

Research Article

Nutritional Factors To Control Vitiligo: An Autoimmune Disorder.

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Short title: Dietary influence on Vitiligo.

Abstract

Vitiligo is a chronic autoimmune disorder characterized by the loss of melanocytes, the cells responsible for producing melanin, the pigment that gives skin, hair, and eyes their color. This loss results in the appearance of white patches on the skin, which can vary in size and location. The exact cause of vitiligo remains unclear, but genetic predisposition, environmental factors, and oxidative stress and auto immunity are believed to play crucial roles. The autoimmune component means the body's immune system when attacks its own melanocytes and kills the cells, vitiligo appears. Here we will discuss the link of nutrition, if any, has any role to control the disease when there is no such cure present at this time.

Keywords: Tyrosinase. Melanogenesis, Autoimmunity, Vitiligo, Nutrients.

INTRODUCTION

Vitiligo, an autoimmune skin disorder linked to hormonal and genetic factors, results in reduced pigmentation due to a gradual decline of the pigment producing cell, melanocytes [1-6]. The potential link between diet and vitiligo, in its severity or progression have been suggested [7,8]. Here we will discuss that the regulation of melanogenesis [15, 16]. Here, we discuss issue in details with pros and cons of the melanocyte activity several issues regarding "what and how" nutrients can help under the influence of different nutritional factors and diet pigmentary disorders.

This systematic review deals with the comprehensive search of the issue on PubMed, Google Scholar, and European PMC studies.

A: What is the Skin Pigmentation or Melanogenesis?

Skin pigmentation (melanogenesis) is driven by melanocytes, present in the basal layer of the epidermis [9,10]. Synthesized melanin are packaged into a specialized organelles called melanosomes before they are transferred to surrounding "keratinocytes" through cellular extensions known as dendrites [11, 12].

The production of melanin is triggered by various factors including sun exposure [13]. The melanin pigment is a polymer, synthesized from L-tyrosine amino acid, by the key as MITF regulate the expression of these enzymes [22, 23].

enzyme, tyrosinase [9]. Besides tyrosinase there are two other important enzymes involved in the synthesis of melanin,

and they are TRP-1 and TRP-2 [10]. Disruptions of any of the above factors can lead to pigmentation disorders like hyperpigmentation or hypopigmentation [14]. While genetics are the major factor, diet can also play an effective role in the regulation of melanogenesis [15, 16]. Here, we discuss several issues regarding "what and how" nutrients can help under the influence of different nutritional factors and diet pigmentary disorders.

A-1: Melanogenesis Pathway in the Skin: Melanogenesis is the biological process responsible for melanin production in the skin, primarily within melanocytes located in the epidermis.

This process synthesizes two types of melanin: eumelanin (brown-black) and pheomelanin (yellow-red), which protect the skin from harmful UV radiation. Melanogenesis is regulated by both intrinsic factors (e.g., hormones, cytokines) and extrinsic factors (e.g., UV radiation) [9, 16- 18]. Key signaling pathways involved include cAMP, p53, ERK/MAPK, and PI3K/Akt [19, 20]. Enzymes like tyrosinase and tyrosinase-related proteins (TRP-1, TRP-2) are the main factors to synthesize melanin from L-tyrosine [10, 21]. Transcription factors such as MITF regulate the expression of these enzymes [22, 23].

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UV exposure induces DNA damage, leading to the release of α -MSH, which binds to MC1R on melanocytes, activating the steps for melanogenesis [24-26]. Dysregulation of this process can result in the pigmentation disorders like melasma or contribute to the development of skin cancer, melanoma [27-29]. Understanding these pathways is crucial for developing the therapies for the treatment of vitiligo (hypopigmentation) or hyperpigmentation.

A-2: Understanding of Oxidative Stress in Vitiligo.

Understanding of oxidative stress in vitiligo involves recognizing how an imbalance between damaging free radicals and the body's natural defenses can affect skin pigment. When oxidative stress is high, melanocytes become more fragile and susceptible to damage [30].

Diet plays a role to resist this damage because antioxidants presents in diet help to neutralize the free radicals. Certain foods contain compounds that support the cellular repair, and deficiencies of certain nutrients can worsen oxidative imbalance.

B: The Potential Link Between Diet and Vitiligo:

B-1: Does Diet Affect Vitiligo? Diet, on its own, isn't a direct cause of vitiligo, and neither a cure. However, research increasingly suggests a correlation between dietary habits and the severity or progression of the disease [31]. The link centers primarily on the following:

- **Oxidative Stress:** As mentioned above, vitiligo is associated with increased oxidative stress in the body. Fruits and vegetables, those rich in vitamins A, C, and E, are good to be consumed [32, 33]. Foods like berries, spinach, kale, citrus fruits, nuts, and seeds are also should be included in diet [32]. Spices like turmeric and ginger, known for their antioxidant and anti-inflammatory properties, are noted to be considered [34, 35].
- **Inflammation:** Chronic inflammation can exacerbate autoimmune conditions like vitiligo [36, 37]. Certain foods can promote inflammation, while others have anti-inflammatory properties. Identifying and avoiding pro-inflammatory foods can be a helpful strategy [38]. Processed foods, refined sugars, and unhealthy fats (trans fats and saturated fats) are to be avoided [39]. Further, food that may cause allergies, as these can trigger inflammation, are not to be taken by the vitiligo victims [39]. Some individuals found that avoiding gluten or dairy products reduces inflammation [40].
- **Nutrient Deficiencies:** Some studies suggest that individuals with vitiligo may have deficiencies in certain nutrients, such as Vitamin D, Vitamin B12, folic acid, copper, zinc, and iron [32]. Addressing these deficiencies through diet or supplementation may support melanocyte function and overall health.

- **Vitamin B12 and Folic Acid:** These nutrients play a role in melanocyte function [32].
- **Antioxidants:** Supplements like Vitamin C, Vitamin E, and alpha-lipoic acid may help reduce oxidative stress [41].
- **Minerals:** Copper, zinc, and selenium are essential for various bodily functions, including immune function and pigment production [42].

B-2: Gut Health: The gut microbiome plays a crucial role in immune function [43]. An imbalanced gut microbiome (dysbiosis) can contribute to inflammation and autoimmune responses [44]. Diet significantly influences the composition of the gut microbiome are pro-inflammatory foods, like processed foods, refined sugars, and unhealthy fats (trans fats and saturated fats) [45-47]. Potential food allergies can trigger inflammation, also [48, 49].

• Prioritize Nutrient-Dense Foods:

- Whole, unprocessed foods that provide essential vitamins and minerals.
- Lean protein sources like fish, poultry, beans, and lentils.
- Healthy fats from sources like olive oil, avocados, and fatty fish.

B-3: Support Gut Health:

- Probiotic-rich foods like yogurt, kefir, sauerkraut, and kimchi promote a healthy gut microbiome.
- Prebiotic foods like garlic, onions, bananas, and asparagus feed beneficial gut bacteria.
- Fiber-rich foods help to create a balanced gut environment.

B-4: Supplements are Necessary:

Addressing nutritional deficiencies through diet alone can sometimes be challenging. In such cases, supplementation may be beneficial. However, it's crucial to consult with a healthcare professional or registered dietitian before starting any new supplements. Self-treating with supplements can be harmful. Potentially helpful supplements include: vitamin D, vitamin B12, folate, zinc, or copper [32, 39]. These supplements do not reverse vitiligo but can improve overall health, support immune function, and contribute to skin resilience. Any supplementation should be medically supervised, age-appropriate, and balanced with dietary intake to prevent overdosing or interactions.

C: Diet for Children with Vitiligo [32, 50]:

Children often respond better to lifestyle patterns rather than strict regimens, however:

- A variety of fruits and vegetables are recommended.
- It is better to avoid strict diet rules unless medically

necessary.

- Any supplements should be used upon medical advice.

D: The Importance of Personalized Approach:

- Working with a healthcare professional or registered dietitian:** They can assess your individual needs, identify potential nutrient deficiencies, and develop a tailored dietary plan [51-53].
- Keeping a food diary:** This can help you track your food intake and identify potential triggers [51-53].
- Monitoring your symptoms:** Pay attention to how your skin reacts to different foods and supplements.
- Considering food sensitivity testing:** If you suspect food sensitivities, testing may help you identify specific foods to avoid.

DISCUSSIONS

Vitiligo is an autoimmune condition that typically requires medical treatment, however, as of yet, there is no such cure available [1-6]. Though diet one cannot cure vitiligo but it can manage the disease through the antioxidant and anti-inflammatory food constituents present in them [8]. However, there's no one-size-fits-all "vitiligo diet." A balanced, nutrient-rich diet is generally recommended [8]. Stress management, sun protection, and regular exercise are also important for managing vitiligo [54].

Food allergies or sensitivities can trigger inflammation and potentially worsen vitiligo symptoms. Identifying and avoiding these triggers can be helpful [55]. While food supplements can be beneficial to manage vitiligo, it is crucial to consult with a healthcare professional before hand to ensure that they are safe and appropriate for the individual. Since stress can exacerbate vitiligo, certain foods and nutrients, such as, those are rich in magnesium and B vitamins, may help support stress management. Therefore, a balanced diet, coupled with stress-reduction techniques, is important. Improving gut health through diet can help vitiligo. Probiotic-rich foods, prebiotic foods, and fiber-rich foods are good in this sense. Limiting processed foods and refined sugars is also important to consider in your diet.

In brief, for the vitiligo victims, the key nutrients include vitamins A, C, D, and E, B vitamins (especially B12 and folic acid), and minerals like copper, zinc, and selenium. A balanced diet rich in these nutrients is recommended.

Abbreviations

TRP-1: Tyrosinase-related protein 1,

TRP-2: Tyrosinase-related protein 2, (Dopachrome tautomerase)

MITF: Microphthalmia-associated Transcription Factor."

MC1-R: Melanocortin 1 Receptor."

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Conflict of interests

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Consent for publications

The author agreed to submit this paper for publication.

Ethical Approval

Not applicable

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