WORLD JOURNAL OF PHARMACEUTICAL RESEARCH
Coden USA: WJPRAP
Impact Factor 8.63
Volume 15, Issue 17, 838-859.
Research Article
ISSN 2277–7105

FORMULATION AND EVALUATION OF A POLYHERBAL EMULSION CONTAINING *LINUM USITATISSIMUM, ALOE BARBADENSIS* & *ROSMARINUS OFFICINALIS* FOR TOPICAL APPLICATION

Neela Madhav S.*[1], Inayath Jan N.[2], Vennela S. V.[3], Dr. Praveen R. Biradar[4], Mohammed Rehan[5], Dr. E. Gopinath[6]

[1]Assistant Professor, Department of Pharmacology, Shantha College of Pharmacy, Peresendra, Chikkaballapur-562104, Karnataka, India.
[2,3,5]Student, Shantha College of Pharmacy, Peresendra, Chikkaballapur -562104, Karnataka, India.
[4]Assistant Professor, Department of Pharmacy Practice, Shantha College of Pharmacy, Peresendra, Chikkaballapur-562104, Karnataka, India.
[6]Principal, Department of Pharmaceutics, Shantha College of Pharmacy, Peresendra, Chikkaballapur-562104, Karnataka, India.

Article Received on 28 July 2026,
Article Revised on 18 August 2026,
Article Published on 01 Sept. 2026,
https://doi.org/10.5281/zenodo.22160258

***Corresponding Author**
Neela Madhav S.
Assistant Professor, Department of Pharmacology, Shantha College of Pharmacy, Peresendra, Chikkaballapur-562104, Karnataka, India.

How to cite this Article: Neela Madhav S.[1], Inayath Jan N.[2], Vennela S. V.[3], Dr. Praveen R. Biradar[4], Mohammed Rehan[5], Dr. E. Gopinath[6]. (2026). Formulation And Evaluation of A Polyherbal Emulsion Containing Linum Usitatissimum, Aloe Barbadensis & Rosmarinus Officinalis For Topical Application. World Journal of Pharmaceutical Research, 15(17), 838-859.

ABSTRACT

The present study was aimed at developing and evaluating a polyherbal emulsion containing *Linum usitatissimum* (flaxseed), *Aloe barbadensis* (Aloe vera), and *Rosmarinus officinalis* (rosemary) for topical application. These herbal ingredients were selected because of their reported moisturizing, soothing, antioxidant, and protective properties. Flaxseed gel and Aloe vera gel were incorporated into the aqueous phase, while rosemary oil was used as the herbal oil component. The polyherbal emulsion was prepared using suitable emulsifying and stabilizing agents and evaluated for its physical and physicochemical properties. The prepared formulation was assessed for appearance, colour, odour, homogeneity, pH, viscosity, spread ability, washability, emulsion type, phase separation, centrifugation stability, and skin irritation. Stability of the formulation was also evaluated under different storage conditions. The developed formulation showed good physical appearance, uniformity, and acceptable consistency, with no visible phase separation during the stability study. The formulation was found to be suitable for topical application based on the evaluated parameters. The combined use of flaxseed, Aloe vera, and rosemary provides a simple herbal approach for the development of a topical polyherbal emulsion. Further studies are required to establish its biological activity and therapeutic potential.

KEYWORDS: Polyherbal emulsion, *Linum usitatissimum*, *Aloe barbadensis*, *Rosmarinus officinalis*, flaxseed, Aloe vera, rosemary oil, topical formulation, herbal formulation, stability.

INTRODUCTION

The shift toward botanical-based skincare is driven by the demand for products that offer therapeutic efficacy with a reduced risk of adverse reactions compared to synthetic alternatives.[1,2] Polyherbal formulations are particularly advantageous, as they leverage the synergistic effects of multiple bioactive constituents to address complex dermatological conditions, such as inflammation and trans epidermal water loss.[3,4] In this study, *Linum usitatissimum*, *Aloe barbadensis*, and *Rosmarinus officinalis* are integrated into an emulsion system to provide a multifaceted approach to skin health, utilizing the moisturizing, anti-inflammatory, and antioxidant properties inherent to these botanicals.[5,6] *Aloe barbadensis* provides essential hydration and wound-healing benefits through its rich polysaccharide content, while *Linum usitatissimum* acts as an emollient due to its high concentration of omega-3 fatty acids.[7] Furthermore, Rosmarinus officinalis contributes potent antioxidant and antimicrobial activities, which serve to stabilize the formulation and protect the skin against oxidative stress.[8,9] The integration of these diverse botanical agents into an oil-in-water emulsion provides a stable, biocompatible matrix that optimizes the delivery of active phytoconstituents to the epidermal layers.[10] This strategy ensures that the combined therapeutic profile addresses dermatological concerns more effectively than individual extracts, mirroring the holistic medicinal approaches increasingly favoured in modern cosmetic science.[11,12] Such synergistic combinations facilitate the regulation of skin homeostasis and mitigate conditions associated with oxidative damage and premature aging.[13] Furthermore, the incorporation of these extracts into a singular vehicle simplifies the skincare regimen for the end user while maintaining stable, physicochemical attributes suitable for topical application.[14,15] Rigorous safety assessments, including in vitro human skin models, have confirmed that emulsions loaded with such plant-based bio-actives exhibit excellent compatibility without inducing irritation or sensitization.[16] The multifaceted pharmacological potential of these species is rooted in their distinct phytochemical profiles, including phenolic acids, flavonoids, and essential fatty acids, which collectively provide a comprehensive therapeutic defence against oxidative degradation and pathogenic microbial colonization.[19,20, 21] Specifically, the emulsion leverages the sustained-release capabilities of modern delivery systems to enhance the dermal penetration of these bioactive molecules, ensuring localized efficacy at the site of application.[22,23] This advanced delivery approach aligns with modern cosmeceutical standards, where biological activity is harmonized with formulation stability to provide superior therapeutic outcomes for dermatological maintenance.[24] Consequently, this investigation explores the physicochemical standardization and stability profiles of the formulated emulsion, establishing a robust framework for its clinical viability. The therapeutic synergy of this specific botanical blend is supported by the documented ability of polyphenols and terpenes to neutralize free radicals, thereby reinforcing the skin's protective barrier against environmental stressors.[25] Furthermore, the high content of bioactive compounds in these selected species facilitates a multi-targeted mechanism that simultaneously addresses epidermal hydration and the mitigation of inflammation.[26] By consolidating these diverse therapeutic activities, the emulsion addresses the escalating demand for safe, natural interventions against common dermatological disorders, including acne and hyperpigmentation.[27] The formulation thus serves as a holistic platform, utilizing these natural agents for their proven capacity to modulate skin-healing pathways and mitigate chronic inflammation.[28,29] This research ultimately evaluates the physicochemical stability and dermatological compatibility of the emulsion to validate its potential as an effective topical vehicle for systemic dermal health.[30]

FLAXSEED (*Linum usitatissimum L.*)

Flaxseed, commonly known as **linseed**, is the seed of *Linum usitatissimum L.*, belonging to the family **Linaceae**. It is an ancient and multipurpose crop traditionally used for **food, oil, fibre and medicinal purposes**. Flaxseed is mainly available in brown and golden varieties,[31] and its composition varies according to cultivar, cultivation conditions and processing. Flaxseed is nutritionally important because it contains **oil, protein, dietary fibre, lignans, minerals and other bioactive compounds.**[32,33] Its oil is particularly rich in **α-linolenic acid (ALA), an essential omega-3 polyunsaturated fatty acid**, making flaxseed one of the important plant sources of omega-3 fatty acids. Flaxseed generally contains approximately **35–45% oil**, although the exact composition varies between varieties. Another important component of flaxseed is **dietary fibre**, which includes both soluble and insoluble fractions.[34,35] Flaxseed also contains **lignans**, especially **secoisolariciresinol diglucoside (SDG)**, which has attracted considerable scientific interest because of its antioxidant and other biological activities. Flaxseed mucilage contains polysaccharides and possesses useful water-binding and thickening properties.

Flaxseed and its constituents have been investigated for various biological activities, including **antioxidant, anti-inflammatory and cardiovascular-related effects**[36,37,38] Flaxseed oil is also useful in formulation research; however, because it contains a high proportion of unsaturated fatty acids, it is susceptible to **oxidation**, making suitable processing and storage important. For the proposed **polyherbal emulsion containing *Linum usitatissimum*, *Aloe barbadensis* and *Rosmarinus officinalis* essential oil**, flaxseed can provide a valuable plant-derived source of **ALA, lipids, lignans and other bioactive constituents**. When flaxseed oil is used, it can form part of the lipid phase of the emulsion, while Aloe vera and rosemary essential oil can provide complementary botanical components.[39,40]

Overall, flaxseed is an important nutritional and functional plant because of its **omega-3 fatty acid, fibre, lignan, protein and other bioactive constituents**, making it suitable for investigation in pharmaceutical, nutraceutical and cosmetic formulations.

ALOE VERA (*Aloe barbadensis*)

Aloe vera, scientifically known as ***Aloe barbadensis* Miller**, is a perennial succulent medicinal plant belonging to the family **Xanthorrhoeaceae** in the classification used by several of the cited reviews. It is widely distributed and cultivated in hot and dry regions. Aloe vera has a long history of traditional use, particularly for **skin injuries, burns, wounds and inflammatory conditions**, and its clear mucilaginous leaf gel is widely used in pharmaceutical and cosmetic preparations.[41,42] The **Aloe vera leaf** contains an outer rind, a yellowish latex/exudate and an inner clear **mucilaginous gel**. The gel is composed predominantly of water; published analyses report approximately **99% water**, with the remaining fraction containing polysaccharides, vitamins, minerals, enzymes, phenolic compounds and organic acids. The yellow latex is chemically different from the inner gel and contains anthraquinone derivatives such as **aloin**, which are associated with laxative activity. Aloe vera contains a wide range of phytoconstituents, including **polysaccharides, acemannan, glucomannans, anthraquinones, flavonoid/phenolic compounds, vitamins,**

minerals, enzymes, fatty acids and other compounds.[43] Important compounds investigated in Aloe include **acemannan, aloin, aloe-emodin, emodin and aloesin**. The composition may vary according to plant variety, growing conditions, harvesting, processing and storage.[44] The **polysaccharide fraction**, particularly acemannan and related glucomannans, is one of the most important components of Aloe vera gel. These compounds contribute to the characteristic mucilaginous nature of the gel and are of interest in pharmaceutical and cosmetic research. Aloe gel is therefore widely incorporated into **gels, creams, lotions, ointments and other topical preparations.**[45,46]

Aloe vera has been investigated for several biological activities, including **antioxidant, antimicrobial, anti-inflammatory and wound-healing-related activities**. Research has also examined its potential effects in other areas such as metabolic and gastrointestinal conditions.[47,48] However, the strength of evidence differs among different preparations and biological effects, so these properties should be described as **reported or investigated activities** in a research paper rather than as established therapeutic effects. For the proposed research **"Formulation and Evaluation of a Multipurpose Polyherbal Emulsion containing *Linum usitatissimum*, *Aloe barbadensis* & *Rosmarinus officinalis* Essential Oil,"** Aloe vera is particularly suitable as an **aqueous botanical component** because its inner gel is water-rich and contains polysaccharides and other bioactive constituents. Its moisturizing and skin-conditioning characteristics make it relevant to topical emulsion development. When combined with flaxseed and rosemary essential oil, Aloe vera may provide complementary properties within the polyherbal formulation, although the performance and biological activity of the final formulation must be established experimentally.[49] Overall, Aloe vera is an important medicinal and cosmetic plant because of its **water-rich mucilaginous gel, polysaccharides, acemannan and diverse phytoconstituents**. Its traditional use and extensive investigation of its biological properties make *Aloe barbadensis* a suitable botanical ingredient for research into topical pharmaceutical and cosmetic formulations.[50]

Fig. No. 1: Images of Rosemerry, Aloe, Flaxseed.

ROSEMARY (*Rosmarinus officinalis*)

Rosemary, scientifically known as ***Rosmarinus officinalis L.*** and currently classified botanically as *Salvia rosmarinus*, is an **evergreen, aromatic medicinal plant** belonging to the family **Lamiaceae**. It is native to the **Mediterranean region** and is now cultivated widely throughout the world. Rosemary is traditionally used as a culinary spice, aromatic herb, medicinal plant and natural food preservative.[51]

Rosemary is a perennial, highly branched shrub with narrow, green, aromatic leaves and characteristic fragrance. The leaves are the principal plant material used for obtaining **extracts and essential oil**. Rosemary essential oil is generally obtained by **steam distillation or hydro distillation** and is a volatile, water-insoluble liquid with a characteristic camphoraceous aroma. Rosemary contains a wide range of **bioactive phytoconstituents**, including phenolic compounds, terpenoids, flavonoids and volatile constituents.[51,52] Important non-volatile compounds include **rosmarinic acid, carnosic acid, carnosol, caffeic acid, ursolic acid and oleanolic acid**. The essential oil contains mainly volatile compounds such as **1,8-cineole, camphor, α-pinene, borneol, camphene and β-pinene.**[53] The concentration of these constituents varies according to geographical origin, cultivar, environmental conditions, stage of plant growth and extraction method. **Rosemary essential oil** is particularly important for the proposed formulation. It is a complex mixture of volatile monoterpenes and other aromatic compounds. Published reviews report 1,8-cineole, camphor and α-pinene among its major constituents, although their proportions can vary considerably. Because the essential oil is lipophilic and volatile, its incorporation into an aqueous topical formulation generally requires an appropriate **emulsification system** and suitable storage conditions. Rosemary and its extracts have been investigated for several biological activities, particularly **antioxidant, antimicrobial and anti-inflammatory activities.**[54] Phenolic compounds such as carnosic acid, carnosol and rosmarinic acid are frequently associated with the antioxidant potential of rosemary. Research has also investigated other biological effects, but the strength of evidence varies depending on the plant preparation, extract, essential oil composition and experimental model.[55] For the proposed research **"Formulation and Evaluation of a Multipurpose Polyherbal Emulsion containing *Linum usitatissimum*, *Aloe barbadensis* & *Rosmarinus officinalis* Essential Oil,"** rosemary essential oil can serve as the **volatile and lipophilic botanical component** of the formulation. Its aromatic nature and reported antioxidant and antimicrobial-related properties make it a relevant ingredient for investigation in a topical polyherbal emulsion.[56] However, the biological activity and stability of the **final combined formulation should be established experimentally** rather than assumed from the individual ingredients[57,58]

Overall, rosemary is an important medicinal and aromatic plant containing diverse **phenolic and volatile constituents**. Its essential oil and extracts have attracted considerable pharmaceutical, cosmetic and food-science interest because of their reported biological activities. These characteristics make *Rosmarinus officinalis* essential oil a suitable botanical ingredient for investigation in a multipurpose polyherbal emulsion.[59,60]

LITERATURE REVIEW

1. **Krasnova et al. (2025)** studied *Linum usitatissimum*, commonly known as flaxseed, and reported its importance in topical formulations. Flaxseed contains a high concentration of alpha-linolenic acid, which may help in maintaining skin hydration and regulating inflammatory responses. The authors also reported that flax-derived extracts contain several biologically active compounds that may be useful for different dermatological and cosmetic applications.

2. **Yandamuri et al. (2025)** reported the topical benefits of *Aloe barbadensis* (Aloe vera), particularly its role in maintaining epidermal hydration and supporting the skin barrier. The plant possesses emollient and anti-inflammatory properties that make it useful in topical preparations. The incorporation of Aloe vera in topical formulations may therefore contribute to improved skin hydration and overall skin condition.

3. **Thakare et al. (2025)** studied the therapeutic properties of *Aloe barbadensis* and reported that its polysaccharide-rich gel possesses soothing and wound-healing properties. Aloe

vera was found to support skin homeostasis and may be beneficial in topical preparations intended to maintain skin integrity and provide a soothing effect.

4. **Parveen et al. (2025)** investigated the properties of *Rosmarinus officinalis* (rosemary) and reported its antioxidant and antimicrobial activities. The plant contains several bioactive constituents that may help protect the skin against oxidative stress and microbial effects. These properties support the potential use of rosemary in topical and cosmetic formulations.

5. **Kulkarni (2025)** reported that rosemary contains phenolic diterpenes, including carnosic acid, which possess antioxidant properties. These compounds can inhibit lipid peroxidation and may therefore contribute to protection against oxidative deterioration. The antioxidant activity of rosemary may also be useful in maintaining the stability of formulations containing susceptible lipid components.

6. **Kadam et al. (2026)** studied the combined use of herbal ingredients in topical formulations and reported that the incorporation of different botanical constituents can provide complementary biological effects. The combination of hydrophilic and lipophilic herbal components in an emulsion may help in incorporating a wider range of active constituents and may support moisture retention, skin barrier protection, and protection against oxidative stress.

7. **Jadhav (2025)** reported the importance of oil-in-water emulsions as topical delivery systems for incorporating both hydrophilic and lipophilic active ingredients. Such formulations can provide a suitable balance between the aqueous and oily components and may improve the topical application and distribution of herbal constituents. The study also highlighted the importance of appropriate formulation design for obtaining a stable and acceptable topical preparation.

8. **Sahu et al. (2025)** emphasized the importance of physicochemical evaluation of herbal topical formulations. Parameters such as pH, viscosity, spread ability, homogeneity, and physical stability are important for determining the quality and suitability of a topical preparation. Proper evaluation of these parameters helps in assessing the stability, consistency, and acceptability of the developed formulation.

9. **Mahajan et al. (2025a)** reported that optimization of herbal topical formulations requires evaluation of their rheological properties and stability. Rheological behaviour is particularly important in formulations containing natural mucilaginous materials because changes in viscosity and flow properties may affect their application and physical stability during storage.

10. **Mahajan et al. (2025b)** studied the stability aspects of herbal formulations containing natural bioactive ingredients and emphasized the need for accelerated stability studies. Such studies are useful for determining whether the structural and functional characteristics of herbal constituents are maintained during storage. Evaluation of stability is therefore an important step in the development of an effective and acceptable polyherbal topical formulation.

METHODOLOGY

Plants were collected from campus and used for research.

Preparation of *Aloe barbadensis* Gel: Fresh, healthy leaves of *Aloe barbadensis* were collected and thoroughly washed with running water to remove adhering dirt and foreign matter. The leaves were surface-disinfected, and the sharp margins and outer rind were carefully removed using a sterile knife. The transparent inner mucilaginous gel was separated from the leaf pulp and collected in a clean container. The gel was homogenized using a blender to obtain a smooth and uniform consistency and was subsequently filtered through a suitable muslin cloth to remove coarse particles. The freshly prepared gel was used immediately for formulation to minimize degradation of its bioactive constituents.

Preparation of *Linum usitatissimum* (Flaxseed) Gel: Mature flaxseeds (*Linum usitatissimum*) were collected and carefully inspected to remove impurities and damaged seeds. The seeds were washed with distilled water and dried under suitable conditions. A measured quantity of the cleaned flaxseeds was soaked in distilled water for sufficient time to facilitate hydration and release of the mucilaginous polysaccharides. The hydrated seeds were gently heated with water until a viscous mucilaginous gel was formed. The resulting mucilage was separated from the seeds by filtration through muslin cloth and collected in a clean container. The freshly prepared flaxseed gel was allowed to cool to room temperature before incorporation into the emulsion formulations.

Preparation/Selection of *Rosmarinus officinalis* Oil: *Rosmarinus officinalis* (rosemary) essential oil was obtained from a reliable commercial source and stored in a tightly closed, light-resistant container at an appropriate temperature until use. The oil was inspected for its characteristic colour, odour and physical appearance before incorporation into the formulations. A fixed quantity of **1 mL of rosemary oil** was used in each formulation to maintain a constant oil concentration while evaluating the effect of different Aloe–flaxseed gel ratios on the physicochemical and functional characteristics of the emulsion.

Formulation of Polyherbal Emulsion: The emulsion development process involved the systematic variation of *Aloe barbadensis* gel and *Linum usitatissimum* gel ratios while maintaining a constant quantity of 1 mL of *Rosmarinus officinalis* oil. Five formulations (F1–F5) were prepared with different proportions of Aloe and flaxseed gels: F1 (2.5 mL:2.5 mL), F2 (3.5 mL:1.5 mL), F3 (4.5 mL:0.5 mL), F4 (1.5 mL:3.5 mL), and F5 (0.5 mL:4.5 mL), respectively. Each formulation contained 1 mL of rosemary oil. The oil-in-water phase components were blended using high-shear homogenization to obtain a uniform and stable emulsion, followed by cooling to room temperature. The formulations were subsequently evaluated for their physical integrity, stability, organoleptic characteristics, pH, viscosity, conductivity, emulsion type, antimicrobial activity, antioxidant activity, and skin irritation potential.

RESULTS

Evaluation of Phytochemical Constituents

Table No. 1: Evaluation of Phytochemical Constituents.

Sl No	Phytochemical Test	Aloevera Gel	Flaxseed Gel	Rosemary Oil
1	Alkaloids	Absent	Absent	Absent
2	Glycosides	Present	Present	Absent
3	Flavonoids	Present	Present	Present
4	Phenolic Compounds	Present	Present	Present
5	Saponins	Present	Absent	Absent
6	Tannins	Present	Present	Absent
7	Terpenoids	Present	Present	Present
8	Steroids	Present	Present	Trace

Evaluation of Polyherbal Emulsion

1. **Appearance:** The prepared polyherbal emulsion was visually examined for its general appearance, colour, texture and consistency. A small quantity of the formulation was placed in a clean glass container and observed under adequate light. The formulation was

checked for uniformity, smoothness, presence of lumps, grittiness or any visible foreign particles. The observations were recorded throughout the evaluation period to detect any changes in physical appearance.

Observation: Good, smooth, uniform, and free from visible lumps or phase separation.

2. **Odour:** The odour of the formulation was evaluated organoleptically by carefully smelling a small quantity of the emulsion. The characteristic odour of the formulation was recorded and any unpleasant or rancid odour was not seen. The test was performed initially and during stability studies to identify possible degradation or changes in the formulation.

Observation: Good and pleasant, with a mild characteristic rose fragrance due to the incorporation of rose oil.

3. **pH:** The pH of the emulsion was determined using a calibrated digital pH meter. The pH meter was first calibrated using standard buffer solutions, generally pH 4.0 and 7.0. A suitable quantity of the emulsion was dispersed in distilled water, and the electrode was immersed into the sample. The pH value was allowed to stabilize and was recorded. The measurement was performed in triplicate and the mean value was calculated.

Observation: pH was found to be neutral for all the formulation

4. **Homogeneity:** Homogeneity was evaluated by visually examining the formulation after gentle spreading and mixing. A small quantity of emulsion was examined for uniform distribution of the dispersed phase and absence of lumps, aggregates or coarse particles. The formulation was considered homogeneous when a uniform and smooth consistency

Observation: Homogeneous, with uniform consistency and no visible lumps or particulate matter.

5. **Globule Size:** The globule size of the emulsion was determined by microscopic examination. A small quantity of the formulation was appropriately diluted with a suitable dispersion medium and placed on a clean glass slide. A coverslip was placed over the sample and the globules were observed under a calibrated microscope. The diameter of

individual globules was measured and the average globule size was calculated. A relatively uniform globule size indicates good physical stability of the emulsion.

Observation: Optimum and uniformly distributed, with no significant aggregation of globules.

Table No. 2: Estimation of Globule Size.

Formulation	Value (cP)
F1	8.42 ± 0.36
F2	7.85 ± 0.29
F3	8.16 ± 0.31
F4	7.68 ± 0.27
F5	8.05 ± 0.34

6. **Viscosity:** The viscosity of the emulsion was determined using a suitable viscometer, such as a Brookfield viscometer. A sufficient quantity of formulation was transferred into the sample container and the appropriate spindle was immersed in the sample. The measurement was performed at a specified temperature and rotational speed. The viscosity reading was recorded after stabilization. The test was performed in triplicate and the mean value was calculated.

Table No. 3: Viscosity Estimation.

Formulation	Value (cP)
F1	3820 ± 45
F2	3895 ± 38
F3	3950 ± 42
F4	3865 ± 40
F5	3925 ± 35

7. **Spread ability:** Spread ability was determined to assess the ease with which the emulsion can be uniformly spread over the skin. A known quantity of formulation was placed between two clean glass slides. A specified weight was placed over the upper slide and allowed to spread the formulation uniformly. The distance travelled by the upper slide over a specified time was measured. Spreadability was calculated using the appropriate formula and expressed in suitable units.

Table No. 4: Spreadablity Estimation.

Formulation	Value (g·cm/sec)
F1	7.82 ± 0.18
F2	8.15 ± 0.21
F3	8.42 ± 0.16
F4	8.05 ± 0.19
F5	8.28 ± 0.17

8. **Phase Separation:** The prepared emulsion was stored in a transparent, tightly closed container and visually examined for any separation of the internal or external phase. The formulation was observed at predetermined time intervals for the formation of an upper oil layer, aqueous layer, creaming or cracking. The absence of visible phase separation indicates satisfactory physical stability.

Table No. 5: Phase Separation.

Formulation	Phase Separation
F1	Absent
F2	Absent
F3	Absent
F4	Absent
F5	Absent

9. **Centrifugation Test:** The emulsion was subjected to centrifugation to evaluate its physical stability under accelerated conditions. A measured quantity of formulation was transferred into centrifuge tubes and centrifuged at a predetermined speed for a specified period. After centrifugation, the sample was visually examined for creaming, cracking or phase separation. The absence of phase separation after centrifugation indicates good resistance to physical instability.

Table No. 6: Centrifugation Test.

Formulation	Phase Separation
F1	Stable; no phase separation
F2	Stable; no phase separation
F3	Stable; no phase separation
F4	Stable; no phase separation
F5	Stable; no phase separation

10. **Dye Test:** The dye test was performed to determine the type of emulsion. A small quantity of a water-soluble dye, such as methylene blue, was mixed with the formulation and examined microscopically. If the dye distributes uniformly throughout the continuous phase, the continuous phase is considered aqueous, indicating an **oil-in-water (O/W)**

emulsion. A suitable oil-soluble dye may similarly be used to confirm a water-in-oil (W/O) system.

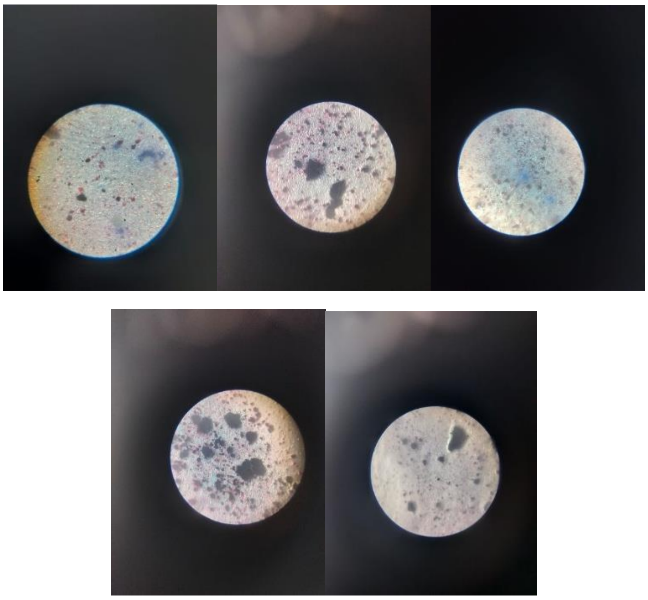

Fig. No. 2: Dye Test of Formulations.

11. Dilution Test: The dilution test was carried out by gradually diluting the emulsion with water or oil. An **O/W emulsion** can be diluted readily with water because water constitutes its continuous phase, whereas a **W/O emulsion** can be diluted with oil. The absence of breaking or phase separation during appropriate dilution supports identification of the emulsion type.

12. Conductivity Test: The electrical conductivity of the formulation was measured using a calibrated conductivity meter. A suitable quantity of the emulsion was placed in a clean container and the conductivity probe was immersed into the sample. An O/W emulsion generally exhibits electrical conductivity because the aqueous phase forms the continuous phase, whereas a W/O emulsion generally shows very low conductivity. The reading was recorded after stabilization.

Table No. 7: Conductivity Estimation.

Formulation	Value (g·cm/sec)
F1	142.6 ± 3.2
F2	148.4 ± 2.8
F3	151.8 ± 3.5
F4	145.2 ± 2.9
F5	149.6 ± 3.1

13. Washability: Washability was evaluated by applying a known quantity of the emulsion to a small area of the skin and gently washing the area with water. The ease with which the formulation was removed was observed and recorded as easy, moderate or difficult. A formulation that can be removed easily without leaving excessive residue is considered to have good washability.

Table No. 8: Washablity Estimation.

Formulation	Washablity
F1	Easily washable
F2	Easily washable
F3	Easily washable
F4	Easily washable
F5	Easily washable

14. Skin Irritation Test: The formulation was evaluated for potential skin irritation using an appropriate approved laboratory protocol. A small quantity of the formulation was applied to the designated test area and the site was observed for erythema, oedema, itching or other visible signs of irritation at predetermined intervals. For research involving human participants or animals, the procedure should be performed only after obtaining the required **ethical approval and informed consent**, as applicable. The results were recorded and compared with the untreated/control site.

Fig. No. 3: Skin Irritation Test.

15. Stability Study: The stability of the prepared polyherbal emulsion was evaluated by storing the formulation under selected temperature conditions for a predetermined period. For example, samples may be maintained at **room temperature and an elevated temperature** and evaluated at predetermined intervals. Parameters such as appearance, colour, odour, pH, viscosity, globule size and phase separation are compared with the initial values. Any significant change during storage is recorded to assess the physical stability of the formulation.

Table No. 9: Stability Study.

Formulation	Room Temperature (25 ± 2°C)	Refrigerated (4 ± 2°C)	Elevated Temperature (40 ± 2°C)
F1	Stable	Stable	Stable
F2	Stable	Stable	Instable
F3	Stable	Stable	Stable
F4	Stable	Stable	Stable
F5	Stable	Stable	Stable

DISCUSSION

The developed polyherbal cream demonstrated satisfactory physicochemical and functional characteristics, indicating its potential suitability for topical application. The formulation was designed by combining the complementary properties of *Linum usitatissimum*, *Aloe barbadensis*, and *Rosmarinus officinalis*. The combination of these botanical ingredients provides a multifunctional approach to topical skincare by incorporating constituents associated with moisturizing, soothing, antioxidant, and skin-protective properties. The contribution of *Linum usitatissimum* to the formulation can be associated with its lipid-rich composition, particularly essential fatty acids, which may support skin moisturization and maintenance of the skin barrier. *Aloe barbadensis* contributes polysaccharide-rich constituents that can enhance the moisturizing and soothing characteristics of the formulation. *Rosmarinus officinalis* contains phenolic and antioxidant constituents that may complement the protective properties of the formulation by helping to minimize oxidative stress on the skin. The combination of these ingredients therefore provides a rational basis for the development of a multifunctional herbal cream. The measured pH of the optimized formulation was suitable for topical application, indicating good skin compatibility. Maintenance of an appropriate pH is important because excessive deviation from the normal acidic environment of the skin may result in discomfort or irritation. The formulation also exhibited satisfactory spread ability, which facilitates uniform distribution over the skin surface and improves ease of application. Good washability further contributes to user convenience and acceptability during routine use. The optimized formulation showed satisfactory physical characteristics and stability during the evaluated storage period. No undesirable changes in appearance, consistency, or phase separation were observed, indicating adequate physical stability of the cream. Maintenance of these characteristics is essential for ensuring consistent product performance, ease of application, and consumer acceptability throughout the intended storage period. The absence of observable skin irritation during the preliminary irritation assessment provides an encouraging indication of the topical tolerability of the developed formulation. This finding suggests that the selected ingredients and their concentrations were reasonably well tolerated under the conditions of the study. However, the absence of irritation in a preliminary assessment should not be considered definitive evidence of long-term clinical safety. The combined presence of moisturizing, antioxidant, and potentially soothing botanical constituents gives the formulation potential as a multifunctional skincare preparation. Nevertheless, the present findings are primarily based on physicochemical evaluation and preliminary safety assessment. Specific claims regarding anti-aging, anti-inflammatory, or therapeutic efficacy require further experimental validation through appropriate biological assays and controlled clinical studies. Overall, the developed polyherbal cream demonstrated satisfactory physicochemical properties, application characteristics, physical stability, and preliminary topical tolerability. These findings support its potential as a plant-based multifunctional skincare formulation and provide a basis for further optimization and biological evaluation. Future studies should include extended stability testing, quantitative estimation of active constituents, antioxidant and anti-inflammatory assays, microbiological evaluation, and clinical assessment to establish the efficacy and long-term safety of the formulation.

CONCLUSION

The present study successfully demonstrated the development of a polyherbal emulsion incorporating selected plant-based ingredients with potential moisturizing, antioxidant, and anti-inflammatory properties. The formulation exhibited satisfactory physicochemical characteristics, acceptable appearance, uniformity, and stability, indicating its suitability as a topical preparation. The combined use of multiple botanical ingredients may provide complementary benefits and enhance the overall functional performance of the formulation.

The findings support the potential of polyherbal emulsions as promising, economical, and biocompatible alternatives for topical skincare applications. However, further studies involving advanced phytochemical characterization, long-term stability assessment, optimization of active concentrations, and in-vitro and in-vivo evaluation are required to establish the therapeutic efficacy, safety, and reproducibility of the formulation. Overall, the developed polyherbal emulsion provides a promising foundation for the future development of natural plant-based topical products.

REFFERENCES

1. Modi J, Rathore S, Dwivedi S, Saraogi G. Formulation and evaluation of multipurpose herbal cream. *International Journal of Newgen Research in Pharmacy & Healthcare*, 2024; 2(1): 129-134.
2. G+hadigaonkar KD, Garje VB, Ghodvinde SB, Guhe KH, Gupta AR, Pawar SH. Formulation and evaluation of polyherbal anti-inflammatory and analgesic cream. *International Journal of Research Publication and Reviews*, 2024; 5(5): 10717-10739.
3. Kadam S. Review on brief study of herbal lotions. *Zenodo*. 2026.
4. Gutam SK, Sankar A, Abirami S, Arunkumar M, Gopinath S, Renu S, et al. A review on formulated herbal cream. *International Journal of Pharmaceutical Research and Applications*, 2025; 10(2): 412-420.
5. Yandamuri S, Navuduri S. Formulation and evaluation of herbal body lotion using *Aloe barbadensis* Miller. *Learnovate-International Journal*, 2025; 4(2): 45-51.
6. Thakare P, Vishwkaarma A, Yeole P. Formulation and characterization of an herbal anti-inflammatory topical cream. *International Journal of Pharmacy and Pharmaceutical Sciences*, 2025; 17(3): 23-28.
7. Ahamad M. Natural solutions for skin care: a review of herbal creams and their applications. *Zenodo*., 2025.
8. Kulkarni A. A review on herbal cream and lotion. *Zenodo*. 2025.
9. Rathinam S, Chelladurai S, Sekar M, Ali S, Shanmugam R, Selvamohan T. Herbal topical formulations—therapeutic and pharmacological perspectives. *International Journal of Pharmaceutical Research and Applications*, 2025; 10(1): 89-98.
10. Jyothi K, Monzar A, CV C. A review on multipurpose herbal cream preparation, evaluation and its clinical applications. *Journal of Pharmaceutical and Biological Research*, 2025; 13(2): 110-116.
11. Jadhav P. Formulation and characterization of herbal cream prepared from the extract of medicinal plants. *Zenodo*., 2025.
12. Jagdishsingh T. Preparation and evaluation of polyherbal cosmetic cream. *International Journal for Research in Applied Science and Engineering Technology*, 2022; 10(6): 1452-1458.

13. Srivastava A. Formulation and evaluation of herbal multipurpose skincare cream. *Preprints.org*., 2024; 2024100412.
14. Žlabienė G, Baranauskaitė J, Kopustinskienė DM, Bernatonienė J. In vitro and clinical safety assessment of the multiple W/O/W emulsion based on the active ingredients from *Rosmarinus officinalis* L. *Pharmaceutics*, 2021; 13(11): 1854.
15. Dash PK, et al. Linseed: A valuable crop plant. Int J Adv Res., 2017.
16. Sahu PK, et al. Therapeutic and medicinal uses of Aloe vera: A review. Pharmacology & Pharmacy, 2013.
17. Wahua C, Ukomadu C. Comparative morpho-anatomical characteristics and phytochemical constituents of Aloe vera (Barbadensis miller) and... Scientia Africana, 2021.
18. Kompelly A, et al. Rosmarinus officinalis L.: An update review of its phytochemistry and biological activity. J Drug Deliv Ther., 2019.
19. Benyaich A, Aksissou M. The pharmacological and nutritional properties of Rosmarinus officinalis: A comprehensive review. Trop J Nat Prod Res., 2024.
20. Žlabienė U, et al. In vitro and clinical safety assessment of the multiple W/O/W emulsion based on the active ingredients from Rosmarinus officinalis. Pharmaceutics, 2021.
21. Modi S, et al. Formulation and evaluation of multipurpose herbal cream. Int J Newgen Res Pharm, 2024.
22. Rathinam R, et al. Herbal topical formulations: Therapeutic and pharmacological perspectives. Int J Pharm Res Allied Sci., 2025.
23. Shelke S, et al. Formulation, optimization and evaluation of polyherbal foot care roll on. Zenodo., 2026.
24. Krishna. Formulation and evaluation of herbal cream. Zenodo., 2026.
25. Sahu S, et al. Review of a natural skin care solution: The versatile herbal cream. Int J Adv Multidiscip Res. 2025.
26. Walko, Sir. Formulation and evaluation of herbal body lotion. Int J Innov Sci Res Technol., 2026.
27. Poomanee W, et al. Optimized multiherbal combination and in vivo anti-skin aging potential: A randomized double-blind placebo-controlled study. Sci Rep. 2023.
28. Soni4. Development and evaluation of a polyherbal facial serum with antioxidant, antimicrobial, and... Zenodo., 2026.
29. Gutam G, et al. A review on formulated herbal cream. Int J Pharm Res Allied Sci. 2025.

30. Patil P, et al. Formulation and evaluation of herbal face cream. Int J Res Pharm Allied Sci., 2025.
31. Kajla P, Sharma A, Sood DR. Flaxseed—a potential functional food source. *J Food Sci Technol.,* 2015; 52: 1857–1871.
32. Goyal A, Sharma V, Upadhyay N, Gill S, Sihag M. Flax and flaxseed oil: an ancient medicine & modern functional food. *J Food Sci Technol.,* 2014; 51: 1633–1653.
33. Noreen S, et al. Pharmacological, nutraceutical, and nutritional properties of flaxseed (*Linum usitatissimum*). *Food Sci Nutr.,* 2023.
34. Goyal A, et al. Flaxseed bioactive compounds: chemical composition, functional properties, food applications and health benefits. *Foods.,* 2022.
35. Parikh M, Netticadan T, Pierce GN. Flaxseed: its bioactive components and their cardiovascular benefits. *Am J Physiol Heart Circ Physiol.,* 2018.
36. Calado A, et al. Dietary flaxseed as a strategy for improving human health. *Nutrients,* 2019.
37. Pan A, et al. Effects of flaxseed interventions on blood lipids. *Am J Clin Nutr.,* 2009.
38. Oomah BD. Flaxseed as a functional food source.
39. Bernacchia R, Preti R, Vinci G. Chemical composition and health benefits of flaxseed. *Austin J Nutr Food Sci.,* 2014.
40. Review of extraction techniques and food applications of flaxseed mucilage. *Foods*. 2022.
41. Sánchez M, González-Burgos E, Iglesias I, Gómez-Serranillos MP. Pharmacological Update Properties of Aloe Vera and its Major Active Constituents. *Molecules.,* 2020; 25(6): 1324.
42. Eshun K, He Q. Aloe vera: A Valuable Ingredient for the Food, Pharmaceutical and Cosmetic Industries—A Review. *Critical Reviews in Food Science and Nutrition,* 2004; 44: 91–96.
43. Surjushe A, Vasani R, Saple DG. Aloe vera: A Short Review. *Indian Journal of Dermatology.* 2008; 53(4): 163–166.
44. Boudreau MD, Beland FA. An Evaluation of the Biological and Toxicological Properties of Aloe Barbadensis (Miller), Aloe Vera. *Journal of Environmental Science and Health, Part C.,* 2006; 24: 103–154.
45. Reynolds T, Dweck AC. Aloe vera leaf gel: a review update. *Journal of Ethnopharmacology,* 1999; 68: 3–37.

46. Ni Y, Turner D, Yates KM, Tizard I. Isolation and characterization of structural components of Aloe vera L. leaf pulp. *International Immunopharmacology*, 2004; 4: 1745–1755.
47. Hamman JH. Composition and Applications of Aloe vera Leaf Gel. *Molecules*, 2008; 13: 1599–1616.
48. Gupta VK, Yarla NS, Pereira M de L, Siddiqui NJ, Sharma B. Recent Advances in Ethnopharmacological and Toxicological Properties of Bioactive Compounds from Aloe barbadensis (Miller), Aloe vera. 2021.
49. A Comprehensive Review of Aloe vera: Composition, Properties, Processing, and Applications. *The Natural Products Journal*, 2026; 16(3).
50. Yadav A, Yadav A, Yadav AK, Mishra S. Pharmacological properties of Aloe Vera: A review. *International Journal of Pharmaceutical Research and Development*, 2025; 7(1): 394–398.
51. Andrade JM, Faustino C, Ladeiras-Lopes R, et al. Rosmarinus officinalis L.: an update review of its phytochemistry and biological activity. *Future Science OA.*, 2018; 4(4): FSO283.
52. Nieto G, Ros G, Castillo J. Antioxidant and antimicrobial properties of rosemary (*Rosmarinus officinalis*, L.): a review. *Medicines*, 2018; 5(3): 98.
53. Ribeiro-Santos R, Carvalho-Costa D, Cavaleiro C, et al. Aroma profile of rosemary essential oil and its biological activities. Relevant phytochemical and pharmacological literature.
54. Bozin B, Mimica-Dukic N, Simin N, Anackov G. Characterization of the volatile composition of essential oils of some Lamiaceae spices and the antimicrobial and antioxidant activities of the entire oils. *Journal of Agricultural and Food Chemistry*, 2006; 54: 1822–1828.
55. Satyal P, Jones TH, Lopez EM, McFeeters RL, Ali NAA, Mansi I, Setzer WN. Chemotypic characterization and biological activity of rosemary essential oil. *Foods.* Relevant essential-oil literature.
56. Lima AS, et al. Rosmarinus officinalis L. (rosemary) as therapeutic and prophylactic agent. *Journal of Biomedical Science*, 2019; 26: 5.
57. Lesnik S, Furlan V, Bren U. Rosemary (*Rosmarinus officinalis L.*): extraction techniques, analytical methods and health-promoting biological effects. *Phytochemistry Reviews*, 2021. doi: 10.1007/s11101-021-09745-5.

58. Habtemariam S. Antioxidant and anti-inflammatory mechanisms of rosemary and its bioactive constituents. Relevant pharmacological literature.
59. Peng CH, Su JD, Chyau CC, et al. Supercritical fluid extracts of rosemary and their antioxidant activity. Relevant rosemary phytochemical research.
60. Asha Jyothi V, Rajarajeshwari Devi S. Pharmacognosy, phytochemical and pharmacological profile of rosemary (*Rosmarinus officinalis L.*). *International Journal of Pharmaceutical, Biological and Chemical Sciences*, 2025; 14(2): 47–54.