ORIGINAL ARTICLE

Development and Characterisation of Polyherbal Phyto-Somal Gel for Wound-Healing Activity

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Abstract

Background: The global demand for herbal-based cosmetic products has increased because they have a lower risk of side effects compared to synthetic items. Natural remedies are increasingly valued for their effectiveness in healing wounds. **Objectives:** This study aims to develop and characterize a polyherbal phytosomal gel that includes Singapore daisy (*Sphagneticola trilobata*) leaf extract and *Hibiscus rosa-sinensis* flower extract. The goal is to explore their combined potential for wound healing, reducing inflammation, and fighting bacteria. **Methods:** Three formulations (F1, F2, F3) were created with different concentrations of the two herbal extracts. These gels underwent tests to evaluate their physical and biological properties, such as appearance, pH, viscosity, solubility, skin irritation, acid content, saponification value, consistency, ease of removal, and phase separation. **Results:** All formulations showed good physical stability. Among them, Formulation F3 displayed the best features, with no signs of redness, swelling, or irritation when applied to the skin. The phytosomal system improved the stability and effectiveness of the extracts. **Conclusion:** The polyherbal gel, especially Formulation F3, is a strong candidate for safe and effective wound healing. This study supports the use of herbal extracts in modern cosmetic products and opens the door for further clinical research.

Key words: *Hibiscus*, polyherbal phytosomal gel, Singapore daisy, and herbal formulation

INTRODUCTION

Herbal medicines and wound management

Herbal medicines, derived from different parts of plants such as leaves, flowers, and roots, since ancient times for treating ailments and promoting health. Despite advancements in synthetic pharmacology, traditional plant-based remedies continue to play a pivotal role, particularly in developing countries, where approximately 80% of the population depends on herbal therapies (World Health Organization [WHO]). The widespread use is attributed to affordability, accessibility, cultural acceptance, and a generally favorable safety profile.[1,2]

Herbal plants are rich in bioactive compounds that have therapeutic effects against chronic conditions such as infections, inflammation, cardiovascular disorders, and immune dysfunctions. The WHO has established a comprehensive guideline to ensure the safety, efficacy, and quality.[2]

In wound healing, herbal agents facilitate tissue regeneration by mitigating inflammation, combating microbial infections, and reducing oxidative stress. Key therapeutic activities include:

- Anti-inflammatory: Alleviates pain and swelling
- Antimicrobial: Inhibits bacterial and fungal growth
- Antioxidant: Protects tissues from oxidative damage.[3]

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Structure and functions of skin

The largest organ of the body is skin, which spans approximately 1.5–2 m^2 in adults and constitutes about 7% of total body weight (4.5–5 kg). It serves as a protective barrier, regulating hydration, body temperature, and sensory function. It comprises two primary layers:

1. Epidermis- The outer protective layer
2. Dermis- The supportive layer beneath the epidermis
3. The subcutaneous (hypodermis) layer provides the insulation and cushioning but is not considered part of the skin.[4]

Wounds and their classification

It is a disruption of the integrity of skin, mucosal surfaces, or internal tissues due to trauma (mechanical, thermal, or chemical) or pathological conditions such as diabetes or vascular disease. Wound types vary in cause, depth, and infection status, and appropriate treatment requires careful classification and evaluation.[4]

Wound classification

- Acute wounds: Arise from trauma and follow a predictable healing trajectory through the classical phases of hemostasis, inflammation, proliferation, and remodeling
- Open wounds: Include incisions, lacerations, and punctures
- Closed wounds: Include contusions, blisters, and sprains
- Chronic wounds: Fail to heal within a typical timeframe (often >3 months), frequently due to underlying health conditions or prolonged inflammation.[4,5]

Mechanism of wound healing

It is a biological process involving four overlapping phases:

1. Hemostasis: Initiated immediately post-injury; involves vasoconstriction, platelet aggregation, and fibrin clot formation to arrest bleeding
2. Inflammation: Characterized by immune cell infiltration, edema, and removal of pathogens and cellular debris. While essential, excessive inflammation may impair healing
3. Proliferation: Involves fibroblast activation, collagen deposition, angiogenesis, and re-epithelialization to restore tissue architecture
4. Maturation (remodeling): Type III collagen is replaced by type I, increasing tissue tensile strength and resulting in scar formation. This phase may extend over several months.[6]

Gels in pharmaceutical applications

Gels semisolid liquid phase is dispersed within a solid-like, cross-linked three-dimensional network. Although gels are mostly liquid by mass, their structure provides rigidity and adhesiveness. The gelation process forms this network, enabling controlled drug release and enhanced stability. The term "gel" was first introduced by Thomas Graham in the 19th century, inspired by gelatinous substances.

Phytosomes: A novel delivery system

Phytosomes are lipid-based vesicular nanocarriers formed by complexing plant-derived bioactives with phospholipids, particularly phosphatidylcholine. This system enhances the solubility, permeability, and bioavailability of both hydrophilic and lipophilic constituents. Phytosomes exhibit favorable pharmacokinetic and pharmacodynamic profiles, are biocompatible, and minimize immunogenic responses. Typically, they are synthesized in aprotic solvents by coupling the hydrophilic portion (choline) with water-soluble components and the lipophilic moiety (phosphatidyl) with fat-soluble compounds.[7]

Phytosomal gels: Integration in dermatological applications

Phytosomal gels integrate phytosome complexes into a gel base comprising water, glycerin, and gelling agents (e.g., carbomer or xanthan gum). This formulation enhances the delivery of active phytoconstituents through the skin, improving therapeutic outcomes in dermatological applications.[7,8]

Advantages

- Enhanced drug bioavailability and chemical stability
- Facilitated targeted and sustained drug delivery
- Minimized systemic side effect.[9]

MATERIALS AND METHODS

Plants we selected for study and procedure were dried, coarsely powdered, and extracted with liquid-based alcoholic solution and used for formulation.

Collection of plant material

Crude plant material was obtained from careful collection of plants leaves of *Wedelia trilobata* and flower of *Hibiscus rosa-sinensis* from the Botanical garden present in the Vishwakarma University Campus.

The crude material was washed and dried before grinding it to obtain the powdered crude drug. The obtained crude powdered material was subjected to an extraction process using by Soxhlet apparatus.

Procedure for extraction

Procedure for extracting W. trilobata leaves

The finely powdered material undergoes the extraction method by using (100 mL ethanol) for a duration of 2 successive h the temperature should not exceed more than 70°C. The dark green colour extract was collected, and the filter was used for further study. The product was stored in the desiccator to preserve it as it was utilized in an additional experimental trial.[10-13]

Procedure for extracting H. rosa sinesis flowers

The finely powdered material undergoes the extraction method by using (100 mL ethanol) for a duration of 2 successive hours, the temperature should not exceed more than 70°C. The pink colour extract was collected, and the filter was used for further study. The product was stored in the desiccator to preserve it as it was utilized in an additional experimental trial.[13]

Methods of extraction

Soxhlet extraction

1. A dried powder of 10 g of the *W. trilobata* leaves powder was weighed,
2. The weighed sample was placed in the Soxhlet extraction.
3. The birth was carried out using ethanol as a birth detergent. In the Soxhlet outfit, the detergent in the round-bottom flask was heated from the heating mantle to come faded and condensed down through the sample, where it was suitable to prize the chemical constitution.
4. The same procedure of the Soxhlet line was followed for the crude remedy *Hibiscus*.[14]

Procedure for formulation

Preparation of phytosomes

i. Weigh 1 g of soya lecithin powder (containing 30% L-a-phosphatidyl choline)
ii. Then take 30 mL of Methanol in round-bottom flask
iii. Add 1 g of soya lecithin powder to it and stir it
iv. Add 0.8 mL of Singapore daisy extract and 0.4 mL of *Hibiscus* extract to the mixture and stir it
v. By using the hand shaking method, place the round bottom flask on the heating mantle at an angle of 45° and continuously rotate it in the same direction at a constant speed and temperature for 6 h.
vi. When the methanol is evaporated, a thin layer of phytosome is formed on the inner surface of the round-bottom flask.
vii. Add 100 mL of distilled water to it and sonicate it for 15 min.
viii. This mixture is used for further preparation of the formulation.

Preparation of gel

i. Weigh 1 g of Carbomer 934 (Gelling agent)
ii. Take a 150 mL beaker and add 100 mL of distilled water to it, and also add 1 g of carbomer 934
iii. Stir it properly and store it overnight to ensure complete hydration and dispersion of carbomer 934 in distilled water
iv. Add 1 mL of tri-ethanolamine and mix it to form a gel
v. Preparation of gel was done.

Preparation of formulation

i. Slowly add the phytosomal mixture to the gel and stir it continuously
ii. Phytosomal gel is prepared
iii. Add 1 drop of rose oil to enhance the fragrance of the formulation
iv. The final product was prepared.

Evaluation of phytosomes

Entrapment efficiency

0.1 mL of phytosomes were added to phosphate buffer at pH 7.4 and centrifuged at 2000 rpm for 30 min to separate the outlined medicine from the unencapsulated drug using a Medico centrifuge. This process created a pellet and a supernatant. The untrapped drug was collected by removing the supernatant. The precipitate was then ground with methanol and analyzed at 517 nm using a ultraviolet -visible spectrophotometer. The rate of medicine retention was calculated using the formula.[15]

$$EE\% = \text{Amount of active drug/total amount of active drug} \times 100$$

Evaluation of gel

Physical evaluation

Physical evaluation, like colour, odour, transparency, uniformity and consistency.

1. pH of the gel[16]
   This was calibrated using a standard buffer solution and the pH. About 1 g of the gel was weighed and dissolved in 20 mL of distilled water.
2. Spreadability[16]
   The spreadability of the product was evaluated by applying a small amount of gel to the hand and gently spreading it. Observation was made regarding the ease of application. The test aimed to assess the product's ability to evenly spread and provide a smooth, comfortable application experience for users.
3. Irritancy test[17]
   A small amount of gel was applied to 12 cm of the dorsal surface of the left hand, and the time was recorded.

Irritation and redness were noted at regular intervals up to 24 h and reported.

4. Smear type[17]
   When the herbal gel was applied to the skin for the test, either an oily was watery smear was created.
5. Removal[17]
   A small amount of gel was applied to the hand, and it is then washed with running water.
6. Drug content[17]
   1 g of gel was dissolved in 100 mL of phosphate buffer at pH 7.4. The resulting solution was filtered, and the pharmaceutical content was analyzed using a spectrophotometer.
7. Stability study[17,18]
   The stability study of the phytosomal gel was conducted in a moisture chamber and at room temperature. Samples were analyzed for physical appearance and gel content over 1 month.
8. Diffusion study[3,17]
   An *in vitro* diffusion study of the phytosomal gel (F1-F3) was performed using a modified Franz diffusion cell with a dialysis membrane in phosphate buffer at pH 6.8 for 8 h.

RESULTS

Chemical tests for *Sphagneticola trilobata*

By testing the product, all the chemical constituents were present in the given drug. Mentioned in Tables 1 and 3.

Chemical tests for *Hibiscus*

By testing the *Hibiscus*, all the chemical constituents were present in the given drug. Mentioned in Tables 2 and 3.

Evaluation parameter of different formulation

Different evaluation parameters were done for formulation, like pH, colour, transparency, texture, spreadability, and smear test performed, and result was shown in a Table 4.

Final formulation of phytosomal gel

The gel was prepared by using the prepared phytosome and the quantity was mentioned in Table 5 and shown in Figure 1.

Evaluation of phytosomes

Entrapment efficiency

EE% = Amount of Entrapped Active Constituent/
Total amount of active constituent × 100

Absorbance at wavelength 517 nm was 0.609.

Total amount of active constituent (*W. trilobata*) = 0.8 mL.

Therefore,

EE% = 0.609/0.8 × 100

EE% = 76.125 %

The entrapment efficiency was found to be 76.125%.

Evaluation of phytosomal gel

Physical evaluation

Physical parameters such as color, appearance, odour, transparency, uniformity, and consistency.

pH of the gel

The pH value was found to be 6.92 as mention in Figure 2.

Spreadability

The gel was easily applicable and was evenly spread, and provided a smooth and comfortable application experience for the user shown in Figure 4.

Irritancy test

Treatment	Day 1	Day 2	Day 3
Formulation	A	A	A

A: No reaction, B: Slight reaction, C: Moderate reaction, D: Severe reaction shown in Figure 5.

Smear type

When the herbal gel was applied to the skin for the test, a watery smear with non-greasiness was created.

Removal

The gel that had been applied to the skin was removed by washing under running water and exerting as little effort as possible.

Drug content

Drug content was found to be 92.34% at 517.

Stability study

The stability study of the phytosomal gel was conducted, and there was no change in the physical appearance and gel content as it was stored in air-tight container for 1 month.

Table 1: Chemical tests for Sphagneticola Trilobata

Test	Procedure	Observations	Inference
Detection of Alkaloids			
1. Dragendroff's test	Few ml filtrate+1-2 ml Dragendroff's reagent	A reddish-brown precipitate	Alkaloids present
2. Hager's test	Few ml filtrate+1-2 ml Hager's reagent	A creamy white precipitate	Alkaloids present
3. Mayer's test	Few ml filtrate+1-2 drops Mayer's reagent	A creamy white precipitate	Alkaloids present
4. Wagner's test	Few ml filtrate+1-2 drops Wagner's reagent	A brown precipitate	Alkaloids present
Detection of Flavonoids			
1. Lead acetate test	1 ml plant extract+few drops of 10% lead acetate solution	A yellow fluorescence	Flavonoids present
2. Ferric chloride test	Extract aq. Solution+Few drops 10% ferric chloride solution	A green precipitate	Flavonoids present
3. Ammonia test	Filtrate+5ml dil. Ammonia solution+H_2SO_4	A yellow color	Flavonoids present
4. Conc. H_2SO_4	Plant extract+Conc. H_2SO_4	An orange color	Flavonoids present
Detection of Tannins			
1. Gelatin test	Plant extract is dissolved in 5 ml distilled water+1% gelatin solution+10% NaCl	A white precipitate	Tannins present
2. Braymer's test	1 ml filtrate+3 ml distilled water+3 drops of 10% ferric chloride solution	Blue-green color	Tannins present
3. 10% NaOH test	0.4 ml plant extract+4 ml 10% NaOH+shaken well	Formation of emulsion	Tannins present
4. Bromine water test	10 ml of bromine water+0.5 gm plant extract	Decoloration of bromine	Tannins present
Detection of Saponins			
1. Foam test	0.5 gm plant extract+2 ml water (vigorously shaken)	Persistent foam for 10 min	
Detection of Phenolic compounds			
1. Iodine test	1 ml extract+few drops of dil. Iodine solution	A transient red color	Phenols present
2. Ferric chloride test	Extract aq. Solution+few drops 5% ferric chloride solution	Dark green color	Phenols present
Detection of Terpenoids			
1.	2ml chloroform+5 ml plant extract, (evaporated on water bath) + 3 ml conc. H_2SO_4 (boiled on water bath)	A grey colored solution	Terpenoids present
Detection of Triterpenoids			
1. Salkowski's test	Filtrate+few drops of conc. H_2SO_4	Golden yellow layer	Triterpenoids
Detection of Diterpenes			
1. Copper acetate test	Plant extract is dissolved in distilled water+3-4 drops of copper acetate solution	Emerald green color	Diterpenes present

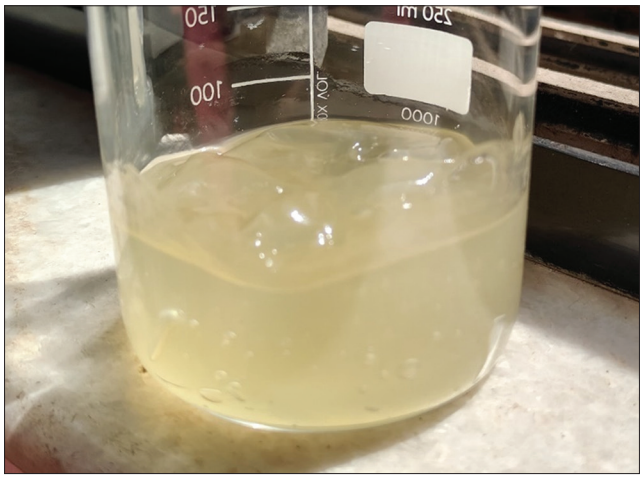

Figure 1: Formulation of phytosomal gel

Figure 2: pH of gel

Table 2: Chemical tests for *Hibiscus rosa sinesis*

Test	Procedure	Observations	Inference
Detection of Alkaloids			
1. Dragendroff's test	Few ml filtrate+1-2 ml Dragendroff's reagent	A reddish-brown precipitate	Alkaloids present
2. Hager's test	Few ml filtrate+1-2 ml Hager's reagent	A creamy white precipitate	Alkaloids present
3. Mayer's test	Few ml filtrate+1-2 drops Mayer's reagent	A creamy white precipitate	Alkaloids present
4. Wagner's test	Few ml filtrate+1-2 drops Wagner's reagent	A brown precipitate	Alkaloids present
Detection of Flavonoids			
1. Lead acetate test	1 ml plant extract+few drops of 10% lead acetate solution	A yellow fluorescence	Flavonoids present
2. Ferric chloride test	Extract aq. Solution+Few drops 10% ferric chloride solution	A green precipitate	Flavonoids present
3. Ammonia test	Filtrate+5ml dil. Ammonia solution+H_2SO_4	A yellow color	Flavonoids present
4. Conc. H_2SO_4	Plant extract+Conc. H_2SO_4	An orange color	Flavonoids present
Detection of Tannins			
1. Gelatin test	Plant extract is dissolved in 5 ml distilled water+1% gelatin solution+10% NaCl	A white precipitate	Tannins present
2. Braymer's test	1 ml filtrate+3 ml distilled water+3 drops of 10% ferric chloride solution	Blue-green color	Tannins present
3. 10% NaOH test	0.4 ml plant extract+4 ml 10% NaOH+shaken well	Formation of emulsion	Tannins present
4. Bromine water test	10 ml of bromine water+0.5 gm plant extract	Decoloration of bromine	Tannins present
Detection of Saponins			
1. Foam test	0.5 gm plant extract+2 ml water (vigorously shaken)	Persistent foam for 10 min	
Detection of Phenolic compounds			
1. Iodine test	1 ml extract+few drops of dil. Iodine solution	A transient red color	Phenols present
2. Ferric chloride test	Extract aq. Solution+few drops 5% ferric chloride solution	Dark green color	Phenols present
Detection of Cardiac glycosides			
1. Keller-Killani test	1 ml filtrate+1.5 ml glacial acetic acid+1 drop of 5% ferric chloride+conc. H_2SO_4	A blue colored solution (in acetic acid layer)	Cardiac glycosides present
Detection of Terpenoids			
1.	2ml chloroform+5 ml plant extract, (evaporated on water bath) + 3 ml conc. H_2SO_4 (boiled on water bath)	A grey colored solution	Terpinoides present
Detection of Triterpenoids			
1. Salkowski's test	Filtrate+few drops of conc. H_2SO_4	Golden yellow layer	Triterpinoides present
Detection of Anthraquinones			
1. Borntrager's test	10 ml 10% ammonia solution+few ml filtrate (shaken vigorously for 30 sec)	A red colored solution	Anthraquinones present
Detection of Anthocyanins			
1. HCl test	2 ml plant extract+2 ml 2N HCl (+ Few ml ammonia)	Pink-reed solution which turns blue-violet after addition of ammonia	Anthocyanins present

Diffusion study

In vitro drug release study of poly-herbal phyto-somal gel

Diffusion study *In vitro* drug release study of poly-herbal phytosomal gel. An in vitro diffusion study of the phyto-somal gel (F1-F3) was performed using a modified Franz diffusion cell with a dialysis membrane in phosphate buffer pH 6.8 for 8 h. The data obtained from diffusion studies are summarized in Tables 7-9 and Figures 5-8 and regression value shown in Table 10.

Table 3: Chemical evaluation of the herb used in the formulation of phyto-constituents

Name of analysis	*Wedelia trilobata* (yellow creeping Daisy)	*Hibiscus rosa sinensus* (*Hibiscus*)
Alkaloids	+	+
Flavanoids	+	+
Tannins	+	+
Saponin	+	+
Phenol	+	+
Terpenoids	+	+
Triterpenoids	+	+
Diterpenes	+	-
Cardiac glycosides	–	+
Anthocynin	–	+
Anthroquinones	–	+

DISCUSSION

The primary motivation for this research is the increasing acceptance of natural remedies, which are known to produce fewer side effects compared to synthetic formulations, and incorporating active constituents in a phytosomal drug delivery system, which enhances its bioavailability, stability, efficacy, and penetration power of the formulation.

The study's main objectives were to create a gel that promotes wound healing, prevents inflammation, provides antimicrobial properties, and offers antioxidant benefits. To achieve these goals, crude drugs were sourced from the Vishwakarma University Botanical Garden. The plant extracts were prepared using a Soxhlet apparatus, and various chemical tests were conducted to identify the phytoconstituents present in the extracts. These phytoconstituents were then used to formulate polyherbal phytosomes, which were incorporated into a gel base.

Two key plants were used in this formulation: Singapore daisy (*W. trilobata*) and *Hibiscus (H. rosa-sinensis)*. Singapore daisy is known for its wound healing, anti-inflammatory, and antibacterial properties, while *Hibiscus* is valued for its

Table 4: Evaluation parameter of different formulation

Sr. No.	Ingredients	F1	F2	F3
1	Colour	Pale color	Pale color	Pale color
2	Transparency	Opaque	Opaque	Opaque
3	Texture	Inconsistent	Inconsistent	Smooth
4	pH	7.90	6.10	6.92
5	Spreadability	Unevenly Spread	Unevenly Spread	Easy application & evenly spread
6	Irritancy test	Slight Irritation	No irritation	No Irritation
7	Smear type	Non-greasy	Greasy	Non-Greasy
8	Stability	Unstable	Unstable	Stable product
9	Removal	Easily removable by water	Easily removeable by water	Easily removable by water
10	Diffusion Study	89.710%	89.749%	92.118%

Table 5: Formulation of Phytosomal gel

Sr. No.	Ingredients	Formula (100g)	Use
1	Soya Lecithin (L-a-phosphatidyl choline 30%)	1 gm	Phospholipid, Penetration enhancer,
2	Sphagneticola trilobata extract	0.8 ml	Active Ingredient
3	Hibiscus rosa sinesis extract	0.4 ml	Anti-bacterial, Anti-oxidant agent
4	Carbomer 934	1 gm	Gelling agent
5	Tri-ethanolamine	1 ml	Stabilizers
6	Rose oil	Qs	Fragrances
7	Distilled water	Qs	Vehicle

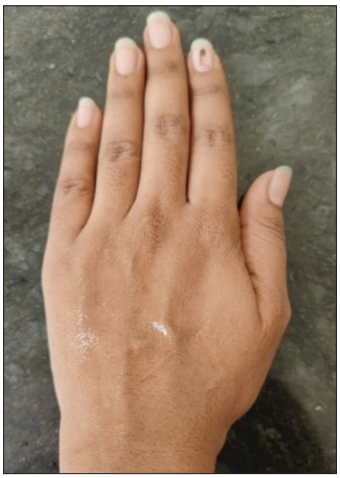

Figure 3: Application of gel

Figure 4: Irritancy test

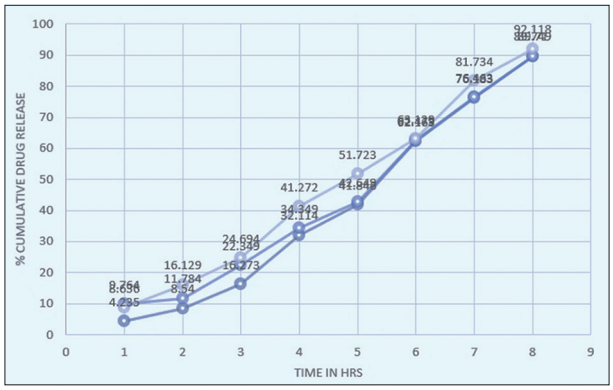

Figure 5: Cumulative percent drug released v/s time (zero order plots) (F1-F3)

Table 6: Physical evaluation of gel

S. No.	Physical evaluation tests	Result
1	Color	Pale color
2	Odour	Pleasant
3	Texture	Smooth
4	Consistency	Good
5	Transparency	Opaque

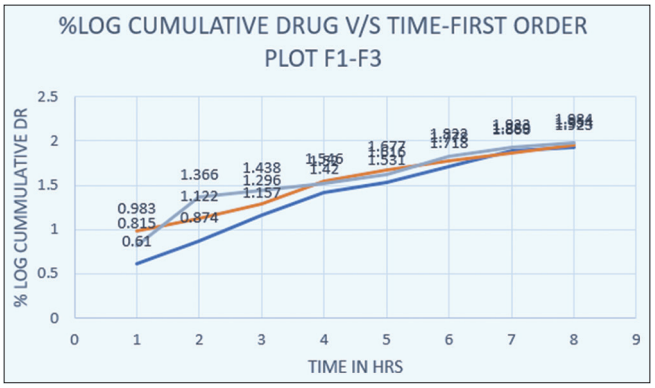

Figure 6: Log cumulative percent drug remaining v/s time (first order plots) (F1-F3)

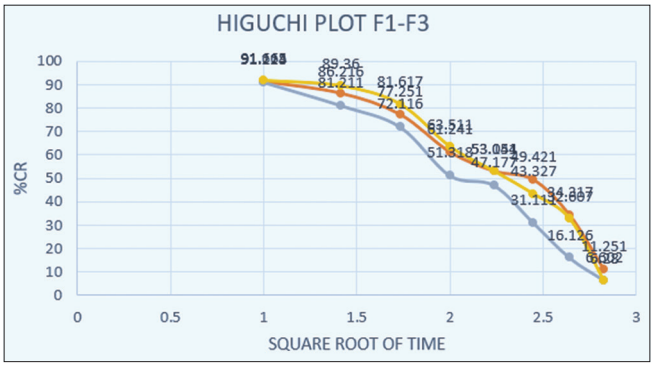

Figure 7: Cumulative percent drug released v/s square root of time (higuchi equation) (F1-F3)

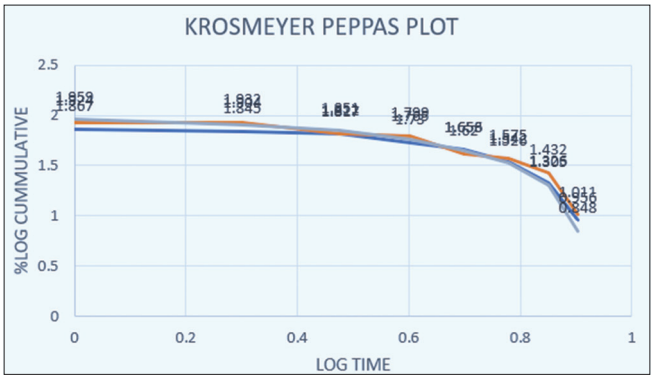

Figure 8: Cumulative drug release v/s log time (Peppa's plots) (F1-F3)

antibacterial and antioxidant properties. The study involved preparing different batches of formulations, labeled F1, F2, and F3, each with varying concentrations of the extracts. These formulations were subjected to a series of evaluations to assess their physical properties and wound healing efficacy.

The evaluations included tests for appearance, pH, irritation, and stability. Among the formulations, F3 was found to be particularly effective, showing no signs of redness, inflammation, swelling, or irritation during the irritation tests. This indicates that the F3 formulation is safe for use on small wounds. The gel demonstrated good stability. Moreover, it exhibited significant anti-inflammatory and antibacterial activities.

Table 7: *In vitro* drug release data for F1

S. No.	Time (Hrs)	Square Root of Time	Log Time	Cumulative Percentage Drug Release	Log Cumulative Percentage Drug Release	Cumulative Percent Drug Remaining	Log cumulative Percent Drug Remaining
1	1	1	0	4.235	0.610	91.665	1.867
2	2	1.414	0.301	8.540	0.874	89.360	1.845
3	3	1.732	0.477	16.273	1.157	81.617	1.817
4	4	2	0.602	32.114	1.420	63.511	1.730
5	5	2.236	0.698	41.846	1.531	53.044	1.656
6	6	2.449	0.778	62.163	1.718	43.327	1.542
7	7	2.645	0.85	76.183	1.889	32.607	1.326
8	8	2.828	0.903	89.710	1.923	6.280	0.956

Table 8: *In vitro* drug release data for F2

S. No.	Time (Hrs)	Square Root of Time	Log Time	Cumulative Percentage Drug Release	Log Cumulative Percentage Drug Release	Cumulative Percent Drug Remaining	Log cumulative Percent Drug Remaining
1	1	1	0	9.764	0.983	91.213	1.924
2	2	1.414	0.301	11.784	1.122	86.216	1.932
3	3	1.732	0.477	22.349	1.296	77.251	1.822
4	4	2	0.602	34.349	1.546	61.241	1.799
5	5	2.236	0.698	42.649	1.677	53.151	1.620
6	6	2.449	0.778	62.479	1.778	49.421	1.575
7	7	2.645	0.85	76.463	1.866	34.317	1.432
8	8	2.828	0.903	89.749	1.954	11.251	1.011

Table 9: *In vitro* drug release data for F3

S. No.	Time (Hrs)	Square Root of Time	Log Time	Cumulative Percentage Drug Release	Log Cumulative Percentage Drug Release	Cumulative Percent Drug Remaining	Log cumulative Percent Drug Remaining
1	1	1	0	8.636	0.815	91.124	1.959
2	2	1.414	0.301	16.129	1.366	81.211	1.904
3	3	1.732	0.477	24.694	1.438	72.116	1.851
4	4	2	0.602	41.272	1.520	51.318	1.765
5	5	2.236	0.698	51.723	1.616	47.177	1.653
6	6	2.449	0.778	63.129	1.822	31.111	1.526
7	7	2.645	0.85	81.734	1.923	16.126	1.305
8	8	2.828	0.903	92.118	1.984	6.602	0.848

Table 10: Regression analysis data of phytosome-gel formulation

Batch	Zero order	First order	Higuchi's model	Korsmeyer's Peppas equation
	R^2	R^2	R^2	R^2
F1	0.961	0.813	0.928	0.935
F2	0.973	0.825	0.925	0.933
F3	0.994	0.837	0.985	0.982

Overall, the project successfully developed a polyherbal phytosomal gel with promising properties for wound care. The use of herbal extracts from Singapore daisy and *Hibiscus* provides a natural and effective alternative to synthetic wound healing formulations, with the added benefits of being safer and having fewer side effects. The research highlights the potential of herbal remedies in modern wound care and suggests further investigation to isolate and identify the active compounds responsible for the observed therapeutic effects.

CONCLUSION

In this study, we aimed to develop and evaluate a polyherbal phytosomal gel using extracts from Singapore daisy (*W. trilobata*) and *Hibiscus (H rosa-sinensis)* for wound healing purposes. Our research was driven by the growing preference for natural remedies due to their lower risk of side effects compared to synthetic formulations. By integrating these herbal extracts into a phytosomal drug delivery system, we aimed to enhance the bioavailability, stability, efficacy, and penetration power of the active compounds.

Our findings demonstrated that the formulated polyherbal phytosomal gel possesses significant wound healing properties. The extracts of Singapore daisy, known for their anti-inflammatory and antibacterial activities, and *Hibiscus*, known for its antioxidant and antibacterial properties, were successfully incorporated into the gel. The evaluation of different formulations, namely F1, F2, and F3, revealed that the F3 formulation was particularly effective. It showed excellent stability and no adverse reactions during irritancy tests, making it safe for application on small wounds.

The physical and chemical evaluations confirmed that the gel had a desirable pH, texture, and spreadability, ensuring user comfort and ease of application. In addition, the gel exhibited promising anti-inflammatory and antibacterial activities, which are crucial for effective wound healing. The stability study further indicated that the gel maintained its properties over time, supporting its potential for long-term use.

In conclusion, the polyherbal phytosomal gel developed in this study offers a natural and effective alternative for wound care. The incorporation of herbal extracts from Singapore daisy and *Hibiscus* into a phytosomal delivery system enhances the therapeutic potential of these plants. This formulation not only promotes wound healing but also provides anti-inflammatory, antioxidant, and antimicrobial benefits, aligning with the objectives of this research. The success of this study suggests that further exploration and isolation of active compounds from these herbs could lead to more advanced and specialized wound healing treatments. Overall, this research highlights the potential of herbal remedies in modern wound care and underscores the importance of integrating traditional medicinal knowledge with contemporary pharmaceutical techniques.

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