

Overview of Benzoyl Peroxide (BPO) As an Acne Treatment

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ABSTRACT

A popular topical medication with keratolytic, antibacterial, and anti-inflammatory qualities is benzoyl peroxide (BPO). Because of its capacity to lower populations of *Cutibacterium acnes* (previously *Propionibacterium acnes*) and reduce inflammation within the pilosebaceous unit, it is mostly used to treat acne vulgaris. As a strong oxidizing agent, BPO breaks down bacterial cell walls by producing reactive oxygen species. Furthermore, it promotes pore unclogging and prevents comedone formation by facilitating the shedding of dead skin cells.

BPO is often combined with other acne therapies, such as topical retinoids or antibiotics, to enhance efficacy and reduce bacterial resistance. Common side effects include dryness, redness, and irritation, which can be mitigated by adjusting concentrations or frequency of application. Advances in formulation, such as microencapsulation and water-based gels, have improved tolerability. Beyond acne, BPO shows promise in treating other skin conditions, including folliculitis and as a decolonization agent for *Staphylococcus aureus*. Despite its benefits, appropriate use and patient education are crucial to minimize side effects and optimize outcomes.

Keywords: Benzoyl Peroxide, Controlled Release, Acne Treatment, Efficacy, Dermatology.

INTRODUCTION

A potent chemical substance that is frequently used to treat acne is benzoyl peroxide. This topical drug comes in a variety of formulations, including gels, creams, cleansers, and lotions.[1,2,3] It can be obtained in both prescription and over-the-counter (OTC) medications. Because of its diverse action on the variables that contribute to acne development, it is known to be effective in treating mild to moderate acne.

Chemical Structure and Properties: Benzoyl peroxide is a white, crystalline powder with the chemical formula $C_{14}H_{10}O_4$. It is classified as an organic peroxide and has both antibacterial and keratolytic properties.[2] When applied to the skin, benzoyl peroxide decomposes, releasing oxygen, which helps to target the *Propionibacterium acnes* (now *Cutibacterium acnes*) bacteria responsible for acne.

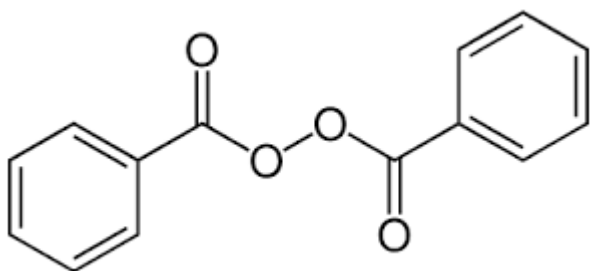


Fig. 1: Benzoyl peroxide

Chemical Formula : $C_{14}H_{10}O_4$

IUPAC Name : Benzoic Peroxyanhydride

Common Name : Benzoyl Peroxide

Molar Mass/Molecular Weight : 242.23 grams per mole

Melting Point : 103°C

Density : 1.33 g/cm³

Solubility : Poorly soluble in water but soluble in acetone, ethanol, and many other organic solvents.



Fig. 2: Benzoyl peroxide white, crystalline powder

MECHANISM OF ACTION

A major contributor to acne vulgaris, *Cutibacterium acnes*, is susceptible to the bactericidal effects of topical benzoyl peroxide [1][2]. After benzoyl peroxide is absorbed via the skin, it is transformed into benzoic acid. Approximately 5% of the benzoic acid is absorbed systemically before being eliminated by the kidneys. In order to release active free-radical oxygen species and oxidize bacterial proteins, cysteine in the skin breaks down the remaining benzoic acid [10]. By lowering lipids, free fatty acids, and *P. acnes*, acne vulgaris can be improved.

Following a daily application of 10% benzoyl peroxide for a duration of two weeks, there was a notable 98% reduction in the presence of *P. acnes* within hair follicles, alongside a 50% decrease in free fatty acids. These results are comparable to those achieved after four weeks of antibiotic treatment. Additionally, topical benzoyl peroxide exhibits mild sebostatic properties, which enhance its keratolytic effects and effectiveness in managing comedonal acne.[1] Furthermore, benzoyl peroxide is proficient in treating cutaneous ulcers by promoting the healthy formation of granulation tissue and facilitating rapid epithelial ingrowth.[12]

PHARMACOKINETICS

Absorption: Both in vivo research on rhesus monkeys and in vitro research using excised human skin show that benzoyl peroxide enters the skin's layers and transforms into benzoic acid. By using formulations with lower benzoyl peroxide concentrations (2.5%), skin irritation can be reduced, increasing therapy results and acceptability [13].

Distribution: The radiolabeled dose effectively permeates the skin and is subsequently recovered as benzoic acid. The concentration of the substance within the skin consists of approximately equal parts benzoic acid and benzoyl peroxide.[13]

Metabolism: The peroxide bond present in benzoyl peroxide undergoes cleavage, resulting in the formation of two benzoyloxy radicals. Benzoic acid serves as a key metabolite derived from benzoyl peroxide.[13]

Elimination: Benzoic acid, which is a metabolite of benzoyl peroxide, is excreted through urine. Information regarding its elimination via feces is not readily accessible.[13]

USES AND BENEFITS

Most often, benzoyl peroxide is used to treat acne vulgaris, the most common kind of acne that usually affects teenagers and young adults. Both inflammatory acne, which is characterized by red, swollen pustules and cysts, and comedonal acne, which is defined by blackheads and whiteheads, can be effectively treated with it.[20] Its effectiveness can be increased by using benzoyl peroxide either by alone or in conjunction with other therapies such topical retinoids or antibiotics.

FORMS OF BENZOYL PEROXIDE

Topical Creams and Gels: These are available in different concentrations (usually between 2.5% and 10%) and are applied directly to the affected areas of the skin.

Cleansers and Face Washes: These are commonly used to help manage acne on a daily basis by keeping the skin clear of excess oils and impurities.

Lotions and Spot Treatments: These are designed for targeted application to specific areas of the skin.

Side Effects and Considerations: While benzoyl peroxide is highly effective, it can cause side effects, especially for those with sensitive skin:

Skin Irritation: It may cause dryness, peeling, redness, or a burning sensation, particularly when first starting treatment.

Allergic Reactions: Though rare, some users may experience severe irritation or allergic reactions.

Bleaching: Benzoyl peroxide has the potential to bleach fabrics and hair, so care should be taken to avoid contact with clothes and linens.

Sun Sensitivity: It can increase the skin's sensitivity to sunlight, so it is essential to apply sunscreen when using benzoyl peroxide.

ADMINISTRATION

Available Dosage Forms and Strengths

Benzoyl peroxide is available commercially in both prescription and over-the-counter formats, with concentrations of 2.5%, 5%, and 10%. Various product forms include lotions, creams, gels, foams, solutions, cleansing bars, pads, masks, and shaving creams.[23][24] Additionally, there are combination formulations that pair benzoyl peroxide with other active ingredients, such as clindamycin, erythromycin, adapalene, tretinoin, and hydrocortisone. Each product type comes with specific usage instructions detailing the recommended frequency of application.

Adult Dosage

Masks are utilized weekly in a thin layer and left on for a duration of 15 to 25 minutes, whereas cleansing bars and washes are employed one to three times daily.[14] Studies have shown that the combination of topical antibiotics, benzoyl peroxide, and adapalene is more effective in treating acne vulgaris than the use of any single agent alone.[14][15] Combination treatments that include adapalene are typically applied once a day, while those containing erythromycin or clindamycin are used twice daily.

Specific Patient Populations

Hepatic impairment: The product labeling for benzoyl peroxide does not indicate any necessary dosage adjustments for individuals with hepatic impairment.

Renal impairment: Similarly, the product labeling for benzoyl peroxide does not recommend any dosage modifications for those with renal impairment.

Pregnancy considerations: Benzoyl peroxide is categorized as a pregnancy risk category C by the FDA. It is uncertain how benzoyl peroxide affects fetal and reproductive health. However, topical benzoyl peroxide use is typically regarded as safe during pregnancy due to its low systemic absorption. Throughout pregnancy, using 5% benzoyl peroxide twice a day is thought to be a safe way to treat acne. Because of its rapid renal elimination and low systemic absorption, it is thought to pose little harm, despite the paucity of study on the subject.

Breastfeeding considerations: Benzoyl peroxide use during lactation is not well-documented. The topical application of benzoyl peroxide is generally regarded as safe during breastfeeding, provided that it is not applied in areas where the infant would have close skin-on-skin contact or direct contact during breastfeeding, due to its low rate of systemic absorption, which means that the infant is unlikely to be at significant risk.[18]

Pediatric patients: There is limited evidence regarding the clinical safety and effectiveness of benzoyl peroxide in children. However, due to its low systemic absorption, topical benzoyl peroxide is typically regarded as safe for use in the pediatric population.[19]

Older patients: No modifications to the dosage for elderly patients are indicated in the product labeling.

ADVERSE EFFECTS

Benzoyl peroxide's bleaching properties are its most frequent side effect, which can result in bleaching hair and discoloring colored textiles. At higher doses, topical benzoyl peroxide causes moderate dryness, erythema, and scaling.[20] Individuals who have significant erythema and irritation at the treatment site should be suspicious because there are case reports of contact dermatitis in a tiny percentage of individuals. Stopping benzoyl peroxide is the wisest line of action in these situations.

DRUG-DRUG INTERACTIONS

Patients are advised against the simultaneous use of topical sulfone products, such as dapsone, with topical benzoyl peroxide, as this combination has been associated with yellowing of the skin and facial hair.[21] Additionally, the concurrent application of topical hydroquinone with topical benzoyl peroxide should be avoided due to the potential for heightened skin irritation and temporary epidermal staining. The combination of oral isotretinoin and topical benzoyl peroxide has also been noted to lead to increased skin irritation and dryness. Furthermore, patients should refrain from using topical benzoyl peroxide alongside topical tretinoin, as this may diminish the effectiveness of tretinoin.[22] In contrast, adapalene is not affected by oxidation from benzoyl peroxide and can be used together without concern. Lastly, the use of topical anesthetics in conjunction with topical benzoyl peroxide may reduce the effectiveness of the anesthetics; therefore, it is recommended to thoroughly cleanse the treatment area prior to the application of topical anesthetics for optimal results.[24]

Contraindications

Individuals with a documented history of hypersensitivity to benzoyl peroxide are advised against the use of products containing this compound. Furthermore, those who exhibit hypersensitivity to cinnamon and other derivatives of benzoic acid should exercise caution when utilizing benzoyl peroxide, as there is a potential for cross-reactivity.[15]

Warning and Precautions

Benzoyl peroxide should not be applied near the eyes, nose, mouth, mucous membranes, or on open skin due to the potential for significant irritation. In the event of contact with mucous membranes or the eyes, it is essential to rinse the

affected areas with water for at least 15 minutes. Patients are advised to limit their exposure to ultraviolet light and to use sunscreen to mitigate the risk of phototoxicity and skin irritation.[16]

Certain formulations of benzoyl peroxide may contain elevated levels of propylene glycol or dimethyl sulfoxide, both of which have been linked to a higher likelihood of adverse reactions. High doses or prolonged use of propylene glycol can result in toxicity. In children, symptoms of propylene glycol toxicity may manifest as seizures, central nervous system (CNS) effects, cardiac arrhythmias, hyperosmolarity, agitation, hemolysis, and lactic acidosis.[18]

Monitoring

No specific monitoring parameters have been established for benzoyl peroxide, and routine testing is not advised. It is important to observe for the development of contact dermatitis associated with benzoyl peroxide, necessitating the cessation of the medication in patients who exhibit significant erythema and irritation. Prior to the application of benzoyl peroxide, a test area should be treated to assess tolerability and sensitivity.[20]

Toxicity

Topical benzoyl peroxide is intended solely for external application and must not be ingested. In the event of accidental ingestion, individuals are advised to call 911, reach out to the poison control center at 1-800-222-1222, or proceed to the nearest emergency room. It is important to note that there are no recognized antidotes for this medication.[20]

ENHANCING HEALTHCARE TEAM OUTCOMES

The medications most frequently prescribed by healthcare professionals for the treatment of acne vulgaris include benzoyl peroxide, retinoids, and both topical and oral antibiotics.[2] In cases of rosacea or persistent acne vulgaris, a referral to a dermatologist may be necessary. It is essential for pharmacists to inform patients about potential adverse drug reactions, while nurses should emphasize the significance of adhering to prescribed treatment regimens.[25] Research indicates that while benzoyl peroxide, antibiotics, and retinoids are effective for mild to moderate acne vulgaris, their combined use is more beneficial than administering each treatment separately. This combination is thought to work synergistically and may also help in preventing antibiotic resistance. However, a survey revealed that only 30% of patients who were advised to use benzoyl peroxide as an adjunct treatment actually acquired the product.[28] To enhance patient adherence and treatment effectiveness, healthcare providers should consider prescribing combination products that simplify skincare routines.

One of the primary drawbacks of combination products is their higher cost and the requirement for refrigeration to maintain stability. While refrigeration is recommended, costs can be mitigated by utilizing specialty compounding pharmacies.[14] A collaborative approach involving clinicians (MDs, DOs, NPs, PAs), pharmacists, dermatologists, and nurses is crucial for optimizing patient outcomes when using benzoyl peroxide.

CONCLUSION

One of the most popular and successful acne treatments is still benzoyl peroxide. It is a mainstay of acne treatment because of its capacity to tackle several elements of acne production, such as inflammation, pore blockage, and bacterial growth. The advantages of benzoyl peroxide in treating acne are well-established, therefore many people with this common skin problem turn to it for therapy despite possible negative effects including dryness and inflammation.

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