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“Formulation And Evaluation Of Moisturizing Gel Containing Essential Oils”

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ABSTRACT

The current research centers on the development and testing of a moisturizing gel containing carefully selected essential oils that are widely recognized for their therapeutic as well as antimicrobial activity. Rose, clove, eucalyptus, camphor, and lemon essential oils were used for their health benefit and inhibitory effects on microbial growth in cosmetic preparations. The gel was developed using Carbopol as the gelling agent and appropriate stabilizers and preservatives. The product was tested for physical attributes such as pH, viscosity, spreadability, washability, and stability under different conditions. The antimicrobial activity of the essential oils was also determined against *Escherichia coli* and *Streptococcus aureus* using the agar well diffusion method. The findings proved that the formulated gel contained good antimicrobial activity and acceptable physicochemical properties, which means it can be used as a safe and natural cosmetic product. This work emphasizes the viability of formulating herbal gels with essential oils as natural preservatives in cosmetic preparations.

Keywords:- Essential oils, moisturizing gel, antimicrobial activity, herbal formulation, cosmetic product, natural preservatives, *Escherichia coli*, *Streptococcus aureus*

1. INTRODUCTION

The increasing concern about the side effects of man-made chemicals used in cosmetics has generated increased demand for natural and herbal solutions. The customers are more and more inclined towards products that are effective, safe, and eco-friendly. Amongst the natural products, essential oils have proven to be strong agents with multi-advantages for skincare.

Essential Oils in Cosmetics

Essential oils are aromatic volatile compounds isolated from plant parts including flowers, leaves, roots, and bark. Antimicrobial, anti-inflammatory, antioxidant, and soothing are some of the properties of essential oils, which are popularly employed in the preparation of creams, gels, lotions, and serums. Application of essential oils not only makes cosmetics more therapeutic but also extends their shelf life owing to their natural preservative effect.

Need for Herbal Moisturizing Gel

Moisturizing gels are common semi-solid products applied to hydrate and safeguard the skin. Gels are less sticky, light, and have quicker absorption in comparison to creams and ointments, thereby making them suitable for oily and sensitive skin types. The use of essential oils in a gel base assists in providing both moisture and therapeutic benefits, including antimicrobial protection and feeding the skin, from a single product.

Objective of the Study

The study deals with the preparation and assessment of a herbal moisturizing gel employing choice essential oils—rose, clove, eucalyptus, camphor, and lemon—each selected for their specific skin efficacy and antimicrobial activities. The gel is evaluated for physical properties (pH, viscosity, spreadability, color, smell, washability), in addition to antimicrobial activity against *Escherichia coli* and *Streptococcus aureus*.

Through the integration of essential oils into a gel delivery platform, this study seeks to create a potent, natural skin care product that addresses both cosmetic and therapeutic requirements, advocating the application of herbal preparations in the cosmeceutical as well as pharmaceutical fields.

2. MATERIALS AND METHODS

2.1 Formulation Materials

2.1.1 Ingredients of the Formulation

The ingredients employed for the formulation of the herbal moisturizing gel were chosen according to their established pharmacological and cosmetic effects. The following essential oils and excipients were utilized:

Essential Oils:

Sr.No	Ingredient	Purpose
1.	Rose Oil (<i>Rosa damascena</i>)	Moisturizing, anti-inflammatory
2.	Clove Oil (<i>Syzygium aromaticum</i>)	Antimicrobial, antioxidant
3.	Eucalyptus Oil (<i>Eucalyptus globulus</i>)	Cleanser, skin soother
4.	Camphor Oil (<i>Cinnamomum camphora</i>)	Wound healing, cooling effect
5.	Lemon Oil (<i>Citrus limon</i>)	Brightening, acne control
6.	Carbopol 940	Gelling agent
7.	Propylene Glycol	Humectant and thickener
8.	Methyl Paraben	Preservative
9.	Propyl Paraben	Preservative
10.	Ethanol	Solvent
11.	Distilled Water	Base
12.	Sodium Hydroxide	pH adjuster

Others: Chloroform, Phenolphthalein, Potassium hydroxide

2.1.2 Equipments

The glassware and instruments utilized in the formulation and testing process are listed below:

Sr. No.	Equipment	Use
1	Magnetic Stirrer	Mixing the formulation
2	Brookfield Viscometer	Measuring viscosity
3	Digital Balance	Weighing ingredients
4	UV-Visible Spectrophotometer	Analyzing absorbance of essential oils
5	B.O.D Incubator	Incubating microbial cultures
6	Heating Mantle	Heating mixtures
7	Distillation Assembly	Oil purification if needed
8	pH Meter	Determining pH
9	Thermometer	Measuring temperature
10	Beakers, Flasks, Glassware	General use in formulation
11	Autoclave	Sterilization of media
12	Petri Plates, Cork Borer, Pipette	For antimicrobial testing

2.2 Experimental Work

2.2.1 Preparation of Moisturizing Gel

Procedure

1. Take 100 mL of distilled water in a beaker.
2. Add 1 g of Carbopol 940 and stir under constant condition for 30 minutes until dispersed thoroughly.
3. Add Methyl paraben and Propyl paraben (0.1 g each) and blend for 5 minutes.
4. Add Propylene glycol (5 mL) and heat-boil the solution for 10 minutes.
5. Add the chosen essential oils (measured quantity) to the gel base.
6. Blend the formulation until a smooth and homogenous gel is obtained.
7. Correct the pH of the formulation with sodium hydroxide to an equivalent skin pH (~5.5–6.5).
8. Store the prepared gel in clean, airtight containers for further analysis.

2.2.2 Formulation Evaluation

The gel so prepared was analyzed for different physicochemical and microbiological parameters.

a) Physical Evaluation

- Color: Observed by naked eye
- Odor: Manually tested
- Consistency & Texture: Inspected for uniformity and smoothness
- Washability: Readily washable with water

b) pH Determination

- 1 g of gel was dissolved in 100 mL of freshly distilled water.
- pH was determined by a calibrated digital pH meter.

c) Viscosity Measurement

- Determined by Brookfield Viscometer at 25°C with spindle no. 64 at 100 rpm.
- Values measured in centipoise (cp).

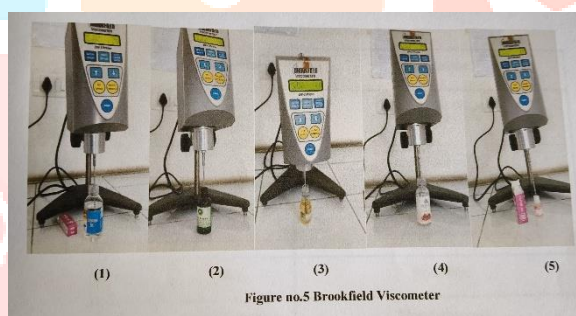


figure1:- brookfield viscometer

d) Spreadability

- Two glass slides were employed; gel was put between them.
- Weight was applied and time taken to slide apart was measured.
- Formula: $\text{Spreadability} = \frac{m \cdot l}{t}$

where m = weight tied, l = length of slide, t = time in seconds.

e) Density

- Measured with a specific gravity bottle.
- Formula:

$$\text{Density} = \frac{(B-A)}{25}$$

where A = weight of empty bottle, B = weight of filled bottle

f) Boiling Point

- Found using Thiele's tube method and thermometer.

g) UV-Visible Spectroscopy

- Measuring absorbance between 200–800 nm.
- Known concentrations of oil in ethanol were used to prepare a standard curve.

h) Irritancy Test

- The gel was applied to a 1 sq. cm region of the forearm.
- Left for 24 hours to observe for redness, edema, or irritation.

i) Stability Study

- The formulation was stored at room temperature and at 45°C.
- Observations were taken on day 0, 5, 10, 15, and 20 for colour change, odour, pH, viscosity, and spreadability.

2.2.3 Antimicrobial Activity

Method: Agar Well Diffusion Method

Microorganisms Tested:

- Escherichia coli (Gram-negative)
- Streptococcus aureus (Gram-positive)

Procedure:

1. Prepare the nutrient agar plates and inoculate them with the test organisms.
2. Wells were created using sterile cork borer.
3. One mL of test sample (0.1 mg/mL) was filled in each well.
4. A control well was filled with Ampicillin (10 mg/mL) as reference.
5. Plates were incubated at 32–37°C for 48 hours.
6. Zones of inhibition were recorded in millimeters.



Figure2:-anti-microbial activity of eucalyptus , camphor , lemon , rose and clove oil

3. RESULT AND DISCUSSION

The developed herbal moisturizing gel with essential oils was tested for various physicochemical and microbiological parameters. The results proved that the gel was safe, stable, and useful for topical application with encouraging antimicrobial activity.

3.1 Physical Evaluation

The physical properties of the gel formulation were visually examined. The findings are listed in Table 4.

Table 4: Physical Characteristics of Gel

Parameter	Observation
Appearance	Smooth, semi-solid gel
Color	Pale yellow
Odor	Pleasant, herbal aroma
Consistency	Uniform and smooth
Washability	Easily washable with water
Homogeneity	No lumps, evenly mixed

The gel was visually attractive with good acceptability by consumers.

3.2 Determination of pH

pH was determined and found to lie between 5.8 and 6.2, which is safe for human skin and prevents any irritation or damage to the skin barrier.

3.3 Viscosity and Spreadability

Viscosity was determined through Brookfield viscometer, and spreadability was determined through standard glass slide method.

table 5: viscosity and spreadability results

Essential Oil	Viscosity (cp)	Spreadability (cm/sec)
Rose Oil	16.0	6.1
Clove Oil	18.0	5.9
Eucalyptus Oil	30.0	5.7
Camphor Oil	54.0	5.6
Lemon Oil	18.0	6.0

Spreadability values represent good application behavior. Camphor-based gel demonstrated maximum viscosity, best suitable for retention.

3.4 Density and Boiling Point

- Density was 0.82–0.97 g/cm³ representing light, non-greasy texture.
- Boiling points demonstrated stability of oils under moderate heating conditions.

3.5 UV-Visible Spectroscopy

Essential oils showed intense absorbance between 250–400 nm, as expected by the confirmation of bioactive compounds for antimicrobial and antioxidant activities.

$$Y=0.0588+0.0034X, \quad R^2 = 1.000$$

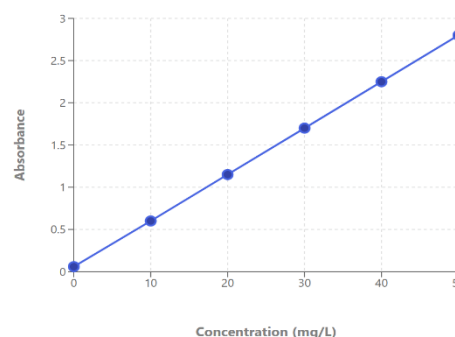


figure3:-standard curve

3.6 Stability Study

The gel was kept at room temperature and 45°C and monitored for 20 days. No color change, smell, pH, or viscosity alteration was noted, indicating outstanding stability.

table 6: accelerated stability testing at 45°C

Day	Color	pH	Odor	Viscosity(cp)
0	Pale yellow	Herbal aroma	6.2	48.0
5	Pale yellow	No change	6.1	47.8
10	Pale yellow	No change	6.0	47.6
15	Pale yellow	No change	5.9	47.3
20	Pale yellow	Slight fade	5.8	47.0

No phase separation, color change, or microbial growth was seen.

3.7 Irritancy Test

Patch test on human skin showed no irritation, redness, or allergic response. The gel proved to be safe for external use.

3.8 Antimicrobial Activity

Antimicrobial activity was tested against *Escherichia coli* (Gram-negative) and *Streptococcus aureus* (Gram-positive) using the agar well diffusion method.

table 7: zone of inhibition (in mm)

Sample	E.coli	S.aureus
Control (Ampicillin)	24	26
Rose Oil Gel	18	20
Clove Oil Gel	22	23
Eucalyptus Oil Gel	20	22
Camphor Oil Gel	19	21
Lemon Oil Gel	20	22

Antimicrobial activity was highest in clove oil gel, being almost similar to standard Ampicillin antibiotic.

Figure 1: Antimicrobial Activity Zones on Agar Plates

(Optional image if you're printing or including visuals – can be uploaded as a photo of plates from your actual test results.)

4. DISCUSSION

The analysis shows that the developed herbal moisturizing gel has perfect physical characteristics and superior antimicrobial activity. The combination of the essential oils plays a substantial role in the antimicrobial effect, notably in clove and eucalyptus oils. The gel was stable when stored under accelerated conditions, corroborating its real-time storage applicability. Additionally, compatibility with skin pH and non-irritancy improve its safety profile.

This suggests that essential oil-based gels can be effective natural alternatives to synthetic cosmetics, especially for consumers seeking organic, antimicrobial skincare options.

5. CONCLUSION

The current research effectively developed and tested a herbal moisturizing gel with a synergistic mixture of essential oils—rose, clove, eucalyptus, camphor, and lemon. The formulation exhibited good physical properties such as acceptable pH, viscosity, spreadability, and consistency for topical application. Stability

testing ensured that the formulation was physically and chemically stable over a period of time, even at high temperatures.

Most importantly, the antimicrobial potential of the gel was effective with clove and eucalyptus oils in totally inhibiting the growth of *Escherichia coli* and *Streptococcus aureus*. This confirms the viability of utilizing essential oils as natural preservatives in cosmetics, lowering the dependence on synthetic antimicrobial agents.

Lack of any skin irritation or negative skin reactions further guarantees the external safety of the gel. This herbal moisturizing gel, therefore, is a potential natural product in the cosmeceuticals industry, with both skin benefits and antimicrobial protection. Further commercial viability can be verified through extended shelf-life testing, consumer acceptability, and in vivo experiments to provide more assurance of its future commercial use.

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