EUROPEAN JOURNAL OF BIOMEDICAL AND PHARMACEUTICAL SCIENCES
http://www.ejbps.com

ISSN 2349-8870
Volume: 12
Issue: 1
Year: 2025

EXPLORING THE EFFICACY AND SAFETY OF BENZOYL PEROXIDE IN ACNE VULGARIS MANAGEMENT

Ravendra Sahu[1], Yograj Sahu[1], Rishu Kumar[1], Shobha Sahu[2*], Gyanesh Kumar Sahu[2] and Rajesh Kumar Nema[2]

[1]Rungta Institute of Pharmaceutical Sciences & Research.
[2]Rungta Institute of Pharmaceutical Sciences.

***Corresponding Author: Shobha Sahu**

Rungta Institute of Pharmaceutical Sciences.

Article Received on 27/11/2024 **Article Revised on 17/12/2024** **Article Accepted on 06/01/2025**

ABSTRACT

Benzoyl peroxide (BPO) is a popular topical treatment for acne vulgaris, a common skin condition that can be identified by an outbreak of pustules, blackheads, and cysts. BPO has antiseptic, anti-inflammatory, and keratolytic effects on the skin in addition to reducing sebaceous gland activity, which helps to prevent congestion in the pores, and including oxygen into the skin, which helps to kill Propionibacterium acnes, also known as the bacteria that causes acne. This abstract examines the pharmacology, efficacy, and safety properties of benzoyl peroxide in acne treatment, emphasizing its role as the initial course of treatment and its significance in achieving sustained acne control. Benzoyl peroxide comes in a variety of forms, such as creams, gels, and washes, and is commonly used in concentrations ranging from 2.5% to 10%. Despite its effectiveness, its use can cause skin irritation, dryness, and peeling, especially in the early stages of treatment. The potential for combination therapies with other agents, such as oral antibiotics, retinoids, and salicylic acid, has been investigated recently.

KEYWORDS: Acne Vulgaris, Cysts, Effectiveness, Topical Treatment.

1. INTRODUCTION

One of the most popular and successful remedies for the vulgar form of acne, a skin disorder marked by the development of acne breakouts, blackheads, and cysts, is benzoyl peroxide (BP). It is readily accessible in both prescription-strength and over-the-counter (OTC) versions. Because of its shown ability to lessen the two violent and non-inflammatory acne tumours, BP has emerged as a key component in acne treatment, making it appropriate for a range of acne severity. The two main impacts of benzoyl peroxide's mechanism of action are keratolytic and antimicrobial. By releasing oxygen free radicals, BP destroys Propionibacterium acnes, also known as the bacteria that causes acne. Additionally, it promotes peeling of dead skin cells, which inhibits the creation of new comedones and helps to avoid pore obstruction. Because of these combined effects, BP is an effective treatment for existing breakouts as well as a preventative measure against new ones. The concentrations of topical benzoyl peroxide, which come in a variety of formulations including as gels, moisturizers, washes, and pads, usually range from 2.5% to 10%. BP is frequently some of the first-line therapies for those with intermediate to moderate acne because of its efficacy and accessibility. Notwithstanding its advantages, it may have certain negative effects that should be carefully controlled to maximize its usage, including as irritation, chapped lips, and higher reactivity to sunlight. It is almost insoluble in water and readily soluble in ether, chloroform, and other organic solvents. Benzoyl peroxide dissolves after dissolve or at temperatures higher than 66 °C, although being stable in solid state at normal temperature. Heating can cause explosive breakdown. Because the pure material oxidizes and ignites itself, it is marketed in blends of varying proportions with an inert filler. Benzoyl peroxide of pharmaceutical grade has a water content of 25% (w/w). Even at room temperature, benzoyl peroxide breaks down in solution due to homolytic breakage of the O-O bond, which releases radicals. These radicals have an antibacterial effect on nearby protein structures, for example, which contributes to the clinical effect. However, they also have an irritating effect on healthy skin components, which has made it difficult for patients to adhere to their benzoyl peroxide-based acne treatment since the start.

BACKGROUND

One of the most popular remedies for acne vulgaris is benzoyl peroxide (BP). Acne vulgaris is a common skin ailment that is mostly caused by bacterial infections and excessive sebum production. It is characterized by the

creation of pores (blocked pores), acne breakouts, and cysts. Because it effectively reduces acne lesions, has bactericidal qualities, and can stop new acne lesions from forming, BP is a potent antimicrobial drug that have been used to treat acne for decades. A steadily increasing amount of research demonstrating its efficacy, especially in minimizing acne lesions and regulating bacterial proliferation. Clinical reviews have evolved over time to include synthesis studies, patient-reported outcomes, and an emphasis on side effects and tolerance. Because of its dual-action mechanism, affordability, and ease of use, benzoyl peroxide is still one of the most popular acne treatments; nevertheless, innovative compositions and combination therapies are continually improving its application.

(Fig 1 Benzoyl Peroxide)

2. MECHANISM OF ACTION

Benzoyl peroxide has modest anti-inflammatory properties, comedolytic, and antibacterial properties that can cure acne. Although it may bring about dehydration, separating, and irritation, especially in individuals with sensitivity, it is useful in treating mild to severe acne.

a) Antibacterial Action

Strong antibacterial qualities are possessed by benzoyl peroxide. When sprayed to the skin, it releases oxygen, which aids in the destruction of the Propionibacterium acnes strain (P. acnes), the microorganism that causes acne. The introduction of oxygen interferes with P. acnes' capacity to survive and multiply since it flourishes in the anaerobic (oxygen-deficient) environment of closed pores.

b) Comedolytic Effect

By encouraging skin cell turnover, BPO helps stop comedones—the blocked pores that cause acne—from forming. By exfoliating the skin's outer layer, it helps keep cellular debris from building up and blocking pores. Both blackhead and whitehead formation can be decreased by taking this procedure.

c) Sebum Regulation

Although BPO doesn't directly lower the production of sebum, or skin oil, it can have an indirect impact on sebaceous gland activity. The excessive oil accumulation that causes acne can be lessened by decreased bacterial presence and increased skin cell turnover.

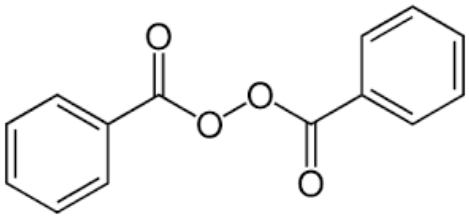

Fig 2: Structure of Benzoyl Peroxide.

3. EFFICACY

One of the best ways to treat acne is using topical benzoyl peroxide (BPO), especially for mild to moderate cases. Numerous clinical investigations have demonstrated its effectiveness, and dermatologists frequently suggest it as a first-line therapy.

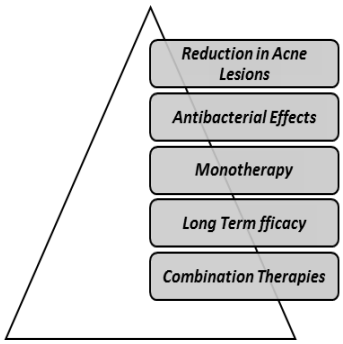

Fig 3: Table of Efficacy of the Benzoyl Peroxide.

a) Monotherapy

BP has been shown in several clinical trials to be beneficial in decreasing acne lesions, especially at doses of 2.5%, 5%, and 10%. BP is a good first-line treatment for mild to severe acne since it dramatically lowers the amount associated with inflammatory and non-inflammatory lesions related to acne.

b) Combination Therapies with Retinoids

BPO and conventional retinoids, such as adapalene, work very well together to treat acne that is both inflammatory and non-inflammatory. By decreasing acne-causing germs and encouraging a quicker turnover of skin cells, this combination works in concert.When using topical antibiotics like clindamycin are frequently used with benzoyl peroxide to target P. acnes and lower the likelihood that bacteria will develop resistance.

c) Diminished Acne Lesions Comedones

By assisting in preventing the accumulation of skin cells that have died and oils in hair follicles, BPO effectively reduces both open comedones, also known as blackheads, and closed comedones, also known as whiteheads. New lesions are less likely to occur as a result.Inflammatory Lesions: By eliminating P. acnes germs and lowering the inflammation brought on by

infections caused by bacteria in blocked pores, BPO dramatically decreases acne-related inflammation (papules and pustules). According to studies, after four to eight weeks of therapy, BPO can decrease the number of autoimmune lesions by as much as 50–60%.

d) Continuous Efficacy

BP has demonstrated long-term efficacy in managing acne. Over time, using BP-based therapies on a regular basis can help lessen the degree of severity of acne and stop future outbreaks.

4. FORMULATION

The efficacy, stability, and acceptability of topical benzoyl peroxide, among others, (BPO) treatment for acne depend heavily on its formulation. It comes in a variety of forms, with varying doses, delivery systems, and other substances to boost its effectiveness and lessen any discomfort.

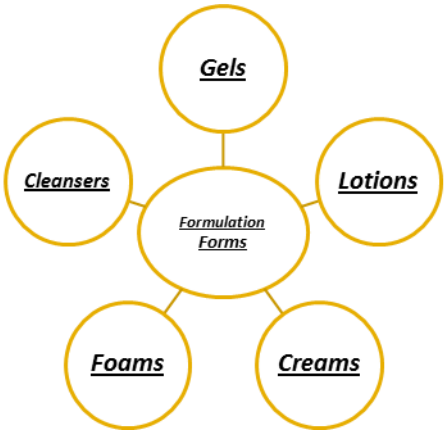

Fig 4: Table of the Formulation of Benzoyl Peroxide.

a) Common Concentrations

The most often utilized percentages are 2.5%, 5%, and 10%. 2.5% BPO is a popular option since studies demonstrate that it works just as well as larger doses (such 5% or 10%) while causing less discomfort.

b) Microencapsulated BP

The regulated release of BP made possible by microencapsulated BP technology reduces discomfort while preserving its effectiveness. Because microencapsulation delivers blood pressure in smaller, longer-lasting doses throughout time, it lowers the risk of drying of the skin and redness.

c) Hybrid formulations

BP is frequently found in products that combine it with adapalene, clindamycin, or salicylic acid, such as gels or washes. A more thorough approach to managing acne as well as treating its numerous underlying causes is offered by these combo treatments.

5. IDEAL QUALITIES

The best benzoyl peroxide for treating acne should balance comfort, skin compatibility, and efficacy. It should come in protected packaging, be properly made with calming and moisturizing components, and have the right concentration. For the treatment of acne while preserving the health of the layer underneath, look for a formula that suits your skin type, clinical evidence of its effectiveness, and encouraging user reviews.

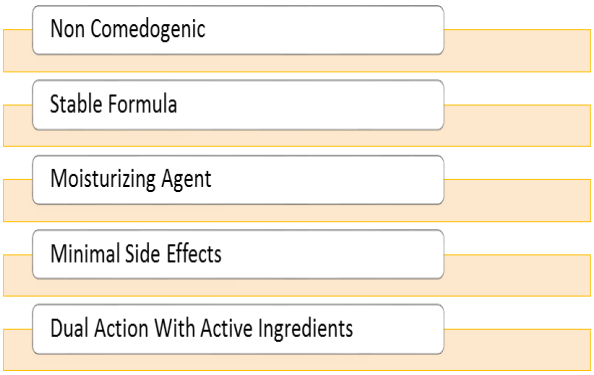

Fig 5: Ideal Qualities of the Benzoyl Peroxide.

- **Non Comedogenic**

The outcome ought to have marked as hypoallergenic, which means it won't clog pores, in order to prevent making acne worse while treating it.

- **Stable Formula**

When benzoyl peroxide, among others, is exposed to air and light, it can break down. To prevent the benzoyl peroxide ingredient against degrading and losing its potency, the perfect product will be packaged opaquely or in a closed manner.

- **Moisturizing Agent**

Considering benzoyl peroxide may be drying, an effective acne remedy should also contain soothing and moisturizing substances like hyaluronic acid, glycerine, or aloe vera to help keep the skin hydrated.

- **Minimal Side Effects**

Decreased Irritation While a slight hurting or buzzing is normal while using the product for the first time, an excellent benzoyl peroxide facial treatment shouldreduce adverse effects like as inflammation, scaling, or drying out of the skin.

- **Dual Action with Active Ingredients**

Interaction with Additional Face-Fighting Ingredients: Benzoyl peroxide products may contain niacinamide, sulphur, or salicylic acid as supplementary acne treatments. These can improve the product's capacity to lessen aggravation and acne while providing further skincare advantages.

6. MARKET FORMULATION

S.no	Marketed Product	Concentration	Formulation	Qualities
01	**Neutrogena On-the-Spot Acne Treatment**	2.5% benzoyl peroxide	Cream	Treating mild to moderate acne.
02	PanOxyl Acne Foaming Wash	4% and 10% benzoyl peroxide	Foaming wash	Reduce acne breakouts
03	Clean & Clear Advantage Acne Spot Treatment	10% benzoyl peroxide	Gel	Ideal for more severe breakouts or cystic acne
04	Adapalene Gel 0.1% Acne Treatment	Retinoid	Gel	Strong acne treatment
05	Cleansing Gel by Paula's Choice CLEAR	2.5% benzoyl peroxide	Gel cleanser	Help reduce acne without excessively drying the skin
06	ZitSticka KILLA Kit	5% benzoyl peroxide	Patch treatment	Spot treatment of pimples
07	AcneFree Clear Skin Treatment	3.5% benzoyl peroxide	Gel	For acne-prone skin

7. FUTURE PROSPECTIVE

The constant advances in formulations, delivery systems, and combination treatments, benzoyl peroxide appears to be a viable therapy for acne. The future of benzoyl peroxide in blemish therapy is promising, with developments concentrating on sophisticated delivery methods, combination treatments, and softer formulations that preserve efficacy while minimizing discomfort. Benzoyl peroxide's function in treating acne is expected to become more adaptable, customized, and long-lasting as skincare research advances, providing customers with a better experience regardless of their skin type or the severity of their acne.

8. CONCLUSION

The concentrated form of benzoyl peroxide to neutralize bacteria that causes acne, reduce inflammatory conditions, and prevent pore obstruction makes it one of the most popular and effective acne treatments. Benzoyl is a fundamental of acne treatment, providing many individuals with quick and noticeable results. Yet, it can cause irritation, drying, or peeling, especially for those with delicate skin, which emphasizes the significance of selecting the right formulation and memory. With developments centered on better delivery methods, combination treatments with additional acne-fighting chemicals, and the creation of safer for the skin formulations that reduce irritation while optimizing efficacy, benzoyl peroxide has a bright future. More individualized therapies that can more effectively address various skin types and acne issues may potentially become possible as research advances. All things considered, benzoyl peroxide is still a very successful acne treatment, and new developments are probably going to make it even more widely available, effective, and appropriate for a wider variety of skin types.

9. REFERENCES

1. Thiboutot D, Gollnick H, Bettoli V et al. New insights into the management of acne: an update from the global alliance to improve outcomes in acne group. J. Am. Acad. Dermatol, 2009; 60(5): S1–S50.
2. Worret WI, Fluhr JW. Acne therapy with topical benzoyl peroxide, antibiotics and azelaic acid. J. Dtsch. Dermatol. Ges, 2006; 4(4): 293–300.
3. Mills OH Jr, Kligman AM, Pochi P, Comite H. Comparing 2.5%, 5%, and 10% benzoyl peroxide on inflammatory acne vulgaris. Int. J. Dermatol, 1986; 25(10): 664–667.
4. 9 Krakowski AC, Stendardo S, Eichenfield LF. Practical considerations in acne treatment and the clinical impact of topical combination therapy. Pediatr. Dermatol, 2008; 25(Suppl. 1): 1–14.
5. Hughes BR, Norris JF, Cunliffe WJ. A double-blind evaluation of topical isotretinoin 0.05%, benzoyl peroxide gel 5% and placebo in patients with acne. Clin. Exp. Dermatol, 1992; 17(3): 165–168.
6. Naithani V, Kumar S, Srivastava SM, Pathak N, Chaudhary M. An evaluation of antimicrobial efficacy of acano against some acne causing microorganisms. Int. J. Drug Dev. Res, 2010; 2(1): 134–140.
7. Misra A, Kalariya M, Padhi BK, Chougule M. Methotrexateloaded solid lipid nanoparticles for topical treatment of psoriasis: formulation & clinical implications. Drug Dev. Deliv, 2004; 4(8).
8. Noriega-Pelaez EK, Mendoza-Munoz N, Ganem-Quintanar A, Quintanar-Guerrero D. Optimization of the emulsification and solvent displacement method for the preparation of solid lipid nanoparticles. Drug Dev. Ind. Pharm, 2011; 37(2): 160–166.
9. Levy MY, Schutze W, Fuhrer C, Benita S. Characterization of diazepam submicron emulsion interface: role of oleic acid. J. Microencapsul, 1994; 11(1): 79–92.
10. Kumar VV, Chandrasekar D, Ramakrishna S, Kishan V, Rao YM, Diwan PV. Development and evaluation of nitrendipine loaded solid lipid nanoparticles: influence of was and glyceride lipids on plasma pharmacokinetics. Int. J. Pharm, 2007; 335(1–2): 167–175.
11. Tiyaboonchai W, Tungpradit W, Plianbangchang P. Formulation and characterization of curcuminoids loaded solid lipid nanoparticles. Int. J. Pharm, 2007; 337(1–2): 299–306.

12. Jenning V, Gysler A, Schäfer-Korting M, Gohla SH. Vitamin A loaded solid lipid nanoparticles for topical use: occlusive properties and drug targeting to the upper skin. Eur. J. Pharm. Biopharm, 2000; 49(3): 211–218.
13. Raza K, Singh B, Singla S et al. Nanocolloidal carriers of isotretinoin: antimicrobial activity against Propionibacterium acnes and dermatokinetic modeling. Mol. Pharmaceutics, 2013**;** 10(5): 1958–1963.
14. Vaghasiya H, Kumar A, Sawant K. Development of solid lipid nanoparticles based controlled release system for topical delivery of terbinafine hydrochloride. Eur. J. Pharm Sci, 2013; 49(2): 311–322.
15. Pardeike J. Nanosuspensions and nanostructured lipid carriers for dermal application. PhD Dissertation, Freie Universität Berlin, Germany, 2008**.**
16. Ridolfi DM, Marcato PD, Justo GZ, Cordi L, Machado D, Durán N. Chitosan-solid lipid nanoparticles as carriers for topical delivery of tretinoin. Colloids Surf. B. Biointerfaces, 2012; 93: 36–40.
17. Chen-yu G, Chun-fen Y, Qi-lu L, Qi T, Yan-wei X, Weina L, Guang-xi Z. Development of a quercetin loaded nanostructured lipid carrier formulation for topical delivery. Int. J. Pharm, 2012; 430(1–2): 292–298.
18. Mehnert W, Mäder K. Solid lipid nanoparticles: production, characterization and applications. Adv. Drug Deliv. Rev, 2001; 47(2–3): 165–196.
19. EpiCast Report: Acne - Epidemiology Forecast to 2022. www.prnewswire.com/news-releases/epicast-report-acne--- epidemiology-forecast-to-2022–223444231
20. Pople PV, Singh KK. Development and evaluation of topical formulation containing solid lipid nanoparticles of vitamin A. AAPS Pharm. Sci. Tech, 2006; 7(4): 91.