Formulations and Evaluation of Sunscreen Cream from Licorice Root Extract

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Abstract-Cosmetics are products designed to enhance appearance, maintain skin and hair health, and provide protection. Some cosmetics, such as sunscreens, have functional benefits beyond aesthetics. Sunscreens help shield the skin from harmful ultraviolet (UV) radiation by absorbing, scattering, or blocking UV rays. This protection prevents premature aging, including sagging, wrinkles, and hyperplasia caused by UV exposure. The use of sunscreens for UV protection has become increasingly popular. A sunscreen formulation is applied topically to safeguard the skin from sunburn and damage. It supports the body's natural defense mechanisms against UV rays. UV radiation consists of three types: UV-A, UV-B, and UV-C, with UV-B being the primary cause of sunburn due to its impact on the epidermis. Sunscreen agents are broadly categorized into synthetic products, including organic and inorganic filters.

Keywords: Sunscreen, Licorice, Leguminosae, UV Radiation, Glycyrrhiza glabra, SPF.

I. INTRODUCTION

Sunscreens are substances that either block, scatter, or absorb ultraviolet light. It regulates harmful consequences such as accelerated aging, which can result in wrinkles, sagging, and UV-induced hyperplasia. Sunscreen is increasingly being used as a photo-protective agent to defend against UV rays[1]. A formulation that prevents sunburn on the treated region when applied topically is called a sunscreen preparation. The purpose of sunscreens is to support the body's defenses against the sun's damaging UV rays[2]. In addition to individual differences, skin varies geographically and in terms of the color, texture, and thickness of the skin layers as well as adrenal structures such sebum glands, sweat glands, and hair follicles. The natural substance licorice root extract (Glycyrrhiza glabra) has drawn interest due to its anti-inflammatory, antioxidant, and skin-brightening qualities. This study investigates how well licorice extract works to improve skin tone and prevent UV damage when added to sunscreens[3].

Skin: Skin The skin the largest organ in the human body, the skin is essential for shielding the body from harmful substances, toxins, and ultraviolet light. It also contributes to touch perception and helps control body temperature. Three main layers make up the skin: The epidermis The dermis The hypodermis, or subcutaneous tissue: The epidermis—more especially, the stratum corneum—is the layer of skin that is largely in charge of shielding the skin from UV rays and sunburn. Keratin, a protein found in this layer, offers some protection from UV radiation, although it is not infallible [4].

Sun exposure can harm the skin's defenses, increasing the risk of skin cancer and causing sunburn [5]. In terms of medicine, it's critical to comprehend that the stratum corneum, or epidermis, is the main defense against the damaging effects of ultraviolet light. In order to avoid sunburn and UV-induced skin damage, this barrier function is essential. For this reason, sunscreen products—which are frequently found in pharmacies—are designed to give the skin an extra layer of protection[6].

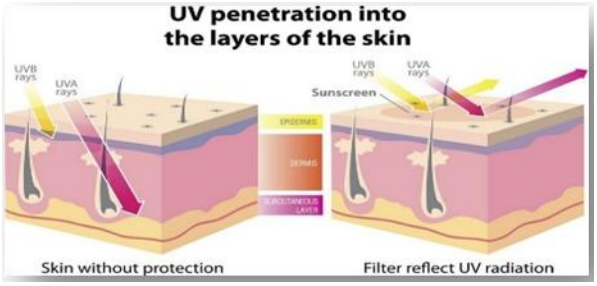


Fig. No. 1 Skin

Sunscreen classification

They can be categorized according to their mode of action.

Physical form: Reflect dangerous radiation away from the skin. For instance, titanium dioxide and zinc oxide.

Chemical sunscreen: Absorbs UV ray. For instance, oxybenzone, avobenzone, and microfine titanium dioxide.

UV radiation (UVR):

UVA: the longest wavelength, measuring between 320 and 400 nm, damages the dermis and other interior cells in the skin, resulting in instant tanning and sunburn.

UVB: Medium wavelength with 290-320nm, it affects the cells in the top layer of skin and causes delayed tanning, sunburn, and blisters.

UVC: The shortest wavelength, 100-290nm, affects the outermost cells in the top layer of skin and causes redness, ulcers, and lesions [7].

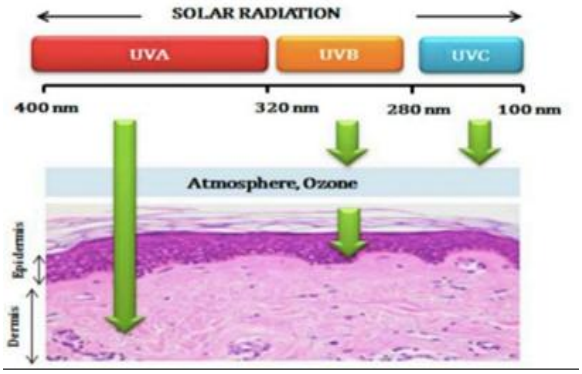


Fig. No. 2 Effect of solar radiation on skin

Advantages of sunscreen:

Protection from UV Rays – Shields skin from harmful UVA and UVB radiation, reducing sunburn and long-term damage.

Prevents Premature Aging – Helps prevent wrinkles, fine lines, and age spots caused by sun exposure.

Prevents Hyperpigmentation – Helps reduce dark spots, melasma, and uneven skin tone.

Moisturizing Benefits – Some sunscreens contain hydrating ingredients that prevent skin dryness.

Disadvantages of sunscreen:

Chemical Absorption Concerns – Some chemical sunscreens may penetrate the skin and cause irritation or hormonal disruption.

Can Cause Allergic Reactions – Certain ingredients may trigger allergies or skin irritation in sensitive individuals.

White Cast – Some sunscreens, especially physical (mineral) ones, may leave a visible white layer on the skin.

Frequent Reapplication Needed – Needs to be reapplied every 2-3 hours, especially after sweating or swimming.

Mechanism of photoprotection- Enzymatic and non-enzymatic antioxidants in the stratum corneum, epidermis, and dermis are depleted as a result of UV-mediated photo-oxidative damage that travels via the epidermis and dermis to the dermal capillaries. Pre-existing melanin and its precursors will undergo photo-oxidation, causing an instantaneous and long-lasting darkening of the pigment. Sunscreens work by blocking and reducing the harmful effects of UV radiation from the sun. They have been shown to improve the skin's resistance to UV rays after being exposed to sunscreen. They operate using two mechanisms: UV radiation is reflected and scattered by minerals on the skin's surface that are based on inorganic This is how sunscreens function: they provide a layer that prevents UV rays from passing through the skin [8].

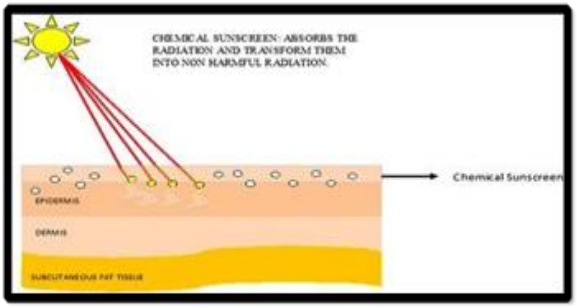


Fig. No. 3 Mechanism of photo protection

Ideal Properties of a Sunscreen
Broad-Spectrum Protection—Shields against both UVA and UVB rays.

Water & Sweat Resistant—Stays on even during sweating or swimming

Non-Greasy & Lightweight—Should feel comfortable and not sticky.

Fast Absorbing—Should not leave an oily residue.

II. PLANT PROFILE

[1] LICORICE
Taxonomy of Licorice root
Biological source: Glycyrrhiza glabra
Family: Fabaceae

Fig.No.4 Licorice root

Geographic origin:
It is extensively dispersed throughout Europe, the Middle East, and portions of Asia, such as China, India, and Pakistan. It is frequently found in Andhra Pradesh, Maharashtra, and Punjab in India.
Kingdom: The Plantae.
Division: Magnoliopsida.
Class: The Rosidae subclass.
Subclass: Rosidae.
Chemical Components:
The triterpenoid saponin glycyrrhizin (6–10%) is what gives it its sweet flavor.
Root of licorice Liquiritin and isoliquiritin are flavonoids that have antioxidant qualities.
Sterols (β-sitosterol, stigmasterol).
Coumarins (umbelliferone, herniarin).

Morphology:

Part	Characteristics
1.Root System:	Herb licorice has a wide, deep root system. The thick, branching, cylindrical roots have a brownish-yellow exterior.
2. Stem:	The plant can reach a height of one to one and a half meters on an upright or semi-prostrate stem. Woody in the base, the stems turn herbaceous as they rise.
3.Leaves:	Nine to seventeen elliptical leaflets with a sticky glandular surface are found on each leaf. Leaves are innately compound, about 10-20 cm long.
4.Flowers:	Axillary racemes are used to arrange the flowers. Their hue ranges from violet to purple. Like those of the pea family (Fabaceae), each blossom is papilionaceous.
5.Fruits	A tiny, oblong pod that is 1-2 cm long is the fruit. It is frequently somewhat bent and has two to eight seeds. The glandular hairs cover the pods.

USES FOR SUNSCREEN

- Natural UV Protection: Glabridin, which helps shield the skin from UVB-induced damage and pigmentation, is a component of natural UV protection.
- Skin Brightening: Diminishes dark spots and hyperpigmentation brought on by exposure to the sun.
- Anti-Inflammatory: This product is perfect for sun-exposed skin because it soothes inflamed skin and lessens redness.
- Antioxidant Properties: Prevents premature aging by neutralizing UV-induced free radicals.

[2] VITAMIVM E:
Uses for sunscreen:
As a potent antioxidant, vitamin E is added to sunscreen formulations to improve UV protection, lower the risk of sunburn, and fight against sun-induced skin damage. It also provides extra advantages like better skin health and decreased inflammation.

[3] GLYCERINE:
Uses for sunscreen:
To enhance skin hydration by drawing moisture from the air and retaining it within the skin's outer layers, contributing to a smoother, more comfortable feel.

[4] SHEA BUTTER:
Uses for sunscreen:
Shea butter can be used in sunscreen formulations to provide a natural moisturizing and emollient base, and it can also enhance the effectiveness of UV filters, although it doesn't provide a high SPF on its own.

[5] ROSE OIL:
Uses for sunscreen: Acts as a natural antioxidant, protecting skin from UV-induced damage. Works as a natural fragrance, enhancing the sensory appeal of sunscreen formulations.

III. METHODOLOGY

1. Collect fresh Glycyrrhiza glabra roots.
2. After cleaning, these roots were left to dry for three to four days in the shade.
3. Roots were ground into a coarse powder after drying.
4. The active ingredient, glycyrrhizinic acid, wasthen extracted using the appropriate extraction technique, maceration

Fig. No.5 licorice root and powder

Extraction:
Licorice root powder Extraction is the process of using a suitable standard procedure and a selected solvent to separate a medicinally active component from its parent source. Glycyrrhizin has been extracted from licorice using a variety of techniques, including: • Analytical • Soxhlet, etc.; solvent-based (dipping, percolation, maceration).

Maceration Method:
Procedure:
1. Preparation of Licorice Root Powder: Dry the licorice root and grind it into a fine powder.
2. Defatting: Weigh the powdered licorice root (typically 100 grams for a small-scale extraction). Add enough acetone to cover the powder, usually in a 1:10 ratio (20 grams of powder to 200 ml of acetone).
Stir the mixture for 24 hours to defeat the powder.
Filter the mixture to remove the acetone-soluble components.
3.Extraction with Dilute Nitric Acid:
Prepare a dilute nitric acid solution (e.g., 2% concentration). For every 40 grams of licorice powder, use approximately 200 ml of dilute nitric acid. Mix the defatted licorice powder with the dilute nitric acid solution for 24 hours, then filter it to remove the solid residue.
4.Neutralization:
Neutralize the filtrate with a base (e.g., sodium hydroxide or ammonia) to a pH of around

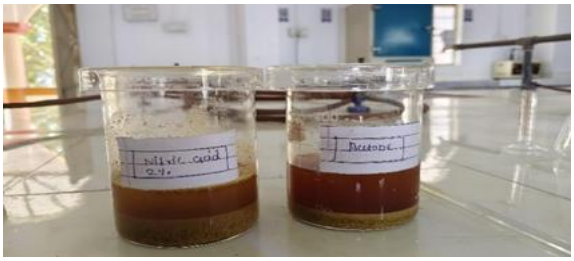


Fig No.7 Maceration

Fig. No.8 Filtration assembly

METHOD OF PREPARATION
Formula:
Table no.1 Formula for preparation of sunscreen (20g)

Sr. No.	Phase	Ingredient	Quantity	Role
1.	C	Licorice extract	3 ml	Active ingredient
2.	B	Shea butter	2 g	Emollient
3.	A	Glycerin	1 ml	Humectant
4.	C	Vit. E	0.2 g	Antioxidant
5.	B	Zinc oxide	1 g	UV absorber
6.	B	Stearic acid	2.5 g	Emulsifying
7.	A	Borax	0.2 g	Preservative
8.	C	Rose oil	1ml	Perfume
9.	A	Distilled water	QS	Vehicle

Procedure for preparation of sunscreen from licorice extract

Preparation Steps:

1.Heat Phase A – Dissolve borax and glycerin in distilled water at 70°C.

2Heat Phase B – Melt shea butter, steric acid, and zinc oxide at 70°C.

3.Emulsification – Slowly add Phase B into Phase A while stirring continuously.

4.Cool Down mixture – When the mixture cools to around 40°C, add phase C is (vitamin C, licorice root extract, and essential oils.)

5.Final Mixing – Blend until smooth and transfer to a clean container.

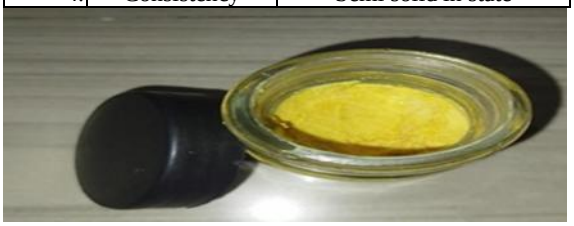
IV. RESULT

1. Organoleptic Character:

The prepared sunscreen formulation was inspected visually for their color, odour, texture and consistency.

Table No. 2 Organoleptic properties

Sr. No.	Parameter	Result
1.	Color	Light brown
2.	Odour	Pleasant odour
3.	Texture	Gritty, smooth
4.	Consistency	Semi solid in state



2. Phytochemical investigation test of Glycyrrhiza glabra

Where, ++ indicates presence of the required constituent and - - sing shows absence of the constituent.

Secondary metabolites	Name of Test	Observation	Result
1.Alkaloid	Mayer's test	Red ppt	++
	Dragendroff's test	Red ppt	++
	Wagner's test	No red ppt	- -
	Hager's test	No yellow color formation	- -
2.Glycosides	Modified Borntrager's Test	Rose pink color in ammonium layer formation	++
	Lugal's Test	Initial pink color converted to blood red color	++

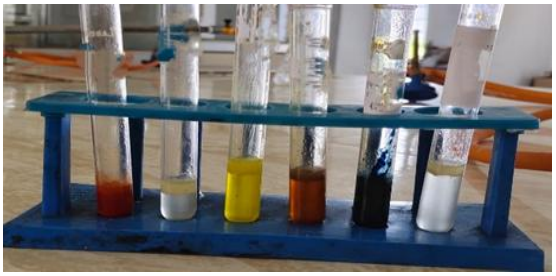


Fig.No.8: Phytochemical tests

3. Skin irritation test

Observation: there is no irritation, redness or itching was observed on skin.

4. Spredability test:

Weigh 0.5 g of the cream sample precisely, place it between two slides, and let it sit for about five minutes, or until no more spreading is anticipated.

The spreader circle's diameter, expressed in centimeters, served as a benchmark for spreadibility

Formula: S=ML/T

Where, M= weight of upper slide

L = length of circle T = time in minute

M=5.59 g, L=3 cm, T=5 min

S=5.59×3/5

S=3.35cm g/min

5. Antimicrobial test:

Table no.3 Result of antimicrobial test

Sr. No.	Name of Bacteria	Zone of inhibition					
1.	E. coli	50unit/ml	100unit/ml	200unit/ml	300unit/ml	400unit/ml	500unit/ml
		1.4	1.8	2	2.5	2.7	3.5

Fig.No.9 Result of microbial test

6. pH testing:

Table No.4 pH of licorice root base sunscreen

FORMULATION	pH
Licorice base sunscreen	5.32

Fig.No.10 pH Meter

7. Determination of sun protection factor by using UV Spectrophotometer (SPF):

Formula:

SPF spectrophotometric =Σ (λ) x I (λ) Abs (λ) x CF

Table No.5 Value of EE*I at different wavelength

Wavelength (nm)	EE*I (constant) Employed	Absorbance(A)
290	0.0150	3.3128
295	0.0817	3.3396
300	0.2874	3.2615
305	0.3278	3.0848
310	0.1864	2.6477
315	0.0837	1.9752
320	0.0180	1.4646

a) Multiply EE*I with absorbance Calculation:

=(0.0150×3.3128)+(0.0817×3.3396)+(0.2874×3.2615)+(0.3278×3.0848)+(0.1864×2.6477)+(0.0839×1.9752)+(0.0180×1.4646)+(0.3278×3.0848)+(0.1864×2.6477)+(0.0839×1.9752)+(0.0180×1.4646)

=0.0497+0.2728+0.9379+1.0108+0.4934+0.1657+0.02 64

= 2.9567

b) Multiply by CF:

SPF =10 × 2.95

SPF≈ 30

Fig.No.11 UV spectrophotometer

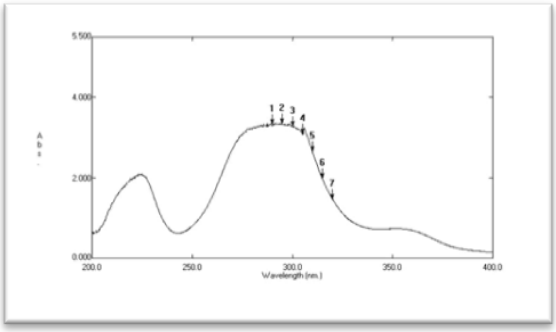


Fig.no. 12 UV spectra of sunscreen cream

8. Stability Testing:

Table No.6 stability testing

Sr No	Parameter	Initial Day (0 day)	7 Day	15 Day	30 Day	Acceptane Criteria
1.	Appearance	Smooth, Uniform	No Change	No Change		
2.	Colour	Pale Yellow	No Change	No Change	No Change	No significant Change
3.	Odour	Pleasant Odour	No Change	No Change	No Change	No off Odour
4.	pH	5.34	5.34	5.30	5.20	5.0 to 7.5
5.	Microbial Growth	Absent	Absent	Absent	Absent	No Microbial Contamination

V. DISCUSSION

The licorice root-based sunscreen was formulated to provide UV protection along with antioxidant and skin-brightening benefits. Glycyrrhiza glabra, containing glycyrrhizin, offered anti-inflammatory and skin-lightening properties. Zinc oxide acted as a physical UV filter, while shea butter, glycerin, and vitamin E provided hydration and antioxidant effects. The formulation exhibited good physicochemical stability with an ideal pH (5.32) and smooth texture. It demonstrated an SPF of 29.57, ensuring moderate to

strong sun protection. Skin irritation tests confirmed safety for daily use, and antimicrobial tests indicated stability, reducing contamination risks and extending shelf life.

VI. CONCLUSION

The study confirmed that the licorice root-based sunscreen is effective, safe, and stable. It offers UV protection with an SPF of 29.57, while its pH (5.32) ensures skin compatibility. The formulation demonstrated good spreadability, making it comfortable to apply. No irritation was observed, proving its safety for daily use. Additionally, it showed excellent microbiological stability, ensuring a longer shelf life. Overall, the findings support herbal sunscreens as viable alternatives to chemical-based ones, with potential for further improvements in SPF and stabili

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