

A REVIEW ON EVALUATION OF 2.5% BENZOYL PEROXIDE AND 5% NIACINAMIDE TOPICAL SERUM IN ACNE MANAGEMENT

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ABSTRACT

Acne vulgaris is among the most common skin disorders, impacting approximately 70–87% of people worldwide. The rising need for efficient and gentle on-skin topical treatments has driven the creation of combination products aimed at various acne-triggering mechanisms. This assessment centres on the creation and testing of a topical serum that includes 2.5% Benzoyl Peroxide (BPO) and 5% Niacinamide. Benzoyl Peroxide is a recognized antimicrobial and keratolytic compound celebrated for its efficacy yet frequently linked to irritation. Niacinamide, a form of vitamin B3, enhances BPO by decreasing inflammation, fortifying the skin barrier, managing oil production, and boosting tolerability. The combined serum provides a well-rounded therapeutic effect by decreasing *Propionibacterium acnes* growth, lowering inflammation, and stopping the development of new lesions. This review outlines the pharmacological mechanisms, formulation approaches, physicochemical assessments (pH,

viscosity, Spreadability, stability), safety aspects, and therapeutic efficacy of the combined serum. The results endorse this dual-action formulation as an effective, stable, and well-tolerated choice for treating mild to moderate acne.

KEYWORDS: Acne vulgaris, Benzoyl Peroxide, Niacinamide, Topical serum, Anti-inflammatory, Antibacterial, Formulation evaluation.

1. INTRODUCTION

Acne vulgaris is a long-lasting inflammatory skin condition impacting the pilosebaceous units, typically affecting the face, chest, back, and shoulders. Worldwide, it impacts roughly 70–87% of people in their teenage years and early adulthood, ranking it among the most prevalent skin conditions.^[1] Acne manifests through various types of lesions such as comedones (blackheads, whiteheads), papules, pustules, nodules, and cysts. The psychological effects are considerable and might hinder self-esteem and overall life quality.^[2]

Acne results from four major pathogenic factors:

1. Excess sebum production
2. Follicular hyperkeratinization
3. Colonization by *Cutibacterium acnes*
4. Inflammatory response

Effective acne treatment should therefore target multiple pathways.^[3]

Topical treatments continue to be the primary option for mild to moderate acne. Benzoyl Peroxide (BPO) is a commonly recommended medication because of its potent antibacterial properties and its effectiveness in decreasing follicular obstruction. Nonetheless, BPO may lead to dryness, irritation, and redness in certain patients.^[4] Niacinamide provides additional advantages, such as reducing inflammation, enhancing barrier function, regulating oil production, and improving skin tolerance.^[5]



Merging 2.5% BPO with 5% Niacinamide produces a synergistic blend that enhances treatment results while minimizing irritation.^[6,7] This review article explores the formulation procedure, scientific reasoning, assessment studies, and therapeutic importance of this dual-action topical serum.^[8]

2. Face serum

A face serum is a light and concentrated skincare product that helps deliver useful ingredients deep into the skin. Unlike creams or lotions, serums have tiny particles that go deeper into the skin and treat specific problems like pimples, dark spots, aging signs, and dryness.^[9] and^[10]

2.1 Types of face serum

1). Oil serum:- An oil serum is a simple type of face serum made mainly with natural oils that easily absorb into the skin. It is especially good for dry skin because it helps to keep the skin soft and moisturized using high-quality oils.

2). Gel serum:- A gel serum helps to tighten and firm the skin where it is applied. Water-based plant extracts can be added to the gel serum to make it more effective.

3). Water based serum:- A water-based serum is a light, watery serum that contains a small amount of gum to give it thickness. It is usually applied before creams or lotions so that the water-loving (hydrophilic) plant extracts can stay on the skin. Water-based serums absorb deeply into the skin and help deliver active ingredients effectively.^[11] and^[12]

4). Hydrating Serum:- Has ingredients like Hyaluronic Acid and Glycerin. It helps the skin stay soft and moisturized by keeping water inside the skin. Best for people with dry or rough skin.

5) Brightening Serum:- Made Serum with Vitamin C or Niacinamide. It helps to lighten dark spots, make the skin tone even, and give a healthy glow. Good for dull or uneven skin.

6). Anti-Aging Serum:- Contains Retinol, Peptides, and Collagen. It helps to reduce wrinkles and fine lines and makes the skin firm and smooth. Best for older or aging skin. Anti-Acne Serum Has ingredients like Benzoyl Peroxide, Salicylic Acid, or Niacinamide. It helps to kill acne-causing germs, reduce pimples, and control excess oil. Suitable for oily and acne-prone skin.

7). Exfoliating Serum:- Contains AHAs and BHAs, which are gentle skin acids. These help to remove dead skin cells, clean pores, and make the skin smooth and glowing.^[13,14,15]

3. Benzoyl Peroxide

3.1 Drug profile of benzoyl peroxide

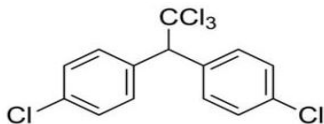


Fig. 1: structure of benzoyl peroxide.

- Chemical name: - Dibenzoyl peroxide
- Molecular formula: - $C_{14}H_{10}O_4$
- Appearance: - White crystalline powder
- Solubility: - Insoluble in water, soluble in alcohol and acetone

3.2 Mechanism of action

Benzoyl Peroxide is an organic substance known for its strong antimicrobial and keratolytic properties. Its procedures include:

- Antibacterial effect: Releases free oxygen radicals that destroy Cutibacterium acnes, thriving in low-oxygen conditions.
- Keratolytic action: Helps remove dead skin cells, preventing follicular blockage.
- Comedolytic effect: Reduces the formation of blackheads and whiteheads.
- Anti-inflammatory effect: Decreases the severity of inflammatory lesions.^[16]

4. Niacinamide

4.1 Drug profile of Niacinamide

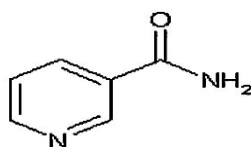


Fig. 2: Structure of Niacinamide.

- Chemical Name: - Nicotinamide
- Molecular Formula: - $C_6H_6N_2O$
- Solubility: - Freely soluble in water, ethanol, and glycerin
- Nature: - Stable, non-acidic, and non-irritating form of Vitamin B3 (43).

4.2 Mechanism of action

Niacinamide (Vitamin B3) provides multiple skin advantages pertinent to acne treatment:

- Decreases inflammation: Inhibits cytokines and other inflammatory substances.

- Fortifies the skin barrier: Boosts the synthesis of ceramides, cholesterol, and fatty acids.
- Regulates sebum production: Decreases the overproduction of oil.
- Enhances skin tone: Diminishes redness, hyperpigmentation, and marks left by acne.
- Offers antioxidant protection: Shields the skin from oxidative harm.

At a concentration of 5%, niacinamide effectively soothes irritated skin and improves the tolerance to benzoyl peroxide (BPO).^[17,18]

4.3 Synergistic Advantages of the BPO–Niacinamide Combination

The pairing of benzoyl peroxide (BPO) and niacinamide offers several significant therapeutic benefits:

- Decreased irritation typically linked to BPO used alone.
- Increased patient adherence due to improved tolerability.
- Dual action: antibacterial (BPO) + anti-inflammatory (niacinamide).
- Enhanced skin barrier function, supporting recovery.
- Improved long-term management of acne through complementary mechanisms.
- Less post-inflammatory hyperpigmentation (PIH), particularly advantageous for individuals with darker skin tones.
- These synergistic benefits render the formulation suitable for treating mild to moderate acne.^[19]

5. Evaluation Parameters

5.1 Physical appearance

Method: Examine three samples from each batch under controlled daylight or D65 illumination. Capture images against a neutral backdrop. Document the color, clarity (clear/cloudy), and any visible particles or signs of phase separation.

Criteria for Acceptance: consistent color and appearance among samples; absence of phase separation or visible particles.

1.2 Aroma

Method: Assemble a small trained panel (3–5 individuals) to evaluate odor strength and acceptability using a 5-point scale (0 = none, 4 = very strong). Note any undesirable odors.

Criteria for Acceptance: odor score must fall within the acceptable range for the product (as determined by the panel); no rancid or chemical off-odors.

1.3 Homogeneity

Procedure: Conduct a visual examination and, when feasible, perform a microscopic analysis of three samples. For emulsions or serums, centrifuge at 3000 rpm for 10 minutes and check for any signs of separation.

Acceptance: There should be no visible phase separation; the appearance must be uniform following centrifugation.

1.4. PH

Rationale: To ensure compatibility with skin and the stability of BP/niacinamide.

Procedure: Dissolve 1 g of the product in 9 mL of distilled water (10% w/v) OR utilize a flat-surface electrode on the undiluted product if the electrode allows. Calibrate the pH meter at 25°C. Conduct measurements in triplicate.

Acceptance: The typical pH range for facial serums is 4.5–6.5 (adjust as necessary based on formulation and irritation profile). Document the mean \pm SD.

1.5. Viscosity & Rheology

Rationale: This parameter influences spreadability, dosing, and stability.

Procedure: Use a Brookfield rotational viscometer or a cone-plate rheometer. Measure viscosity at shear rates ranging from 0.5 to 100 s⁻¹ (or speeds that encompass the intended range). Execute an up-and-down shear sweep to assess thixotropy (time-dependent recovery).

Acceptance: Values should remain consistent across batches ($\pm 10\%$); the flow behavior must align with expectations (e.g., shear-thinning).

1.6. Spreadability / Texture / Sensory Evaluation

• Spreadability

Procedure: Position 0.5 g of the product between two glass plates, apply a constant weight (e.g., 500 g) for 1 minute, and measure the resulting diameter. Repeat this process three times.

Acceptance: The spread diameter must be consistent within $\pm 10\%$ across batches.

- **Texture & sensory**

Procedure: A trained panel evaluates tackiness, greasiness, and absorption time using 5-point scales.

Acceptance: Scores must fall within the product specifications.^[20,21]

6. Application

1. Used as a topical treatment for acne vulgaris to reduce pimples, blackheads, and whiteheads.
2. Helps to control excess sebum (oil) production, keeping the skin less oily.
3. Provides antibacterial action against *Propionibacterium acnes*, the bacteria responsible for acne.
4. Promotes skin healing and reduces inflammation caused by acne lesions.
5. Helps in lightening acne scars and improving overall skin tone due to niacinamide.
6. Acts as a skin barrier protector, improving hydration and reducing irritation.
7. Can be used in daily skincare routines for people with oily or acne-prone skin.
8. Helps in preventing the recurrence of acne by unclogging pores and maintaining skin clarity.
9. Provides a non-greasy and fast-absorbing alternative to traditional acne creams.
10. Useful as a combination therapy along with other mild acne treatments for better results.^[22]

7. Clinical Importance in Acne Treatment

Advantages seen in patients

- Decreased inflammatory and non-inflammatory lesions
- Reduced redness and swelling
- Decrease in *C. acnes* bacterial count
- Enhanced texture and clarity
- Reduced frequency of acne
- Quicker reduction of post-acne scars

Appropriate for

- Light to moderate pimples
- Skin that is oily or susceptible to acne
- Teenagers and grown-ups

- Ongoing treatment.^[23]

8. Safety and Patient Compliance

Benzoyl Peroxide may lead to dryness, peeling, or redness; however, the inclusion of niacinamide greatly mitigates these negative effects. Serum formulations are quickly absorbed and are more visually appealing than creams or gels.

Counselling points

- Start slowly (once daily, then increase to twice daily if well-tolerated)
- Apply sunscreen to avoid photosensitivity
- Refrain from using strong exfoliants in the same regimen
- The combination is considered safe for extended use.^[24]

9. CONCLUSION

The combination of 2.5% Benzoyl Peroxide and 5% Niacinamide in a topical serum provides an evidence-based, effective, and well-tolerated approach for treating mild to moderate acne. The simultaneous action of these agents—antibacterial, keratolytic, anti-inflammatory, and barrier-strengthening—delivers enhanced therapeutic benefits compared to using either one alone. Studies on formulation and evaluation verify that the serum possesses favourable physicochemical traits, stability, and user satisfaction. This review emphasizes the potential of this combination as a noteworthy advancement in acne treatment, providing greater effectiveness while reducing irritation and improving patient adherence.

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