sun protection.

INTRODUCTION

Sun Damage and Sun Exposure

Although we frequently mistake a tanned appearance for being healthy and youthful, prolonged sun exposure can actually hasten the ageing process of the skin. It's critical to comprehend how the sun affects your skin in order to comprehend how sunscreen protects your skin from the sun's rays.

The visible and invisible rays of sunlight that reach the earth include a significant amount of ultraviolet (UV) light. Your skin's look and the rate at which your skin cells grow are both impacted when UV rays strike your skin cells. A sunburn that hurts to the touch may result in the short term from exposure to UV radiation, notwithstanding how pleasant it seems to bask in the warm rays. In the long run, it could result in wrinkles, skin damage, and in the worst instance, potentially fatal skin cancer.

There are two types of UV radiation that can affect your skin; longer UV rays are called UVA rays, while shorter rays are called UVB rays. Excessive exposure

to UVB rays can lead to sunburns and superficial damage to the epidermis, or outer layer of the skin; because UVA rays are longer, they can penetrate deeper into the dermis—your skin's thickest layer—resulting in more permanent damage.

UVB rays actually account for almost 95% of the radiation that penetrates the Ozone layer, but UVA rays are always present, regardless of season or time of day. Though UVA rays don't cause sunburns, they are the primary cause of signs of skin ageing and cases of skin cancer.

How does sunscreen shield your skin from both of these damaging radiation types? What you use as a product matters. It's crucial to use sunscreens that offer broad spectrum (or full spectrum) protection, which guards against UVA and UVB radiation on your skin.

Sunscreen ^[7]

A substance called sunscreen can shield you from UV rays. UVB radiation, which causes sunburn, but may

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be more harmful to the skin than UVA. The optimal sunscreen should block both wavebands.

This study's goal was to create a herbal topical sunscreen solution based on few fixed oils and a few medicinal herbs. Regular application of sunscreen slows the growth of melanoma, squamous cell carcinoma, and actinic keratosis. Chemicals in sunscreen can be either organic or inorganic. Sunblock lotion is another name for sunscreen. The product that shields the skin from UV light from the sun by reflecting or absorbing it. Sunscreen products are being used more frequently as a result of the rising prevalence of skin malignancies and the photodamaging effects of UV radiation. These products have shown effective in lessening symptoms.

Sunscreens should be completely able to protect the skin from sun damage and should be safe chemically, non-irritating, non-toxic, and photo-stable. Herbal sunblock is another name for herbal sunscreen. An herbal suntan lotion is a lotion, spray, or other topical product that lessens sunburn and other skin damage while protecting the skin from the sun's ultraviolet rays.

- Sunscreen is Divided into Two Categories.

1) Physical sun protection:

those that catch the sun's rays.

2) Chemical sunscreens

that block ultraviolet light

Sunscreen products should only be used externally. the use of photoprotective sunscreens for UV protection. The sunscreen formulation relies on its capacity to prevent UV-induced sunburn and its chemo preventive action when it comes to protecting treated skin from sunburn. photo carcinogenesis, accelerated ageing, and skin pigmentation. The generation of Reactive Oxygen Species (ROS), which interact with proteins and lipids and subsequently modify them, is the primary mechanism of skin damage by UV radiations. Skin damage is caused by UVB and, to a lesser ex in order to effectively prevent photoaging and skin cancer, sunscreen should also contain an antioxidant ingredient. Plants are regarded as an appealing choice to be utilized in sunscreen

formulation for the protection of skin damage from UV radiation due to their antioxidant capabilities. Sunscreen is a topical substance that shields the skin from the sun's damaging rays.

The Photoprotection Mechanism ^[8]

Following exposure to the sunscreen, it has been shown to raise the skin's resistance to ultraviolet radiation. Sunscreen works by preventing and minimizing the harmful effects of the sun's ultraviolet rays. The two mechanisms they use are

Mineral-based, inorganic sunscreens that are based on this principle produce a covering that prevents sun rays from passing through the skin by scattering and reflecting ultraviolet radiation from the skin surface.

Organic sunscreen uses this technique to absorb UV energy and convert it to heat energy, minimizing the negative effects and the depth to which it can infiltrate the skin

Herbal Sunscreen Benefits Include: ^[9]

- (1) Widely accessible.
- (2) No adverse effects.
- (3) No specialised tools are required for preparation.
- (4) Resources that are reusable.
- (5) It's simple to find ingredients made of plants. They are inexpensive.

Photo Stability

Refers to the ability of a molecule to remain intact with irradiation is potentially a problem with all UV filters because they are deliberately selected as UVR-absorbing molecules.

Possible Adverse Effect

Potential negative consequences Certain sunscreen components, particularly the substance benzophenone, also known as phenyl ketone, biphenyl ketone, or benzoyl benzene, can cause mild to serious allergic reactions in certain people. Trace levels of benzophenone can be identified in urinalysis following use, while it is unclear how much of it enters the bloodstream. Sunscreens work well to

prevent sunburn, but they don't always lower the risk of cancer.

MATERIALS AND METHODS: [12]

1) Materials:[5]

The use of natural ingredients in cosmetic products has gained immense popularity in recent years due to their perceived safety and potential health benefits. Polyherbal formulations, which combine multiple natural ingredients, have been widely used for the treatment of various skin conditions and have shown promising results. One such application is in the development of polyherbal sunscreens that utilize the beneficial properties of various herbal extracts to provide protection from harmful UV radiation.

The ingredients used in the preparation of polyherbal sunscreens are carefully selected based on their individual properties and synergistic effects. Aloe vera gel is a widely used natural ingredient in skincare products due to its hydrating and soothing properties. Rose water is another popular ingredient that is known for its ability to balance the pH of the skin and reduce inflammation. Vitamin E capsule, a potent antioxidant, helps to protect the skin from oxidative stress caused by UV radiation. Glycerin is a natural humectant that helps to retain moisture in the skin, while coconut oil provides nourishment and promotes skin healing. Butterfly Pea Flower, a natural blue dye, provides the polyherbal sunscreen its distinctive color.

In this study, we aimed to formulate a polyherbal sunscreen using aloe vera gel, rose water, vitamin E capsule, glycerin, coconut oil, and Butterfly Pea Flower. The optimized formulation was evaluated for its physical and chemical properties, including SPF, Spreadability, and stability. The efficacy of the sunscreen was also evaluated through in vitro and in vivo tests. The use of natural ingredients in the formulation of polyherbal sunscreen offers an alternative to synthetic sunscreens and potentially provides additional benefits for the skin.

2) Method of Preparation:

Different formulations were prepared using varying amount of gelling agent. The method only differed in process of making gel in different formulation. The

preparation of emulsion was same in all the formulations. The gel bases were prepared by dispersing gelatin, Xanthum Gum in distilled water separately with constant stirring at a moderate speed using mechanical shaker. Formulations G1 were prepared by using gelatin as a gelling agent with different concentration and formulation G2 were prepared by using Xanthum gum as a gelling agent with different concentration and formulation G3 were prepared by combination of both i.e., gelatin and Xanthum gum with different concentration. The gel was prepared by dispersing the gelling agent in heated distilled water (75°C) and the dispersion was cooled and left over night. The pH of all the formulations was adjusted to 6.5 to 8.5 using Triethanolamine (TEA).

Formation of Emulsion: - [8]

The Emulsion was prepared according to the pseudo ternary phase diagram the optimum concentration was 1:1. The extract was dissolved in the oil with continuous agitation then Smix was added into the mixture and the water is added drop wise while triturating the mixture to get the emulsion.

Ingredient	Quantity
Aloe vera gel	2 gm
Coconut Oil	7ml
Rose Water	2 ml
Vitamin E capsule	2 gm
Butterfly Pea Flower	Q.S.

Table-1 Formulation of Emulsion

Formation of Sunscreen: -

The gel bases were prepared by dispersing the gelling agent in heated distilled water (75°C) and the dispersion was cooled and left overnight. The pH of all the formulations was adjusted to 6.5 to 8.5 using triethanolamine (TEA). The obtained emulsion was mixed with the gel in 1:1 ratio with gentle stirring to obtain the Sunscreen.

Ingredients	F1	F2	F3	F4	F5
Aloe vera gel	2gm	2gm	2gm	2gm	2gm
Coconut Oil	7ml	7ml	7ml	7ml	7ml
Rose water	2ml	2ml	2ml	2ml	2ml
Vitamin E	2gm	2gm	2gm	2gm	2gm
Butterfly Pea Flower Extract	2ml	2ml	2ml	2ml	2ml
Gelatin	4gm	-	1gm	2gm	3gm
Xanthum Gum	-	4gm	3gm	2gm	1gm
Glycerine	2ml	2ml	2ml	2ml	2ml
Triethanolamine (TEA)	0.6ml	0.6ml	0.6ml	0.6ml	0.6ml
Water	Q.S.	Q.S.	Q.S.	Q.S.	Q.S.

Table-2 Formulation of Sunscreen

3) Evaluation of Sunscreen:^[6]

Phase separation: Sunscreen were subjected to centrifugations at 3000 rpm for a period of 60 min and observed for any phase separation.

Evaluation of Sunscreen:

The above formulated Sunscreen formulation was subjected to evaluation of following parameters:

I. Physical observation

Physical parameters such as color, appearance, consistency, grittiness on application and other visual factors like clarity and color of formulation are first thing decides quality of formulation. Any change in physical observation with time reflects physical instability of formulation and make the product cosmetically unacceptable. Physical instability refers to the change in color, texture, gloss, appearance, feel and other visual factors. Generally, in dispersion system like emulsion, physical instability is caused by phase separation of emulsion as the effect of temperature, time and other dependent factors which may try to affect the separation immediately after preparation of emulsion. This unwanted separation of phases makes the product cosmetically inelegant and un acceptable. Physical parameters such as color,

homogeneity, consistency, grittiness, and phase separation were recorded.

II. Determination of pH

The pH value can be considered as an indicator to possible instability as any deterioration of ingredient/s due to varied climatic conditions during storage and incompatibility of ingredients can lead to change in viscosity. pH of all formulations was determined by a pH meter (Digital pH meter). The pH meter was calibrated with a standard buffer solution having pH 4 and 7 before use. 1 g of the formulation was dissolved in distilled water and stirred until it forms a uniform suspension, kept it aside for 2 h. The volume made up to 100 ml and pH of the suspension was measured with the help of calibrated pH meter.

III. Viscosity

Viscosity is the most important parameter in the evaluation as it governs many properties of the formulation such as spread ability, pourability of the product from the container etc. As there are various factors which can affect the viscosity like change in temperature, change manufacturing conditions, quality of raw materials etc. The viscosity of Sunscreen was determined by LVT Brookfield viscometer. The sample was placed in a clean and dried container and viscosity was checked as per

standard operating procedure of viscometer by using spindle no. 4 at speed 30 rpm. After recording the dial reading viscosity was calculated in the centipoises (cps). Following formula is used for the calculation of the viscosity:

IV. Rheograms

For studying rheology of Sunscreen, this is very important for the above-mentioned reasons. Brookfield viscometer LV dial type was used. For obtaining nature of system and Rheograms, both ascending and descending readings were noted down i.e., firstly, by increasing shear stress and then by decreasing. Rheograms obtained were plotted by taking RPM on Y-axis and Dial reading on X-axis.

V. Extrudability test (tube test)

In the present study, the method adopted for evaluating Sunscreen formulation for extrudability is based upon the quantity in percentage of Sunscreen and Sunscreen extruded from lacquered aluminum collapsible tube on application of weight in grams required to extrude at least 0.5 cm ribbon of Sunscreen in 10 seconds. More quantity extruded better is extrudability. The measurement of extrudability of each formulation is in triplicate and the average values are presented. The extrudability is then calculated by using the following formula:

Extrudability = Weight applied to extrude Sunscreen from tube (in gm) / Area (in cm²).

VI. Stability study:

Stability may be defined as the ability of the drug to retain its property within specified limits throughout its shelf life. Improper storage of cosmetic product can lead to their physical deterioration & chemical degradation resulting in reduced activity & occasionally in the form of toxic degradation product. So, stability studies are carried out for each product. The present stability studies are carried out according to guidelines given by international council of Harmonization.

VII. Sun protection factor

Sun protection factor (SPF) was measured with a UV-2000S transmittance analyzer (Labsphere, North Sutton, NH, USA). The creams (1.3 mg/cm²), placed on polymethylmethacrylate plates (25 cm²), were tested following the COLIPA guidelines. Cream base without UV-absorbing agents was used for blank scan. Three sample plates were prepared and kept in dark for 15 minutes for curing. Then, the plates were scanned at three different locations and the SPF value was recorded.

RESULTS AND DISCUSSION:

Method of preparation of Sunscreen:

The Sunscreen were prepared by the procedure as mentioned in the experimental work under method of preparation.

Physical appearance of Sunscreen formulation:

The prepared Sunscreen formulations were inspected visually for their color, homogeneity and consistency.

Table 3. Determination of physical properties of formulated Sunscreen

Formulation	color	Homogeneity	Consistency	Phase separation
F1	Milky white	Homogeneous	Creamlike semisolid	No
F2	Milky white	Homogeneous	Creamlike semisolid	No
F3	Milky white	Homogeneous	Creamlike semisolid	No
F4	Milky white	Homogeneous	Creamlike semisolid	No
F5	Milky white	Homogeneous	Creamlike semisolid	No

Determination of pH:

The pH of the all-sunscreen formulations was modified with the help of triethanolamine and when

checked it was found in between the range 6.5 and 7.84, which is acceptable for Sunscreen preparations.

Formulation	pH (mean±SD)	Spread ability (gm./s) (mean±SD)	Extrudability
F1	6.53±0.05	18.5±0.57	92.74% (Very Good)
F2	6.57±0.07	22.5±0.57	94.86% (Very Good)
F3	6.48±0.07	29.61±0.57	97.66% (Excellent)
F4	6.58±0.07	36.5±0.57	98.56% (Excellent)
F5	6.58±0.07	34.61±0.57	95.59% (Excellent)

Table 4. Determination of physical properties of formulated Sunscreen
Extrudability: -a) 95%-100%=Excellent, b)90%-95%=Very good c)85%-90%=Good(n=3)

Viscosity

Rheological behavior of the Sunscreen formulations exhibited non-Newtonian shear thinning pseudo plastic type of flow, i.e., decreases in viscosity at increasing shear rates. As the shear stress is increased, the disarranged molecules of the gelling material are caused to align their long axes in the direction of flow. Viscosity for respective Sunscreen was found to be

Formulation	Viscosity (CPS)
F1	18342
F2	14100
F3	15580
F4	12280
F5	10840

Table 5. Determination of viscosity of formulated Sunscreen

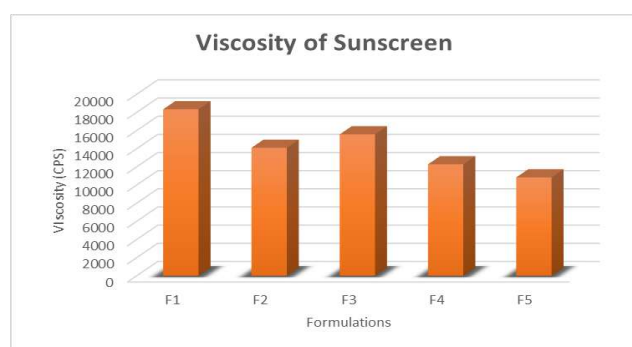


Chart 01. Bar graph showing viscosity of formulated Sunscreen

Rheological Studies:

The rheograms depict that all formulations F1 to F5 show the thixotropic behaviors, since the down curve shifted to the left of the up curve when r.p.m. plotted against dial reading. Thus, formulations F1 to F5 are shear thinning systems. The shear

thinning systems indicate that the breakdown of structure is not reformed immediately when the stress is removed. The phenomenon is thixotropic and is exhibited by only shear thinning systems. Shear thinning nature for topical preparations are desired because they can spread easily on the affected area. Viscosity at higher temp.is slightly decreased but rheological property remains thixotropic.

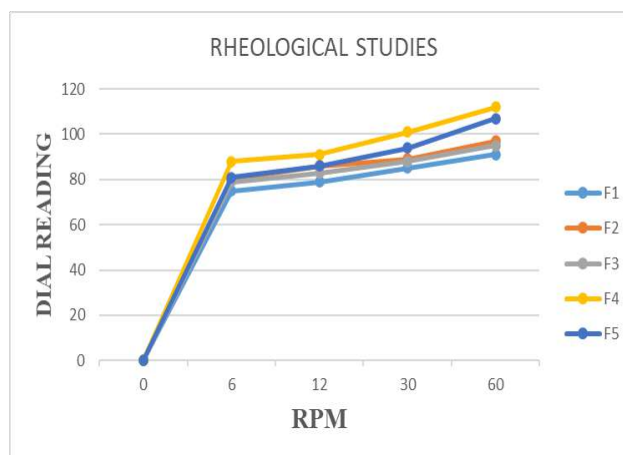


Chart 02: Rheological behavior of F1, F2, F3, F4, F5

Kinetic Modeling Data of Optimized Batch F3

The mathematical models are used to evaluate the kinetics and mechanism of drug release from the tablets. The model that best fits the release data is selected based on the correlation coefficient (r) value

in various models. The model that gives high 'r' value is considered as the best fit of the release data.

The optimized batch follows the Hixon Crowell model

R2				
Zero Order	First Order	Hixon Crowell	korse meyer peppas model	Higuchi Plot
0.9432	0.9091	0.9692	-0.5875	0.85

Table No.7 Kinetic Modeling Data of Optimized Batch F5

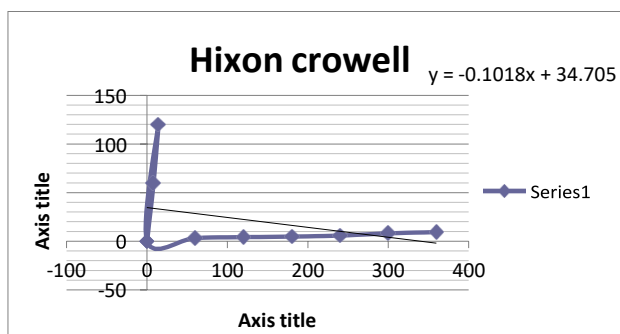


Chart 04: - Hixon Crowell model

Stability study:

The stability test was carried out for three months and results revealed that all the Sunscreen showed better stability at 40°C and 30°C. And all the parameter obtained are satisfactory.

Formulation	Color	Homogeneity	Consistency	Phase separation
F1	No Change	No Change	No Change	No
F2	No Change	No Change	No Change	No
F3	No Change	No Change	No Change	No
F4	No Change	No Change	No Change	No
F5	No Change	No Change	No Change	No

Table 8: Changes in physical properties at 40°C

Formulation	Color	Homogeneity	Consistency	Phase separation
F1	No Change	No Change	No Change	No
F2	No Change	No Change	No Change	No
F3	No Change	No Change	No Change	No
F4	No Change	No Change	No Change	No
F5	No Change	No Change	No Change	No

Table 9. Changes in physical properties at 30°C

Batch	Day	pH	Viscosity	Spreadability
F1	0	NC	NC	NC
	60	NC	NC	NC
F2	0	NC	NC	NC
	60	NC	NC	NC
F3	0	NC	NC	NC
	60	NC	NC	NC
F4	0	NC	NC	NC
	60	NC	NC	NC
F5	0	NC	NC	NC
	60	NC	NC	NC

Table 10: Accelerated stability testing of developed Sunscreen formulations at 400 C

Formulation	Day	pH	Viscosity	Spreadability
F1	0	NC	NC	NC
	60	NC	NC	NC
F2	0	NC	NC	NC
	60	NC	NC	NC
F3	0	NC	NC	NC
	60	NC	NC	NC
F4	0	NC	NC	NC
	60	NC	NC	NC
F5	0	NC	NC	NC
	60	NC	NC	NC

Table 11: Stability results of developed Sunscreen at 300C:

NC=No change

SUN PROTECTION FACTOR DETERMINATION:

FACTOR

& in accordance with the limit set for the topical sunscreen.

The Sun Protection Factor of the prepared sunscreen was found to be more than SPF30 which is acceptable

SUMMARY:



The aim was to design Sunscreen to give enhanced sun protection using polyherbal ingredients such as aloe vera gel, coconut oil, Vitamin E capsule, Rose water, etc. The formulation prepared by using these ingredients was found to be shown significant sun protection when applied the evaluation of the prepared sunscreen was found to be as follow.

- **Physical Appearance:**

Physical Appearance was milky white

- **pH:**

pH was in between 6.5-7.84

- **Viscosity:**

Viscosity was found to be 12280.

- **Extrudability:**

Extrudability was found to be excellent

- **Spreadability:**

Spreadability was found to be excellent

Kinetic study: optimized batch follow Hixon Crowell model

CONCLUSION

From the result and summary, we have concluded that the formulation F4 in which contain aloe vera gel, rose water, vitamin E capsule, glycerine, coconut oil, Butterfly Pea Flower in 1:1 Ratio and in which the ratio of Extract and cream Base ratio was 1:1 shows the satisfactory result as compare to other batches Hence the objective of this study i.e.

- To develop safe and efficient Sunscreen.
- To achieve improved Sun protection.
- To make a stable Sunscreen.

To improve patient compliance.

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HOW TO CITE: Markunde Onkar Ramu^{*1}, Yede Sainath Nagorao¹, Jadhav Pramod Ramrao¹, Kale Ajwita Satishrao², Zanwar Vijaykumar Jugalkishor², Formulation, Development & Evaluation Of Polyherbal Sunscreen, *Int. J. Sci. R. Tech.*, 2026, 3 (4), 1227-1237. <https://doi.org/10.5281/zenodo.19925070>