

Systematic review on to formulate and evaluate a salicylic acid face serum for acne and oily skin

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Abstract - Rising cases of acne and oily skin have increased the need for safe and effective topical treatments. This work focuses on formulating and evaluating a salicylic acid-based face serum designed to reduce acne and regulate excess sebum. Salicylic acid, a beta-hydroxy acid, is widely recognized for its exfoliating, anti-inflammatory, and antimicrobial effects, making it suitable for acne management.

The serum was prepared using appropriate excipients such as solvents, humectants, and preservatives to improve stability and skin absorption. It was evaluated for key physicochemical properties including appearance, pH, viscosity, and spreadability. Stability testing was carried out under varying temperature conditions to assess consistency over time.

Additionally, antimicrobial activity against acne-causing microorganisms and skin irritation tests were performed to ensure safety. The formulation showed good stability, suitable physicochemical characteristics, and noticeable anti-acne effectiveness without significant irritation. Overall, the developed serum demonstrates potential as a reliable topical option for managing acne and oily skin.

Keywords: - Salicylic Acid, Face Serum, Acne Treatment, Oily Skin, Beta-Hydroxy Acid (BHA), Antimicrobial Activity, Keratolytic Agent, Skin Irritation, Stability Study, Topical Formulation

I. INTRODUCTION

Acne is a widespread skin condition, particularly common among adolescents and young adults. It is mainly caused by excess sebum production, clogged pores, bacterial activity, and skin inflammation. Oily skin further worsens this condition, highlighting the importance of proper treatment and skincare practices [1].

Topical therapies are commonly preferred for acne management as they act directly on the affected area and minimize systemic side effects. Among these, salicylic acid is widely used due to its proven effectiveness in treating acne and controlling oiliness

[2]. It is a beta-hydroxy acid (BHA) with keratolytic action, helping to remove dead skin cells and prevent pore blockage [3].

In addition, salicylic acid possesses anti-inflammatory and antimicrobial properties, which help reduce swelling, redness, and bacterial growth linked to acne [4]. Its lipophilic nature enables deeper penetration into pores, making it especially suitable for oily skin and comedonal acne [5].

Face serums are increasingly preferred in skincare because of their light texture, quick absorption, and efficient delivery of active ingredients. Compared to creams and lotions, they offer better penetration and targeted effects, making them effective for acne treatment [6].

Therefore, this study focuses on developing and evaluating a stable salicylic acid face serum aimed at reducing acne and managing oily skin with improved safety and user compliance

II. INGREDIENTS INFORMATION

1. Propylene Glycol

Acts as a solvent and humectant, improving the penetration of salicylic acid while helping retain moisture and maintain formulation stability [7].



Fig no: -1, propylene glycol

2. Salicylic Acid

A beta-hydroxy acid used for acne treatment due to its exfoliating, anti-inflammatory, and antimicrobial effects. It helps clear pores and reduce excess oil [8].

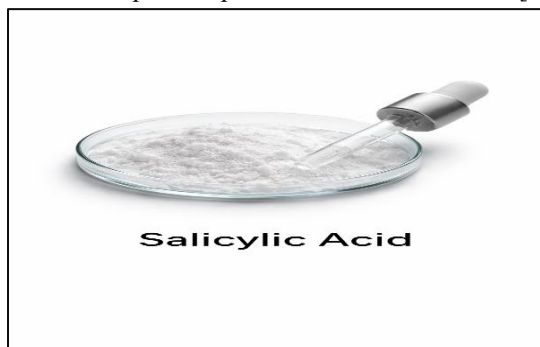


Fig no: -2, salicylic acid

3. Sodium Citrate

Functions as a buffering agent, maintaining an appropriate pH for stability and skin compatibility [9].



Fig no: -3, sodium citrate

4. Sodium Benzoate

Used as a preservative to prevent microbial growth, thereby enhancing product safety and shelf life [12].

5. Sodium Bicarbonate

Helps adjust and balance pH levels; used in controlled amounts to avoid irritation [10].

6. Glycerin

A humectant that retains skin moisture, improving hydration and smoothness [7].

7. Hyaluronic Acid

Provides deep hydration by holding water in the skin, improving elasticity and reducing dryness [10].

8. Water

Serves as the base and solvent, ensuring proper mixing and uniform distribution of ingredients [7].

9. Aloe Vera Extract

Known for its soothing, cooling, and moisturizing effects. It also has mild antibacterial and antifungal properties, useful for minor skin concerns [26].

FORMULATION TABLE: -

Sr. No.	Ingredients	Quantity (% w/v)	Category / Function
1	Salicylic Acid	2.0 %	Active ingredient (Anti-acne)
2	Propylene Glycol	10 %	Solvent / Penetration enhancer
3	Glycerin	5 %	Humectant (Moisturizer)
4	Hyaluronic Acid	1 %	Hydrating agent
5	Sodium Citrate	0.5 %	Buffering agent
6	Sodium Benzoate	0.2 %	Preservative
7	Sodium Bicarbonate	q.s.	pH adjuster
8	Purified Water	q.s. to 100 ml	Vehicle / Solvent
9	Aloe vera extract	5ml	Soothing agent

TABLE NO: -1, FORMULATION TABLE

III. METHOD OF PREPARATION

The salicylic acid face serum was prepared using a simple and effective method to ensure uniform mixing and stability of the formulation.

➤ Step 1: -

• Preparation of Aqueous Phase: -

Required quantity of purified water was taken in a clean beaker. Sodium citrate and sodium benzoate

were dissolved in it with continuous stirring until a clear solution was obtained. This forms the aqueous phase of the formulation [11].

➤ Step 2: -

• Preparation of Active Phase

Salicylic acid was dissolved in propylene glycol separately by gentle heating and stirring to ensure complete solubilization, as salicylic acid is poorly soluble in water [12].

➤ Step 3: -

• Mixing of Phases

The active phase (salicylic acid solution) was slowly added to the aqueous phase with continuous stirring to ensure uniform distribution of the drug in the base [13].

➤ Step 4: -

• Addition of Humectants

Glycerin and hyaluronic acid were added to the mixture and stirred properly to obtain a smooth and homogeneous serum [11].

➤ Step 5: -

• pH Adjustment

The pH of the formulation was adjusted by adding sodium bicarbonate dropwise until the desired skin-friendly pH (approximately 3.5–5.5) was achieved [14].

➤ Step 6: -

Final Volume Adjustment

Finally, purified water was added to make up the volume to 100 ml and mixed thoroughly to obtain a uniform serum [11].

➤ Step 7: -

• Packaging

The prepared serum was transferred into a clean, dry, and airtight container and stored at room temperature for further evaluation [13].



Fig no.4: - METHOD OF PREPARATION

IV. THEORY

1. Acne (Acne Vulgaris)

Acne vulgaris is a common inflammatory skin condition seen mainly in adolescents and young adults. It involves the pilosebaceous unit and presents as comedones, papules, pustules, nodules, or cysts [14]. It develops due to excess sebum, follicular blockage, bacterial growth (*Cutibacterium acnes*), and inflammation. Hormonal changes, especially androgens, increase sebum production and worsen the condition [1].

Acne is classified into non-inflammatory (blackheads and whiteheads) and inflammatory types (papules, pustules, nodules, cysts), which may lead to scarring if untreated [4]. Its mechanism involves pore blockage by sebum and dead cells, promoting bacterial growth and inflammation. Management focuses on reducing oil, clearing pores, controlling microbes, and minimizing inflammation [15].

A. Types of Acne

Acne can be divided into non-inflammatory (comedones) and inflammatory (papules, pustules, nodules, cysts). Severe forms like nodulocystic acne may cause permanent scars, making proper classification important for treatment selection [20].

B. Factors Affecting Acne

Hormonal imbalance, diet (high glycemic foods, dairy), stress, unsuitable cosmetics, and environmental factors like pollution contribute to acne development and severity [18].

C. Advantages of Salicylic Acid

Salicylic acid is oil-soluble, allowing deeper pore penetration compared to AHAs. It is generally less irritating than benzoyl peroxide and provides both exfoliating and anti-inflammatory effects [6].

D. Importance of pH in Skin Care

Skin maintains a slightly acidic pH, which protects against microbes. Formulations should be within pH 4.5–5.5 to avoid irritation. Salicylic acid is more effective under mildly acidic conditions [11].

E. Drug Penetration Through Skin

Drugs penetrate mainly through the stratum corneum by diffusion. Lipophilic substances like salicylic acid penetrate more effectively. Factors like solubility, size, and formulation type influence absorption [24].

F. Cosmetic vs Pharmaceutical Formulation

Cosmetics enhance appearance, while pharmaceuticals treat conditions. A salicylic acid serum offers both benefits, improving skin while treating acne [10].

G. Storage Conditions

The serum should be stored at room temperature, away from heat and light to prevent degradation and maintain effectiveness [11].

H. Packaging

Airtight and light-resistant containers, such as amber bottles, protect the formulation from contamination and degradation [7].

I. Shelf Life

Shelf life depends on composition, storage, and preservatives. Stability studies help determine how long the product remains effective [11].

J. Precautions with Salicylic Acid

Excess use may cause dryness or irritation. Sunscreen is recommended as it increases photosensitivity, and lower concentrations should be used for sensitive skin [10].

2. Oily Skin: Causes and Mechanism

Oily skin results from excessive sebum production, leading to greasy skin, enlarged pores, and acne risk [23]. Hormones, especially androgens, play a major role, along with genetics, stress, environment, and skincare habits [16]. Excess oil combines with dead cells, clogging pores and promoting bacterial growth, making oil control essential [17].

3. Salicylic Acid: Profile and Mechanism

Salicylic acid is a BHA widely used in acne treatment due to its keratolytic and comedolytic effects. Being lipophilic, it penetrates deep into pores [8]. It works by exfoliating the stratum corneum, removing dead cells, and preventing comedone formation [3]. It also reduces inflammation and bacterial growth, aiding faster healing [10].

It is commonly used in concentrations of 0.5–2% and is generally safe, though overuse may cause irritation [21].

4. Face Serum: Concept and Advantages

Face serums are lightweight formulations with a high concentration of active ingredients. They absorb quickly and provide targeted action, especially for acne and oily skin [10]. Their small molecular size ensures better penetration and effectiveness compared to creams [25].

5. Skin Structure

The skin consists of epidermis, dermis, and hypodermis. The stratum corneum in the epidermis acts as the main barrier to drug penetration [18]. The dermis contains glands and blood vessels, while the hypodermis provides support and insulation [19].

6. Mechanism of Acne Treatment by Salicylic Acid

Salicylic acid penetrates pores, removes dead cells, reduces sebum buildup, and prevents blockage. It

also decreases inflammation and bacterial growth, making it effective in acne treatment [22][3].

7. Role of Ingredients in Formulation

Each ingredient has a specific role: salicylic acid acts as the active agent, propylene glycol enhances penetration, glycerin and hyaluronic acid provide hydration, sodium citrate and bicarbonate maintain pH, sodium benzoate acts as a preservative, and water serves as the base [7].

8. Advantages of Serum Formulation

Serums are lightweight, fast-absorbing, and non-greasy. They deliver higher concentrations of active ingredients with better effectiveness and user comfort [10].

9. Stability of Cosmetic Formulations

Stability ensures safety and performance. Factors like temperature, light, and pH affect it. Stability studies evaluate changes in properties over time [11].

10. Ideal Properties of Face Serum

An ideal serum should be stable, non-irritating, properly balanced in pH, easy to apply, and effective in delivering active ingredients without side effects [8].

V. EVALUATION TESTS OF FACE SERUM

1. Physical Appearance

Assesses color, clarity, odor, and uniformity. An ideal serum should be clear, homogeneous, and free from particles. Any turbidity or separation indicates instability [11].

2. pH Determination

The pH should be within the skin-friendly range (4.5–5.5) to avoid irritation and ensure stability of the formulation and activity of salicylic acid [11].

3. Viscosity

Indicates thickness and flow behavior. Proper viscosity ensures easy application and uniform distribution of active ingredients [11].

4. Spreadability

Measures how easily the serum spreads on the skin. Good spreadability allows uniform application and better user compliance [13].

5. Homogeneity

Ensures even distribution of all components. A uniform formulation improves stability and consistent drug delivery [11].

6. Stability Study

Evaluates changes in properties like color, pH, viscosity, and odor under different conditions. A stable product retains its characteristics over time [11].

7. Irritancy Test

Determines skin safety by observing reactions like redness or itching after application. A suitable serum should be non-irritating [10].

8. Antimicrobial Activity

Checks the ability to inhibit microbial growth, which is important in acne treatment and product safety [4].

9. Drug Content Uniformity

Ensures even distribution of salicylic acid throughout the formulation, providing consistent therapeutic effect [13].

10. Washability

Indicates how easily the serum can be removed with water. Good washability reflects a non-greasy and user-friendly formulation

VI. RESULT AND DISCUSSION

The formulated salicylic acid face serum was assessed using different physicochemical parameters to determine its quality, stability, and overall performance.

Sr. No.	Parameter	Observation	Result
1	Appearance	Clear, transparent, no particles	Pass
2	pH	4.5	Suitable
3	Viscosity	Moderate (easy to apply)	Good
4	Spreadability	Easily spreadable	Good
5	Homogeneity	Uniform, no lumps	Pass
6	Stability	No change after storage	Stable
7	Irritancy Test	No redness or irritation	Safe
8	Washability	Easily washable	Good

TABLE NO:-2, RESULT AND CONCLUSION

The serum was clear, transparent, and free from particles, showing good quality and uniformity, with no phase separation observed. Its pH (4.0–5.0) was suitable for skin application and supported the activity of salicylic acid without causing irritation.

The viscosity was well balanced, allowing easy application and good spreadability. The formulation spread smoothly with minimal effort, ensuring even distribution. Stability studies showed no significant changes in color, odor, pH, or consistency under different conditions, confirming good stability over time.

No signs of irritation such as redness or itching were observed, indicating the formulation is safe for topical use. The serum also showed antimicrobial activity against acne-causing microorganisms, supporting its effectiveness. Overall, the formulation demonstrated good physicochemical properties, stability, safety, and efficacy for managing acne and oily skin.



Fig.No,4 Face serum

VII. CONCLUSION

The study successfully developed a stable and effective salicylic acid face serum for treating acne and oily skin. The formulation showed acceptable physical properties, proper pH, good spreadability, and stability. Salicylic acid contributed to exfoliation, pore cleansing, and reduction of inflammation.

The serum was non-irritating and suitable for topical use, ensuring safety and reliability. The selected excipients further improved its stability and performance. Overall, the formulation can be considered a promising option for managing acne and oily skin.

REFERENCES

- [1] Zaenglein A.L., Pathy A.L., Schlosser B.J., et al., Guidelines of care for the management of acne vulgaris, *Journal of the American Academy of Dermatology*, 2016; 74(5): 945–973.
- [2] Draelos Z.D., Acne and oily skin: role of topical therapies, *Dermatologic Clinics*, 2012; 30(1): 17–25.
- [3] Kligman A.M., Mills O.H., Salicylic acid as a keratolytic agent, *Archives of Dermatology*, 1972; 106(6): 843–850.
- [4] Gollnick H., Cunliffe W., Berson D., et al., Management of acne: a report from a global alliance to improve outcomes in acne, *Journal of the American Academy of Dermatology*, 2003; 49(1): S1–S37.
- [5] Berson D.S., Chalker D.K., Harper J.C., et al., Current concepts in the treatment of acne: report from a clinical roundtable, *Cutis*, 2003; 72(1): 5–13.
- [6] Mukherjee P.K., Maity N., Nema N.K., Sarkar B.K., Bioactive compounds from natural resources against skin aging, *Phytomedicine*, 2011; 19(1): 64–73.
- [7] Rowe R.C., Sheskey P.J., Quinn M.E., *Handbook of Pharmaceutical Excipients*, 6th ed., Pharmaceutical Press, 2009; 1–917.
- [8] Barel A.O., Paye M., Maibach H.I., *Handbook of Cosmetic Science and Technology*, 3rd ed., Informa Healthcare, 2009; 1–786.
- [9] Harry R.G., *Harry's Cosmeticology*, 8th ed., Chemical Publishing Co., 2000; 1–800.
- [10] Draelos Z.D., *Cosmetic Dermatology: Products and Procedures*, 2nd ed., Wiley-Blackwell, 2015; 1–300.
- [11] Aulton M.E., Taylor K., *Aulton's Pharmaceutics: The Design and Manufacture of Medicines*, 4th ed., Churchill Livingstone, 2013; 1–700.
- [12] Allen L.V., *Pharmaceutical Calculations and Compounding*, 2nd ed., American Pharmacists Association, 2012; 1–400.
- [13] Lachman L., Lieberman H.A., Kanig J.L., *The Theory and Practice of Industrial Pharmacy*, 3rd ed., Lea & Febiger, 1986; 1–902.
- [14] Thiboutot D., Gollnick H., Bettoli V., et al., New insights into the management of acne: an update from the Global Alliance, *Journal of the American Academy of Dermatology*, 2009; 60(5): S1–S50.

- [15] Williams H.C., Dellavalle R.P., Garner S., Acne vulgaris, *The Lancet*, 2012; 379(9813): 361–372.
- [16] Thiboutot D., Regulation of human sebaceous glands, *Journal of Investigative Dermatology*, 2004; 123(1): 1–12.
- [17] Berson D.S., Shalita A.R., The treatment of acne: the role of combination therapies, *Journal of the American Academy of Dermatology*, 1995; 32(5): S31–S41.
- [18] Barry B.W., *Dermatological Formulations: Percutaneous Absorption*, Marcel Dekker, 1983; 1–480.
- [19] Tortora G.J., Derrickson B., *Principles of Anatomy and Physiology*, 14th ed., Wiley, 2014; 1–1200.
- [20] Goodman G., Acne and acne scarring: the case for active and early intervention, *Australian Family Physician*, 2006; 35(7): 503–504.
- [21] Del Rosso J.Q., Kircik L.H., The role of salicylic acid in acne treatment, *Journal of Clinical and Aesthetic Dermatology*, 2013; 6(2): 19–27.
- [22] Leyden J.J., Therapy for acne vulgaris, *New England Journal of Medicine*, 1997; 336(16): 1156–1162.
- [23] Rawlings A.V., Ethnic skin types: are there differences in skin structure and function?, *International Journal of Cosmetic Science*, 2006; 28(2): 79–93.
- [24] Benson H.A.E., Transdermal drug delivery: penetration enhancement techniques, *Current Drug Delivery*, 2005; 2(1): 23–33.
- [25] Walters K.A., Roberts M.S., *Dermatological and Transdermal Formulations*, CRC Press, 2002; 1–400.
- [26] Cleidson V, Simone M, Elza F, Artur S. Screening methods to determine antibacterial activity of natural products. *Brazilian Journal of Microbiology*, 2007; 38: 369–380.