

Redefining skin health: The potential of plant-based bakuchiol as a sustainable substitute for retinoids

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ABSTRACT

Background: The skin structure alters with age, leading to a decrease in collagen and diminished elasticity of the skin. While retinol proves to be an excellent anti-aging solution, its side effects prompt the search for gentler alternatives. This study evaluates bakuchiol's effectiveness and safety compared to traditional retinoids. **Material and Methods:** A thorough literature review was performed using PubMed and Google Scholar, employing keywords related to the topic. **Results:** Recent studies highlight bakuchiol's efficacy in reducing wrinkles and hyperpigmentation, with better tolerability than retinol. It is also under investigation for better skin penetration and collagen production. Comparatively, bakuchiol and retinol show significant anti-aging effects, yet bakuchiol's additional antioxidative properties and the lack of side effects present it as a promising skincare ingredient. **Conclusions:** Bakuchiol offers a natural, effective retinol alternative, matching its rejuvenating effects with enhanced antioxidant benefits. Its superior tolerance makes it suitable for sensitive skin. While promising, further research is needed to fully grasp bakuchiol's long-term benefits and confirm its role in skincare.

Key words: Retinol, Retinoids, Bakuchiol, Skin, Photoaging

INTRODUCTION

The skin's structure changes with both natural and external aging, leading to notable alterations in its fibroblasts, collagen, and other elements such as elastic fibers, glycosaminoglycans (GAGs), and proteoglycans (PGs). These changes include a notable decrease in collagen, causing fibroblasts to shrink and lose their shape, which impacts their ability to produce collagen and prevent its breakdown. Similarly, the alteration in elastic fibers, GAGs, and PGs contributes to a reduction in the skin's functional components, manifesting clinically as wrinkles and diminished elasticity [1,2]. Exposure to sunlight has both beneficial aspects, such as vitamin D production and positive psychological effects, and detrimental ones, including an increased risk of skin carcinogenesis and accelerated photoaging

due to excessive ultraviolet radiation exposure. Consequently, diverse strategies are necessary to minimize negative impact [3].

Retinoic acid is known to rejuvenate aging skin. Retinol (ROL, vitamin A), which serves as a precursor to retinoic acid, exhibits significant anti-aging benefits and is extensively utilized for its anti-aging impact on human skin [4]. Retinoid-based skincare treatments continue to be one of the top choices for dermatologists [5].

Recently, bakuchiol has emerged as a prominent figure in the field of cosmetology, being hailed as a *natural alternative* to retinol. What sets bakuchiol apart is its distinction of offering similar benefits to retinol, a renowned ingredient for its anti-aging properties, yet

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without the adverse effects typically associated with the use of retinol [6].

The aim of this study was to investigate bakuchiol as an alternative to retinol for skincare, assessing its effectiveness and safety. This research will compare the impact of bakuchiol and retinoids on skin aging, hyperpigmentation, and photodamage, focusing on bakuchiol's tolerability. The study seeks to provide a comprehensive understanding of bakuchiol's dermatological benefits.

MATERIALS AND METHODS

A literature review was conducted by searching databases such as PubMed and Google Scholar, using the keywords “retinol,” “retinoids,” “bakuchiol,” “skin,” and “photoaging” to identify relevant studies. Additional sources were discovered in the bibliographies of found studies, allowing for a broader collection of research.

RESULTS

Retinoids

Retinoids include both naturally occurring forms of vitamin A (such as retinol, retinal, and retinoic acid) and synthetic versions. They are powerful anti-aging agents, with retinol and its metabolites (retinal, tretinoin, isotretinoin, and alitretinoin) being among the most effective. These first-generation retinoids are fat-soluble, allowing retinol to penetrate the outer skin layer and slightly enter the dermis. Inside keratinocytes, retinol binds to specific receptors, stimulating the activity of skin cells such as keratinocytes, fibroblasts, melanocytes, and Langerhans cells. This interaction boosts cell proliferation, enhances the skin's protective barrier, minimizes water loss through the skin, protects collagen from breakdown, and inhibits enzymes that degrade the skin's structural matrix [7].

Published research suggests that tretinoin, incorporated into regulated medicinal products, stands out as the retinoid with the most robust evidence supporting its anti-aging effects, including its efficacy in reducing wrinkles and counteracting photoaging [8].

Despite advancements in retinoid formulations, their use continues to be hindered by several adverse effects, including skin irritation, dryness, peeling,

redness, and a burning sensation. These negative reactions frequently lead to patients stopping their use, highlighting the urgent need for the development of better retinoid compounds. Ideally, these new compounds would mimic the gene expression patterns of retinol, delivering its beneficial effects without the associated unwanted side effects. Increasing evidence suggests that bakuchiol may offer this retinol-like functionality, presenting a promising alternative in skincare treatments [9].

Bakuchiol

Bakuchiol, a distinctive meroterpene phenol sourced extensively from the *Psoralea corylifolia* plant, is quickly becoming a prominent figure in the cosmeceutical landscape due to its compelling range of properties. To date, around 100 bioactive compounds have been extracted from *P. corylifolia*, with the most significant ones categorized under coumarins, flavonoids, and meroterpenoids [10]. Bakuchiol is a key member of the meroterpenoids class of natural compounds. The plant from which it is derived, *Psoralea corylifolia*, is extensively utilized in traditional Indian (Ayurvedic) and Chinese medicine for a broad spectrum of ailments. The seeds of this plant have been commonly employed in the treatment of various skin conditions such as psoriasis, leukoderma, leprosy, and acne, as well as inflammatory diseases of the skin. Additionally, they have been used for their aphrodisiac, anthelmintic (anti-parasitic), laxative, and diuretic properties [11]. Recognized for its potential in anti-aging applications, bakuchiol effectively addresses signs of skin aging by diminishing wrinkles and enhancing skin elasticity. Moreover, its anti-inflammatory attributes are known to soothe skin inflammation, making it beneficial for treating conditions such as acne and redness. Additionally, its antibacterial capabilities offer protection against harmful bacteria, contributing to healthier skin. This combination of effects marks bakuchiol as a versatile and valuable agent in skincare formulations, signaling its rising importance in both dermatological treatment and everyday skincare routine [12].

The benefits of bakuchiol include evening out the skin tone, causing no irritation or adverse reactions, and being safe for twice-daily use. It is suitable for all skin types, helps soothe and heal the skin, reduces the appearance of fine lines, and accelerates cell regeneration [13].

It is worth mentioning that bakuchiol is currently the subject of extensive research due to its complex

nature that is yet to be fully understood. For instance, bakusylan (bakuchiol salicylate) represents an innovative compound created by combining bakuchiol with salicylic acid. This fusion aims to develop a new category of functional retinoids that offer superior skin advantages. Studies suggest that bakusylan may provide better skin penetration through the stratum corneum, boost the expression of type IV collagen genes in skin models that include both epidermal and dermal components, and promote collagen production in cultures of adult human dermal fibroblasts [14].

Comparison of the Effects of Retinoids and Bakuchiol

In a clinical trial that compared the effects of retinol and bakuchiol [15], it was found that both substances significantly decreased the area affected by fine facial wrinkles relative to the baseline measurements. Additionally, clinical assessments revealed that participants using bakuchiol experienced greater improvements in hyperpigmentation compared to those using retinol. Both treatments were effective in reducing the intensity of pigmentation and the affected area. Interestingly, it is notable that participants in the retinol group experienced significantly more skin scaling at every follow-up appointment. This indicates that bakuchiol matches retinol in its capacity to ameliorate signs of photoaging, while being better tolerated by the skin. Hence, bakuchiol emerges as a promising and more tolerable alternative to retinol. Further research, particularly long-term studies, is essential to fully understand the trade-offs between increased application frequency and reduced side effects, especially since the observed results with bakuchiol required twice-daily application. This study indicates that bakuchiol could be a feasible choice for patients interested in natural treatment options [16].

In a comparative study between retinol and bakuchiol [17], researchers explored their antioxidative and anti-inflammatory effects, including their impact on cell activation, and their role in the development of extracellular matrix (ECM) components and skin renewal processes. This research found that bakuchiol not only shares several functional properties with retinol yet also offers distinctive, advantageous traits. Using bakuchiol as a treatment method introduces a comprehensive, multi-faceted approach to combating skin aging. It functions as an antioxidant, reduces inflammation, stimulates cell activity, enhances the

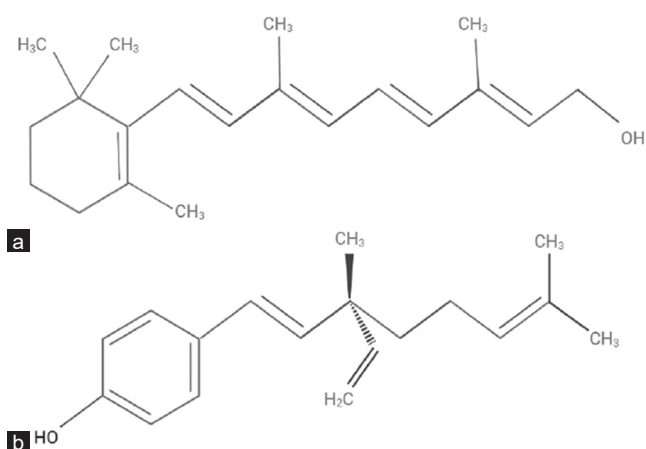


Figure 1: Chemical structures of retinol (a) and bakuchiol (b) show that bakuchiol and retinol lack structural similarity.

production of vital ECM components, and promotes the repair and rejuvenation of the epidermis.

Bakuchiol matches retinol's effectiveness in regulating gene expression, with a significantly improved tolerance profile compared to retinoids. Moreover, it may be used without the need to gradually increase the dose. Its photostability also simplifies its incorporation into skincare products. Additionally, bakuchiol does not lead to phototoxicity, so there is no mandatory requirement for sunscreen use when applying it, unlike retinoid treatments [18].

Interestingly, research indicates that the anti-photoaging properties of retinal are amplified when it is paired with natural retinol-like substances such as bakuchiol. Remarkably, this combination enhances retinal's effectiveness without compromising its safety profile [19]. It is also worth noting that bakuchiol possesses unique antioxidant properties that retinol lacks, enabling it to engage a different mechanism of action. The effectiveness of antioxidants is often maximized when they are used together, due to their synergistic effects. This synergy was evident in research findings where bakuchiol proved to be more effective in photoprotection when used in conjunction with other antioxidants, underscoring its enhanced and synergistic capabilities [20].

It is also important to note bakuchiol's potential for treating acne. Research shows that bakuchiol shows promise as a new agent that may complement and enhance the effectiveness of currently available anti-acne formulations. Bakuchiol is likely the only agent after retinoic acid shown to be effective against multiple pathophysiologic features of acne [21].

DISCUSSION AND CONCLUSIONS

Topical bakuchiol presents itself as a compelling alternative to traditional retinol, demonstrating comparable efficacy in skin rejuvenation with added antioxidant benefits. These antioxidant properties are notably enhanced when bakuchiol is formulated alongside other antioxidants, providing a synergistic effect that may contribute to improved skin health. Clinical studies have established bakuchiol's similarity to retinol in terms of effectiveness, with a distinct advantage in skin tolerability and safety profiles. This makes bakuchiol especially advantageous in skincare formulations intended for individuals with sensitive skin types, who may experience adverse reactions to stronger retinoids. Moreover, its natural origin appeals to a growing demographic of consumers seeking skincare products with organic, plant-based ingredients. However, while the current data is promising, further in-depth research is crucial to fully understand the long-term impacts of bakuchiol, optimize its formulations, and validate its therapeutic potential in broader skincare applications.

Statement of Human and Animal Rights

All the procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the 2008 revision of the Declaration of Helsinki of 1975.

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