Current Pharmaceutical Research (CPR)
Vol 1, Issue 3, July-September 2025
Journal Homepage: https://cpr.org.in/

Exploring the Role of Herbal Remedies and Alternative Therapies in Managing Vitiligo: A Comprehensive Review

[1]Shalini Rana*, [1]Suhail Ahmad Mir, [1]Abu Rafee Sohil, [1]Bhumi Ruhil

[1] *School of Pharmacy, Desh Bhagat University, Mandi Gobindgarh, Punjab, India.*

Keywords

Vitiligo, Melanocytes, Herbal remedies, Pigmentation, Skin disorder.

Abstract

Vitiligo is a chronic skin disorder marked by the progressive loss of skin pigmentation due to the destruction or dysfunction of melanocytes; the cells responsible for melanin production. Although the exact etiology remains unclear, it is widely attributed to a multifactorial origin involving genetic susceptibility, autoimmune reactions, and environmental triggers such as emotional stress or physical trauma. The condition results in depigmented patches on the skin, hair, and mucous membranes. Though vitiligo is not life-threatening or contagious, it often causes significant psychological distress, including low self-esteem, social anxiety, and depression. Current treatment strategies include topical corticosteroids, calcineurin inhibitors, phototherapy (such as PUVA and NB-UVB), and surgical interventions. However, outcomes vary, and a definitive cure is still lacking. This gap has prompted growing interest in complementary and alternative therapies, particularly herbal remedies. Natural agents like Ginkgo biloba, Curcumin (from turmeric), and Green Tea extracts have shown potential in modulating immune responses, reducing oxidative stress, and promoting melanocyte regeneration. These properties make them promising adjuncts or alternatives to conventional therapies. This paper presents a concise overview of vitiligo's pathophysiology, classification, and epidemiology, while also discussing conventional treatment modalities and their limitations. Emphasis is placed on the emerging role of herbal remedies and ongoing research into molecular and regenerative therapies. Given the psychological burden and persistent nature of vitiligo, continued investigation into both traditional and novel treatment strategies is crucial for improving patient outcomes and quality of life.

***Corresponding Author:**
Ms. Shalini Rana (Shalinirana292@gmail.com)

Article Info
Received: 22 May 2025, Received in revised form: 13 June 2025, Accepted: 16 June 2025, Available online: 10 October 2025

DOI: https://doi.org/10.63785/2025.1.3.338347

1. Introduction

Vitiligo is a condition marked by the appearance of white patches on the skin, caused by the loss of melanocytes, the cells responsible for producing skin pigment. While the exact cause remains unclear, vitiligo is believed to result from a complex interaction of autoimmune responses, genetic predisposition, and environmental factors such as stress or trauma. The immune system mistakenly targets and destroys melanocytes, which leads to the loss of pigment in the affected skin areas [1]. This disruption in pigmentation is typically evident as depigmented macules or patches, which can occur on various parts of the body, including the skin, hair, and mucous membranes. Vitiligo has profound psychological and social effects on patients due to the visible nature of the disorder. It often carries social stigma, which may contribute to emotional distress, depression, and a decreased quality of life. Though its precise cause remains uncertain, research into vitiligo's underlying mechanisms continues to advance [2].

Traditionally, vitiligo has been managed using various treatment modalities, including corticosteroids, phototherapy, and surgical options such as melanocyte transplantation. However, the effectiveness of these treatments varies from person to person, and there is no definitive cure for the condition [3]. As interest in alternative medicine has grown, herbal remedies have become a popular area of research for vitiligo management. Some herbal treatments, such as Ginkgo biloba, Curcumin, and Green Tea, have been explored for their potential benefits in reducing oxidative stress, enhancing immune function, and promoting melanocyte regeneration. These herbal therapies offer promising alternative approaches for patients seeking non-pharmaceutical options to manage their condition [4], [5].

Vitiligo's pathophysiology is primarily driven by the destruction or dysfunction of melanocytes, which are responsible for skin pigmentation. In autoimmune-related vitiligo, the body's immune system mistakenly targets and destroys melanocytes, causing the skin to lose its natural color. This process leads to the appearance of depigmented patches, which can vary in size from small macules (less than 1 cm in diameter) to larger patches [6]. These patches can affect any part of the skin, but they are most often seen on the face, hands, and arms. Vitiligo also affects the hair, leading to depigmentation of the hair follicles, resulting in white or gray hair in affected areas. The condition can extend to mucous membranes such as the mouth and genital regions as well [7].

A review of various epidemiological studies suggests that the global prevalence of vitiligo ranges between 0.06% and 2.28%, with higher prevalence rates observed in regions like Africa and India. In the Indian subcontinent, vitiligo is particularly common, with prevalence rates reaching up to 9.98%. Other regions with notable prevalence include Nigeria (2.8%) and Romania (2.28%) [8]. Studies suggest that vitiligo affects both genders equally, though some reports indicate a slight predominance in females, which may be attributed to a higher incidence of autoimmune disorders in women or their greater concern with the cosmetic aspects of the condition. The onset of vitiligo generally occurs before the age of 30, and many individuals experience the first signs of the disease before turning 20. Early onset is often linked to a family history of the condition, suggesting a genetic predisposition [9], [10].

Vitiligo is classified into two main types: segmental and non-segmental. Non-segmental vitiligo is more common, particularly in individuals between the ages of 10 and 30. Around 25% of vitiligo cases develop before the age of 10. Segmental vitiligo, on the other hand, typically develops earlier, often before age 10, and tends to remain localized to one side of the body. Both types have distinct clinical features, but the underlying mechanisms of melanocyte destruction remain similar [11].

Recent studies using the Fitzpatrick skin phototype scale, which classifies skin types based on their response to sun exposure, show varying prevalence rates of vitiligo across different skin types. The highest prevalence rates are seen in individuals with Fitzpatrick skin types III (light brown skin) and IV (moderate brown skin). A survey of over 35,000 participants across Europe, Japan, and the USA estimated the global prevalence of vitiligo at 1.3%, with Europe having the highest rate at 1.6%, followed by the USA at 1.4%, and Japan at 0.5% [12], [13].

In addition to conventional treatments, herbal remedies such as Ginkgo biloba, Curcumin, and Green Tea have been investigated for their potential to modulate oxidative stress and promote melanocyte regeneration. These natural treatments may offer a more holistic approach to managing vitiligo and are often considered by patients seeking alternative options [14]. Current molecular formulations in vitiligo treatment are also focused on understanding the pathways involved in melanocyte loss and exploring compounds that can target these mechanisms to restore pigmentation. This article provides a comprehensive overview of vitiligo, including its causes, classifications, pathogenesis, diagnosis, and available treatments. It also discusses the role of herbal medicine in managing vitiligo, along with the promising molecular formulations in development for future therapies [15], [16].

2. Psychological Impact of Vitiligo and Social Consequences

2.1. Emotional and Psychological Challenges

Appearance plays a significant role in how individuals are judged, and those with skin conditions like vitiligo may face negative social consequences. These conditions can affect daily life, mental health, and social interactions, leading to feelings of guilt, shame, insecurity, and depression. Vitiligo, in particular, is associated with a decline in quality of life, impacting routine activities and work [17]. Lesions on visible areas such as the face and hands can have a more profound effect on well-being. Many vitiligo patients report emotional distress and discrimination, with over 50% experiencing staring, 16% overhearing rude comments, and 13% facing job discrimination. A survey of 600 individuals found that 59% felt vitiligo significantly impacted their lives [18].

2.2. Associated Conditions in Vitiligo

2.2.1. Thyroid Dysfunction

Thyroid issues and autoimmune thyroid diseases have been found to be linked to vitiligo, with individuals suffering from vitiligo being more prone to developing both clinical and subclinical thyroid conditions compared to healthy individuals. The most common autoimmune thyroid diseases associated with vitiligo are Hashimoto's thyroiditis and Graves' disease [19]. A study conducted in 1994 on 35 vitiligo patients revealed that 43% had signs of thyroid disease, with 22.8% showing thyroid dysfunction (17.1% hyperthyroidism and 5.7% hypothyroidism). People with autoimmune thyroid disease exhibit a significantly higher prevalence of vitiligo compared to those with non-autoimmune thyroid conditions. Additionally, individuals with generalized (non-segmental) vitiligo, especially those with a family history, are more likely to have autoimmune disorders than those with segmental vitiligo [20], [21].

2.2.2. Other Associated Disorders

Research has suggested a link between vitiligo and other autoimmune conditions, including pernicious anemia, diabetes, systemic lupus erythematosus, rheumatoid arthritis, psoriasis, alopecia areata, and Addison's disease. A study conducted between 2001 and 2006 in a Romanian population with a high rate of familial connections found that out of 51 patients with vitiligo, 22 also had one or more autoimmune disorders [22]. Among those with both vitiligo and other autoimmune diseases, about 82% had generalized vitiligo. Of these patients, 31% had autoimmune thyroid disease, 14% had rheumatoid

arthritis, and 12% had adult-onset type 1 diabetes. Furthermore, these autoimmune conditions appeared to be more prevalent among first-degree relatives of vitiligo patients, suggesting a genetic predisposition to autoimmune and autoinflammatory disorders in certain families [23].

3. Classification

Vitiligo can be classified into three main forms: segmental, non-segmental, and mixed/unclassified. These forms differ not only in their clinical presentation but also in their underlying causes. Factors such as the appearance, location, and extent of the initial skin lesions, the presence of other autoimmune disorders, and the progression of the disease all contribute to the classification of vitiligo. Commonly affected areas include regions with darker pigmentation, such as the face (especially around the mouth and eyes), hands, nipples, armpits, navel, sacrum, and genital areas. Vitiligo also often affects areas like the elbows, knees, fingers, and wrists. The condition is classified into segmental, non-segmental, and undetermined types based on clinical presentation in table 1 [24], [25].

4. Management Approaches for Vitiligo

Phototherapy, along with topical and oral immunomodulators like corticosteroids and calcineurin inhibitors, is commonly utilized in the treatment of vitiligo. Other available options include psychosocial interventions, depigmentation methods, alternative therapies, and surgical treatments. While vitiligo lesions often show resistance to these approaches, spontaneous repigmentation can occur in 1–25% of cases [26].

5. Pharmacological Approaches for Vitiligo Treatment

Phototherapy and both topical and oral immunomodulators, like corticosteroids and calcineurin inhibitors, are commonly used to treat vitiligo. Topical corticosteroids (TCS) and calcineurin inhibitors (TCI) help suppress the immune response that damages the skin. Studies show that combining betamethasone with narrow-band UVB (NB-UVB) and calcipotriol enhances repigmentation compared to NB-UVB alone. Topical steroids such as mometasone or clobetasol are equally effective as tacrolimus or pimecrolimus, with manageable side effects [27]. However, concerns regarding the long-term use of tacrolimus, due to potential cancer risks, have been raised.

Research into 5-fluorouracil (5-FU), combined with microneedling, shows improved effectiveness in vitiligo treatment. Oral corticosteroids, administered in a micropulse regimen, reduce side effects while maintaining efficacy. Topical corticosteroids are more effective than TCIs for achieving 50% repigmentation, and both treatments show similar results for 75% repigmentation. The main side effect of corticosteroids is skin thinning, which can be managed with lower-potency steroids and treatment breaks [28], [29].

Other treatments include methotrexate and Janus kinase (JAK) inhibitors. Low-dose methotrexate offers similar benefits to corticosteroids, while JAK inhibitors like tofacitinib, ruxolitinib, and baricitinib inhibit IFN-g signaling to aid repigmentation [30].

6. Vitamin D and Phototherapy in Vitiligo Treatment

6.1. Vitamin D Analogues

A study found that vitiligo may be linked to polymorphisms in the vitamin D receptor (VDR) gene, particularly the Apa-I polymorphism. Families with vitiligo also show higher rates of thyroid issues, diabetes, and rheumatoid arthritis [31]. Calcipotriol combined with psoralen-UVA (PUVA) has been shown to speed up vitiligo treatment, while vitamin D analogues, such as cholecalciferol and ergocalciferol, can stimulate melanogenesis and enhance repigmentation when combined with UV therapy [32].

6.2. Phototherapy

UVB phototherapy, especially narrow-band UVB (NB-UVB), is a common and effective treatment for vitiligo. It is often combined with topical corticosteroids or calcineurin inhibitors for better results. While PUVA was initially used, NB-UVB is preferred due to fewer side effects and better efficacy. Studies suggest that NB-UVB treatment should last 6 to 12 months to achieve significant repigmentation [33], [34].

6.3. Surgery

Surgery is often considered a suitable treatment for segmental or stable vitiligo, with skin grafting and micropigmentation being the most common procedures. Before performing a permanent graft on hypopigmented areas that have remained stable for at least two years, a mini-grafting test is recommended to evaluate the patient's response and the potential risk of Koebner's phenomenon at the donor site after 2-3 months [35]. Potential side effects of vitiligo surgery include Koebner's phenomenon, keloid formation, hyperpigmentation, "cobblestoning," scarring, and infections. Split-thickness suction grafting has been shown to provide superior results compared to other techniques, such as control or suction blister grafts. Hyaluronic acid is increasingly used in grafting due to its improved compatibility with the skin. A double-blind trial demonstrated that a hyaluronic acid-enriched graft led to more than 70% repigmentation in 77% of patients after 12 months, compared to a placebo [36], [37].

7. Herbal Compounds for the Treatment of Vitiligo

Herbal compounds have long been recognized as potential therapeutic options for managing vitiligo. Since ancient times, various herbal products with different properties and effects have been used to treat this condition [38]. This overview highlights several herbal remedies that are commonly used to address vitiligo, a skin disorder characterized by the loss of pigment in certain areas, resulting in white patches on the skin. The causes of vitiligo are often associated with autoimmune factors, oxidative stress, and a disruption in the skin's ability to produce melanin

[39].

Figure 1 showcases various herbal and traditional treatments for vitiligo. Ginkgo biloba is known for improving circulation and reducing oxidative stress, potentially aiding skin repigmentation. Cucumis melo may stimulate melanin production, while Khellin enhances melanin synthesis. Picrorhiza kurroa and Polypodium leucotomos have anti-inflammatory effects, promoting melanocyte survival [40]. Traditional Chinese Medicine uses herbs like Rehmannia glutinosa to balance the body's energy and improve pigmentation. Green Tea Polyphenols and Capsaicin stimulate melanin production, while Curcumin reduces inflammation, potentially aiding repigmentation. These treatments show promise, but more clinical trials are needed [41], [42].

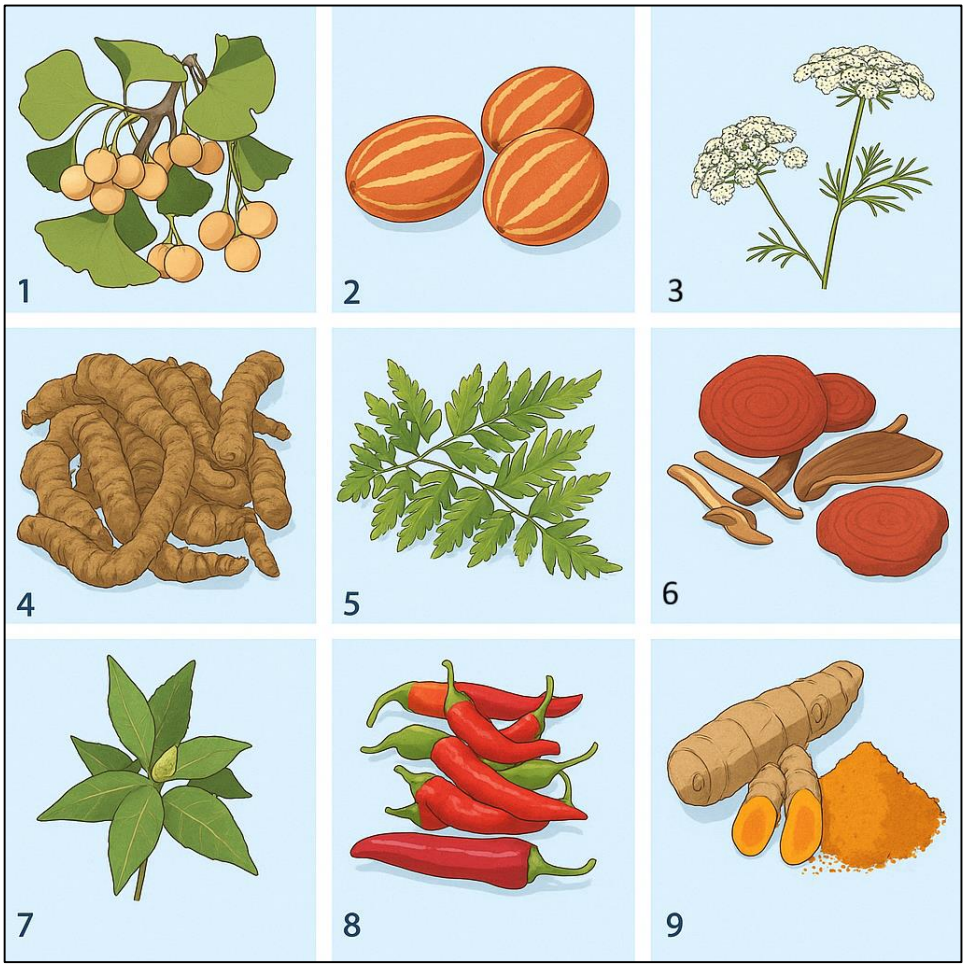

Figure 1: Herbal and Traditional Treatments for Vitiligo (Including 1. Ginkgo biloba, 2. Cucumis melo, 3. Khellin, 4. Picrorhiza kurroa, 5. Polypodium leucotomos, 6. Traditional Chinese Medicine, 7. Green Tea Polyphenols, 8. Capsaicin, and 9. Curcumin).

Table 2 provides a detailed overview of several herbal compounds that have been investigated for their potential benefits in managing vitiligo. Each compound is associated with unique mechanisms that may help address the underlying causes of the condition, such as oxidative stress, inflammation, immune dysfunction, and melanocyte regeneration [43].

Ginkgo biloba is known for its antioxidant properties and its ability to improve circulation, which may promote the regeneration of melanocytes, the cells responsible for skin pigmentation. Cucumis melo, or cantaloupe, is rich in superoxide dismutase, an antioxidant that neutralizes free radicals and helps protect melanocytes from oxidative damage, potentially aiding in the reduction of depigmentation and encouraging repigmentation. Khellin, derived from Ammi visnaga, is a photosensitizing agent with anti-inflammatory effects that can enhance melanogenesis, promoting pigmentation in vitiligo-affected areas, especially when combined with phototherapy [44], [45].

Picrorhiza kurroa, an herb used in Ayurvedic medicine, possesses immunomodulatory, anti-inflammatory, and antioxidant properties, potentially reducing autoimmune activity that contributes to melanocyte destruction in vitiligo. Polypodium leucotomos, a fern extract, also has antioxidant and anti-inflammatory effects, which may protect skin cells from further oxidative damage while supporting repigmentation [46]. Various herbs used in Traditional Chinese Medicine, such as Reishi and Ginseng, are believed to restore balance in the body, enhance immune function, and reduce inflammation, offering a holistic approach to managing vitiligo [47].

Green Tea polyphenols, especially epigallocatechin gallate (EGCG), act as potent antioxidants and immune modulators, helping to reduce oxidative stress and support immune function. Capsaicin, found in chili peppers, is known for stimulating melanogenesis and reducing inflammation, potentially aiding in the regeneration of pigment in the skin. Finally, Curcumin, the active compound in turmeric, has anti-inflammatory and antioxidant properties that may help reduce oxidative stress in vitiligo lesions and support melanocyte regeneration [48], [49].

These herbal compounds present promising options for managing vitiligo by targeting various mechanisms involved in the condition. While they offer potential as adjunct treatments, further clinical research is needed to confirm their safety and efficacy in vitiligo management [50], [51].

Table 2: Herbal Compounds and Their Potential Benefits for the Treatment of Vitiligo.

S. No.	Compound	Source/Origin	Mechanism/Action	Potential Benefits for Vitiligo	References
1.	Ginkgo biloba	Plant (Ginkgo tree leaves)	Antioxidant, improves circulation and immune modulation	May help in repigmentation by improving blood circulation to affected areas.	[52], [53]
2.	Cucumis melo	Cantaloupe (Melon)	Rich in antioxidants, particularly superoxide dismutase (SOD)	May reduce oxidative stress, a key factor in vitiligo development.	[54], [55]
3.	Khellin	Plant (Ammi visnaga)	Photosensitizing agent, anti-inflammatory, enhances melanogenesis	Can induce repigmentation by promoting melanin production.	[56]
4.	Picrorhiza kurroa	Plant (Picrorhiza)	Immunomodulatory, anti-inflammatory, antioxidant	Used in Ayurvedic medicine for skin disorders and may help reduce autoimmune activity in vitiligo.	[57]
5.	Polypodium leucotomos	Fern (Polypodium)	Antioxidant, reduces oxidative stress, anti-inflammatory	Protects skin cells from oxidative damage, may help in skin depigmentation.	[58], [59]
6.	Traditional Chinese Medicine	Various plants and herbs (e.g., Reishi, Ginseng)	Restores balance in the body, anti-inflammatory, improves immune function	Offers a holistic approach to treat vitiligo, focusing on internal harmony.	[60]
7.	Green Tea Polyphenols	Green Tea (Camellia sinensis)	Antioxidant, anti-inflammatory, immune modulation	Polyphenols may reduce oxidative stress and support immune function in vitiligo.	[61]
8.	Capsaicin	Stimulates melanogenesis, anti-inflammatory	Capsaicin has been shown to help stimulate melanin production in vitiligo areas.	Capsaicin has been shown to help stimulate melanin production in vitiligo areas.	[62], [63]
9.	Curcumin	Turmeric (Curcuma longa)	Anti-inflammatory, antioxidant, immune modulation	May reduce inflammation and oxidative stress in vitiligo lesions, promoting repigmentation.	[64], [65]

Herbal remedies have garnered interest for their potential in treating vitiligo, with various plants and compounds offering unique mechanisms to address the underlying causes of the condition. One such remedy is Ginkgo biloba, a well-known herbal supplement that is primarily used for its antioxidant properties. By combating oxidative stress, Ginkgo biloba helps to improve circulation, which can be particularly beneficial for vitiligo patients. Enhanced blood flow to the affected skin areas may stimulate melanocytes, the cells responsible for skin pigmentation, potentially aiding in repigmentation [66], [67].

Another plant, Cucumis melo (cantaloupe), is rich in superoxide dismutase (SOD), a powerful antioxidant that neutralizes harmful free radicals. In the case of vitiligo, oxidative stress contributes to the destruction of melanocytes, and Cucumis melo may help protect these cells from further damage while promoting skin repigmentation. Similarly, Khellin, derived from the plant Ammi visnaga, shows promise for vitiligo treatment due to its photosensitizing properties. This means it may enhance the skin's responsiveness to light therapy, commonly used in vitiligo treatment, while its anti-inflammatory effects and ability to stimulate melanogenesis (the production of melanin) make it a potential therapeutic candidate for repigmentation [68].

In Ayurvedic medicine, Picrorhiza kurroa has been used for centuries for its immune-modulating and anti-inflammatory properties. It is believed to balance the immune system, possibly reducing the autoimmune attack on melanocytes that contributes to vitiligo. Additionally, as an adaptogen, it may alleviate stress, a known exacerbator of vitiligo symptoms. Another herbal remedy, Polypodium leucotomos, an extract from a fern, has shown both antioxidant and anti-inflammatory effects, both crucial in managing vitiligo. It can protect skin cells from oxidative damage and may assist in halting further depigmentation while supporting repigmentation [69].

Traditional Chinese Medicine (TCM) utilizes herbs like ginseng and Reishi, focusing on restoring balance within the body. TCM often treats vitiligo through a holistic approach, addressing both the condition itself and the underlying factors such as stress and immune system imbalance. Green tea polyphenols, especially epigallocatechin gallate (EGCG), have been identified as powerful antioxidants with immune-modulating effects, which can be beneficial for vitiligo patients, particularly those with autoimmune-related conditions [70], [71].

Capsaicin, a compound found in chili peppers, has also been studied for its potential to treat vitiligo. Known for its ability to stimulate melanogenesis and reduce inflammation, capsaicin may support the regeneration of pigment in affected skin areas. Finally, Curcumin, the active compound in turmeric, has anti-inflammatory and antioxidant properties that help reduce oxidative stress, a major contributor to vitiligo. Curcumin may also promote the regeneration of melanocytes, offering an additional therapeutic pathway for vitiligo management [72].

Collectively, these herbal remedies provide promising alternatives to traditional treatments, targeting various mechanisms involved in vitiligo, from oxidative stress and inflammation to immune modulation and melanocyte regeneration. Further clinical studies are needed to fully validate their efficacy and safety in managing vitiligo, but their use in complementary and alternative medicine provides hope for patients seeking holistic treatment options [73].

8. Current Challenges

Vitiligo presents several current challenges in its management. Despite the availability of various treatment options, there is no definitive cure for the condition. Treatments like corticosteroids, phototherapy, and surgical interventions often show variable results, and many patients experience limited effectiveness. This gap in treatment efficacy has led to an increased interest in alternative therapies, such as herbal remedies, but these too require further clinical validation to confirm their long-term benefits [74].

The psychological impact of vitiligo is profound, with many individuals experiencing emotional distress, social stigma, and a diminished quality of life. The visible nature of the condition often leads to discrimination, contributing to mental health issues such as depression and anxiety. These psychological aspects are frequently overlooked in treatment plans, leaving many patients to deal with the emotional burden of their condition without adequate support [75], [76].

While herbal remedies like Ginkgo biloba, Curcumin, and Green Tea show promise, there is a lack of comprehensive clinical research to support their efficacy and safety for vitiligo treatment. More extensive studies are needed to validate their potential in repigmentation and immune modulation. Additionally, conventional treatments, such as corticosteroids and calcineurin inhibitors, come with side effects, including skin thinning, cancer risks, and the possibility of developing other autoimmune conditions. These concerns raise doubts about the long-term use of such therapies [77].

Vitiligo's genetic predisposition and autoimmune nature further complicate its management. It often coexists with other autoimmune conditions, which requires a more integrated approach to treatment. Additionally, the availability of advanced treatments, like phototherapy and specialized surgical options, can be limited depending on geographical location, which creates a barrier to care, especially in low-resource settings [78].

These challenges underscore the need for continued research, better psychological support for patients, and more accessible treatment options to improve outcomes for individuals with vitiligo [79].

9. Future Direction

The future direction for vitiligo treatment and management involves several key areas of development. Research into the underlying mechanisms of vitiligo, particularly its genetic and autoimmune components, is essential to identify more targeted therapies. Advancements in molecular biology and immunology could lead to the development of personalized treatments that address the specific causes of melanocyte destruction in each individual [80].

Herbal and alternative therapies hold promise, but more rigorous clinical trials are needed to establish their safety and efficacy. Future research should focus on validating the potential of natural remedies, such as Ginkgo biloba, Curcumin, and Green Tea, in clinical settings, with an emphasis on understanding their mechanisms of action and how they may complement traditional treatments [81].

The exploration of combination therapies is another promising direction. Combining conventional treatments like phototherapy and immunomodulators with emerging therapies such as JAK inhibitors or novel botanical compounds could provide more effective results in repigmentation. Additionally, the development of topical formulations that enhance melanocyte regeneration and protect against oxidative stress could improve treatment outcomes [82].

Psychological support and interventions will play an increasingly important role in the holistic management of vitiligo. Integrating mental health care into treatment plans, including counseling, support groups, and stress management techniques, will help address the emotional and psychological impact of the disease [83].

Advances in gene therapy, stem cell research, and regenerative medicine also hold potential for vitiligo treatment. Investigating the use of stem cells to regenerate melanocytes or gene editing techniques to correct the immune response may offer groundbreaking therapies in the future [84].

Finally, efforts to improve access to treatment, especially in low-resource settings, are crucial. Expanding the availability of phototherapy, surgical options, and specialized care to underserved populations will ensure that more individuals can benefit from the latest advancements in vitiligo treatment [85].

Conclusion

Vitiligo is a condition that can affect anyone, regardless of gender, age, ethnicity, or skin color, and often emerges before the age of 30. While it is not life-threatening, its impact on an individual's appearance and the associated social stigma can be profound, leading many patients to seek ways to conceal their skin lesions. Although existing treatments are available, they often have limitations, and the condition's chronic nature, combined with psychological challenges, calls for more comprehensive approaches. Alternative treatments, including herbal remedies like Psoralea corylifolia, Ginkgo biloba, and Curcuma longa, show promise in alleviating symptoms and improving patient quality of life. Additionally, molecular formulations designed to enhance the effectiveness of these treatments may provide more targeted solutions. However, further clinical research is essential to confirm the safety and efficacy of these alternative therapies in vitiligo management, offering hope for improved outcomes for those affected by this condition.

Acknowledgement

We would like to extend our heartfelt gratitude to the faculty and staff at the School of Pharmacy, Desh Bhagat University, Mandi Gobindgarh, Punjab, India, for their unwavering support throughout the course of this review. A special thank you to the research scholars for their insightful suggestions and collaborative efforts. Our sincere appreciation goes to our families for their constant encouragement and patience during this research. Additionally, we acknowledge the authors and researchers whose work has greatly contributed to the completion of this paper. Their pioneering research in the field of vitiligo and herbal remedies has significantly shaped this review.

Author Contribution

SR; Conceptualized the study, **SAM;** Visualization, and **ARS;** Prepared the manuscript draft, **BR;** Data Collection.

Conflict of Interest

No conflicts of interest are disclosed by the authors.

Source of Funding

There is no funding available to conduct this study.

References

1. C. Bergqvist and K. Ezzedine, "Vitiligo: A Review," 2020. doi: 10.1159/000506103.
2. [2] K. AL-smadi, M. Imran, V. R. Leite-Silva, and Y. Mohammed, "Vitiligo: A Review of Aetiology, Pathogenesis, Treatment, and Psychosocial Impact," 2023. doi: 10.3390/cosmetics10030084.
3. T. Iwanowski, K. Kołkowski, R. J. Nowicki, and M. Sokołowska-Wojdyło, "Etiopathogenesis and Emerging Methods for Treatment of Vitiligo," 2023. doi: 10.3390/ijms24119749.
4. [4] P. Karagaiah et al., "Emerging drugs for the treatment of vitiligo," 2020. doi: 10.1080/14728214.2020.1712358.
5. T. Ali, "Chromatography and Spectroscopic Characterization of Nano-Carrier Pharmaceuticals," Pharm. Nanotechnol., 2024, doi: 10.2174/0122117385319695240911115239.
6. [6] Z. A. Abdel-Malek, C. Jordan, T. Ho, P. R. Upadhyay, A. Fleischer, and I. Hamzavi, "The

enigma and challenges of vitiligo pathophysiology and treatment," 2020. doi: 10.1111/pcmr.12878.
7. R. Speeckaert and N. van Geel, "Vitiligo: An Update on Pathophysiology and Treatment Options," 2017. doi: 10.1007/s40257-017-0298-5.
8. K. Boniface, J. Seneschal, M. Picardo, and A. Taïeb, "Vitiligo: Focus on Clinical Aspects, Immunopathogenesis, and Therapy," 2018. doi: 10.1007/s12016-017-8622-7.
9. J. E. Lommerts, M. W. Bekkenk, and R. M. Luiten, "Vitiligo induced by immune checkpoint inhibitors in melanoma patients: an expert opinion," 2021. doi: 10.1080/14740338.2021.1915279.
10. Sawood Alam et al., "Overview of the Vital Role of Vitamin D: Functions, Deficiency Syndromes, and Impact Throughout Life," Curr. Pharm. Res., pp. 1–12, 2025, doi: 10.63785/cpr.2025.1.1.125136.
11. [11] W. Luo, J. Liu, Y. Huang, and N. Zhao, "An effective vitiligo intelligent classification system," J. Ambient Intell. Humaniz. Comput., 2023, doi: 10.1007/s12652-020-02357-5.
12. E. Pusey-Reid, L. W. Quinn, J. Wong, and A. Wucherpfennig, "Representation of dark skin tones in foundational nursing textbooks: An image analysis," Nurse Educ. Today, 2023, doi: 10.1016/j.nedt.2023.105927.
13. K. Singh et al., "Recent Advances in the Synthesis of Antioxidant Derivatives: Pharmacological Insights for Neurological Disorders," Curr. Top. Med. Chem., vol. 24, no. 22, pp. 1940–1959, 2024, doi: 10.2174/0115680266305736240725052825.
14. S. Gianfaldoni et al., "Herbal compounds for the treatment of vitiligo: A review," 2018. doi: 10.3889/oamjms.2018.048.
15. A. A. Alshaikh and R. K. Bharti, "Spontaneous Reversal of Vitiligo, a Rare Phenomenon Reported in a Case in Saudi Arabia with an Insight into Metabolic Biochemical Derangements," Med., 2023, doi: 10.3390/medicina59030427.
16. Shivmohan, Gurpreet Kaur, Shivam Kumar, and Nisha, "Neuroprotective Effects of Seaweeds in Alzheimer's Disease: A Review," Curr. Pharm. Res., pp. 13–28, 2025, doi: 10.63785/cpr.2025.1.1.137149.
17. M. T. Tlhah, N. H. F. A. H. Abdul Halim, and N. A. Ab Rahman, "CHALLENGES AND EFFECTS OF TECHNOLOGY IN EMOTIONAL AND PSYCHOLOGICAL DEVELOPMENT OF CHILDREN," Al Athfal J. Kaji. Perkemb. Anak dan Manaj. Pendidik. Usia Dini, 2023, doi: 10.52484/al_athfal.v6i1.410.
18. Z. Shuo, D. Xuyang, Z. Xin, C. Xuebin, and H. Jie, "The Relationship Between Postgraduates' Emotional Intelligence and Well-Being: The Chain Mediating Effect of Social Support and Psychological Resilience," Front. Psychol., 2022, doi: 10.3389/fpsyg.2022.865025.
19. H. Khaled, E. El-Sabagh, and H. Bazid, "Female sexual dysfunction in patients with psoriasis and vitiligo: An Egyptian pilot study," J. Egypt. Women's Dermatologic Soc., 2021, doi: 10.4103/JEWD.JEWD_51_20.
20. S. Garelli et al., "Autoimmune polyendocrine syndrome type 1: an Italian survey on 158 patients," J. Endocrinol. Invest., 2021, doi: 10.1007/s40618-021-01585-6.
21. Navdeep Singh and Talit Masood, "Berberine in Breast Cancer Management: Molecular Mechanisms, Therapeutic Applications, and Future Directions," Curr. Pharm. Res., pp. 29–41, 2025, doi: 10.63785/cpr.2025.1.1.150160.
22. S. B. Shaikh, I. M. Haji, P. Doddamani, and M. Rahman, "A study of Autoimmune Polyglandular Syndrome (APS) in patients with type1 diabetes mellitus followed up at a teritiary care hospital," J. Clin. Diagnostic Res., 2014, doi: 10.7860/JCDR/2014/7013.4011.
23. R. Anjum, F. Altaf, Raffad, Z. Rani, N. Shahzadi, and W. Saeed, "To determine frequency of Anti-TPO antibodies in vitiligo patients," J. Pakistan Assoc. Dermatologists, 2019.
24. Z. Hu and T. Wang, "Beyond skin white spots: Vitiligo and associated comorbidities," 2023. doi: 10.3389/fmed.2023.1072837.
25. M. R. Khan, D. Kumar, S. Shamim, K. Sunand, S. Sharma, and G. Rawat, "Ethnopharmacological relevance of Citrus limon (L.) Burm. f. as adjuvant therapy," Ann. Phytomedicine An Int. J., vol. 12, no. 2, pp. 169–179, 2023, doi: 10.54085/ap.2023.12.2.19.
26. M. Grochocka, A. Wełniak, A. Białczyk, L. Marek-Jozefowicz, T. Tadrowski, and R. Czajkowski, "Management of Stable Vitiligo—A Review of the Surgical Approach," 2023. doi: 10.3390/jcm12051984.
27. A. Chaudhary, M. Patel, and S. Singh, "Current Debates on Etiopathogenesis and Treatment Strategies for Vitiligo," Curr. Drug Targets, 2022, doi: 10.2174/1389450123666220406125645.
28. J. Y. Wang et al., "Network pharmacological mechanisms of Vernonia anthelmintica (L.) in the treatment of vitiligo: Isorhamnetin induction of melanogenesis via up-regulation of melanin-biosynthetic genes," BMC Syst. Biol., 2017, doi: 10.1186/s12918-017-0486-1.
29. Shamim, S. Ali, T. Ali, H. Sharma, B. N. Kishor, and S. K. Jha, "Recent Advances in Monodisperse Gold Nanoparticle Delivery, Synthesis, and Emerging Applications in Cancer Therapy," Plasmonics, vol. 20, no. 1, 2025, doi: 10.1007/s11468-024-02732-4.
30. Y. Wang and X. Zhu, "Investigation of potential targets and mechanisms of action of Bailing tablets on vitiligo based on network pharmacology and molecular docking," Trop. J. Pharm. Res., 2023, doi: 10.4314/tjpr.v22i4.15.
31. P. Das, D. Kumar, V. Gupta, S. Gupta, R. Tanwar, and K. Behmani, "Sphingosomes: Advancements and Emerging Applications in Advanced Drug Delivery Systems," Curr. Pharm. Res., vol. 1, pp. 199–208, 2025, [Online]. Available: https://cpr.org.in/index.php/files/article/view/134/83.
32. X. Liu, Z. Yao, Y. Wang, L. Chai, and X. Zhou, "Vitamin D analogs combined with different types of phototherapy in the treatment of vitiligo: A systematic review of randomized trials and within-patient studies," Int. Immunopharmacol., 2022, doi: 10.1016/j.intimp.2022.108789.

33. E. Wang and M. Rodrigues, “An update and review of narrowband ultraviolet B phototherapy for vitiligo,” Dermatological Rev., 2022, doi: 10.1002/der2.142.
34. A. K. Jaiswal et al., “Multi-targeted therapeutic exploration of Tamarix gallica flowers for anti-ulcer activity and associated complications,” J. Ayurveda Integr. Med., vol. 15, no. 4, p. 100947, 2024, doi: 10.1016/j.jaim.2024.100947.
35. K. Al-Smadi et al., “Using a Topical Formulation of Vitamin D for the Treatment of Vitiligo: A Systematic Review,” 2023. doi: 10.3390/cells12192387.
36. M. Jamgochian, M. Alamgir, and B. Rao, “Diet in Dermatology: Review of Diet’s Influence on the Conditions of Rosacea, Hidradenitis Suppurativa, Herpes Labialis, and Vitiligo,” 2023. doi: 10.1177/15598276211026592.
37. K. Singh et al., “Deciphering the Genetic Landscape: Exploring the Relationship Between HLA-DQA1, HLA-DQB1, and HLA-DRB1 Genes in Diabetes Mellitus,” Curr. Pharmacogenomics Person. Med., vol. 21, pp. 1–11, 2024, doi: 10.2174/0118756921310081240821065036.
38. Abhishek Kumar Singh and Fayyaz Husain, “Advancements in Endoscopic Techniques: Revolutionizing Patient Care and Surgical Precision,” Curr. Pharm. Res., pp. 53–67, 2025, doi: 10.63785/cpr.2025.1.1.171183.
39. A. Qadir, S. N. M. N. Ullah, S. Jahan, A. Ali, and N. Khan, “Drug delivery of natural products through nano-carriers for effective vitiligo therapy: A compendia review,” 2022. doi: 10.1111/jocd.15158.
40. S. Gianfaldoni et al., “Herbal Compounds for the Treatment of Vitiligo : A Review Ginkgo biloba Ayurvedic medicine : Picrorhiza kurroa,” Herb. Compd. Treat. Vitiligo A Rev. Ginkgo biloba Ayurvedic Med. Picrorhiza kurroa, 2018.
41. B. Zhu, C. Liu, L. Zhang, J. Wang, M. Chen, and Y. Wei, “Comparison of NB-UVB combination therapy regimens for vitiligo: A systematic review and network meta-analysis,” J. Cosmet. Dermatol., 2023, doi: 10.1111/jocd.15534.
42. P. Kumar et al., “Fused Deposition Modeling 3D-Printed Scafolds for Bone Tissue.pdf,” Appl. Biochem. Biotechnol., vol. 12, no. 22, pp. 1–11, 2024, doi: 10.54085/ap.2023.12.2.19.
43. K. Kaur, G. Kaur, and V. Singh, “Picrorhiza kurroa Royle ex Benth.: Kutki,” in Immunity Boosting Medicinal Plants of the Western Himalayas, 2023. doi: 10.1007/978-981-19-9501-9_15.
44. A. Mastan, “A systemic review on vitiligo (baraṣ) and role of Unani medicines towards its treatment,” TMR Integr. Med., 2021, doi: 10.53388/tmrim202105002.
45. B. Pratap, S. Shamim, and S. Ali, “Formulation and Characterisation of Herbal Ethosomal Gel of Luliconazole and Clove Oil for Modified Drug Diffusion to the Skin,” Res. J. Pharm. Technol., vol. 18, no. 8, pp. 3501–3508, 2025, doi: 10.52711/0974-360X.2025.00504.
46. Shukar Singh, Gursewak Singh, Tawqeer Shafi, and Shafkat Hussain Malik, “Overview of Peptic Ulcer Disease: Epidemiology, Causes, Pathophysiology, and Clinical Importance,” Curr. Pharm. Res., pp. 68–79, 2025, doi: 10.63785/cpr.2025.1.2.184192.
47. R. N. Chaudhari, A. K. Jain, and V. K. Chatap, “An Overview on Phyto-chemistry, Traditional and Pharmacological aspects of Pyrostegia Venusta,” 2022. doi: 10.52711/0974-360X.2022.00389.
48. N. Mahajan, B. Koul, P. Gupta, B. A. Shah, and J. Singh, “Psoralea corylifolia L.: Panacea to several maladies,” 2022. doi: 10.1016/j.sajb.2022.01.024.
49. A. Anand et al., “Neuroprotective Efficacy and Complementary Treatment with Medicinal Herbs: A Comprehensive Review of Recent Therapeutic Approaches in Epilepsy Management,” CNS Neurol. Disord. - Drug Targets, vol. 24, no. 1, pp. 60–73, 2024, doi: 10.2174/0118715273332140240724093837.
50. R. Bouceiro Mendes, M. Alpalhão, and P. Filipe, “UVB phototherapy in the treatment of vitiligo: State of the art and clinical perspectives,” 2022. doi: 10.1111/phpp.12740.
51. S. et al. Singh, K., Gupta, J. K., Chanchal, D. K., Khan, S., Varma, A., Shanno, K., Kumar, S., & Shamim, “Deciphering the Genetic Landscape: Exploring the Relationship Between HLA-DQA1, HLA-DQB1, and HLA-DRB1 Genes in Diabetes Mellitus,” Curr. Pharmacogenomics Person. Med., vol. 21, no. 3, pp. 1–11, 2024, doi: 10.2174/0118756921310081240821065036.
52. S. K. Singh, S. Srivastav, R. J. Castellani, G. Plascencia-Villa, and G. Perry, “Neuroprotective and Antioxidant Effect of Ginkgo biloba Extract Against AD and Other Neurological Disorders,” 2019. doi: 10.1007/s13311-019-00767-8.
53. S. Chawla, R. Gupta, S. K. Jha, and K. T. Jha, “Stereoisomerism in Chemistry and Drug Development: Optical, Geometrical, and Conformational Isomers,” Med. Chem. (Los. Angeles)., 2025, doi: 10.2174/0115734064366389250923044201.
54. A. Białczyk, A. Wełniak, B. Kamińska, and R. Czajkowski, “Oxidative Stress and Potential Antioxidant Therapies in Vitiligo: A Narrative Review,” 2023. doi: 10.1007/s40291-023-00672-z.
55. Murari Kumar Maharaj, Aman Kumar, Tawqeer Shaf, and Shafkat Hussain Malik, “Mouth-Dissolving Films: A Novel Approach for Oral Drug Delivery in Diabetic Management,” Curr. Pharm. Res., pp. 80–87, 2025, doi: 10.63785/cpr.2025.1.2.193199.
56. N. Khalil, M. Bishr, S. Desouky, and O. Salama, “Ammi Visnaga L., a potential medicinal plant: A review,” 2020. doi: 10.3390/molecules25020301.
57. T. M. Almeleebia, A. Alsayari, and S. Wahab, “Pharmacological and Clinical Efficacy of Picrorhiza kurroa and Its Secondary Metabolites: A Comprehensive Review,” 2022. doi: 10.3390/molecules27238316.
58. A. Rodríguez-Luna, A. Zamarrón, Á. Juarranz, and S. González, “Clinical Applications of Polypodium leucotomos (Fernblock®): An Update,” 2023. doi: 10.3390/life13071513.
59. Riya Chandel, Firoz Khan, and Taranvirinderdeep Singh, “The Expanding Role of Sphingolipids in

Liver Fibrosis and Disease Progression," Curr. Pharm. Res., pp. 88–104, 2025, doi: 10.63785/cpr.2025.1.2.200214.
60. J. Wang, D. Wang, and G. Si, "Efficacy and safety of Chinese patent medicine compound preparation combined with routine treatment in vitiligo: A Bayesian network meta-analysis," 2023. doi: 10.1097/MD.0000000000035327.
61. V. R. Sinija and H. N. Mishra, "Green tea: Health benefits," 2008. doi: 10.1080/13590840802518785.
62. Q. Wu et al., "Capsaicin Inhibits the Expression of Melanogenic Proteins in Melanocyte via Activation of TRPV1 Channel: Identifying an Inhibitor of Skin Melanogenesis," J. Agric. Food Chem., 2020, doi: 10.1021/acs.jafc.0c06321.
63. Imanshu, Mohita Thakur, and Deepika Bhatia, "Gingko biloba Herbal Plant Used for Treating Dementia and Alzheimer's Disease," Curr. Pharm. Res., pp. 105–115, 2025, doi: 10.63785/cpr.2025.1.2.215224.
64. A. B. Kunnumakkara et al., "Role of Turmeric and Curcumin in Prevention and Treatment of Chronic Diseases: Lessons Learned from Clinical Trials," 2023. doi: 10.1021/acsptsci.2c00012.
65. Mohita Thakur, "Importance of In-Process Quality Control for Product Safety and Integrity in Pharmaceutical Packaging," Curr. Pharm. Res., pp. 116–124, 2025, doi: 10.63785/cpr.2025.1.2.225232.
66. O. Szczurko, N. Shear, A. Taddio, and H. Boon, "Ginkgo biloba for the treatment of vitilgo vulgaris: An open label pilot clinical trial," BMC Complement. Altern. Med., 2011, doi: 10.1186/1472-6882-11-21.
67. A. et al. Kumar, J., M., T., Musayev, "Stimuli-responsive Hydrogels for Targeted Antibiotic Delivery in Bone Tissue Engineering," AAPS PharmSciTech, vol. 26, no. 217, pp. 1–23, 2025, doi: https://doi.org/10.1208/s12249-025-03218-0.
68. I. Vouldoukis et al., "Antioxidant and anti-inflammatory properties of a Cucumis melo LC. extract rich in superoxide dismutase activity," J. Ethnopharmacol., 2004, doi: 10.1016/j.jep.2004.04.023.
69. R. Kumar, Y. K. Gupta, S. Singh, and A. Raj, "Anti-inflammatory Effect of Picrorhiza kurroa in Experimental Models of Inflammation," Planta Med., 2016, doi: 10.1055/s-0042-106304.
70. A. P. Lu, H. W. Jia, C. Xiao, and Q. P. Lu, "Theory of traditional chinese medicine and therapeutic method of diseases," 2004. doi: 10.3748/wjg.v10.i13.1854.
71. P. Kumar et al., "Trends of Nanobiosensors in Modern Agriculture Systems," Appl. Biochem. Biotechnol., vol. 197, no. 1, pp. 667–690, 2024, doi: 10.1007/s12010-024-05039-6.
72. Q. Wu et al., "Capsaicin, a Phytochemical From Chili Pepper, Alleviates the Ultraviolet Irradiation-Induced Decline of Collagen in Dermal Fibroblast via Blocking the Generation of Reactive Oxygen Species," Front. Pharmacol., 2022, doi: 10.3389/fphar.2022.872912.
73. Y. Pang et al., "Plant-Derived Compounds as Promising Therapeutics for Vitiligo," 2021. doi: 10.3389/fphar.2021.685116.
74. A. B. Dillon, A. Sideris, A. Hadi, and N. Elbuluk, "Advances in Vitiligo: An update on medical and surgical treatments," 2017.
75. A. H. Salama, L. Alnemr, A. R. Khan, H. Alfakeer, Z. Aleem, and M. Ali-Alkhateeb, "Unveiling the Unseen Struggles: A Comprehensive Review of Vitiligo's Psychological, Social, and Quality of Life Impacts," Cureus, 2023, doi: 10.7759/cureus.45030.
76. S. A. Ali, S. Ali, S. Rastogi, B. Shivhare, and M. Muztaba, "A Comprehensive Review on Advancements in Nanocarriers-Based Peptide Delivery for Cancer Therapeutics," Micro Nanosyst., vol. 17, no. 4, pp. 283–297, 2025, doi: 10.2174/0118764029358553250325040749.
77. D. Parsad, R. Pandhi, and A. Juneja, "Effectiveness of oral Ginkgo biloba in treating limited, slowly spreading vitiligo," Clin. Exp. Dermatol., 2003, doi: 10.1046/j.1365-2230.2003.01207.x.
78. V. Thakur, A. Bishnoi, K. Vinay, S. M. Kumaran, and D. Parsad, "Vitiligo: Translational research and effective therapeutic strategies," 2021. doi: 10.1111/pcmr.12974.
79. R. E. Simons, D. L. Zevy, and M. Jafferany, "Psychodermatology of vitiligo: Psychological impact and consequences," 2020. doi: 10.1111/dth.13418.
80. Y. Feng and Y. Lu, "Advances in vitiligo: Update on therapeutic targets," 2022. doi: 10.3389/fimmu.2022.986918.
81. I. Grabska-Kobyłecka et al., "Polyphenols and Their Impact on the Prevention of Neurodegenerative Diseases and Development," 2023. doi: 10.3390/nu15153454.
82. J. Perez-Bootello, R. Cova-Martin, J. Naharro-Rodriguez, and G. Segurado-Miravalles, "Vitiligo: Pathogenesis and New and Emerging Treatments," 2023. doi: 10.3390/ijms242417306.
83. A. N. Mahama, C. N. Haller, and A. M. Ahmed, "Psychosocial considerations in the management of vitiligo," Clin. Dermatol., 2023, doi: 10.1016/j.clindermatol.2023.02.008.
84. "Abstracts of the 17th International Symposium on Bioluminescence and Chemiluminescence - (ISBC 2012)," Luminescence, 2012, doi: 10.1002/bio.2341.
85. [I. Majid, "Efficacy of targeted narrowband ultraviolet B therapy in Vitiligo," Indian J. Dermatol., 2014, doi: 10.4103/0019-5154.139892.