

Formulation And Evaluation of Herbal Face Serum for Anti-Acne

Hrishikesh Bhagaji Jadhav¹, Prasad Ramchandra Gavli², Shreya Arvind Hamand³, Manisha Manikrao Gharjale⁴, Shradha.S. Mantri⁵
^{1,2,3,4,5}Prerna Institute of Pharmacy, Parbhani.

Abstract—The present study focused on the formulation and evaluation of a herbal face serum intended for anti-acne application. The formulation was developed using natural ingredients such as neem extract, hibiscus extract, nutmeg oil, aloe vera gel, and other suitable excipients. Five different formulations (F1-F5) were prepared by varying the concentration of active ingredients. All the prepared formulations were evaluated for various parameters including physical appearance, pH, spreadability, stability, and washability. The physical evaluation revealed that all formulations possessed acceptable organoleptic properties, with smooth texture and pleasant odour. The pH values of all batches were found to be within the acceptable skin range (5.2-6.0), indicating good compatibility with skin. The spreadability test demonstrated that the formulations could be easily applied on the skin, while the stability studies confirmed that most formulations remained stable under different storage conditions. Washability studies indicated that the formulations were easy to remove and non-greasy in nature. Among all the formulations, F5 showed the most desirable characteristics in terms of pH, viscosity, spreadability, stability, and overall appearance. Hence, it was selected as the optimized formulation.

I. INTRODUCTION

The skin is the largest organ of the human body, forming the outer protective covering. It acts as a barrier between internal tissues and the external environment, protecting against physical, chemical, and microbial damage. Skin also plays a vital role in thermoregulation, sensation, immune defense, and prevention of water loss.

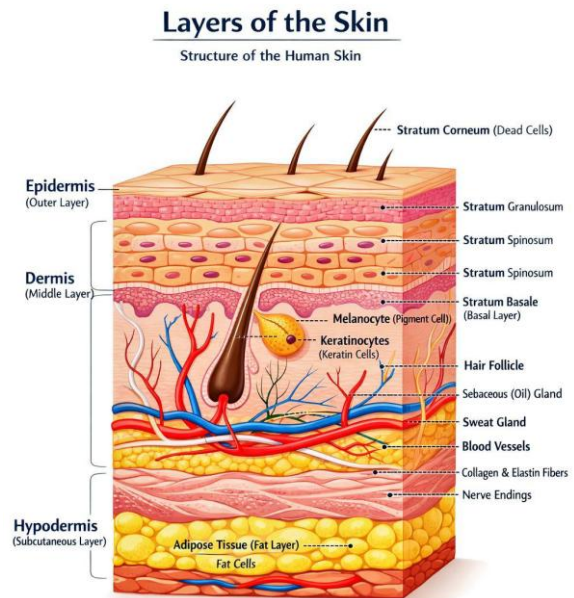
Human skin

The skin is the largest organ of the body, with a entire area of about 20 square feet. The skin protects us from

germs and the elements, helps regulate body temperature, and permits the sensations of touch, heat, and cold. In pharmaceutical and cosmetic sciences, the skin is an important site for topical and transdermal drug delivery, making it highly relevant in the formulation of products such as herbal face serums.

Functions of Skin

Protection: Shields the body from pathogens, UV radiation, and harmful chemicals
Regulation: Maintains body temperature through sweating and blood flow
Sensation: Contains receptors for touch, pain, heat, and cold
Excretion: Eliminates waste products through sweat
Absorption: Allows limited absorption of substances, important for topical formulations
Vitamin D synthesis: Helps in the production of Vitamin D upon sunlight exposure.



STRUCTURE AND LAYERS OF SKIN

Skin has three layers:-

1. Epidermis:- The epidermis is the outermost layer and serves as the first line of defense. It is composed of keratinized stratified squamous epithelium and lacks blood vessels. The outermost part, the stratum corneum, plays a vital role in controlling the permeability of substances into the skin.

2. Dermis:- The dermis lies beneath the epidermis and contains connective tissues, blood vessels, nerves, hair follicles, and glands. It provides strength, elasticity, and nourishment to the skin.

3. Hypodermis:- The hypodermis or subcutaneous layer is composed mainly of adipose tissue. It provides insulation, cushioning, and energy storage.

Skin Diseases:

There are many types of skin disease following.

1. Infectious Skin Diseases:

Bacterial Infections, Fungal Infections, Viral Infections

2. Inflammatory Skin Diseases

Acne vulgaris, Eczema (Dermatitis), Psoriasis

3. Allergic Skin Conditions

Contact dermatitis, Urticaria, Drug rashes

4. Pigmentary Disorders

Hyperpigmentation, Hypopigmentation

Acne is a common skin condition that occurs when hair follicles get clogged with oil (sebum), dead skin cells, and sometimes bacteria. It leads to pimples, blackheads, whiteheads, and sometimes cysts.

Acne vulgaris is a chronic inflammatory condition of the skin involving the pilosebaceous units. It is characterized by comedones, papules, pustules, and sometimes cysts. The major causes of acne include excessive sebum production, bacterial infection, hormonal imbalance, and clogged pores.

Acne affects over 85% of teenagers, making it one of the most common skin illnesses. Acne Often develops in adolescence and fades by the age of 20, while some people suffer with acne into their 40s and 50s. It is generally dismissed as a self-limiting condition that is rarely life-threatening. It gets less attention in graduate and undergraduate schools. Despite its ostensibly cosmetic look, its effects can go well behind the skin's surface, causing patients to endure extreme emotional and psychological discomfort that may be considerably worse than the physical symptoms. Personal and functional issues at work, as

well as suicidal ideas. According to estimates, the decline in quality of life is comparable to that caused by epilepsy, Asthma, diabetes, or arthritis.

Acne is assumed to be caused by four factors: excessive sebum production, aberrant Keratinocyte proliferation and differentiation in the hair follicle, bacterial colonization, and a Host inflammatory response. Propionibacterium acnes, a skin commensal, is hypothesized to Generate an inflammatory reaction, resulting in subclinical and inflammatory acne lesions. A persistent inflammatory process of the pilosebaceous glands that results in the development of blackheads, papules, pustules, and nodules is the cause of acne. Numerous elements, including hormones, foods, genetics, stress, inflammation, and bacteria, contribute to acne.

According to reports, Propionibacterium acnes bacteria are the primary cause of acne-related inflammation. Moreover, acne lesions have reportedly been shown to contain germs such Staphylococcus aureus and Staphylococcus epidermidis. Giving antibacterial is one step that can be taken to treat acne. Acne can frequently be treated with antibiotics. In this instance, an antibiotic functions as a chemical that might hinder bacterial growth or even cause bacterial death by interfering with its metabolism.

Using antibiotics derived from natural resources is an alternate method for treating acne. One of the compounds created by plants, essential oil, contains the oxygenated hydrocarbon substance (phenol), which has antibacterial properties. Certain essential oils, like nutmeg oil, work as anti-bacterial to treat acne. Its capacity to activate complements and its capacity to metabolize sebum triglycerides into fatty acids, which chemotactically attract neutrophils, are implicated in the development of inflammatory acne. S. epidermidis, an aerobic organism, is usually involved in superficial infections within the sebaceous unit. Modern acne therapy has been designed to interrupt the pathogenic pathway at one or more points. For the treatment of acne, there are two options: topical therapy, which uses comedolytic agents, antibiotics, and various anti-inflammatory medications, and systemic therapy, which uses antibiotics, zinc, and hormones. The excessive use of antibiotics for long periods has led to increased resistance in acne causing bacteria i.e. P. acnes and S. epidermidis against antibiotics that used to treat acne. To overcome the problem of antibiotic resistance,

essentials oils and medicinal plant extracts have been extensively studied as an alternative. Herbs are safe, efficacious and multifunctional. Herbs and naturally derived compounds have less adverse effect than synthetic agents in topical acne treatments.

Modern treatments include antibiotics, retinoids, and benzoyl peroxide, which often produce side effects such as skin irritation, dryness, and resistance. Therefore, herbal formulations are gaining importance due to their safety and efficacy.

Causes of Acne

1. **Hormonal Changes**
Increase in androgens (male hormones) during puberty, menstruation, pregnancy.
Conditions like Polycystic Ovary Syndrome can worsen acne.
2. **Bacterial Growth**
Bacteria called Propionibacterium acnes grow in clogged pores, causing inflammation.
3. **Clogged Hair Follicles**
Dead skin cells mix with oil → blockage → formation of comedones.
4. **Diet Factors**
High glycemic foods (sugar, junk food)
Dairy products (in some individuals)
5. **Stress**
Stress increases hormone levels → more oil production.
6. **Cosmetics & Lifestyle**
Oily or comedogenic products, Poor hygiene habits.

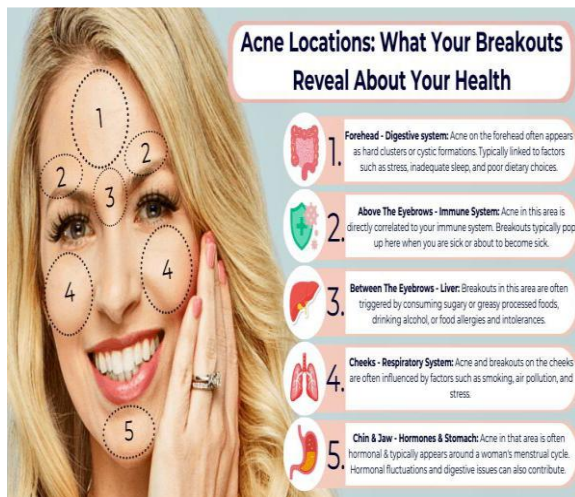


Fig Causes of Acne

AETIOPATHOGENESIS:

Acne is a multifactorial disease: genetic factors, Stress, androgens, and excess sweating all Influence its development and/or severity. Corticosteroids, oral contraceptives, iodides, bro-Mides, lithium, and chemicals such as dioxins Are known to induce acne eruptions, as are Endocrine disorders such as Cushing's syndrome And polycystic ovary syndrome. It is often found That acne is worse in current smokers, but Despite popular myth, diet, lack of exercise, lack of hygiene, greasy hair hanging over the face, And masturbation do not have any effect. Acne is a disease of the pilosebaceous units in the skin. A changed keratinisation pattern in the Hair follicle leads to blockage of sebum secre-Tion. It is probable that hyperresponsiveness to The stimulation of sebocytes and follicular Keratinocytes by androgens leads to the hyper-Plasia of sebaceous glands and seborrhea that Characterise acne. The enlarged follicular Lumen attributable to inspissated keratin and Lipid debris forms a closed comedone (white-Head). When the follicle has a portal of entry at The skin, the semisolid mass protrudes forming a Plug, producing an open comedone (black-Head).

Cosmetics is a Greek word which means to _adorn '(addition of something decorative to a person or a thing). Cosmetology is the study and application of beauty treatment. It's an art or science of beautifying and improving The skin, nails and the study of cosmetics and their application.

Serum is the concentrated solution which is commonly used in cosmetology. In water or oil the cosmetic serum Is just as potent as any other cream therefore, it deals with the skin problem quickly and effectively. A skin care Formulation must be able to deliver the powerful agent into the skin to fulfil the intended objective. Face serum is the answer to deliver the precious active ingredient into the skin thus eliminating the use of Hazardous chemicals in giving, instant results. The skin serum are designed to penetrate the skin deeply and Provide nourishment, hydration or address issues like wrinkles or pigmentation.

Conventional treatments for acne include topical and systemic therapies such as antibiotics, retinoids, benzoyl peroxide, and hormonal agents. While these treatments are effective, they are often associated with side effects like skin irritation, dryness, erythema, antibiotic resistance, and long-term toxicity. This has

led to increased interest in herbal and natural remedies, which are considered safer, cost-effective, and more compatible with skin physiology.

A face serum is a lightweight, fast-absorbing topical formulation designed to deliver active ingredients directly into the deeper layers of the skin. Compared to creams and lotions, serums have a higher concentration of active compounds and better penetration ability, making them more effective for targeted skin concerns such as acne.

Serum is a concentrated solution which is commonly used in cosmetology. In water or oil, the cosmetic serum is just as potent as Any other cream Therefore, it deals with the skin problem quickly and effectively. Because serum is composed of a small molecule that can penetrate the skin deeply and deliver a very high concentration of active Substances, it is especially well suited for this role. This makes them a tool to identify specific skin care concerns, such as colour, Signs of aging, acne. A skin condition called acne vulgaris causes acne. It is one of the most prevalent skin conditions and can cause comedones or severe Inflammatory lesions on the face, back, and chest. The condition of the disease is linked to an increased rate of sebum excretion.

Herbal cosmetics, called products, are made from various approved cosmetics to form a base, Where one or more herbal ingredients are used only to obtain certain cosmetics, are called herbal Cosmetics. Plant extracts are mainly added to cosmetic products due to several related properties such As antioxidant, anti-inflammatory, antiseptic and antimicrobial properties. Herbal preparations have received considerable attention because of their good efficacy and relatively few or no side effects of synthetic drugs. Herbal cosmetic products that are usually prepared and used for daily Use include herbal facials, herbal conditioners, herbal soaps, herbal shampoos, etc. Herbal cosmetics are defined as beauty products with desirable physiological effects such as healing, smoothing appearance, healing and conditioning properties, because of the herbal ingredient. Herbal cosmetics have gained prominence due to their Perceived safety, efficacy and low- risk profiles Compared to synthetic products. Increasing awareness About potential side effects associated with synthetic Actives has shifted consumer priorities, creating Demand for natural solutions in skin care.

Hyperpigmentation, dull complexion, and uneven skin Tone are common cosmetic concerns, driving research Into innovative topical products.

Herbal cosmetics have gained significant popularity due to their natural origin, minimal effects, and therapeutic benefits. Medicinal plants contain a wide range of bioactive compounds such as flavonoids, tannins, alkaloids, phenolics, and essential oils, which exhibit antimicrobial, anti-inflammatory, antioxidant, and wound-healing properties. These characteristics make herbal ingredients highly suitable for the treatment and management of acne

Herbal cosmetics are formulations containing plant-derived ingredients that provide cosmetic and therapeutic benefits. These products are preferred due to their biocompatibility and reduced side effects.

II.AIM AND OBJECTIVES

Aim:-To formulate and evaluate a herbal face serum containing natural ingredients for the effective treatment of acne.

Objectives:-

- 1.To prepare plant extracts.
- 2.To formulate a stable serum.
- 3.To evaluate physicochemical properties.
- 4.To assess antimicrobial activity.
- 5.To formulate a herbal face serum using natural ingredients.
- 6.To evaluate the physicochemical properties of the formulation.
- 7.To assess antimicrobial activity against acne-causing bacteria.
- 8.To ensure stability and safety of the product.

DRUGS AND EXCIPIENT

HIBISCUS:-

SYNONYMS: Bombycidendronu hassk, Brockmania W.Fitzg, Pariti Adnas, Wilhelminia Hochr, Rudrapuspa, Shoe flower plant, Semparutti.

BIOLOGICAL SOURCES: A genus of blooming plants known as hibiscus, Hibiscus rosa-sinensis Linn.

FAMILY: *Malvaceae*.



Fig. Hibiscus Powder

CHEMICAL CONSTITUENTS: Hibiscus rosa sinensis includes proteins, saponins, cardiac glycoside, glucose, reducing sugars, essential oils, steroids, anthraquinones, tannins, and alkaloids

USES: Hibiscus contains flavonoids, antioxidants, and alpha hydroxy acids which help in exfoliation, skin rejuvenation, and acne reduction.

Hibiscus has a legendary reputation for boosting skin elasticity to deliver a spectacular natural youth-boost and is one of the Most potent anti-ageing plant actives. Hibiscus actively fights the ageing process by firming and lifting your skin thanks to its Amazing capacity to suppress the activity of the enzyme elastase, which is responsible for breaking down our skin's priceless elastin.

Benefits for skin:

- a) Combats ageing symptoms
- b) Clears the skin's pore
- c) Tightens pore-opening skin
- d) Eliminates acne and inflammation
- e) Hasten the healing of wounds
- f) Guard skin collagen

NEEM:-

SYNONYMS: Azadirachta indica, Nira, Nimb, Vespa, Limba, Nimba

BIOLOGICAL SOURCES: Neem is made out of the seed oil and fresh or dried leaves of the Meliaceae family plant Azadirachta indica.

FAMILY: *Meliaceae*

CHEMICAL CONSTITUENTS: Various photochemical can be found in neem fruit, seeds, leaves, stems, and bark; some of these compounds were initially found in azadirachta seed extracts, such as azadirachtin, which was first used as an insecticide and anti infectant in the 1960s . The seed oil contains glycerides, various polyphenols, imboiled, triterpenes, and beta-sitosterol in addition to azadirachtin and related limonoids. [15][17] About 2% of the oil's composition is limonoid molecules, which have a garlic-like aroma and are yellow and bitter. Quercetin, catechins, carotenes, and vitamin C are all present in the leaves. It contains Quercetin, n-hexacosanol, amino acids, 6-desacetylnimbinene, Nimbiene, Nimbandiol, nimbolide, Nimbin, and Nimbidinin.



Fig. Neem Powder

GEOGRAPHICAL SOURCES: It can be found in Australia, India, Pakistan, Sri Lanka, Malaya, Indonesia, Japan, and Africa. It is present in Uttar Pradesh, Maharashtra, Tamil Nadu, Rajasthan, and M.P, in India.

USES: Neem can help cure inflamed skin because of its antibacterial and anti-inflammatory qualities. Neem is advantageous for treating skin irritation since it has the benefit of cooling the skin. Neem also has a calming effect on dry or parched skin. Neem possesses strong antibacterial, antifungal, and anti-inflammatory properties, making it highly effective against acne-causing bacteria.

Benefits of Neem for skin:

- a) Decreases the appearance of early signs of ageing
- b) Neem protects the skin from damaging UV radiation, pollution, and other environmental factors
- c) Aids in the management of acne
- d) Addresses blackheads and whiteheads

- e) Encourages collagen synthesis
- f) Use for bright skin
- g) Prevents skin infection

NUTMEG:-

SYNONYMS: *Myristica fragrans*, nutmeg tree.

BIOLOGICAL SOURCES: The Banda Islands in Indonesia, a small group of islands, are where nutmeg originally came from. It is The seed of a fruit that resembles a peach and grows on the *Myristica fragrans* tree.

FAMILY :*Myristicaceae*

CHEMICAL CONSTITUENTS : 5 to 15% volatile oil, lignin, stearin, starch, gum, colouring material, and 0.08% acid substance are all present in nutmeg. Clemicine, Myristicin, geraniol, borneol, pinene, camphene, and dipentene are all present in the volatile oil. It also has trace amounts of Isoeugenol, p-cymene, safrol, and eugenol.



Fig. Nutmeg Oil

USES: Nutmeg contains several bioactive compounds, such as myristicin, elemicin, and eugenol, which exhibit antimicrobial properties.

The bioactive compound present in nutmeg which acts as a natural weapon against various harmful microbes

Benefits of Nutmeg for Skin:

- a) Reduces Pigmentation
- b) Gently Exfoliates Your Skin
- c) Promotes Youthful Skin
- d) Acts As a Natural Toning Cleanser
- e) Reduce acne

Antibacterial activity of nutmeg: Both gram-positive and gram-negative bacteria can be defeated by the oils:

Escherichia coli, *Aeromonas hydrophile*, *Salmonella Chlorosis*, *Pseudomonas aeruginosa*, *Staphylococcus aureus*, *Listeria monocytogenes*, *Listeria innocuus* and others: *Actinobacteriacalcaemic*, *Alcaligenesfaecalis*, *Bacillus subtilis*, *Benecken antigens*, *Eubacterium linens*, *Brochure theosophical*, *Citrobacter fundi*, *Enterobacter aerogenes*, *Erwiniakrotovina*, *Flavobacterium suaveolens*, *Klebsiellapneumonia*, *Micrococcusluteus*, *Moraxella sp.*, *Proteus vulgaris*, *Serratia marcescens* and *Yersinia enterocolitica*.

ALOE VERA:

SYNONYMS: *Aloe indica* Royle, *Aloe perfoliate* L.vera and *Aloe vulgaris* Lam.

BIOLOGICAL SOURCE: Aloe is dried latex of leaves of it

FAMILY: *Liliaceae*

CHEMICAL CONSTITUENTS: Anthracene glycoside (11-40%) Barbaloin or Aloin, C glycoside. Isobarbaloin, aloe-emodin and aloesone. Resins (retinol+cinnamic acid or Coumaric acid). Aloinositides A and B (only in cape aloes) Aloeticacid, homonataloin etc



Fig. Aloe Vera

USES: Aloe Vera gel acts as a versatile, hydrating, and soothing, natural, non-greasy, lightweight serum that repairs skin barrier, fights acne, reduces dark spots, and boosts collagen for a glowing, youthful complexion. It is suitable for all skin types as a daily morning/night moisturizer, particularly for calming irritation and inflammation.

Benefits of Aloe Vera for Skin:

- a) Helps soothe sunburn.
- b) Helps in moisturize the skin.
- c) Boosts healing of wounds.
- d) Fights skin ageing.

- e) Helps in treating Eczema.
- f) Helps in the treatment of psoriasis.
- g) Use to treat inflammatory acne.

ROSE WATER:

SYNONYMS: Gulab Jal, Rosa Water, Rose Distillate, Aqua Rosae

BIOLOGICAL SOURCE: Rose water is obtained by steam distillation of fresh petals of the plant *Rosa damascena* (Damask rose)

FAMILY: *Rosaceae*



Fig. Rose Water

Chemical Constituents: Rose water contains small amounts of volatile oil and water-soluble components:

1. Volatile Oils (Essential oil components)

Citronellal

Geraniol

Nerol

2. Phenyl ethyl alcohol (major aromatic component)

Flavonoids

3. Quercetin

4. Kaempferol

Glycosides

Tannins

Anthocyanins

Responsible for color of petals

Benefits Of Rose Water for Skin :

- a) Acts as a natural skin toner
- b) Helps in cleansing and refreshing skin
- c) Used to reduce acne and pimples (mild antibacterial action)
- d) Provides hydration and glow to skin
- e) Soothes irritated and sensitive skin
- f) Acts as a vehicle in pharmaceutical preparations
- g) Mild antiseptic and anti-inflammatory agent
- h) Used as a flavoring agent in Formulation

III. MATERIALS AND METHODS

Materials

- Hibiscus flowers
- Neem leaves
- Nutmeg Oil
- Aloe Vera Gel
- Rose Water
- Carbopol 940
- Glycerin
- Propylene glycol
- Methyl paraben
- Vitamin E
- Distilled water

EXTRACTION OF MATERIALS:

1. Neem extraction: For water extraction of neem mixture of 100 gm of dried leaves and 1000 ml of distilled water was heated for 10 minutes while being stirred. Then, filter paper was used to separate the extract.

2. Hibiscus extraction: For water extraction of hibiscus 100 gm of dried flowers was taken in 1000 ml distilled water and mixture was boiled for 10 minutes while stirring. Then, filter paper was used to separate the extract.

3. Aoevera extraction: In the early morning, Aloe barbadensis leaves that had just been picked were manually cut. Aloe vera leaves are picked and carefully removed from the mother plant to avoid breaking the rind. Immediately following cutting, the leaves were preserved in an icebox at a temperature of 4-5° C and delivered to the lab. Fresh water was used to completely wash the leaves. To create the fillet, the outer peel and exudates of the leaves were painstakingly removed with the use of a knife. The fillets were ground in a household blander to create homogenised pulp. To separate the crude gel and fibre, the 60 ml of pulp on a volume basis was centrifuged in a cooling type centrifuge. To purify the charcoal, crude gel was combined with it. The process of vacuum filtering was employed to separate the pure gel from the crude gel.

4. Rose Water: Procured from market

5. Nutmeg oil: Procured from market.

Formulation of Serum:-

Step 1: Preparation of Base

Fresh aloe vera gel was collected and filtered to remove impurities. The gel was then blended to obtain a smooth and uniform consistency free from lumps.

Step 2: Preparation of Aqueous Phase

Neem extract, hibiscus extract, and rose water were accurately measured and mixed thoroughly to form a homogeneous aqueous phase.

Step 3: Incorporation into Base

The prepared aqueous phase was added slowly into the aloe vera gel under continuous gentle stirring to ensure uniform mixing and to avoid incorporation of air bubbles.

Step 4: Addition of Active Ingredients

Glycerin was added gradually with continuous stirring. Nutmeg oil was incorporated dropwise, followed by the addition of Vitamin E to enhance antioxidant properties.

Step 5: Final Adjustment

A suitable preservative was added to the formulation. The pH was adjusted within the range of 5.5–6.5 to match skin compatibility. The final volume was made up to 20 mL using rose water.

Step 6: Packaging

The prepared serum was filled into amber-colored glass bottles to protect it from light and ensure stability.

Composition of Batches (F1–F5)

Ingredient	F1 (mL)	F2 (mL)	F3 (mL)	F4 (mL)	F5 Optimized (mL)
Neem extract	0.4	0.8	1.2	1.6	1.6
Hibiscus extract	0.4	0.6	0.8	1.0	0.8
Nutmeg oil	0.04	0.06	0.08	0.10	0.08
Aloe vera gel	8.0	8.0	8.0	8.0	8.0
Glycerin	1.0	1.0	1.0	1.0	1.0
Vitamin E	0.2	0.2	0.2	0.2	0.2
Preservative	0.04	0.04	0.04	0.04	0.04
Rose water	q.s to 20 mL	q.s	q.s	q.s	q.s

EVALUATION PARAMETERS

The formulated herbal face serum was subjected to various evaluation parameters to determine its

physicochemical properties, stability, and suitability for topical application.

1. Physical Evaluation

The physical evaluation of the formulation was carried out by visual inspection and tactile assessment. The serum was examined for its colour, odour, appearance, and texture. An ideal formulation should possess a uniform colour, characteristic pleasant odour, clear or slightly translucent appearance, and a smooth, non-gritty consistency. These parameters are essential to ensure the aesthetic acceptability and quality of the product.

2. Determination of pH

The pH of the formulation was determined using a calibrated digital pH meter. The instrument was standardized using buffer solutions of known pH (4.0 and 7.0) prior to measurement. Approximately 1 mL of the serum was diluted with 50 mL of distilled water, and the electrode was immersed in the solution to record the pH value.

The pH of topical formulations should be within the range of 4.1 to 6.7 to match the natural acidic pH of the skin. Maintaining an appropriate pH is crucial to prevent skin irritation, ensure compatibility, and maintain the stability of active constituents.

3. Determination of Spreadability

Spreadability is an important parameter that determines the ease of application of the formulation on the skin. It was evaluated using the glass slide method. A known quantity (approximately 3 g) of the formulation was placed between two glass slides, and a weight of 20 g was applied to obtain a uniform film of desired thickness.

The upper slide was then allowed to move under the influence of a pulling force, and the time taken to travel a distance of 10 cm was recorded.

Spreadability was calculated using the following formula: $S = M \times L \div T$

where S is spreadability, M is the weight applied, L is the length moved, T is the time taken.

Good spreadability ensures uniform application and enhances the therapeutic effectiveness of the formulation

4. Stability Studies

Stability studies were conducted to evaluate the physical and chemical stability of the formulation under different environmental conditions. The study was performed in accordance with ICH guidelines.

The prepared serum was stored at different temperatures, including 25°C (room temperature), 35°C, and 40°C with relative humidity of 60% and 75%, respectively, for a specified period. The samples were periodically evaluated for changes in colour, odour, pH, consistency, and phase separation.

These studies are essential to determine the shelf life, storage conditions, and overall stability of the formulation.

5. Washability

Washability of the formulation was evaluated by applying a small quantity of the serum on the skin and subsequently washing it with water. The ease of removal was observed manually.

A good formulation should be easily washable without leaving any residue on the skin. This parameter is important for ensuring user convenience and acceptability, as well as confirming the non-greasy nature of the product.

IV.RESULTS AND DISCUSSIONS

1. Physical Evaluation

Table: Physical Evaluation of Formulations

Batch	Colour	Odour	Appearance	Texture
F1	Light brown	Mild herbal	Clear	Smooth
F2	Light brown	Pleasant	Clear	Smooth
F3	Brown	Herbal	Slightly viscous	Smooth
F4	Dark brown	Strong herbal	Slightly thick	Slightly sticky
F5 (Optimized)	Brown	Pleasant	Clear	Smooth, non-sticky

2. pH Determination

Table: pH of Formulations

Batch	pH
F1	5.2
F2	5.5
F3	5.8
F4	6.0
F5 (Optimized)	5.6

3. Spreadability

Table: Spreadability of Formulations

Batch	Spreadability (cm)
F1	5.0
F2	5.5
F3	6.0
F4	6.5
F5 (Optimized)	6.2

4. Stability Studies

Table: Stability Study (28 Days)

Batch	Stability Observation
F1	Stable
F2	Stable
F3	Stable
F4	Slight change observed
F5 (Optimized)	Stable

5. Washability

Table: Washability Test

Batch	Washability
F1	Easily washable
F2	Easily washable

F3	Easily washable
F4	Slightly difficult
F5 (Optimized)	Easily washable

V.DISCUSSION

The present study was carried out to formulate and evaluate a herbal face serum for anti-acne activity using natural ingredients. A total of five formulations (F1–F5) were prepared by varying the concentration of herbal extracts and evaluated for physicochemical properties, stability, and applicability.

The physical evaluation of all formulations indicated acceptable organoleptic characteristics such as colour, odour, appearance, and texture. However, formulation F4 showed a comparatively thicker consistency and slightly sticky texture, which may affect user acceptability. In contrast, F5 exhibited a smooth, non-sticky texture with a pleasant odour, making it more suitable for topical use.

The pH values of all formulations were found within the range of 5.2 to 6.0, which is compatible with the natural pH of the skin. This suggests that the formulations are safe for topical application and are unlikely to cause irritation. Maintaining this pH range is essential for preserving skin integrity and enhancing formulation stability.

The spreadability test revealed that the formulations exhibited good spreading properties, which are essential for uniform application on the skin surface. Although F4 showed the highest spreadability, its higher viscosity and stickiness may reduce ease of application. The optimized batch F5 demonstrated a balanced spreadability, ensuring efficient and comfortable application.

The stability studies indicated that most formulations remained stable under different storage conditions, with no significant changes in physical properties. However, F4 showed slight instability over time, possibly due to higher concentrations of active ingredients. The optimized formulation F5 remained stable throughout the study period, indicating good shelf life and formulation integrity.

The washability test confirmed that all formulations were easily washable except F4, which showed slight difficulty in removal due to its higher viscosity. Easy

washability is an important factor for user convenience and ensures that the formulation does not leave any residue on the skin.

Overall, the results suggest that increasing the concentration of herbal extracts improves certain properties such as spreadability but may negatively affect stability and texture at higher levels. Among all formulations, F5 demonstrated the most balanced performance in terms of physicochemical properties, stability, and user acceptability.

VI.CONCLUSION

From the present study, it can be concluded that a stable and effective herbal face serum can be successfully formulated using natural ingredients. The evaluation results confirmed that all formulations were suitable for topical application; however, formulation F5 exhibited the best overall performance.

The optimized formulation (F5) showed ideal physicochemical properties, good stability, excellent spreadability, and ease of washability, making it highly suitable for anti-acne application. The use of herbal ingredients provides added advantages such as safety, minimal side effects, and better patient compliance.

Thus, the developed herbal face serum can be considered a promising and safe alternative to conventional synthetic formulations for the management of acne.

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