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# PREPARATION AND EVALUATION OF KALMEGH (ANDROGRAPHIS PANICULATA) BASED HERBAL FACE WASH OF THE MANAGEMENT OF ACNE VULGARIS

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## ABSTRACT

The increasing awareness regarding the harmful effects of synthetic chemicals has led to a growing demand for herbal cosmetic products. Herbal face wash formulations are widely used for cleansing the skin, removing dirt, excess oil, and microorganisms, while maintaining the natural moisture and pH balance of the skin. The present project work focuses on the formulation and evaluation of a herbal face wash using Kalmegh (Andrographis paniculata), a medicinal plant known for its therapeutic properties.Kalmegh is extensively used in traditional systems of medicine and is reported to possess antimicrobial, anti-inflammatory, antioxidant, and detoxifying activities. These properties make it a suitable herbal ingredient for skin care formulations, particularly for the management of acne, pimples, and skin infections. In the present study, the extract of Kalmegh was prepared and incorporated into a gel-based herbal face wash formulation along with other excipients such as aloe vera, glycerin, surfactants, preservatives, and purified water to enhance cleansing action and skin compatibility. The formulated herbal face wash was evaluated for various physicochemical parameters including appearance, color, odor, pH, viscosity, foamability, spreadability, homogeneity, and stability studies. The pH of the formulation was found to be within the acceptable range for topical application, indicating that it is suitable for daily skin use. The formulation showed good foamability, uniform consistency, and adequate spreadability, which are essential characteristics for consumer acceptance. Stability studies carried out

under different storage conditions revealed no significant changes in physical properties, indicating good stability of the formulation. The results obtained from the evaluation studies suggest that the formulated herbal face wash containing Andrographis paniculata is safe, effective, and skin-friendly. The study concludes that Kalmegh-based herbal face wash can be considered a promising natural alternative to synthetic face wash products and has potential for further research and commercial development.

**KEYWORDS:** Herbal face wash, Kalmegh, Andrographis paniculata, Herbal cosmetics, Skin care.

## 1. INTRODUCTION

The skin is the largest organ of the human body and performs a wide range of essential physiological, protective, and regulatory functions. It forms the outermost covering of the body and acts as the first line of defense against external environmental factors. Due to its extensive surface area and continuous exposure to physical, chemical, and biological agents, the skin plays a crucial role in maintaining overall health and homeostasis. Healthy skin is not only important for physical protection but also contributes significantly to appearance, confidence, and psychological well-being.[1]

Anatomically, the skin is a complex and dynamic organ composed of three primary layers: the epidermis, dermis, and hypodermis. The epidermis is the outermost layer and provides a protective barrier against environmental hazards, pathogens, and dehydration. It consists mainly of keratinocytes along with melanocytes, Langerhans cells, and Merkel cells, which together contribute to pigmentation, immune defense, and sensory perception. Beneath the epidermis lies the dermis, which is rich in connective tissue, collagen, elastin fibers, blood vessels, nerves, sweat glands, and sebaceous glands. The dermis provides strength, elasticity, nourishment, and thermoregulation. The hypodermis, or subcutaneous tissue, consists mainly of adipose tissue and acts as an insulating layer, shock absorber, and energy reservoir.[1,2]

One of the primary functions of the skin is protection. The skin serves as a physical barrier that protects the body from mechanical injuries, harmful chemicals, ultraviolet radiation, and invasion by microorganisms such as bacteria, fungi, and viruses. The stratum corneum, the outermost layer of the epidermis, is particularly important in preventing excessive water loss and blocking the entry of harmful substances. Damage to this barrier can compromise skin

integrity, leading to dehydration, irritation, inflammation, infections, and various dermatological disorders.[1,3]

In addition to protection, the skin plays a vital role in sensory perception. It contains a wide variety of sensory receptors that respond to touch, pressure, pain, temperature, and vibration. These receptors allow the body to perceive environmental stimuli and respond appropriately to potentially harmful conditions. Sensory perception through the skin is essential for survival, as it helps prevent injuries and enables interaction with the surrounding environment.[1,4]

The skin also plays a key role in thermoregulation. Through mechanisms such as sweating and regulation of blood flow, the skin helps maintain a stable internal body temperature. Sweat glands secrete sweat, which evaporates from the skin surface and dissipates excess heat. Blood vessels in the dermis dilate or constrict in response to temperature changes allowing heat to be released or conserved as needed. This thermoregulatory function is essential for maintaining normal metabolic processes and overall physiological balance.[1,5]

Another important function of the skin is excretion and secretion. The skin eliminates metabolic waste products such as salts, urea, and ammonia through sweat. Sebaceous glands secrete sebum, an oily substance that lubricates the skin and hair and provides a protective film on the skin surface. Sebum also possesses mild antimicrobial properties, which help protect the skin from microbial invasion.[1,6]

The skin further contributes to water retention and hydration by regulating transepidermal water loss (TEWL). A healthy skin barrier helps maintain optimal moisture levels, ensuring softness, elasticity, and smooth texture. Excessive water loss can lead to dryness, scaling, irritation, and increased susceptibility to environmental damage. Therefore, maintaining skin hydration is essential for both functional and aesthetic reasons.[1,7]

Due to its multifunctional nature and continuous exposure to external factors, the skin requires regular care and maintenance. Skin care refers to practices that help preserve skin integrity, enhance appearance, and prevent or manage skin disorders. Proper skin care is essential for preventing infections, delaying aging, improving texture, and maintaining overall skin health. Among the various skin care practices, cleansing is universally recognized as the most fundamental and essential step.[1,8]

Daily cleansing is necessary to remove dirt, sweat, excess sebum, dead skin cells, cosmetic residues, environmental pollutants, and microorganisms that accumulate on the skin surface throughout the day. Environmental pollution, urban lifestyle, and increased use of cosmetic products have significantly increased the burden of impurities on the skin. If these impurities are not removed effectively, they can clog pores, disrupt normal skin physiology, and create favorable conditions for microbial growth.[1,9]

Cleansing plays a critical role in maintaining the natural pH of the skin, which typically ranges between 4.5 and 5.5. This slightly acidic pH, commonly referred to as the acid mantle, is essential for maintaining the skin's barrier function and supporting healthy skin microflora. The acid mantle inhibits the growth of pathogenic microorganisms while allowing beneficial bacteria to thrive. Disruption of skin pH due to harsh cleansers or improper skin care practices can weaken the barrier function, leading to dryness, irritation, inflammation, and increased risk of infections.[1,10]

Unclean or poorly cleansed skin can lead to a wide range of dermatological problems. Accumulation of excess sebum, dirt, and dead skin cells can block hair follicles and sebaceous ducts, resulting in comedone formation. This environment promotes the growth of acne-causing bacteria, leading to acne vulgaris, characterized by pimples, pustules, nodules, and inflammation. Additionally, unclean skin can contribute to conditions such as dermatitis, folliculitis, fungal infections, and allergic reactions.[5,1]

Regular and effective cleansing helps prevent these skin disorders by maintaining cleanliness, reducing microbial load, and supporting the skin's natural defense mechanisms. However, it is important that cleansing agents are mild and compatible with the skin to avoid damage to the protective barrier. Over-cleansing or the use of harsh chemical cleansers can strip away natural oils, disrupt pH balance, and cause irritation, dryness, and sensitivity.[6]

In modern society, a wide range of cosmetic and personal care products are available for skin cleansing and care. Many conventional cosmetic formulations contain synthetic ingredients such as artificial surfactants, preservatives, fragrances, and colorants. Although these products provide immediate cleansing and foaming effects, their long-term use has been associated with adverse effects such as skin irritation, allergic reactions, dryness, barrier disruption, and cumulative toxicity. Increasing consumer awareness regarding these potential risks has led to a growing demand for safer and more natural alternatives.[6,1]

As a result, herbal cosmetics have gained considerable popularity in recent years. Herbal cosmetics are formulations that incorporate natural ingredients derived from plants, including herbs, extracts, oils, and natural excipients. These products are designed to enhance beauty while simultaneously providing therapeutic benefits. Herbal cosmetics are widely accepted due to their natural origin, better skin compatibility, minimal side effects, and suitability for long-term use.[7]

The effectiveness of herbal cosmetics is attributed to the presence of various bioactive phytochemicals, such as flavonoids, alkaloids, tannins, saponins, phenolic compounds, terpenoids, glycosides, and essential oils. These phytoconstituents exhibit a wide range of pharmacological activities, including antioxidant, antimicrobial, anti-inflammatory, wound-healing, soothing, and moisturizing effects. By neutralizing free radicals, herbal ingredients help protect the skin from oxidative stress, premature aging, and environmental damage.[7,2]

Herbal cosmetic formulations not only cleanse the skin but also nourish and protect it. Unlike synthetic products, herbal formulations work in harmony with the skin's natural physiology. They help maintain moisture balance, support skin regeneration, improve texture, and enhance overall skin health. Due to their gentle nature, herbal cosmetics are particularly suitable for sensitive skin and for individuals prone to allergic reactions.[8]

Among various herbal cosmetic products, herbal face washes are widely used as daily cleansing agents. Herbal face washes are formulated using plant-based extracts combined with mild cleansing agents to remove impurities effectively without damaging the skin barrier. They cleanse the skin gently while preserving its natural oils and maintaining pH balance. Many herbal face washes also possess antimicrobial and anti-inflammatory properties, making them suitable for acne-prone and sensitive skin.[8,1]

Herbal face washes often include medicinal plants that have been traditionally used in ancient systems of medicine such as Ayurveda, Unani, and Siddha. These traditional systems emphasize the use of natural remedies for maintaining skin health and treating skin disorders. According to Ayurveda, skin health reflects the balance of bodily doshas, and herbal preparations help restore balance and promote holistic wellness.[8,2]

The increasing popularity of herbal cosmetics is also influenced by environmental and ethical considerations. Herbal products are generally biodegradable, eco-friendly, and free from

harsh synthetic chemicals. They are considered safer for both human health and the environment. Moreover, the global trend toward natural, organic, and sustainable products has further encouraged research and development in the field of herbal cosmetic formulations.[8,3]

In recent years, there has been growing scientific interest in the formulation, evaluation, and standardization of herbal cosmetic products. Scientific validation is essential to ensure the quality, safety, stability, and efficacy of herbal formulations. Standardization of herbal ingredients, selection of appropriate excipients, and evaluation of physicochemical and microbiological parameters are important aspects of herbal cosmetic research.[8,4]

The development of effective herbal face wash formulations aims to combine traditional herbal knowledge with modern pharmaceutical and cosmetic science. Such formulations should provide effective cleansing while maintaining skin pH, preventing microbial growth, and offering additional therapeutic benefits. Evaluation studies help assess parameters such as pH, viscosity, foaming ability, cleansing efficiency, skin irritation potential, and stability, ensuring product safety and consumer acceptability.[9]

In conclusion, the skin is a complex and multifunctional organ that plays a crucial role in protection, sensation, thermoregulation, excretion, and water retention. Proper skin care is essential to maintain skin health, prevent infections, and enhance appearance. Cleansing is the most basic and essential step in skincare, as it helps remove impurities, maintain pH balance, and prevent dermatological problems. Growing awareness regarding the harmful effects of synthetic chemicals has led to increased interest in herbal cosmetics. Due to their natural origin, therapeutic properties, and minimal side effects, herbal cosmetics offer a safe and effective alternative for long-term skin care. Therefore, the formulation and evaluation of herbal cosmetic products, particularly herbal face washes, hold significant importance in modern pharmaceutical and cosmetic research.[9,1]

### 1.2 Comparison between Herbal and Synthetic Face Wash

Face washes are an essential part of daily skincare routines, designed to cleanse the skin by removing dirt, excess oil, sweat, pollutants, dead skin cells, and microorganisms from the skin surface. With increasing awareness about skin health and safety, consumers are now more conscious of the ingredients used in skincare products. As a result, there is growing interest in comparing herbal face washes, which are formulated using natural plant-based

ingredients, and synthetic face washes, which mainly contain chemically synthesized components. Each type has its own advantages and limitations in terms of composition, mechanism of action, safety, efficacy, and long-term impact on skin health.[9,2]

**Composition and Ingredients**

Herbal face washes are formulated using natural ingredients derived from plants, such as herbal extracts, essential oils, and natural excipients. Common herbal ingredients include aloe vera,Rose water ,Honey , tea tree oil, and various medicinal plant extracts. These ingredients are rich in bioactive phytoconstituents like flavonoids, tannins, saponins, alkaloids, and phenolic compounds, which provide therapeutic benefits in addition to cleansing.[9,3]

In contrast, synthetic face washes are primarily composed of chemically synthesized surfactants, preservatives, fragrances, colorants, and stabilizers. Common synthetic surfactants include sodium lauryl sulfate (SLS), sodium laureth sulfate (SLES), and other anionic or amphoteric surfactants that provide strong cleansing and foaming action. Preservatives such as parabens and formaldehyde releasers are often used to enhance shelf life, while artificial fragrances and colors are added to improve consumer appeal.[9,4]

**Mechanism of Cleansing Action**

The cleansing action of herbal face washes is generally mild and gentle. Herbal formulations rely on natural surfactants or mild synthetic surfactants combined with herbal extracts to remove impurities without excessively stripping the skin's natural oils. The presence of plant-based saponins contributes to gentle foaming and cleansing action. Additionally, herbal ingredients provide antimicrobial, anti-inflammatory, and antioxidant effects, which support overall skin health.[10]

Synthetic face washes, on the other hand, depend largely on strong chemical surfactants for their cleansing action. These surfactants effectively emulsify and remove oils, dirt, and debris from the skin surface. While this results in a deep cleansing effect, excessive or frequent use of strong surfactants can disrupt the skin barrier, remove natural lipids, and alter skin pH, potentially leading to dryness and irritation.[10,1]

**Effect on Skin pH and Barrier Function**

Maintaining the natural pH of the skin is essential for preserving the skin barrier and preventing microbial infections. Herbal face washes are typically formulated to be pH-

balanced and compatible with the skin's natural acidic pH. The presence of herbal ingredients helps support the acid mantle and promotes healthy skin microflora.[10,2]

Synthetic face washes may or may not be pH-balanced, depending on the formulation. Some synthetic cleansers are alkaline in nature, which can disturb the skin's acid mantle. Prolonged use of such products may weaken the skin barrier, increase transepidermal water loss, and make the skin more susceptible to irritation, dryness, and infections.[10,3]

**Safety and Skin Compatibility**

One of the major advantages of herbal face washes is their high level of skin compatibility. Due to their natural origin and mild action, herbal face washes are generally well tolerated and suitable for long-term use. They are particularly beneficial for individuals with sensitive, dry, or acne-prone skin. The anti-inflammatory and soothing properties of herbal ingredients help reduce redness, irritation, and inflammation.[10,4]

In contrast, synthetic face washes may cause adverse skin reactions in some individuals, especially those with sensitive skin. Ingredients such as harsh surfactants, artificial fragrances, and preservatives are known to cause skin irritation, allergic reactions, and contact dermatitis in susceptible individuals. Long-term exposure to certain synthetic chemicals may also lead to cumulative skin damage.[10,5]

**Therapeutic Benefits**

Herbal face washes offer additional therapeutic benefits beyond basic cleansing. Many herbal ingredients possess antimicrobial properties that help prevent acne and skin infections. Antioxidant compounds protect the skin from oxidative stress and premature aging, while anti-inflammatory agents help soothe irritated and inflamed skin. Some herbal extracts also promote wound healing and skin regeneration.[11]

Synthetic face washes generally focus on cleansing and cosmetic effects rather than therapeutic benefits. While some synthetic formulations may include active ingredients such as salicylic acid or benzoyl peroxide for acne treatment, these ingredients can cause dryness, irritation, and peeling if not used properly. Synthetic products often provide quick results but may not support long-term skin health.[11,1]

**Environmental Impact**

Herbal face washes are considered more environmentally friendly due to their biodegradable nature and use of renewable plant-based resources. The production and disposal of herbal cosmetics generally have a lower environmental impact compared to synthetic products. Additionally, herbal formulations are often free from harsh chemicals that can pollute water systems.[11,2]

Synthetic face washes may contain ingredients that are not easily biodegradable and can accumulate in the environment. Certain synthetic surfactants and preservatives have been associated with aquatic toxicity and environmental pollution. Increasing environmental concerns have led to greater scrutiny of synthetic cosmetic ingredients.[11,3]

**Shelf Life and Stability**

One limitation of herbal face washes is their relatively shorter shelf life compared to synthetic products. Natural ingredients are more prone to microbial contamination and degradation if not properly preserved. Ensuring stability and safety of herbal formulations requires careful selection of preservatives and appropriate packaging.[11,4]

Synthetic face washes generally have a longer shelf life due to the use of strong chemical preservatives and stabilizers. These products are more resistant to microbial growth and environmental degradation, making them convenient for mass production and long-term storage.[11,5]

## 2. Anatomy of Skins

The skin is the largest organ in the body; it covers the whole outside of the body, weighs around six pounds in adults, and has an average thickness of two millimetres. It creates a dynamic barrier that senses touch, controls temperature, guards against environmental dangers, and boosts immunity. The skin, which is made up of water, proteins, lipids, and minerals, varies in colour, thickness, and texture throughout the body. There are two primary varieties of skin: thick, hairless skin on areas that see a lot of friction, such as the palms and soles, and thin, hairy skin, which is the most prevalent.[2,1]

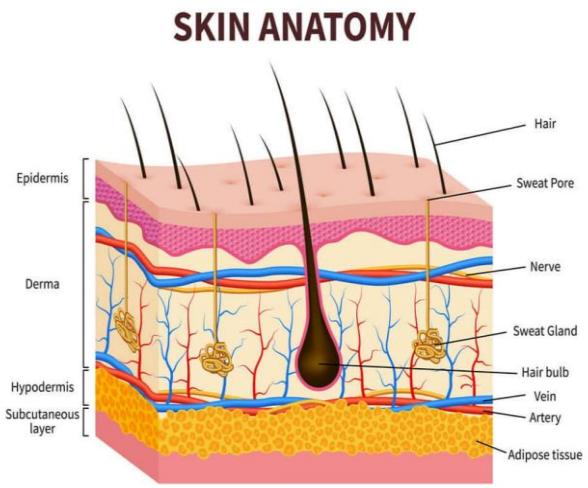



**Figure 1: Cross-sectional diagram of human skin.**

### 2.1 Epidermis

Outermost layer

Provides a physical barrier

Contains keratinocytes, melanocyte

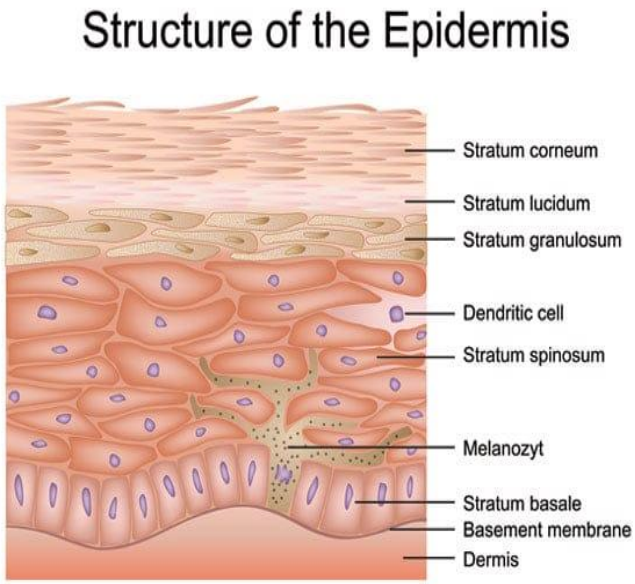



**Figure 2: Epidermis.**

### 2.2 Dermis

Middle layer

Contains connective tissue, blood vessels, nerves, hair follicles, and sweat glands

Provides elasticity and strength.[2.2]

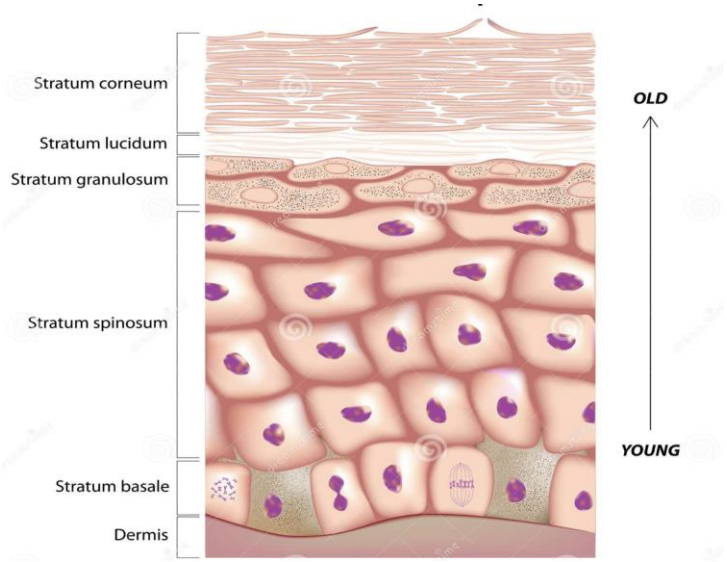



**Figure 3: Dermis.**

Middle layer

Contains connective tissue, blood vessels, nerves, hair follicles, and sweat glands

Provides elasticity and strength.

### 2.3 Hypodermis

Subcutaneous layer

Composed of fat and connective tissue

Provides insulation and energy storage

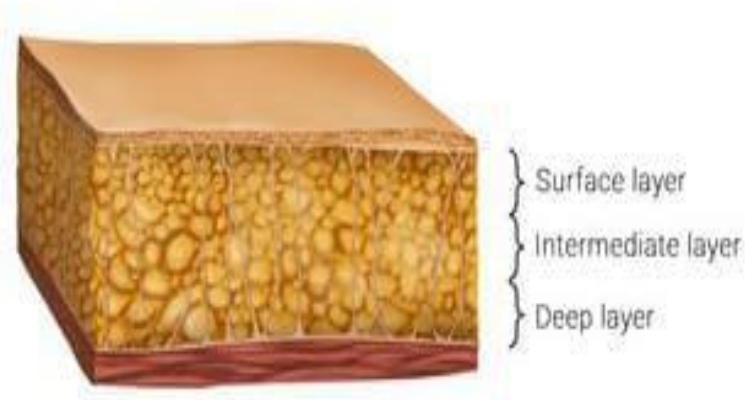



**Figure 4: Hypodermis**

**Functions of Skin**

- Skin is the largest organ of the human body.
- It forms a protective covering over the body.
- Skin protects against bacteria, chemicals, and physical injury.
- It helps in regulating body temperature.
- Sweating helps in cooling the body.
- Blood vessels in the skin control heat loss and retention.
- Skin contains sensory receptors for touch, pain, heat, and cold.
- It helps in excretion of waste products through sweat.
- Skin prevents excessive loss of water from the body.
- It helps in the synthesis of Vitamin D in sunlight.
- The skin plays an important role in immunity.
- It stores fat and energy in the hypodermis layer.
- Skin helps in maintaining body hydration.
- It provides strength and flexibility to the body.
- Skin also contributes to appearance and overall health.

**3. Face Wash**

A face wash is a topical cosmetic product formulated to cleanse the skin by removing dirt, excess oil, dead cells, and microorganisms. Unlike traditional soaps, face washes maintain skin pH and are less likely to cause dryness or irritation.[3,1]

**Types of Face Wash**

Gel-based

Cream-based

Foam-based

Herbal face wash

Face wash products are an essential part of daily skincare routines and are specifically designed to cleanse the skin by removing dirt, sweat, excess sebum, dead skin cells, cosmetic residues, pollutants, and microorganisms from the skin surface. Regular use of an appropriate face wash helps maintain skin hygiene, prevent dermatological problems, and enhance overall skin appearance. With increasing awareness of skin health and individual skin types, various types of face wash formulations have been developed to meet specific skin needs.

The most commonly used types of face wash include gel-based face wash, cream-based face wash, foam-based face wash, and herbal face wash.[3,2]

### 3.1. Gel-Based Face Wash

Gel-based face washes are among the most popular cleansing products, especially for individuals with oily and acne-prone skin. These formulations have a transparent or semi-transparent gel-like consistency and are usually lightweight and non-greasy in nature. Gel-based face washes are designed to provide deep cleansing while maintaining a refreshing and cooling effect on the skin.[3,3]

**Composition**

Gel-based face washes typically contain water as the primary solvent, along with mild surfactants such as sodium laureth sulfate, cocamidopropyl betaine, or other gentle cleansing agents. Gelling agents like carbomers or xanthan gum are used to achieve the desired consistency. Additional ingredients may include humectants such as glycerin, preservatives, fragrances, and active ingredients like salicylic acid or botanical extracts.[3,4]

**Mechanism of Action**

Gel-based face washes work by emulsifying excess oil, dirt, and impurities present on the skin surface. The surfactants in the formulation reduce surface tension and allow the removal of sebum and debris when rinsed with water. These face washes often produce a moderate amount of foam, which enhances the cleansing action without leaving a heavy residue.[3,5]

**ADVANTAGES**

Effectively removes excess oil and impurities

Provides a refreshing and cooling sensation

Non-greasy and lightweight texture

Suitable for oily and acne-prone skin

Helps unclog pores and prevent acne formation

**Limitations**

May cause dryness if used excessively

Not ideal for very dry or sensitive skin

Some formulations may contain harsh surfactants

### 3.2. Cream-Based Face Wash

Cream-based face washes are formulated to provide gentle cleansing while maintaining skin hydration. These face washes have a thick, creamy texture and are particularly suitable for individuals with dry, sensitive, or mature skin. They are designed to cleanse without stripping away the skin's natural oils.[3,6]

**Composition**

Cream-based face washes typically contain emollients, moisturizing agents, and mild surfactants. Ingredients such as fatty alcohols, natural oils, glycerin, shea butter, and ceramides are commonly used to provide hydration and nourishment. The surfactant concentration in cream-based formulations is generally lower compared to gel or foam-based cleansers.[3,6]

**Mechanism of Action**

Cream-based face washes cleanse the skin by gently lifting impurities and dissolving dirt without excessive foaming. The emollients form a protective layer on the skin, preventing moisture loss and maintaining skin softness. These formulations often produce minimal foam, which helps reduce irritation and dryness.[3,7]

**Advantages**

Gentle and moisturizing cleansing action
Maintains skin hydration and softness
Suitable for dry, sensitive, and aging skin
Reduces irritation and skin tightness
Supports skin barrier function

**Limitations**

Less effective in removing excess oil
May feel heavy on oily skin
Not ideal for acne-prone individuals

### 3.3 Foam-Based Face Wash

Foam-based face washes are widely used for their convenience and effective cleansing action. These products are dispensed as a rich foam, making them easy to apply and rinse off. Foam-based face washes are suitable for normal to oily skin types.[3,8]

**Composition**

Foam-based face washes contain surfactants capable of producing rich foam, often combined with propellants or pump-based foaming systems. Common ingredients include anionic and amphoteric surfactants, water, preservatives, and fragrances. Some formulations also include moisturizing agents to counteract dryness.[3,9]

**Mechanism of Action**

The foam spreads easily over the skin, allowing uniform distribution and effective cleansing. The surfactants trap oil, dirt, and impurities within the foam, which are then removed during rinsing. Foam-based cleansers provide a deep cleansing effect due to their high foaming capacity.

**Advantages**

Easy and convenient to use

Provides effective and uniform cleansing

Suitable for normal to oily skin

Removes excess oil and impurities efficiently

Leaves a clean and fresh feeling

**Limitations**

May strip natural oils from the skin

Can cause dryness and irritation with frequent use

Not suitable for dry or sensitive skin

**3.4 Herbal Face Wash**

Herbal face washes are formulated using natural plant-based ingredients and are gaining popularity due to their mild action and therapeutic benefits. These face washes combine cleansing properties with medicinal effects, making them suitable for long-term and daily use.[3,10]

**Composition**

Herbal face washes contain herbal extracts, essential oils, and natural excipients such as aloe vera, neem, tulsi, turmeric, sandalwood, tea tree oil, and other medicinal plants. Mild surfactants or natural saponins are used to provide gentle cleansing. Herbal formulations are often free from harsh synthetic chemicals, artificial fragrances, and colorants.[3,11]

**Mechanism of Action**

Herbal face washes cleanse the skin gently while providing additional benefits such as antimicrobial, anti-inflammatory, antioxidant, and soothing effects. The herbal ingredients help maintain the skin's natural pH and protect against microbial infections. Natural humectants present in herbs help retain moisture and prevent dryness.[3,12]

**Advantages**

Gentle and skin-friendly formulation

Provides therapeutic benefits along with cleansing

Suitable for sensitive and acne-prone skin

Maintains natural pH and moisture balance

Safe for long-term use.

**Limitations**

Shorter shelf life compared to synthetic products

Variability in efficacy due to natural ingredients

May require proper preservation and standardization

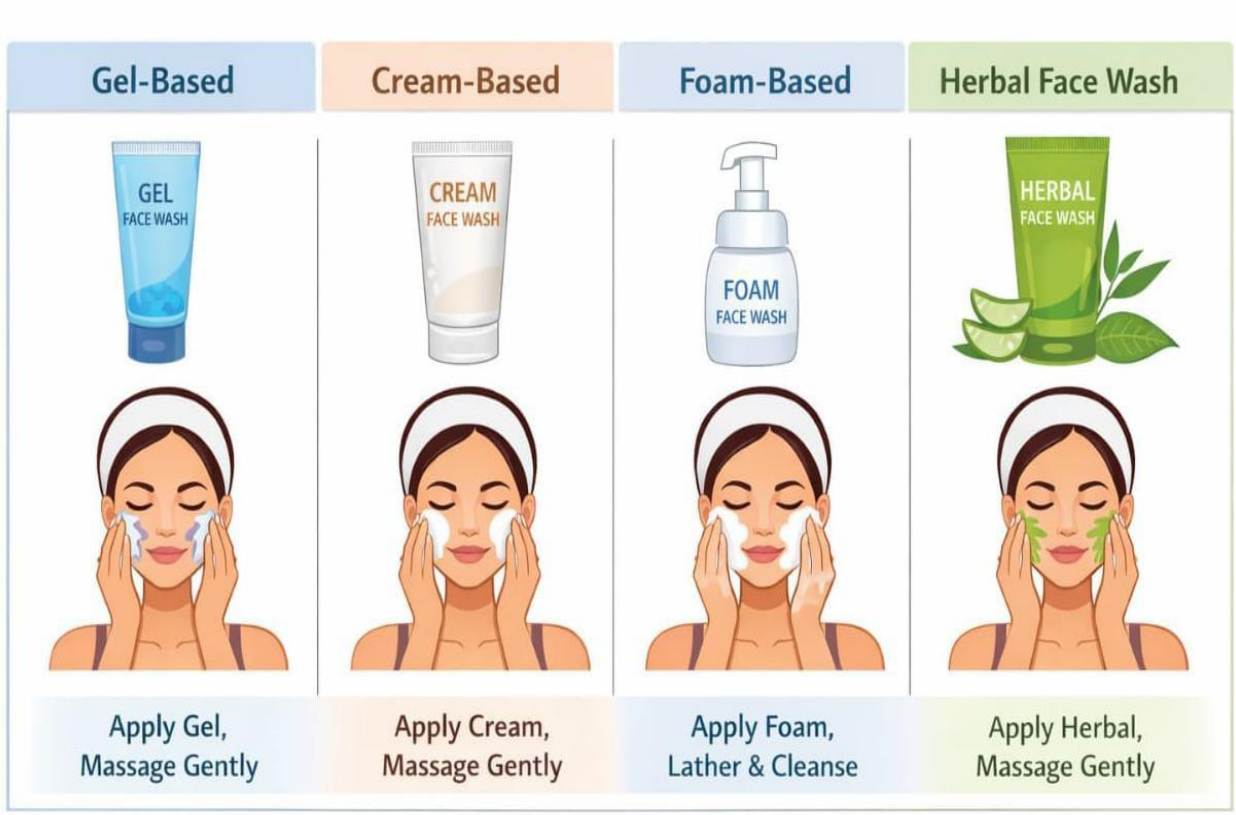



**Figure 5: Diagram showing types of face wash and application method.**

**Table 1: Advantages of Herbal vs. Synthetic Face Wash.**

| Parameter | Herbal face Wash | Synathetic Face Wash |
|---|---|---|
| Cleansing | Gentle | Harsh |
| Lrritation | Rare | Common |
| Moisturization | Good | May cause dryness |
| Long –term Safety | High | Low |
| Environmental impact | Biodegradable | Non biodegradable |

## 4. Kalmegh (Andrographis paniculata)

### 4.1 Botanical Description

Common Name: Kalmegh

Scientific Name: Andrographis paniculata

Family : Acanthaceae

### 4.2 Geographical Source

Grows naturally in India, Sri Lanka, China, and Southeast Asia; thrives in tropical and subtropical climates.

### 4.3 Morphological Characteristics

Annual herb with green leaves, small white flowers with purple markings

Leaves are the primary medicinal part

### 4.4 Chemical Constituents

Andrographolide

Neoandrographolide

Flavonoids

Lactones



**Figure 6: Image of Kalmegh plant showing leaves, flowers, and stem.**

**Role in Skin Care**

Antimicrobial: Prevents acne and infections

Anti-inflammatory: Reduces redness and irritation

Antioxidant: Protects against free radical damage

Detoxifying: Helps cleanse impurities

### 4.5 Need for Herbal Face Wash

Synthetic products often contain harsh chemicals such as Sodium Lauryl Sulfate, parabens, and artificial fragrances, which may cause irritation, dryness, and allergies. Herbal face washes with Kalmegh offer.[4,1]

Gentle cleansing action

Therapeutic benefits

Moisturization and hydration

Eco-friendly and biodegradable formulation

### 4.6 Historical Perspective of Herbal Cosmetics

Herbal cosmetics have been used since ancient times in Ayurveda, Unani, and other traditional systems. Medicinal plants were incorporated in face care, hair care, and body care formulations for therapeutic and beautifying purposes.[4,2]

**For example**

Neem

Aloevera

Rose Water

Honey

were widely used for skin cleansing and treatment of acne.

### 4.7 Global Market and Demand for Herbal Face Wash

The global herbal cosmetic market is growing at an average of 8–10% per year. Consumers increasingly prefer herbal products due to.[4,3]

Safety and minimal side effects

Environmental friendliness

Awareness of chemical hazards

Natural therapeutic benefits

**Table 2: Market share of herbal cosmetic products by cate.**

| Category | Market share (%) |
|---|---|
| Skincare | 40 |
| Haircare | 30 |
| Oral care | 15 |
| Others | 15 |

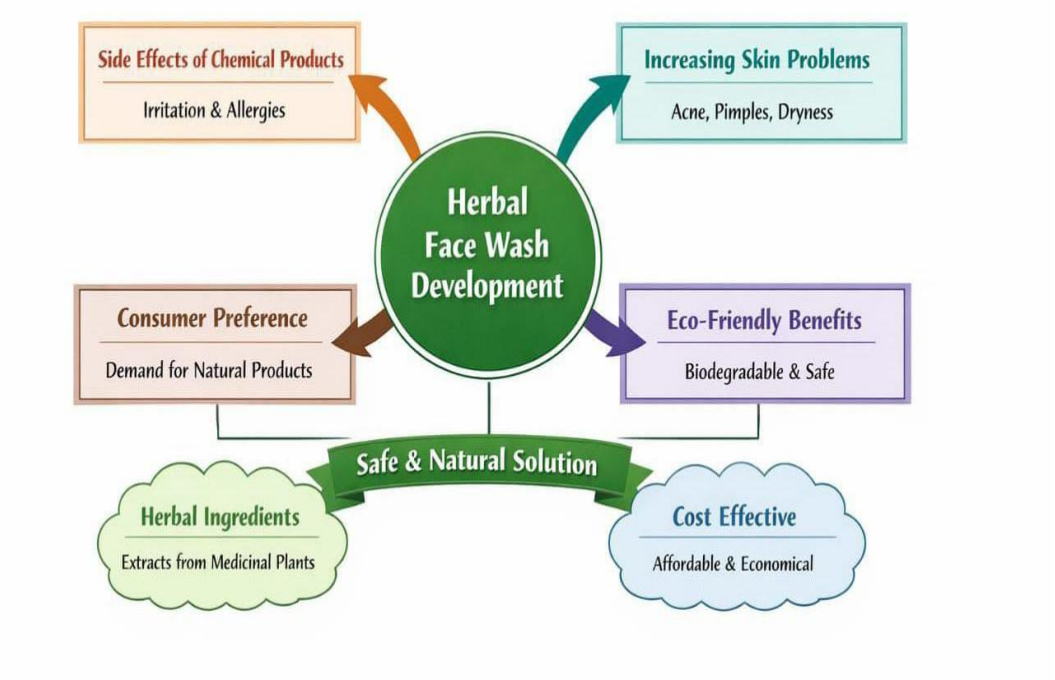



**Figure 7: Flowchart showing rationale for herbal face wash development.**

## 5. PLANT PROFILE OF KALMEGH (Andrographis paniculata)

### 5.1 Botanical Description

Scientific Name: Andrographis paniculata

Family: Acanthaceae

Common Names: Kalmegh, King of Bitters

Synonyms: Andrographis paniculata (Burm. f.) Nees

### 5.2 Morphology

Habit: Annual erect herb

Height: 30–110 cm

Leaves: Opposite, lanceolate, dark green

Flowers: Small, white, 2-lipped

Stem: Green, quadrangular

Roots: Fibrous



**Figure 8: Leaves and flowers of Kalmegh.**

### 5.3 Geographical Distribution

Kalmegh is native to India, Sri Lanka, China, and Southeast Asia. It thrives in tropical and subtropical climates, usually found in plains and low hills with well-drained soils.[5,1]

## 6. Phytochemical Constituents

Andrographis paniculata, commonly known as Kalmegh, is an important medicinal plant widely used in traditional Ayurvedic, Siddha, and modern herbal medicine. The plant is well known for its bitter taste and remarkable therapeutic properties. It is extensively used for the treatment of infections, inflammation, liver disorders, and skin-related problems.[6,1]

The medicinal value of Andrographis paniculata is mainly attributed to the presence of various phytochemical constituents. These phytochemicals possess antimicrobial, anti-inflammatory, antioxidant, and immunomodulatory properties. Due to these properties, the plant is widely used in herbal cosmetic preparations, especially in herbal face wash formulations for skin cleansing and protection.[6,2]

The major phytochemical constituents present in Andrographis paniculata include

Andrographolide

Neoandrographolide

Flavonoids

Lactones

Tannins

Saponins

**Phenolic compounds**

These bioactive compounds collectively contribute to the medicinal and cosmetic importance of the plant.

**6.1 Andrographolide**

Andrographolide is the most important and active phytochemical present in Andrographis paniculata. It is a diterpenoid lactone and is considered the principal bioactive compound responsible for most of the pharmacological activities of the plant.[6,3]

**Biological Activities**

Strong anti-inflammatory activity

Antibacterial and antiviral action

Antioxidant property

Immunomodulatory effect

**Role in Skin Care**

Andrographolide helps in reducing acne, skin irritation, and inflammation. It prevents the growth of acne-causing bacteria and protects the skin from oxidative damage. Due to its healing and soothing properties, it is widely used in herbal face wash and skincare products.[6,4]

**6.2 Neoandrographolide**

Neoandrographolide is another important diterpenoid compound found in Andrographis paniculata. It possesses milder but effective pharmacological activity compared to andrographolide.[6,4]

**Functions**

Anti-inflammatory

Antioxidant

Skin-soothing agent

**Cosmetic Importance**

Neoandrographolide helps in reducing redness and irritation of the skin. It maintains skin hydration and is suitable for sensitive skin types. It also enhances the overall stability and effectiveness of herbal cosmetic formulations.[6,5]

### 6.3 Flavonoids

Flavonoids are naturally occurring polyphenolic compounds known for their strong antioxidant properties. They play a major role in protecting the skin from oxidative stress.

**Functions**

Neutralize free radicals

Prevent premature aging

Improve skin tone and texture

Protect against UV radiation

**Cosmetic Benefits**

Flavonoids enhance skin glow, reduce pigmentation, and protect the skin from environmental damage such as pollution and sunlight.[6,6]

### 6.4 Lactones

Lactones are bioactive compounds responsible for antimicrobial and anti-inflammatory activities.

**Functions**

Control bacterial growth

Reduce acne formation

Maintain skin cleanliness

Support detoxification

**Importance in Skin Care**

Lactones help in keeping the skin free from infections and improve overall skin health by reducing microbial contamination.

### 6.5 Tannins

Tannins are polyphenolic compounds known for their astringent properties.

**Functions**

Tighten skin pores

Reduce excess oil secretion

Improve skin firmness

Provide antimicrobial action

**Role in Herbal Face Wash**

Tannins are especially beneficial for oily and acne-prone skin. They help in reducing pimples, blackheads, and excessive oil production.

**6.6 Saponins**

Saponins are natural surfactants found in many medicinal plants.

**Properties**

Mild foaming action

Natural cleansing agent

Antimicrobial and anti-inflammatory

**Cosmetic Importance**

Saponins help remove dirt, oil, and impurities from the skin without causing irritation. They act as a natural alternative to synthetic surfactants used in commercial face washes.

**6.7 Phenolic Compounds**

Phenolic compounds are powerful antioxidants that protect the skin from oxidative stress and environmental damage.

**Benefits**

Delay skin aging

Improve skin elasticity

Enhance skin brightness

Protect against pollution and UV rays

These compounds play an important role in maintaining healthy and youthful skin.

## 7. REVIEW OF LITERATURE

The review of literature provides a detailed survey of previous research work carried out on acne vulgaris, herbal anti-acne formulations, Kalmegh (Andrographis paniculata), and herbal face wash preparations. It helps in understanding the scientific background of the present study and justifies the selection of herbal ingredients.

**Kligman (1974)** described acne vulgaris as a chronic inflammatory disorder of the pilosebaceous unit and emphasized the role of sebum overproduction and follicular hyperkeratinization in acne development.

**Thiboutot et al. (2009)** reported that hormonal imbalance, particularly androgens, plays a significant role in stimulating sebaceous glands, leading to excessive sebum secretion and acne formation.

**Zaenglein et al. (2016)** highlighted that Cutibacterium acnes is a major causative organism responsible for inflammatory acne lesions and contributes to the release of inflammatory mediators.

**Leyden (1997)** reported that long-term use of topical antibiotics leads to the development of bacterial resistance and reduced therapeutic effectiveness.

**Dreno et al. (2014)** observed that synthetic agents like benzoyl peroxide and retinoids cause adverse effects such as skin dryness, irritation, peeling, and erythema.

**Tan and Bhate (2015)** concluded that patient compliance is often poor with synthetic acne treatments due to unpleasant side effects.

WHO **(2002)** emphasized the importance of traditional medicine and recommended the use of herbal drugs due to their safety and efficacy.

**Mukherjee (2011)** stated that herbal cosmetics are gaining global acceptance as they provide therapeutic benefits with minimal side effects.

**Pandey and Tripathi (2014)** reported that herbal skin care products improve skin health by providing antioxidant, antimicrobial, and anti-inflammatory effect

**Sharma et al**. **(2012)** formulated a herbal face wash using neem, tulsi, and aloe vera and reported good cleansing action with minimal skin irritat.

**Patel and Desai (2013)** evaluated a polyherbal face wash and found it effective in reducing acne lesions and excess sebum.

**Kumar et al. (2015)** reported that herbal face washes maintain skin pH and moisture balance better than synthetic cleansers.

**Kirtikar and Basu (2005)** described Andrographis paniculata as an important medicinal plant used extensively in Ayurvedic medicine for treating infections and skin disorders.

**Chopra et al. (2006)** reported that Kalmegh possesses strong antimicrobial and anti-inflammatory properties due to the presence of andrographolide.

**Akbar (2011)** reviewed the pharmacological activities of Andrographis paniculata and highlighted its antibacterial, antioxidant, and immunomodulatory effects.

**Singha et al. (2003)** demonstrated significant antibacterial activity of Kalmegh leaf extract against Gram-positive and Gram-negative bacteria.

**Mishra et al. (2009)** reported that andrographolide inhibits the growth of acne-causing bacteria and reduces inflammation.

**Rao et al**. **(2012)** concluded that Kalmegh extract is effective in treating skin infections due to its broad-spectrum antimicrobial activity.

**Shen et al. (2002)** reported that andrographolide suppresses inflammatory mediators and reduces oxidative stress.

**Burgos et al. (2010)** observed that Kalmegh extract significantly reduces inflammation and skin redness.

**Jarukamjorn and Nemoto (2008)** highlighted the antioxidant activity of Kalmegh, which helps in protecting skin from free radical damage.

**Biswas et al. (2002)** reported that neem (Azadirachta indica) possesses strong antibacterial and anti-acne activity.

**Molan (2001)** reported that honey exhibits antimicrobial and wound-healing properties and is beneficial for skin care.

**Ali et al. (2015)** found that peppermint oil shows antimicrobial and cooling effects, making it useful in topical formulations.

**Bisset (1994)** reported that rose water acts as a soothing and skin-toning agent.

**Saha and Bhattacharya (2010)** studied xanthan gum as a natural gelling agent and reported its safety and good rheological properties.

**Patel et al**. **(2014)** concluded that xanthan gum improves spreadability and consistency of topical formulations.

**Kumar and Singh (2016)** formulated a polyherbal gel for acne treatment and reported enhanced antimicrobial activity due to synergistic effects of herbs.

**Gupta et al**. **(2017)** observed that polyherbal formulations show better efficacy and reduced side effects compared to single-herb formulations.

**Joshi et al. (2018)** reported that herbal gels and face washes are effective, safe, and economical for long-term acne management.

**Rao et al**. **(2022)** analyzed consumer preference for herbal cosmetic products and reported increased demand due to natural origin, safety, and eco-friendly nature of herbal cosmetics.

**Sharma and Jain (2023)** reported that herbal face washes are widely accepted among consumers due to their gentle action and suitability for all skin types.

**Iyer et al**. **(2023)** reviewed recent advances in herbal cosmetic technology and highlighted the use of novel extraction techniques and improved formulation strategies to enhance stability and efficacy of herbal products.

**Kumar and Singh (2024)** reported that incorporation of standardized herbal extracts improves consistency, quality, and performance of herbal cosmetic formulations.

**AIM**

To formulate and evaluate a herbal face wash using Kalmegh (Andrographis paniculata) for its physicochemical properties, antimicrobial activity, stability, and skin compatibility."

**OBJECTIVES**

**The objectives of the study are as follows**

To collect and authenticate Kalmegh plant material for preparation of herbal extract.

To prepare Kalmegh extract using suitable extraction methods.

To develop a herbal face wash formulation incorporating Kalmegh extract along with other excipients like aloe vera, glycerin, surfactants, and preservatives.

**To evaluate the formulated herbal face wash for physicochemical parameters including**

Appearance and color

Odor

pH

Viscosity

Foamability

Spreadability

Homogeneity.

To perform stability studies under different storage conditions to assess shelf life.

To assess antimicrobial activity of the formulated herbal face wash against common skin pathogens (Staphylococcus aureus, Propionibacterium acnes, etc.).

To determine the skin compatibility and safety of the formulation through preliminary skin irritation studies.

To compare the herbal formulation with standard or marketed face wash products for efficacy and user acceptability.

To provide a natural, safe, and effective alternative to synthetic face wash products for daily skin

## 9. PROCEDURE / METHODOLOGY

### 9.1 Collection and Authentication of Plant Material

1. Fresh Kalmegh (Andrographis paniculata) leaves were collected from a local medicinal plant garden.
2. Authentication of plant material was carried out by a qualified botanist. A voucher specimen was deposited in the institute herbarium for future reference.
3. Collected leaves were thoroughly washed with running tap water to remove dust, soil particles, and foreign matter.
4. Washing was followed by rinsing with distilled water to ensure purity.
5. Leaves were shade dried at room temperature for 10–15 days to retain bioactive constituents, avoiding direct sunlight which may degrade sensitive phytochemicals.
6. After drying, leaves were mechanically powdered using a grinder. Powdered material was sieved to obtain uniform particle size (~40–60 mesh) for better extraction efficiency.

7. The powdered leaves were stored in airtight glass containers in a cool and dry place, preventing moisture uptake and microbial contamination.

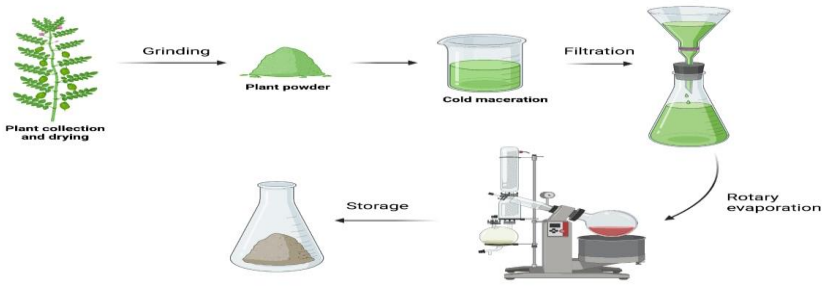



**Figure 9: Flowchart showing steps in plant collection and preparation.**

### 9.2 Preparation of Kalmegh Extract

Choice of Extraction Method: Extraction of bioactive compounds from Kalmegh leaves was performed using maceration or Soxhlet extraction, depending on laboratory availability and solvent efficiency.

### 9.3 Maceration Method

For the preparation of the extract, freshly dried Kalmegh leaves will be powdered using a mechanical grinder to obtain a coarse powder. Accurately weighed 50 g of the powdered plant material will be transferred into a clean, dry, and sterile conical flask. To this, 250 mL of ethanol or a hydroalcoholic solvent system will be added, ensuring complete immersion of the plant material.

The contents of the flask will be sealed and will be subjected to intermittent shaking at regular intervals for a period of 48 hours. This process will facilitate effective penetration of the solvent into the plant tissues and will enhance the dissolution of phytoconstituents present in the leaves. During the maceration period, the flask will be maintained at room temperature and protected from direct light to prevent degradation of light-sensitive compounds.

After completion of the maceration process, the mixture will be filtered using Whatman No. 1 filter paper to separate the solvent extract from the residual plant marc. The clear filtrate obtained will be collected and will be subjected to concentration under reduced pressure using a rotary evaporator. The evaporation process will be carried out at a controlled temperature range of 40–45 °C in order to prevent thermal degradation of heat-sensitive bioactive constituents such as andrographolide and related diterpenoids.

The concentrated extract obtained will be allowed to cool and will be transferred into sterile, dark amber-colored glass bottles. These bottles will be properly labeled and will be stored at 4 °C in a refrigerator to ensure stability, minimize oxidative degradation, and preserve the pharmacological activity of the extract until further use.

**Soxhlet Extraction Method (Alternative Technique)**

As an alternative and more exhaustive extraction technique, the Soxhlet extraction method will be employed. For this purpose, 50 g of powdered Kalmegh leaves will be accurately weighed and will be placed into a thimble made of filter paper, which will then be fitted into the Soxhlet extraction apparatus.

A volume of 250 mL of ethanol or hydroalcoholic solvent will be poured into a round-bottom flask attached to the Soxhlet unit. The entire assembly will be connected to a condenser and will be heated using a heating mantle. The extraction process will be maintained at a temperature of 60–65 °C for a duration of approximately 6–8 hours.

During this process, the solvent will continuously circulate through the plant material, allowing repeated washing and efficient extraction of soluble phytochemicals. The extraction cycle will continue until the siphon tube solvent appears colorless, indicating exhaustive extraction of the active constituents.

Upon completion of the extraction, the solvent extract will be collected and will be concentrated under reduced pressure using a rotary evaporator. The concentrated extract will then be transferred into amber-colored bottles and will be stored at 4 °C to maintain chemical stability and prevent microbial growth.




**Figure 10: Diagram showing Maceration extraction.**



**Figure 11: Diagram showing Soxhlet extraction setup.**

### 9.4 Formulation of Herbal Face Wash

Formulation of Kalmegh Leaves Face Wash (50 ml Batch – Optimized)

This formulation uses fresh Kalmegh leaves extract along with Aloe vera gel, Honey, Glycerin, and optionally Rose Water and Peppermint Oil, to prepare a herbal, mild, skin-friendly face wash. The formulation is designed to cleanse the skin gently while providing antioxidant, moisturizing, and soothing

### 9.5 Fresh Kalmegh Leaves extract( liquid)

Aloe vera gel

Honey

Glycerin

Xanthan Gum

Surfactant(SLS/SLES)

Triethanolamine (TEA)

Rose Water (optional)

Peppermint oil(optional)

Distilled water

### 9.6 Procedure for Preparation of Herbal Face Wash

The herbal face wash formulation will be prepared using a standard laboratory method with careful selection and incorporation of ingredients to ensure homogeneity, stability, and skin compatibility. The entire procedure will be carried out under hygienic conditions using clean and dry glassware to avoid any contamination.

Initially, 25 ml of distilled water will be taken in a clean and dry beaker. Distilled water will be used as the solvent to ensure purity and to prevent microbial contamination or interference from dissolved impurities. To this, 0.5 g of xanthan gum will be added gradually with continuous stirring using a glass rod. The xanthan gum will be sprinkled slowly into the water to avoid lump formation and to ensure uniform hydration. Continuous stirring will be maintained until a smooth, clear, and lump-free gel base will be formed. Xanthan gum will act as a natural thickening and stabilizing agent, providing suitable viscosity to the formulation.

After the formation of the gel base, 1.5 g of glycerin will be added slowly to the gel and will be stirred thoroughly. Glycerin will function as a humectant that helps retain moisture in the skin and prevents dryness. Proper mixing will be ensured to achieve uniform distribution of glycerin throughout the gel base.

Subsequently, 2.5 g of honey will be added gradually to the mixture. Honey will be incorporated slowly while stirring continuously to ensure complete dispersion. Honey will serve as a natural humectant and antimicrobial agent, contributing to skin hydration and protection against microbial growth. Continuous mixing will be carried out to avoid phase separation and to maintain formulation uniformity.

Next, 2–3 ml of freshly prepared Kalmegh (Andrographis paniculata) leaves extract will be added to the formulation. The extract will be introduced slowly with gentle stirring to ensure uniform incorporation. Kalmegh extract will provide antioxidant, anti-inflammatory, and antimicrobial properties, which will be beneficial for skin health and acne prevention. Care will be taken to avoid excessive agitation to prevent degradation of active phytoconstituents.

Following this, 5 g of Aloe vera gel will be added to the mixture. Aloe vera gel will be included for its moisturizing, soothing, and wound-healing properties. It will help in calming irritated skin and improving hydration. The formulation will be mixed gently but thoroughly until a uniform consistency will be obtained.

After uniform mixing of the herbal ingredients, 5 ml of rose water will be added to the formulation. Rose water will be used as a natural fragrance and skin-toning agent. Its addition will enhance the sensory appeal of the face wash and will contribute mild soothing effects. This step will remain optional depending on formulation requirements.

Subsequently, 3–5 drops of peppermint oil will be added carefully to the mixture. Peppermint oil will be incorporated to provide a cooling and refreshing effect on the skin and to improve the overall fragrance of the formulation. The oil will be added in minimal quantity to avoid skin irritation and will be mixed gently to ensure even distribution.

After incorporation of all herbal and auxiliary ingredients, 5 g of SLS or SLES will be slowly added to the formulation with continuous gentle stirring. SLS/SLES will act as a surfactant and will provide cleansing and foaming properties to the face wash. The surfactant will be added gradually to prevent excessive foam formation and to maintain formulation uniformity.

The pH of the formulation will then be measured using a calibrated digital pH meter. The pH will be adjusted to a skin-friendly range of 5.5–6.5 by adding triethanolamine (TEA) dropwise (approximately 0.25 ml). pH adjustment will be carried out carefully with continuous stirring to avoid localized pH variation. Maintaining an appropriate pH will ensure skin compatibility and will prevent irritation.

After pH adjustment, a sufficient quantity of distilled water will be added to make up the final volume to 50 ml. The formulation will be stirred thoroughly to ensure complete mixing and homogeneity of all ingredients.

The prepared face wash formulation will then be allowed to stand undisturbed for 10–15 minutes at room temperature. This step will be carried out to remove any entrapped air bubbles formed during stirring and to stabilize the formulation.

Finally, the finished herbal face wash will be transferred into clean, dry, and airtight containers. The containers will be properly labeled and will be stored at room temperature (25°C), protected from direct sunlight and heat to maintain product stability and prevent degradation of active ingredients.

### 9.7 Herbal Face Wash

Herbal face wash formulations are designed using plant-based and mild synthetic ingredients that ensure effective cleansing while maintaining skin health. Each ingredient plays a specific scientific role in improving the stability, safety, and therapeutic value of the formulation.

**Fresh Kalmegh Extract (Andrographis paniculata)**

Kalmegh contains andrographolide, a bioactive diterpenoid lactone responsible for its medicinal properties.

It exhibits strong antioxidant activity, which helps in neutralizing free radicals that cause premature aging and skin damage.

Possesses anti-inflammatory properties, making it effective in reducing skin redness, swelling, and irritation.

Shows antimicrobial and antibacterial action, helping to control acne-causing microorganisms.

Protects the skin from environmental stress, pollution, and microbial infection.

Supports skin healing and regeneration by reducing oxidative stress.

Helps in maintaining healthy and clear skin.




**Figure:- 12. Kalmegh Extract.**

**Aloevera Gel**

Aloe vera is widely used in cosmetic and dermatological preparations due to its excellent moisturizing and healing properties.

**Scientific Importance**

Contains polysaccharides, vitamins (A, C, E), enzymes, amino acids, and minerals.

Acts as a natural humectant, helping the skin retain moisture.
Exhibits anti-inflammatory and soothing properties, reducing irritation and redness.
Promotes wound healing and skin regeneration.
Improves skin elasticity and smoothness.
Provides a cooling and refreshing effect on application.
Enhances hydration without clogging pores.

**Scientific Role**

Acts as a moisturizer, soothing agent, and skin-conditioning agent.




**Figure:-13 Aloe Vera .Gel.**

**Honey and Glycerin**

Honey and glycerin are widely used natural humectants in cosmetic formulations.

Scientific Importance:

**Honey**

Contains natural sugars, enzymes, and antioxidants.

Exhibits antibacterial and antimicrobial activity.

Helps in wound healing and acne control.

Maintains moisture balance of the skin.

Improves skin softness and glow.




**Figure:- 14 Honey.**

**Glycerin**

A trihydroxy alcohol that attracts water from the atmosphere.

Prevents dryness and maintains skin hydration.

Strengthens the skin barrier.

Improves elasticity and smoothness of the skin.

Reduces irritation caused by cleansing agents.

They act as natural moisturizers and humectants, preventing dryness and maintaining skin hydration.

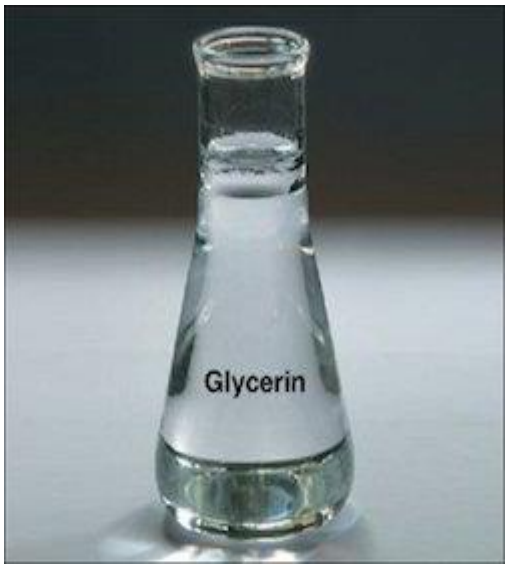



**Figure:- 15 Glycrin.**

**Xanthan Gum**

Xanthan gum is a natural polysaccharide produced by fermentation of carbohydrates.

**Scientific Importance**

Used as a thickening and stabilizing agent in cosmetic formulations.

Provides desired viscosity and gel consistency.

Prevents phase separation of ingredients.

Enhances stability and shelf life of the product.

Improves spreadability and texture.

Ensures uniform dispersion of active ingredients.

**Scientific Role**

Acts as a rheology modifier and stabilizer for formulation consistency

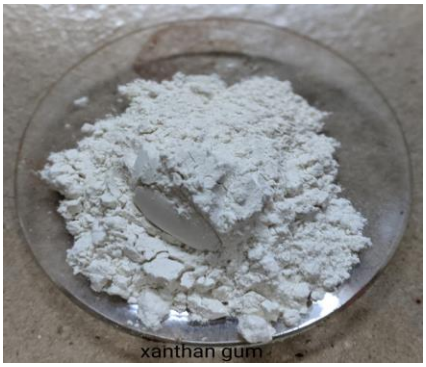



**Figure:- 16: Xanthan Gu.**

**SLS / SLES (Sodium Lauryl Sulfate / Sodium Laureth Sulfate)**

SLS and SLES are commonly used surfactants in cleansing products.

**Scientific Importance**

Act as surface-active agents that reduce surface tension.

Remove dirt, excess oil, sweat, and impurities from the skin.

Produce mild foam, improving cleansing efficiency.

SLES is milder and less irritating than SLS.

When used in low concentration, they are safe and skin-compatible.

Help in uniform distribution of active ingredients.

**Scientific Role**

Serve as cleansing and foaming agents ensuring effective removal of impurities.

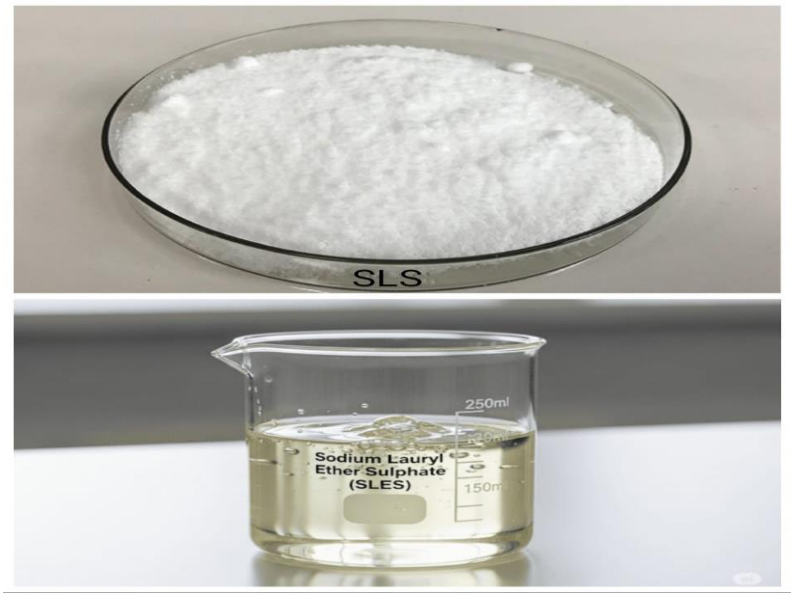



**Figure:-17 SLS / SLES.**

**Triethanolamine (TEA)**

Triethanolamine is a commonly used organic compound in cosmetic and pharmaceutical formulations. It plays an important role in maintaining product stability and performance.

**Scientific Importance**

TEA is a weak alkaline compound used to adjust and maintain the pH of cosmetic formulations.

Helps in neutralizing acidic ingredients such as fatty acids and surfactants.

Acts as an emulsifying agent, allowing oil and water-based ingredients to mix uniformly.

Enhances the stability and consistency of the formulation.

Improves the texture and appearance of the face wash.

Prevents product separation during storage.

Ensures skin compatibility by maintaining skin-friendly pH levels.

Helps reduce irritation caused by harsh surfactants when used in controlled amounts.

**Scientific Role**

Acts as a pH adjuster, emulsifier, and stabilizing agent, ensuring product safety, uniformity, and skin compatibility.




**Figure:- 18 Triethanolamine (TEA).**

**Rose Water (Rosa damascena / Rosa centifolia)**

Rose water is a natural floral distillate widely used in herbal and cosmetic formulations for its soothing and refreshing properties.

**Scientific Importance**

Contains natural antioxidants, flavonoids, and phenolic compounds.

Exhibits anti-inflammatory and soothing effects, reducing redness and irritation.

Helps in maintaining the natural pH of the skin.

Acts as a mild astringent, tightening pores and refreshing the skin.

Provides hydration and improves skin tone.

Possesses mild antibacterial properties that help prevent acn

Acts as a natural toner, soothing agent, and fragrance enhancer, improving skin freshness and overall formulation acceptability.



**Figure:- 19. Rose Water (optional).**

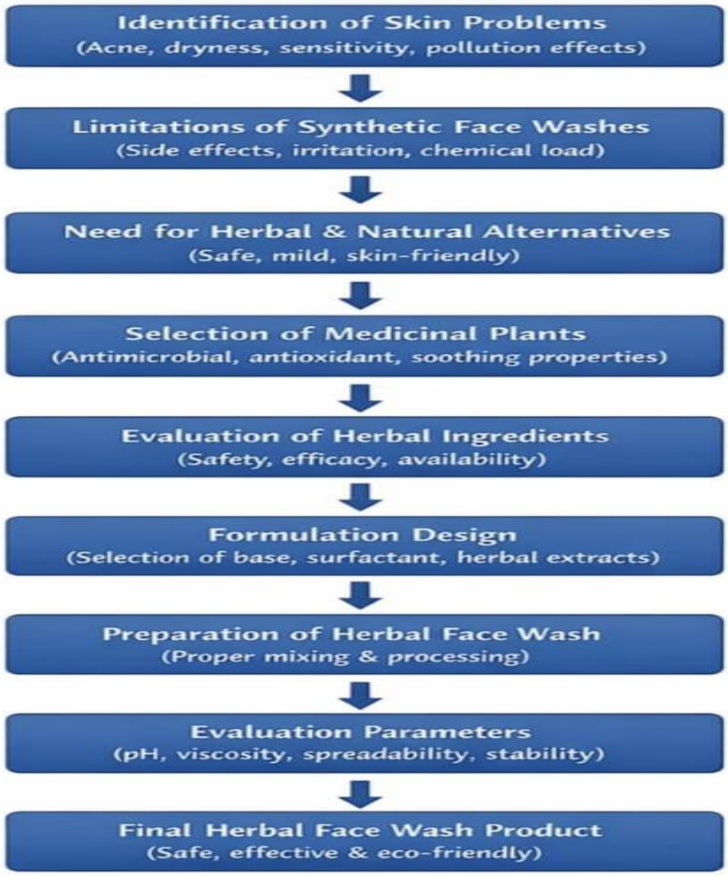



**Figure 20: Flowchart of herbal face wash formulation process.**

## 10. Evaluation Parameters of Face Wash Formulation

Evaluation of a face wash formulation is a critical step in determining its quality, safety, stability, and consumer acceptability. A well-formulated face wash should possess appropriate physical, chemical, and functional characteristics to ensure effective cleansing without causing irritation or damage to the skin. Physical evaluation parameters play a vital role in assessing the overall performance and suitability of the formulation for daily use. These parameters include appearance, odor, texture and consistency, pH measurement, viscosity, foamability and foam stability, spreadability, and homogeneity.

### 10.1. Physical Evaluation

Physical evaluation involves the visual and sensory assessment of the face wash formulation. These parameters significantly influence user acceptance and provide preliminary information regarding formulation quality and stability.

**Appearance**

Appearance is one of the most important physical parameters, as it directly affects consumer pe

### 10.2 Homogeneity

Checked visually; smooth, lump-free formulation indicates uniformity.

### 10.3 Stability Studies

Observed for color change, odor, consistency, phase separation over 30–60 days.
pH and viscosity monitored periodically.

**Types of Stability Testing**

**Real-Time Stability:** Storing products under recommended conditions and monitoring them until they no longer meet quality specifications.

**Accelerated Stability:** Storing products at exaggerated conditions (e.g., 40°C and 75% humidity) to predict long-term shelf life in a shorter period, typically six months.

**Intermediate Stability:** Conducted at conditions between real-time and accelerated when significant changes occur during accelerated testing.

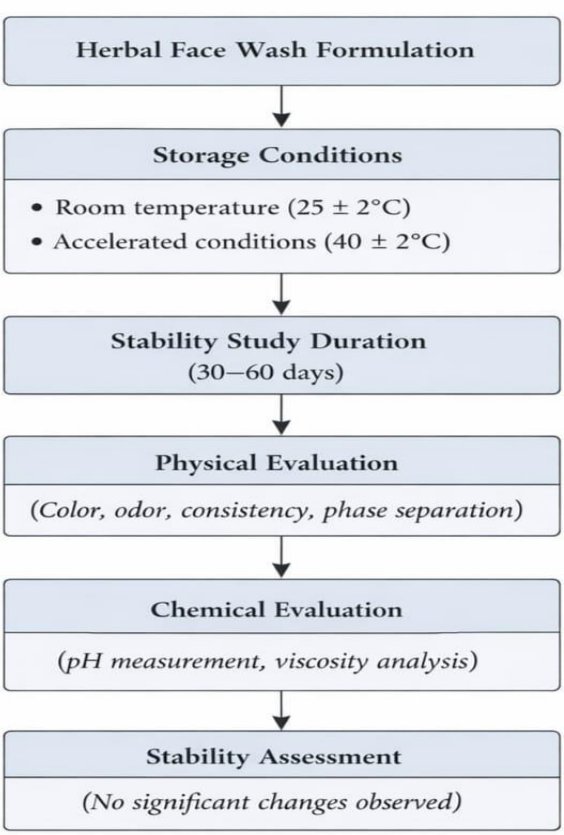



**Figure 21: Stability study setup.**

### Organoleptic Evaluation

The formulated Kalmegh herbal face wash was evaluated for organoleptic properties.

**Table 3: Organoleptic Evaluation of Herbal Face Wash.**

| Parameter | Observation | Remarks |
|---|---|---|
| Color | Light green | Acceptable |
| Odor | Mild herbal aroma | Pleasant |
| Texture | Gel –Like,smooth | Uniform |
| Homogeneity | NO lumps | Excellent |

## DISCUSSION

The light green color corresponds to the presence of Kalmegh extract. Mild herbal odor is preferred for consumer acceptance. Smooth texture and uniform homogeneity indicate proper formulation and efficient mixing during preparation.

### 10.4 pH Measurement

pH of the formulation was measured using a digital pH meter at 25°C.

Observed pH: 5.8 ± 0.2

Ideal for skin application (5.5–6.5).

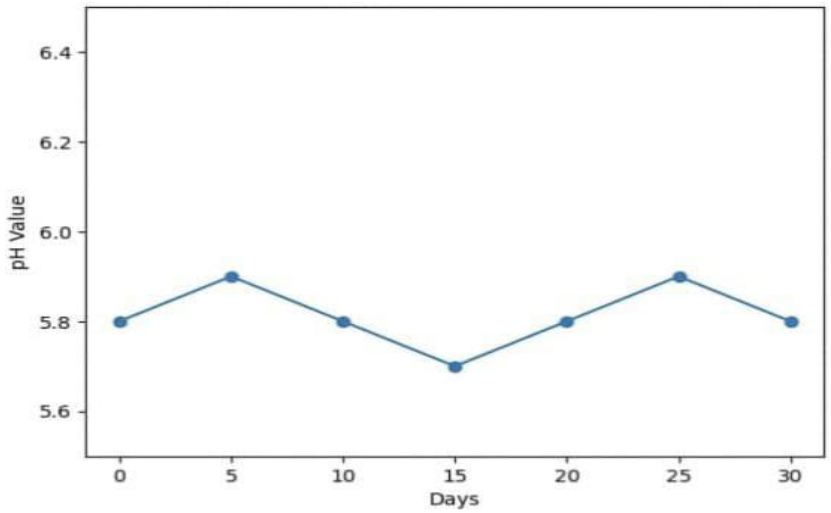



**Figure 22: Graph showing pH values of formulation over 30 days.**

## DISCUSSION

Maintaining skin-friendly pH ensures minimal irritation and maintains skin barrier integrity. Slight variation over storage period was within acceptable range.

### 10.5 Viscosity

Measured using Brookfield viscometer.

Viscosity observed: 3500 ± 50 cP

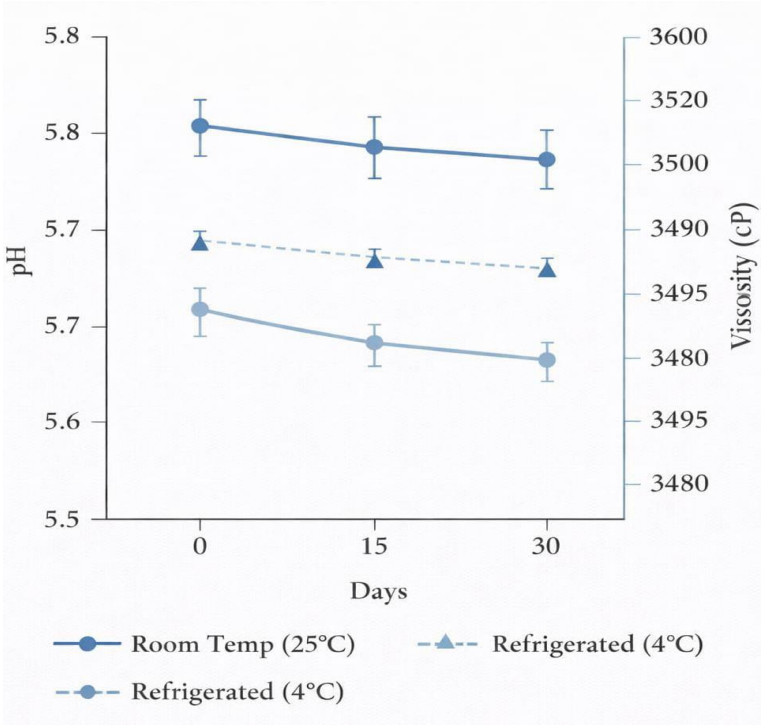



**Figure 23: Viscosity measurement graph.**

**DISCUSSION**

Viscosity ensures proper spreadability and application. Optimal viscosity also affects foam formation, which is important for cleansing efficacy.

### 10.6 Foamability and Foam Stability

**Table 4: Foamability & Foam Stability of Face Wash.**

| Formulation | Standard |
|---|---|
| 100 | 8 |
| 110 | 10 |

**DISCUSSION**

The foam formed was stable enough for cleansing but not excessive, which is beneficial for skin that is prone to dryness.

### 10.7 Spreadability

Determined using glass slide method.

Observed spread: 6.2 ± 0.3 cm

**DISCUSSION**

Good spreadability indicates the product can be applied easily and evenly on the skin surface.

### 10.8 Antimicrobial Activity

Tested against Staphylococcus aureus, Propionibacterium acnes, and Escherichia coli.

Method: Agar well diffusion

Zone of inhibition measured in mm

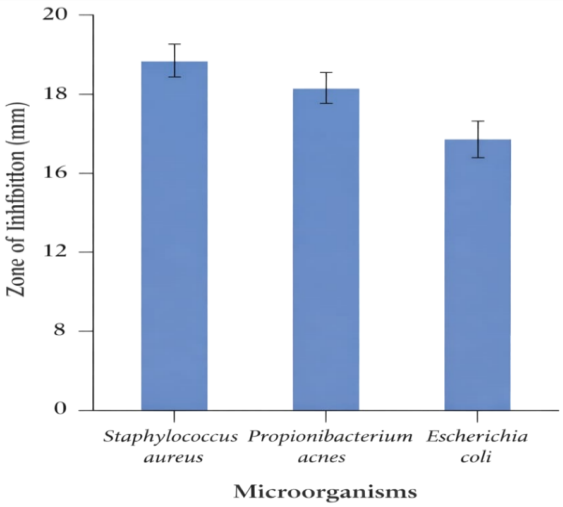



**Figure 24: Bar graph showing antimicrobial activity against different pathogens.**

**Discussion**

The formulation exhibits significant antimicrobial activity, particularly against acne-causing bacteria. This demonstrates the therapeutic potential of Kalmegh extract in skin care.

**10.9 Stability Studies**

Observed for 30 days at room temperature and refrigerated conditions

Parameters: Color, odor, consistency, pH, viscosity

No significant changes observed

**Table 5: Stability Study Results.**

| Storage Condition | Days | Color | Odor | pH | Viscosity |
|---|---|---|---|---|---|
| Room Temp(25 c) | 0 | Light green | Mild | 5.8 | 3500 |
| Room Temp | 15 | Light green | Mild | 5.8 | 3490 |
| Room Temp | 30 | Light green | Mild | 5.7 | 3485 |
| Refrigerated(4c) | 0 | Light green | Mild | 5.8 | 3500 |
| Refrigerated | 15 | Light green | Mild | 5.8 | 3495 |
| Refrigerated | 30 | Light green | Mild | 5.7 | 3480 |

**Discussion**

The formulation is stable under both conditions, indicating good shelf-life. No phase separation or color change observed, which supports the formulation's physical stability.

**6.8 Skin Compatibility / Safety Test**

Patch test performed on 10 volunteers

No redness, itching, or irritation observed

Confirms safety for human skin

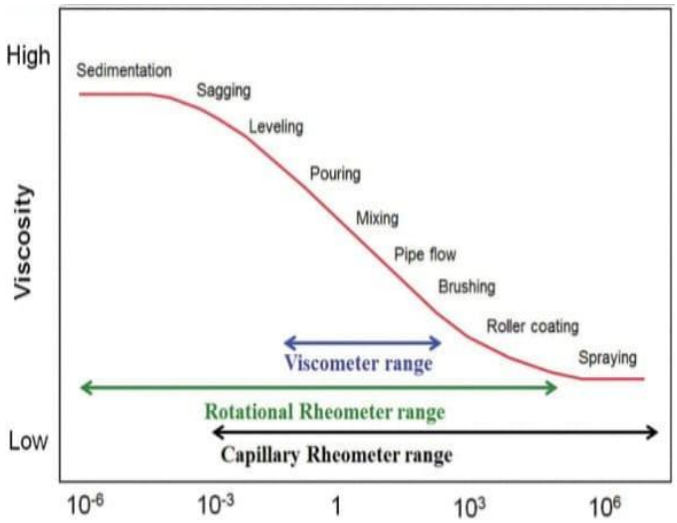



**Figure 25: Line graph showing pH and viscosity changes over 30 days.**

## DISCUSSION

Herbal formulation with Kalmegh extract is well-tolerated and suitable for daily use. This aligns with the pH, viscosity, and mild surfactant selection ensuring skin-friendliness.

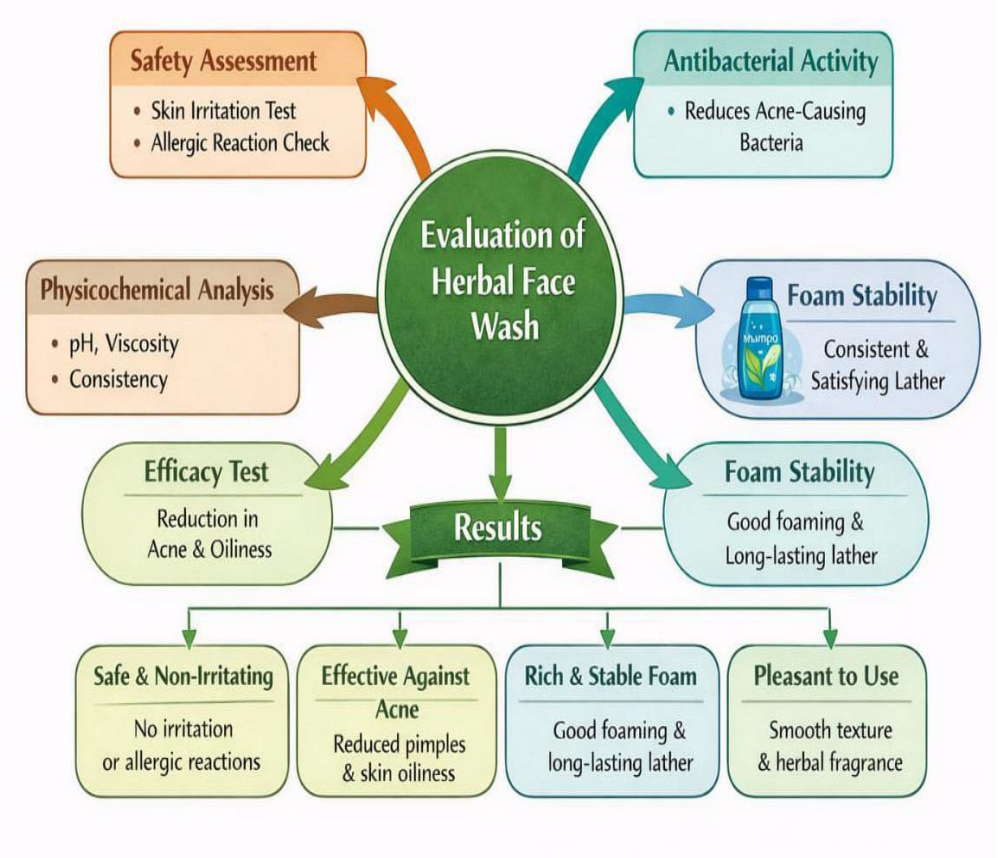



**Figure 26: Flowchart summarizing evaluation and results of the herbal face wash.**

## RESULT

The present study successfully resulted in the preparation and standardization of a Kalmegh (Andrographis paniculata)–based herbal face wash intended for the management of Acne vulgaris. The formulated herbal face wash exhibited satisfactory physicochemical, microbiological, and organoleptic properties, indicating its suitability for topical application.

The face wash showed a smooth, uniform gel consistency with a pleasant herbal odor and an acceptable greenish appearance, reflecting good consumer acceptability. The pH of the formulation was found to be within the skin-friendly range (5.5–6.5), suggesting that it is mild and non-irritating to the skin. The formulation demonstrated good spreadability and washability, ensuring easy application and effective cleansing action without leaving residue on the skin.

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## CONCLUSION

The present study was undertaken to formulate and evaluate a herbal face wash incorporating Kalmegh (Andrographis paniculata), a medicinal plant widely recognized for its antimicrobial and anti-inflammatory properties. The primary objective was to develop a safe, effective, and skin-friendly herbal formulation that could serve as a natural alternative to conventional chemical-based face washes. The results obtained from various evaluation parameters clearly indicate the success of the formulation.

Organoleptic evaluation revealed that the herbal face wash possessed a pleasant light green color and a mild herbal odor, both of which contribute positively to consumer acceptability. The formulation exhibited a smooth, gel-like texture with good homogeneity, indicating proper mixing and uniform distribution of ingredients. These physical characteristics make the product visually appealing, easy to apply, and suitable for routine skincare use.

Physicochemical evaluation further confirmed the quality of the formulation. The pH value of 5.8 ± 0.2 was found to be within the ideal range for human skin, helping to maintain the natural skin barrier and reduce the risk of irritation. The viscosity of 3500 ± 50 cP ensured good spreadability and appropriate consistency, enhancing user comfort. Additionally, the formulation showed satisfactory foamability and foam stability, providing effective cleansing action without causing excessive dryness.

The antimicrobial activity study demonstrated significant inhibitory effects against acne-causing microorganisms, particularly Staphylococcus aureus and Propionibacterium acnes. These findings confirm that the bioactive constituents of Kalmegh remained stable and effective after formulation. The antimicrobial efficacy suggests that regular use of the herbal face wash may help in controlling acne, pimples, and microbial skin infections.

Stability studies conducted for a period of 30 days under room temperature and refrigerated conditions revealed no significant changes in physical appearance, color, odor, pH, or viscosity. This indicates that the formulation is stable and possesses acceptable shelf-life, making it suitable for storage and possible commercialization.

Skin compatibility studies showed no signs of irritation, redness, or allergic reactions during patch testing, confirming the safety of the formulation for topical application. The use of natural ingredients such as Kalmegh, aloe vera, and glycerin contributed to the mild and non-irritating nature of the product, making it suitable for sensitive skin.

In conclusion, the Kalmegh-based herbal face wash developed in this study was found to be safe, stable, effective, and consumer-friendly. The study highlights the potential of herbal cosmetics formulated using scientific principles to provide therapeutic benefits along with effective skin.

**Future Prospective**

Standardized herbal face wash with proven safety and efficacy can be scaled up for industrial production.

Marketing as a natural, eco-friendly, and therapeutic skincare product will meet the increasing consumer demand for herbal cosmetics.

The present work lays the foundation for development of safe, effective, and natural herbal skincare products.

With further scientific validation, formulation optimization, and clinical studies, Kalmegh-based herbal cosmetics can emerge as a popular alternative to synthetic products.

The study contributes to herbal cosmetic research, sustainable skincare, and consumer health awareness

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