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# "SHOTHAGEL: A SYNERGISTIC HERBAL GEL APPROACH USING BOSWELLIA SERRATA AND CURCUMA LONGA FOR TOPICAL INFLAMMATION THERAPY"

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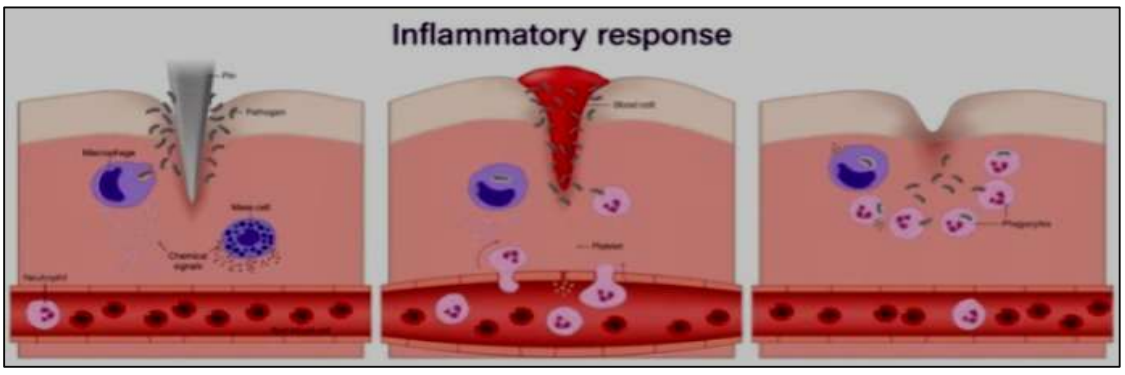
## ABSTRACT

This study was carried out to develop and evaluate a herbal anti-inflammatory gel using Boswellia serrata and Curcuma longa. The main goal was to create a natural and safe topical treatment that can help reduce inflammation and relieve pain. These two medicinal plants are widely known for their strong healing properties, including anti-inflammatory, antioxidant, and pain-relieving effects, which make them highly suitable for use in a gel formulation. The gel was prepared using a suitable base to ensure it has a smooth texture, spreads easily on the skin, and does not cause irritation. The plant extracts were carefully combined to enhance their overall effectiveness. After preparation, the gel was tested for important parameters such as appearance, pH, viscosity, spreadability, and stability to ensure its quality and performance. The anti-inflammatory activity of the gel was evaluated using a membrane stabilization method. The results showed that the formulation effectively protected red blood cells from damage, indicating good anti-inflammatory action. Stability testing also confirmed that the gel remains stable under different storage conditions. Overall, the developed herbal gel showed encouraging results, with good effectiveness, stability, and user acceptability. It can be considered a natural and safer alternative to synthetic topical anti-inflammatory products.

**Keywords:** Anti-inflammatory gel; Boswellia serrata*;* Curcuma longa; Herbal formulation; Membrane stabilization; Natural therapy; Topical drug delivery

## 1. INTRODUCTION

### 1.1. Inflammation




**[figure 1: inflammation response]**

Inflammation is a defensive response of cell defense system, happens when the body reacts to infection, injury, destruction of cells, or irritation to tissues [1,2]. During the inflammation process, the injured area may appear red, warm, swollen, and painful. Sometimes, the normal function of a part of the body is temporarily reduced. This reaction helps the body to remove toxic stimuli and start repair of the affected area [1,3]. However, when this response becomes out of control it can cause more toxic problems than the original problems. Anti-inflammatory drugs are the most important drugs in medical treatment because they are broadly used to treat diseases like arthritis, lupus, pemphigus, rheumatic fever, pain, fever (pyrexia), and swelling [3].

Inflammation occurs in three main stages:

1. Increased blood flow and fluid leakage at the injured area
2. Movement of leukocytes to kill microorganisms and remove damaged tissue
3. Healing and regulate the affected tissue [6].

**Signs of inflammation**

A. Redness (Rubor): Caused by increased blood flow to the affected area
B. Swelling (Tumor): Due to accumulation of fluid in the tissues
C. Heat (Calor): The area feels warm because of increased circulation
D. Pain(Dolor): Results from pressure on nerves and release of certain chemicals
E. Loss of functions (Function laesa): Difficulty in utilizing the affected part because of pain and inflammation

**Causes of the inflammation**

Inflammation can be triggered by the different types of factors.

1. Physical causes – include extreme heat or cold, radiation exposure, and physical injury such as cuts and stroke.
2. Chemical causes – include exposure to toxic substances including various poisons and irritants.
3. Infections causes – rush by microorganisms like bacteria, viruses, and the toxins produce by them [6,8].

### 1.1.1. Types of the inflammation

There are five main types of the inflammation:

**A) Acute inflammation-** A short-term and sudden response to any harm or germs. It produces redness, swelling, heat, and pain. Example: cut or sore throat.
**B) Chronic inflammation-** A Long-lasting inflammation that may continue for months or years. It can harm tissues and is detect in diseases like Rheumatoid arthritis.
**C) Sub acute inflammation-** Lasts longer than acute inflammation but not long as chronic inflammation. This occurs during the healing stage.
**D) Muscular inflammation-** Restricted to muscles of the body.
**E) Systemic inflammation-**Influence the entire body and it may produce fever and weakness[6,7,8].

Many anti-inflammatory medicines including NSAIDs (non-steroidal anti-inflammatory drugs) and corticosteroids have been developed which can have many side effects and are not completely safe [3,2]. Because of growing concern about the side effects of synthetic drugs, many people are turning to natural remedies such as ginger, turmeric, boswellia, olive oil, aloe vera, which have strong anti-inflammatory activity [3,4].

Boswellia serrata is a medicinal plant from the Burseraceae family, commonly used in traditional unani medicine. It is used in treating asthma, cough, fever and joint problems and mainly known for anti-inflammatory, anti-arthritic, pain-relieving, etc. properties [3]

Curcuma Longa belongs to the Zingiberaceae family. It has been used since ancient times and is known for its anti-inflammatory and protective effects. It helps in managing conditions like cancer, depression, heart disease [4].

## 1.2. Introduction of herbal gels

**Definition**

The word **"gel"** comes from the Latin word *gelu*, which means **"frost" or "cold"** [5].

According to the United States Pharmacopeia (USP), gels-also known as jellies are semi-solid preparation in which a liquid is trapped within a three-dimensional network formed by either tiny inorganic particles or large organic molecules. This network structure holds the liquid inside it giving the product a thick, jelly-like consistency [5,6,8].

### 1.2.1: Classification of the gels

Gels are mainly classified into three methods based on:

**1. Based on the colloidal phases**

**A) Inorganic gels**

- It is a two-phase system containing two separate phases in which small solid particles are dispersed in a liquid.
- These particles form a three-dimensional network.
- The system may not always be stable.

**B) Organic gels**

- It is a single-phase system containing only one continuous phase.
- This system is made of large natural or synthetic polymer molecules.
- These molecules tangle or attract each other (through weak intermolecular forces) to form a gel structure [5,6,8].

**2. Based on the nature of solvent**

**A) Hydrogels**

- These are water-based gels (aqueous gels) in which water is the only liquid.
- It is made of water-loving polymers.
- It is highly absorbent and soft like natural tissues.

**B) Organogels**

- These are Non-aqueous gels made using oils or organic solvents.
- The liquid was trapped inside a 3D network.
- Example liquids include vegetable oil, and mineral oil.
- The structure affects firmness and elasticity [13,5,6,8].

**C) Xerogels**

- It is formed when a gel is dried.
- Porous solids with large surface areas.
- An **aerogel is formed** when dried under specific conditions**.**

**3. Based on the rheological properties**

**A) Plastic gels**

- They do not flow until a certain force (yield value) is applied.
- Example: Aluminum hydroxide gel.

**B) Pseudoplastic gels**

- The viscosity decreased when the shear force increased.
- No yield value.
- Example: Tragacanth, sodium alginate, and sodium CMC.

**C) Thixotropic gels**

- It becomes liquid upon shaking.
- The gel returned to its original form when left undisturbed.

- Example: Kaolin, bentonite, agar [5,6,8].

### 1.2.2: Properties of gels

- **A gelling agent used in pharmaceutical or cosmetic products should be safe, non-toxic, stable, and should not chemically interact with other ingredients in the formulation.**
- **The gel should remain firm and stable** during storage**, but it must become smooth and easy to spread when pressure is applied, such as shaking, squeezing, or rubbing on the skin.**
- **The formulation should** provide adequate **protection against microorganisms to avoid contamination and spoilage.**
- **A gel** intended **for skin application should feel smooth and non-sticky after use.**
- **Gels prepared for eye application must be completely sterile to ensure safety and prevent infection [9].**

### 1.2.3: Advantages of topical gel formulations

- Medicines are delivered directly through the skin for better local or systemic action.
- Avoid problems related to stomach acid, digestive enzymes, and food interactions.
- It is useful when oral medicines cannot be administered.
- Bypassing first-pass metabolism in the liver reduces drug breakdown.
- It is painless and easy to apply, improving patient compliance.
- It is non-sticky, light, and easy to wash off.
- They are economical compared to many other dosage forms.
- It may require lower doses than the oral form.
- Provide targeted action at the application site with fewer side effects [5,6,8].

### 1.3: Types of herbal formulations

**1. Traditional preparations**
- These are age-old formulations used in systems such as Ayurveda.
- Examples include Herbal powders such as Churna, medicated oils such as Taila, etc.

**2. Conventional dosage forms**
- Herbal ingredients are also made into tablets, capsules, syrups, creams, etc. to ensure proper dosing, stability, and ease of use.

**3. Advanced or novel formulations**
- Modern technologies are used to enhance the effectiveness of herbal drugs.
- These include phytosomes, liposomes, niosomes, patches, herbal gels, hydro gel etc. which improve absorption and therapeutic action [9,10].

### 1.4: Mechanism of action of phytopharmaceutics

**1) Curcuma longa**

**a. Anti-inflammatory effects**

Curcuma Longa blocks COX (Cyclo-oxygenase) and LOX (Lipoxygenase) enzymes, which reduces inflammatory chemicals like prostaglandins and leukotrienes.

It also lowers cytokines (TNF-α, IL-1, IL-6) by suppressing NF-κB [2,11].

**b. Antioxidant effects**

Neutralizes harmful free radicals (ROS) and boosts the body's natural antioxidant defense system (Nrf2 pathway) [12].

**2) Boswellia serrata**

**a. Specific action:**

Boswellic acid Blocks 5-LOX (5-Lipoxygenase) enzyme, lowering leukotrienes formation and reducing inflammation.

**b. Cytokine control**

Decreases inflammatory mediators like IL-1, IL-6, and TNF-α.

**c. Other effects:**

Inhibits complement activation and reduces oxidative enzyme activity [2,11,12].

### 1.5: Review of literature

#### 1.5.1 Literature review on inflammation

**Gaikwad, Vaishnavi V., Sameeksha R. Gitaje, Saurabh D. Joshi, Shrirang V. Kharmate, Dipak R. Phalle, Mrudula P. More, Mrunal A. Mali, and Pratibha P. Shingade (2025)** highlights the two main types of inflammation acute and chronic along with their causes, key biological mechanisms, diagnosis (CRP, ESR, IL-6), inflammatory response in various organs such as Brain, Liver, Lung, Gastrointestinal Tract, etc., and chronic diseases like cancer, cardiovascular diseases, Rheumatoid Arthritis, etc. can become worse when inflammation in the body is not properly controlled [14].

**Noor Jameel, Aradhana Dwivedi, Mohammad Khushtar, Md. Faheem Haider, Md. Nematullah, Md. Azizur Rahman. Biomed. Res. Ther (2025)** presents current information about inflammation and its treatment and it also explains the role of immune cells, chronic inflammation, available therapies like NSAIDs and biologics, highlights the importance of personalized medicine to improve outcomes in inflammatory diseases [15].

#### 1.5.2: Literature review on herbal gels

**Mohammad Faizan, Anuj Kumar Sharma, Mohd Murad Azmi, Naina Srivastava, Kailash Bihari, Vinod Kumar Gautam (2023)** states that herbal gels can be formulated using various techniques, including flocculation processes, temperature-induced changes, and specific chemical reactions. They also explain that these gels are assessed through several evaluation tests such as measuring pH, checking uniformity, analyzing viscosity, and determining spreadability. In addition, physicochemical characteristics like color, smell, and stability are examined to ensure the quality and performance of the formulation [16].

**Loveleen Preet Kaur, Tarun Kumar Guleri (2013)** reviews topical gel as recent approach for novel drug delivery system. Topical gel drug delivery is a way of applying medicine directly to a particular part of the body where treatment is needed. The drug is incorporated into a semi-solid gel base and used on areas such as the skin, eyes, rectum, or vagina. This approach mainly produces its effect at the site of application, which helps limit the amount of drug reaching the rest of the body and reduces unwanted side effects. Gel formulations help improve drug absorption and effectiveness. They also support the development and evaluation of new herbal anti-inflammatory gels, providing better treatment outcomes and improving patient compliance [9].

#### 1.5.3: Literature review on curcuma longa

**Satruhan and DK Patel (2022)** states that Curcuma longa (turmeric) has been used for many years in traditional systems like Unani medicine due to its healing properties. Modern research, such as laboratory studies, animal studies, and clinical trials, supports these traditional uses. The main active compound, curcumin, has been found to be safe, affordable, and useful in treating different health conditions. However, even with many studies available, the full medical potential of turmeric is still not completely understood, so more research is needed [17].

**Dutta RN. Aesthet Int. (2023)** reviews Curcuma longa (turmeric) is a medicinal spice traditionally used in Ayurveda and Chinese medicine. Its main active compound, curcumin, has been widely studied for its anti-inflammatory and antioxidant properties. Research suggests it may help in arthritis, lipid disorders, metabolic syndrome, and may also support physical performance and recovery, even at low doses [18].

#### 1.5.4: Literature review on boswellia serrata

**Huang et al. (2022)** various species of Boswellia, including Boswellia serrata, have long been utilized in ancient medical systems like Ayurveda, Chinese medicine, and Persian medicine. Numerous bioactive compounds, particularly terpenoids and boswellic acids, are responsible for the therapeutic effects of the plant's resin. These compounds have been shown to have significant anti-inflammatory, antioxidant, and anti-tumor properties in studies. Inhibition of enzymes like lipoxygenase and cyclooxygenase and suppression of inflammatory mediators like cytokines and NF-B pathways are primarily responsible for the anti-inflammatory effect. By reducing oxidative stress and controlling inflammatory responses, further research indicates that Boswellia extracts can assist in the management of chronic conditions such as cardiovascular diseases, diabetes, neurodegenerative disorders, and inflammatory diseases. However, the authors highlight that more studies are required to understand its long-term safety and pharmacokinetics [19].

**Yu et al. (2020)** analyzed multiple studies to evaluate the effectiveness of Boswellia serrata in treating osteoarthritis. Their findings indicated that Boswellia extract can significantly ease pain, decrease stiffness, and improve joint mobility. These effects are largely linked to boswellic acids, particularly AKBA, which block inflammatory pathways such as 5-lipoxygenase. The review also found that Boswellia is safe and well tolerated, even when taken in higher amounts. Compared to conventional NSAIDs, it shows fewer side effects. Therefore, it may serve as a safer and beneficial option for managing joint inflammation when used regularly over time [20].

### 1.6. Novelty of the study

The present study focuses on the development of a synergic herbal gel combining boswellia serrata and curcuma longa, which provides enhanced anti-inflammatory activity compare to individual extract and offers a promising alternative for topical therapy.

### 1.7. Objective

- To formulate herbal anti-inflammatory gel using Boswellia serrata and Curcuma longa
- To evaluate physicochemical properties
- To study in-vitro anti-inflammatory activity
- To check synergistic effect

## 2. MATERIALS AND METHODS

### 2.1. Authentication of plant materials

- **Selection of plants materials**
  The powder of Boswellia and Curcuma Longa were purchased from the local market, Bhavnagar, Gujarat, India.
- **Selection of other materials**
  Carbopol, HPMC, Methyl Paraben, Propyl Paraben, Tri-ethanolamine were collected from local store, Bhavnagar, Gujarat, India.

### 2.2. Preparation of the extracts

Extract of Boswellia was obtained by using methanol as solvent by hot extraction method. Weigh Twenty grams of powder of boswellia resin and added to the methanol in round bottom flask and extract for 6-7 hours using soxhlet apparatus [21,22].

Curcuma Longa extract was obtained by maceration process. Weigh 10gm powder of curcuma longa and extract with methanol for 72 hours with occasional stirring. Filter the extract; evaporate solvent using water bath and dry completely [23].

**[figure 2: soxhlet apparatus for extraction]**

### 2.3. Preparation of herbal gel

Required quantity of HPMC was accurately weighted and sprinkled slowly into a measured quantity of distilled water and stir the mixture continuously on a magnetic stirrer until uniform dispersion is obtained. Kept undisturbed for 24 hours to ensure complete hydration. Accurately weighed carbopol 934 added slowly into the heated distilled water at 65-70℃ without stirring and keep the dispersion undisturbed for 24 hours to allow complete swelling and hydration [3, 22]. After 24 hours, both hydrated HPMC and Carbopol dispersion were heated separately to about 70℃. Once both reach the same temperature, the HPMC solution was slowly added to the carbopol dispersion with continuous stirring using a magnetic stirrer. After mixing, add half or one drop of triethanolamine (TEA). Continue stirring until a uniform and homogenous gel base obtained then add boswellia and curcuma longa extract to the gel base with continuous stirring. Methyl Paraben, Propyl Paraben as preservatives were added slowly with continuous stirring [22].

**[table no. 1: composition of formulation]**

| Sr. No. | Ingredients | F1 | F2 | F3 | F4 | F5 |
|---|---|---|---|---|---|---|
| 1. | Extract of Boswellia | 100 mg | 100 mg | 150 mg | 150 mg | 150 mg |
| 2. | Extract of Curcuma Longa | 150 mg | 100 mg | 100 mg | 150 mg | 100 mg |
| 3. | Carbopol 934 | 0.5 gm | 1 gm | 1 gm | 1.5 gm | 1.5 gm |
| 4. | HPMC | 1 gm | 0.5 gm | 1 gm | 1 gm | 1.5 gm |
| 5. | Triethanolamine | q.s. | q.s. | q.s. | q.s. | q.s. |
| 6. | Methyl Paraben | 0.02% | 0.10% | 0.2% | 0.30% | 0.20% |
| 7. | Propyl Paraben | 0.02% | 0.01% | 0.02% | 0.02% | 0.02% |
| 8. | Distilled Water | Upto 100ml | Upto 100ml | Upto 100ml | Upto 100ml | Upto 100ml |

## 3. RESULTS AND DISCUSSION

The F3 formulation given best result for pH, appearance, viscosity, etc.

**[table no 2: result]**

| Parameter | F1 | F2 | F3 | F4 | F5 |
|---|---|---|---|---|---|
| **Appearance** | Smooth but slightly thin | Smooth | Smooth | Thick | Thick, stiff gel |
| **Colour** | Pale yellow | Pale yellow | Pale yellow | Yellow | Dark yellow |
| **Odour** | Characteristic | Characteristic | Characteristic | Characteristic | Characteristic |
| **Homogeneity** | Good | Good | Excellent | Excellent | Excellent |
| **pH** | 6.20 | 6.10 | 5.99 | 5.85 | 5.75 |
| **Viscosity (mPa·s)** | 980 | 1205 | 1461.3 | 1750 | 1980 |
| **Spreadability (g·cm/s)** | 0.52 | 0.44 | 0.35 | 0.28 | 0.22 |
| **Stability Study** | Passed (28 days) at 25±2°C | Passed (28 days) at 25±2°C | Passed (28 days) at 25±2°C | Passed (28 days) at 25±2°C | Passed (28 days) at 25±2°C |

### 3.1. pH

A digital pH meter calibrated at 25 ± 2°C was used to measure the pH of each formulation, which consisted of one gram dissolved in ten milliliters of distilled water. Prior to measurement, buffer solutions of pH 4.0 and 7.0 were used to standardize the pH meter [24]. pH of prepared gel formulation was found to be 5.99 The formulation maintain pH in range of 5.8-6.3, which is physiologically compatible with skin (pH 5.5-7.0).


**[figure 3: pH measurement]**

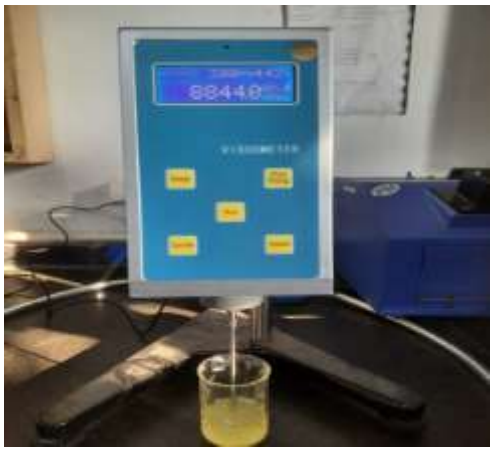
### 3.2. Appearance

Under sufficient light, the prepared gel formulations were examined for clarity, homogeneity, color consistency, and the presence of any undissolved particles or phase separation. Additionally, the presence of air bubbles or lumps in each formulation was investigated by visual observation [25]. The appearance of the gel formulation was uniform, homogeneous, and pale yellow to translucent, with no visible particles, lumps, or phase separation. Curcuminoids derived from Curcuma longa naturally pigment the plant, resulting in the characteristic pale to deep yellow color.

**[figure 4: appearance]**

### 3.3. Viscosity

A Brookfield Digital Viscometer with spindle No. 4 was used to measure the viscosity of each gel formulation at different RPM and 25 ± 2°C [26].Viscosity of herbal gel at 30 rpm, was found to be 8844 mPa·s.



**[figure 5: viscosity]**

### 3.4. Spreadability

Spreadability was determined using the parallel-plate method. The gel, which was contained in a predetermined quantity of 1 g, was covered by a second glass plate. A standard weight of 100 g was used for 60 seconds. Two perpendicular axes were used to measure the spread's diameter. Spreadability was calculated as:
S = M. L / T
Where,

M is the applied weight in grams, L is the spread length in centimetres, and T is the time in seconds [27].

Spreadability of prepared gel was measured by using the parallel-plate method. Spreadability of prepared gel was found to be 0.35 g·cm/s.

### 3.5. Anti- Microbial activity

Microbial testing was performed to detect the presence of microorganisms such as bacteria, fungi, etc. in a formulation to ensure that the product is safe, free from contamination, and suitable for use [28]. Zone of inhibition of prepared gel was found to be 2mm to 10 mm. We also perform microbial test by streak plate method where gel was applied in half portion of the plate and half portion is without gel. In gel portion there was less microbial growth than other portion.

**[figure 6: streak plate method]**

**[figure 7: zone of inhibition]**

### 3.6. Stability study

A stability study examines how a product maintains its effectiveness, safety, and quality over time in various storage conditions. It assists in determining the product's storage requirements and shelf life [27].The stability study was carried out for 30 days and during this time periodic evaluation of appearance, pH, Viscosity of gel was carried out.

**[table no 3: stability study of gel]**

| Days | Temperature | Change in Appearance |
|---|---|---|
| 0 | 25±2°C | No |
| 7 | 25±2°C | No |
| 14 | 25±2°C | No |
| 21 | 25±2°C | No |
| 30 | 25±2°C | No |

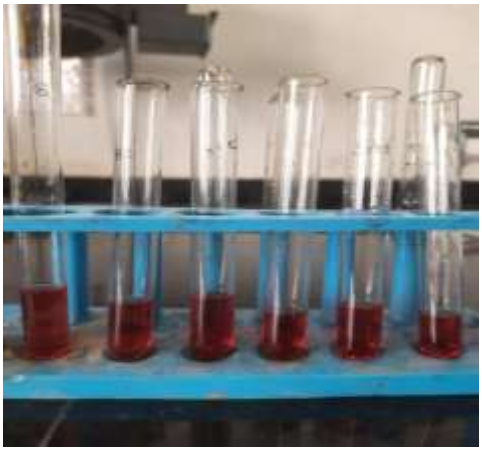
### 3.7. In Vitro Anti-inflammatory assay

In vitro anti-inflammatory assay carried out by membrane stabilisation method. This test is used to check the anti-inflammatory potential of a sample by observing its ability to protect red blood cell membranes from damage. Inflammation can lead to the weakening and rupture of lysosomal membranes, resulting in the release of harmful enzymes. The membrane of human red blood cells (HRBCs) closely resembles that of lysosomes, making it a useful model for study. Compounds that protect RBCs from breaking down in a hypotonic environment are therefore considered to have anti-inflammatory properties. Curcumin and Boswellia help

maintain the stability of the RBC membrane and limit the release of hemoglobin, which reflects their potential to act as anti-inflammatory agents [29, 30].

The in vitro study showed that the combination of Curcuma longa and Boswellia serrata effectively stabilized RBC membranes by reducing haemolysis in a hypotonic solution. The activity followed the order: **Standard > Combination > Curcumin > Boswellia.**

Lower absorbance indicated less haemolysis and higher anti-inflammatory activity, while higher absorbance indicated greater haemolysis and lower activity. The combination showed better effect than individual extracts due to synergistic action.



**[figure 8: anti-inflammatory assay]**

**[table no 4: absorbance of different concentration]**

| Group | Absorbance (560nm) |
|---|---|
| Standard (50µg/ ml) | 0.277 |
| Standard (100µg/ml) | 0.480 |
| Curcuma + Boswellia (50µg/ml) | 0.569 |
| Curcuma + Boswellia(100µg/ ml) | 0.616 |
| Curcuma longa (50µg/ml) | 0.715 |
| Curcuma longa (100µg/ml) | 0.764 |
| Boswellia (50µg/ml) | 1.026 |
| Boswellia (100µg/ml) | 1.581 |

### 3.8. Phytochemical screening:

All the above prepared extracts were subjected to preliminary phytochemical screening tests to identify the presence of various components, by using different test and reagents.

### 3.8.1. Boswellia Serrata:

**1. Test for Alkaloids (Dragendorff's Test)**
• **Procedure:**
o Take 2 ml of extract.
o Add a few drops of Dragendorff's reagent.
• **Observation:**
An orange or reddish-brown precipitate indicates the presence of alkaloids.

**2. Test for Saponin (Foam Test)**
• **Procedure:**
o Take 2 ml of extract and dilute with 5 ml of distilled water.
o Shake vigorously for 2–3 minutes.
• **Observation:**
Persistent foam formation indicates the presence of Saponin.

**3. Test for Flavanoids (Lead Acetate Test)**
• **Procedure:**
o Take 2 ml of extract.
o Add a few drops of lead acetate solution.
• **Observation:**
Formation of a yellow precipitate indicates the presence of flavonoids.

**4. Test for Steroids (Salkowski Test)**
• **Procedure:**
o Take 2 ml of extract.
o Add 2 ml of chloroform.
o Carefully add 1–2 ml of concentrated sulfuric acid ($H_2SO_4$) along the side of the test tube.
• **Observation:**
A reddish-brown ring at the interface indicates the presence of steroids.

**5. Test for Tannins (Ferric Chloride Test)**
• **Procedure:**
o Take 2 ml of extract.
o Add a few drops of 5% ferric chloride solution.
• **Observation:**
A blue-black or greenish coloration indicates the presence of tannins.
**6. Test for Glycosides (Keller–Kiliani Test)**

**Procedure:**
o Take 2 ml of extract.
o Add 1 ml of glacial acetic acid containing a trace of ferric chloride.
o Carefully add 1 ml of concentrated sulfuric acid ($H_2SO_4$) along the side of the test tube.
• **Observation:**
A brown ring at the junction of two layers indicates the presence of glycosides [31,32].

**Alkaloids**

**Saponin**

**Flavanoids**

**Steroids**

**Glycosides**

**[figure 9: phytochemical screening tests for boswellia serrata]**

### 3.8.2. Curcuma Longa

**1. Test for Alkaloids (Mayer's Test)**
• **Procedure:**
o Take 2 ml of extract.
o Add a few drops of Mayer's reagent.
• **Observation:**
Formation of a cream or white precipitate indicates the presence of alkaloids.

**2. Test for Flavanoids (Lead Acetate Test)**
• **Procedure:**
o Take 2 ml of extract.
o Add a few drops of lead acetate solution.
• **Observation:**
Formation of a yellow precipitate indicates the presence of flavonoids.

**3. Test for Saponin (Foam Test)**
• **Procedure:**
o Take 2 ml of extract and dilute with 5 ml of distilled water.
o Shake vigorously for 2–3 minutes.
• **Observation:**
Persistent froth (foam) formation indicates the presence of Saponin.

**4. Test for Glycosides (Legal's Test)**

• **Procedure:**

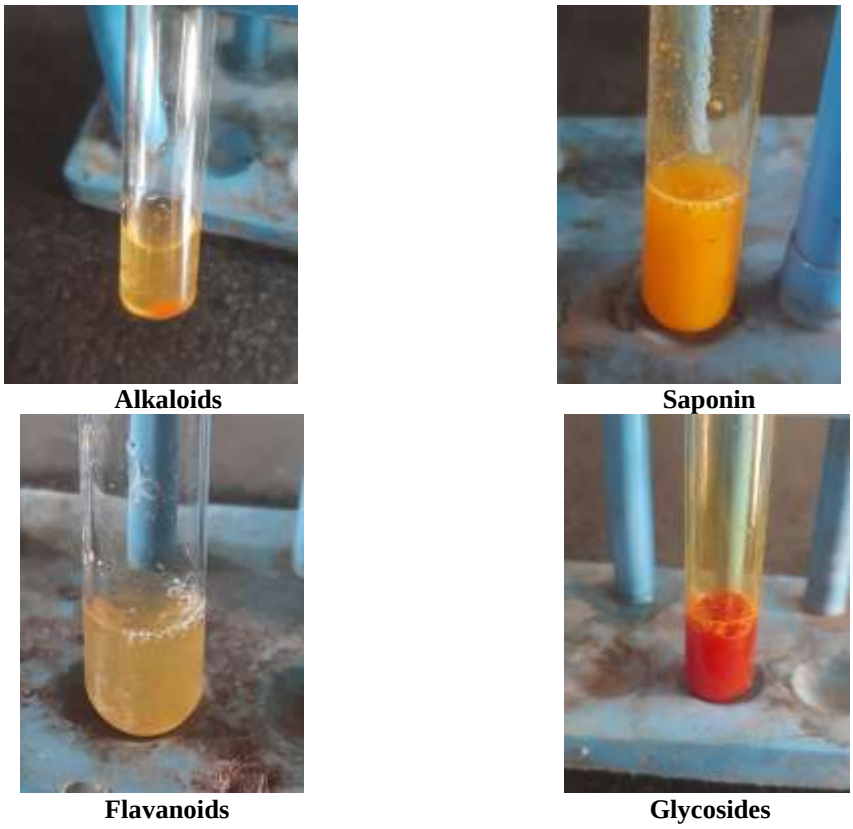
o Take 2 ml of extract.

o Add 1 ml of pyridine and a few drops of sodium nitroprusside solution.

o Make the solution alkaline by adding sodium hydroxide (NaOH).

• **Observation:**

A pink to red color indicates the presence of glycosides [33,34,35].




**[figure 10: phytochemical screening tests for curcuma longa]**

- Chemical test result of some chemical test of Phytoconstituents:

1. Boswellia Serrata:

**[table no. 5: test results of phytochemical constituents boswellia serrata]**

| Sr. No. | Phytoconstituents | TestPerformed | Result |
|---|---|---|---|
| 1. | Alkaloids | Dragendorff's Test | + |
| 2. | Saponins | Foam Test | + |
| 3. | Flavanoids | Lead Acetate Test | + |
| 4. | Steroids | Salkowski Test | + |

| | | | |
|---|---|---|---|
| 5. | Tannins | Ferric Chloride Test | + |
| 6. | Glycosides | Keller–Kiliani Test | + |

2. Curcuma longa:

**[table no. 6: test results of phytochemical constituents curcuma longa]**

| Sr. No. | Phytoconstituents | TestPerformed | Result |
|---|---|---|---|
| 1. | Alkaloids | Mayer'sTest | + |
| 2. | Saponins | Foam Test | + |
| 3. | Flavanoids | Lead Acetate Test | + |
| 4. | Glycosides | Legal's Test | + |

## 4. CONCLUSIONS

The present study successfully developed a herbal anti-inflammatory gel using Curcuma longa and Boswellia serrata, combining traditional herbal knowledge with modern formulation techniques. The prepared gel showed suitable physicochemical properties such as skin-friendly pH, good viscosity, smooth texture, and excellent spreadability, making it ideal for topical application. Stability studies confirmed that the formulation remained consistent and stable over time. The in vitro anti-inflammatory results demonstrated that the combination of both extracts provided better membrane stabilization compared to individual components, indicating a synergistic effect. This suggests enhanced therapeutic potential in reducing inflammation. Additionally, the observed antimicrobial activity supports its safety and effectiveness for topical use. Overall, the formulation offers a natural, effective, and safer alternative to synthetic anti-inflammatory drugs, with fewer side effects. This herbal gel can be considered a promising option for managing inflammation and related conditions in a more gentle and patient-friendly way.

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