

Formulation And Evaluation of a Gel Containing Curcuma Longa and Azadirachta Indica for Arthritis Therapy

Mr. Gopal Shankar Mule¹, Akanksha Premdas Chavan², Miss. Vidya Raosaheb Kale³

^{1,2}B Pharmacy Final Year (VIII Sem), Yashodeep institute of pharmacy chh.Sambhaji Nagar

³Guide, (M. Pharma in Pharmaceutics), Ass. Professor, Yashodeep institute of pharmacy chh.Sambhaji Nagar

Abstract—The present study focuses on the formulation and evaluation of an herbal gel incorporating turmeric, neem, glucose, rose water, and glycerin for topical application. Herbal gels have gained increasing attention as safe, effective, and natural alternatives to synthetic skin products, particularly for managing minor skin conditions, enhancing hydration, and providing antimicrobial protection. In this formulation, turmeric and neem were selected for their well-established anti-inflammatory, antibacterial, and wound healing properties. Glucose and glycerin were incorporated as humectants to maintain skin moisture, while rose water served as a soothing, aromatic base.

The gel was prepared using Carbopol 940 as a gelling agent and neutralized with triethanolamine to achieve a stable pH suitable for skin application. The final product was evaluated for various physicochemical parameters including appearance, pH, viscosity, homogeneity, spreadability, washability, and stability under ambient conditions. The gel exhibited a smooth texture, uniform consistency, a skin-compatible pH (5.8), and excellent spreadability. Stability studies over 30 days showed no significant changes in color, odor, pH, or consistency, and microbial testing confirmed its safety for use.

The results indicate that the formulated herbal gel is stable, cosmetically acceptable, and holds promise as a natural skincare product for antimicrobial protection and skin hydration. Further studies including in vivo evaluations, skin irritation testing, and long-term stability assessments are recommended to establish its clinical efficacy and potential for commercial application.

Index Terms—Herbal gel, Turmeric, Neem, Glucose, Glycerin, Rose water, Antimicrobial, Anti-inflammatory, Natural skincare, pH.

I. INTRODUCTION

Traditional medicine plays an important role in health care services. The large number of medicinal plants are used with various pharmacological activities. Gel formulations are used to deliver topical drug delivery system because of easy application also with increases penetration time and lesser side effects. As per the I. P the gel is defined as homogeneous semi-solid preparation consists of dispersion of one or more medicaments in suitable hydrophobic or hydrophilic bases.

The gel formulations were designed by using aqueous extract of turmeric rhizomes. Topical anti-inflammatory activity of the gel was also evaluated. The ayurveda is a science based on Indigenous system of medicine. The turmeric has been used as a nontoxic drug in ayurveda for treatment of various diseases including skin diseases, inflammation hepatic disorders etc.

The plant selected for present work are curcumin longa which contain the high percentage of flavonoids & also responsible for anti-inflammatory activity. The herbal medicines are more accepted in the world for their lesser side effects & low cost. It has great significance for nutritional & health benefits. It plays an important role in health benefit. Turmeric is the spice that gives curry its yellow color. It has been used in India for thousands of years as both a spice and medicinal herb. Recently, science has started to back up Trusted Source traditional claims that turmeric contains compounds with medicinal properties. These compounds are called curcuminoids. The most important one is curcumin. Curcumin is the main

active ingredient in turmeric. It has powerful anti-inflammatory effects and is a very strong antioxidant.

Here are the top 5 evidence-based health benefits of turmeric and curcumin:

1. Arthritis patients respond well to curcumin supplements

Arthritis is a common problem in Western countries. There are several different types of arthritis, most of which involve inflammation in the joints. Given that curcumin is a potent anti-inflammatory compound, it makes sense that it may help with arthritis. In fact, several studies show that there is an association. In a study Trusted Source in people with rheumatoid arthritis, curcumin was even more effective than an anti-inflammatory drug.

Turmeric gel offers a natural, topical alternative to conventional anti-inflammatory drugs for the management of arthritis-related pain, swelling, and stiffness. The primary active compound in turmeric, curcumin, has strong anti-inflammatory, analgesic, and antioxidant properties. When formulated as a gel and applied directly to affected joints, turmeric can help relieve local symptoms without systemic side effects commonly seen with oral medications like NSAIDs.

Key benefits:

- Reduces joint inflammation and swelling
- Relieves localized pain
- Enhances mobility and joint flexibility
- Minimizes gastrointestinal and cardiovascular side effects
- Suitable for long-term use and elderly patients

Mode of Action

Curcumin, the bioactive compound in turmeric, acts through multiple mechanisms:

Types of Arthritis	Relevance of Turmeric Gel
Osteoarthritis (OA)	Most common type; curcumin reduces joint pain, swelling, and stiffness.
Rheumatoid arthritis (RA)	An autoimmune condition; turmeric reduces inflammation and joint damage.
Psoriatic arthritis	Anti-inflammatory and soothing effects can reduce joint and skin symptoms.

Types of Arthritis	Relevance of Turmeric Gel
Gout	May help in reducing uric acid-induced inflammation.
Reactive arthritis	Topical turmeric may reduce flare-ups and pain locally.

- Inhibits inflammatory enzymes such as COX-2 and 5-LOX, reducing prostaglandin and leukotriene synthesis
- Suppresses pro-inflammatory cytokines like TNF- α , IL-1 β , and IL-6, which play key roles in arthritis progression
- Neutralizes reactive oxygen species (ROS), protecting joint tissues from oxidative damage
- Blocks NF- κ B signaling pathway, a major regulator of chronic inflammation
- Enhances blood flow and local tissue oxygenation, promoting healing

As a topical gel, curcumin acts directly at the site of inflammation, bypassing first-pass metabolism and ensuring higher local bioavailability.

Treatment Approach Using Turmeric Gel Application Protocol:

- Apply a thin layer of turmeric gel to the affected joint area 2–3 times daily
- Gently massage in circular motion to enhance absorption
- Use continuously for several weeks to notice improvements
- May be combined with physical therapy or other topical treatments for synergistic effects
- Precautions:
 - Perform a patch test before first use to rule out allergic reaction
 - Avoid contact with eyes or open wounds
 - Not a substitute for systemic medication in severe cases, but useful as adjunct therapy.

1. Introduction:

Turmeric is a perennial herbaceous plant belonging to the Zingiberaceae (ginger) family. It is widely cultivated in India and other parts of Southeast Asia. The rhizome (underground stem) of the plant is used both as a spice and medicinal agent, primarily due to its vibrant yellow-orange pigment and therapeutic properties.

2. Common Name:

- English: Turmeric
- Hindi: Haldi
- Sanskrit: Haridra
- Botanical name *Curcuma longa*
- Family: Zingiberaceae

3. Major Chemical Constituent:

The most important bioactive compound in turmeric is:

- Curcumin ($C_{21}H_{20}O_6$) – a yellow polyphenolic compound
- Other constituents:
Demethoxycurcumin
Bisdemethoxycurcumin
Volatile oils like turmerone, atlantone, zingiberene

4. Chemical structure

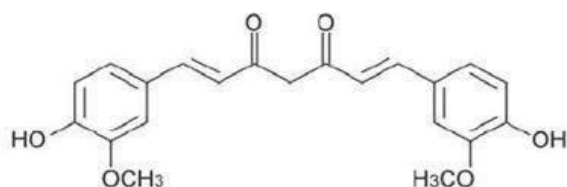


Fig: Structure of Turmeric

5. Uses of Turmeric (*Curcuma longa*):

Medicinal Uses:

- Anti-inflammatory: Reduces swelling and pain in conditions like arthritis.
- Antioxidant: Scavenges free radicals, protecting cells from damage.
- Antimicrobial: Active against bacteria, fungi, and viruses.
- Wound healing: Speeds up healing and reduces infection.
- Liver protection: Hepatoprotective in traditional medicine.
- Anticancer (research stage): May inhibit tumor growth in experimental studies.

Cosmetic Uses:

- Skin brightening and toning
- Acne and pimple treatment
- Anti-aging properties due to antioxidant content.

2. Turmeric contains bioactive compounds with medicinal properties

However, the curcumin content of turmeric isn't that

high. It's around 3%, by weight Trusted Source. Most of the studies on this herb use turmeric extracts that contain mostly curcumin itself, with dosages usually exceeding 1 gram per day. It would be very difficult to reach these levels just using turmeric as a spice in your foods. That's why some people choose to use supplements.

However, curcumin is poorly absorbed into your bloodstream. In order to experience the full effects of curcumin, its bioavailability Trusted Source (the rate at which your body absorbs a substance) needs to improve.

3. Curcumin is a natural anti-inflammatory compound Inflammation is incredibly important. It helps fight foreign invaders and has a role in repairing damage in your body. Although acute, short-term inflammation is beneficial, it can be a concern if it becomes chronic and attacks your body's own tissues. Scientists now believe that chronic low-level inflammation can play a role in some health conditions Trusted Source and diseases.

4. Curcumin has benefits against depression:

Curcumin has shown some promise in treating depression. In a controlled trial Trusted Source, 60 people with depression were randomized into three groups. One group took Prozac, another group took 1 gram of curcumin, and the third group took both Prozac and curcumin. After 6 weeks, curcumin had led to improvements similar to those of Prozac. The group that took both Prozac and curcumin fared best.

5. Curcumin may help delay aging and fight age-related chronic diseases

If curcumin can really help prevent heart disease, cancer, and Alzheimer's, it may have benefits for longevity as well. This suggests that curcumin may have potential as an anti-aging supplement Trusted Source. Given that oxidation and inflammation are believed to play a role in aging Trusted Source, curcumin may have effects that go way beyond just preventing disease.

Wound healing is a process in which damaged cutaneous tissues are repaired and is a dynamic physiological interaction involving several types of cells, tissues, and proteins. Compared with typical treatments, specifically in terms of multifunctional properties, bioactive drug-loaded wound dressing in a

controlled and sustained delivery system is an advanced tool that significantly improves wound healing. Curcumin substantially enhances wound healing and prevents oxidative damage. However, the effects of this compound on improving wound healing are limited by its aqueous solubility, poor tissue absorption, and rapid metabolism. Hence, the current study aimed to investigate the therapeutic effect of curcumin-loaded self-micro emulsifying gel on wound healing.

II. LITERATURE SURVEY

1. Professor and Head, Department of Periodontics, MNR Dental College & Hospital, Sangareddy, Medak, (2013)

Curcumin(diferuloylmethane), a constituent of *Curcuma longa* plant, which possess antioxidant, anti-inflammatory, anti-carcinogenic, anti-microbial, anti-hyper algetic and hypocholesterolemia properties. The aim of the present study is to compare the effects of the curcumin gel as an adjunct to subgingival scaling and root planning with the effect achieved using subgingival scaling and root planning alone.

2. Abhijeet AloK, Indra Deo Singh, Shivani Singh, Mallika Kishore, Prakash Chandra Jha Journal of clinical and diagnostic research (2014)

Turmeric has been in use for thousands of years as a dye, flavouring and a medicinal herb. Ancient Indian medicine has touted turmeric as an herb with the ability to provide glow and luster to the skin as well as vigour and vitality to the entire body. Since curcumin has antimicrobial, antioxidant, astringents and other useful properties, it is

quite useful in dentistry also. Curcumin, the most active polyphenolic constituent, is the active ingredient in the traditional herbal remedy and dietary spice turmeric. In gel form it is a component in local

3. SD Devaraj, P Neelakantan (2014):

Turmeric (*Curcuma longa*) is an ancient dye, flavouring and medical herb, widely used in Asian countries. It is a herb that has been widely used in Indian medicine, cookery, and cosmetics. The main component of turmeric is curcumin. Curcumin has a surprisingly wide range of beneficial properties includes anti-inflammatory, antioxidant, chemopreventive, chemotherapeutic activity etc. The

activity of curcumin derived from its complex chemistry as well as its ability to influence the multiple signaling pathways.

4. D Akbik, M Ghadiri, W Chrzanowski, R Rohanizadeh(2014):

Turmeric (*Curcuma longa*) is a popular Indian spice that has been used for centuries in herbal medicines for the treatment of a variety of ailments such as rheumatism, diabetic ulcers, anorexia, cough and sinusitis. Curcumin (diferuloylmethane) is the main curcuminoid present in turmeric and responsible for its yellow color. Curcumin has been shown to possess significant anti-inflammatory, anti-oxidant, anti-carcinogenic, anti-mutagenic, anti-coagulant and anti-infective effects.

5. Ajaikumar B. Kunnumakkara*, Mangala Hegde, Dey Parama, Sosmitha Girisa, Aviral Kumar, Uzini Devi Daimary, Prachi Garodia, Sarat Chandra Yeniseti, Oommen V. Oommen, and Bharat B. Aggarwal (2015)

Turmeric (*Curcuma longa*) has been used for thousands of years for the prevention and treatment of various chronic diseases. Curcumin is just one of >200 ingredients in turmeric. Almost 7000 scientific papers on turmeric and almost 20,000 on curcumin have been published in PubMed. Scientific reports based on cell culture or animal studies are often not reproducible in humans. Therefore, human clinical trials are the best indicators for the prevention and treatment of a disease using a given agent/drug.

Herein, we conducted an extensive literature survey on PubMed and Scopus following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines. The keywords “turmeric and clinical trials” and “curcumin and clinical trials” were considered for data mining. A total of 148 references were found to be relevant for the key term “turmeric and clinical trials”, of which 70 were common in both PubMed and Scopus, 44 were unique to PubMed, and 34 were unique to Scopus.

Similarly, for the search term “curcumin and clinical trials”, 440 references were found to be relevant, of which 70 were unique to PubMed, 110 were unique to Scopus, and 260 were common to both databases. These studies show that the golden spice has enormous health and medicinal benefits for humans. This Review will extract and summarize the lessons learned

about turmeric and curcumin in the prevention and treatment of chronic diseases based on clinical trials.

6. Seema Yuvraj Mendhekar*, Pratik Bharat Thorat, Nikita Nivruti Bodke, Jadhav S. L. and Gaikwad D. D (2016)

The present research has been undertaken with the aim to formulate and evaluate of gel containing Neem (*Azadirachta indica* A.Juss, Meliaceae), Turmeric (*Curcuma longa* L., Zingiberaceae), Aloe (*Aloe vera* (L.) Burm.f., Asphodelaceae), Green tea (*Camellia sinensis* (L.) Kuntze, Theaceae) and Lemon extract (*Citrus limon* (L.) Osbeck., Rutaceae) with activated Charcoal and Honey as a cleansing agent, anti-acne and skin nourishing. Natural remedies are more acceptable in the belief that they are suffer with fewer side effects than the synthetic ones. Herbal formulation has growing demand in the world market. The plant has been reported in literature having good antimicrobial, anti-inflammatory, refreshing activity, cleansing agent, dirt absorbent and anti-oxidant. F1 and F2 formulation are prepared by using varied concentration of extract prepared formulation (F1 and F2) where evaluated for various parameters like colour, appearance, consistency, wash ability, pH and Spreadability, Extrudability, skin irritation and compared with marketed formulation.

III. AIM AND OBJECTIVE

Aim:

Formulation and Evaluation of Turmeric Gel

OBJECTIVES

1. Turmeric gel is useful for Wound healing.
2. It is easy to apply.
3. It is not expensive than other product that already exists in market
4. Turmeric gel useful for Arthritis patients because it's anti-inflammatory property
5. Turmeric gel contains bioactive compounds and medicinal activities.

IV. PLAN OF WORK

1. Literature survey
2. Selection of materials
3. Preparation of Turmeric Gel
4. Experimental work

5. Evaluation Parameters

- A. PH
- B. Homogeneity
- C. Viscosity
- D. Spreadability
- E. Antimicrobial Study
- F. Washability
- G. Stability Test

V. DRUG PROFILE

1. Turmeric

Common name: - Haldi

Binomial name: - *Curcumin longa*

Family- Zingiberaceae

Kingdom- Plantae

Genus - *Curcuma*



Morphology:

Macroscopic Characteristics (observable by the eye):

- Rhizome shape: Cylindrical or ovate with branches (called fingers)
- Color: Yellow to orange externally and internally
- Surface: Rough due to root scars and wrinkles
- Fracture: Short and granular
- Odor: Aromatic
- Taste: Slightly bitter and pungent

Microscopic Characteristics (under the microscope):

- Cork cells: Multiple layers of thin-walled cells
- Cortex: Contains oil cells, starch grains (oval, simple or compound), and aleurone grains
- Vascular bundles: Scattered, collateral
- Parenchyma cells: Filled with starch grains

Chemical Constituents

Curcuminoids

- Curcumin
- Demethoxycurcumin

Volatile Oils

- Turmerone
- Atlantone
- Zingiberene

Others

- Starch; Resins; Proteins; Sugars.

2. Neem

Common name- Margosa neem

Binomial name - *Azadirachta indica*

Family - Meliaceae

Kingdom - Plantae

Genus - *Azadirachta*



Morphology (Macroscopic & Microscopic)

A. Macroscopic Leaves:

- Type: Pinnate compound
- Leaflets: Lanceolate, serrated edges
- Color: Bright to dark green
- Odor: Slightly aromatic
- Taste: Extremely bitter

B. Microscopic (Neem Leaf)

- Upper epidermis: Covered with cuticle
- Mesophyll: Differentiated into palisade and spongy parenchyma
- Trichomes: Glandular and unicellular
- Vascular bundle: Collateral and prominent midrib
- Calcium oxalate crystals: Present

Chemical Constituents

Main classes of compounds in Neem include:

- Triterpenoids and Limonoids:
Azadirachtin
Nimbin
Nimbidin
Salannin
- Flavonoids

3. Glycerine

Chemical Name: Propane-1,2,3-triol

Molecular Formula: $C_3H_8O_3$

Chemical Structure: $HO-CH_2-CH(OH)-CH_2-OH$

Uses:

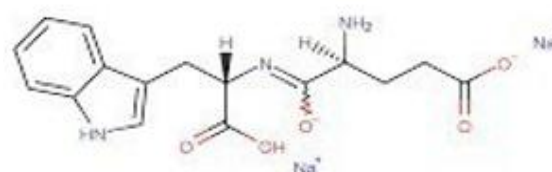
- Humectant: Retains moisture in skin by drawing water from the environment.
- Emollient: Softens and smoothens the skin.
- Solvent: Helps dissolve herbal or active ingredients.
- Stabilizer: Enhances cons

4. Rose Water (Aqueous distillate of *Rosa damascena*)

Main Components:

- Water (solvent)
- Essential oils (traces of geraniol, citronellol, nerol, phenyl ethanol)

Structure:



Uses:

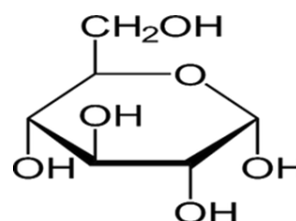
1. Skin toner and cleanser: Soothes and hydrates skin.
2. Anti-inflammatory: Calms irritated or red skin.
3. Aromatherapy: Provides a natural fragrance with calming effects.
4. Solvent/base: Used in herbal formulations as a vehicle.

5. Glucose

Chemical Name: D-Glucopyranose

Molecular Formula: $C_6H_{12}O_6$

Chemical Structure:



Uses:

- Humectant: Retains skin moisture, similar to glycerin.

- Energy source: Used in medical and nutritional products.
- Skin conditioning agent: Helps nourish and soften the skin.
- Stabilizer: Provides thickness and slight sweetness in formulations.
- Healing aid: Supports wound repair when used in topical products.

VI. MATERIALS AND METHODS

Materials

1. Curcuma Longa (Turmeric)
2. Neem
3. Carbapol
4. Propylene glycol
5. Triethanolamine
6. Rose water

METHODS

1. Preparation of Extract

The rhizome soft turmeric was collected and washed thoroughly with distilled water. In that the 150 gm pieces of turmeric rhizomes was imbibed with 500 ml water for 3 hours or overnight with occasional stirring finally extract was collected and concentrated to get yellowish residue. This extract was stored in airtight containers at cool and dark place.



Fig: Soxlet Appartus

2. Neem Extraction

Take the leaves from the stems and put them into the bowl together. Add enough water to cover the leaves and stems. Put the bowl onto a low fire and gradually let the water boil. When it boils thoroughly, reduce the fire and cover the bowl with a lid. Keep on boiling the leaves for 5 more minutes. 5 minutes are enough to transmit everything useful from the leaves into the water. Remove the bowl from the fire and let it cool down. When the liquid is not scalding hot anymore, remove the leaves from the water with your hands, squeezing the leaves tightly to press out the remaining essential oil. Then, filter the water into a jar or bottle with a tight lid to remove particles of leaves.



Fig: - Extraction of Ingredients

Sr. No	Ingredients	Role	Quantity
1	Haridra water	Essence cool water	100 ml
2	Triethanolamine	Clear gel base	2 gm
3	Carbapol	Gelling agent	3 gm
4	Glycerin	Preservative	1 ml
5	Rose water	Moisturiser	1 ml
6	Neem Extract	Antiseptic	5 ml

Ingredients

3. Procedures for Formulation of Gel

Procedure

Step 1: Preparation of Herbal Extract Mixture

1. Take 2 g of turmeric powder and 2 g of neem extract (or dried neem leaf powder).
2. Mix them in 20 mL of rose water.
3. Stir well and let it sit for 30–60 minutes for maximum extraction.
4. Filter the mixture through muslin cloth or Whatman filter paper to remove coarse particles.
5. Keep the filtrate aside for use as the active herbal base.

Step 2: Preparation of Gel Base

1. Disperse 1 g of Carbopol 940 slowly into 50 mL of distilled water.
2. Stir continuously to prevent lump formation. Let it hydrate for 1–2 hours or until fully swollen.
3. Add 1 g glucose and 5 mL glycerin to the hydrated gel base.
4. Mix until a uniform and clear viscous gel is formed.

Step 3: Incorporation of Herbal Extracts

1. Slowly add the filtered herbal extract (from Step 1) into the gel base while stirring gently.
2. Mix thoroughly to ensure uniform distribution of actives throughout the gel.

Step 4: pH Adjustment and Gel Formation

1. Measure the pH of the mixture (it will be acidic due to herbs).
2. Add Triethanolamine dropwise to raise the pH to around 5.5–6.0, which is ideal for skin and gel formation.
3. You will notice the mixture turns into a clear gel as the pH adjusts.

Step 5: Final Make-Up Volume

1. Add distilled water to make up the final volume to 100 mL if needed.
2. Stir gently to ensure complete mixing.

Step 6: Preservation and Storage

1. Add 0.2 g of methylparaben or any suitable preservative (optional) if long-term storage is intended.
2. Transfer the final gel into a clean, labeled, airtight container.

3. Store at room temperature away from light and moisture.



Fig: - Formulation of Gel



Fig: - Formulation 01 Of Turmeric G



Fig: -Formulation 02 of Turmeric Gel

VII. EVALUATION PARAMETERS

Evaluation Parameter for Gel

A. Physical Evaluation

1. PH:

Purpose:

Ensure the gel's pH is compatible with skin (ideal: 4.5–6.5).

Procedure:

- Take 1 g of gel and disperse in 10 ml of distilled water.
- Stir well and allow to equilibrate for 2 hours.
- Measure the pH using a calibrated digital pH meter.

Acceptance Criteria:

- pH should be in the skin-friendly range (typically 4.5–6.5).



Fig: pH meter

2. Homogeneity:

Purpose: Ensure uniformity of the gel without lumps or phase separation.

Procedure:

- Visually inspect the gel for uniform color and consistency.
- Rub a small amount between fingers or on a glass slide.

Observation:

- No lumps or air bubbles.
- Smooth, even texture throughout.

3. Viscosity:

Purpose:

Determine the thickness and flow behavior of the gel.

Procedure:

- Use a Brookfield viscometer or similar.
- Place gel in a beaker and measure using a spindle at a specific RPM (e.g., spindle 64 at 10 rpm).

Acceptance Criteria:

- Viscosity should be in the range typical for topical gels (e.g., 10,000–100,000 cP depending on formulation).

4. Spreadability:

Adequate amount of sample is taken in between two glasses slides and a weight of

1 gm applied on the slides for 5 min and the observe the spreadability. Spreadability can be calculated by following formula: $S = M \times L / T$

Where,

S: Spreadability

M: Weight tide the upper slide.

L: Length of glass slide

T: Time taken to separate the slides.

5. Washability:

Purpose:

Check if the gel can be easily removed from the skin.

Procedure:

- Apply gel on the skin or a synthetic skin model.
- After 5–10 minutes, attempt to wash off with water.

Observation:

- Easy removal with water is ideal for consumer convenience.

Stability Test: Purpose:

Assess physical, chemical, and microbiological stability over time.

Procedure:

Store gel under different conditions:

- Room temperature ($25 \pm 2^\circ\text{C}$)
- Accelerated conditions ($40 \pm 2^\circ\text{C}$ with $75 \pm 5\%$ RH)
- Refrigerator ($4 \pm 2^\circ\text{C}$)

Evaluation Intervals:

0, 15, 30, 60, 90 days

Parameters Monitored:

- Color change
- Phase separation
- pH change
- Viscosity
- Microbial growth

Acceptance Criteria:

- No significant changes in appearance, pH, or viscosity.

- No microbial contamination.

Parameter	Observation
Appearance	Smooth, Yellow-Colored gel
pH	5.8 (skin-compatible)
Homogeneity	Excellent
Viscosity	34,000 cP
Spreadability	15.4 g.cm/sec
Washability	Easily washable with water
Stability	No change in color, pH, or consistency

VIII. RESULT AND DISCUSSION**1) Physical and Physicochemical Evaluation**

The formulated herbal turmeric gel was subjected to various evaluation parameters to assess its suitability for topical application. The gel was yellow in color with a smooth, homogeneous appearance and showed no signs of phase separation or sedimentation over the test period. It exhibited excellent physical characteristics including appropriate viscosity, spreadability, pH compatibility, and stability under short-term storage.

Sr. No.	Parameter	Result	Evaluation
1	Appearance	Smooth, yellow-colored gel	Visual observation
2	Homogeneity	Excellent; no lumps or phase separation	Manual inspection and rubbing between fingers
3	pH	5.8	pH meter (within skin-compatible range of 4.5–6.5)
4	Viscosity	34,000 cP	Brookfield viscometer
5	Spreadability	15.4 g.cm/sec	Slip and drag method
6	Washability	Easily washable with water	Simple wash-off test
7	Stability	No change in color, odor, pH	Stored at room temp & observed at 0, 15, and 30 days
8	Microbial Load	Within permissible limits	Standard plate count, absence of <i>E. coli</i> , <i>aureus</i> and fungi

2) PH

The PH of the turmeric gel was measured by using digital PH meter. The PH of the turmeric gel was found to be 6.56

3) Loss on Drying

Loss on drying was determined by placing the formulation in petri plate on water bath and dried for temperature 105°C .

Loss on drying was found to be 30%.

4)Antimicrobial Activity

The anti –microbial activity of formulation was observed.

Interpretation of Results

The evaluation of the herbal turmeric gel formulation yielded favorable results. The gel exhibited a pleasant appearance with uniform consistency and excellent homogeneity, showing no signs of grittiness or separation. The pH of 5.8 was within the ideal range for topical formulations, indicating compatibility with the skin and reducing the risk of irritation. The viscosity of 34,000 cP provided a smooth texture and ideal thickness, which ensures that the gel remains on the skin surface for an adequate time without dripping. In terms of spreadability, the value of 15.4 g·cm/sec confirmed that the gel spreads easily with minimal effort, ensuring better patient compliance. The gel was also found to be easily washable with plain water, making it convenient for daily use. Short-term stability testing over 30 days revealed no significant changes in physical appearance, pH, or consistency, indicating acceptable stability under room temperature conditions. Additionally, microbial testing showed that the formulation was free from harmful pathogens, ensuring microbiological safety for users.

These results collectively demonstrate that the herbal turmeric gel formulation meets the desired criteria for a safe, stable, and effective topical product.

IX. CONCLUSION

The present study highlights the significant therapeutic potential of turmeric (*Curcuma longa*), particularly its active compound curcumin, in the formulation of a topical gel with anti-inflammatory and wound-healing properties. Traditional medicine systems, such as Ayurveda, have long utilized turmeric for its medicinal value, and modern research supports these claims through evidence-based findings. Despite its low natural bioavailability, curcumin demonstrates powerful antioxidant, anti-inflammatory, and antimicrobial effects, making it a promising candidate for topical drug delivery systems. The development of a curcumin-loaded self-micro emulsifying gel addresses some of the limitations associated with curcumin's solubility and absorption, enhancing its efficacy for skin-related conditions. Overall, the

integration of herbal medicine into modern pharmaceutical formulations offers a safe, cost-effective, and efficient approach to managing inflammation, promoting wound healing, and improving overall skin health.

Summary:

The study successfully formulated an herbal turmeric gel using natural ingredients with minimal use of synthetic excipients. The formulation showed:

- pH in the acceptable skin range, which minimizes the risk of irritation.
- Good homogeneity and spreadability, ensuring smooth application.
- Adequate viscosity, contributing to better retention on the skin surface.
- Excellent washability, enhancing user compliance.
- Short-term stability, with no significant changes in physical characteristics.

The results validate the traditional use of turmeric in skincare, now optimized into a modern gel delivery system. The incorporation of turmeric in gel form enhances its convenience, aesthetic appeal, and potential efficacy.

Future Perspectives

- Long-term stability studies should be conducted over 6–12 months.
- Microbiological testing and preservative efficacy studies should be added for product safety.
- In vivo testing is needed to confirm therapeutic claims.
- Formulation optimization using other natural agents (e.g., aloe vera, neem, or essential oils) could enhance efficacy.
- Commercial scaling and packaging development with shelf-life assessment.
- Possibility to incorporate nanotechnology for improved skin penetration and sustained release of curcumin.

The encouraging results obtained from the formulation and evaluation of the herbal turmeric gel lay a strong foundation for its further development into a clinically effective and commercially viable product. Future research should focus on conducting long-term stability studies under various environmental conditions, in accordance with ICH guidelines, to

establish the product's shelf life and optimal storage parameters. In parallel, comprehensive microbial testing and skin safety evaluations, including irritation and allergy studies on suitable models, will be necessary to ensure the product's safety profile for regular use. Additionally, in vivo and clinical efficacy studies should be undertaken to scientifically validate the gel's therapeutic claims such as anti-inflammatory, antimicrobial, and wound healing effects. These studies will not only confirm the efficacy of turmeric in a gel form but also provide essential data for regulatory approval. To enhance the gel's therapeutic potential, advanced drug delivery techniques such as nanoemulsions, liposomes, or micellar systems could be explored to improve the bioavailability and skin penetration of curcumin, which is known for its poor solubility and rapid degradation.

Furthermore, incorporating other synergistic herbal agents like aloe vera, neem, or tea tree oil could broaden the gel's applications for various skin conditions, making it a multi-functional product. Optimization of the gel formulation to suit different skin types—such as oily, sensitive, or acne-prone skin—would also help cater to diverse consumer needs. From a sustainability perspective, efforts should be made to adopt eco-friendly packaging and green manufacturing processes using organic raw materials and biodegradable containers, aligning the product with current environmental and consumer trends. To transition the gel from a laboratory prototype to a marketable product, detailed regulatory documentation, pilot-scale production, and cost-benefit analyses are essential. Educating consumers about the scientific validity of herbal formulations and the benefits of turmeric in dermatology can further support product acceptance and market growth. Overall, the formulation has immense potential to evolve into a widely accepted herbal skincare solution, provided that it undergoes systematic scientific validation, safety assurance, and regulatory compliance in future developmental phases.

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