A REVIEW OF INDIAN HERBAL APPROACHES FOR VITILIGO: REPIGMENTATION POTENTIAL OF PSORALEA CORYLIFOLIA AND MORINGA OLEIFERA EXTRACTS

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ABSTRACT

Non-Segmental Vitiligo (NSV) is an autoimmune skin disease characterized by the presence of depigmented patches of skin due to a chronic loss of melanocytes. Current therapies includes topical steroids, narrowband UVB, and surgical interventions are commonly used but can carry risks such as skin thinning, irritation, or long-term health concerns. This study explores the potential review of *Psoralea corylifolia* and *Moringa oleifera* extracts as a potential natural solution for non-segmental vitiligo. Both are rich in antioxidant compounds and antimicrobial properties which help neutralize free radicals and reduce oxidative stress, a factors linked to vitiligo. *Psoralea corylifolia* is high in psoralen, stimulates melanocyte activity by exposing to UVA light, forms covalent bonds with DNA, leading to cross-links between DNA strands that promotes the migration of melanocytes from hair follicles into depigmented areas. Moringa oleifera, recognized for its high antioxidant and skin-repairing properties, contains flavonoids, an essential enzyme for melanin synthesis which supports melanocyte regeneration. Both *Psoralea corylifolia* and *Moringa oleifera* effectively addresses cosmetic aspects and cause of vitiligo by enhancing melanocyte activity, which makes this treatment an efficient substitute for traditional therapies.

Keywords— Repigmentation, Psoralea corylifolia, Moringa oleifera, Psoralen, Flavonoids.

I. INTRODUCTION

Vitiligo is a non-familial depigmenting skin condition characterized by the selective disappearance of melanocytes, thus resulting in sharply demarcated, chalky white macules that lack pigment [1]. Affecting around 0.1%–2% of the global population, vitiligo primarily appears on exposed areas such as the face, hands, and other regions with skin pigmentation, although it can affect the entire body[5].Advances in our understanding of vitiligo have classified it as an autoimmune disease associated with genetic susceptibility and environmental triggers[1].

A. Findings from Literature Insights

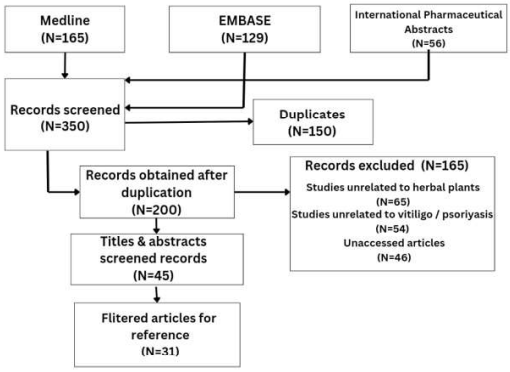

Figure 1: Flowchart on searching and selection of articles.

There seems to be 80% genetic contribution, leaving behind 20% that contributes to the development of vitiligo through environmental triggers[5]. Oxidative stress disrupts melanocytes and to subsequent complexity in the immune system in the form of immune cytokines and exosome secretion, which keeps leading tissue to destruction. As a result, cytotoxic CD8+ T cells and interferon-γ (IFN-γ) are generated in a feedback loop, which repeatedly recruits T cells to affected areas[6].

We conducted a systemic review across research databases, including PubMed, ScienceDirect, and Google Scholar, to gather multidisciplinary materials such as research articles, patents, theses, and books (See Figure 1). Initially, 350 articles were identified, but those did not focus on conditions like vitiligo therapy and duplicates were excluded from our selection. This refinement process led to the identification of 200 relevant articles. Of these, an additional 165 articles were excluded since those are unrelated to herbal therapies and unassessed articles. Finally, 31 articles with efficient role on herbs for treating vitiligo were retained for analysis.

B. Pathophysiology

Vitiligo is a multifactorial disorder in which the functional melanocytes are selectively lost, resulting in areas of depigmentation on the skin. Although many mechanisms have been proposed over the years, the current consensus is that it is an autoimmune condition, and that innate and adaptive immune responses participate in the progressive loss of melanocytes. Key mechanisms are genetic predispositions, oxidative stress, liberation of inflammatory mediators and cellular detachment processes-all of which go to determine the melanocyte destruction witnessed in patients presenting with the disease of vitiligo[6]. Melanocytes produce DAMPs (Damage-Associated Molecular Patterns) upon oxidative insult, which stimulates the innate immune system. In addition, Hsp70i (Inducible Heat Shock Protein 70**)** has been shown to enhance DC (Dendritic Cell) cytotoxicity, which promotes the activity of cytotoxic CD8+ T cells potentially accelerates melanocyte damage in the context of cellular stress[26].

C. Prevalence

Vitiligo is the most prevalent depigmenting skin condition, affecting 0.5 - 2 percent of the global population in both adults and children. Vitiligo affects people of all ethnicity and skin types equally[18]. Males and females are equally impacted, yet women and girls seek counsel more frequently probably because the negative social influence than for men and boys. Non segmental vitiligo can occur in all ages, but approximately fifty percent of the patients develop it before 20 years old; most commonly at around age ten. Populations with bimodal distribution of the age of onset or more than one peak were considered to have an intermediate effect size as far reported[19].

II. CLASSIFICATION

Two broad classifications for vitiligo exist, non-segmental vitiligo (NSV) and segmental vitiligo (SV), which characterize the extent of vitiligo spread. The majority form of NSV presents on symmetric body parts-often on the face, neck, hands, and feet. NSV encompasses subtypes: each delineated according to the appearance and arrangement of depigmentation. Generalized vitiligo features widespread, scattered white patches across various areas, while acrofacial vitiligo is specific to the facial orifices and distal fingers. Universal vitiligo, a rare form, involves over 80% of the body's surface area[1]. Mixed vitiligo combines segmental vitiligo with any non-segmental form, often resulting in complex depigmentation patterns[16] (See Figure 2).

Mucosal vitiligo is another variety of NSV, in which mucous membranes are affected, mostly involving oral and genital mucous membranes. Focal vitiligo is a precursor to generalized forms and typically appears as isolated patches within a small area, and this pattern remains stable over time. Unique regional types of vitiligo include "lip-tip" vitiligo, where depigmentation occurs around the lips, fingertips, and toes primarily in individuals from Southern Asia[12] (See Figure 2).

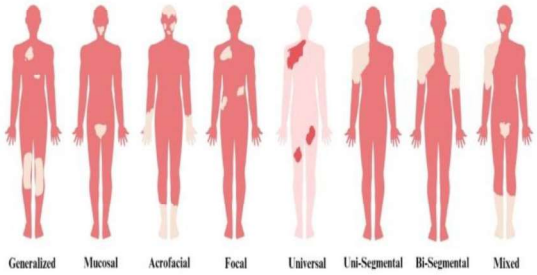

Figure 2: Classification of Vitiligo

Segmental vitiligo (SV), also known as unilateral vitiligo, generally occurs in younger patients and is less frequent than NSV. This is characterized by block-like or linear depigmented patches on one side of the body, and does not cross the midline. SV often rapidly progresses over six months to two years and then stabilizes, often with the appearance of leukotrichia (white hair) in the affected areas. Compared to NSV, SV is relatively insensitive to the treatment and is linked with lower autoimmune diseases as its common characteristic, which is typically more in NSV cases[1] (See Figure 2).

III. CONVENTIONAL TREATMENT

The conventional treatments for Repigmentation of vitiligo includes afamelanotide, prostaglandin E2 and the prostaglandin analogue bimatoprost. In these patients, more notable repigmentation can be observed where traditional treatment with oral corticosteroids failed. The JAK inhibitors like ruxolitinib, Methotrexate, and cyclophosphamide also shows promising results when given along with phototherapy- NB-UVB, although some adverse effect koebnerization have been noted. Moreover, PUVA therapy or psoralen with UVA is effective in adult patients, although monitoring is needed due to potential side effects[6]
(See Figure 3).

Topical treatments are essential for localized vitiligo to minimize adverse effects. For stabilizing vitiligo, oral therapies such as corticosteroids aim to prevent new lesion formation but require careful monitoring. Also, extracts such as Cucumis melo have catalase-like activity and have mixed results. Several natural products, including Callumae (containing L-phenylalanine and antioxidants) and Polypodium leucotomos (FernBlock®), have also been explored indicating enhanced efficacy when combined with narrowband UVB or UVA therapy[12,20,30](See Figure 3).

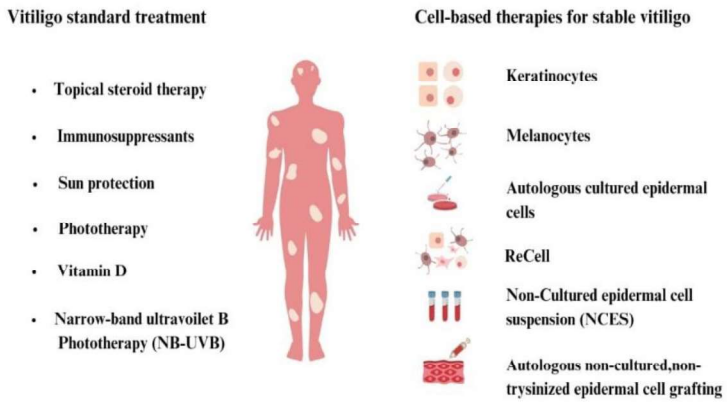

Figure 3: Treatment for Vitiligo

For patients unresponsive to medications or phototherapy, surgical options like skin grafting, blister grafting, and cellular
suspension transplant have been employed, targeting stable restoration of color. However, these methods entail risks such as scarring, infection, and abnormal pigmentation. Other topical agents like Vitilax and Novitil are commercially available for vitiligo, but evidence for effectiveness is not very strong. Agents with phototoxic activity such as Psoralea corylifolia, khellin, and barberry root are also reported; however, their safety in phototherapy and with sunlight exposure must be viewed with caution. Integrating therapies and balancing safety with effectiveness remains essential in the management of vitiligo, as individualized approaches often yield the best outcomes[6,20] (See Figure 3).

A. Side Effects

Phototherapy for vitiligo should preferably use UVB because it inhibits cytokine activity and prevents apoptosis in skin cells. Such treatment further activates inactive melanocytes in the hair follicle and allows these cells to proliferate and migrate into the depigmented areas in vitiligo. While having certain advantages, this mode of treatment possesses its demerits. Principle Side Effects includes Painful Burns, Itching, Dry skin, Increased Sensitivity of Skin, Hyperpigmentation, Enhanced Cancer Risk. Side effects accrued can attest to the necessity for carefully intertwined therapy guidelines. The use of emollients, sunscreen, and topical creams can palliate some of those side effects, further enhancing the efficacy and vitiligo treatment with UVB phototherapy[31].

IV. MORINGA OLEIFERA AND PSORALEA CORYLIFOLIA

Moringa oleifera is a perennial tropical deciduous arbor belonging to the family of Moringaceae; it originated in India and has been widely planted in Asia, Africa, and tropical and subtropical regions of Central America. Moringa oleifera has an important economic value and it is rich in active compounds such as flavonoids, phenols, phytosterols, carotenoids, quercetin and kaempferol. It has broad pharmacological properties, including anti-oxidation, anti-inflammation, anti-diabetes, lipids lowering, anti-cancer, and anti-bacterial, among others. Moringa oleifera as it is famously known as the "miracle tree" powerhouse of bioactive compounds that contribute to its numerous medicinal properties[28]. It decreases inflammation, oxidative stress, protect cells from scavenging free radicals, and promotes skin health In particular, β-carotene help to maintain healthy pigmentation and guard against UV-induced skin damage.

Psoralea corylifolia is an annual plant growing up to 50 - 90 cm tall and bears corolla, a pale purple flowers on short, condensed axillary spikes that has been widely used as a in traditional Chinese and Indian medicine. The seeds of this species contain coumarins, which are psoralen[2]. Bakuchi oil, derived from Psoralea corylifolia seeds, which includes flavonoids (neobavaisoflavone, isobavachalcone, bavachalcone, bavachinin, bavachin, corylin, corylifol, corylifolin, and 6-prenylnaringenin), coumarins (psoralidin, psoralen, isopsoralen, and angelicin), and meroterpenes (bakuchiol and 3-hydroxybakuchiol)[2,27].

A. Versatile Applications on Treating Vitiligo

Both *Moringa Extract* and *Psoralea corylifolia* are traditional as well as efficient remedy in managing and treating vitiligo. It tyrosinase which induces melanin production that helps to restore pigmentation. Antioxidants present mitigates oxidative stress (Reactive Oxygen Species ROS) prevents melanocytes from apoptosis. It modulates immune response CD8+T cells which is more important in autoimmune mediated destruction[2,5,6,19,27,28]. Hence, herbal combination addresses different aspects of vitiligo pathogenesis in restoring pigmentation and preventing further melanocyte damage.

V. CONCLUSION

While investigating the Indian herbal remedies for vitiligo, two botanicals, namely *Psoralea corylifolia* and *Moringa oleifera*, have shown to be effective in treating the disease. There are indications that *Psroalea Corylifolia* can enhance the growth and activity of melanocytes as well as the production of the pigment melanin due to its high composition of psoralen. In addition, *Moringa Oleifera* is known to possess immunomodulatory and antioxidant properties which may also help facilitate the repigmentation process. These extracts have therefore provided a more integrated method of treating vitiligo which seeks to incorporate traditional Ayurveda medicine as well as contemporary science. More clinical studies and controlled trials are also encouraged to

demonstrate the optimal dosages, assess the long-term outcomes and the effectiveness in different ethnicity groups. This means integrating this approach to treatment of vitiligo may lead to development of safer, affordable and culturally appropriate options for patients with the condition in dermatology which is more organic and customized herbal therapeutic remedy to the patients.

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