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Cover Page Footnote
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Systematic Review

# The effect of bakuchiol in the skin aging process: A systematic review

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## Abstract

**Background:** With aging, the skin gradually loses its structural and morphological coherence, decreasing its function. With aging and chronic ultraviolet (UV) exposure, the skin becomes thin and loses elasticity, and wrinkles, pigmentation, and texture irregularities appear. Today, people of all ages become interested in the cosmetic industry, aiming to make their skin appropriate to their age or look younger. Bakuchiol is a pure meroterpene phenol found mainly in the seeds of the Indian plant *Psoralea corylifolia* (babchi). It triggers antioxidant and anti-inflammatory activity and has anti-aging properties like retinol. The study aimed to know the effect of bakuchiol on the skin aging process.
**Methods:** A systematic review of the literature was conducted. Data were collected and synthesized from online databases with the preferred reporting items for systematic reviews and meta-analyses (PRISMA) protocol.
**Results:** More than 125 articles were found, and six studies were selected according to this research. Of the six existing clinical trial studies, all showed that bakuchiol had a beneficial effect on reducing signs of skin aging.
**Conclusion:** Bakuchiol has shown beneficial effects in preventing or reducing signs of skin aging, such as fine lines and wrinkles, loss of elasticity and firmness, dull skin, uneven hyperpigmentation, skin dryness, and texture irregularities, with minimal side effects.

***Keywords:*** *bakuchiol, skin aging*

## Background

With aging, the skin gradually loses its structural and morphological coherence, decreasing its function. This chronic deterioration is influenced by the accumulation of various chemical, environmental, and mechanical disturbances.[1] Many extrinsic and intrinsic factors can hasten the appearance of skin aging. Enormous ultraviolet (UV) exposure, environment, lifestyle habits, and genetic predispositions affect the quality of human skin. Most often, skin aging is generated by UV exposure, such as those that cause an increase in the expression of matrix metalloproteinase (MMP).[2] Chronic exposure to UV and aging makes the skin thin and less elastic, and wrinkles, pigmentation, and texture irregularities appear.[3]

Today, people of all ages have become interested in the cosmetic industry, aiming to make their skin more consistent and match their intrinsic age, or even younger if possible. Cosmetic options are varied, and research continues to search for new and robust solutions.[4] Today, topical retinoids are a potent preventive and therapeutic intervention.[5] However, remarkable side effects on the skin are common, for example, erythema, pruritus, peeling, stinging or burning, and sensitivity.[6]

The market for anti-aging products is expanding, driving demand for medicines like retinoids with minimal adverse effects. Bakuchiols are a class of medicines that have lately been considered as alternatives to topical retinoids. A refined meroterpene phenol called bakuchiol is primarily present in the seeds of the Indian plant *Psoralea*

*corylifolia*, often known as babchi.[3,7] Bakuchiol shows antioxidant and anti-inflammatory activity and owns anti-aging properties similar to retinol.[2] Like retinoids, bakuchiol targets several biological pathways, such as upregulating collagen and extracellular matrix formation enzymes and modulating the retinoic acid receptor gene.[3] This study aims to investigate the effect of bakuchiol on the skin aging process. Moreover, it can provide information about bakuchiol for future researchers for scientific development and information to the general public regarding its benefits and side effects for daily use, particularly as an anti-aging skin agent.

## Methods

A systematic review of the literature was carried out. A comprehensive strategy was carried out.

Protocol
PRISMA (preferred reporting items for systematic reviews and meta-analyses).

## Focus Question

PICO elements (population, intervention, comparison, and outcome)
1. Population : Men and women with signs of skin aging
2. Intervention : Bakuchiol
3. Comparison : Retinol, placebo
4. Outcome : Reducing signs of skin aging

### Search strategy

We collected the data from online databases (PubMed, ScienceDirect, Springer, Europe PMC, Wiley) from 2011 to 2023.

### Type of study

Every clinical trial study, both open-label and blind/double-blind, which examined the effect of bakuchiol on skin aging.

### Domain being studied

Effect of bakuchiol on skin aging process (fine lines, wrinkles, pigmentation, firmness, and brightness).

### Inclusion criteria

Studies included are those where bakuchiol serves as a component of the tested substance (in combination with substances not exceeding three substances) and its effect on skin aging, studies involving humans, and signs of skin aging in the subjects.

### Exclusion criteria

Studies are excluded if the examined effects of bakuchiol are on things other than skin aging (e.g., acne vulgaris, post-inflammatory hyperpigmentation), combinations of bakuchiol with more than three other substances, and articles that cannot be accessed in full.

### Data extraction

The data in this study were taken based on the chart below (Figure 1).

## Result

From the results of the literature search, in the end, six research articles were obtained that described the effect of bakuchiol on skin aging and met the inclusion criteria mentioned above (Figure 1). Six selected articles were all mentioned in the table below (Table 1).

Draelos, et al. in their research using bakuchiol in cleansers and facial moisturizers, proved that bakuchiol improves smoothness/wrinkles, clarity, brightness, overall appearance, and skin moisture ($p<0.001$).[8] Overall, the acceptance is also very good on sensitive skin.[8] This is in line with research conducted by Dhaliwal, et al. and Chaudhuri and Bojanowski in a different study, where both tried to compare bakuchiol with retinol, a compound renowned for its beneficial effect on preventing or improving skin aging.[3,9] Both studies state that bakuchiol has an effect equivalent to retinol in reducing fine lines and wrinkles.

Dhaliwal, et al. also stated that bakuchiol can diminish skin hyperpigmentation, while Chaudhuri and Bojanowski stated that bakuchiol boosts elasticity, firmness, and overall reduction in signs of photodamage.[3,9] In a separate study, Goldberg, Robinson, and Granger, used a triple combination of melatonin, bakuchiol, and ascorbyl tetraisopalmitate to determine its effect on skin aging. They used a similar combination of creams in 2 separate studies, in 2018 and 2020.[10,11] The former study used a large sample size of 103 people, where they were split into five experimental groups, and each group was tested personally in terms of respectively: Wrinkles, skin hydration, transepidermal water loss (TEWL), oily skin, and non-comedogenic.

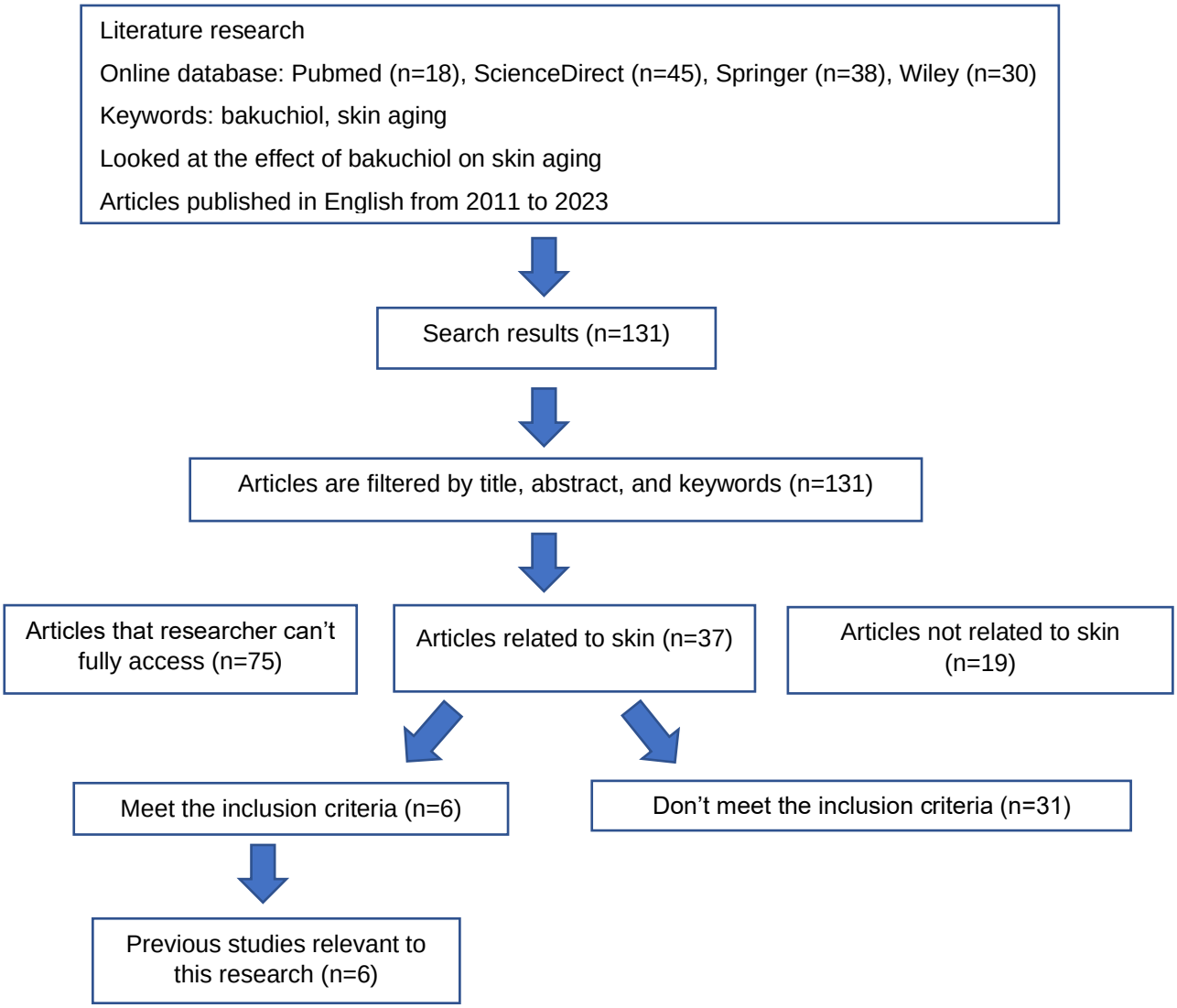


**Figure 1**. Data Extraction Chart.

The results showed a notable decrease in wrinkles and redness, with increased skin firmness ($P < 0.01$) and improved overall skin quality and complexion. Hydration levels significantly increased, and TEWL decreased significantly. Good acceptance in all skin types, including oily skin.[10] The latter study in 2020 also showed similar results, using a smaller number of samples, namely 24 people. The skin texture, pigmentation, erythema, skin tone, complexion, fine lines, and wrinkles were significantly enhanced ($P < 0.05$).[11]

The last study using combination substances is research by Bacqueville, et al. but the substances used combine bakuchiol and vanilla tahitensis extract (VTE). His research proves that the extract of the combination of these two substances can significantly increase the firmness and brightness of the skin.[12]

## Discussion

Aging is a complex but inevitable biological process that happens with time. It is inevitable and occurs spontaneously. Deterioration of organ architecture and functions typically occurs with aging, leading to decreased flexibility and resistance to different types of stress. Extrinsic aging, or photoaging, is linked to factors like smoking, hunger, and sun exposure that erode the structure and functions of the skin. In contrast, intrinsic aging, also known as chronological, spontaneous, and biological aging, is an automated, natural process.[13] The skin ages due to various variables that affect it and cause some function loss.[14,15] Usual signs of skin aging include thinning skin, loss of elasticity and the appearance of wrinkles, uneven pigmentation, skin dryness, and texture irregularity.[3]

**Table 1.** Articles Selected

| No | Origin | Design | Purpose | Sample | Assessment Method | Result |
|---|---|---|---|---|---|---|
| 1. | America[8] | Clinical trial | Knowing the tolerability, efficacy, and barrier effect of cleansers and moisturizers containing bakuchiol on sensitive skin | 60 women aged 40-65 with uneven skin color, wrinkles, and sensitive skin | Clinical assessment | Significant improvement in smoothness, clarity, brightness, overall appearance, and global anti-aging. Tolerability is very good on sensitive skin. Cheek corneometry measurements showed a significant increase in skin moisture. |
| 2. | America[3] | Randomized, double blind study | Comparing the efficacy and side effects of bakuchiol and retinol in improving signs of skin aging | 44 patients applied either bakuchiol cream 0.5% twice a day or retinol cream 0.5%/day | Face photography, questioner | Bakuchiol and retinol significantly reduced wrinkles and hyperpigmentation without statistically significant differences. |
| 3. | America[9] | Clinical trial, blind study | Comparing activities related to skincare between retinol and bakuchiol | 17 women aged 40-65 with aging skin | Clinical assessment | Significant improvement in fine lines and wrinkles, elasticity, firmness and overall reduction in signs of photodamage. |
| 4. | America[10] | Open-label clinical trial study | Clinically assess the anti-aging efficacy and safety of NFS 3-in-1 in all skin types | 103 men/women aged 18-65 with aging skin, some having oily skin and facial acne. | Instrument, clinical assessment, questionnaires | Significant reduction in wrinkles, redness, and transepidermal water loss. Skin firmness, overall skin quality, and hydration levels increased significantly. Good tolerance in all skin types, including oily skin. |
| 5. | America[11] | Open-label clinical trial study | Determining the clinical and histological effects of NFS 3-in-1 on signs of skin aging | 24 female/male patients aged 40-75 years with signs of skin aging | Clinical and histological assessment | Skin texture, pigmentation, erythema, skin color, fine lines, and wrinkles increased significantly. A significant decrease in photodamage, hyperpigmentation, and wrinkles. |
| 6. | France[12] | Clinical trial | Investigating the beneficial effects of combinations of bakuchiol and tahitensis vanilla extract for skin aging | 43 women aged 45-65 years with signs of skin aging | Instruments | Facial ptosis and depth of skin deformation reduced significantly. Brightness increased significantly. Serum shows good tolerance/safety. |

NFS: night facial serum

One of human skin's most crucial structural proteins is collagen, primarily produced and secreted by fibroblasts. Collagen keeps skin firm and repairs age-related skin shrinking.[15,16] Collagen is a main component of the skin's extracellular matrix (collagen types I and III) and the basement membrane (collagen type IV). Because of the aging process and ultraviolet, the production of new collagen is reduced due to the low number and quality of dermal fibroblasts.[9]

Based on Table 1, the first study by Dreaelos, et al. from America proved that the bakuchiol appliance significantly affects signs of skin aging, such as smoothness, clarity, brightness, and overall appearance.[8] Scientists at the Indian Institute of Chemical Technology (IICT) initially isolated bakuchiol [(1E, 3S)-3-ethenyl-3, 7-dimethyl-1, 6-octadien-1-yl] phenol from *Psoralea corylifolia* L. Medik seeds. This plant, which is in the Fabaceae family, has been used in traditional Chinese and Indian treatments. Bakuchiol has been renowned for its antioxidant, antibacterial, anti-aging, anti-inflammatory, anti-cancer, antidepressant, and hypoglycemic properties.[14,15]

A study done by Yu, et al. stated that bakuchiol can raise the activity of human skin fibroblasts by stimulating collagen production by increasing the expression of tissue inhibitior of matrix metalloproteinase-2 (TIMP-2) and mRNA of MMP inhibitors, thus prohibiting MMP mRNA expression to delay skin aging (Figure 2).[17] Elevated MMP and elastase activity can changes extracellular matrix, therefore result in the appearance of wrinkling, sagging, and other structural changes in the skin.[18] They also mentioned that bakuchiol has very good acceptance on sensitive skin.[8] This aligns with the theory that bakuchiol is very safe to use, does not cause irritation, nor makes the skin sensitive to sunlight.[17] With good tolerability, photostability, and ability to decelerate skin aging, bakuchiol can be considered an acceptable plant-based alternative to retinol, which is traditionally extracted from animal sources.[18]

The second study by Dhaliwal, et al. from America attempted to compare the effectiveness and side effects of bakuchiol and retinol in correcting signs of skin aging.[3] The results of their study showed that both substances significantly reduced wrinkles and hyperpigmentation, with no remarkable statistical differences. Nevertheless, retinol users report more scaly facial skin and a stinging feeling.[2,3] This is similar to the results of a third study by Chaudhuri and Bojanowski from America, who also compared the anti-aging effects between bakuchiol and retinol, where there was a significant improvement in fine lines and wrinkles, elasticity, firmness, and overall reduction in signs of photodamage by the bakuchiol.[9]

It is widely known that retinoic acid and its derivatives have been used as therapeutic agents for various skin conditions such as psoriasis and acne vulgaris and are also clinically effective against signs of skin aging, like wrinkles. On enzyme-linked immunosorbent assay (ELISA) and histochemical examination, both retinoids and bakuchiol could arouse collagen formation by fibroblasts. Both are also proven to stimulate the expression of the aquaporin-3 (AQP3) gene in the stratum corneum to maintain hydration in the stratum corneum, so it can reduce skin dryness often found in aging skin.[9] However, retinoid therapy has many unwanted side effects on the skin, such as irritation, dryness, peeling, erythema, and burning sensation. These side effects often result in non-compliance and termination of therapy.[9] Bakuchiol, unlike retinol, has excellent photochemical and hydrolytic stability and a good safety profile. It can be used during the day due to its photostability.[19,20] In the fourth study by Goldberg, Robinson, and Granger from America, it was found that the mixture of bakuchiol with other substances, namely melatonin and ascorbyl tetraisopalmitate in night facial serum (NFS) 3-in-1 could make a significant decrease in wrinkles, increased skin firmness, reduced redness, and improved overall skin quality and complexion.[10]

Hydration levels improved significantly, and acceptance was good in all skin types, including oily ones.[10] In the following year, an identical study had been done by the same researcher with the same serum.[11] From that study, NFS 3-in-1 can enhance the skin's texture, pigmentation, erythema, skin color, complexion, fine lines, and meaningful wrinkles. On histological examination, dermal and epidermal thickness increases, indicating a change in the extracellular matrix.[11] The epidermis and dermis tend to lose their thickness in aging skin.[21,22] Collagen, especially type 1 and 3, are increased, matched with several published journals that stated bakuchiol arouses collagen production.[1,17] The results are similar to another study by Narda, et al. which investigated the effectiveness of NFS 3-in-1 cream in vitro and ex vivo. From that study, it was found that the compounds increase the barrier function, the skin hydration TEWL, and the formation of collagen and elastin in the dermis, thereby contributing to a positive effect on the clinical appearance and function of the skin.[23] In addition to reducing UV-induced skin aging, combining these three creams synergizes skin biology.[24,]

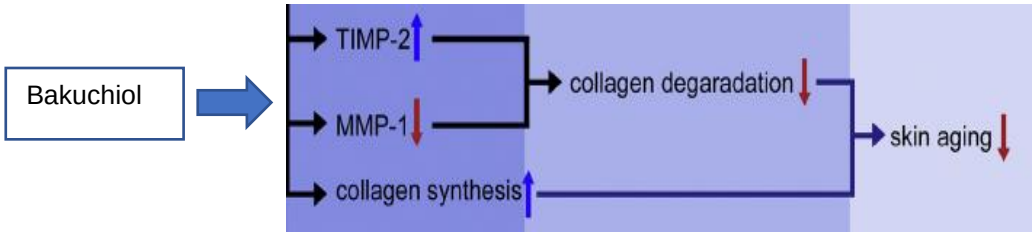


**Figure 2**. Mechanism of Action
MMP-1: matrix metalloproteinase-1; TIMP-2: matrix metalloproteinase-2

The last study by Bacqueville, et al. from France tried to analyze the beneficial effects of a combination of bakuchiol and vanilla. The result of this study was the reduction of facial ptosis and the depth of skin deformation, brightness increased significantly, and the serum showed good tolerance.[12] This study also states that skin aging is not only caused by lessening collagen as the extracellular matrix but also by the inflammatory process induced by interleukin (IL) 8, which is produced by fibroblasts. UV light acts as a trigger factor, and the p16 protein proceeds as a precursor to aging cells.[12,18] P16 expression indicates biological aging in almost all organs.[26]

According to previous journals, bakuchiol has anti-inflammatory and anti-cytokine effects, for example, against tumour necrosis factor alpha (TNF-α), IL-1, and IL-8.[27,28] The combination of bakuchiol and VTE shows a new synergy in serving benefits in inflammation (IL-8) and aging (p16).[12] Other than acting as an anti-inflammatory agent, bakuchiol has been reported to have a variety of pharmacological properties and acts as an antibiotic, anti-cancer, anti-hypolipidemic, and anti-convulsant agent.[2,29]

## Conclusion

Based on the collected literature, it can be determined that bakuchiol has a beneficial outcome in preventing or reducing signs of skin aging, such as fine lines, wrinkles, loss of elasticity and firmness, dull skin, uneven hyperpigmentation, skin dryness, textural irregularities, and so on. In addition, bakuchiol has low side effects. Nevertheless, some literature still uses a mixture of bakuchiol and other substances, so it does not eliminate the possibility of overlapping effects. Thus, it is recommended that more specific research be carried out in the future.

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None.

## Author Contributions

All authors act as the guarantor of the manuscript. OJP is the main investigator of this study. YFRS, OJP, and DSS are participated in the conception, data acquisition, data interpretation, and writing of the study. OJP and DSS have been involved in drafting the manuscript or revising it critically for important intellectual content.

## Conflict of Interest

No conflict of interest.

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