Formulation and Evaluation of Lecithin Containing Herbal Cream

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Abstract
The present study aimed to formulate and evaluate a herbal cream with wound healing and anti-inflammatory activity, along with a comparative assessment of soya lecithin and sunflower lecithin as natural emulsifiers. Neem oil was used as the primary active ingredient, while aloe vera gel and sweet almond oil were incorporated to provide soothing, regenerative, and emollient effects. A total of six formulations were prepared as water-in-oil (W/O) emulsions by varying ingredient proportions, comprising three formulations each of soya lecithin (F1–F3) and sunflower lecithin (F1–F3). The study focused on evaluating the effect of these emulsifiers on formulation stability and performance. All formulations were evaluated for physicochemical parameters including appearance, pH, viscosity, spreadability, homogeneity, centrifugation, and TLC analysis. Among them, the F3 formulation containing sunflower lecithin and F2 formulation of containing soya lecithin were found to be optimized based on overall evaluation tests. Out of these, the F3 formulation containing sunflower lecithin exhibiting superior viscosity, spreadability, and stability compared to the corresponding soya lecithin formulation. The optimized F3 formulation of sunflower lecithin was further evaluated for biological activity using the protein denaturation method for anti-inflammatory activity and scratch assay for wound healing, showing moderate anti-inflammatory and considerable wound healing effects. In conclusion, the developed herbal cream was found suitable for topical application, and sunflower lecithin proved to be a more effective natural emulsifier for achieving enhanced stability and performance.

Keywords: Herbal Cosmetics, Emulsion System, Natural Ingredients, Stability Studies, Moisturizing Cream, Dermatological Evaluation.

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Introduction

Herbal Medicines

Herbal medicine represents one of the oldest systems of healthcare, developed and refined across ancient civilizations such as Mesopotamia, Egypt, Greece, Rome, China, India, and the Americas. It is often referred to as traditional or folk medicine and involves the use of plant parts—including roots, leaves, seeds, flowers, fruits, and stems—for therapeutic purposes.

Herbal extracts are increasingly used in modern cosmetic formulations to enhance beauty and improve skin health. Herbal cosmetics can be categorized based on their dosage forms—such as creams, powders, soaps, and solutions—or by the body part they are intended for, including skin, hair, nails, and oral care. Creams are semi-solid emulsions designed for application on the skin or mucous membranes. Herbal creams are typically oil-in-water (o/w) emulsions that contain both aqueous and oily phases.

Types of Herbal Cream

Creams are mainly classified into two types based on how oil and water are distributed within the formulation

Oil-in-Water (O/W) creams contain tiny oil droplets dispersed in a continuous water phase. These creams are generally lighter, less greasy, and easily absorbed into the skin.

Water-in-Oil (W/O) creams have water droplets dispersed within a continuous oil phase. They are thicker, more moisturizing, and form a protective barrier on the skin.

In short, the key difference lies in which component (oil or water) forms the outer continuous phase and which one is dispersed within it.[8]

Advantages

Herbal cosmetics are modern beauty products formulated using natural plant extracts instead of synthetic chemicals. They are widely preferred because they are gentle on the skin and help maintain overall skin health.

1. Safe to use
2. Compatibility with all skin types
3. Fewer side effects
4. Better safety profile
5. Cost effective and natural

Disadvantages

1. Lack of Standardization
2. Risk of Allergic Reactions

3. Short Shelf Life
4. Microbial Contamination

Drug Profile

Neem

Biological Source - Azadirachta indica

Neem (Azadirachta indica) is one of the oldest medicinal plants known to humankind, with its origin deeply rooted in the Indian subcontinent. Ancient Indian systems of medicine such as Ayurveda, Siddha, and Unani extensively documented neem for its healing properties. Classical Ayurvedic texts described neem as a plant capable of treating multiple ailments, earning it names like "Sarva Roga Nivarini" (the healer of all diseases). Over centuries, neem became an integral part of Indian culture, religion, and healthcare practices.

The botanical name Azadirachta indica is derived from Persian words meaning "free tree of India," reflecting its long-standing association with health and wellness.

Extracts from different parts of Azadirachta indica (neem) contain a wide range of bioactive compounds such as azadirachtin, nimbin, nimbolide, nimbidol, gedunin, tannins, quercetin, along with vitamins, minerals, antioxidants, and amino acids. These constituents contribute to its antimicrobial, anti-inflammatory, immunomodulatory, and overall therapeutic effects.

Neem oil is highly effective in treating various skin disorders. It is commonly used for dressing infected wounds, ulcers, eczema, and conditions such as ringworm, scabies, and mange in animals. The oil exhibits multiple therapeutic properties, including insect-repellent, antibacterial, antifungal, antiviral, and anti-inflammatory effects, while also enhancing the body's immune response. Rich in essential fatty acids, neem oil supports collagen production, promotes wound healing, and helps maintain skin elasticity and softness. These fatty acids keep the affected area moisturized, aiding faster recovery and preserving skin suppleness. Additionally, the active compounds present in neem contribute significantly to the healing process.

Aloe vera

Biological Source - Aloe Barbadensis Miller

The name is derived from the Arabic word alloeh, meaning bitter, referring to the bitter juice present in its leaves, where it was used to treat burns, infections, and parasitic conditions. The fresh aloe plant is composed of about 96% water, while the remaining portion contains essential oils, amino acids, vitamins, minerals, enzymes, and glycoproteins. The clear gel extracted from its leaves is well known for its wound-healing and soothing properties, as it forms a protective layer over affected areas and promotes faster healing of wounds, ulcers, and minor burns. Aloe vera also possesses anti-inflammatory activity and helps in stimulating tissue repair.

Sweet Almond oil

Biological Source- Prunus dulcis (Miller)

The sweet variant is commonly used in cosmetics and is especially valued as a carrier oil in skincare formulations. Alongside their growing commercial importance, there has been a notable rise in scientific research focused on these oils. Studies increasingly explore their chemical composition, biological activities, safety profiles, and potential health benefits. Many natural oils contain unique bioactive compounds that provide multiple skin benefits, including antioxidant, anti-inflammatory, and anti-itch effects. Because of these properties, they are considered useful complementary treatments for dry and inflamed skin conditions, especially those linked to damage or dysfunction of the skin's protective barrier.[16]

Lecithin

The term "lecithin" is often used generically to describe a mixture of lipid substances rather than a single compound. It primarily consists of phosphatidylcholine, phosphatidylethanolamine, phosphatidylserine, and phosphatidylinositol, along with varying quantities of triglycerides, fatty acids, sterols, and carbohydrates. Lecithin is widely distributed in nature and can be obtained from both plant and animal sources, including soybean, sunflower seeds, egg yolk, and marine organisms. lecithin is commercially available in multiple forms, including liquid, granular, and powdered forms, each suited for specific industrial or pharmaceutical applications. lecithin mainly comprises glycerophospholipids, which are amphiphilic molecules consisting of a glycerol backbone, two hydrophobic fatty acid chains, and a hydrophilic phosphate-containing head group. This dual affinity for both water and lipids give lecithin its characteristic amphiphilic nature, making it highly effective as an emulsifying agent. The hydrophilic head interacts with aqueous environments, while the hydrophobic tails associate with lipid phases, thereby stabilizing oil–water interfaces. This unique property enables lecithin to reduce surface tension and form stable emulsions, which are essential in food, pharmaceutical, and cosmetic formulations. In plant-derived lecithin, soybean is the most abundant and widely used source, containing a high percentage of lecithin, followed by sunflower, canola, corn, rice bran, and cottonseed. Among these, sunflower lecithin has gained increasing popularity due to its non-genetically modified (non-GMO) status, improved sensory properties, and relatively higher phosphatidylcholine content.. The extraction of lecithin from plant sources is commonly associated with oilseed processing. During the refining of vegetable oils, lecithin is obtained as a by-product through a process known as degumming. This involves the hydration of phospholipids, followed by their separation from crude oil. Advanced purification techniques such as filtration, drying, and fractionation are then employed to obtain lecithin of desired quality and composition.

Use of Lecithin

lecithin has been reported to improve liver function, support cardiovascular health, and enhance cognitive performance, making it a valuable component in nutraceutical and dietary supplements. One of the most significant functional properties of lecithin is its emulsifying ability.

Sunflower lecithin also possesses a pleasant flavor profile and better oxidative stability, making it suitable for use in high-quality food products. However, it is generally more viscous and may require specialized processing techniques during formulation. The growing demand for natural and sustainable ingredients has further increased the importance of lecithin, particularly from non-GMO plant sources such as sunflower.

Wound Healing

Wound healing is a dynamic biological process in which damaged tissue is repaired or regenerated. The normal wound-healing process begins immediately after injury through a sequence of coordinated events. Initially, platelets interact with exposed collagen, leading to platelet aggregation and the release of clotting factors that form a fibrin clot at the injured site. This clot acts as a temporary matrix for further healing. Inflammatory cells then migrate to the wound area along with platelets and release signaling molecules such as cytokines and growth factors that regulate tissue repair. Fibroblasts play an important role in healing by producing collagen, which restores tissue strength, structure, and function. Since collagen is essential for maintaining the integrity of normal tissues, its deposition is necessary for repairing damaged tissue.

Inflammation

Inflammation, derived from the Latin term meaning "to set on fire," is a common biological response and a key part of the body's innate defense system against injury or disease, whether infectious or non-infectious. It involves a series of physiological reactions that protect affected tissues, remove damaged cells, and create conditions that support healing. Alongside these local effects, inflammation also triggers systemic changes that aid recovery.

The classical signs of local inflammation—first described in ancient times—include pain (caused by chemical mediators acting on nerve endings), redness (due to increased blood flow), swelling (resulting from fluid accumulation and increased vascular permeability), and heat (caused by elevated temperature in the affected tissue.

Materials and Method

Materials

List of Ingredients

Sr. No.	List of herbal ingredients	Company/Grade
1.	Neem oil	Arihant Pvt. Ltd.
2.	Almond Oil	Hamdard Pvt. ltd
3.	Lecithin	Giiava (India) Pvt. Ltd
4.	Steric Acid	Research lab fine chem industries
5.	Borax	Research Lab fine chem industries
6.	Liq. Paraffin	Research lab fine chem industries
7.	Glycerin	Research lab fine chem industries
8.	n – hexane	Research lab fine chem industries
9.	Diethyl ether	Research lab fine chem industries
10.	Methylene blue	Research lab fine chem industries
11.	Distilled water	Adarsh college of pharmacy, vita

Method

Sr. No	Ingredients	Sunflower Lecithin			Soya Lecithin			Role
		F1	F2	F3	F1	F2	F3	
1	Stearic acid	1.7 gm	1.5 gm	2 gm	2.1gm	2gm	2.3gm	Thickening agent
2	Almond oil	0.7 ml	0.8 ml	0.9 ml	1.1 ml	1ml	1.2 ml	Moisturizer and skin nourishing agent
3	Neem oil	0.9 ml	0.7 ml	0.8 ml	0.75 ml	0.8 ml	0.5 ml	Anti-inflammatory agent
4	Sunflower lecithin	0.47 gm	0.4 gm	0.54 gm	0.55 gm	0.53 gm	0.48 gm	Natural Emulsifier
5	Borax	2.2 gm	1.5 gm	2gm	2.1gm	1.9gm	1.5gm	Stabilizer
6	Glycerin	0.18 ml	0.12 ml	0.28 ml	0.25 ml	0.27 ml	0.26 ml	Humectant, Moisturizing agent
7	Liquid Paraffin	0.9 ml	0.5 ml	1ml	0.8 ml	1.1 ml	1.2 ml	Emollient
8	Aloe vera	0.20 ml	0.15 ml	0.28 ml	0.25 ml	0.27 ml	0.22 ml	Soothing and healing agent
9	Distilled Water	8.7 ml	8.5 ml	9.2 ml	9.1 ml	9.5 ml	9.3 ml	Vehicle
10	Methylparaben	0.7gm	0.6gm	0.7gm	0.5 ml	0.6gm	0.8gm	Preservative
11	Rose oil	1 drop	1drop	1 drop	1drop	1 drop	1drop	Fragrance and soothing agent

Method of Preparation

Step 1 - Oil Phase Preparation

Stearic acid was accurately weighed and was melted on a water bath at 70–75°C

Neem oil was added to the molten stearic acid and was mixed thorough hly.

Sunflower lecithin/soya lecithin was incorporated into the oil phase with continuous stirring until a uniform mixture was formed.

Step 2 - Aqueous Phase Preparation

Aloe vera gel, glycerin, and paraffin oil were mixed with distilled water to prepare the aqueous phase.

Borax was completely dissolved in the aqueous phase.

Step 3 – Emulsification

The hot aqueous phase was slowly added to the oil phase with continuous stirring using a glass rod.

Stirring was continued until a smooth, homogeneous cream was formed.

Evaluation of Cream Formulation

1.Visual assessment

The visual assessment test was conducted to examine parameters such as color, odour and foam formation, ensuring the formulation's overall appearance, fragrance, and foaming ability.

2.Physicochemuical tests

2.1 Determination of pH

The pH meter was first calibrated using a standard buffer solution to ensure accuracy. Approximately 0.5 g of the cream sample was accurately weighed and transferred into a clean beaker. The sample was then dissolved in 50 ml of distilled water with proper stirring to obtain a uniform solution. The electrode of the calibrated pH meter was immersed in the prepared solution, and the pH value was recorded once the reading stabilized.

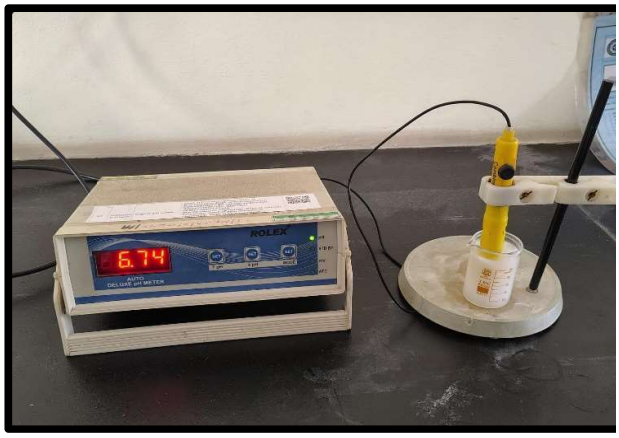


Figure no. 9 -pH test of formulated herbal cream

Spreadablity test

Spreadability was measured by parallel-plate method to assess the ease of application and uniform distribution over the skin. Surplus amount of the cream sample was placed between two glass slides, and 30g weight was applied on the top slide, for 5 minutes to achieve uniform thickness. The time in seconds required for the two slides to separate was recorded as a measure of spreadability.

Formula to measure the spreadability,

$$S = m \times l / t$$

S is Spreadability,

m is weight tied on upper slide,

l is length of slide and

t is time in seconds.

Figure no. 10 – Spreadability test of formulated herbal cream

2.3 Viscosity test

Evaluated using a Brookfield viscometer to determine the rheological properties of the formulations. 50g sample was placed in a beaker and allowed to equilibrate for 5 minutes before measuring the dial reading using a T -D spindle (Number 7, 6,) at speeds of 30 rpm. The corresponding dial readings were recorded at each speed. The spindle speed was then gradually reduced, and the dial readings were noted again. The measurements were performed in triplicate at ambient temperature, Viscosity in centipoises (CPS) was calculated by multiplying the dial readings by the factors provided in the Brookfield Viscometer catalogue.

Figure no. 11 – Viscosity test of formulated herbal cream

2.4 Washability test

Washability of cream was evaluated by applying it on the hand, rinsing with water and observing residue. The test repeated three times, assessed ease of removal, smoothness, and absence of stickiness, ensuring user comfort.

2.5 Greasiness

The greasiness of the cream formulation was evaluated by applying a small quantity of cream onto the skin surface and gently spreading it. After application, the skin was observed for the presence of oily or greasy residue.

2.6 Irritancy

The safety of the herbal-based cream was evaluated using an irritation (patch) test on. A small amount of the cream was applied to the forearm and left for 24 hours. After this period, the area was observed for any signs of redness, swelling, itching, or rashes. The graded reactions showed that the cream was safe, non-irritant, and suitable for regular use on the skin.

3. Emulsion test

3.1 Dilution test

The cream sample was diluted in different solutions, and the solubility behavior of the formulation was observed visually.

3.2 Dye Solubility Test

A small quantity of the formulation was taken on a glass slide and a few drops of methylene blue were added. The sample was mixed gently and covered with a cover slip. It was then observed under a microscope. The distribution of the dye was noted to determine the type of emulsion.

4. Stability test

4.1 Centrifugation

i. The sample was taken in centrifuge tubes.

ii. The tubes were placed in the centrifuge in a balanced (symmetrical) position.

iii. The required RPM and time (1000 rpm for 10 minutes) were set.

iv. The centrifuge was started and allowed to run.

v. After completion, the tubes were carefully removed.

vi. The sample was observed for any signs of instability such as phase separation or sedimentation.

5. Chromatographic analysis

5.1 Thin layer chromatography

Stationary Phase – coated silica gel plate

Mobile phase – n-Hexane and Diethyl Ether

A TLC plate coated with silica gel was used for the test. A line was drawn about 2 cm from the bottom of the plate using a pencil, and a small amount of sample was placed on the line. The plate was then kept in a chamber containing the mobile phase made of n-hexane and diethyl ether. The solvent moved upward on the plate and carried the sample along with it. The process was stopped when the solvent reached near the top of the plate. After drying, the plate was sprayed with anisaldehyde sulfuric acid reagent to produce colored spots. These spots were observed and the Rf value was calculated to identify the sample components.

RF = Distance travelled by sample / Distance travelled by solvent

6. Biological evaluation

6.1 Scratch Assay

The wound healing capabilities of Sample was assayed by performing In vitro cell migration studies on L929 cells by a previously described method. Briefly, 2 x 105 cells/mL were seeded in 6- well plates and were cultured overnight. Cells were then washed with Dulbucco's Phosphate Buffered Saline (DPBS) and a scratch was made with a sterile 200uL tip. The detached cells and other cellular debris were removed by washing the cells with DPBS. The cells were treated with 100 uL of Sample and 5 ug/mL of positive control, Cipladine and incubated for 24 h. Cipladine is a standard drug that is used in wound healing. Untreated cells were negative control. The cell migration and morphological changes of cells were observed in the images taken by inverted microscope, equipped with digital camera. The experiments were performed in triplicate (n ¼ 3). The width of the scratch and wound closure at different time intervals (48hrs) was analyzed by SAGLO software.

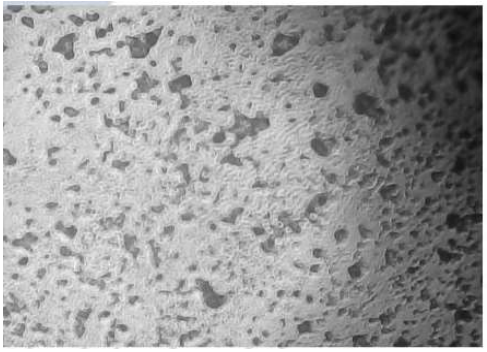


Figure – Normal morphology of L929

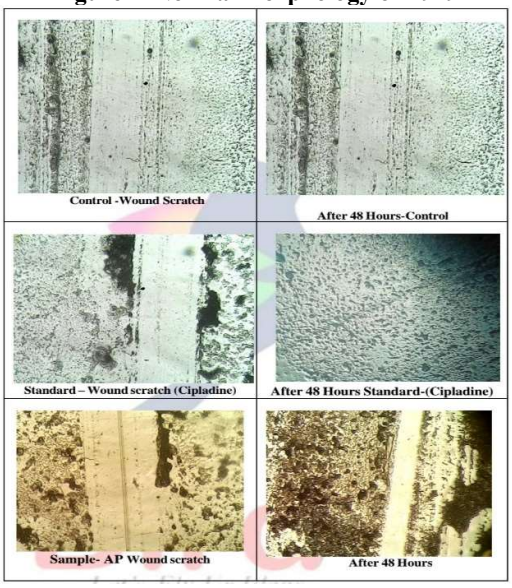


Figure – Comparative results of control, standard and sample AP

6.2 Anti-inflammatory Activity

Preparation of Solutions

BSA/Egg Albumin Solution (1% w/v)

1 g of BSA/egg albumin was accurately weighed and dissolved in 100 mL of phosphate buffer (pH 6.4) to prepare a 1% w/v solution.

Standard Solution

Standard stock solutions of Diclofenac sodium / Ibuprofen having concentrations of 250, 500, and 1000 µg/mL were prepared using distilled water or phosphate buffer solution (PBS).

Test Sample

Different concentrations of the test sample (250, 500, and 1000 µg/mL) were prepared using a suitable solvent.

Reaction Setup

In separate test tubes, 0.5 mL of the test sample or standard solution was mixed with 0.5 mL of 1% BSA solution. For the control, 0.5 mL of phosphate buffer was mixed with 0.5 mL of BSA solution.

Incubation

All the test tubes were incubated at 37°C for 15–20 minutes to allow interaction between the protein and the sample.

Protein Denaturation

The samples were then heated at 70°C for 5–10 minutes in a water bath to induce protein denaturation. After heating, the samples were cooled to room temperature.

Measurement of Absorbance

The absorbance of all samples was measured at 660 nm using a UV-Visible spectrophotometer.

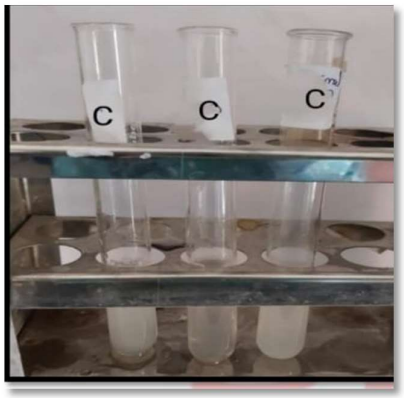


Figure – Control

Figure- Std. Diclofenac Sodium

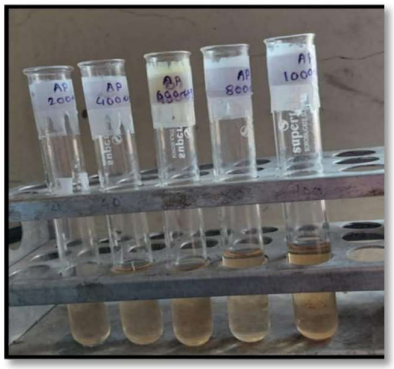


Figure – Sample AP

Result

1. Visual assessment

Sunflower lecithin cream

Table no. 1 – Visual assessment of sunflower lecithin containing cream

Sr. No.	Evaluation test	(F1)	(F2)	(F3)
1	Appearance	Semi-solid	Semi-solid	Semi- solid
2	Color	Whitish Yellow	Whitish Yellow	Whitish Yellow
3	Odor	Pleasant smell	Pleasant smell	Pleasant smell
4	Foam Formation	No foam formation	No foam formation	No foam formation
5	Texture	Uneven	Uneven	Smooth

For Sunflower Lecithin Cream: All three formulations (F1, F2, F3) showed semi-solid appearance, whitish yellow color, and pleasant odor. No foam formation was observed in any formulation. However, texture varied—F1 and F2 showed uneven texture, while F3 showed a smooth texture. Hence, F3 is the best formulation based on texture and overall appearance.

Soya lecithin cream

Table no. 2 – Visual assessment of soya lecithin containing cream

Sr.no.	Evaluation test	(F1)	(F2)	(F3)
1	Appearance	Semi-solid	Semi-solid	Semi-solid
2	Colour	White	White	White
3	Odor	Pleasant smell	Pleasant smell	Pleasant smell
4	Foam Formation	No foam formation	No foam formation	No foam formation
5	Texture	Uneven	Smooth	Uneven

For Soya Lecithin Cream: All formulations (F1, F2, F3) were semi-solid with white color and pleasant smell. No foam formation was observed. Texture was uneven in F1 and F3, whereas F2 showed smooth texture. Therefore, F2 is the best formulation among soya lecithin creams.

In both sunflower and soya lecithin creams, Formulation F3 and F2 respectively showed smooth texture with good physical properties, making it the most suitable formulation.

2. Physicochemical evaluation

2.1 pH

Sunflower lecithin cream

Table no. 3 – pH of sunflower lecithin containing cream

Sr. No.	Formulation	pH
1	F1	7.8
2	F2	7.6
3	F3	6.7

For Sunflower Lecithin Cream: The pH values of formulations F1, F2, and F3 were found to be 7.8, 7.6, and 6.7 respectively. Among these, F3 has a pH closest to neutral (7), which is more suitable for skin application. Hence, F3 is considered the most appropriate formulation in terms of pH.

Soya lecithin cream

Table No. 4 – pH of soya lecithin containing cream

Sr. No	Formulation	pH
1	F1	7.2
2	F2	7
3	F3	7.5

For Soya Lecithin Cream: The pH values of formulations F1, F2, and F3 were 7.2, 7, and 7.5 respectively.

All formulations fall near the skin-friendly pH range, but F2 (7) is closest to the natural skin pH (~6–7), making it the most suitable formulation.

Formulation F3 of Sunflower lecithin creams and Formulation F2 of soya lecithin cream shows pH values closest to the ideal skin pH, indicating better compatibility and safety for topical use.

2.2 Spreadability Test

Sunflower lecithin cream

Table no. 5 – Spreadability of sunflower lecithin containing cream

Sr. no.	Formulation	Consistency	Ease of spread	Coverage	Time (sec)	Spreadability (g.cm/sec)
1	F1	Thin	Spread Smoothly	Spread Evenly	15	15.18
2	F2	Thick	Spread Smoothly	Spread Unevenly	7	32.4
3	F3	Thick	Spread Smoothly	Spread Evenly	10	22.8

For Sunflower Lecithin Cream: All formulations (F1, F2, F3) showed smooth spreading. F1(thick) spread evenly but had the lowest spreadability (15.18 g·cm/sec) and took more time (15 sec). F2 (thick) showed the highest spreadability (32.4 g·cm/sec) in 7 sec but spread unevenly Hence, F3(thin consistency) spread evenly with a spreadability of 22.8 g.cm/sec in 10 sec.is considered better due to uniform coverage and good spreadability, while F3 shows higher spreadability but poor uniformity.

Soya lecithin containing cream

Table no. 6 - Spreadability of soya lecithin containing cream

Sr. no.	Formulation	Consistency	Ease of spread	Coverage	Time (sec)	Spreadability
1	F1	Thin	Spread Smoothly	Spread Evenly	17	13.23
2	F2	Thick	Spread Smoothly	Spread Evenly	12	20.45
3	F3	Thick	Spread Smoothly	Spread Unevenly	11	18.75

For Soya Lecithin Cream: All formulations spread smoothly. F1(thick) spread evenly but had lower spreadability (13.23 g·cm/sec) and required more time (17 sec), F2(thin) showed even spreading with 20.45 g·cm/sec in 12 sec. F3 (thick) had higher spreadability (20.45 g·cm/sec) but uneven coverage. Therefore, F2 is the best formulation due to balanced spreadability and uniform application.

In Sunflower lecithin Cream F3 shows higher spreadability value, whereas in soya lecithin cream F2 shows more suitability because they provide smooth and even spreading with acceptable spreadability, making them preferable for topical application.

2.3Viscosity

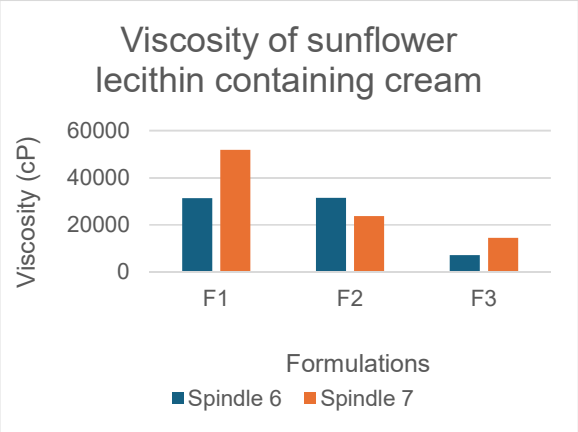
Sunflower lecithin cream

Table no. 7 –Viscosity of sunflower lecithin containing cream

Sr.no.	Formulation	Spindle no.	RPM	Viscosity	Torque
1	F1	7	30	52000	13%
		6	30	31400	15.7%
2	F2	7	30	23700	7.1%

Sr.no.	Formulation	Spindle no.	RPM	Viscosity	Torque
		6	30	31600	7.9%
3	F3	7	30	14500	10.9%
		6	30	7200	7.2%

For sunflower lecithin cream: All the three formulations were evaluated for viscosity, from which the F3 formulation shows at spindle no. 7 shows 14500 cp viscosity and 10.9 % torque which shows better viscosity compared to others.



Graphical representation of viscosity of sunflower lecithin containing cream

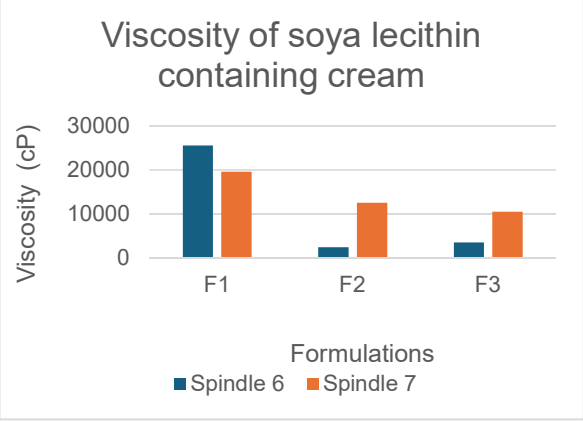
Soya lecithin cream

Table no. 8 –Viscosity test of soya lecithin containing cream

Sr. no.	Formulation	Spindle no.	RPM	Viscosity	Torque
1	F1	7	30	19600	14.7%
		6	30	25500	19.1%
2	F2	7	30	12500	9.4%
		6	30	2400	7.2%
3	F3	7	30	10500	9.2%
		6	30	3470	10.4%

All the three formulations were evaluated for viscosity, from which the F2 formulation shows at spindle no. 7 shows 12500 cp viscosity and 9.4 % torque which shows better viscosity compared to others.

F3 formulation of sunflower lecithin cream and F2 formulation of soya lecithin cream shows better viscosity



Graphical representation of viscosity of sunflower lecithin containing cream

2.4 Washability Test

Sunflower lecithin cream

Sr. no.	Formulation	Washability
1	F1	Cream not easily washed off with water
2	F2	Cream not easily washed off with water
3	F3	Cream easily washed off with water

Table no. 9 –Washability test of sunflower lecithin containing cream

Formulations F1 and F2 were not easily washed off with water, indicating poor washability. In contrast, F3 was easily washed off with water, showing better washability. Hence, F3 is the best formulation in terms of washability.

Soya lecithin cream

Table no. 10 –Washability test of soya lecithin containing cream

Sr. no.	Formulation	Washability
1	F1	Cream not easily washed off with water
2	F2	Cream easily washed off with water
3	F3	Cream not easily washed off with water

For Soya Lecithin Cream: Similarly, F1 and F3 were not easily washed off with water, whereas F2 was easily washable. Therefore, F2 is considered the best formulation among soya lecithin creams.

In sunflower lecithin cream formulation F3 and in soya lecithin cream F2 shows superior washability and making it more convenient and user-friendly for topical application.

3.2 Greasiness

Sunflower lecithin cream

Table no.11 – Greasiness test of sunflower lecithin containing cream

Sr. no.	Formulation	Observation
1	F1	Greasy
2	F2	Slightly Greasy
3	F3	Non- Greasy

For Sunflower Lecithin Cream: Formulation F1 was observed to be greasy, while F2 was slightly greasy. In contrast, F3 was found to be non-greasy, indicating better acceptability for topical use. Hence, F3 is the best formulation in terms of greasiness.

Soya Lecithin Cream

Table no. 12 – Greasiness test of soya lecithin containing cream

Sr. no.	Formulation	Observation
1	F1	Greasy
2	F2	Non-Greasy

Sr. no.	Formulation	Observation
3	F3	Greasy

For Soya Lecithin Cream: Similarly, F1 showed greasy nature and F3 was greasy, whereas F2 was non greasy. Therefore, F2 is considered the best formulation among soya lecithin creams.

In sunflower lecithin cream Formulation F3 and in soya lecithin cream formulation F2 exhibits non-greasy characteristics, making it more suitable and comfortable for skin application.

3.3 Irritancy

Sunflower lecithin cream

Table no. 13– Irritancy test of sunflower lecithin containing cream

Sr. no.	Formulation	Irritancy	Edema (Swelling)	Irythema (Redness)
1	F1	No Irritation	No Irritation	No Irritation
2	F2	No Irritation	No Irritation	No Irritation
3	F3	No Irritation	No Irritation	No Irritation

For Sunflower Lecithin Cream: All formulations (F1, F2, and F3) showed no irritation, with no signs of edema (swelling) or erythema (redness). This indicates that all formulations are safe and non-irritant to the skin.

Soya lecithin cream

Table no.14 – Irritancy test of Soya lecithin containing cream

Sr. no.	Formulation	Irritancy	Edema(Swelling)	Irythema(Redness)
1	F1	No Irritation	No Irritation	No Irritation
2	F2	No Irritation	No Irritation	No Irritation
3	F3	No Irritation	No Irritation	No Irritation

For Soya Lecithin Cream: Similarly, all formulations (F1, F2, and F3) exhibited no irritation, with absence of edema and erythema. This confirms good skin compatibility.

All formulations of both sunflower and soya lecithin creams are non-irritant and safe for topical application, showing excellent skin tolerance.

4. Emulsion tests

4.1 Dilution Test

Sunflower lecithin cream

Table no. 15 –Dilution test of sunflower lecithin containing cream

Formulation	Solubility organic phase
F1	Partially soluble
F2	Soluble
F3	Completely soluble

For sunflower lecithin cream, formulation F1 was not easily diluted with water, indicating poor dilution properties. Formulation F2 showed moderate dilution characteristics. In contrast, F3 was easily diluted with water, indicating better dilution ability and uniform dispersion. Hence, F3 was considered the best formulation in terms of dilution test.

Soya lecithin cream

Table no. 16 –Dilution test of soya lecithin containing cream

Formulation	Solubility organic phase
F1	Partially soluble
F2	Soluble
F3	Partially soluble

F1 and F3 were not easily diluted with water, whereas F2 was easily diluted with water, indicating better dilution properties and uniform dispersion. Therefore, F2 was considered the best formulation among soya lecithin creams in terms of dilution test.

By performing the dilution test from optimized formulation it shows that the Cream was soluble in organic phase (n hexene), the Cream was W/O type of Cream.

On comparison, sunflower lecithin cream exhibited better solubility in the organic phase and higher stability than soya lecithin cream, confirming it as the superior and optimized formulation.

4.2 Dye solubility

Sunflower lecithin cream

Table no. 17 – Dye solubility test of Sunflower lecithin containing cream

Formulation	Dye distribution	Emulsion type
F1	Patchy	O/W
F2	Slightly patchy	O/W
F3	Uniform	W/O

For sunflower lecithin cream, all the formulations exhibited Oil in Water (O/W) emulsion characteristics. However, formulation F3 showed better stability, uniformity, and miscibility with water compared to F1 and F2. Therefore, F3 was considered the best formulation in terms of emulsion type and stability.

Soya lecithin cream

Table no. 18 – Dye solubility test of soya lecithin containing cream

Formulation	Dye distribution	Emulsion type
F1	Patchy	O/W
F2	Slightly patchy	W/O

Formulation	Dye distribution	Emulsion type
F3	Slightly Uniform	O/W

All the formulations showed uniform distribution of dye, indicating the formation of Oil in Water (O/W) emulsion. However, F2 exhibited better uniformity and stability compared to F1 and F3. Therefore, F2 was considered the best formulation among soya lecithin creams in terms of dye solubility and emulsion type test.

By performing dye test from optimized formulation, the continuous phase remains colorless it was shows that the W/O type of Cream. On comparison, sunflower lecithin cream exhibited better dye distribution and higher stability than soya lecithin cream, confirming it as the superior and optimized formulation.

5. Stability

5.1 Centrifugation

Sunflower lecithin cream

Table no. 19 - Stability test of sunflower lecithin containing cream

Formulation	Phase separation	Creaming	Cracking	Stability result
F1	Yes	Slight	Yes	Less stable
F2	Slight	Slight	Slight	Moderately stable
F3	No	No	No	Most stable

For sunflower lecithin cream, formulations F1 and F2 showed slight instability after centrifugation, indicating lower stability. In contrast, F3 did not show any phase separation and remained stable throughout the test. Hence, F3 was considered the best formulation in terms of centrifugation stability.

Soya lecithin cream

Table no. 20 – Stability test of sunflower lecithin containing cream

Formulation	Phase separation	Creaming	Cracking	Stability result
F1	Yes	Slight	Yes	Less stable
F2	No	No	Slight	stable
F3	Slight	Slight	Slight	Moderately stable

All the formulations showed uniform distribution of dye, indicating the formation of Oil in Water (O/W) emulsion. However, F2 exhibited better uniformity and stability compared to F1 and F3. Therefore, F2 was considered the best formulation among soya lecithin creams in terms of dye solubility and emulsion type test.

By performing stability test from optimized formulation, it was observed that cream remains stable throughout the study period. There were no significant changes in color, odor and consistency it indicating good physical stability. On comparison, sunflower lecithin cream exhibited better uniformity and stability than soya lecithin cream, confirming it as the optimized and superior formulation.

6. Thin layer chromatography (TLC)

Sunflower lecithin cream

Table no. 21 –TLC of sunflower lecithin containing cream

Sr. no.	Solvent/ Component	Distance travelled on TLC plate(cm)	RF value
1	Solvent	4.2	-
2	Test	3.2	0.76
3	Standard	2.9	0.69

For Sunflower Lecithin Cream: The solvent front travelled 4.2 cm. The test sample travelled 3.2 cm with an Rf value of 0.76, while the standard travelled 2.9 cm with an Rf value of 0.69. The Rf values of test and standard are close to each other, indicating similarity in composition and confirming the presence of the desired component in the formulation**.**

Soya lecithin cream

Table no. 22 –TLC of soya lecithin containing cream

Sr. no.	Solvent/ Component	Distance travelled on TLC plate (cm)	RF value
1	Solvent	3.5	-
2	Test	3.1	0.88
3	Standard	2.4	0.68

For Soya Lecithin Cream: The solvent front travelled 3.5 cm. The test sample travelled 3.1 cm with an Rf value of 0.88, while the standard travelled 2.4 cm with an Rf value of 0.68. The Rf values of test and standard are close to each other, indicating similarity in composition and confirming the presence of the desired component in the formulation**.**

Both the sunflower lecithin and soya lecithin containing cream indicate s the presence of active ingredient in the formulation.

7. Biological evaluation

7.1 Scratch Test

Sunflower lecithin cream

Table no.23 – Scratch test

Sample	Reading 0 hours (mm)	Mean	Reading 48 hours (mm)	Mean	Percentage of cell Migration
Control	10.00 09.98 10.05	10.01	9.79 9.80 9.70	9.76	-
Standard Cipladine 5 (ug/ml)	10.00 09.98 10.05	10.01	1.22 1.20 1.24	1.22	87.53

Sample	Reading 0 hours (mm)	Mean	Reading 48 hours (mm)	Mean	Percentage of cell Migration
Sample AP	10.00 09.98 10.05	10.01	3.40 3.60 3.20	3.40	65.16

The results of the scratch assay indicate that the standard (Cipladine-5) showed a high percentage of cell migration (87.53%), confirming its strong wound healing efficacy. The Sample-AP demonstrated a notable cell migration of 65.16%, indicating good wound healing potential. Although its activity is lower than the standard, it shows significantly higher migration compared to control, suggesting effective promotion of cell proliferation and migration. The control group exhibited negligible wound closure, validating the assay conditions. Overall, Sample-AP possesses considerable wound healing activity.

7.2 Anti-inflammatory Test

Sunflower lecithin cream

Table no. 24 – Anti-inflammatory test

Sr.no.	Sample	Conc.	O.D.			Mean	Percent inhibition
1	Control		0.82	0.89	0.87	0.86	
2	Standard Diclofenac sodium	200	0.25	0.24	0.21	0.23	72.87
		400	0.19	0.18	0.19	0.19	78.29
		600	0.15	0.17	0.16	0.16	81.40
		800	0.13	0.14	0.12	0.13	84.88
		1000	0.11	0.18	0.09	0.13	85.27
3	Sample-AP		0.67	0.65	0.67	0.66	22.87
		400	0.59	0.58	0.57	0.58	32.56
		600	0.52	0.52	0.51	0.52	39.92
		800	0.45	0.48	0.44	0.46	46.90
		1000	0.35	0.32	0.31	0.33	62.02

The results indicate that Sample-AP possesses moderate in vitro anti-inflammatory activity, with a clear dose dependent response. While its activity is comparatively lower than the standard Diclofenac sodium, the significant inhibition observed at higher concentrations suggests its potential as a natural anti-inflammatory agent.

Summary and Conclusion

Based on the Organoleptic and physicochemical evaluation data, the formulated cream shows excellent characteristics. The evaluated formulation is a stable, water-in-oil type semi-solid c**ream** with properties suitable for topical application

Conclusion

The present study successfully formulated and evaluated a herbal cream using natural ingredients, with a comparative assessment of soy lecithin and sunflower lecithin as emulsifiers. Among the developed formulations, the sunflower lecithin-based cream (F3) exhibited superior physicochemical properties, including appropriate pH, good spreadability, suitable viscosity, smooth texture, and excellent stability without phase separation. The formulation was non-greasy, easily washable, and showed no signs of irritation, indicating good safety and patient acceptability. TLC analysis confirmed the presence of active phytoconstituents in the formulation. Biological evaluation further supported its effectiveness, where the formulation demonstrated considerable wound healing activity in the scratch assay, showing significant cell migration compared to control, although slightly lower than the standard. Additionally, it exhibited moderate, dose-dependent anti-inflammatory activity in the protein denaturation method. Overall, the study concludes that the sunflower lecithin-based herbal cream is stable, safe, and effective for topical application, with promising wound healing and anti-inflammatory potential, and can be considered a suitable natural alternative for topical therapy.

Optimized Formulation Summary

Parameter	Sunflower lecithin optimized batch	Soya lecithin optimized batch
Best formulation	F3	F2
Appearance and texture	Semi-solid, whitish yellow, smooth	Semi-solid, white, smooth
pH	6.7	7.0
Spreadability	22.8 g·cm/sec	20.45 g·cm/sec
Viscosity	14,500 cP (spindle 7, 30 rpm)	12,500 cP (spindle 7, 30 rpm)
Washability and greasiness	Easily washable; non-greasy	Easily washable; non-greasy
Irritancy	No irritation, edema or erythema	No irritation, edema or erythema
Emulsion/stability	W/O type; most stable after centrifugation	W/O type; stable
TLC	Test Rf 0.76; standard Rf 0.69	Test Rf 0.88; standard Rf 0.68

Parameter	Sunflower lecithin optimized batch	Soya lecithin optimized batch
Biological activity	Scratch assay: 65.16% cell migration; anti-inflammatory inhibition up to 62.02%	Biological test not performed/reported

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