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Formulation And Evaluation Of Herbal Antimicrobial Cream Using *Moringa Oleifera*

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➢ **Abstract:**

Antibiotic resistance is reducing the effectiveness of synthetic antibiotics, which makes it important to explore natural antibacterial agents. The Moringa plant (Moringa oleifera Lam.) has shown antibacterial properties that can inhibit and kill pathogenic bacteria, including Multi-Drug Resistant (MDR) strains. This review article aims to gather and present data related to the antibacterial activity of Moringa as a possible solution to antibiotic resistance. This research covers the phytochemistry, mechanisms of antimicrobial action, extraction methods, formulation strategies, and evaluation parameters of antimicrobial creams made from M. oleifera. Special focus is given to topical cream formulation, physicochemical properties, stability testing, and antimicrobial evaluation techniques. The potential use of Moringa-based creams in treating wound infections is also discussed. Although current findings suggest that antimicrobial creams prepared using M. oleifera extracts could be a promising, cost-effective, and eco-friendly alternative to synthetic topical antibiotics, there is still a need for well-structured clinical trials and standardized formulation methods for successful pharmaceutical application.

Keywords: Moringa oleifera, antimicrobial cream, herbal formulation, phytochemicals, wound infection, antimicrobial resistance, evaluation and mechanism of action of herbal phytochemicals

➢ **Introduction:**

Multidrug resistance in pathogenic microorganisms has become a major global concern, mainly due to the overuse of antibiotics. Since ancient times, plants have been used for food, fodder, and medicinal purposes. They are a valuable source of therapeutic antimicrobial compounds. The side effects associated with synthetic antibiotics have encouraged researchers to look for new antimicrobial products to address serious health issues (Joshi et al., 2010).

Moringa oleifera, commonly known as the drumstick tree, horseradish tree, or miracle tree, belongs to the family Moringaceae. It is native to South Asia, especially the Himalayan foothills of India. This is a small, fast-growing plant that retains its leaves even during dry seasons. It is mentioned in the Charaka Samhita and has been widely used in African traditional medicine.

Almost all parts of the plant are edible, but the leaves and pods are most commonly consumed. The leaves are known to boost immunity and can be eaten fresh, cooked, or used as a food supplement.

Moringa oleifera is well known for both its nutritional and medicinal properties. Traditionally, it has been used as a stimulant, diuretic, antipyretic, antitumor, antiepileptic agent, and cardiac tonic. Studies such as Abou Zaid et al. (2014) have also evaluated its use in food products like chocolate.

This plant contains a wide range of nutrients, including minerals, proteins, vitamins, beta-carotene, amino acids, and phenolic compounds. Its medicinal benefits include hepatoprotective, antiplasmodic, antibacterial, and antifungal effects. It has also been used in traditional medicine for managing diabetes.

Jung (2014) suggested that soluble extracts from Moringa leaves may have therapeutic potential in cancer treatment. The leaves are rich in calcium and potassium and act as strong antioxidants due to compounds like ascorbic acid, flavonoids, phenolics, and carotenoids, which also help extend the shelf life of fat-containing foods.

In many regions, M. oleifera is called "Mother's best friend" because it helps increase milk production in lactating women. Studies have also reported its hypolipidemic effects. Additionally, the analgesic properties of Moringa leaves and seeds have been found to be comparable to aspirin.

Due to these significant medicinal properties, this study focuses on evaluating the antibacterial potential and phytochemical composition of different parts of Moringa oleifera against both human and plant pathogenic bacteria.

- **Introduction to Moringa Leaf**

  - **Botanical Features:**
    - Moringa leaves are compound and feathery in structure, consisting of small leaflets attached to a central stalk.
  - **Nutritional Value:**
    - The leaves are highly nutritious, containing vitamins such as vitamin A and vitamin C, along with important minerals like calcium and iron.
  - **Cultural Importance:**
    - In traditional systems like Ayurveda, Moringa leaves have been valued for their wide range of health benefits, including anti-inflammatory and antioxidant properties.
  - **Daily Use:**
    - Moringa leaves can be easily included in everyday diets, whether in fresh salads, cooked dishes, or as tea. They are also used as dietary supplements and in traditional remedies due to their therapeutic benefits.

- **Botanical Aspects of Moringa*:***

Moringa oleifera is a fast-growing deciduous tree belonging to the family Moringaceae. It is native to the Indian subcontinent and can grow in a wide range of tropical and subtropical climates. The tree usually reaches a height of 10–12 meters, with a straight trunk, compound leaves, and delicate white flowers (Adedapo et al., 2009).

Taxonomy

The classification of Moringa oleifera is as follows:

Kingdom: Plantae
Order: Brassicales
Family: Moringaceae
Genus: Moringa
Species: oleifera

- **Phytochemical Composition:**

  - Moringa contains a wide variety of phytochemicals, including phenols, alkaloids, flavonoids, tannins, carbohydrates, saponins, reducing sugars, proteins, steroids, cardiac glycosides, and minerals (Anwar, 2007). These compounds form the basis of its medicinal and health-promoting properties (Amar & Das, 2013).

  - It is also rich in essential nutrients such as minerals, proteins, vitamins, beta-carotene, amino acids, and phenolic compounds, which enhance its overall nutritional value.

  - The presence of these phytochemicals highlights the versatility of Moringa as a natural source of therapeutic compounds. This makes it highly valuable for medicinal use and encourages further research to fully explore its potential (Tanya et al., 2023).

- **Objectives of the Study**
  - To extract and bioactive constituents from the leaves of *Moringa oleifera* using suitable extraction methods.
  - To formulate a stable and effective herbal antimicrobial cream incorporating *Moringa oleifera* extract as the active ingredient.
  - To evaluate the physicochemical properties of the formulated cream, including pH, viscosity, spreadability, homogeneity, and appearance.
  - To assess the antimicrobial activity of the formulated cream against selected pathogenic microorganisms such as and *Escherichia coli*.
  - To compare the antimicrobial efficacy of the herbal formulation with a standard marketed antimicrobial cream.
  - To conduct stability studies under different environmental conditions to determine the shelf-life and consistency of the formulation.
  - To analyze the suitability of *Moringa oleifera* as a natural, safe, and cost-effective alternative to synthetic antimicrobial agents.

- **Rationale for Selection of *Moringa oleifera:***

  - *Moringa oleifera* was selected for the formulation of the herbal antimicrobial cream due to its well-documented medicinal properties, broad-spectrum antimicrobial activity, availability, economic feasibility, and suitability for topical application. Numerous studies have demonstrated that *Moringa oleifera* exhibits significant antimicrobial effects against Gram-positive bacteria such as *B. cereus* & *M. luteus*, Gram-negative bacteria such as *Escherichia coli*

  - The antimicrobial activity is primarily attributed to the presence of bioactive phytoconstituents such as flavonoids (quercetin and kaempferol), tannins, saponins, alkaloids, and phenolic compounds, which act through mechanisms including disruption of microbial cell membranes, protein denaturation, enzyme inhibition, and induction of oxidative stress.

  - Additionally, *Moringa oleifera* is native to the Indian subcontinent and is widely cultivated across tropical and subtropical regions of India, ensuring easy accessibility and sustainable supply of raw material. The plant is cost-effective due to its rapid growth, drought resistance, low cultivation requirements, and high biomass yield, making it economically viable for large- scale formulation development.

  - Furthermore, the leaves are rich in vitamins A, C, and E, which provide antioxidant and skin-protective benefits, enhancing its suitability for topical preparations. Its anti-inflammatory and wound-healing properties further support its use in managing infected or damaged skin conditions. Considering its potent antimicrobial efficacy, rich phytochemical composition, availability, affordability, and compatibility with topical dosage forms, *Moringa oleifera* was selected as the active herbal ingredient for the development and evaluation of the antimicrobial cream in the present study.

➢ MATERIAL & METHODS

- The fresh leaves of **Moringa oleifera** were collected from a garden of B.Pharmacy College, Rampura and were authenticated by a botanist or pharmacognosy from (Jay Jalaram Ayurvedic Medical College) expert to ensure correct plant identification. The collected leaves were thoroughly washed with clean water to remove dust and impurities, followed by shade drying at room temperature to preserve the active phytoconstituents. After complete drying, the leaves were powdered using a mechanical grinder and stored in an airtight container for further extraction.
- All other excipients required for cream formulation such as stearic acid, cetyl alcohol, liquid paraffin, triethanolamine, methyl paraben, and distilled water were procured from a "Central Store of B.Pharmacy College Rampura". All chemicals used were of analytical grade and were stored under suitable conditions according to standard laboratory practices to maintain their quality and stability.

SR.NO	INGREDIENTS	COLLECTION	ROLE
APIs			
1	Moringa extract (Quercetin)	From Garden B.Pharmacy College Rampura	Antimicrobial agent
OIL PHASE			
2	Stearic acid	From Lab Of B.Pharmacy College Rampura	Emulsifying agent
3	Cetyl alcohol	From Lab Of B.Pharmacy College Rampura	Emollient & consistency enhancer
4	Liquid paraffin	From Lab Of B.Pharmacy College Rampura	Emollient & improve spreadability
WATER PHASE			
5	Glycerin	From Lab Of B.Pharmacy College Rampura	Humectant
6	Triethanolamine (TEA)	From Lab Of B.Pharmacy College Rampura	Alkalizing agent
7	Methyl paraben	From Lab Of B.Pharmacy College Rampura	Preservatives
8	Distilled water	From Lab Of B.Pharmacy College Rampura	Vehicle

➢ **Optimization of Polyherbal cream Formulation:**

Optimization of the herbal antimicrobial cream formulation was carried out to obtain a stable, smooth, effective, and cosmetically acceptable product. The optimization process involved adjusting the concentration of active ingredients and excipients, selecting a suitable emulsification system, and evaluating physicochemical properties to achieve the best formulation characteristics.

Initially, different trial batches of cream were prepared by varying the concentration of **Moringa oleifera extract** and the ratio of oil phase to aqueous phase components. The purpose of optimization was to ensure proper consistency, spreadability, homogeneity, stability, and antimicrobial effectiveness of the final formulation.

The oil phase consisting of stearic acid, cetyl alcohol, and liquid paraffin was optimized to provide appropriate viscosity and emollient properties. The aqueous phase containing distilled water, triethanolamine, and preservatives was adjusted to maintain proper emulsification and pH balance. The concentration of emulsifying agents was carefully optimized to produce a stable oil-in-water (O/W) cream without phase separation.

During optimization, different formulations were evaluated for parameters such as appearance, texture, pH, viscosity, spreadability, washability, and stability under varying storage conditions. The formulation that showed smooth consistency, uniform texture, acceptable pH close to skin pH (5.5–7), good spreadability and no phase separation was selected as the optimized formulation.

Thus, optimization ensured the development of a stable, effective, and patient-friendly herbal antimicrobial cream suitable for topical application.

Initially, different trial batches of cream were prepared by varying the concentration of **Moringa oleifera extract** and the ratio of oil phase to aqueous phase components. The purpose of optimization was to ensure proper consistency, spreadability, homogeneity, stability, and antimicrobial effectiveness of the final formulation.

JAY JALARAM AYURVEDIC MEDICAL COLLEGE

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OUTWARD NO: D/a/2026/04 DATE: 28/01/2026

AUTHENTICATION CERTIFICATE

Based upon the organoleptic & macroscopic examination of sample, it is certified that the specimen given by Krishna Darji, Kavya Patel & Nisha Patel is identified as below:

Biological name	:	Moringa oleifera
Family	:	Moringaceae
Regional name	:	Saragvo, Shevaga
Pharmacological action:		It exhibits wide range of the pharmacological actions such as antimicrobial activity, antioxidant, antidiabetic and hepatoprotective effects.
Collection date	:	27/01/2026
Location / habitat	:	From The Garden Of B.Pharmacy College Rampura Kakanpur Ta-Godhra,Dist-Panchmahals,State-Gujarat
Identified by	:	Dr.Swati Dabhi M.D,Ph.D(Ayu) Associate professor Department of dravyaguna

Signature of Identifier
H.O.D.
Dravyaguna Department
Jay Jalaram Ayurvedic Medical College

Fig: authentication certificate

➢ **Preparation Of herbal cream:**

1. Extraction
2. Formulation of cream

Formulation:

SR NO.	INGREDIENTS	BATCHES (50 gm)			
		F1	F2	F3	F4
1	Moringa extract (Quercetin)	1 ml	0.5 ml	0.5 ml	1 ml
2	Stearic acid	6 g	5 g	6 g	6 g
3	Cetyl alcohol	2 g	1.5 g	1.5 g	2 g
4	Liquid paraffin	5 ml	6 ml	6 ml	5 ml
5	Glycerin	2 ml	2 ml	2 ml	2 ml
6	Triethanolamine (TEA)	0.7 ml	0.7 ml	0.7 ml	0.7 ml
7	Methyl paraben	0.1 g	0.1 g	0.1 g	0.1 g
8	Distilled water	q.s to 50ml	q.s to 50ml	q.s to 50ml	q.s to 50ml

EXTRACTION PROCEDURE

✓ **Maceration:** Powder is soaked in ethanol or hydro-alcoholic solvent for 48–72 hours with occasional shaking and concentrate the extract using evaporator.

• **Soxhlet Extraction:** Powder is extracted with ethanol or hydro-alcoholic solvent for 6–8 hours.

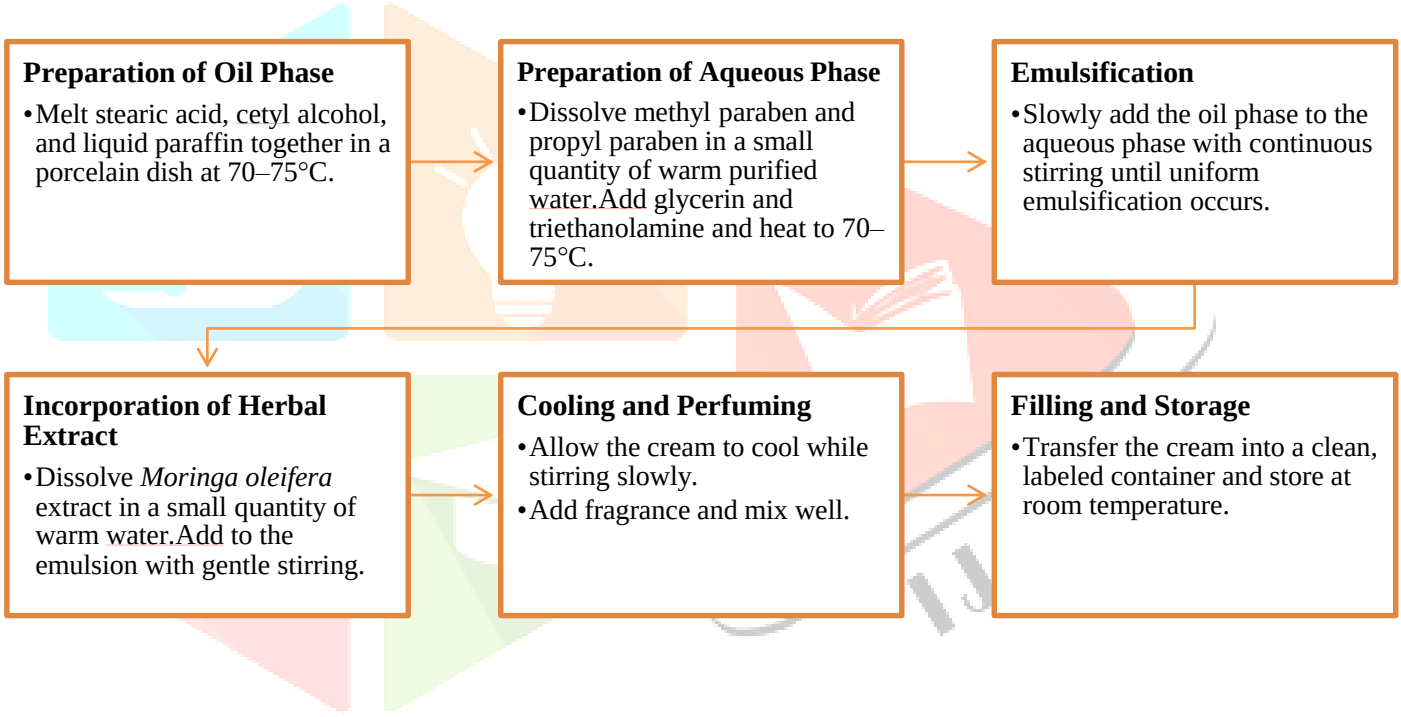
Fig: extract

✓ *We perform the maceration for the extraction of the phytochemicals from moringa leaves*

1. Take 10 g dried *Moringa oleifera* leaf powder in a clean conical flask.
2. Add 100 mL of 70% ethanol (drug: solvent ratio 1:10).
3. Seal the flask properly to prevent solvent evaporation.
4. Keep the mixture at room temperature for 72 hours.
5. Shake the flask occasionally
6. After 72 hours, filter through muslin cloth to remove coarse particles.
7. Further filter using Whatman filter paper for clear extract.
8. Concentrate using a water bath below 50°C.

FORMULATION OF CREAM

Oil-in-Water (O/W) Emulsion Method:



➢ EVALUATION PARAMETERS

The formulated cream was evaluated for the following parameters:

1. Preliminary Phytochemical analysis
2. Physical evaluation & Homogeneity
3. pH determination
4. Viscosity
5. Spreadability test
6. Washability
7. Drug–Excipient Compatibility Study
8. Antimicrobial test
9. Stability test

1. PRELIMINARY PHYTOCHEMICAL ANALYSIS:

PHYTOCHEMICAL	TEST NAME	PROCEDURE	POSITIVE RESULT
Flavonoids (Quercertin)	Shinoda Test	Add Mg + HCl to extract	Pink/red color
	Alkaline Reagent Test	Add NaOH	Yellow → colorless with acid
	Lead Acetate Test	Add lead acetate solution	Yellow precipitate
Phenolic Compounds	Ferric Chloride Test	Add $FeCl_3$ solution	Blue/green color
	Lead Acetate Test	Add lead acetate	White precipitate
	Gelatin Test	Add gelatin solution	White ppt
Alkaloids	Dragendorff's Test	Add Dragendorff reagent	Orange ppt
	Mayer's Test	Add Mayer reagent	Cream ppt
	Wagner's Test	Add Wagner reagent	Reddish-brown ppt

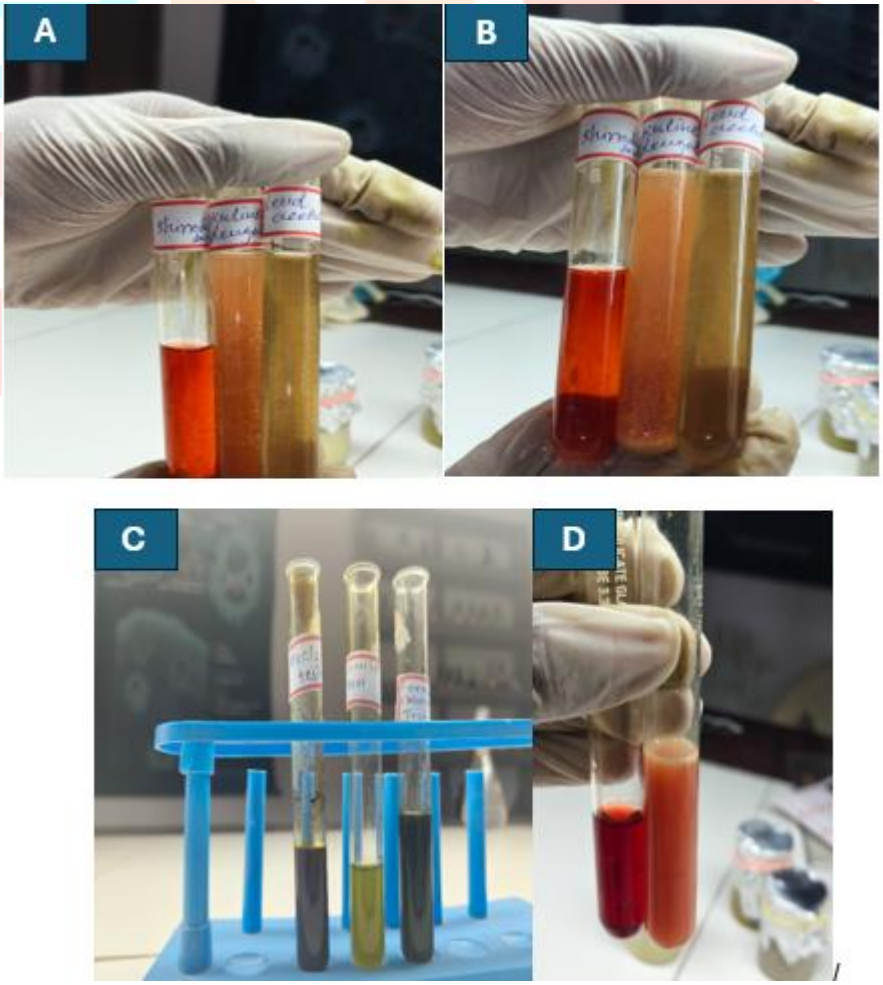


Fig: Showing Of:

A & B: Test For Flavonoids, C: Test For Phenolic Compounds And D: Test For Alkaloid

2. PHYSICAL EVALUATION:

Fig: formulated batches

Physical evaluation of cream is carried out by observing its external characteristics to ensure quality and uniformity. The colour is examined visually under natural light, while odour is checked by gentle smelling to confirm it is pleasant and characteristic. Appearance is evaluated by spreading the cream on a glass slide to ensure smoothness and absence of lumps. Texture and consistency are tested by pressing the cream between fingers to assess softness and ease of spreading. Homogeneity is determined by visual inspection and touch to confirm uniform distribution without phase separation, and grittiness is checked by rubbing the cream between fingers to ensure it is free from coarse particles.

In we see,

- Colour
- Odour
- Appearance
- Texture
- Phase separation

3. pH DETERMINATION

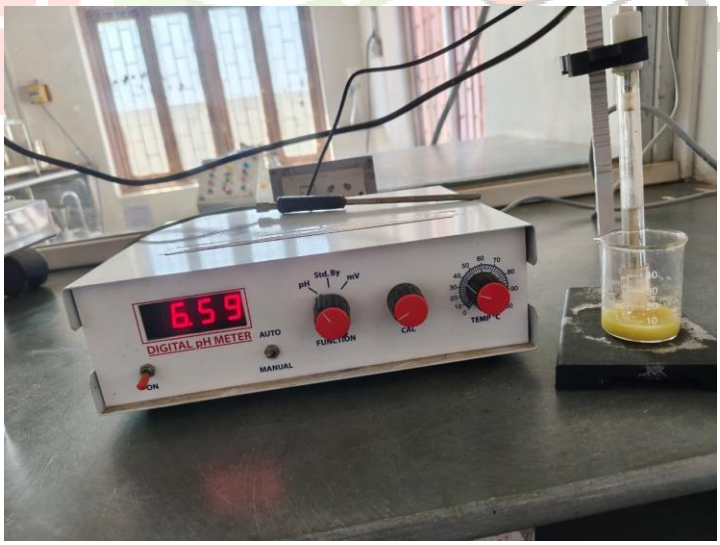


Fig: determination of pH using the pH meter & litmus paper

Procedure

1. Weigh 1 g of cream accurately.

2. Dissolve/disperse it in 10 ml of distilled water.
3. Stir the mixture thoroughly to obtain a uniform dispersion.
4. Allow it to stand for 5–10 minutes.
5. Calibrate the digital pH meter using standard buffer solutions.
6. Dip the electrode into the cream dispersion.
7. Record the pH reading.

4. VISCOSITY

Procedure

1. Take a sufficient quantity of cream in a beaker.
2. Switch on the Brookfield Viscometer.
3. Select a suitable spindle (usually spindle No. 61,62,63 or 64 for creams).
4. Immerse the spindle into the cream without trapping air bubbles.
5. Set the required speed (e.g., 10, 20 or 50 rpm).
6. Allow the reading to stabilize.
7. Note the viscosity value in centipoise (cP).

Fig: Brookfield's viscometer along with various spindles

5. SPREADABILITY TEST

Procedure:

1. Take two glass slides of equal size.
2. Place about 1 g of cream between the slides.
3. Place a known weight (e.g., 100 g) on the upper slide to form a uniform film.
4. Record the time taken for the upper slide to move a distance.

Formula:

$$S = \frac{M \times L}{T}$$

Where:

- **S** = Spreadability (g·cm/sec)
- **M** = Weight tied to upper slide (g)
- **L** = Length moved by slide (cm)
- T = Time taken (s)

Fig : Spreadability Test

6. WASHABILITY

Procedure

1. Apply a small amount of cream on the skin (hand surface).
2. Spread it uniformly over the applied area.
3. Wash the area with **running tap water**.
4. Observe whether the cream is removed easily or not.
5. Record the washability as **good, moderate, or poor**.

7. STABILITY STUDY

Procedure

1. Fill the prepared cream into suitable **airtight containers**.
2. Store samples at different temperature conditions:
   - ✓ Room temperature: 25 ± 2°C
3. Store for a specific period (usually **1–3 months**).
4. Observe samples periodically (weekly or monthly) for:
   - Colour change
   - Odour change
   - Phase separation
   - pH change
   - Texture change
5. Record observations.

8. ANTIMICROBIAL ACTIVITY (ZONE OF INHIBITION)

Method: Agar Well Diffusion Method

The antimicrobial activity of the formulated cream was evaluated against ***Escherichia coli, Micrococcus luteus*** and ***Bacillus cereus*** using the agar well diffusion method.

1. Sterile nutrient agar plates were prepared.
2. The plates were inoculated culture separately.
3. Wells of 8 mm diameter were made using a sterile cork borer.
4. Cream samples were placed into the wells.
5. A standard antibiotic (control) was used as positive control, and base cream (without active ingredient) as negative control.
6. Plates were incubated at 37°C for 24 hours.
7. The Zone of Inhibition (ZOI) was measured in millimetres.
8. Antimicrobial testing was performed at institute of science & technology for advanced studies & research (ISTAR).

9.Drug–Excipient Compatibility Study (FTIR Method)

Principle of FTIR Analysis

Fourier Transform Infrared (FTIR) spectroscopy is based on the absorption of infrared radiation by molecules. When IR radiation passes through a sample, specific wavelengths are absorbed, causing vibrations (stretching and bending) of chemical bonds. Each functional group absorbs IR radiation at a characteristic frequency, producing a unique spectrum. This spectrum acts as a molecular fingerprint of the substance. Hence, FTIR is used to identify functional groups and detect drug–excipient interactions.

➢ RESULTS

1. Preliminary Phytochemical Analysis

Sr. No.	Phytochemical	Name Of Test	Observation (Colour / Ppt / Change)	Result
1	Flavonoids	Shinoda Test	Pink / red colour observed	Present
		Alkaline Reagent Test	Yellow colour turns colourless with acid	Present
		Lead Acetate Test	Yellow precipitate formed	Present
2	Phenolic Compounds	Ferric Chloride Test	Blue-green colour developed	Present
		Lead Acetate Test	White precipitate formed	Present
4	Alkaloids	Dragendorff's Test	Orange precipitate formed	Present
		Mayer's Test	Cream precipitate observed	Present
		Wagner's Test	Reddish-brown precipitate	Present

Result: show presence the presence of the flavonoids, Phenolic Compounds, Tannins, Alkaloids and terpenoids in the extract.

2. Physical Evaluation

Sr. No.	Parameter	Batch F1	Batch F2	Batch F3	Batch F4
1	Colour	Yellow	Yellow	Dark Yellow Green	Light Yellow
2	Odour	Pleasant	Pleasant	Characteristic herbal	Pleasant
3	Appearance	Smooth	Smooth	Smooth	Smooth
4	Texture	Soft	Soft	Soft	Soft
5	Consistency	Good	Good	Good	Good
7	Grittiness	Absent	Absent	Absent	Absent
8	Phase Separation	None	None	None	None

Result: All four batches showed good physical characteristics with smooth texture, uniform colour, pleasant odour, no grittiness, and no phase separation, indicating acceptable physical quality of the formulated cream.

3. pH Determination

Sr. No.	Batch	pH Value
1	F1	6.59
2	F2	6.02
3	F3	6.32
4	F4	6.78

Result: The pH of all formulated batches was found to be within the range of **6–7**, which is suitable for skin application and indicates that the cream is non-irritant and safe for topical use.

4. Viscosity

Observation table (By Brookfield Viscometer):

Sr.No	Batch	Spindle No	Rpm	Torque	mPas/cps
1	F1	S64	10	40.6	24350
2	F2	S64	10	68	40783.3
3	F3	S64	10	89.7	53810
4	F4	S64	10	90	27140

Result: All batches showed good viscosity within the acceptable range for topical creams, indicating proper consistency, stability, and suitability for easy application.

5. Spreadability Test:

Result: All batches showed good spreadability, indicating that the cream can be easily applied on the skin with minimal effort.

6. Washability Test:

Sr. No.	Batch	Washability
1	F1	Good
2	F2	Good
3	F3	Good
4	F4	Good

Result: All batches showed good washability, indicating that the formulated cream can be easily removed from the skin using water and is suitable for topical application.

7. Homogeneity

Sr. No.	Batch	Homogeneity
1	F1	Uniform & Smooth
2	F2	Uniform & Smooth
3	F3	Uniform & Smooth
4	F4	Uniform & Smooth

Result: All batches showed good homogeneity with uniform distribution of ingredients and smooth texture, indicating proper mixing and stability of the cream formulation.

8. Stability Study

Batch	Condition	Colour Change	Phase Separation	pH Change	Stability
F1	Room Temp	No	None	No	Stable
F2	Room Temp	No	None	No	Stable
F3	Room Temp	No	None	No	Stable
F4	Room Temp	No	None	No	Stable

Result: All batches remained stable under room temp without significant changes in colour, pH, or phase separation, indicating good stability of the formulated cream.

9. Antimicrobial Activity (Zone of Inhibition)

As shown in antimicrobial test report

Sample	Concentration	*B. cereus* (mm)	*E. coli* (mm)	*M. luteus* spp. (mm)
Control	DMSO	13	13	13
Cream Sample (F1)	100 mg/mL	17	17	16
Dry Extract (DP)	10 mg/mL	28	16	20

Result: The antimicrobial activity was evaluated against *Bacillus cereus*, *Escherichia coli*, and *Micrococcus luteus* by measuring the zone of inhibition. The control (DMSO) showed a uniform zone of 13 mm against all microorganisms. The cream formulation (F1) at 100 mg/mL exhibited moderate activity with zones of 17 mm against *B. cereus* and *E. coli*, and 16 mm against *M. luteus*. The dry extract (DP) at 10 mg/mL showed the highest activity with zones of 28 mm (*B. cereus*), 16 mm (*E. coli*), and 20 mm (*M. luteus*).

The antimicrobial activity was observed against all three test organisms for the formulation of cream (F1) and dry extract. The extent of inhibition varied among the samples, suggesting differences in efficacy based on formulation and concentration.

Project Title: Formulation and Evaluation of the Herbal Antimicrobial Cream using *Moringa oleifera* extract

Report of antimicrobial testing of herbal cream and dry extract

➢ **Sample Information**

Product Name	Herbal Antimicrobial Cream
Active Ingredient	*Moringa oleifera* Extract
Dosage Form	Semisolid Cream
Additional Sample	Dry Powder Extract
Number of Samples	3 (2 Cream (F1 & F2) + 1 Extract)

➢ **Methodology: Agar Well Diffusion Assay**

The antimicrobial activity of the submitted samples was evaluated using the agar well diffusion method. Sterile nutrient agar plates were prepared and allowed to solidify under aseptic conditions. Test microorganisms, including *Bacillus cereus* ATCC 11778, *Escherichia coli* ATCC 23716, and *Micrococcus luteus* ATCC 9341, were uniformly activated, and 1 O.D was set at 600 nm. The 1.4% soft agar was inoculated with 100 µl of the activated test microorganism and then poured onto the sterile nutrient plate. Wells of approximately 8 mm diameter were aseptically bored into the N. agar plate using a sterile cup borer. The test samples were prepared: Herbal cream at a concentration of 100 mg/mL and dry powder extract at 10 mg/mL using DMSO as a solvent. A fixed volume of 100 µl of each sample was carefully inoculated into the respective wells. The inoculated plates were incubated to allow diffusion for 30 min in the refrigerator. Then plates were incubated at 37°C for 24 hours. After incubation, the antimicrobial activity was assessed by measuring the diameter of the zone of inhibition (in mm) around each well (Das et al., 2025).

➢ **Results**

The antimicrobial activity of the tested samples was determined by measuring the zone of inhibition against selected microorganisms.

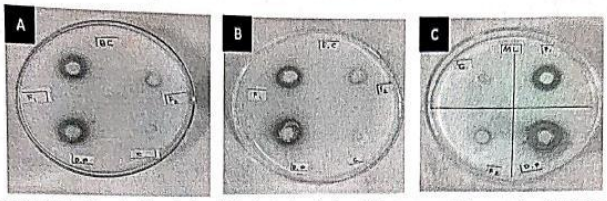


Figure 1: Antibacterial activity of the herbal antimicrobial cream and dry powder *Moringa oleifera* against test organisms A) *B. cereus*, B) *E. coli*, C) *M. luteus*

Table 1: Zone of inhibition of bacterial pathogens against the herbal antimicrobial cream and dry powder of *Moringa oleifera*

Sample	Concentration	*B. cereus* (mm)	*E. coli* (mm)	*M. luteus* spp. (mm)
Control	DMSO	13	13	13
Cream Sample (F1)	100 mg/mL	17	17	16
Cream Sample (F2)	100 mg/mL	-	-	-
Dry Extract (DP)	10 mg/mL	28	16	20

➢ **Conclusion**

The antimicrobial activity was observed against all three test organisms for the formulation of cream (F1) and dry extract. The extent of inhibition varied among the samples, suggesting differences in efficacy based on formulation and concentration.

Overall, the herbal cream and dry extract preparation using *Moringa oleifera* has demonstrated a potential antimicrobial nature.

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MOTABAZAR, VALLABH VIDYANAGAR-388 120.

Fig: antimicrobial test report

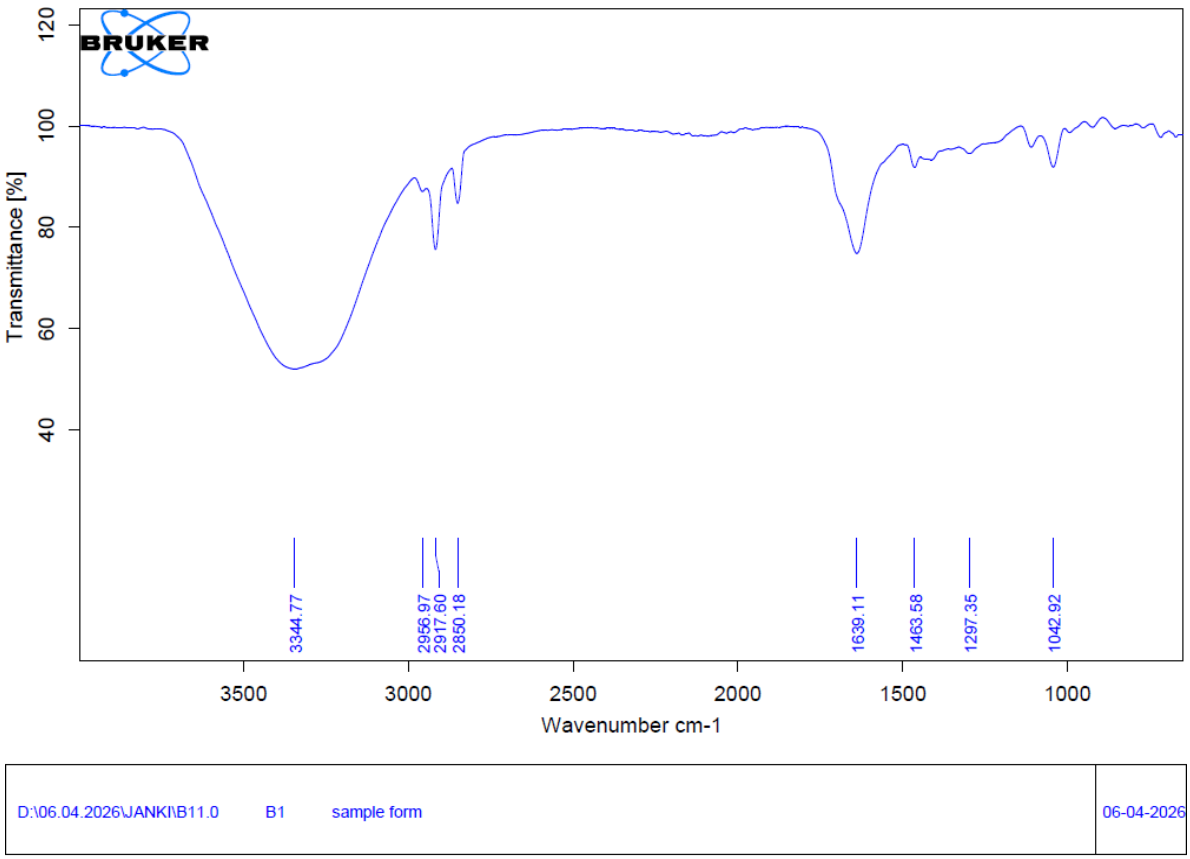
10. Drug–Excipient Compatibility Study:

Overall Conclusion:

Your FTIR spectrum confirms:

- Presence of lipid base (paraffin, stearic acid, cetyl alcohol)
- Presence of emulsifier system (triethanolamine + fatty acid)
- Presence of humectant (glycerin)
- Presence of herbal active compounds (moringa, flavonoids)
- No major chemical incompatibility (no new unwanted peaks)

➢ **Observed Major Peaks & Interpretation**



1. 2917 cm⁻¹ & 2850 cm⁻¹

- Type: C–H stretching (alkane)
- Indicates:
  - Presence of long-chain hydrocarbons
  - Comes from:
    - Cetyl alcohol
    - Stearic acid
    - Liquid paraffin
    - Confirms lipid/oily base of cream.

2. 1463 cm⁻¹

- Type: C–H bending (CH_2 scissoring)
- Indicates:
  - Alkyl chains (fatty compounds)
- Present in:
  - Fatty acids and alcohols
  - Supports presence of emulsifying base components

3. 1297 cm⁻¹

- Type: C–O stretching / O–H bending
- Indicates:
  - Alcoholic groups
- Comes from:
  - Glycerin
  - Triethanolamine
  - Shows humectants & emulsifier presence

4. 1042 cm⁻¹

- Type: C–O stretching (alcohols / phenols)

- Indicates:
  - Strong presence of:
    - Phenolic compounds
    - Alcohol groups
- Likely from:
  - Moringa oleifera extract
  - Quercetin
  - Confirms bioactive phytochemicals responsible for antimicrobial activity

Important Observation

No strong peak around 1700 cm^{-1} (C=O stretching)

- Normally seen in:
  - Free fatty acids (like stearic acid)
- Possible reasons:
  - Formation of soap/emulsion (TEA-stearate)
  - Peak overlapping or reduced intensity
  - Indicates successful emulsification and interaction

Result: The FTIR spectrum of the formulated herbal antimicrobial cream showed characteristic peaks at 2917 cm^{-1} and 2850 cm^{-1} corresponding to C–H stretching of aliphatic hydrocarbons, indicating the presence of fatty components. The peak at 1463 cm^{-1} confirmed CH_2 bending vibrations of lipid chains. Peaks at 1297 cm^{-1} and 1042 cm^{-1} were attributed to C–O stretching of alcohols and phenolic compounds, confirming the presence of glycerin and plant-derived bioactives. Absence of any significant additional peaks indicates compatibility among formulation ingredients and successful cream formation.

➢ CONCLUSION

The present study successfully formulated and evaluated a **herbal antimicrobial cream using Moringa oleifera extract**. The cream was prepared by the oil-in-water emulsion method using suitable excipients to obtain a stable and cosmetically acceptable formulation.

All formulated batches exhibited satisfactory physical properties such as uniform colour, smooth texture, good homogeneity, appropriate viscosity, and excellent spreadability. The pH of the cream was found to be within the skin-friendly range, indicating its safety for topical application. Stability studies confirmed that the formulation remained stable under different storage conditions without significant changes in physical characteristics.

The antimicrobial study showed significant zones of inhibition against **Escherichia coli** and **Staphylococcus aureus**, confirming the effectiveness of Moringa extract as a natural antimicrobial agent. Furthermore, the skin irritancy test indicated that the formulation was non- irritant and safe for use on the skin.

Thus, the study concludes that **Moringa oleifera-based herbal cream** can be successfully formulated with good stability, safety, and antimicrobial activity, making it a promising natural alternative for the treatment and prevention of microbial skin infections.

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