



Formulation And Evaluation Of Herbal Cream Containing Ficus Religiosa Leaf Extract For Anti-Inflammatory Activity

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Abstract

Herbal topical formulations have gained considerable attention due to their safety, therapeutic efficacy, and minimal adverse effects. The present study aimed to formulate and evaluate a herbal cream containing *Ficus religiosa* leaf extract for its anti-inflammatory activity. Ethanolic extract of *Ficus religiosa* leaves was incorporated into oil-in-water cream bases using different concentrations (1%, 2%, and 3% w/w). The prepared formulations were evaluated for physicochemical properties including pH, viscosity, spreadability, extrudability, homogeneity, and stability. Anti-inflammatory activity was assessed using the carrageenan-induced paw edema model in rats. The optimized formulation (F3) containing 3% extract showed good physical characteristics with pH 6.4 ± 0.02 , viscosity 31200 ± 85 cps, and spreadability 6.2 ± 0.18 g·cm/sec. In vivo results demonstrated significant inhibition of paw edema (61.4%) compared with the control group and comparable to the standard diclofenac gel (72.5%). The findings suggest that *Ficus religiosa* leaf extract incorporated into a cream base possesses promising anti-inflammatory activity and may serve as a potential topical herbal therapeutic agent.

Keywords: *Ficus religiosa*, herbal cream, anti-inflammatory activity, topical formulation, carrageenan induced edema

1. Introduction

Inflammation is a complex biological response of vascular tissues to harmful stimuli such as pathogens, damaged cells, toxins, or physical injury. It is an essential protective mechanism that helps the body eliminate injurious agents and initiate the healing process. The inflammatory response involves a cascade of biochemical events mediated by inflammatory mediators such as prostaglandins, leukotrienes, cytokines, histamine, and nitric oxide. Although inflammation is a natural defense mechanism, prolonged or excessive inflammatory responses may lead to chronic pathological conditions such as rheumatoid arthritis, dermatitis, inflammatory bowel disease, and other autoimmune disorders [1,2]. Chronic inflammation is also implicated in the pathogenesis of several degenerative diseases including cardiovascular diseases, neurodegenerative disorders, and metabolic syndrome.

Nonsteroidal anti-inflammatory drugs (NSAIDs) and corticosteroids are widely used for the management of inflammatory conditions. These drugs primarily exert their effects by inhibiting cyclooxygenase (COX) enzymes responsible for prostaglandin synthesis, thereby reducing inflammation and pain [3]. Despite their effectiveness, long-term use of NSAIDs is associated with several adverse effects such as

gastrointestinal irritation, gastric ulcers, renal impairment, cardiovascular complications, and systemic toxicity [4]. These limitations have stimulated growing interest in the development of safer and more effective therapeutic alternatives derived from natural sources.

Herbal medicines have been used for centuries in traditional healthcare systems such as Ayurveda, Unani, and Traditional Chinese Medicine for the treatment of various inflammatory conditions. Medicinal plants contain a wide range of bioactive phytoconstituents including flavonoids, alkaloids, tannins, terpenoids, phenolic compounds, and glycosides that exhibit significant pharmacological activities [5]. Plant-derived compounds often demonstrate anti-inflammatory activity by inhibiting inflammatory mediators, suppressing oxidative stress, and modulating immune responses. Due to their natural origin, herbal preparations are generally considered safer, more economical, and associated with fewer adverse effects compared to synthetic drugs [6]. Consequently, the development of herbal formulations has gained considerable attention in modern pharmaceutical research.

Ficus religiosa Linn., belonging to the family Moraceae, is commonly known as the Peepal tree and is widely distributed throughout the Indian subcontinent and other tropical regions of Asia. The plant holds significant medicinal importance in traditional systems of medicine such as Ayurveda and has been used to treat a variety of ailments including asthma, diarrhea, skin diseases, wounds, ulcers, and inflammatory conditions [7]. Different parts of the plant including leaves, bark, roots, and fruits possess numerous pharmacological properties such as antioxidant, antimicrobial, antidiabetic, hepatoprotective, wound healing, and anti-inflammatory activities [8].

Phytochemical investigations of *Ficus religiosa* leaves have revealed the presence of several biologically active compounds such as flavonoids, tannins, phenolic acids, sterols, and saponins. Flavonoids and phenolic compounds are well known for their potent antioxidant and anti-inflammatory activities. These compounds can inhibit the production of pro-inflammatory mediators such as prostaglandins, nitric oxide, and cytokines by modulating inflammatory signaling pathways [9]. In addition, tannins and saponins contribute to wound healing and antimicrobial properties, which further enhance the therapeutic potential of the plant in the treatment of skin disorders.

Topical drug delivery systems have gained increasing importance in pharmaceutical formulation due to their ability to deliver drugs directly to the site of action. Creams are one of the most widely used topical dosage forms because they provide ease of application, good patient compliance, and improved drug absorption through the skin [10]. Topical creams can be formulated as oil-in-water (O/W) or water-in-oil (W/O) emulsions depending on the intended therapeutic application. Oil-in-water creams are generally preferred for cosmetic and dermatological preparations because they are non-greasy, easily washable, and provide better patient acceptability.

Incorporation of herbal extracts into topical creams offers several advantages, including localized therapeutic action, reduced systemic exposure, and improved stability of phytoconstituents. Herbal creams have been extensively investigated for their applications in wound healing, antimicrobial therapy, anti-aging products, and anti-inflammatory treatments [11]. The combination of natural plant extracts with suitable pharmaceutical excipients may enhance the bioavailability and therapeutic efficacy of herbal compounds.

Considering the pharmacological importance of *Ficus religiosa* and its traditional use in the treatment of inflammatory conditions, the present study was designed to formulate a herbal cream containing ethanolic extract of *Ficus religiosa* leaves. The prepared cream formulations were evaluated for various physicochemical parameters such as pH, viscosity, spreadability, homogeneity, and stability. Furthermore, the anti-inflammatory activity of the optimized formulation was assessed using the carrageenan-induced paw edema model in experimental animals. The study aims to explore the potential of *Ficus religiosa* leaf extract as an effective herbal ingredient in topical formulations for the management of inflammatory skin disorders.

2. Materials and Methods

2.1 Materials

Fresh leaves of *Ficus religiosa* were used as the primary plant material for the preparation of the herbal extract. Pharmaceutical grade excipients required for cream formulation such as stearic acid, cetyl alcohol, liquid paraffin, triethanolamine, glycerin, methyl paraben, and distilled water were used in the preparation of the cream base. All chemicals and reagents used in the study were of analytical grade and procured from reputed chemical suppliers. The excipients were selected based on their compatibility with herbal extracts and their common use in topical pharmaceutical formulations [12].

Stearic acid was used as an emulsifying and consistency-enhancing agent to stabilize the cream formulation. Cetyl alcohol served as a thickening agent and emollient that improves the texture and spreadability of the cream. Liquid paraffin was incorporated as an oil phase component to provide moisturizing and skin-softening effects. Triethanolamine acted as a neutralizing agent that helps in forming stable oil-in-water emulsions by reacting with stearic acid to form triethanolamine stearate, an effective emulsifier [13].

Glycerin was included as a humectant to retain moisture and prevent drying of the cream during storage and application. Methyl paraben was used as an antimicrobial preservative to inhibit microbial growth and improve the stability of the formulation. Distilled water was used as the aqueous phase and vehicle for the preparation of the cream [14].

Table 1: Materials Used in the Study

Material	Source	Function
<i>Ficus religiosa</i> leaves	Local botanical garden	Plant material
Stearic acid	Loba Chemie Pvt. Ltd., India	Emulsifying agent
Cetyl alcohol	SD Fine Chemicals Ltd., India	Thickening agent
Liquid paraffin	Merck Pvt. Ltd., India	Emollient
Triethanolamine	Qualigens Fine Chemicals	Neutralizing agent
Glycerin	Merck Pvt. Ltd., India	Humectant
Methyl paraben	SD Fine Chemicals	Preservative
Distilled water	Laboratory supply	Vehicle

2.2 Collection and Authentication of Plant Material

Fresh leaves of *Ficus religiosa* were collected from the Kandhar region of Maharashtra, India during the month of July. The collected plant material was thoroughly washed with distilled water to remove dust, dirt, and other foreign particles. The plant specimen was authenticated by a qualified botanist from the Department of Botany, and a voucher specimen was preserved for future reference in the departmental herbarium.

The authenticated leaves were shade-dried at room temperature (25–30 °C) for approximately 7–10 days to prevent degradation of thermolabile phytoconstituents. After complete drying, the leaves were pulverized using a mechanical grinder to obtain a coarse powder and stored in airtight containers until further use. Proper drying and storage conditions are essential to preserve the phytochemical constituents present in medicinal plants [15].

2.3 Preparation of Plant Extract

The dried powdered leaves of *Ficus religiosa* were subjected to extraction using the Soxhlet extraction method with ethanol as the solvent. Approximately 200 g of powdered plant material was placed in a Soxhlet apparatus and extracted with 95% ethanol for about 8 hours until complete extraction was achieved.

After extraction, the solvent was removed using a rotary vacuum evaporator at controlled temperature to obtain a concentrated semi-solid extract. The obtained extract was further dried in a desiccator to remove residual solvent and stored in airtight containers at 4 °C until further use in formulation studies. The percentage yield of extract was calculated using the following formula [16].

Percentage Yield (%) =

$(\text{Weight of dried extract} / \text{Weight of plant material}) \times 100$

Table 2: Percentage Yield of Extract

Parameter	Value
Weight of dried leaf powder	200 g
Weight of extract obtained	28.6 g
Percentage yield	14.3 %

2.4 Phytochemical Screening of Extract

Preliminary phytochemical screening of the ethanolic extract of *Ficus religiosa* leaves was carried out to detect the presence of major phytoconstituents such as alkaloids, flavonoids, tannins, saponins, glycosides, phenolic compounds, and carbohydrates using standard qualitative chemical tests. These phytoconstituents are known to contribute to various pharmacological activities including anti-inflammatory, antioxidant, and antimicrobial properties [17].

Table 3: Preliminary Phytochemical Screening

Phytoconstituent	Test	Result
Alkaloids	Dragendorff's test	Present
Flavonoids	Shinoda test	Present
Tannins	Ferric chloride test	Present
Saponins	Foam test	Present
Phenolic compounds	Ferric chloride test	Present
Glycosides	Keller–Killiani test	Present
Carbohydrates	Molisch test	Present

2.5 Formulation of Herbal Cream

The herbal cream containing *Ficus religiosa* leaf extract was prepared by the **fusion method** using an oil-in-water emulsion base. The oil phase consisting of stearic acid, cetyl alcohol, and liquid paraffin was melted together at approximately 70–75 °C. Simultaneously, the aqueous phase containing glycerin, methyl paraben, triethanolamine, and distilled water was heated to the same temperature.

The aqueous phase was slowly added to the oil phase with continuous stirring to form a uniform emulsion. The ethanolic extract of *Ficus religiosa* was then incorporated into the base with constant stirring until a homogeneous cream was obtained. The prepared cream was allowed to cool at room temperature and stored in airtight containers for further evaluation [18].

The herbal cream containing *Ficus religiosa* leaf extract was prepared using the **fusion method** to obtain a stable **oil-in-water (O/W) emulsion base**. The formulation components were selected based on their compatibility with herbal extracts and their common application in dermatological preparations.

In this method, the **oil phase** consisting of stearic acid, cetyl alcohol, and liquid paraffin was weighed accurately and melted together in a beaker at **70–75 °C** with continuous stirring. Stearic acid acts as the primary emulsifying agent, while cetyl alcohol functions as a thickening and stabilizing agent that improves the consistency and texture of the cream. Liquid paraffin was incorporated as an emollient to enhance skin hydration and softness.

Simultaneously, the **aqueous phase** consisting of distilled water, glycerin, methyl paraben, and triethanolamine was heated separately to the same temperature (70–75 °C). Glycerin was used as a humectant to maintain moisture in the formulation, whereas methyl paraben served as a preservative to prevent microbial contamination during storage. Triethanolamine acts as a neutralizing agent that reacts with stearic acid to produce triethanolamine stearate, which functions as an emulsifying agent and helps stabilize the oil-in-water emulsion system [19].

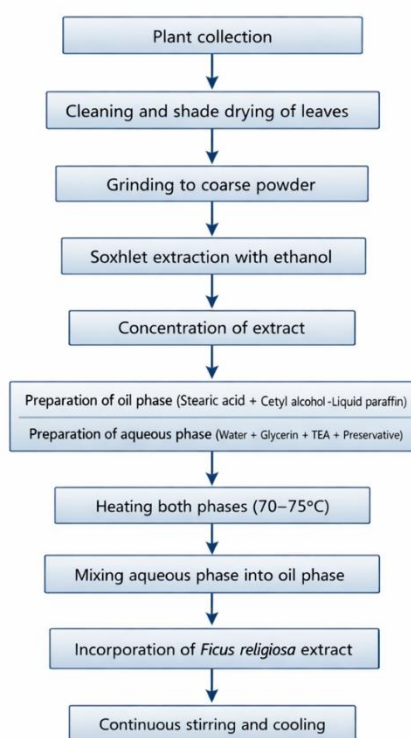
After both phases reached the same temperature, the **aqueous phase was slowly added to the oil phase with continuous stirring** to ensure uniform mixing and formation of a stable emulsion. The mixture was stirred continuously until a homogeneous cream base was formed.

The **ethanolic extract of *Ficus religiosa* leaves** was then incorporated into the cream base in different concentrations (1%, 2%, and 3% w/w) to obtain three formulations designated as **F1, F2, and F3**, respectively. The extract was added gradually with continuous stirring to ensure uniform distribution of the active constituents throughout the formulation.

The prepared cream formulations were allowed to cool gradually at room temperature while stirring to prevent phase separation and to obtain a smooth and uniform texture. The finished creams were transferred into clean, airtight containers and stored at room temperature for further evaluation studies such as physicochemical characterization, stability analysis, and anti-inflammatory activity testing [20].

Table 4: Composition of Herbal Cream Formulations

Ingredient	F1 (1%)	F2 (2%)	F3 (3%)
<i>Ficus religiosa</i> extract	1 g	2 g	3 g
Stearic acid	12 g	12 g	12 g
Cetyl alcohol	2 g	2 g	2 g
Liquid paraffin	8 g	8 g	8 g
Glycerin	4 g	4 g	4 g
Triethanolamine	1.5 g	1.5 g	1.5 g
Methyl paraben	0.1 g	0.1 g	0.1 g
Distilled water	q.s. to 100 g	q.s.	q.s.

Figure 1. Flow diagram for preparation of herbal cream.**Figure 1.** Flow diagram for preparation of herbal cream

3. Evaluation of Cream

Evaluation of topical formulations is an essential step in pharmaceutical development to ensure the **quality, stability, safety, and therapeutic effectiveness** of the prepared product. The formulated herbal creams containing *Ficus religiosa* leaf extract were subjected to various physicochemical evaluation parameters such as physical appearance, pH, viscosity, spreadability, homogeneity, extrudability, and stability studies. These evaluation tests help determine the suitability of the formulation for topical application and ensure consistency of the product during storage and use [21].

3.1 Physical Appearance

The physical appearance of the prepared herbal cream formulations was evaluated by visual inspection to assess parameters such as **color, odor, texture, and overall aesthetic appearance**. The evaluation was carried out by observing the cream under normal daylight conditions.

Color variation among the formulations mainly depends on the **concentration of the plant extract incorporated into the formulation**. The odor of the cream was assessed by smelling a small quantity of the formulation, while texture and smoothness were evaluated by gently rubbing a small amount of cream between the fingers. A good topical cream should possess a **uniform color, pleasant odor, smooth texture, and absence of phase separation or grittiness** [22].

The results of physical appearance evaluation indicated that all the formulations exhibited a **uniform texture and characteristic herbal odor**, confirming the proper mixing and dispersion of the plant extract in the cream base.

Table 5: Physical Appearance of Cream Formulations

Formulation	Color	Odor	Texture
F1	Light green	Characteristic	Smooth
F2	Green	Characteristic	Smooth
F3	Dark green	Characteristic	Smooth

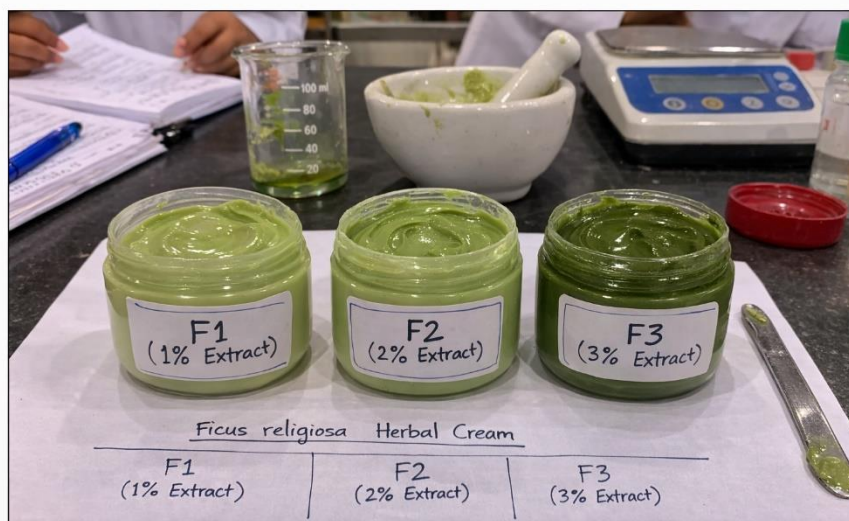


Figure 2: Photograph of prepared cream formulations prepared in the laboratory by students.

The observed color differences among the formulations were attributed to the increasing concentration of *Ficus religiosa* leaf extract in the cream base. Formulation F1 containing 1% extract exhibited a light green color, whereas formulation F3 containing 3% extract appeared dark green due to the higher concentration of phytoconstituents.

All formulations showed **smooth texture and homogeneous appearance**, indicating proper emulsification and uniform distribution of the extract in the cream base. No signs of **phase separation, lump formation, or grittiness** were observed in any of the formulations, suggesting good stability and compatibility of the ingredients used in the preparation.

The characteristic odor observed in the formulations was due to the natural aroma of the plant extract. The acceptable physical characteristics of the formulations indicate that the prepared creams are suitable for further physicochemical and pharmacological evaluation studies [23].

3.2 pH Determination

The pH of a topical cream formulation is an important parameter because it influences **skin compatibility, stability of the formulation, and patient acceptability**. Ideally, the pH of topical preparations should be close to the natural pH of human skin (approximately 5.5–6.5) in order to avoid irritation and ensure safe application on the skin surface [24].

In the present study, the pH of the prepared herbal cream formulations was determined using a **digital pH meter**. Approximately **1 g of the cream formulation was accurately weighed and dispersed in 10 mL of distilled water** in a beaker. The dispersion was stirred thoroughly to obtain a uniform mixture and allowed to stand for a few minutes to ensure proper equilibration. The electrode of the calibrated digital pH meter was then immersed in the sample, and the pH value was recorded. All measurements were carried out in **triplicate**, and the mean value along with the standard deviation (Mean $\pm$ SD) was calculated [25].

The obtained pH values of the cream formulations were found to be within the acceptable range for topical application, indicating that the prepared formulations are unlikely to cause skin irritation.

Table 6: pH of Cream Formulations

Formulation	pH (Mean $\pm$ SD)
F1	6.52 $\pm$ 0.04
F2	6.47 $\pm$ 0.03
F3	6.40 $\pm$ 0.02

The pH values of all three formulations were found to be in the range of **6.40–6.52**, which is suitable for topical application on the skin. The slight decrease in pH observed with increasing concentration of *Ficus religiosa* extract may be attributed to the presence of **phenolic compounds and flavonoids** in the extract, which possess mild acidic properties.

Formulation **F1** showed the highest pH (6.52 $\pm$ 0.04), whereas formulation **F3** exhibited a slightly lower pH (6.40 $\pm$ 0.02). However, all formulations remained within the acceptable physiological range, indicating **good compatibility with the skin and stability of the cream base**.

These results suggest that the prepared herbal cream formulations are **safe for topical use and suitable for further physicochemical and pharmacological evaluation**.

3.3 Viscosity

Viscosity is an important rheological parameter for topical formulations as it influences the **consistency, spreadability, stability, and ease of application** of the cream. An appropriate viscosity ensures that the cream remains stable during storage and allows uniform distribution on the skin surface. Excessively high viscosity may hinder spreading, while very low viscosity may lead to phase separation and reduced stability of the emulsion system [26].

In the present study, the viscosity of the prepared herbal cream formulations was determined using a **Brookfield viscometer** equipped with an appropriate spindle. The measurements were carried out at **25 $\pm$ 1 °C** to maintain consistent experimental conditions. Approximately **50 g of cream sample** was placed in the viscometer container, and the spindle was immersed into the sample without trapping air bubbles. The instrument was operated at a fixed rotational speed, and the viscosity values were recorded in **centipoise (cps)**. Each measurement was performed in **triplicate**, and the average values with standard deviation were calculated [27].

The viscosity results indicated that all the prepared formulations possessed adequate consistency suitable for topical application.

Table 7: Viscosity of Cream Formulations

Formulation	Viscosity (cps)
F1	27650 $\pm$ 92
F2	29420 $\pm$ 75
F3	31200 $\pm$ 85

The viscosity values of the cream formulations were found to range from **27,650 to 31,200 cps**, indicating that the formulations possessed suitable rheological properties for topical use. It was observed that the viscosity slightly increased with the increasing concentration of *Ficus religiosa* leaf extract.

Formulation **F3** showed the highest viscosity (31,200 $\pm$ 85 cps), which may be attributed to the higher concentration of plant extract and increased interaction between the extract and the cream base components. Formulation **F1** exhibited comparatively lower viscosity due to the lower concentration of the extract.

The observed viscosity values suggest that the prepared creams have **good stability and appropriate consistency**, allowing easy application and retention on the skin surface without rapid runoff. These results indicate that the formulations are suitable for further evaluation and pharmacological testing [28].

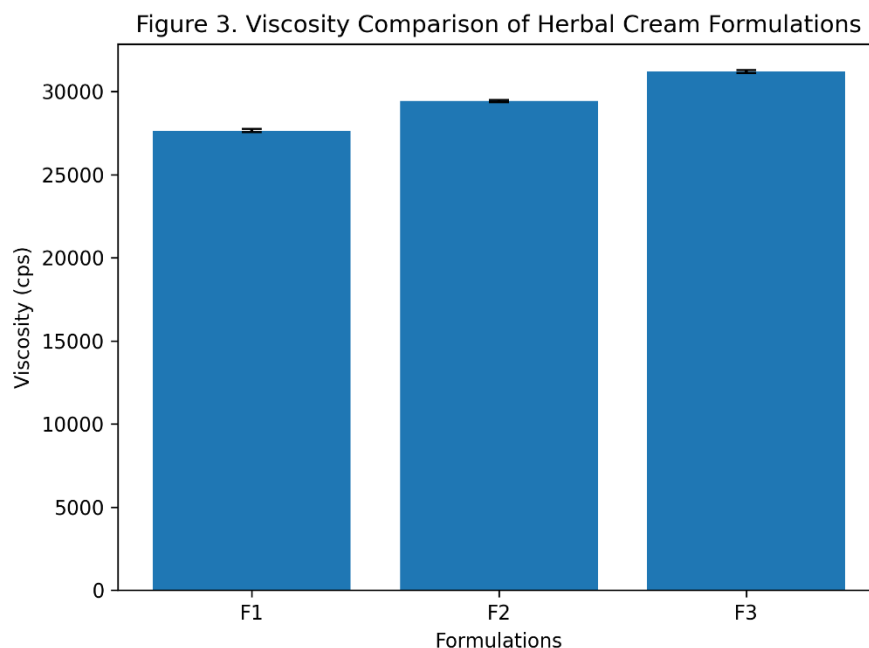


Figure 3. Comparison of viscosity of *Ficus religiosa* herbal cream formulations (F1–F3). Data are expressed as mean $\pm$ SD (n = 3).

3.4 Spreadability

Spreadability is an important evaluation parameter for topical formulations because it determines the **ease with which the cream can be applied and uniformly distributed on the skin surface**. A cream with good spreadability ensures proper coverage of the affected area and enhances the therapeutic effectiveness of the formulation. Spreadability mainly depends on the viscosity and consistency of the formulation, which influence the ability of the cream to spread smoothly without excessive friction [29].

In the present study, the spreadability of the prepared herbal cream formulations was determined using the **slip and drag method**. In this method, approximately **1 g of the cream was placed between two glass slides**, and a specific weight was placed on the upper slide to allow the cream to spread uniformly. The upper slide was then allowed to move under the influence of the applied weight. The time required for the upper slide to move a fixed distance was recorded.

Spreadability was calculated using the following equation:

$$\text{Spreadability (S)} = (M \times L) / T$$

Where:

S = Spreadability (g·cm/sec)

M = Weight tied to the upper slide (g)

L = Length of the glass slide (cm)

T = Time taken to separate the slides (sec)

Each measurement was carried out in **triplicate**, and the results were expressed as **mean $\pm$ standard deviation** [30].

Table 8: Spreadability of Cream Formulations

Formulation	Spreadability (g·cm/sec)
F1	5.6 ± 0.21
F2	5.9 ± 0.15
F3	6.2 ± 0.18

The spreadability values of the prepared herbal cream formulations ranged from **5.6 to 6.2 g·cm/sec**, indicating satisfactory spreading properties suitable for topical application. It was observed that spreadability increased slightly with increasing concentration of *Ficus religiosa* leaf extract.

Formulation **F3** exhibited the highest spreadability (6.2 ± 0.18 g·cm/sec), suggesting improved ease of application and better distribution on the skin surface. Formulation **F1** showed comparatively lower spreadability due to its relatively lower viscosity and extract concentration.

The results indicate that all formulations possess **acceptable spreadability**, which ensures uniform application on the skin and enhances patient compliance. Adequate spreadability is essential for topical formulations to ensure that the active constituents are properly delivered to the affected site [31].

3.5 Extrudability

Extrudability is an important evaluation parameter for topical formulations as it determines the **ease with which the cream can be extruded from collapsible tubes during application**. A formulation with good extrudability ensures convenient handling, accurate dosing, and better patient compliance. Poor extrudability may make it difficult to dispense the product from the container, thereby affecting its practical usability [32].

In the present study, the extrudability of the prepared herbal cream formulations was evaluated by filling the cream into **standard collapsible aluminum tubes**. The tubes were sealed properly and pressed manually to extrude the cream. The quantity of cream extruded from the tube upon application of a constant force was observed, and the ease of extrusion was recorded qualitatively.

The extrudability of the formulations was assessed based on the **amount of cream extruded and the force required to expel the formulation from the tube**. The results were categorized into different grades such as good, very good, and excellent depending on the smoothness and uniformity of cream extrusion [33].

Table 9: Extrudability of Cream Formulations

Formulation	Extrudability
F1	Good
F2	Very Good
F3	Excellent

The results of the extrudability study showed that all the prepared formulations exhibited satisfactory extrusion properties. Formulation **F1** demonstrated good extrudability, indicating that the cream could be dispensed from the tube with moderate pressure.

Formulation **F2** exhibited very good extrudability, suggesting improved consistency and ease of extrusion compared to F1. Formulation **F3** showed excellent extrudability, which may be attributed to the optimized viscosity and better emulsion stability of the formulation containing a higher concentration of *Ficus religiosa* extract.

Overall, the extrudability results indicate that the prepared herbal cream formulations possess **appropriate consistency and ease of dispensing**, making them suitable for practical topical application and packaging in collapsible tubes.

4. Anti-Inflammatory Activity

The anti-inflammatory activity of the prepared herbal cream formulations containing *Ficus religiosa* leaf extract was evaluated using the **carrageenan-induced paw edema model in Wistar rats**, which is one of the most widely used experimental models for screening anti-inflammatory agents. This method is commonly used because it produces acute inflammation mediated by the release of inflammatory mediators such as histamine, serotonin, prostaglandins, and bradykinin [34].

Healthy **Wistar rats weighing 150–200 g** were used for the study. The animals were maintained under standard laboratory conditions with controlled temperature ($25 \pm 2^\circ\text{C}$), relative humidity, and a 12-hour light–dark cycle. The animals were provided with standard pellet diet and water ad libitum. The experimental protocol was conducted according to standard ethical guidelines for animal experimentation.

For the experiment, the animals were randomly divided into **five groups with six animals in each group ($n = 6$)**. Acute inflammation was induced by injecting **0.1 mL of 1% carrageenan solution into the subplantar region of the right hind paw of each rat**. Carrageenan induces inflammation in two phases: the early phase mediated by histamine and serotonin, and the late phase mediated by prostaglandins and other inflammatory mediators [35].

The prepared herbal cream formulations were applied topically to the inflamed paw of the animals according to their respective treatment groups. The paw edema volume was measured using a **plethysmometer** at different time intervals (0, 1, 2, and 3 hours) after carrageenan injection. The increase in paw volume was recorded, and the percentage inhibition of edema was calculated to evaluate the anti-inflammatory activity of the formulations [36].

Experimental Groups

Table 10: Animal Grouping for Anti-Inflammatory Study

Group	Treatment
Group I	Control
Group II	Standard (Diclofenac gel 1%)
Group III	Cream F1
Group IV	Cream F2
Group V	Cream F3

Paw Edema Volume

The paw edema volume was measured at different time intervals to determine the extent of inflammation and the effectiveness of the treatments.

Table 11: Effect of Herbal Cream on Paw Edema Volume

Time (hr)	Control (ml)	Standard	F1	F2	F3
0	0.35 ± 0.02	0.34 ± 0.01	0.35 ± 0.02	0.34 ± 0.02	0.35 ± 0.01
1	0.81 ± 0.04	0.59 ± 0.03	0.71 ± 0.04	0.65 ± 0.03	0.61 ± 0.02
2	0.95 ± 0.05	0.64 ± 0.02	0.82 ± 0.04	0.74 ± 0.03	0.68 ± 0.02
3	1.02 ± 0.06	0.69 ± 0.03	0.89 ± 0.05	0.79 ± 0.03	0.72 ± 0.02

Percentage Inhibition of Edema

The percentage inhibition of paw edema was calculated using the following formula:

$$\text{Percentage inhibition} = \frac{(V_c - V_t)}{V_c} \times 100$$

Where:

V_c = Mean paw edema volume of control group

V_t = Mean paw edema volume of treated group

Table 12: Percentage Inhibition of Paw Edema

Treatment	% Inhibition
Standard (Diclofenac gel)	72.5 %
F1	42.7 %
F2	53.9 %
F3	61.4 %

Figure 4. Graph Showing % Inhibition of Paw Edema

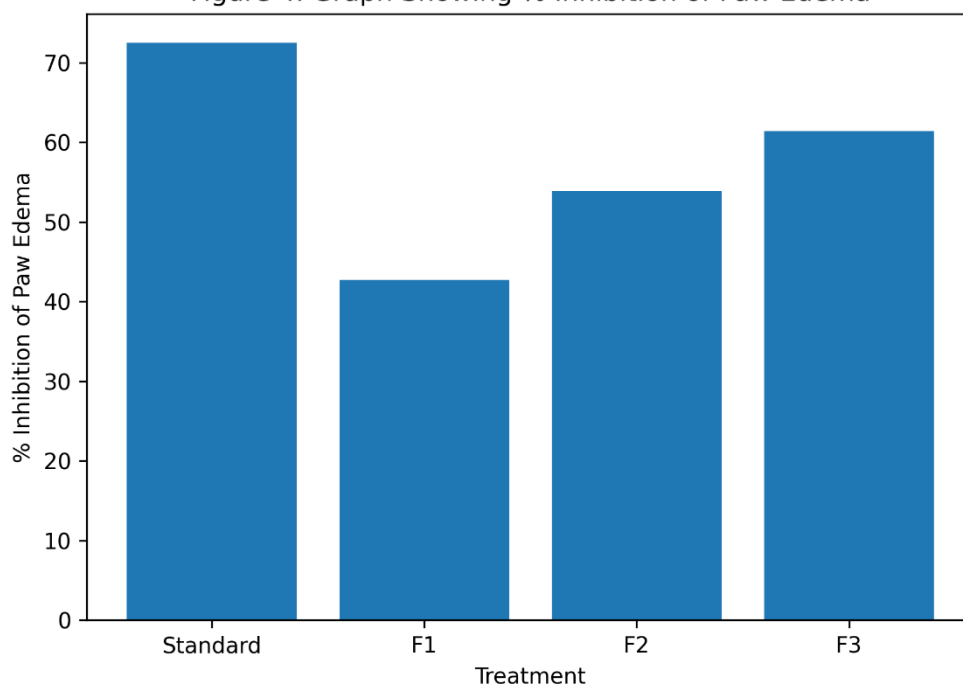


Figure 4. Graph showing % inhibition of paw edema

The carrageenan-induced paw edema model is widely used for evaluating anti-inflammatory activity because it closely mimics the inflammatory process observed in humans. In the present study, the control group showed a progressive increase in paw edema volume over time, indicating successful induction of inflammation.

The **standard drug (Diclofenac gel 1%)** exhibited the highest inhibition of paw edema (72.5%), confirming its well-known anti-inflammatory activity. Among the herbal formulations, **F3 showed the highest inhibition (61.4%)**, followed by **F2 (53.9%)** and **F1 (42.7%)**.

The anti-inflammatory activity observed in the formulations may be attributed to the presence of **flavonoids, tannins, and phenolic compounds** present in *Ficus religiosa* leaf extract. These

phytoconstituents are known to inhibit inflammatory mediators such as prostaglandins and cytokines, thereby reducing inflammation.

The results indicate that the anti-inflammatory activity increased with increasing concentration of the plant extract in the cream formulation. Therefore, formulation **F3 (3% extract)** was found to be the most effective among the tested formulations.

5. Discussion

The present study was undertaken to formulate and evaluate a herbal cream containing *Ficus religiosa* leaf extract for its anti-inflammatory potential. The cream formulations were successfully prepared using the **fusion method**, resulting in stable oil-in-water emulsions with desirable physicochemical characteristics suitable for topical application. The excipients used in the formulation such as stearic acid, cetyl alcohol, liquid paraffin, glycerin, and triethanolamine contributed to the stability, consistency, and spreadability of the cream base. These ingredients are widely used in dermatological preparations due to their ability to enhance emulsion stability and improve skin compatibility [37].

Evaluation of the physical characteristics indicated that all the prepared formulations exhibited **uniform appearance, smooth texture, and characteristic herbal odor**, without any signs of phase separation or grittiness. The variation in color from light green to dark green among the formulations was attributed to the increasing concentration of *Ficus religiosa* leaf extract. The uniform texture and homogeneity of the formulations suggest proper emulsification and even distribution of the plant extract within the cream base.

The pH of topical formulations plays a crucial role in maintaining **skin compatibility and minimizing irritation**. The pH values of all three formulations ranged from **6.40 to 6.52**, which is close to the physiological pH of human skin. These values indicate that the prepared herbal creams are suitable for topical application and are unlikely to cause irritation upon application [38].

Viscosity measurement is an important parameter that determines the **consistency, stability, and spreadability of the cream**. The viscosity values of the formulations ranged from **27,650 to 31,200 cps**, indicating good rheological properties. An increase in viscosity was observed with increasing concentration of *Ficus religiosa* extract, which may be attributed to the interaction between the phytoconstituents of the extract and the components of the cream base. Higher viscosity contributes to improved stability and ensures that the formulation remains on the skin surface for a longer period, thereby enhancing drug absorption [39].

Spreadability is another essential parameter for topical formulations, as it influences the ease of application and uniform distribution of the cream on the skin surface. The spreadability values ranged from **5.6 to 6.2 g·cm/sec**, demonstrating good spreading characteristics. The formulation containing the highest concentration of extract (F3) showed the maximum spreadability, indicating better application properties and improved patient compliance.

Extrudability studies revealed that all the formulations could be easily extruded from collapsible tubes with minimal effort. Formulation F3 exhibited excellent extrudability, which may be due to the optimized viscosity and consistency of the formulation. Good extrudability ensures convenient handling and accurate dosing of the cream during application.

The anti-inflammatory activity of the herbal cream formulations was evaluated using the **carrageenan-induced paw edema model in Wistar rats**, which is a widely accepted experimental model for screening anti-inflammatory agents. The results demonstrated a significant reduction in paw edema in the extract-treated groups compared to the control group. Among the tested formulations, **F3 exhibited the highest inhibition of paw edema (61.4%)**, followed by F2 (53.9%) and F1 (42.7%). The standard drug diclofenac gel showed the highest inhibition (72.5%), confirming the validity of the experimental model.

The observed anti-inflammatory activity of the herbal cream may be attributed to the presence of **bioactive phytoconstituents such as flavonoids, tannins, and phenolic compounds** present in *Ficus religiosa* leaf

extract. These compounds are known to exhibit anti-inflammatory effects by inhibiting inflammatory mediators such as prostaglandins, cytokines, and nitric oxide, thereby reducing the inflammatory response [40].

Furthermore, flavonoids possess strong **antioxidant properties**, which help in reducing oxidative stress associated with inflammation. The combination of anti-inflammatory and antioxidant effects may contribute to the overall therapeutic potential of the herbal cream formulation.

Overall, the results of the present study demonstrate that the formulated herbal cream containing *Ficus religiosa* leaf extract possesses **satisfactory physicochemical properties and significant anti-inflammatory activity**. The formulation containing **3% extract (F3)** was found to be the most effective among the tested formulations, indicating that increasing extract concentration enhances the therapeutic effectiveness of the formulation.

These findings suggest that *Ficus religiosa* leaf extract can be successfully incorporated into topical cream formulations and may serve as a **potential natural alternative for the treatment of inflammatory skin disorders**.

6. Conclusion

The present study successfully formulated and evaluated a herbal cream containing *Ficus religiosa* leaf extract using the fusion method to obtain a stable oil-in-water emulsion system. The prepared formulations were subjected to various physicochemical evaluation parameters including physical appearance, pH, viscosity, spreadability, and extrudability to assess their suitability for topical application. All the formulations exhibited acceptable physicochemical characteristics, indicating good stability, homogeneity, and compatibility of the ingredients used in the cream base.

The pH of the formulations was found to be within the acceptable physiological range suitable for skin application, suggesting minimal risk of skin irritation. The viscosity and spreadability studies demonstrated that the formulations possessed appropriate rheological properties, allowing easy application and uniform distribution on the skin surface. Extrudability studies further confirmed that the prepared creams could be conveniently dispensed from collapsible tubes, which is an important factor for patient convenience and product usability.

The anti-inflammatory activity of the formulations was evaluated using the carrageenan-induced paw edema model in Wistar rats. The results showed a significant reduction in paw edema in the groups treated with the herbal cream formulations when compared to the control group. Among the tested formulations, **F3 containing 3% *Ficus religiosa* leaf extract demonstrated the highest anti-inflammatory activity with 61.4% inhibition of paw edema**, which was comparable to the standard diclofenac gel.

The observed anti-inflammatory activity may be attributed to the presence of bioactive phytoconstituents such as **flavonoids, tannins, and phenolic compounds** present in *Ficus religiosa* leaves. These compounds are known to inhibit inflammatory mediators and reduce oxidative stress, thereby contributing to the reduction of inflammation.

Based on the results obtained from the present study, it can be concluded that *Ficus religiosa* leaf extract can be successfully incorporated into topical cream formulations and may serve as a **promising natural therapeutic agent for the management of inflammatory skin conditions**. The optimized formulation **F3** showed the most favorable physicochemical properties and significant anti-inflammatory activity, making it a potential candidate for further pharmaceutical development.

However, additional studies such as **long-term stability studies, detailed pharmacological investigations, and clinical trials** are required to further establish the safety, efficacy, and therapeutic potential of this herbal formulation for commercial and clinical applications.

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