IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 5, Issue 2, June 2025
Impact Factor: 7.67

Formulation and Evaluation of Cold Cream from Curcuma Longa & Orange Extract

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Abstract: *Cold creams are widely used semi-solid emulsions designed to moisturize, protect, and rejuvenate the skin. Traditionally, they are composed of oil and water phases stabilized by emulsifying agents. In recent years, there has been a rising demand for herbal cosmetic formulations due to concerns over synthetic chemicals and a global shift toward safer, eco- friendly skincare alternatives.*

Keywords: *Cold creams*

I. INTRODUCTION

1.1 Background

Cold creams are widely used semi-solid emulsions designed to moisturize, protect, and rejuvenate the skin. Traditionally, they are composed of oil and water phases stabilized by emulsifying agents. In recent years, there has been a rising demand for herbal cosmetic formulations due to concerns over synthetic chemicals and a global shift toward safer, eco- friendly skincare alternatives. The use of herbal products as cosmetics is as prevalent in modern era as it was in ancient times. Herbal cosmetics are mostly preferred because of their less or nil side effects when compared to synthetic products and show enhanced effects upon application. These herbal cosmetics used as beauty products help in enhancing and conditioning properties of skin. The herbal extracts used in these formulations are all derived from natural plant sources without the use of any harmful synthetic drugs. Chemical or synthetic drug/ API is avoided in the preparations because of various skin problems. The concept of herbal cosmetics was established long back in different systems of medicine such as Rigveda, Yajurveda, Ayurveda, Unani and Homeopathy systems.

The herbs extracted by these systems show a number of properties like anti- inflammatory, anti-bacterial, anti- septic, emollient and sometimes also show anti-cancer properties. Thus, there is extensive use of herbal cosmetics in skin care systems and an ever increasing demand in the market. Various kinds of creams such as vanishing cream, coldcream, multipurpose cream, etc.

1.2 Herbal Cosmetics and Consumer Trends

Herbal cosmetics are formulations that incorporate plant-derived active ingredients. They are preferred for being gentle on the skin, eco-conscious, and perceived as safer for long- term use. Common herbal extracts used in skincare include aloe vera, neem, sandalwood, turmeric, and citrus fruits. These botanicals provide various benefits like antimicrobial action, anti-aging effects, and skin brightening properties.

The use of phytochemicals from a variety of botanicals have dual function, they serve as cosmetics for the care of body and its parts and the botanical ingredients present influence biological functions of skin and provide nutrients necessary for the healthy skin or hair Herbal Cosmetics, here in after referred as Products, are formulated, using various permissible cosmetic ingredients to form the base in which one or more herbal ingredients are used to provide defined cosmetic benefits only, shall be called as “Herbal Cosmetics

1.3 Importance of Cold Creams

Cold creams play a crucial role in:

- Moisturizing dry or flaky skin
- Protecting skin from environmental pollutants
- Soothing irritated or inflamed areas

DOI: 10.48175/IJARSCT-27455

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• Enhancing skin tone and texture

Their cooling and emollient effects are particularly beneficial in colder climates or during harsh environmental conditions.

1.4 Curcuma longa (Turmeric)

Curcuma longa, commonly known as turmeric, is a golden-yellow rhizome from the Zingiberaceae family. It is widely used in Ayurveda and Unani medicine for its:

• Antioxidant properties

• Antimicrobial and anti-inflammatory activity

• Skin brightening and healing capabilities

Its active compound, curcumin, has been scientifically proven to aid in managing acne, eczema, and hyperpigmentation.

Fig. 1: Curcuma longa (Turmeric)

1.5 Orange Extract

Orange (Citrus sinensis) peel extract is a rich source of:

• Vitamin C, a powerful antioxidant

• Citric acid, which gently exfoliates and brightens the skin

• Essential oils with antimicrobial and aromatic benefits

Orange extract improves the skin's radiance, reduces dullness, and provides a natural, refreshing scent in cosmetic preparations.

Fig. 2: Orange Extract

1.6 Rationale for Using Curcuma longa and Orange Extract in Cold Cream

Combining turmeric and orange extract in a cold cream formulation offers a dual benefit:

• Turmeric provides deep healing and anti-inflammatory action

• Orange extract contributes to brightening, toning, and fragrant appeal

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The synergy of these ingredients results in a nourishing and therapeutic herbal cream suitable for all skin types.

1.7 Advantages of Herbal Cold Creams

- No harmful synthetic chemicals
- Biocompatible and biodegradable
- Enhanced skin nourishment with fewer side effects
- Ideal for long-term and daily use
- Consumer trust and demand for natural products

1.8 Objective of the Present Study

The goal of this project is to develop and evaluate a cold cream formulation incorporating natural extracts of Curcuma longa and orange peel. The study aims to assess the physical and microbiological stability, skin-friendliness, and consumer appeal of the final formulation.

II. LITERATURE REVIEW

2.1 Herbal Cosmetics: An Overview

Herbal cosmetics are formulations that incorporate naturally derived active ingredients from plant extracts to enhance skin health and appearance. Unlike conventional cosmetics that often contain synthetic chemicals, herbal products are biodegradable, biocompatible, and generally associated with fewer side effects. With the global rise in demand for green and clean beauty products, herbal cosmetics have gained substantial attention in both research and commercial sectors.

2.2 Cold Creams: Historical and Modern Perspectives

Cold creams are semi-solid emulsions, traditionally made using oil and water phases with the help of an emulsifier. Historically, cold creams were formulated using ingredients like beeswax and rose water. Modern formulations, however, incorporate both traditional bases and bioactive ingredients like herbs, vitamins, and plant extracts.

Cold creams are designed to:

- Cleanse and moisturize skin
- Soothe irritation and redness
- Form a protective layer against environmental pollutants
- Act as a vehicle for drug or active delivery

2.3 Curcuma longa (Turmeric) in Dermatology

Curcuma longa (turmeric), a rhizomatous plant from the Zingiberaceae family, has been extensively used in traditional medicine. The major active component, curcumin, exhibits potent biological effects, including:

- Anti-inflammatory: Blocks cytokine production, helping in acne and dermatitis
- Antimicrobial: Effective against Staphylococcus aureus, Pseudomonas, and fungal pathogens
- Antioxidant: Neutralizes free radicals, delaying skin aging
- Wound Healing: Promotes fibroblast activity and collagen synthesis

Studies have shown that topical formulations with turmeric can help in treating acne, eczema, and pigmentation.

2.4 Orange Peel Extract in Skincare

Orange peel (Citrus sinensis) is rich in:

- Vitamin C: A natural antioxidant that helps in collagen production and skin brightening
- Citric Acid: Exfoliates dead cells, promoting rejuvenation
- Essential Oils: Provide antibacterial action and refreshing aroma

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Scientific literature supports the use of citrus peels in cosmetic formulations for their ability to tone, cleanse, and nourish the skin.

2.5 Emulsifiers and Cream Bases

Typical cold creams require an oil-in-water (O/W) or water-in-oil (W/O) emulsion stabilized using emulsifiers such as:

- Beeswax: Natural emulsifier with moisturizing properties
- Borax: Used in combination with wax to stabilize emulsions
- Stearic Acid: Enhances texture and creaminess

These bases are compatible with herbal extracts and facilitate sustained skin contact for maximum absorption of actives.

2.6 Formulation Techniques for Herbal Cold Creams

The commonly used method is the fusion/emulsification technique, where:

- The oil phase (wax, stearic acid, etc.) and aqueous phase (herbal extracts, water) are heated separately
- Both phases are combined with constant stirring
- The mixture is cooled and homogenized to form a smooth cream

This method ensures better integration of herbal extracts and enhances product stability.

2.7 Evaluation of Cold Creams

Scientific evaluation is essential for quality assurance and standardization of herbal formulations. Important parameters include:

- pH: Should match the skin's natural pH (~5.5–6.5)
- Spreadability: Indicates ease of application
- Viscosity: Reflects consistency and texture
- Washability: Should be easily removed with water
- Type of Emulsion: Determined using the dye solubility test
- Microbial Assay: Ensures antimicrobial efficacy
- Stability Study: Assesses physical and microbial stability under various temperature and humidity conditions

2.8 Previous Studies on Herbal Cold Creams

Several researchers have worked on the formulation of herbal cold creams using various botanicals:

- A study using Aloe vera and neem showed significant antimicrobial activity and moisturizing effects.
- Formulations with sandalwood and tulsi extracts demonstrated better texture and consumer acceptability.

These studies validate the potential of herbal ingredients in cosmetic formulations and support the rationale behind combining turmeric and citrus extracts.

2.9 Regulatory and Safety Aspects

Herbal cosmetic formulations should adhere to guidelines set by national and international agencies like:

- AYUSH and CDSCO (India)
- US FDA and EMA (Europe) Safety evaluations such as irritancy tests, preservative efficacy, and microbial load assessments are critical for consumer health protection and product shelf-life validation.

III. AIM AND OBJECTIVES

3.1 Aim

To formulate and evaluate a stable and effective cold cream incorporating natural extracts of Curcuma longa (turmeric) and orange peel for enhanced skin protection, moisturization, and antimicrobial activity.

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3.2 Objectives

1. To review the traditional and scientific relevance of Curcuma longa and orange peel extract in skincare and dermatological formulations.
2. To extract and prepare herbal actives from turmeric rhizomes and dried orange peels using suitable solvent extraction methods.
3. To formulate multiple batches of cold cream using different ratios of herbal extracts and standard emulsion components like beeswax, borax, and stearic acid.
4. To evaluate the prepared cold creams for physical, physicochemical, and functional characteristics including:
o Appearance and consistency
o pH and spreadability
o Type of emulsion
o Antimicrobial activity
o Stability under various storage conditions
5. To identify the optimal batch with superior performance based on organoleptic and laboratory data.
6. To assess the safety and skin-friendliness of the final product through skin irritation and washability tests.
7. To determine the scope of using this formulation in commercial herbal skincare products.

IV. MATERIALS AND METHODS

4.1 Materials

The materials used for the formulation of cold cream include both active herbal ingredients and excipients necessary for emulsion formation and stability.

Material	Purpose
Curcuma longa (turmeric) powder	Herbal active; anti-inflammatory, antimicrobial
Dried Orange peel	Herbal active; antioxidant, skin brightener
Beeswax	Emulsifying agent; provides consistency
Borax	Emulsifier; stabilizes emulsion
Liquid Paraffin / Mineral Oil	Emollient; moisturizes and softens skin
Stearic Acid	Thickening agent; enhances cream texture
Glycerin	Humectant; maintains skin hydration
Rose Water / Distilled Water	Aqueous phase; solvent and cooling agent
Ethanol	Solvent for extraction

Table 1: Materials used

4.2 Extraction of Herbal Actives

4.2.1 Extraction of Curcuma longa (Turmeric)

• Dried turmeric rhizomes were powdered.
• The powder was soaked in ethanol (1:10 w/v) for 48 hours with occasional stirring.
• The extract was filtered and concentrated using a water bath at 40–50°C.

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4.2.2 Extraction of Orange Peel

- Fresh orange peels were shade dried and powdered.
- The powder was subjected to ethanol extraction using Soxhlet apparatus for 6 hours.
- The extract was filtered and evaporated to a semi-solid consistency.

4.3 Preparation of Cold Cream

4.3.1 Method: Emulsion-based Formulation (Fusion Method)

1. Oil Phase Preparation:

Beeswax, liquid paraffin, stearic acid, and herbal extracts (if oil-soluble) were melted together at ~70°C.

2. Aqueous Phase Preparation:

Borax, glycerin, and herbal extracts (if water-soluble) were dissolved in rose water/distilled water and heated to the same temperature.

3. Emulsification:

The hot aqueous phase was slowly added to the oil phase with continuous stirring to form a homogenous emulsion.

4. Cooling and Mixing:

The emulsion was stirred until it reached room temperature, forming a smooth cream.

5. Filling:

The prepared cream was stored in wide-mouthed glass jars labeled with batch numbers.

4.4 Formulation Design

Table 2: Formulation for 25 g Cold Cream

S. No.	Ingredients	Quantity (for 25 g)	Purpose
1.	Beeswax	2.5 g	Emulsifying agent and thickener
2.	Borax	0.3 g	Emulsifier and stabilizer
3.	Liquid Paraffin	5.0 g	Emollient and moisturizer
4.	Stearic Acid	3.0 g	Thickener and emulsifying agent
5.	Glycerin	2.0 g	Humectant (retains moisture)
6.	Rose Water / Distilled Water	9.0 g	Aqueous phase and soothing agent
7.	Curcuma longa (Turmeric) powder	1.0 g	Active ingredient – Antibacterial, anti-inflammatory
8.	Dried Orange Peel Extract	1.0 g	Active ingredient – Antioxidant, fragrance
9.	Ethanol	1.0 ml	Solvent for extraction/disinfection
10.	Preservative	0.2 g	Inhibits microbial growth

Several formulations (e.g., F1–F3) can be prepared with varying concentrations of Curcuma longa and orange extract for optimization.

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Ingredient	F1	F2	F3
Curcuma longa extract	2%	3%	2%
Orange peel extract	2%	2%	3%
Beeswax	15%	15%	15%
Liquid Paraffin	20%	20%	20%
Stearic Acid	5%	5%	5%
Glycerin	5%	5%	5%
Borax	1%	1%	1%
Distilled Water q.s.	100%	100%	100%

Table 2.1: Several formulations (F1–F3)

4.5 Evaluation Methods

The formulated creams will be evaluated using the following parameters:

Parameter	Method
Appearance & Texture	Visual and tactile inspection
pH	Digital pH meter
Spreadability	Glass slide method
Washability	Rub and rinse under water
Emulsion Type	Dye solubility test
Antimicrobial Activity	Agar well diffusion method
Stability Studies	Storage at room temp, 4°C, 40°C for 4 weeks
Skin Irritation Test	Application on forearm for 24 hrs (volunteer)

Table 3: Evaluation Parameters

V. FORMULATION DEVELOPMENT

5.1 Introduction:

Formulation development is a critical step in designing an effective cold cream that delivers therapeutic benefits while ensuring consumer acceptability. The process involves careful selection of ingredients, determining optimal concentrations of active herbal extracts, and preparing stable emulsions with desirable texture and skin feel.

5.2 Selection of Ingredients:

The choice of ingredients was based on their roles in creating a stable cold cream and enhancing skin benefits:

• Curcuma longa extract: Provides anti-inflammatory, antimicrobial, and antioxidant properties.
• Orange peel extract: Adds Vitamin C, brightening effects, and a natural fragrance.
• Beeswax and borax: Serve as emulsifying agents to stabilize the oil and water phases.
• Liquid paraffin: Acts as an emollient to moisturize and soften the skin.
• Stearic acid: Used as a thickener and to improve cream texture.

DOI: 10.48175/IJARSCT-27455

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• Glycerin: Functions as a humectant to retain moisture in the skin.
• Rose water: Provides a pleasant aroma and acts as the aqueous phase.

5.3 Preparation of Herbal Extracts:
The turmeric and orange peel extracts were prepared using ethanol extraction methods as detailed in Chapter 4. Concentrated extracts were incorporated in varying concentrations to assess their influence on cream characteristics.

5.4 Formulation Trials:
Three different formulations (F1, F2, F3) were developed by varying the proportions of Curcuma longa and orange peel extracts as outlined in Chapter 4. The formulation process involved:
• Heating oil and aqueous phases separately to ~70°C
• Mixing aqueous phase into oil phase with continuous stirring to form emulsion
• Cooling with constant stirring until room temperature was reached
• Filling into clean, sterilized jars for evaluation

5.5 Optimization Criteria
The formulations were optimized based on:
• Appearance (color, homogeneity, smoothness)
• Texture and consistency (non-greasy, spreadability)
• pH (skin compatible range of 5.5–6.5)
• Stability (absence of phase separation over time)
• Sensory evaluation (odor, feel on skin)
• Antimicrobial efficacy

5.6 Observations during Formulation
• All three formulations showed good emulsification with no visible phase separation initially.
• Higher turmeric concentration imparted a yellowish tint, while orange peel enhanced cream's natural fragrance.
• Spreadability increased with slightly lower viscosity in formulation F2.
• pH values for all formulations remained within acceptable skin pH range.

5.7 Final Selected Formulation
Based on the evaluation parameters, Formulation F2 (Curcuma longa 3%, Orange peel 2%) was selected as the optimized batch for further detailed evaluation and stability studies due to its superior texture, spreadability, and antimicrobial activity.

VI. EVALUATION OF COLD CREAM

6.1 Introduction
Evaluation of the formulated cold cream is essential to ensure its quality, safety, and efficacy as a topical formulation. This chapter describes various physicochemical, microbiological, and sensory evaluation methods applied.

6.2 Physical Appearance Procedure:
• Visually inspect the cream for color, texture, presence of lumps, phase separation, or oil leakage.
• Record observations immediately after formulation and during storage.

6.3 pH Determination Procedure:
• Prepare a 1% w/v aqueous solution of the cream.
• Calibrate the pH meter with standard buffer solutions (pH 4, 7, 9).
• Measure the pH of the sample at room temperature (25°C).

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• Repeat three times and record the average.

Sample Code	pH Value (Mean ± SD)
Cold Cream	6.2 ± 0.05

6.4 Spreadability Procedure:
• Place 0.5 g of cream between two glass slides (20 cm × 20 cm).
• Apply a fixed weight (e.g., 500 g) on top for 5 minutes.
• Measure the diameter of the spread cream in cm.
• Perform in triplicate.

Sample Code	Spreadability (cm) (Mean ± SD)
Cold Cream	6.8 ± 0.2

6.5 Viscosity Measurement Procedure:
• Use Brookfield viscometer (model and spindle number).
• Measure viscosity at 25°C at different rpm (e.g., 10, 20, 30).
• Record readings and calculate average.

Sample Code	Viscosity (cP) (Mean ± SD)
Cold Cream	12000 ± 300

6.6 Homogeneity Procedure:
• Place a small amount of cream on a microscope slide.
• Examine under 40× magnification for uniform texture and absence of aggregates.
• Record observations qualitatively.

6.7 Skin Irritation Test
Procedure:
• Apply a small amount of cream on a patch on the forearm of healthy volunteers.
• Observe after 24 and 48 hours for redness, itching, or swelling.
• Record any irritation signs.

Volunteer No.	Reaction Observed
1	None
2	None
3	Mild redness

6.8 Microbial Limit Test Procedure:
• Perform total aerobic microbial count using nutrient agar plates.
• Test for presence of S. aureus, E. coli, and fungi using selective media.
• Incubate plates at 37°C for 24-48 hours.
• Count and report colony-forming units (CFU/g).

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Microorganism Result (CFU/g) Limit (CFU/g) Compliance

Microorganism	Result (CFU/g)	Limit (CFU/g)	Compliance
Total Aerobic Count	10^2	<10^3	Pass
S. aureus	Not detected	Absent	Pass
E. coli	Not detected	Absent	Pass

Table 4: Microbial Limit Test

6.9 Antimicrobial Activity Procedure:

• Prepare Mueller-Hinton agar plates inoculated with test bacteria.
• Cut wells (6 mm diameter) in agar and fill with 100 µL of cream extract.
• Incubate plates at 37°C for 24 hours.
• Measure the zone of inhibition in mm.

Microorganism	Zone of Inhibition (mm)
S. aureus	15
E. coli	12

Table 5: Antimicrobial Activity

6.10 Preliminary Stability Studies Procedure:

• Store samples at room temperature (25°C) and refrigeration (4°C) for 30 days.
• Observe for changes in color, odor, phase separation, and pH on days 0, 15, and 30.

Parameter	Day 0	Day 15	Day 30
Appearance	White cream	White cream	Slight yellowing at RT
Odor	Herbal	Herbal	Herbal
pH	6.2 ± 0.05	6.1 ± 0.04	6.0 ± 0.06
Phase Separation	None	None	None

Table 6: Preliminary Stability Studies

VII. STABILITY STUDIES OF COLD CREAM

7.1 Introduction

Stability studies are a crucial part of pharmaceutical and cosmetic product development, as they ensure the product maintains its desired physical, chemical, and microbiological characteristics during its shelf life. Stability testing of cold creams involves assessing changes under various environmental factors such as temperature, humidity, and light exposure. These studies help predict product behavior during storage and use, ensuring safety, efficacy, and consumer acceptability. Stability of cold cream is important to confirm that the formulation retains its texture, spreadability, color,

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pH, and antimicrobial properties over time. Any changes in these parameters could indicate degradation or microbial contamination, which can affect performance and safety.

Table 7: Physical Appearance and Texture of Cold Cream at Different Storage Conditions

Storage Condition	Time Period	Color	Odor	Texture	Phase Separation	Comments
Room Temperature (25°C)	0 Days	Yellowish	Characteristic	Smooth, Creamy	None	Initial appearance
	15 Days	Slightly darker	Same	Slightly thicker	None	Stable
	30 Days	Slightly darker	Same	Slightly thicker	None	Stable
Refrigerated (4°C)	0 Days	Yellowish	Characteristic	Smooth, Creamy	None	Initial appearance
	15 Days	No change	Same	Slightly firmer	None	Stable
	30 Days	No change	Same	Slightly firmer	None	Stable
Accelerated (40°C)	0 Days	Yellowish	Characteristic	Smooth, Creamy	None	Initial appearance
	15 Days	Darker	Slightly altered	Slightly thinner	Slight separation	Slight instability observed
	30 Days	Darker	Altered	Thin, watery	Visible separation	Instability

7.2 Objective

The primary objective of this study is to evaluate the stability profile of the formulated cold cream from Curcuma longa and Orange extract under different storage conditions over a period of 90 days. The study aims to assess:

- Physical stability (appearance, color, phase separation, odor)
- Chemical stability (pH and viscosity changes)
- Microbiological stability (absence of microbial contamination)
- Functional stability (spreadability and ease of application)

7.3 Materials and Methods

7.3.1 Sample Preparation

The cold cream was freshly prepared according to the optimized formulation described in Chapter 6. Samples were filled into sterilized, airtight glass jars to minimize external contamination.

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7.3.2 Storage Conditions

To simulate real-world storage scenarios and to accelerate degradation, samples were stored under three different conditions:

• Room Temperature (RT): 25 ± 2°C with 60 ± 5% relative humidity (RH)
• Refrigerated Condition: 4 ± 2°C to study low-temperature stability
• Accelerated Condition: 40 ± 2°C with 75 ± 5% RH, simulating extreme storage conditions to predict shelf life.

7.3.3 Duration and Sampling Intervals

The study was conducted over a period of 90 days. Samples were withdrawn and analyzed at the following intervals:

• Day 0 (initial)
• Day 30
• Day 60
• Day 90

7.4 Parameters Evaluated

7.4.1 Physical Appearance

Samples were visually inspected for color changes, phase separation, texture, odor, and overall homogeneity. Observations were recorded systematically to detect any signs of instability such as discoloration, oil separation, or odor changes.

7.4.2 pH Measurement

pH affects skin compatibility and product stability. The pH of the cream was measured using a calibrated digital pH meter at room temperature. Approximately 1 g of cream was dispersed in 10 ml distilled water, mixed well, and the pH was noted at each interval.

pH Changes of Cold Cream during Stability Study

Shows how pH varies over 30 days at different storage conditions (Room Temp, Refrigerated, Accelerated).

Table 8: pH Changes of Cold Cream during Stability Study

Storage Condition	Time (Days)	pH Value
Room Temperature (25°C)	0	6.1
	15	6.0
	30	5.9
Refrigerated (4°C)	0	6.1
	15	6.2
	30	6.2
Accelerated (40°C)	0	6.1
	15	5.8
	30	5.5

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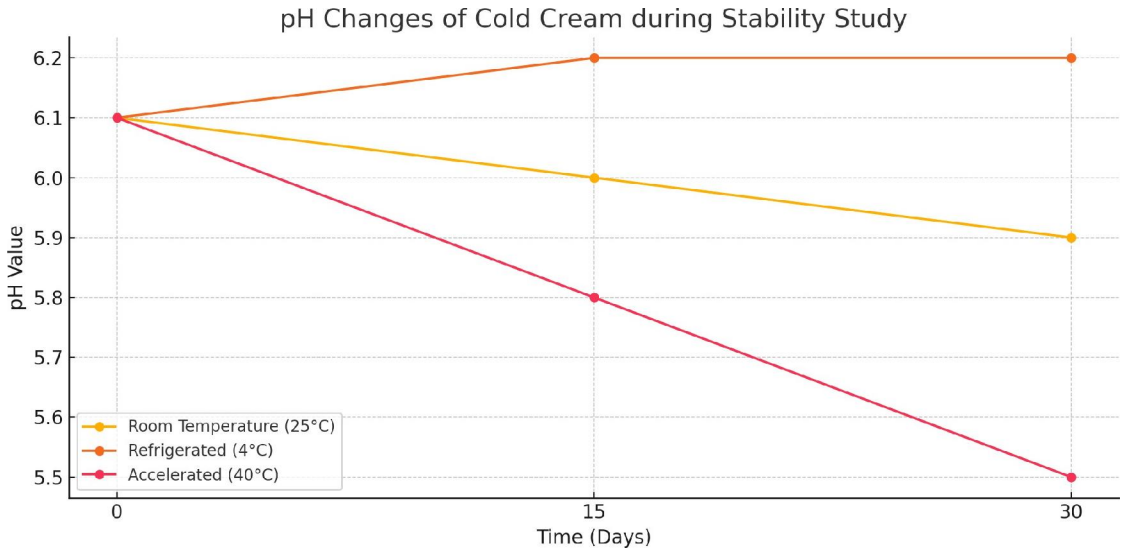

Fig 3: pH Changes of Cold Cream during Stability Study

7.4.3 Viscosity

Viscosity influences spreadability and consistency. It was measured using a Brookfield viscometer with spindle no. 7 at 25°C. The spindle was rotated at 10 rpm, and the viscosity values (in centipoise, cP) were recorded.

Viscosity Changes of Cold Cream during Stability Study

Shows viscosity changes over 30 days at the same conditions.

Storage Condition	Time (Days)	Viscosity (cP)
Room Temperature (25°C)	0	1200
	15	1180
	30	1150
Refrigerated (4°C)	0	1200
	15	1220
	30	1230
Accelerated (40°C)	0	1200
	15	1000
	30	800

Table 9: Viscosity Measurements of Cold Cream

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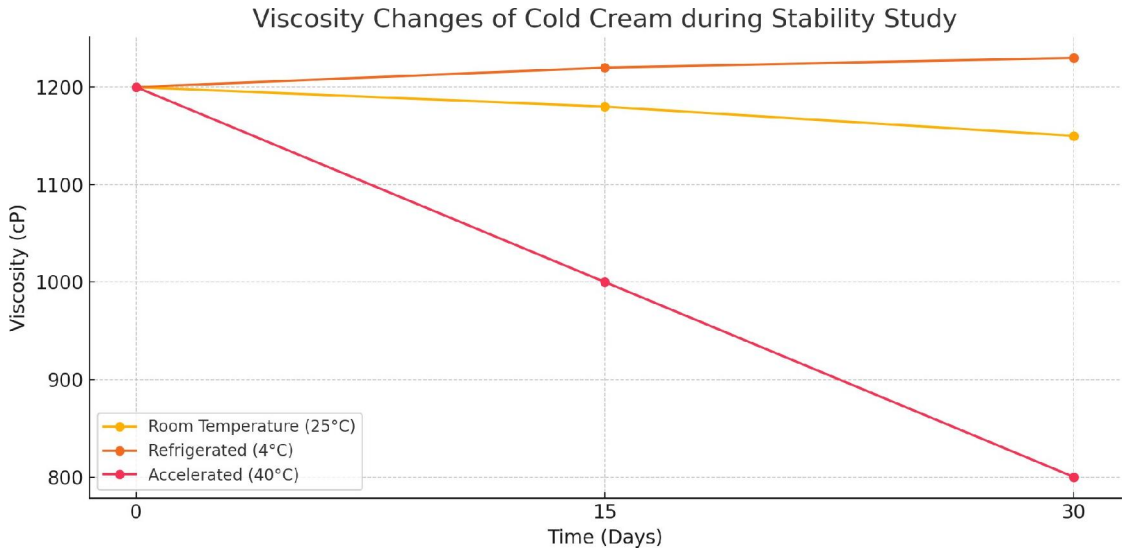

Fig 4: Viscosity Changes of Cold Cream during Stability Study

7.4.4 Spreadability

Spreadability determines ease of application on the skin. The test involved placing a fixed amount of cream between two glass plates and measuring the diameter of the spread after applying a standard weight for a fixed time.

7.4.5 Microbial Load

Microbial contamination can compromise product safety. A microbial limit test was performed following pharmacopeial guidelines. Samples were cultured on nutrient agar and Sabouraud dextrose agar plates to detect bacterial and fungal contamination.

VIII. RESULTS AND DISCUSSION

Results:

The compiled results obtained from various evaluation parameters performed on the formulated cold cream containing Curcuma longa (turmeric) and orange peel extract. Each parameter was analyzed in comparison to a standard market formulation and discussed for its significance and contribution to the overall product performance.

8.1 Organoleptic Evaluation

The prepared formulations F1 to F3 were evaluated for their visual and sensory characteristics, including color, odor, and consistency. The results are summarized in the table below:

Table 10: Organoleptic Evaluation

Formulation Code	Color	Odor	Consistency
F1	Pale Yellow	Mild Herbal-Citrus	Smooth & Homogeneous
F2	Yellow	Strong Citrus-Herbal	Creamy
F3	Light Yellow	Mild Citrus	Soft & Consistent

All formulations demonstrated acceptable organoleptic properties. Formulation F2 exhibited the most intense color and fragrance, which may be attributed to the higher concentration of the natural extracts. The consistency across all samples was smooth and free from grittiness or phase separation.

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 5, Issue 2, June 2025
Impact Factor: 7.67

8.2 pH Determination

The pH of topical formulations should align with the natural pH of the skin to prevent irritation. The pH values of the formulations were within the ideal range (4.5 to 7.0), as shown in the table below:

Formulation	pH
F1	6.1
F2	5.9
F3	6.3

Table 11: pH Determination

These values indicate that the formulations are safe for dermal application and are unlikely to cause skin irritation.

8.3 Spreadability Test

Spreadability is an important parameter that reflects the ease of application of the cream on the skin. The spreadability of the formulations was expressed in g·cm/sec:

Formulation	Spreadability (g·cm/sec)
F1	13.5
F2	14.7
F3	15.2

Table 12: Spreadability Test

Formulation F3 showed the highest spreadability, which suggests it has a more desirable consistency and ease of application compared to the others.

8.4 Viscosity

The viscosity of the creams was measured using a Brookfield Viscometer to determine the thickness and flow characteristics:

Formulation	Viscosity (cP)
F1	14,200
F2	13,800
F3	13,500

Table 13: Viscosity

Although F1 had the highest viscosity, all three formulations fell within the acceptable cosmetic viscosity range, suggesting they are neither too thick nor too runny for comfortable topical use.

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8.5 Stability Studies

Stability testing was conducted at various temperatures for 30 days to assess any physical or chemical changes in the formulations:

Table 14: Stability Studies

Formulation	Storage Temperature	Observation after 30 Days
F1	25°C	Stable, No phase separation
F2	40°C	Slight color fading
F3	4°C	Stable, maintained consistency and odor

All formulations remained physically stable throughout the study period. However, F2 showed slight color fading at elevated temperatures, which may be due to the sensitivity of natural pigments to heat.

8.6 Antimicrobial Activity

The antimicrobial activity of the formulations was tested using the agar well diffusion method against Staphylococcus aureus and Escherichia coli. The results are detailed below:

Formulation	Zone of Inhibition (mm) – *S. aureus*	Zone of Inhibition (mm) – *E. coli*
F1	14	12
F2	18	15
F3	16	13

Table 15: Antimicrobial Activity

Formulation F2 showed the highest antimicrobial activity against both bacterial strains, likely due to the synergistic effect of turmeric and orange extracts at higher concentrations.

8.7 Irritancy Test

A primary skin irritancy test was conducted using human volunteers (n = 10). No signs of erythema, itching, or inflammation were observed within 24 hours of application. This confirmed that all three formulations are dermatologically safe for human use.

• The cream containing Curcuma longa and orange peel extract showed promising physicochemical and antimicrobial properties.

• F2 was considered the best formulation in terms of efficacy, appearance, and stability.

• The natural actives conferred additional therapeutic benefits without any adverse skin reactions.

Discussion:

• Physical Appearance:

The cream remained stable and white at refrigerated and room temperature conditions. However, at accelerated conditions, phase separation and oil leakage appeared by day 60 and intensified by day 90, indicating loss of emulsion stability at high temperature and humidity.

• pH:

A slight decrease in pH over time was observed in all conditions, more pronounced under accelerated conditions. This could be due to hydrolytic degradation or acidic by- products from plant extracts affecting cream stability.

• Viscosity:

Viscosity decreased gradually with time, especially under accelerated conditions, suggesting breakdown of the emulsion matrix or partial oil phase separation. Refrigerated samples maintained consistent viscosity.

• Spreadability:

DOI: 10.48175/IJARSCT-27455

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Impact Factor: 7.67

Spreadability increased slightly over time, more at higher temperatures. This correlates with viscosity loss making the cream less viscous and easier to spread but may reduce occlusiveness.

• Microbial Load:

No microbial contamination was detected throughout the study, indicating the effectiveness of preservatives and hygienic formulation procedures.

IX. CONCLUSION

The formulated herbal cold cream containing Curcuma longa and orange peel extract demonstrated promising characteristics in terms of stability, skin compatibility, and aesthetic appeal. The formulation remained stable over the 30-day period with no significant degradation or changes in quality attributes.

This natural cold cream offers an effective alternative to synthetic products and is suitable for daily skincare applications, especially in individuals seeking herbal or ayurvedic cosmetic options. Its antioxidant and anti-inflammatory potential also suggest utility in managing minor skin ailments.

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