

Formulation And Characterization of Anti-Bacterial Soap from Lantana Camara Leaf Extract

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Abstract- Background

Lantana camara is a widely available invasive weed whose leaves are reported to contain phytochemicals such as flavonoids, tannins, alkaloids, and essential oils with proven antimicrobial activity. Synthetic antibacterial agents in commercial soaps raise concerns of resistance and skin irritation, creating demand for plant-based alternatives. Plant-based knowledge in medicine has a long history in India. Known to treat a number of illnesses, lantana camara is utilized in Many traditional medical formulations. Formulating and testing an anti-bacterial soap with Lantana camara leaf extract—a plant with Antimicrobial and anti-bacterial qualities is the goal of this study. Using conventional phytochemical extraction techniques, the Extract was produced and added to a soap base at different concentrations. The formulations' physical attributes, pH, stability, Spreadability, and antibacterial efficacy against the organism that causes acne, Staphylococcus aureus, were evaluated. The soap With Lantana camara extracts at a concentration of 2% in the first batch was shown to have antibacterial and anti-inflammatory Properties, making it a safe and effective beginning concentration. 3% is the concentration of the second batch, which is still safe and has a more potent antibacterial and anti-inflammatory effect. 4% formulation contain was found to have a high antibacterial And anti-inflammatory power while remaining within a generally safe dermal limit. Additionally, the concentration demonstrated a Better anti-acne effect, significant antibacterial activity, good physicochemical stability, and favourable skin compatibility. The aforementioned results underscore the potential of Lantana camara leaf extract as a natural and efficacious acne treatment Approach. Certain evaluation tests are carried out to determine whether a cream is appropriate for human skin and whether it irritates The skin after application. The increasing demand for herbal and eco-friendly personal care products has encouraged the development of plant-based antibacterial soaps. This study focuses on the formulation and characterization of antibacterial soap prepared using leaf extract of Lantana camara. The leaves of the plant were collected, dried, powdered, and extracted using a suitable solvent extraction method to obtain bioactive compounds possessing antimicrobial properties. The herbal extract

was incorporated into soap formulations in different concentrations along with standard soap base ingredients. The prepared soaps were evaluated for various physicochemical parameters such as pH, foam height, foam retention, moisture content, hardness, total fatty matter, and stability. Antibacterial activity of the formulated soaps was tested against common pathogenic bacteria including Staphylococcus aureus and Escherichia coli using the agar well diffusion method. The results indicated that the soap containing Lantana camara leaf extract exhibited significant antibacterial activity compared to the control formulation. In addition, the formulated soap showed acceptable cleansing ability, good foaming characteristics, and skin-friendly pH. The study concludes that Lantana camara leaf extract can be effectively utilized as a natural antibacterial agent in herbal soap formulations. The developed herbal soap may serve as a safe, cost-effective, and environmentally friendly alternative to synthetic antibacterial soaps.

Keywords - Lantana Camara Leaf

I. ANATOMY OF HUMAN SKIN

1.2 SKIN

The human skin is the body's outer covering and the largest organ of the integumentary system. The Skin has up to seven layers of ectodermal tissue and protects the muscles, bones, ligaments, and internal Organs beneath. Human skin is similar to that of most other mammals, and it is very similar to that of pigs. Despite the fact that nearly all human skin is covered in hair follicles, it can appear hairless. There are two Types of skin: hairy skin and globous skin (hairless). The adjective cutaneous means "of the skin" (from Latin cutis, skin). Skin plays an important immunity role in protecting the body against pathogens and excessive water Loss because it interfaces with the environment. Its other functions include insulation, temperature Regulation, sensation, vitamin D synthesis, and vitamin B folate protection. The skin is the largest organ of the human body and

forms the outer protective covering of the body. It acts as a barrier between the internal organs and the external environment. Skin protects the body from harmful microorganisms, chemicals, ultraviolet (UV) radiation, and physical injury. An average adult has about 1.5–2 square meters of skin, accounting for nearly 15% of total body weight. The skin is flexible, waterproof, and capable of self-repair. The skin is the human body's largest organ, serving as the primary barrier against environmental threats. It is the foundation of the integumentary system, responsible for protecting internal structures, regulating body temperature, facilitating sensation, and synthesizing vital nutrients like vitamin D. The skin is the largest organ of the human body, covering an average area of 1.5–2.0 m² in adults and accounting for ~15% of total body weight. It acts as the primary interface between the internal environment and the external world.

1.2.1 STRUCTURE OF SKIN

The integumentary system is made up of the skin and related structures. The three layers of skin are the epidermis, dermis, and subcutaneous tissue. The epidermis, the outermost layer, is made up of Keratinocytes, which produce keratin, a long, threadlike protein with a protective function. The epidermis is thinnest on The eyelid, measuring less than 0.1 mm, and thickest on the palms and soles of the feet, measuring Approximately 1.5 mm. The dermis is the thickest on the back, where it is 30–40 times thicker than the Epidermis that sits above it.

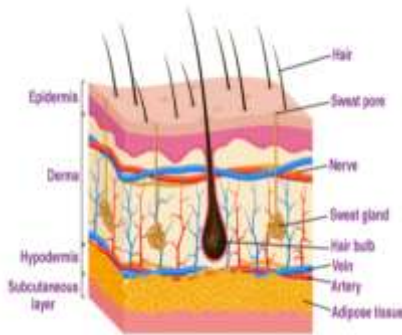


Fig. Structure of Skin

1.2.2 Epidermis

This is made up of keratinized squamous epithelium that has been stratified. The epidermis lacks blood

arteries and nerve endings, but its deeper layers are soaked in interstitial fluid from the dermis, which supplies oxygen and nutrients and drains as lymph. The epidermis has many layers (strata) of cells that span from the deepest basal layer to the most superficial stratum corneum (a thick horny layer). The epidermal cells arise from the basal layer, which is composed of cuboidal, nucleated, highly active epithelial cells that are continually dividing. The epidermis is the outermost layer of the skin. It acts as a protective barrier between the body and the external environment. It protects the body from microorganisms, chemicals, dehydration, and physical injury.

Characteristics of Epidermis:

- # Thin but strong protective layer.
- # Made mainly of keratinized stratified squamous epithelium.
- # Does not contain blood vessels (avascular).
- # Receives nutrients by diffusion from the dermis.
- # Continuously renews itself through cell division.

• Layers of Epidermis:

- The epidermis consists of five layers (from deep to superficial):
 - Stratum basale: (germinativum)
 - Deepest layer
 - Cells divide continuously to form new skin cells .
 - Contains melanocytes that produce melanin pigment.
- Stratum spinosum:
 - Provides strength and flexibility.
 - Cells appear spiny under microscope.
- Stratum granulosum:
 - Contains keratin granules.
 - Cells begin to die and harden.
- Stratum lucidum:
 - Thin transparent layer

Present mainly in thick skin like palms and soles.

- Stratum corneum:
 - Outermost layer
 - Made of dead keratinized cells.
 - Prevents water loss and protects against infection.

Functions of Epidermis

- Protection against pathogens and injury

- Prevents water loss
- Produces keratin for skin strength
- Helps in vitamin D synthesis
- Provides skin colour through melanin

Important Cells in Epidermis

- Keratinocytes – produce keratin
- Melanocytes – produce melanin pigment
- Langerhans cells – immune defence
- Merkel cells – sensory touch receptors

Clinical Importance:

- Damage to the epidermis can lead to:
- Burns
- Infections
- Psoriasis
- Eczema
- Skin cancer

1.2.3 Dermis

The dermis is strong and flexible. It is made of connective tissue, and the matrix is made up of collagen fibres interwoven with elastic fibres. Rupture of elastic fibres occurs when the skin is overstretched, resulting in permanent striae, or stretch scars, which are common during pregnancy and obesity. Collagen fibres bind water and give the skin its tensile strength, but as this ability weakens with age, wrinkles form. The dermis is the middle layer of the skin located between the epidermis and the hypodermis (subcutaneous tissue). It is thicker than the epidermis and provides strength, elasticity, nourishment, and support to the skin.

Structure of the Dermis

The dermis has two main layers:

1. Papillary Layer

- Upper thin layer of the dermis
- Made of loose connective tissue

Contains:

- Capillaries (small blood vessels)
- Nerve endings
- Touch receptors
- Forms dermal papillae that connect with the epidermis

Helps in:

- Supplying nutrients to the epidermis
- Temperature regulation
- Sensation

2. Reticular Layer

- Deeper and thicker layer
- Made of dense connective tissue

Rich in:

- Collagen fibers
- Elastin fibers

Contains:

- Hair follicles
- Sweat glands
- Sebaceous (oil) glands
- Blood vessels
- Lymph vessels

Provides:

- Strength
- Flexibility
- Elasticity to the skin

The dermis contains the following structures:

1. Small blood and lymph vessels.
2. Sensory nerve ends.
3. Sweating glands and ducts.
4. Sebaceous glands, arrector pili muscles, and hairs.

Components Present in Dermis:

- Collagen Fibers
- Give strength and firmness to skin
- Elastin Fibers
- Provide elasticity and flexibility
- Blood Vessels
- Supply oxygen and nutrients
- Help regulate body temperature
- Nerves and Sensory Receptors
- Detect pain, pressure, heat, cold, and touch
- Sweat Glands
- Produce sweat for cooling
- Sebaceous Glands
- Secrete sebum to lubricate skin and hair
- Hair Follicles
- Anchor hair roots in the skin
- Functions of Dermis:
- Provides strength and elasticity

- Supports epidermis
- Regulates body temperature
- Provides sensation
- Supplies nutrients to skin
- Helps in wound healing
- Protects the body from injury.

1.2.4 Hypodermis

It is a subcutaneous layer that extends deep into the dermis but is not skin. This layer, known as superficial fascia, is made up of areolar and adipose tissues that connect the dermis to the underlying structures. The hypodermis, also called the subcutaneous tissue or subcutis, is the deepest layer beneath the skin. It lies below the epidermis and dermis and connects the skin to underlying muscles and bones.

Structure of Hypodermis:

The hypodermis is mainly made up of:

- Adipose tissue (fat cells)
- Loose connective tissue
- Blood vessels
- Nerves

It is not considered a true part of the skin by some anatomists, but it plays an important supportive role.

Functions of Hypodermis

1. Fat Storage

- Stores energy in the form of fat.
- Provides nutritional reserve for the body.

2. Insulation

- Helps maintain body temperature by reducing heat loss.

3. Protection and Cushioning

- Acts as a shock absorber.
- Protects internal organs and muscles from injury.

4. Attachment

- Anchors the skin to underlying tissues such as muscles and bones.

5. Blood Supply

- Contains larger blood vessels that supply nutrients to the skin

Cells Present

- Adipocytes (fat cells) – major cells of hypodermis.
- Fibroblasts – produce connective tissue fibers.
- Macrophages – help in defense against infection.
- Thickness of Hypodermis:

Thickness varies according to:

- Age
- Gender
- Body region
- Nutritional status

It is usually thicker in areas like:

- Abdomen
- Buttocks
- Thighs

1.2.5 Sweat glands

These are found throughout the skin, but are particularly prevalent in the palms of the hands, soles of the feet, axillae, and groynes. They are made up of epithelial cells. The gland bodies are coiled in the subcutaneous tissue. Sweat glands are specialized structures in the skin that produce sweat. They help regulate body temperature, remove waste products, and maintain skin health.

Types of Sweat Glands:

1. Eccrine Sweat Glands

These are the most common sweat glands in the body.

Features:

Distributed all over the body, especially on:

- Forehead
- Palms
- Soles
- Open directly onto the skin surface through pores
- Produce a watery, clear sweat

Functions:

- Regulate body temperature by evaporation
- Help cool the body during exercise or hot weather
- Remove small amounts of salts and waste products

2. Apocrine Sweat Glands

These glands are larger and become active during puberty.

Location:

Found mainly in:

- Armpits (axilla)
- Areola of nipple
- Genital region

Features:

- Open into hair follicles
- Produce thick, milky secretion
- Sweat becomes odorous after bacterial action

Functions:

- Emotional sweating (stress, fear, excitement)
- May play a role in scent communication

Structure of a Sweat Gland:

A sweat gland mainly consists of:

- Secretory portion – produces sweat
- Duct portion – carries sweat to the skin surface or hair follicle

Composition of Sweat:

- Sweat mainly contains:
- Water
- Sodium chloride (salt)
- Urea
- Ammonia
- Lactic acid
- Functions of Sweat Glands:
- Thermoregulation
- Excretion of waste
- Maintaining skin moisture
- Protection against overheating

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1.2.6 Sebaceous glands

Secretory epithelial cells coming from the same tissue as hair follicles form sebaceous glands. They release an oily antibacterial substance, sebum, into hair follicles and are found in all regions of the body's skin save the palms of the hands and the soles of the feet. There are sebaceous glands that are independent of hair follicles and secrete sebum directly on the surface in regions of transition from one kind of superficial epithelium to another, such as the lips, eyelids, nipple, labia minora. Sebaceous glands are small oil-producing glands present in the skin. They are usually attached to hair follicles and secrete an oily substance called sebum. These glands are an important part of the integumentary system (skin system).

Structure of Sebaceous Glands:

- Sebaceous glands are microscopic exocrine glands.
- They are mainly found in the dermis layer of the skin.
- Most glands open into the hair follicle, while some open directly onto the skin surface.
- They are absent on the palms of the hands and soles of the feet.

Sebum

Sebum is an oily secretion made of:

- Lipids (fats)
- Wax esters
- Cholesterol
- Cellular debris

Functions of Sebaceous Glands

1) Lubrication of Skin and Hair

- Keeps skin soft and smooth.
- Prevents hair from becoming dry and brittle.

2) Protection:

- Forms a protective barrier on the skin.
- Helps reduce water loss from the skin.

3) Antibacterial Action:

- Sebum contains substances that help inhibit the growth of some microorganisms.

4) Skin Waterproofing:

- Protects the skin from excessive moisture and dryness.

Distribution in the Body:

Sebaceous glands are abundant in:

- Face
- Scalp
- Chest
- Back

Types of Sebaceous Glands:

1) Hair Follicle Sebaceous Glands

- Associated with hair follicles.

2) Free Sebaceous Glands

- Open directly onto the skin surface.
- Found in lips, eyelids, nipples, and genital areas.

Importance in Skin Health:

Healthy sebaceous glands:

- Maintain skin moisture
- Improve skin flexibility
- Protect against environmental damage

1.2.7 FUNCTIONS OF SKIN

Skin performs the following functions:

1. Protection: An anatomical barrier between the internal and external environments for infections and harm in bodily defence. Perspiration contains lysozyme, which breaks the connections within bacteria's cell walls.

- Shields the body from physical injury, microbes, and harmful chemicals
- Prevents dehydration by reducing water loss
- Protects against ultraviolet (UV) radiation using melanin

2. Sensation: A group of nerve endings that respond to heat and cold, touch, pressure, vibration, and tissue injury; also known as the somatosensory system and haptics.

- Touch, pressure, pain, and temperature
- These signals are sent to the brain for interpretation

3. Evaporation control: The skin acts as a semi-permeable and generally dry barrier to fluid loss. This

function's loss adds to the substantial fluid loss seen in burns.

- Keratin and natural oils form a waterproof protective barrier
- This barrier reduces excessive evaporation of water from body tissues
- It helps maintain proper body hydration and fluid balance

4. Aesthetics and communication: When others look at our skin, they can judge our emotions, physical condition, and beauty

- Skin contributes to a person's physical appearance and beauty
- Skin colour, texture, smoothness, and glow influence attractiveness and self-confidence
- Healthy skin reflects good health and hygiene
- The skin helps express emotions through:
 - Blushing
 - Pallor (paleness)
 - Sweating
 - Facial expressions
- Touch through the skin is also a form of non-verbal communication, such as handshakes, hugs, and comforting touch

5. Regulation of Body Temperature: The skin helps maintain a stable internal temperature:

- Sweat glands release sweat, which cools the body through evaporation
- Blood vessels dilate (expand) or constrict (narrow) to release or conserve heat

6. Excretion:

Through sweat, the skin removes:

- Water
- Salts
- Small amounts of waste products like urea

7. Vitamin D Synthesis:

- When exposed to sunlight, the skin produces vitamin D
- This vitamin is essential for calcium absorption and healthy bones

8. Immune Defence

- The skin contains immune cells that help fight infections

- Acts as the first line of defence against pathogens
9. Storage and Insulation
- Stores fat, which acts as an energy reserve
 - Provides insulation to reduce heat loss

1.2.8 Storage and Synthesis:

Functions as a storage centre for lipids and water, as well as a source of vitamin D production via UV activity on certain regions of the skin.

Excretion: Sweat includes urea, but its concentration is 1/130th that of urine, hence sweating excretion is just a secondary function to temperature regulation.

Absorption: The cells in the skin's outermost 0.25-0.40 mm are "almost entirely supplied by external oxygen," while their "contribution to total respiration is negligible." Furthermore, medicine can be delivered through the skin using ointments or sticky patches, such as the nicotine patch or iontophoresis. In many other creatures, the skin is a key location of transport.

Water resistance: The skin acts as a water-resistant barrier, preventing critical nutrients from being rinsed away.

1.3 GHANERI LEAF BENEFITS FOR SKIN

- 1.3.1 Glowing Skin
- 1.3.2 Cleanses Skin
- 1.3.3 Facial Toner
- 1.3.4 Exfoliates Skin
- 1.3.5 Moisturizes Skin
- 1.3.6 Reduce inflammation
- 1.3.7 Acne control
- 1.3.8 wound healing

II. SOAP INTRODUCTION

Personal hygiene plays a vital role in preventing the spread of infectious diseases. Among hygiene products, antibacterial soaps are widely used to reduce microbial load on the skin and prevent transmission of pathogens. However, most commercial antibacterial soaps rely on synthetic agents like Triclosan, triclocarban, or quaternary ammonium compounds. Long-term use of these chemicals has been linked to skin irritation,

antimicrobial resistance, and environmental toxicity due to their persistence in wastewater. This has increased interest in developing safer, eco-friendly alternatives from natural sources. Medicinal plants have long been recognized for their antimicrobial, antioxidant, and healing properties. *Lantana camara* Linn., commonly known as "gandhari" or "tantuani," is an invasive shrub belonging to the Verbenaceae family. Although considered a weed, its leaves are reported to contain a wide range of bioactive compounds including lantadene, flavonoids, tannins, alkaloids, saponins, and essential oils. Several studies have demonstrated the antibacterial, antifungal, and anti-inflammatory activities of *L. Camara* leaf extracts against pathogens such as *Staphylococcus aureus*, *Escherichia coli*, and *Candida albicans*. Utilizing *L. Camara* leaves for soap formulation not only provides a value-added use for an otherwise invasive plant but also aligns with the growing demand for herbal cosmetics. Soap, as a vehicle for topical delivery, is ideal for incorporating plant extracts because it allows regular contact with skin during washing, enabling the extract's antimicrobial action. The present study aims to formulate antibacterial soap using ethanolic extract of *L. Camara* leaves and to characterize the soap for its physicochemical properties, stability, and antimicrobial efficacy. The work intends to establish a low-cost, plant-based alternative that is safe for skin, environmentally sustainable, and effective against common skin pathogens. Soap is one of the most commonly used cleansing agents for maintaining personal hygiene and preventing the spread of infectious diseases. Antibacterial soaps are specially formulated to inhibit or destroy harmful microorganisms present on the skin. In recent years, there has been increasing interest in the use of medicinal plants in cosmetic and pharmaceutical products because of their natural antimicrobial properties, safety, biodegradability, and fewer side effects compared to synthetic chemicals. *Lantana camara* is a well-known medicinal plant belonging to the family Verbenaceae. It is widely distributed in tropical and subtropical regions and is traditionally used in herbal medicine for the treatment of wounds, skin infections, fever, respiratory disorders, and inflammatory diseases. The leaves of *Lantana camara* contain several bioactive compounds such as flavonoids, alkaloids, tannins, terpenoids,

saponins, and essential oils, which exhibit significant antibacterial, antifungal, antioxidant, and anti-inflammatory activities. The growing resistance of microorganisms to conventional antibiotics has encouraged researchers to explore plant-based antimicrobial agents as alternative therapeutic options. Plant extracts incorporated into soaps can provide effective protection against pathogenic bacteria while also offering moisturizing and skin-healing benefits. Herbal soaps prepared from medicinal plant extracts are increasingly preferred due to their eco-friendly nature and reduced toxicity. The formulation of antibacterial soap using *Lantana camara* leaf extract aims to develop a natural cleansing product with enhanced antimicrobial activity. The extract can be incorporated into a soap base prepared through the saponification process using oils and alkali. Proper formulation is essential to ensure desirable characteristics such as pH, formability, hardness, stability, cleansing efficiency, and skin compatibility. Characterization of the formulated soap involves evaluating its physicochemical parameters and antibacterial effectiveness against common pathogenic microorganisms such as *Staphylococcus aureus* and *Escherichia coli*. These evaluations help determine the quality, safety, and efficacy of the herbal soap formulation. Therefore, the present study focuses on the formulation and characterization of antibacterial soap prepared from *Lantana camara* plant extract and the assessment of its antimicrobial potential as a natural and effective personal care product. Soap is a salt of a fatty acid (sometimes other carboxylic acids) used for cleaning and lubricating products as well as other applications. In a domestic setting, soaps, specifically “toilet soaps”, are surfactants usually used for washing, bathing, and other types of housekeeping. In industrial settings, soaps are used as thickeners, components of some lubricants, emulsifiers, and catalysts. Soaps are often produced by mixing fats and oils with a base. Humans have used soap for millennia; evidence exists for the production of soap-like materials in ancient Babylon around 2800 BC. Soap is a salt of a fatty acid used for cleaning and sanitizing, typically composed of hydrophobic (fatty acid) and hydrophilic (water-soluble) parts that emulsify dirt and grease, lifting them from surfaces. Primarily used for bathing and laundry in bar or liquid form, soaps are produced via

saponification, a reaction of fats and oils with an alkali. Soap is a product resulting from a chemical reaction called saponification between the molecules of a fatty substance and a strong alkaline agent. Soap is essential for health, hygiene, and disease prevention, acting as a primary defence against pathogens by breaking down viral fat membranes and removing bacteria. It reduces respiratory illnesses by up to 21% and diarrheal diseases by over 30% by washing away dirt and germ-trapping. Soap chemistry is the study of creating cleansing agents (soaps) by saponifying fats and oils with an alkaline solution, generally resulting in sodium or potassium salts of fatty acids. These surfactant molecules, which have hydrophobic tails and hydrophilic heads, clean by forming micelles that encapsulate dirt and oil for easy rinsing. Soap is one of the most commonly used cleansing agents for maintaining personal hygiene and preventing the spread of infectious diseases. It is produced through the process of saponification, in which fats or oils react with an alkali to form soap and glycerol. In recent years, there has been increasing interest in herbal and plant-based soaps because of their medicinal value, safety, biodegradability, and fewer side effects compared to synthetic chemical products. Antibacterial soaps are specially formulated to inhibit or destroy harmful microorganisms present on the skin. Natural plant extracts are widely used in antibacterial soap formulations because they contain bioactive compounds such as flavonoids, tannins, alkaloids, and essential oils that possess antimicrobial properties. *Lantana camara* is a medicinal plant known for its antimicrobial, antifungal, antioxidant, and anti-inflammatory activities. The leaves of this plant contain several phytochemicals that can help control the growth of bacteria responsible for skin infections and body odour. Due to these properties, *Lantana camara* leaf extract has gained attention as a potential natural ingredient in herbal antibacterial soap preparation. The formulation and characterization of antibacterial soap from *Lantana camara* leaf extract aim to develop an effective herbal cleansing product with good antibacterial activity and acceptable physicochemical properties such as pH, foam stability, hardness, moisture content, and cleansing ability. This study also helps evaluate the suitability of plant-based ingredients in cosmetic and

pharmaceutical applications while promoting the use of eco-friendly herbal products.



Lantana camara Soap

2.1.3 Ideal Properties of Soap

1. Skin Nourishment and Safety: Herbal soaps should be gentle on the skin, providing hydration and removing sebum without irritation, making them ideal for sensitive or acne-prone skin.
2. Natural Ingredients: They are typically crafted using plant extracts, essential oils, and herbs like lavender, neem, turmeric, or tea tree.
3. Physicochemical Characteristics: An ideal herbal soap should have a high-quality, stable foam (lasting over 5 minutes) and proper, consistent texture.
4. Therapeutic Benefits: Many herbal soaps offer natural antibacterial and antiseptic benefits. They are designed for specific needs, such as, for instance, reducing inflammation, improving skin tone, or providing antioxidant protection.
5. Eco-Friendly and Ethical: They are generally biodegradable and often cruelty-free (not tested on animals), providing a sustainable, natural alternative to synthetic detergents.
6. Aroma therapeutic Effects: Infused with natural essential oils, they offer calming and relaxing properties, contributing to overall well-being.
7. Safe pH Level: The formulation should result in a balanced, safe soap, typically with a pH range of 8–10. Acta Scientific Acta Scientific +7
8. It should effectively inhibit or kill harmful microorganisms such as bacteria, fungi, and some viruses.
9. The antibacterial agent should provide broad-spectrum activity against common skin pathogens.

10. The soap should be non-toxic, non-irritating, and safe for regular use.
11. It should not cause allergies, redness, dryness, or skin damage.
12. It should efficiently remove dirt, oil, sweat, and microorganisms from the skin surface.

2.1.4 CLASSIFICATION OF SOAP

Categories	Soaps	Detergents
Definition	Sodium or potassium salt of carboxylic acids	Sodium or potassium salts having sulfonate group
Ingredients	Natural	Synthetic
Functional groups	-COONa	-SO ₃ Na
Bio-degradability	Bio-degradable	Not all are biodegradable
Work with wools	Not good	Good
Precipitation	Precipitate in water	Do not precipitate
Dissolution time	More	Less
Lather formation	Less	More
Uses	Hands, Bodies, Utensils	Laundry, Cleaning homes
Prices	Cheap	Expensive
Examples	Sodium stearate, Sodium palmitate, etc	SDS, SLS, etc

2.1.5 SOAP FORMING COMPOUNDS



Leaf extract powder



Soap base

1. Core compounds for saponification

This is the actual chemical reaction that makes soap:

Fat/Oil + Alkali → Soap + Glycerol

Fats/Oils Coconut oil, palm oil, castor oil, olive oil, shea butter

Provide fatty acids. Type of oil decides hardness, lather, conditioning

Alkali (Lye). Sodium hydroxide (NaOH) for solid bar soap

Potassium hydroxide (KOH) for liquid soap. Breaks down triglycerides into fatty acid salts = “soap”

2. Functional additives

These don't “form” soap, but are added to the soap base to change properties:

Solvents Water, ethanol Dissolve lye, control reaction rate

Hardness agents. Sodium lactate, salt Make bar harder, longer lasting

Lather boosters. Castor oil, sugar, coconut oil Improve foam quantity & stability

Super fatting oils Shea butter, olive oil

Extra oil left unsaponified for skin conditioning

Antibacterial agents Triclosan (synthetic)

Lantana camara extract (natural) Kill/inhibit microbes on skin

Chelating agents EDTA, citric acid. Bind metal ions, prevent soap scum & rancidity

Preservatives Rosemary extract, vitamin E

Prevent oxidation of oils

For your Lantana camara soap specifically

You'll need:

1. Oil blend: Coconut oil for lather + hardness, palm oil for bulk/hardness, castor oil for creamy foam
2. Alkali: NaOH if you want a hard bar
3. Active: Ethanolic L. Camara leaf extract added at trace, 1-3% w/w
4. Optional: Glycerin for moisture, essential oil for scent

2.1.6 USES

1. Deep Cleansing & Pore Unclogging: Effectively remove dirt, oil, and impurities without the harsh detergents found in conventional soaps.
2. Intense Nourishment & Moisturization: Enriched with natural oils (coconut, castor, olive) and glycerin to keep skin hydrated, soft, and smooth, preventing the dryness caused by synthetic bars.
3. Treatment of Skin Conditions: Ingredients like tea tree, neem, turmeric, and aloe vera help combat acne, psoriasis, eczema, and skin irritation.
4. Natural Exfoliation: Ingredients such as ground herbs or oatmeal gently remove dead skin cells, promoting cell renewal.
5. Aromatherapy and Stress Relief: Essential oils like lavender, peppermint, and rosemary offer a pleasant aroma and therapeutic benefits, reducing stress and anxiety.
6. Skin Protection & Healing: Antioxidant-rich ingredients like green tea and chamomile help protect the skin from free radicals and promote healing.
7. Eco-Friendly and Hypoallergenic: Generally, they are biodegradable, biodegradable and less likely to cause allergic reactions, making them ideal for sensitive skin.

III. AIM AND OBJECTIVES

Aim

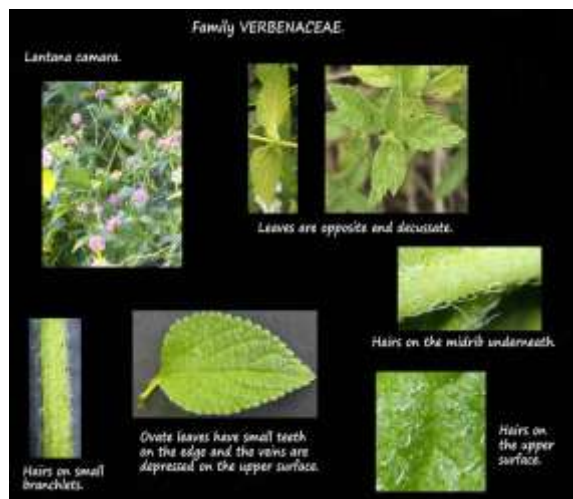
FORMULATION AND CHARACTERIZATION OF ANTI-BACTERIAL SOAP FROM LANTANA CAMARA LEAF EXTRACT.

Research Objectives

A. Preformulation Studies

- a) To collect Ghaneri leaf (Lantana Camara Lin) of authenticate the same.

- b) To obtain ethanolic herb extract by Soxhlet extraction method.
- c) Phytochemical screening of extract.
- B. Formulation Studies
- C. Post formulation Studies
 - a) Physical Evaluation.
 - b) Washability.
 - c) Determination of pH.
 - d) Spreadability.
 - e) Skin irritation Test.
 - f) Viscosity.
 - g) Clarity Test.
 - h) Homogeneity.
 - i) Stability Studies.



Common names:

English: Lantana weed

Marathi: Ghaneri, Tantani

Hindi: Raimuniya

IV. REVIEW OF LITERATURE DRUG PROFILE

4.1. Lantana Camara



Fig. Lantana Camara

Taxonomical classification:

Kingdom – Plantae

Subkingdom – Tracheobionta

Super division – Spermatophyte

Division – Magnoliopsida

Subclass – Asteridae

Order – Lamiales

Family – Verbenaceae

Genus – Lantana

Species – Lantana camara

Plant form – Shrub

V. MATERIAL AND METHODS

To elaborate the study of the Ghaneri in the treatment of various essential parts. Information regarding to drug is collected from various books, various journals, research articles and internet media was also used for availability and necessity for understanding the subject.

Ayurvedic Description:

Sanskrit Name: Chaturangi, Vanacchedi

Properties: Rasa: Kashaya, Tikta, Guna, Guru, Virya:

Sita Therapeutics Uses: Condition of Vata and Kapha

Morphology:

Lantana Camara is a vigorous, low-erect or subscaudent shrub that grows between 1.2 and 2.4 meters (or even more). It has sturdy, recurved prickles with a pungent aroma of black currants. Its root system is very strong.



Fig. Plant, Fruit and Flowers

Stem: Square stems have minute, recurved prickles. The branches have angular shapes and are organized along the margins with curving spines.

Leaves: Along the stem, opposing leaves grow that are bright green, about 6 cm long, and with round toothed edges.

Flowers: They are around 2.5 cm in diameter and come in a variety of colours, including pale cream, yellow, white, pink, orange, red, lilac, and purple. Butterflies and insects fertilize the flowers.

Fruits: Fruits range in colour from blue to black and are glossy, rounded, fleshy, purplish-black when ripe, measuring about 3 mm in diameter.

History:

Native to Mexico is the lantana camara. It arrived in India for the first time from Sri Lanka in 1809. Australia has had lantana as a weed for more than 160 years. Lantanas were introduced to Australia in 1841 as a decorative garden plant. Within 20 years, they spread, eluded domestication, and established themselves in the wild. Its original range has expanded to around 50 different nations, where it has established itself as an invasive species. It originally left the Americas when Dutch explorers carried it to Europe and widely farmed it there. It then quickly spread throughout Asia and Oceania where it quickly became known as a noxious plant, and the Portuguese introduced it to Goa.

Distribution:

A worldwide plant is lantana camara. More than 60 nations have received it, including those in Africa,

America, Australia, China, Hong Kong, Malaysia, India, Sri Lanka, the United States, and New Zealand.

Habitat:

It frequently happens in agricultural areas, coastal regions, natural woods, planted forests, grasslands, riparian zones, shrub lands, urban areas, wet lands, and other wastelands.

Life Cycle:

All year long, germination and flowering take place, but they peak following summer rains. Per square metre, thousands of seeds that are viable for several years can be produced. According to research, some types of ornamental lantana have the capacity to produce seeds and propagate vegetatively. Additionally, they have the capacity to cross-pollinate with wild forms, giving rise to new varieties that may eventually become a part of the environment. They also produce some viable pollen.

Types of Lantana Species:

Because of their eye-catching blooms and capacity to draw native pollinators, Lantana species are common garden plants. Before beginning a lantana garden, though, make careful to consult your state's or region's list of invasive plants because some species have the potential to spread quickly. In general, hot, humid temperatures are necessary for all lantana species to truly flourish. The southern United States is home to several of these species. Lantana species are extremely low maintenance and a lovely addition to your garden if the climate is right for them.

a. Common Lantana (*Lantana camara*):

One of the lantana flower species that is most frequently grown is the common lantana, also known as shrub verbena. You can grow this species as an annual or in a container in cooler locations. Even though this is a wonderful plant to liven up your garden or house, if you reside in a tropical climate, take extra precautions. The common lantana is invasive Texas, Florida, Hawaii, and some regions of Australia because it spreads so quickly.

Local range: South and Central America.

B Trailing Lantana (*Lantana montevidensis*):

Trailing lantana has a wide spread, dense leaves, and lovely flowers, making it an excellent choice for dense ground cover. It is a robust grower as well, and while being less invasive than its cousin, *L. camara*, it has escaped gardens across the southern United States. The plant should be avoided because of its small hairs, which can irritate skin.

Local range: South America's tropics (The species name derives from its discovery in Montevideo, Uruguay)

b. Buttons age (*Lantana involucrate*):

A lantana species that is native to the U.S., buttons age is a sweet little shrub. When the leaves are crushed, they have a fragrance similar to sage, giving this lantana plant its common name.

Native Range: South Florida to Central and South America.

c. Popcorn Lantana (*Lantana trifolia*):

Also called lavender popcorn, this lantana plant is as much cultivated for its decorative fruit as for its flowers. Giving the plant its common name, the fruits form in bundles that look like individual pieces of purple popcorn! Don't be tempted to eat them, however, many lantana species are poisonous.

Local Range: West Indies, Mexico, Central, and South America.

Pharmacological activities:

- Antioxidant Activity:

Matured leaves and older show the strong antioxidant activity and leaves extract exhibited high antioxidant effect. Antioxidant activity due to its high content of phenolic compounds and flavonoids. The plant show metal chelating, radical scavenging and reducing power, and can protect DNA from damage. Strong antioxidant properties by extracts from different parts mainly, leaves, roots etc.

- Antibacterial Activities:

Roots and leaves have a strong antibacterial activity against *E. coli*, *Bacillus subtilis*. *Lantana camara* demonstrated appreciable results against mycobacterial tuberculosis and produce minimum inhibitory concentrations (MICs) and minimum

bactericidal concentrations (MBCs) of 37.5mg/ml against both *salmonella aureus* and *pseudomonas aeruginosa*. Because ethanolic extract exhibits activity against *bacillus subtilis* and *pseudomonas*, *lantana camara* is used to treat microbial disease.

- Antifungal Activity:

Lantana camara plant has a significant antifungal property. *Lantana camara* was screened against wood destroying white and brown rot fungi by hot water extract and antifungal activity of ethanol. *Lantana camara* have great antifungal activity. *Lantana* have nanoparticles and different solvent extract of EO's.

- Anti-inflammatory Activity:

The leaves of *lantana camara* contain chemicals which have anti-inflammatory properties. The including saponins, tannins, flavonoid chemicals can cause of the anti-inflammatory properties of betel leaf extract. The *lantana camara* exhibits anti-inflammatory properties through various mechanism, including inhibiting inflammatory mediators like COX-2, suppressing edema, and reducing inflammation -related signaling pathways.

- Antifertility Activity:

Saponins, triterpenoid and flavonoid chemicals found in *lantana camara* leaves have antifertility activity because of they can suppress the release of FSH and LH, making them antiestrogenic. *Lantana camara* exhibits antifertility activity by including embryo toxicity. The *lantana camara* contain alkaloids having chemical activity. Antifertility is a pharmacological activity of *lantana camara* plant.

- Antipyretic Activity:

Symptoms of malaria, alleviate and fever can reduce by *lantana camara* leaves. Ethyl acetate and ethanolic extract of leaves use to reduce fever. These extracts show a significant reduction in body temperature, with effects becoming around 1.5 hours and significant between the 2nd and 3rd hours affect. prostaglandin synthesis by inhibition by antipyretic drugs work.

- Wound Healing Activity:

Wound healing which is essential for the lowering inflammation of plant aid compounds. Infection is an important factor which can avoided in exposed

wounds by using lantana camara antibacterial action .The leaves extract of lantana camara has been showed antiseptic ,anti-leprosy activity .The ethanol extract of lantana camara increased the rate of wound concentration by 87% in burn wound when compared to controls (82%).The hydroalcoholic extract and fresh juice of lantana camara leaves have flavoured wound concentration.

USES OF LANTANA CAMARA LINN:

- Lantana camara used in food .Ripe fruits can be eaten .
- Taila is prepared by adding the decoction of both Lantana camara leaves, and Eupatorium odoratum is used for external application for the wound.
- The Decoction of leaves and fruits is used as a lotion for wounds.
- Decoction of the leaves is used for the vitiated condition of Vata and Kapha The leaf juice/decoction is used for gargling in mouth ulcers.
- For sprain and contusion, pounded fresh leaves are applied as a poultice.
- For rheumatism, oil is spread on leaves, warmed, and applied to the affected part.
- Leaves are boiled with water, and that water is drunk as an anti-asthmatic and antipyretic.
- For cold tea prepared with leaves of Lantana camara.
- The plant's many parts are used to cure skin disorders, rheumatism, and fever.
- Research community is exploring various uses of the plant, In addition to perfume ingredient.

Essential oil from the leaves possesses adulticidal activity against the different mosquito species. Thus, this species can be utilized for oil-based insecticides as supplementary to synthetic insecticides.

The leaf oil is used in the treatment of itches of skin and also useful as an antiseptic for wounds.

The bark of the stem and roots contain a quinine-like alkaloid, lantanine, with strong antipyretic and antispasmodic properties.

Acid extracts of the shoots show antibacterial activity against Escherichia coli.

Lantana biomass could be utilized as fertilizer, energy, fuel wood, pulp, paper fiber and developing

roofing material (NAS, 1981). Its straw is used for biogas product, dung manufacture.

It could be a good raw material for paper and pulp industry. The stalks have been tried as raw materials for paper pulp and contain furfuroids (21.6%), lignin (14.0%), cellulose (30.6%) and ash (3.50%).

Lantana biomass is used directly for various purposes and most important is as supplementary fuelwood for cooking and heating by people.

Making furniture from Lantana is a direct utilization of biomass from the wild.

This strategy could be useful in control of Lantana weed and simultaneously better utilization of alien species. It regenerates very fast even after lopping and attains high biomass yields.

Stems though are thin the wood is very tough and durable and thus useful for various handicrafts such as wickerwork.

The Soliga of Karnataka is now-a-days utilizing Lantana in their wicker craft as bamboo resources are scarce and costly and the bamboo forests have been invaded by Lantana.

Industry: The stems of Lantana, if treated by the sulphate process, can be used to produce pulp for paper suitable for writing and printing.

Rubber Industry: The roots of Lantana contain a substance that may possibly be used for rubber manufacture.

VI. MATERIALS & METHODOLOGY

6.1 PREFORMULATION STUDY

Preformulation testing is the first step in rational development of dosage forms of a drug substance. Preformulation study is the process of optimizing the delivery of drug through determination of Phytochemical properties of the new compound that could affect drug performance and development of an Efficacious, stable and safe dosage form. It gives the information needed to define the nature of the substance And provide a framework for the drug combination with pharmaceutical excipients in the dosage form. Hence Preformulation study was

performed for the herbal extracts for identification and compatibility.

Sr.No.	Ingredients (w/w%)	100 gm
1.	Ghaneri Leaf Extract	10 ml
2.	Rose Water	5 ml
3.	Aloe Vera Gel	5 ml
4.	Coconut oil	5 ml
5.	Sodium Lauryl sulphate	5 gm
6.	Soap base	60 gm
7.	Castor oil	5 ml
8.	Glycerine	5 ml

Table. List of Ingredients used For Formulation

Name of The Ingredient	Scientific Name and Family	Part Used	Use
Lantana Camara Lin	Lantana Camara Lin Family : Plantae	Leaf	As Anti Bacterial Agent

Table. List of Herbal Ingredient and its use

6.4 FORMULATION OF LANTANA CAMARA SOAP

1. Formulation of *Lantana camara* Soap*

A. Materials

Oil phase: Coconut oil 40%, Palm oil 40%, Castor oil 20% – gives good hardness + lather + conditioning
Alkali: Sodium hydroxide (NaOH) – calculated using saponification values

Solvent: Distilled water – 38% of oil weight for 33% lye concentration

Active extract: Ethanolic *L. camara* leaf extract at 1%, 2%, and 3% w/w of total batch

Optional: 0.5% essential oil for fragrance, 1% glycerin for extra moisture

B. Method: Cold Process Saponification

1. Extract preparation: Shade-dry *L. camara* leaves → powder → macerate in 70% ethanol for 72h → filter → concentrate to thick paste.
2. Lye solution: Dissolve NaOH in distilled water. Cool to 40–45°C.
3. Oil blend: Melt and mix oils. Cool to 40–45°C.
4. Mixing: Pour lye into oils slowly with stirring until emulsion forms.
5. Trace: At light trace, add *L. camara* extract + essential oil. Blend until medium trace.
6. Molding: Pour into molds, cover, insulate 24h.
7. Curing: Unmold after 24–48h, cure 4–6 weeks for complete saponification and hardness.

6.4.1 METHOD OF PREPARATION

1. Collection & drying: Collect fresh, mature *Lantana camara* leaves. Wash with distilled water to remove dirt. Shade-dry for 7–10 days until crisp.
2. Powdering: Grind dried leaves into coarse powder using a mechanical grinder. Pass through sieve #40.
3. Extraction: Take 100 g powder + 500 mL 70% ethanol in a conical flask. Macerate for 72 hours with occasional shaking.
4. Filtration: Filter through Whatman No.1 filter paper. Repeat maceration twice with fresh solvent to maximize yield.
5. Concentration: Combine filtrates and concentrate on a rotary evaporator at 40–50°C or in water bath until a semi-solid dark green residue is obtained.
6. Storage: Store extract in airtight amber container at 4°C until soap formulation.



6.6.2 PHYSICAL APPEARANCE

The physical appearance of the formulation was checked visually.

The physical appearance of soap refers to the visible and sensory characteristics of the soap product. It is an important quality parameter because it affects consumer acceptance and product attractiveness.

1) Colour

- Soap may be white, transparent, herbal green, yellow, pink, or any desired colour.
- Uniform colour indicates proper mixing of ingredients.

2) Texture

- Good soap has a smooth and firm texture.
- It should not be too soft, rough, or cracked.

3) Odour

- Soap should have a pleasant smell.
- Fragrance may come from perfumes, essential oils, or herbal extracts.

4) Shape

- Soap can be round, oval, rectangular, or decorative in shape.
- The shape should be smooth and well-formed.

5) Surface

- The surface should be free from cracks, air bubbles, and impurities.
- A glossy appearance is often preferred

6) Homogeneity

- Improves product quality and appearance
- Ensures proper mixing of ingredients
- Provides uniform cleansing and performance
- Increases consumer acceptance and stability of soap

7) Transparency

- Some soaps are opaque while glycerin soaps are transparent.
- Transparency depends on formulation ingredients.

8) Consistency / Hardness

- Soap should be sufficiently hard for handling and long-lasting use.

6.5 CHARACTERIZATION PARAMETERS

Test	Method	Acceptable Range	Why it matters?
PH	10% soap solution, PH meter	8.5-10.5	Skin computability
Foam height and stability	Cylinder shake method	>10 cm , stable 5 min	User acceptance
Total fatty matter (TFM)	I S 4955 method	Grade 1: >76% , Grade2: >60%	Cleansing and Quality
Free alkali	Titration with HCL	<0.05%	Prevents Skin Irritation
Moisture content	Oven drying 105°C	<15%	Shelf life
Hardness	Penetrometer or by feel	Firm, no denting	Lasting ability
Anti bacterial activity	Agar well diffusion vs S. Aureus, E.coli	Zone >10mm Consider active	Main claim
Organoleptic	Colour, odour, texture, appears	Uniform no rancide odour	Market ability
Skin irritation	Patch test on volunteers	No erythema, itching 24 hour	Safety

- Excess moisture can make soap soft.

9)Foam Appearance

- Good soap produces stable and creamy lather.
- Foam quality improves user satisfaction.

Importance of Physical Appearance:

- Improves consumer attraction and market value.
- Indicates product quality and proper formulation.
- Helps assess stability and storage condition of soap.

6.7 Antibacterial Test for Soap Extract

The antibacterial activity of soap extract can be evaluated by the Agar Well Diffusion Method or Disc Diffusion Method against bacteria such as *Staphylococcus aureus* and *Escherichia coli*.

Materials Required:

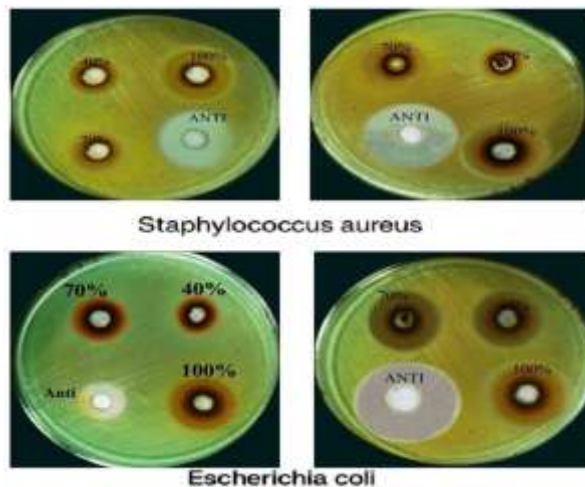
- Soap extract sample
- Nutrient agar medium
- Petri plates
- Sterile cotton swabs
- Micropipette
- Sterile cork borer
- Incubator
- Bacterial cultures (*E. Coli*, *S. Aureus*)
- Sterile distilled water

Procedure (Agar Well Diffusion Method) :

- 1)Prepare nutrient agar and pour it into sterile petri plates.
- 2) Allow it to solidify.
Spread the bacterial culture evenly on the agar surface using a sterile cotton swab.
- 3)Make wells in the agar using a sterile cork borer.
- 4)Add different concentrations of soap extract into the wells.
- 5)Keep one well as a control using distilled water or plain soap base.
- 6)Incubate the plates at 37°C for 24 hours.
- 7)Observe the zone of inhibition around the wells.
- 8)Measure the diameter of the clear zone using a ruler or Vernier caliper.

Observation:

Sample	Bacteria Used	Zone of Inhibition (mm)	Result
Soap extract	<i>Staphylococcus aureus</i>	12mm	Active
Soap extract	<i>Escherichia coli</i>	10mm	Moderate activity
Control		No zone	No activity



Result:

The soap extract showed antibacterial activity against both gram-positive and gram-negative bacteria by producing a visible zone of inhibition.

Conclusion:

The formulated herbal soap extract possesses antibacterial properties and can help inhibit the growth of harmful microorganisms on the skin.

VII. RESULTS AND DISCUSSION

1. Formulation

The antibacterial soap was successfully prepared by cold process saponification using coconut oil 40%, palm oil 40%, and castor oil 20% as the oil phase. Sodium hydroxide was used as alkali, and ethanolic extract of *Lantana camara* leaves was incorporated at 1%, 2%, and 3% w/w at trace stage. A control batch without extract was also prepared. All batches completed saponification and cured for 4 weeks before evaluation.

2. Physico-Chemical Characterization

The results of physico-chemical evaluation are summarized

3. Physical Appearance & Organoleptic Evaluation*

Control soap was off-white with smooth texture and characteristic soap odour. Incorporation of *L. Camara* extract imparted a light green to dark olive colour and mild herbal odour, which intensified with concentration. All soaps were firm, homogenous, and free from cracks, sweating, or mottling. The green colour and herbal smell are desirable for marketing as “herbal antibacterial soap”.

Discussion:

The control soap showed no antibacterial activity, confirming that the activity is solely due to *L. Camara* extract. Zone of inhibition increased in a concentration-dependent manner. F3 (3% extract) showed 16.5 mm against *S. Aureus* and 13.3 mm against *E. Coli*, which is comparable to or slightly better than marketed antibacterial soap. The activity is attributed to phytochemicals such as lantadene, flavonoids, and triterpenoids reported in *L. Camara*, which disrupt bacterial cell membranes. Gram-positive *S. Aureus* was more susceptible than Gram-negative *E. Coli*, likely due to the outer membrane barrier in *E. Coli*.

4. Overall Inference

F3 containing 3% *L. Camara* extract was selected as the optimized batch. It showed acceptable physico-chemical properties, good physical appearance, and significant antibacterial activity without compromising user parameters like pH and foam. The slight reduction in TFM and foam is outweighed by the added therapeutic value. Thus, *L. Camara* leaf extract can be effectively used to formulate herbal antibacterial soap.

CONCLUSION

The present study successfully formulated an antibacterial soap incorporating ethanolic extract of *Lantana camara* leaves using the cold process saponification method. Different concentrations of the extract, 1%, 2%, and 3% w/w, were incorporated into a coconut–palm–castor oil base. Physico-chemical evaluation showed that all formulated

batches complied with standard specifications for toilet soap. pH, free alkali, moisture content, and foam height were within acceptable limits, ensuring safety and consumer acceptability. Although Total Fatty Matter and foam height decreased slightly with higher extract concentration, the values remained satisfactory for Grade 2 toilet soap. Antibacterial studies by agar well diffusion method confirmed that the activity was concentration-dependent, with 3% extract soap showing maximum zone of inhibition against *Staphylococcus aureus* and *Escherichia coli*, comparable to marketed antibacterial soap. The control soap showed no activity, proving that the antibacterial property was due to *L. Camara* phytoconstituents such as lantadene, flavonoids, and triterpenoids. From the results, the 3% *L. Camara* extract formulation was found to be the optimized batch, exhibiting good physical appearance, acceptable physico-chemical parameters, and significant antibacterial efficacy. Thus, it can be concluded that *Lantana camara* leaf extract is a promising natural additive for developing herbal antibacterial soap with good stability and skin compatibility. Further studies on skin irritation, long-term stability, and large-scale production can be carried out to commercialize the formulation. The present study successfully demonstrated the formulation and characterization of antibacterial soap using *Lantana camara* leaf extract. The prepared herbal soap showed satisfactory physicochemical properties such as good appearance, acceptable pH, proper foam formation, adequate hardness, and good cleansing ability. The incorporation of *Lantana camara* leaf extract provided noticeable antibacterial activity against common skin microorganisms due to the presence of bioactive phytochemicals such as flavonoids, alkaloids, tannins, and essential oils.

The formulated soap was found to be safe and suitable for topical application with minimal skin irritation and good homogeneity. The study indicates that herbal antibacterial soap prepared from *Lantana camara* leaves can serve as a natural, economical, and eco-friendly alternative to synthetic antibacterial soaps. Furthermore, the use of plant-based ingredients may reduce the side effects associated with chemical antimicrobial agents. Overall, the research supports the potential of *Lantana camara* leaf extract as an effective herbal ingredient in

cosmetic and pharmaceutical soap formulations. Future studies may focus on stability studies, large-scale production, and evaluation against a wider range of microorganisms to improve the commercial applicability of the product.

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