



FORMULATIONS AND EVALUATION OF HERBAL CREAM OF ACACIA NILOTICA

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ABSTRACT

Herbal formulations have gained considerable importance in recent years due to their improved safety profile, patient compliance, and therapeutic effectiveness. *Acacia nilotica*, commonly known as Babul, is a medicinal plant widely used in traditional medicine systems because of its antimicrobial, anti-inflammatory, antioxidant, wound healing, and skin protective activities. The present study was aimed at the formulation and evaluation of herbal cream containing extract of *Acacia nilotica*.

The herbal cream was prepared using suitable excipients such as stearic acid, cetyl alcohol, glycerin, triethanolamine, liquid paraffin, methyl paraben, propyl paraben, and purified water. Different formulations were developed by varying concentrations of *Acacia nilotica* extract and evaluated for various physicochemical parameters including appearance, pH, viscosity, spreadability, washability, homogeneity, irritancy, stability, and antimicrobial activity.

The prepared formulations showed acceptable organoleptic properties, good consistency, suitable pH compatible with skin, satisfactory spreadability, and stability during storage conditions. The herbal cream demonstrated promising antimicrobial and skin protective properties due to the presence of bioactive phytoconstituents such as tannins, flavonoids, phenolic compounds, and alkaloids present in *Acacia nilotica*.

The study concluded that *Acacia nilotica* can be effectively incorporated into topical cream formulations and may serve as a safe and effective herbal preparation for skin care and management of minor skin infections.

Keywords: Acacia nilotica, Herbal cream, Antimicrobial activity, Skin care, Topical formulation, Evaluation studies.

INTRODUCTION

1.1 Introduction to Herbal Drug Delivery Systems

Herbal drug delivery systems are formulations prepared using plant-derived active constituents intended for therapeutic applications. Herbal medicines have been utilized since ancient times in traditional systems such as Ayurveda, Siddha, Unani, and Traditional Chinese Medicine. Due to increasing awareness regarding the side effects associated with synthetic drugs, herbal preparations are gaining widespread acceptance throughout the world.

The World Health Organization (WHO) has reported that a large proportion of the world population relies on herbal medicines for primary healthcare needs. Herbal formulations possess several advantages including safety, biocompatibility, low toxicity, easy availability, affordability, and therapeutic effectiveness.

Herbal topical formulations are particularly useful in the treatment of skin disorders, wound healing, infections, burns, inflammation, pigmentation disorders, and cosmetic care. Topical herbal products are commonly available in the form of creams, ointments, lotions, gels, emulsions, and pastes.

Among all topical preparations, herbal creams are considered one of the most acceptable dosage forms because of their elegant appearance, ease of application, patient compliance, and better spreadability.

1.2 Herbal Cosmetics

Herbal cosmetics are preparations containing natural ingredients derived from plants that are used to enhance appearance, maintain skin health, and protect the body from environmental damage. Herbal cosmetic products are formulated using extracts, oils, gums, waxes, and powders obtained from medicinal plants.

The use of herbal cosmetics has increased significantly because consumers prefer natural products over synthetic chemicals. Herbal cosmetics not only improve beauty but also provide therapeutic benefits.

Advantages of Herbal Cosmetics

- Reduced risk of adverse effects
- Better compatibility with skin
- Eco-friendly and biodegradable
- Rich source of antioxidants
- Suitable for long-term use
- Cost-effective
- Easily available raw materials
- Improved patient acceptance

1.3 Skin and Its Functions

The skin is the largest organ of the human body and acts as a protective barrier between the internal body tissues and external environment. It performs several physiological functions including protection, sensation, temperature regulation, excretion, and immune defense.

Structure of Skin

The skin consists of three major layers:

1. Epidermis

The epidermis is the outermost layer composed mainly of keratinized epithelial cells. It protects the body from microbial invasion, dehydration, and harmful environmental factors.

2. Dermis

The dermis lies beneath the epidermis and contains connective tissue, blood vessels, sweat glands, sebaceous glands, and hair follicles. It provides strength and elasticity to the skin.

3. Hypodermis

The hypodermis or subcutaneous tissue contains fat cells that provide insulation and cushioning.

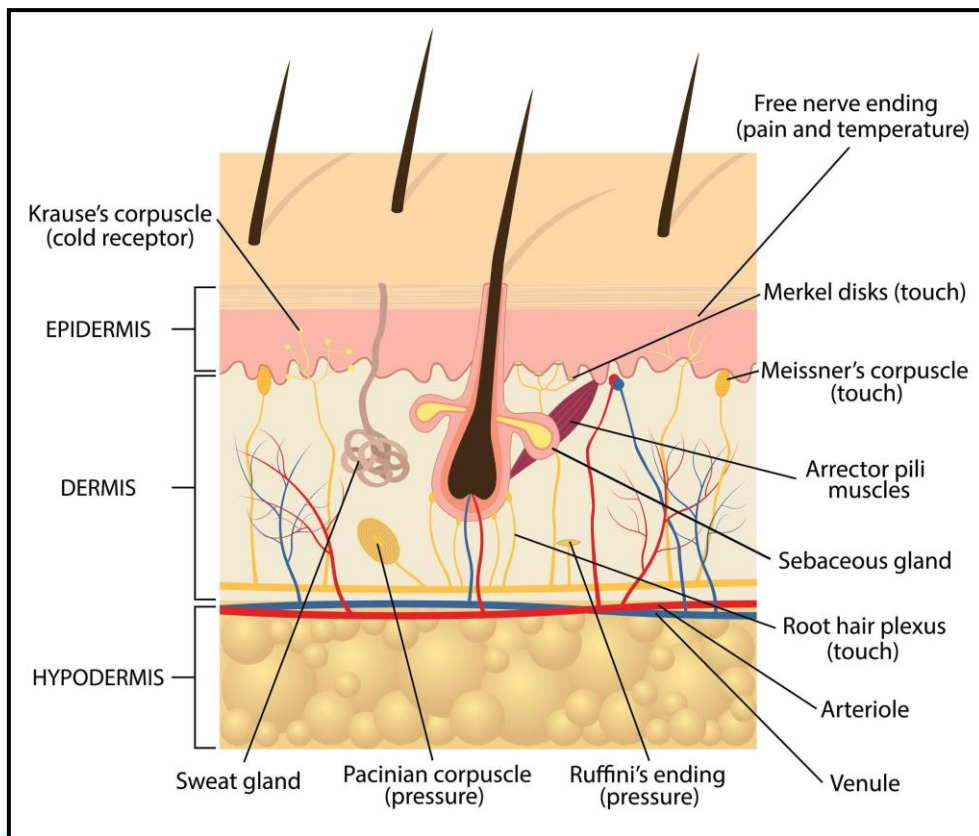


Fig. 1: Sense Organs and Structure of Skin

Functions of Skin

- Protection against microorganisms
- Prevention of water loss
- Sensory perception
- Thermoregulation
- Excretion through sweat glands

1.4 Topical Drug Delivery System

Topical drug delivery systems are pharmaceutical preparations applied externally to the skin for local therapeutic action. These systems are designed to deliver active ingredients directly at the site of action.

Topical formulations are widely used for:

- Skin infections
- Inflammation
- Fungal diseases
- Acne
- Burns
- Wounds
- Cosmetic purposes

Advantages of Topical Drug Delivery

- Avoids first-pass metabolism
- Localized action
- Reduced systemic side effects
- Easy application

1.5 Creams as Topical Dosage Forms

Creams are semisolid emulsified dosage forms intended for external application on the skin or mucous membrane. They may contain medicinal agents dissolved or dispersed in suitable bases.

Creams are generally classified into two major types:

1. Oil in Water (O/W) Creams

In these creams, oil droplets are dispersed in continuous aqueous phase.

Characteristics

- Non-greasy
- Easily washable
- Good patient acceptability
- Suitable for cosmetic use

2. Water in Oil (W/O) Creams

In these creams, water droplets are dispersed in continuous oily phase.

Characteristics

- Greasy in nature
- Excellent moisturizing effect
- Protective barrier formation
- Difficult to wash off

Ideal Properties of Creams

- Smooth appearance
- Homogeneous texture
- Good spreadability
- Stability during storage
- Non-irritant nature

1.6 Herbal Creams

Herbal creams are semisolid topical preparations containing one or more herbal extracts incorporated into suitable cream bases. These formulations provide both cosmetic and therapeutic benefits.

The presence of natural phytoconstituents such as flavonoids, tannins, alkaloids, glycosides, terpenoids, and phenolic compounds contributes to their pharmacological activities.

1.7 Introduction to *Acacia nilotica*

Acacia nilotica is an important medicinal plant belonging to family Fabaceae. It is commonly known as Babul or Gum Arabic tree. The plant has been extensively used in Ayurveda and traditional medicine for treatment of various disorders including skin infections, wounds, inflammation, diarrhea, dental problems, and microbial diseases.

Different parts of the plant such as bark, leaves, pods, seeds, flowers, and gum possess medicinal value.

1.8 Morphological Characteristics of *Acacia nilotica*

Tree

- Medium-sized thorny tree
- Height ranges from 5–20 meters
- Dark brown or black bark

Leaves

- Bipinnate leaves
- Small green leaflets

Flowers

- Yellow colored spherical flowers
- Fragrant in nature

Fruits

- Flat pods containing seeds
- Green when immature and black after maturation

Gum

- Sticky exudate obtained from bark
- Used for medicinal and pharmaceutical applications

1.9 Pharmacological Activities of *Acacia nilotica*

1. Antimicrobial Activity

The plant possesses antibacterial and antifungal activities against several pathogenic microorganisms.

2. Anti-inflammatory Activity

Flavonoids and phenolic compounds present in the plant help reduce inflammation and swelling.

3. Antioxidant Activity

The plant contains natural antioxidants which protect skin cells from oxidative damage caused by free radicals.

4. Wound Healing Activity

The astringent and antimicrobial properties promote faster wound healing and tissue regeneration.

5. Antifungal Activity

The extract inhibits fungal growth and may be useful in treatment of fungal skin infections.

6. Skin Protective Activity

The extract helps maintain skin integrity and protect against microbial invasion.

1.10 Role of *Acacia nilotica* in Herbal Cream Formulation

The incorporation of *Acacia nilotica* extract into cream formulations provides several therapeutic benefits.

Benefits in Topical Formulations

- Prevents microbial growth
- Promotes wound healing
- Reduces inflammation
- Provides antioxidant protection
- Improves skin health
- Acts as natural protective agent

The herbal cream prepared using *Acacia nilotica* may be useful for treatment of minor skin infections, wounds, cuts, burns, and inflammatory conditions.

REVIEW OF LITERATURE

Literature review is an important part of research work that provides information regarding previous studies carried out on the selected topic. It helps in understanding the medicinal importance of the plant, formulation approaches, evaluation methods, and therapeutic applications of herbal creams. Several researchers have reported the pharmacological activities of *Acacia nilotica* including antimicrobial, antioxidant, anti-inflammatory, wound healing, and skin protective effects. Various studies have also been conducted on herbal topical formulations containing medicinal plant extracts.

2.1 Review on Herbal Topical Formulations

Herbal topical formulations such as creams, ointments, gels, and lotions are widely used in pharmaceutical and cosmetic industries due to their therapeutic effectiveness and reduced side effects.

Topical herbal preparations provide localized action and are preferred because they:

- Avoid first-pass metabolism
- Reduce systemic adverse effects
- Improve patient compliance
- Provide prolonged contact with skin
- Are easy to apply and remove

Herbal creams are especially useful in treatment of:

- Skin infections
- Burns
- Wounds
- Acne
- Inflammation
- Dry skin conditions

Many medicinal plants rich in phytoconstituents are incorporated into creams for therapeutic and cosmetic applications.

2.2 Literature Review on *Acacia nilotica*

Study 1

Researchers reported that *Acacia nilotica* bark extract exhibited significant antibacterial activity against pathogenic microorganisms such as *Staphylococcus aureus* and *Escherichia coli*. The antimicrobial effect was mainly attributed to tannins and phenolic compounds present in the plant.

Study 2

A study demonstrated that ethanolic extract of *Acacia nilotica* showed strong antioxidant activity due to the presence of flavonoids and polyphenolic compounds. These antioxidants help in scavenging free radicals and protecting skin cells from oxidative stress.

Study 3

Experimental studies revealed that *Acacia nilotica* extract possesses anti-inflammatory activity by inhibiting inflammatory mediators. The extract was found effective in reducing redness and swelling in experimental models.

Study 4

Research on wound healing activity showed that topical application of *Acacia nilotica* extract accelerated wound contraction and tissue regeneration. The antimicrobial and astringent properties of the plant contributed to faster healing.

2.3 Literature Review on Herbal Creams

Study 5

A herbal cream prepared using plant extracts rich in flavonoids showed good anti-inflammatory and antioxidant properties. The formulation exhibited acceptable spreadability, viscosity, and stability.

Study 6

Researchers formulated antimicrobial herbal cream using medicinal plant extracts and reported effective inhibition against bacterial strains. The cream demonstrated good homogeneity and non-irritant nature.

Study 7

A study on polyherbal cream formulations showed improved wound healing activity and better patient acceptability due to natural ingredients.

2.4 Review on Skin Care Herbal Preparations

Skin care products containing herbal extracts are widely accepted because natural ingredients provide nourishment and protection to the skin.

Important medicinal plants commonly used in skin care formulations include:

- Aloe vera
- Neem
- Turmeric
- Tulsi
- Sandalwood
- Acacia species

These herbal ingredients possess:

- Antimicrobial activity
- Anti-inflammatory effects
- Moisturizing properties
- Antioxidant activity
- Skin rejuvenating action

2.5 Review on Antimicrobial Herbal Formulations

Microbial skin infections are commonly caused by bacteria and fungi. Continuous use of synthetic antimicrobial agents may lead to resistance and adverse effects.

Herbal antimicrobial formulations are preferred because they:

- Contain natural bioactive compounds
- Have fewer side effects
- Possess broad-spectrum antimicrobial activity
- Are suitable for long-term use

Plants rich in tannins and flavonoids exhibit strong antimicrobial effects due to their ability to disrupt microbial cell membranes and inhibit microbial enzymes.

2.6 Review on Antioxidant Activity of Medicinal Plants

Oxidative stress caused by free radicals damages skin cells and accelerates aging. Antioxidants protect the skin by neutralizing free radicals.

Medicinal plants rich in phenolic compounds and flavonoids possess excellent antioxidant properties.

Acacia nilotica contains:

- Polyphenols
- Catechins
- Gallic acid

- Flavonoids

These compounds help protect skin cells from oxidative damage and support skin health.

AIM AND OBJECTIVES

3.1 Aim of the Study

The main aim of the present study was to formulate and evaluate herbal cream containing extract of *Acacia nilotica* for topical application and to investigate its physicochemical, antimicrobial, and skin protective properties.

The study was designed to develop a stable, safe, and effective herbal topical formulation using suitable pharmaceutical excipients and herbal extract possessing therapeutic activities.

3.2 Objectives of the Study

The objectives of the present research work are as follows:

1. Collection and Authentication of Plant Material

- To collect the plant material of *Acacia nilotica* from suitable sources.
- To authenticate the plant material using standard pharmacognostical methods.

2. Drying and Powdering of Plant Material

- To shade dry the collected plant material.
- To prepare coarse powder suitable for extraction process.

3. Extraction of Plant Material

- To prepare extract of *Acacia nilotica* using suitable solvent extraction method.
- To obtain concentrated extract containing bioactive phytoconstituents.

4. Phytochemical Screening

- To perform preliminary phytochemical screening of the extract.
- To identify the presence of:
 - Tannins
 - Flavonoids
 - Alkaloids
 - Saponins
 - Glycosides

- Phenolic compounds

5. Formulation of Herbal Cream

- To formulate herbal cream containing *Acacia nilotica* extract using suitable cream base.
- To prepare stable oil-in-water topical cream formulation.

6. Optimization of Formulation

- To prepare different formulations by varying concentration of herbal extract.
- To select optimized formulation based on evaluation parameters.

7. Evaluation of Herbal Cream

To evaluate prepared formulations for:

Physical appearance, Color, Odor, Texture, Homogeneity, pH, Spreadability, Washability, Viscosity, Consistency

8. Irritancy Testing

- To evaluate skin irritation potential of prepared cream.
- To determine safety of formulation for topical application.

9. Stability Studies

- To study physical and chemical stability of formulations under different storage conditions.
- To observe changes in:
 - Color
 - Odor
 - pH
 - Consistency
 - Homogeneity

10. Antimicrobial Activity

- To evaluate antimicrobial activity of prepared herbal cream against selected microorganisms.
- To determine effectiveness of formulation against skin pathogens.

11. Comparative Evaluation

- To compare different formulations based on evaluation results.
- To identify best optimized formulation with maximum stability and therapeutic activity.

3.3 Expected Outcome of the Study

The study is expected to:

- Develop a stable herbal cream formulation
- Demonstrate good physicochemical properties
- Show satisfactory spreadability and viscosity
- Exhibit antimicrobial activity
- Provide skin protective action
- Produce non-irritant and safe topical formulation

The optimized formulation may be useful for management of minor skin infections, wounds, inflammation, and cosmetic skin care applications.

DRUG PROFILE

4.1 *Acacia nilotica*

Acacia nilotica is an important medicinal plant widely used in traditional systems of medicine such as Ayurveda, Siddha, and Unani. The plant belongs to the family Fabaceae and is commonly known as Babul. Different parts of the plant including bark, leaves, pods, seeds, flowers, roots, and gum possess therapeutic properties.

The plant is well known for its antimicrobial, antioxidant, anti-inflammatory, astringent, and wound healing activities. Due to these medicinal properties, *Acacia nilotica* is extensively used in pharmaceutical, cosmetic, and herbal formulations. The plant contains several phytoconstituents such as tannins, flavonoids, alkaloids, saponins, and phenolic compounds which are responsible for its pharmacological activities.

4.2 Taxonomical Classification

Category	Classification
Kingdom	Plantae
Division	Magnoliophyta
Class	Magnoliopsida

Order	Fabales
Family	Fabaceae
Genus	Acacia
Species	<i>Acacia nilotica</i>

4.3 Synonyms

- *Acacia arabica*
- Babul
- Indian Gum Arabic Tree
- Egyptian Thorn
- Gum Arabic Tree



Fig. 2: *Acacia nilotica*

4.4 Biological Source

Acacia nilotica consists of dried bark, leaves, pods, seeds, flowers, and gum obtained from the plant *Acacia nilotica* belonging to family Fabaceae.

4.5 Geographical Distribution

Acacia nilotica is widely distributed in tropical and subtropical regions of the world.

It is commonly found in:

- India
- Pakistan
- Arabian countries

In India, the plant is commonly found in:

- Maharashtra

- Rajasthan
- Gujarat
- Madhya Pradesh
- Tamil Nadu

4.6 Microscopic Characteristics

Bark

The bark contains:

- Cork cells
- Parenchymatous tissues
- Fibers
- Calcium oxalate crystals
- Tannin-containing cells

Leaves

Leaf microscopy shows:

- Epidermal cells
- Stomata
- Trichomes
- Vascular bundles

4.7 Nutritional Constituents

The plant also contains:

- Proteins
- Carbohydrates
- Minerals
- Amino acids
- Vitamins

4.8 Traditional Uses

In traditional medicine, *Acacia nilotica* is used for treatment of:

- Skin diseases
- Wounds
- Burns
- Diarrhea
- Dental problems
- Sore throat
- Fever
- Inflammation
- Cough
- Ulcers

MATERIALS AND METHODS

5.1 Introduction

Materials and methods play an important role in formulation development and evaluation of pharmaceutical preparations. The present study involved collection and extraction of *Acacia nilotica* followed by formulation and evaluation of herbal cream using suitable pharmaceutical excipients.

5.2 Materials

5.2.1 Plant Material

The bark/leaves/pods of *Acacia nilotica* were collected from local areas and authenticated by a qualified botanist.

5.2.2 Chemicals and Excipients

The following materials were used in formulation of herbal cream.

Sr. No.	Ingredients	Category/Use
1	<i>Acacia nilotica</i> extract	Active ingredient
2	Stearic acid	Emulsifying agent
3	Cetyl alcohol	Stiffening agent
4	Liquid paraffin	Emollient
5	Glycerin	Humectant
6	Triethanolamine	Neutralizing agent
7	Methyl paraben	Preservative
8	Propyl paraben	Preservative
9	Purified water	Vehicle

All chemicals used were of analytical grade.

5.3 Instruments and Apparatus

The following instruments were used during the study.

Sr. No.	Instrument/Apparatus	Use
1	Soxhlet apparatus	Extraction

2	Rotary evaporator	Concentration of extract
3	Digital balance	Weighing
4	pH meter	pH determination
5	Brookfield viscometer	Viscosity measurement
6	Hot plate	Heating
7	Magnetic stirrer	Stirring
8	Beaker	Preparation
9	Glass rod	Mixing
10	Incubator	Microbial studies

5.4 Methodology

The experimental work was carried out in the following stages:

1. Collection and authentication of plant material
2. Drying and powdering
3. Extraction of plant material
4. Phytochemical screening
5. Preparation of herbal cream
6. Evaluation of formulations
7. Stability studies
8. Antimicrobial studies

5.5 Collection of Plant Material

The plant material of *Acacia nilotica* was collected from local regions during suitable season.

The collected material was:

- Cleaned properly
- Washed with water
- Freed from dust and impurities

The plant material was then shade dried at room temperature.

5.6 Authentication of Plant Material

The collected plant material was authenticated by a qualified botanist/pharmacognosist.

Authentication ensures:

- Correct identification of plant
- Purity of raw material
- Absence of adulteration

5.7 Drying and Powdering

The collected plant material was shade dried for several days to remove moisture content.

After complete drying:

- Material was pulverized using grinder
- Coarse powder was prepared
- Powder was sieved
- Stored in airtight container



Fig. 3: Shade Dried Stem Bark

Proper drying prevents microbial growth and degradation of phytoconstituents.

5.8 Extraction of Plant Material

Soxhlet Extraction Method

The powdered plant material was extracted using ethanol as solvent by Soxhlet extraction method.

Procedure

1. Coarse powder was accurately weighed.
2. Powder was packed into thimble of Soxhlet apparatus.
3. Ethanol was added into round bottom flask.
4. Continuous extraction was carried out for several cycles.
5. Solvent containing extract was collected.
6. Extract was concentrated using rotary evaporator.
7. Concentrated extract was dried and stored.



5.9 Principle of Soxhlet Extraction

Soxhlet extraction is a continuous extraction method in which solvent repeatedly passes through plant material and extracts active constituents.

Advantages include:

- Efficient extraction
- Better penetration of solvent
- Maximum extraction of phytoconstituents
- Less solvent consumption

5.10 Percentage Yield of Extract

The percentage yield of extract was calculated using following formula:

$$\% \text{ Yield} = \text{Weight of Extract} / \text{Weight of Powdered Drug} \times 100$$

5.11 Phytochemical Screening

The obtained extract was subjected to preliminary phytochemical screening to identify presence of active constituents.

Tests Performed

1. Test for Alkaloids

Few drops of Dragendorff's reagent were added to extract solution.

Observation

Orange precipitate indicates presence of alkaloids.

2. Test for Flavonoids

Extract was treated with dilute sodium hydroxide solution.

Observation

Yellow coloration indicates presence of flavonoids.

3. Test for Tannins

Ferric chloride solution was added to extract.

Observation

Blue-black or green coloration indicates presence of tannins.

4. Test for Saponins

Extract was shaken with water.

Observation

Persistent foam formation indicates presence of saponins.

5. Test for Glycosides

Extract was treated with glacial acetic acid and ferric chloride.

Observation

Brown ring formation indicates presence of glycosides.

6. Test for Phenolic Compounds

Ferric chloride solution was added.

Observation

Deep blue or black color indicates presence of phenolic compounds.

5.12 Formulation of Herbal Cream

The herbal cream was prepared using oil phase and aqueous phase method.

5.13 Formula for Herbal Cream

Ingredients	F1	F2	F3
<i>Acacia nilotica</i> extract	1%	2%	3%
Stearic acid	12 g	12 g	12 g
Cetyl alcohol	4 g	4 g	4 g
Liquid paraffin	5 ml	5 ml	5 ml
Glycerin	3 ml	3 ml	3 ml
Triethanolamine	q.s.	q.s.	q.s.
Methyl paraben	0.1 g	0.1 g	0.1 g
Propyl paraben	0.05 g	0.05 g	0.05 g
Purified water	q.s.	q.s.	q.s.

5.14 Method of Preparation of Herbal Cream**Step 1: Preparation of Oil Phase**

Stearic acid, cetyl alcohol, and liquid paraffin were taken in a beaker and heated at 70°C until melted completely.

Step 2: Preparation of Aqueous Phase

Glycerin, methyl paraben, propyl paraben, and purified water were mixed and heated separately to same temperature.

Step 3: Emulsification

The aqueous phase was slowly added into oil phase with continuous stirring to form emulsion.

Step 4: Addition of Herbal Extract

Measured quantity of *Acacia nilotica* extract was added slowly into cream base with continuous mixing.

Step 5: Adjustment of pH

Triethanolamine was added to adjust pH of formulation.

Step 6: Cooling and Packing

The cream was cooled while stirring continuously and packed into suitable containers.



5.15 Flowchart of Preparation of Herbal Cream

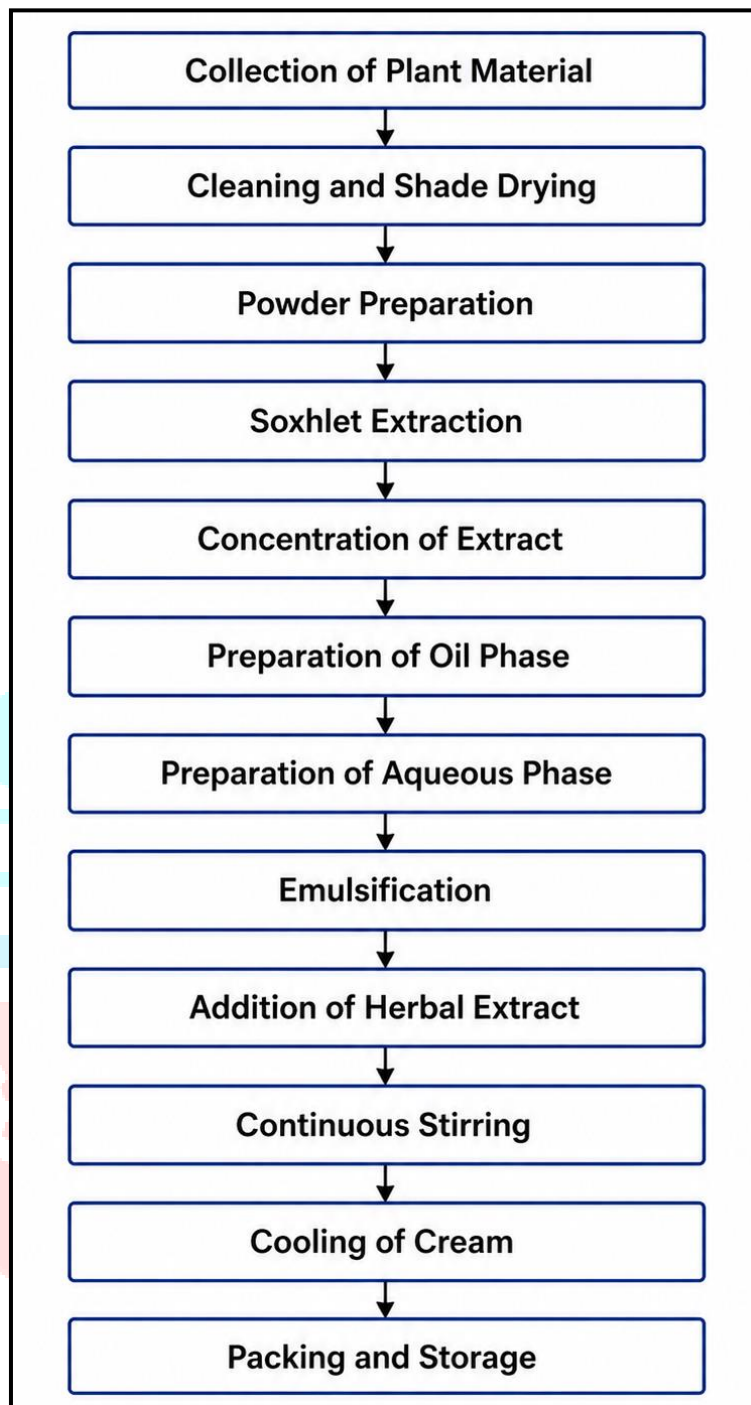


Fig. 5: Flowchart of Preparation of Herbal Cream

FORMULATION DEVELOPMENT

6.1 Formulation development

Formulation development is an important step in preparation of stable and effective topical herbal formulations. The present study involved development of herbal cream containing *Acacia nilotica* extract using suitable pharmaceutical excipients.

The formulation was designed to provide:

- Good spreadability
- Appropriate viscosity
- Skin compatibility
- Stability

Different formulations were prepared by varying concentration of *Acacia nilotica* extract.

6.2 Objectives of Formulation Development

- To prepare stable herbal cream formulation
- To incorporate *Acacia nilotica* extract into cream base
- To obtain smooth and homogeneous formulation
- To optimize concentration of herbal extract
- To develop non-irritant topical preparation

6.3 Selection of Excipients

Ingredient	Function
Stearic acid	Emulsifying agent
Cetyl alcohol	Stiffening agent
Liquid paraffin	Emollient
Glycerin	Humectant
Triethanolamine	Neutralizer
Methyl paraben	Preservative
Propyl paraben	Preservative
Purified water	Vehicle

6.4 Composition of Herbal Cream Formulations

Ingredients	F1	F2	F3
<i>Acacia nilotica</i> extract	1%	2%	3%
Stearic acid	12 g	12 g	12 g
Cetyl alcohol	4 g	4 g	4 g
Liquid paraffin	5 ml	5 ml	5 ml
Glycerin	3 ml	3 ml	3 ml
Triethanolamine	q.s.	q.s.	q.s.
Methyl paraben	0.1 g	0.1 g	0.1 g
Propyl paraben	0.05 g	0.05 g	0.05 g
Purified water	q.s.	q.s.	q.s.

6.5 Method of Preparation

Step 1: Preparation of Oil Phase

Stearic acid, cetyl alcohol, and liquid paraffin were weighed accurately and melted together at 70°C.

Step 2: Preparation of Aqueous Phase

Glycerin, preservatives, and purified water were mixed and heated separately to same temperature.

Step 3: Emulsification

The aqueous phase was added slowly into oil phase with continuous stirring to obtain smooth emulsion.

Step 4: Incorporation of Herbal Extract

Measured quantity of *Acacia nilotica* extract was added slowly with continuous stirring.

Step 5: Adjustment of pH

Triethanolamine was added to adjust pH of cream formulation.

Step 6: Cooling and Packing

The cream was cooled with continuous stirring and transferred into suitable containers.

6.6 Optimization of Formulations

Different formulations were prepared by varying concentration of herbal extract.

The formulations were optimized based on:

- Homogeneity
- Spreadability
- pH
- Viscosity
- Stability
- Antimicrobial activity

6.7 Flowchart of Formulation Development

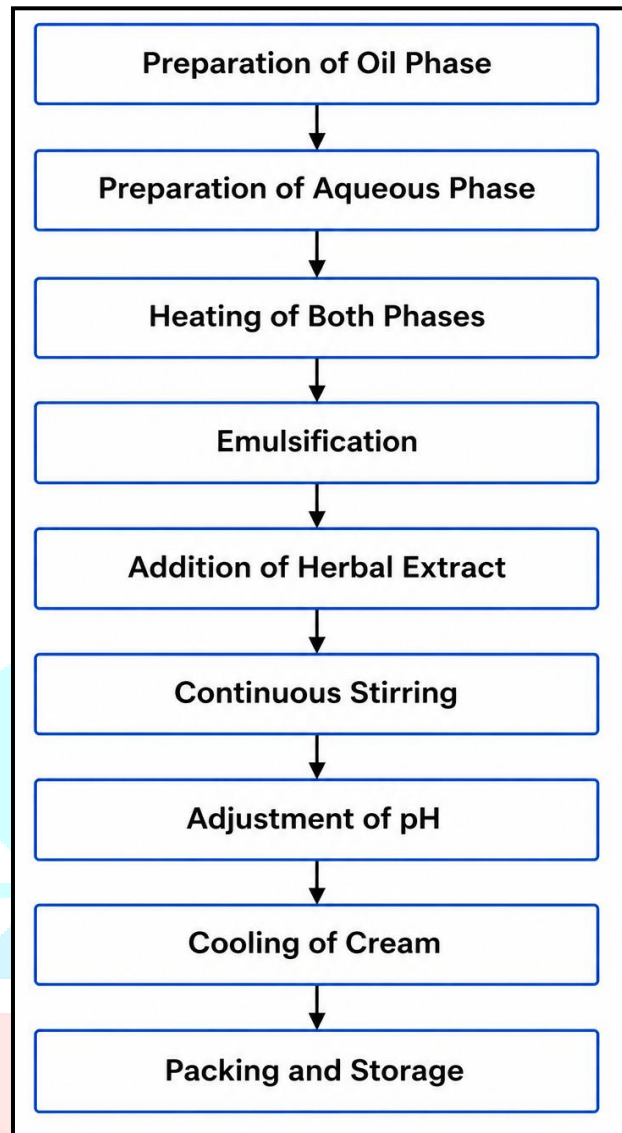


Fig. 6: Flowchart of Formulation Development

6.8 Characteristics of Ideal Herbal Cream

An ideal herbal cream should possess:

- Smooth texture
- Pleasant appearance
- Non-greasy nature
- Good spreadability
- Appropriate viscosity
- Stability during storage
- Skin compatibility
- Non-irritant property

6.9 Advantages of Developed Herbal Cream

- Easy application

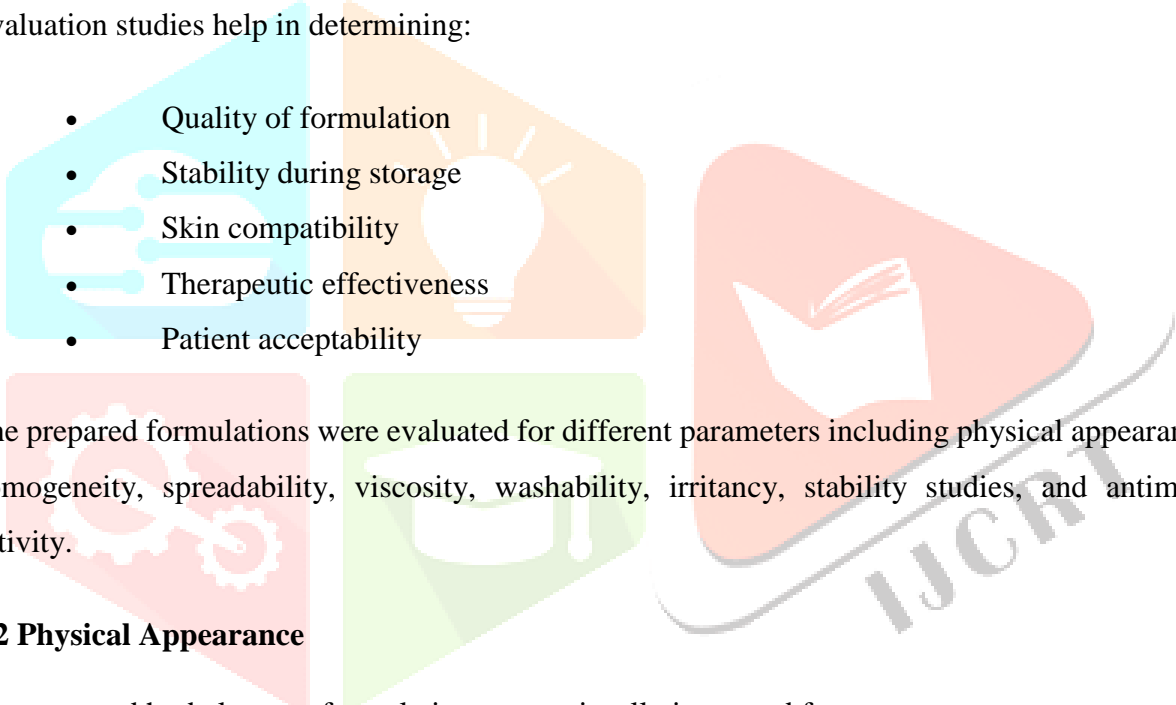
- Better patient compliance
- Good antimicrobial activity
- Natural therapeutic action
- Reduced side effects
- Suitable for skin care applications

EVALUATION PARAMETERS

7.1 Introduction

Evaluation of pharmaceutical formulations is an essential step to ensure quality, stability, safety, and therapeutic effectiveness of the prepared product. The formulated herbal cream containing *Acacia nilotica* extract was evaluated using various physicochemical and biological parameters.

Evaluation studies help in determining:

- 
- Quality of formulation
 - Stability during storage
 - Skin compatibility
 - Therapeutic effectiveness
 - Patient acceptability

The prepared formulations were evaluated for different parameters including physical appearance, pH, homogeneity, spreadability, viscosity, washability, irritancy, stability studies, and antimicrobial activity.

7.2 Physical Appearance

The prepared herbal cream formulations were visually inspected for:

- Color
- Odor
- Texture
- Consistency
- Smoothness
- Phase separation

Procedure

A small quantity of cream was observed visually under normal light.

Observation

The formulations were checked for:

- Uniform appearance

- Smooth texture
- Absence of grittiness
- Absence of phase separation

7.3 Color and Odor

The color and odor of prepared formulations were evaluated by visual inspection and sensory evaluation.

Ideal Characteristics

- Pleasant odor
- Uniform color
- Acceptable appearance

7.4 Homogeneity

Homogeneity indicates uniform distribution of ingredients throughout the cream base.

Procedure

A small quantity of cream was pressed between thumb and index finger and visually observed.

Observation

7.5 pH Determination

The pH of topical formulations is important to avoid skin irritation and ensure compatibility with skin.

Human skin normally possesses pH between 5.5 and 7.

Procedure

1. One gram of cream was dissolved in distilled water.
2. The solution was allowed to stand for few minutes.
3. pH was measured using digital pH meter.

Importance of pH

- Prevents skin irritation
- Maintains skin compatibility
- Improves patient compliance

7.6 Spreadability

Spreadability determines ease of application of cream on skin surface.

Cream with good spreadability provides uniform application and better therapeutic effect.

Procedure

1. Excess sample was placed between two glass slides.

2. A specific weight was placed over upper slide.
3. Time required for movement of slide was noted.

Formula for Spreadability

$$S = M \times L / T$$

Interpretation

- Less time indicates better spreadability.
- Better spreadability improves ease of application.

7.7 Viscosity

Viscosity determines consistency and flow properties of cream formulation.

Procedure

Viscosity of cream was measured using Brookfield viscometer at room temperature.

Importance of Viscosity

- Prevents phase separation
- Maintains consistency
- Improves stability

7.8 Washability

Washability determines ease of removal of cream from skin surface using water.

Procedure

Cream was applied on skin and washed with tap water.

Observation

The formulation was evaluated for:

- Ease of washing
- Residual greasiness

7.9 Consistency

Consistency indicates thickness and smoothness of cream.

Observation

The cream should possess:

- Smooth consistency
- Uniform texture
- Easy applicability

7.10 Greasiness

The formulations were evaluated for greasy nature after application on skin.

Ideal Characteristics

- Non-greasy
- Easily spreadable
- Comfortable after application

7.11 Irritancy Test

Irritancy testing is important to evaluate safety of topical formulations.

Procedure

1. Small amount of cream was applied on skin surface.
2. Area was observed for:
 - Redness
 - Swelling
 - Itching
 - Irritation

Observation

Absence of irritation indicates safety of formulation.

7.12 Stability Studies

Stability studies are carried out to determine shelf life and stability of formulations under different storage conditions.

Objectives of Stability Studies

- To evaluate physical stability
- To determine chemical stability
- To observe changes during storage

Storage Conditions

The formulations were stored at:

- Room temperature
- Refrigerated condition

- Elevated temperature

7.14 Antimicrobial Activity

Antimicrobial activity was performed to evaluate effectiveness of herbal cream against selected microorganisms. The antimicrobial property of *Acacia nilotica* is mainly due to tannins and phenolic compounds.

Method Used

Agar Well Diffusion Method: This method is commonly used for antimicrobial screening.

Procedure

1. Nutrient agar medium was prepared and sterilized.
2. Microbial culture was spread uniformly on agar plates.
3. Wells were prepared using sterile borer.
4. Cream sample was introduced into wells.
5. Plates were incubated for specified time.
6. Zone of inhibition was measured.

Observation

Larger zone of inhibition indicates better antimicrobial activity.

7.15 Extrudability

Extrudability determines ease with which cream can be removed from collapsible tube.

Procedure

The cream-filled tube was pressed and amount of cream extruded was observed.

Ideal Characteristics

- Easy extrusion
- Smooth flow
- Uniform consistency

7.16 After Feel

After feel refers to sensory characteristics remaining after application of cream.

Parameters Evaluated

- Smoothness
- Emolliency
- Residual film

- Stickiness

7.17 Skin Compatibility Test

The prepared cream was evaluated for compatibility with skin.

Observation

The cream should be:

- Non-irritant
- Non-toxic
- Comfortable after application

RESULTS AND DISCUSSION

Results and discussion are important components of research work that help in interpretation of experimental findings. The present study involved formulation and evaluation of herbal cream containing *Acacia nilotica* extract.

Different formulations (F1, F2, and F3) were prepared by varying concentration of herbal extract and evaluated for physicochemical properties, stability, and antimicrobial activity.

The obtained results were compared to identify optimized formulation with best characteristics.

8.1 Phytochemical Screening Results

The ethanolic extract of *Acacia nilotica* was subjected to preliminary phytochemical screening.

Table 8.1: Phytochemical Screening of *Acacia nilotica* Extract

Sr. No.	Phytochemical Test	Observation	Result
1	Alkaloids	Orange precipitate	Present
2	Flavonoids	Yellow coloration	Present
3	Tannins	Blue-black color	Present
4	Saponins	Persistent foam	Present
5	Glycosides	Brown ring	Present
6	Phenolic compounds	Deep blue color	Present

Discussion

The phytochemical screening confirmed presence of tannins, flavonoids, alkaloids, saponins, glycosides, and phenolic compounds in the extract. These constituents are responsible for antimicrobial, antioxidant, anti-inflammatory, and wound healing activities of the plant.

8.3 Physical Evaluation of Herbal Cream

The prepared herbal cream formulations were evaluated for physical appearance, texture, color, odor, consistency, and homogeneity.

Table 8.2: Physical Evaluation of Formulations

Parameter	F1	F2	F3
Color	Light brown	Brown	Dark brown
Odor	Characteristic	Characteristic	Characteristic
Texture	Smooth	Smooth	Smooth
Consistency	Good	Good	Slightly thick
Homogeneity	Good	Good	Good
Phase separation	Absent	Absent	Absent

Discussion

All formulations showed acceptable physical appearance and smooth texture. No phase separation was observed indicating stability of emulsion system. F2 formulation showed optimum consistency and better appearance compared to other formulations.

8.4 pH Evaluation

The pH of formulations was measured to determine skin compatibility.

Table 8.3: pH of Herbal Cream Formulations

Formulation	pH
F1	5.8
F2	6.2
F3	6.5

Discussion

The pH values of all formulations were within acceptable range of skin pH.

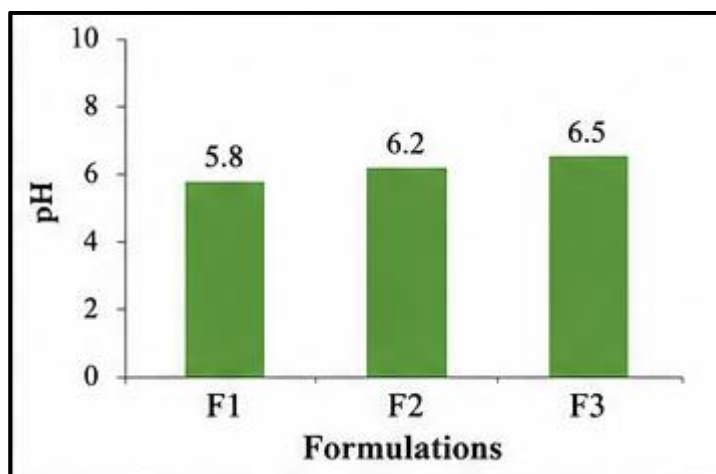


Fig. 7: pH of formulations

8.5 Spreadability Study: Spreadability indicates ease of application of cream on skin surface.

Table 8.4: Spreadability of Formulations

Formulation	Spreadability (gm·cm/sec)
F1	13.2
F2	15.4
F3	12.1

Discussion

F2 formulation exhibited better spreadability compared to F1 and F3.

Good spreadability ensures uniform application and improved patient compliance.

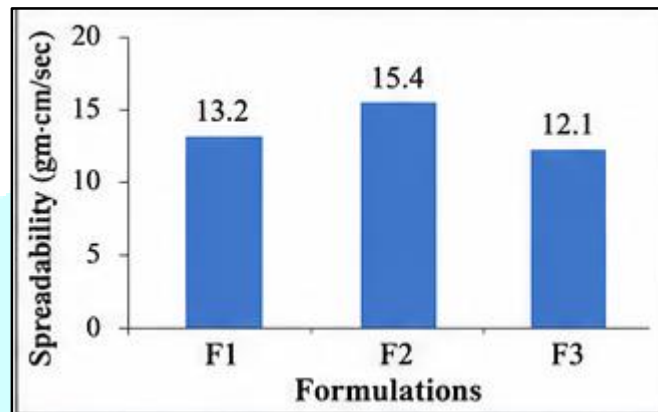


Fig. 8: Spreadability test

8.6 Viscosity Study

Viscosity determines flow behavior and consistency of cream formulation.

Table 8.5: Viscosity of Formulations

Formulation	Viscosity (cps)
F1	12450
F2	13200
F3	14550

Discussion

The viscosity increased with increase in concentration of herbal extract.

F2 formulation showed optimum viscosity with acceptable consistency and spreadability.

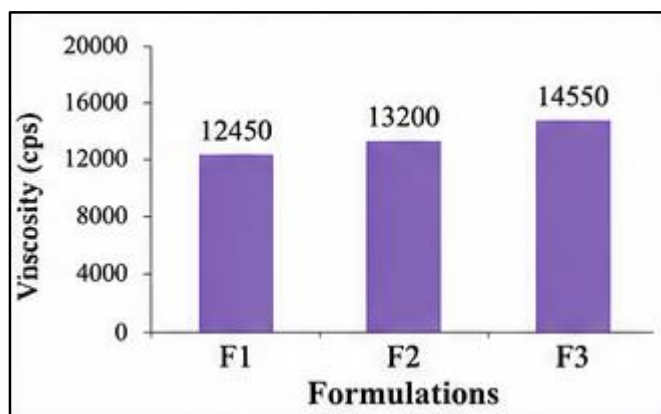


Fig. 9: Viscosity Study

8.7 Washability Study

Washability determines ease of removal of cream from skin surface.

Table 8.6: Washability of Formulations

Formulation	Washability
F1	Good
F2	Excellent
F3	Good

Discussion

F2 formulation exhibited excellent washability due to balanced oil and aqueous phase composition.

8.8 Irritancy Test

The formulations were evaluated for skin irritation.

Table 8.7: Irritancy Test Results

Formulation	Redness	Swelling	Irritation
F1	Absent	Absent	Absent
F2	Absent	Absent	Absent
F3	Mild	Absent	Mild

Discussion

F1 and F2 formulations were found non-irritant and safe for topical application.

F3 showed slight irritation due to higher concentration of extract.

8.9 Stability Studies

Stability studies were carried out under different storage conditions.

Table 8.8: Stability Study Results

Parameter	Observation
Color change	Absent
Odor change	Absent
pH variation	Negligible
Phase separation	Absent
Consistency	Stable

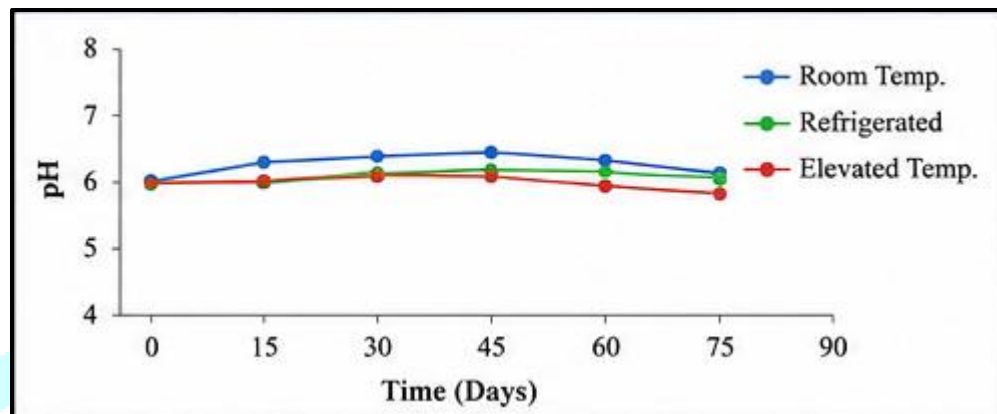


Fig. 10: Stability Study

Discussion

All formulations remained stable during storage period.

No significant changes in physical properties were observed.

SUMMARY AND CONCLUSION

9.1 Summary

The present research work entitled “Formulation and Evaluation of Herbal Cream of *Acacia nilotica*” was carried out with the objective of developing a stable, safe, and effective herbal topical formulation using *Acacia nilotica* extract.

Herbal formulations have gained significant importance in recent years due to their therapeutic benefits, improved patient compliance, and reduced side effects compared to synthetic formulations. *Acacia nilotica* was selected for the present study because of its well-reported antimicrobial, antioxidant, anti-inflammatory, and wound healing properties.

The plant material was collected, authenticated, shade dried, and powdered. The powdered material was subjected to Soxhlet extraction using ethanol as solvent to obtain concentrated herbal extract rich in bioactive phytoconstituents.

Preliminary phytochemical screening confirmed the presence of:

- Tannins
- Flavonoids
- Alkaloids
- Saponins
- Glycosides
- Phenolic compounds

These phytoconstituents are responsible for therapeutic activities of the plant.

Different herbal cream formulations (F1, F2, and F3) were prepared using suitable pharmaceutical excipients such as:

- Stearic acid
- Cetyl alcohol
- Liquid paraffin
- Glycerin
- Triethanolamine
- Methyl paraben
- Propyl paraben
- Purified water

The formulations were prepared using oil phase and aqueous phase emulsification method.

9.2 Conclusion

The present study successfully formulated and evaluated herbal cream containing *Acacia nilotica* extract using suitable pharmaceutical excipients.

The prepared formulations exhibited:

- Good physical appearance
- Smooth texture
- Suitable pH
- Good spreadability
- Appropriate viscosity
- Stability during storage
- Significant antimicrobial activity

The phytochemical constituents present in *Acacia nilotica*, particularly tannins and flavonoids, contributed to the antimicrobial, antioxidant, anti-inflammatory, and skin protective activities of the

formulation. Among all prepared formulations, F2 was selected as optimized formulation due to its balanced physicochemical properties and better therapeutic performance.

The study concluded that herbal cream containing *Acacia nilotica* extract can serve as a safe, effective, and economical topical preparation for skin care and management of minor skin infections and inflammatory conditions.

The developed formulation may be considered as a promising herbal alternative to synthetic topical preparations with reduced side effects and improved patient acceptability.

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