



# FORMULATION AND EVALUATION OF ANTIBACTERIAL LOTION CONTAINING *LANTANA CAMARA* LEAF EXTRACT

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## Abstract

Herbal topical formulations are widely used due to their safety, biocompatibility, and therapeutic potential. This study aimed to formulate and evaluate an antibacterial herbal lotion containing *Lantana camara* leaf extract. Leaves were shade-dried, powdered, and extracted using ethanol via the Soxhlet method. Phytochemical screening confirmed the presence of terpenoids, flavonoids, tannins, saponins, phenolic compounds, and alkaloids associated with antibacterial activity. Three oil-in-water lotion formulations were prepared and evaluated for organoleptic properties, homogeneity, pH, viscosity, spreadability, washability, and antibacterial activity. The formulations showed good texture, stability, skin-compatible pH, and promising antibacterial effectiveness, indicating the potential of *Lantana camara* as a natural topical antibacterial agent.

**Keywords:** Antibacterial herbal lotion, *Lantana camara* leaf extract, Herbal formulation, Phytochemical screening, Soxhlet extraction, Antimicrobial activity, O/W emulsion.

## 1.Introduction

Lotions are defined as monophasic or biphasic solution, emulsion or suspension design to apply on unbroken and also broken or inflamed skin. Lotions are non-friction liquids for external use.<sup>[1][2]</sup>

A lotion is a liquid product mainly used on the skin to improve appearance. People usually choose lotions because they provide moisture, softness, and a soothing effect. Many lotions also have additional beneficial properties such as astringency, a refreshing or cooling sensation, skin lightening effects, and even medicinal benefits.<sup>[3]</sup> Body lotions are the liquid composition applied to the skin to improve aesthetics.<sup>[4][5]</sup>

Lotions typically have low viscosity, meaning they are more fluid and spread easily on the skin. This is different from creams and gels, which are thicker because they contain less water. Hand and body lotions are designed to sooth and moisturize, soften and sometimes perfumes the skin.<sup>[6]</sup>

### 1.1 Advantages<sup>[1][7]</sup>

- Avoid first pass metabolism.
- Provide local therapeutic effect.
- Convenient to use and easy to carry.
- Simple to apply.
- They are incorporated with skin and hair.

### 1.2 Disadvantages<sup>[1][9]</sup>

- Less stable compared to solid dosage form
- Emulsion lotion must be shaken before use to ensure proper mixing.
- Babies may accidentally swallow if applied to hands.

### 1.3 Ideal properties of lotions<sup>[1][8]</sup>

- It should be physically and chemically stable.
- It should be having optimum pH.
- Lotions should be non-sticky.
- Lotions must be non-irritant.
- Lotions must be non-inflammatory.
- Desirable penetration should be provided through the epidermis of the skin.
- Its consistency should be optimum.
- Rubbed easily on the skin without role on effect.<sup>[7]</sup>

### 1.4 Types of lotions

- Simple lotion:** Used to cool and soothe the skin. These types of lotions keep the skin smooth and add moisture.
- Therapeutic lotion:** These types of lotions contain therapeutic agents depending on desired effect required. Eg. Calamine lotion as protectant and astringent.
- Suspension type of lotion:** Some lotions contain insoluble solids known as suspension type of lotion. Here bentonite, sodium carboxy methyl cellulose are used as suspending agent. Eg. Calamine, Sulphur, zinc oxide.
- Emulsion type of lotion:** These are diluted lotion with O/W emulsion that are stabilized by emulsifying agents like emulsifying wax. Eg. Benzoyl benzoate lotion.<sup>[1][9]</sup>

## 1.5 Applications<sup>[1]</sup>

- 1) **Skin softening:** Regular use of lotion helps to protect the skin from environmental damage and the mineral oils in it form a waterproof layer over the epidermis, helping to heal the skin by sealing in moisture.
- 2) **Smoothing:** With continuous use, a replenishing lotion can soften rough skin and make it as smooth and glossy because the rest of your body.
- 3) **Cooling:** Cooling lotions provide a soothing and refreshing effect and is designed to cool down hot or flushed skin.
- 4) **Moisturizing:** These lotions improve the skin's hydration by reducing water loss. Natural skin lipids and sterols further as artificial or natural oils, humectants, emollients, lubricants, etc., a part of the composition of commercial skin moisturizers.
- 5) **Anti-allergic:** Lotion can give temporary relief from itching and pain caused by minor burns, cuts, scrapes, sunburn, insect bites, minor skin irritations, or rashes from plants like poison ivy, poison oak, or poison sumac.
- 6) **Antiseptic:** Cuts, grazes, minor burns and small wounds, tiny areas of sunburn, dry cracked skin, diaper rash, bug bites, spots and pimples can be treated with antiseptic lotions.
- 7) **Humectant:** Lotions that draw moisture to the surface of the skin and enhancing the skin's own hydrating ability.
- 8) **Astringent:** Astringent in lotion are water-based skin care product that remove excess oil present in the skin, tighten pores, and remove leftover makeup.
- 9) **Anti-acne:** These lotions penetrate pores to treat acne, to clean most skin disease blemishes, skin disease pimples, blackhead and as well as whiteheads.
- 10) **Anti-inflammatory:** Topical anti-inflammatory lotions are help to relieve muscle pain, sprains and strains. They may also help to ease painful inflammatory disease.

## 2. Skin

Skin is the body's largest and primary protective organ, covering the entire external surface and acting as physical barrier against the environment. Its functions include regulate temperature and providing protection against UV light, trauma, pathogens, microorganisms and toxins.<sup>[12]</sup>

### Structure of skin

The skin composes of following layers

- 1) Epidermis
- 2) Dermis
- 3) Hypodermis<sup>[10]</sup>

## ➤ Epidermis

Epidermis is the outermost layer of the skin and is made up of several layers of various cells. The epidermis is made up of stratified squamous epithelial tissue.

The epidermis consists of five main layers

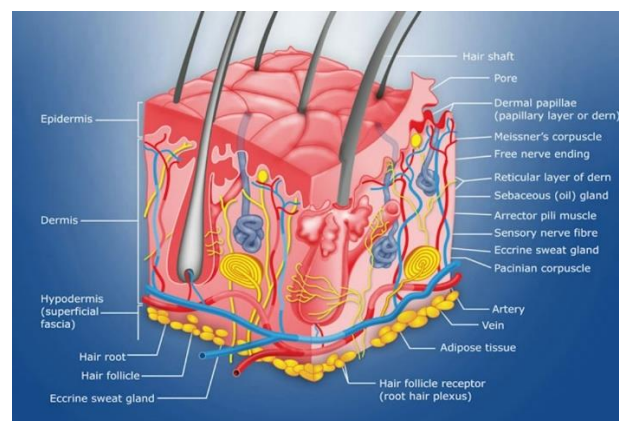
- 1) **Stratum basale:** It is also known as stratum germinativum, is the deepest layer where new skin cells are formed. This layer also contains melanocytes that produce melanin.
- 2) **Stratum spinosum:** it comprises of 8-10 cell layers, also called as prickle cell layer. Provides strength and flexibility to the skin.
- 3) **Stratum granulosum:** it has 3-5 cell layers and contain diamond-shaped cells with keratohyalin and lamellar granules. The lamellar granules contain glycolipids secrete to the cell surfaces, functioning as an adhesive.
- 4) **Stratum lucidum:** it comprises of 2-3 cell layers and present in thicker skin on the palms and soles. It consists of eleidin, a transformation product of keratin.
- 5) **Stratum corneum:** it has 20-30 cell layers and occupies the uppermost epidermal layer. It composed of keratin and dead keratinocytes that forms horny scales

## ➤ Dermis

It is the middle layer of the skin, located just below the epidermis. Thickness of dermis varies in different parts of body, for example, on the eyelids, it is up to 0.6mm, and on the back, palms and soles it is up to 3mm. The dermis consists of 2 connective tissue layers, papillary and reticular. It consists of sweat gland, hair, hair follicles, muscles, sensory neurons and blood vessels.

## ➤ Hypodermis

It is also called as subcutaneous layer; it is the deepest layer of skin. It contains adipose lobules, sensory neurons, blood vessels, and scanty skin appendages, such as hair follicle.<sup>[11]</sup>



### 3. Materials used

**Plant:** *Lantana camara*



#### Synonyms:

- *Lantana aculeate*
- *Camara vulgaris*

#### Biological source:

It is obtained from lantana plant, scientifically known as *Lantana camara*.

**Family:** Verbenaceae

#### Taxonomy:

Species	<i>Lantana camara</i>
Genus	Lantana
Family	Verbenaceae
Domain	Eukaryote
Kingdom	Plantae
Phylum	Spermatophyta
Class	Dicotyledonae
Order	Lamiales

**Common name:** West Indian lantana.<sup>[12][13][14]</sup>

#### Chemical constituents:

- Triterpenes: Lantadene A, Lantadene B, Lantadene C, Oleonic acid, Ursolic acid.
- Volatile terpenoids and fatty acids: Caryophyllene, Humulene, Trans-nerolidol, Phytol, n-hexadecanoic acid, Squalene.
- Flavonoids: Quercetin, Methoxy quercetin derivatives, Rutin.
- Steroids: Sitosterol, Stigmasterol, Campesterol.<sup>[14][15][16]</sup>

**Plant description:**

Yellow green to green colour, oval/broadly lance shaped, rough to touch, oppositely arranged on stem

**Medicinal properties:**<sup>[17]</sup>

- Anti-microbial activity
- Anti-motility activity
- Hemolytic activity
- Anti-ulcerogenic activity
- Anti-hyperglycemic activity
- Anti-inflammatory activity

**Parts used:** Leaves

**3.1 Other ingredients**❖ **Cetyl alcohol**

**Uses:** Opacifier, Emulsifier, Thickening agent, Emollient

❖ **Stearic acid**

**Uses:** Thickening agent, emulsifier, emollient.

❖ **Lanolin**

**Uses:** Emollient, moisturizer.

❖ **Glycerol**

**Uses:** Humectant, emollient.

❖ **Methyl paraben**

**Uses:** Preservative

❖ **Triethanolamine**

**Uses:** pH adjuster, stabilizer, Emulsifier.

❖ **Rose water**

**Uses:** skin toner, hydrator.

❖ **Vitamin E**

**Uses:** Anti-oxidant, Skin healing, Scar fading

❖ **Orange oil**

**Uses:** flavouring agent, aromatherapy, carminative etc

**4. Formulation of herbal lotion****I.Collection of herbs**

Fresh healthy leaves of *Lantana camara* were collected from an uncontaminated and pesticide-free environment in the local region during the early hours of the day to ensure optimal phytochemical

content.<sup>[18][21]</sup> The herbarium of *Lantana camara* leaves were prepared and identified by Dr Abdul Faisal, Botanist, MES Keveeyam College Valanchery. The herbarium is attached in this thesis.

## II.Preparation of plant extract

The collected leaves were thoroughly washed under running tap water followed by rinsing with distilled water to eliminate dirt, dust, and microbial contaminants. The cleaned leaves were then shade-dried at ambient temperature (25-37°C) for 7 days to preserve the thermolabile phytoconstituents. Once dried the leaves were ground into a fine powder using a mechanical grinder and stored in an air tight container.



For extraction, ethanol was used. Approximately 100g of powdered leaf material was subjected to Soxhlet extraction for a duration of 6-8 hours, maintaining consistent temperature conditions to prevent phytochemical degradation.<sup>[19] [20][22][23]</sup>



## III.Formulation of water phase

The preservative and other water-soluble components namely methyl paraben, triethanolamine, glycerol, rose water, vitamin E were dissolved as the aqueous phase and heated up to 75°C.<sup>[35][36]</sup>



#### IV. Formulation of oil phase.

The stearic acid and the other oil soluble components namely cetyl alcohol, lanolin were dissolved as the oil phase by heated up to 75°C. [25][26]



#### V. Formulation of herbal lotion

- After heating, oil phase was added in portions to the aqueous phase with continuous stirring until a homogenous lotion is formed.
- The *Lantana camara* cold extract is taken and levigates in geometric proportion form a homogenous lotion.
- Required amount of water added in the lotion and mix homogeneously.
- Then finally add required amount of orange oil as a fragrance.
- Stored in well-closed container and labelled it. [20][24]



## VI. Formulation table<sup>[27][28][29][30]</sup>

Sl.NO	INGREDIENT S	QUANTITIES			USES
		F1	F2	F3	
1.	<i>Lantana camara</i> leaf extract	1gm	1.5gm	2gm	Anti-bacterial activity
2.	Stearic acid	1.5gm	2gm	2.5gm	Lubricating agent
3.	Cetyl alcohol	0.1gm	0.2gm	0.3gm	Moisturizer
4.	Lanolin	0.4gm	0.5gm	0.6gm	Emollient
5.	Methyl paraben	0.05gm	0.05gm	0.05gm	Preservative
6.	Glycerol	6ml	5ml	4ml	Softening agent
7.	Triethanolamine	0.1ml	0.15ml	0.2ml	Surface active agent
8.	Rose water	2ml	3ml	4ml	Skin whitening agent
9.	Vitamin E	1ml	1ml	1ml	Anti-oxidant
10.	Orange oil	1ml	1ml	1ml	Fragrance
11.	Water	Q.S	Q.S	Q.S	Vehicle

#### 4.1 Phytochemical evaluations

##### 1) Test for terpenoids<sup>[19]</sup>

Si no	Test	Procedure	Observation
1.	Salkowski test	The extract 5ml is mixed with 2ml chloroform and this 3ml con. H <sub>2</sub> SO <sub>4</sub> is added.	A reddish brown color is produced.
2.	Sulphur powder test	Few ml of extract is taken in test tube and add Sulphur powder to it.	Sulphur sinks down.

##### 2) Test for tannins<sup>[31]</sup>

Si no	Test	Procedure	Observation
1.	Gelatin test	Extract is dissolved in 5ml distilled water and add 1% gelatin solution to it followed by 10% NaCl.	A white precipitate is formed
2.	Braymer's test	3ml of distilled water is added to 1ml filtrate and add 3 drops 10% ferric chloride solution.	Blue green color is produced.

##### 3) Test for saponins<sup>[20]</sup>

Si no	Test	Procedure	Observation
1.	Foam test	The extract was mixed with 5ml of water and vigorously shaken.	formation of stable foam.

4) Test for flavonoids <sup>[31]</sup>

Si no	Test	Procedure	Observation
1.	Lead acetate test	To the 1ml of plant extract add few drops of 10% lead acetate solution.	A yellow precipitate is formed.
2.	Alkaline reagent test	2ml of NaOH solution is added to 1ml of extract.	An intense yellow color is formed.

5) Test for phenolic compounds<sup>[31]</sup>

Si no	Test	Procedure	Observation
1.	Iodine test	To the 1ml of extract add few drops of dil. Iodine solution.	A transient red color is produced.
2.	Gelatin test	Plant extract is dissolved in 5ml of distilled water and add 1% gelatin solution. To that add 10% NaCl.	A white precipitate is produced.

6) Test for alkaloids<sup>[31][32][33]</sup>

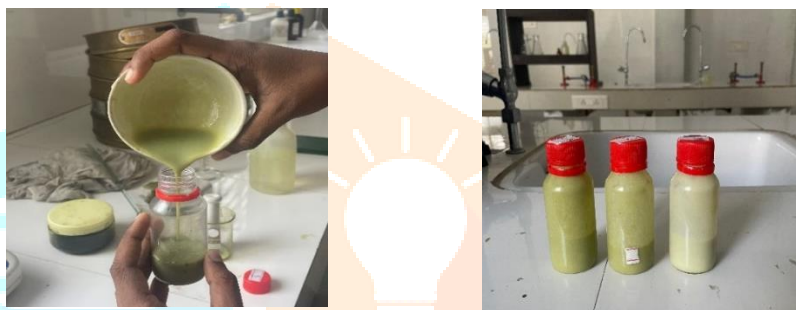
Si no	Test	Procedure	Observation
1.	Mayer's test	To the few ml of extract add 1-2 drops of Mayer's reagent along the side of test tube	A yellow precipitate is formed

## 4.2 EVALUATIONS OF LOTION

1. **Organoleptic evaluation:** The color, odor and texture parameters were evaluated in this. Visual evaluation is carried out for colour and texture. In order to evaluate the odor, the lotion is smelled.<sup>[24]</sup>



2. **Appearance and homogeneity:** It was performed by means of visual examination.<sup>[24]</sup>



3. **pH measurement:** A 10% of lotion was prepared. A digital pH meter was used to measure how acidic or alkaline the lotion is. This ensures the lotion is suitable for the skin and won't cause irritation



4. **Viscosity:** The thickness of lotion was measured using a Brookfield viscometer with an LV-64 spindle. The equipment rotates at 25 RPM. The lotion was placed in spindle.



5. **Spread-ability:** In this, two glass plates were used. About 1g of lotion was placed on one plate. The second plate was put on the top. A 15g weight was placed on the top plate to spread the lotion into a thin layer. After removing the weight, the spread diameter was measured.



6. **Washability test:** A Small amount of lotion was applied to the glass slide. The glass slide was then placed under running tap water for 10 minutes.



7. **Dilution test:** A small amount of lotion is taken in a beaker added few quantities of water to it (1:9). Stir continuously for 2-5 minutes.<sup>[37][38][39][40]</sup>



#### 4.3 DETERMINATION OF ANTI-BACTERIAL ACTIVITY OF LOTION<sup>[34][35][36]</sup>

The antibacterial activity of the lotion was evaluated using the agar well diffusion method, where the test sample diffused into agar inoculated with *Staphylococcus aureus* and produced a clear zone of inhibition around the well. The diameter of this zone, measured in millimeters, indicated the antibacterial potency of the sample, with larger zones representing stronger activity and absence of a zone indicating resistance. Pure cultures of *S. aureus* were aseptically transferred into sterile nutrient broth containing peptone (5.0 g/L), beef extract (3.0 g/L), sodium chloride (5.0 g/L), and distilled water (1000 mL), with the pH adjusted to 7.2–7.4. The medium was sterilized by autoclaving at 121°C for 15 minutes and incubated at 37°C for 18–24 hours to obtain actively growing cultures. The bacterial suspension was then standardized to the 0.5 McFarland standard (approximately  $1.5 \times 10^8$  CFU/mL), prepared using 0.5 mL of 1% barium chloride and 99.5 mL of 1% sulfuric acid. The turbidity was visually adjusted with sterile nutrient broth or bacterial suspension to ensure uniform and reproducible antibacterial assay results.

## 5. Results

### 5.1 Phytochemical evaluations.

Test	Observation	Inference
Salkowski test	A reddish brown color is produced	Presence of terpenoid
Sulphur powder test	Sulphur sinks down	Presence of terpenoid
Gelatin test	A white precipitate is produced	Presence of tannin
Braymer's test	Blue green color is produced	Presence of tannin
Foam test	Formation of stable foam	Presence of saponin
Lead acetate test	A yellow precipitate is formed	Presence of flavonoid
Alkaline reagent test	An intense yellow color is formed	Presence of flavonoid
Iodine test	A transient red color is produced	Presence of phenolic compound
Gelatin test	A white precipitate is formed	Presence of phenolic compound
Mayer's test	A yellow precipitate is formed	Presence of alkaloid <sup>9</sup>

## 5.2 Evaluations of lotion

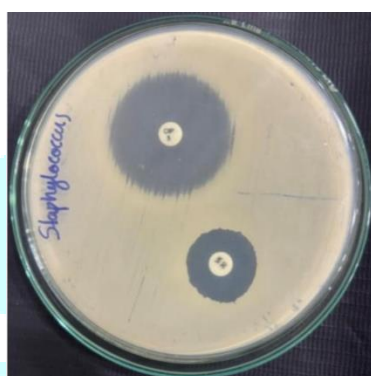
Evaluation	F1	F2	F3
Colour	Light creamy	Yellow to green	Olive green
Odour	Pleasant	Pleasant	Pleasant
Texture	Soft	Creamy	Firm creamy
Appearance	Smooth and creamy	uniform	Uniform and glossy
Homogeneity	Homogenous	Homogenous	Homogenous
pH	6.0	5.8	5.5
Viscosity	3400 cP	3800 cP	4000 cP
Spreadability	6 cm	5.8 cm	5.1 cm
Washability	Washable	Washable	Washable
Emulsion type	Oil in water (O/W)	Oil in water (O/W)	Oil in water (O/W)

## 5.3 Antibacterial activity

Sample code	Zone of Inhibition	Interpretation
F1	10mm	Moderate
F2	11mm	Moderate
F3	13mm	Sensitive



Standard	Zone of inhibition	Interpretation
Vancomycin	19mm	Sensitive
Ciprofloxacin	30mm	Sensitive
Gentamycin	20mm	Sensitive
Amoxicillin	16mm	Sensitive
Erythromycin	11mm	Moderate



## 6. Discussion

The formulated herbal lotion containing *Lantana camara* leaf extract showed acceptable physicochemical and antibacterial properties. Phytochemical screening revealed the presence of bioactive compounds such as terpenoids, tannins, saponins, flavonoids, phenolics, and alkaloids. All formulations (F1, F2, and F3) had good appearance, pleasant odor, suitable pH, smooth texture, easy washability, and non-greasy nature, while viscosity increased from F1 to F3 due to higher thickening agent concentration. Dilution tests confirmed that the lotions were oil-in-water emulsions. Antibacterial studies showed that all formulations inhibited bacterial growth, with F3 exhibiting the strongest activity, suggesting that *Lantana camara* lotion has potential as a natural topical antibacterial preparation.

## 7. Conclusion

The study successfully formulated and evaluated an antibacterial herbal lotion containing *Lantana camara* leaf extract. Phytochemical analysis confirmed the presence of bioactive compounds responsible for antimicrobial and skin-protective effects. The formulations showed good stability, homogeneity, suitable pH, satisfactory viscosity, and excellent washability, making them appropriate for topical use. Among the three formulations, F3 demonstrated the best overall performance and strongest antibacterial activity, although all formulations showed moderate antibacterial effects compared to the standard antibiotic. Overall, the findings suggest that *Lantana camara* has potential as a natural antibacterial agent for topical formulations.

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