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The Role of Antioxidants in Skin Health and Disease Prevention

Hamna Aziz[1], Arshad Nawaz[2], Ahmad Ramzan Noor[1], Sibgha Shafqat[1], Maria Ashfaq[1*]

1. Department of Human Nutrition and Dietetics, Muhammad Nawaz Sharif University of Agriculture, Multan.
2. Faculty of Veterinary and Animal Science, Muhammad Nawaz Sharif University of Agriculture, Multan.

*Corresponding Author: **mariaashfaqo32084@gmail.com**

ABSTRACT

The significant role of antioxidants in maintaining skin health and preventing disease is highlighted in recent research. However, the major contributor to synthesis of free radicals and reactive oxygen species (ROS) is observed in Visible light (VL) exposure and ultraviolet (UV) radiation. These reactive species trigger a cascade of inflammatory responses, DNA damage, and melanogenesis. These reactive species can lead the skin in conditions like photoaging, dark spots, and melasma, particularly Fitzpatrick skin types. Both endogenous and exogenous antioxidants play a crucial role in counteracting these effects. Moreover, glutathione, α-tocopherol, vitamin C, and compounds like licochalcone are key oxidants That help to mitigate oxidative stress and maintain skin integrity. These antioxidants can defuse free radicals and back the skin's natural defense mechanisms augmenting many protective effects. Thoughtful the relationship between oxidative stress and skin health can emphasize the status of antioxidant-rich skincare regimens and dietary supplements that prevent and manage skin damage caused by environmental factors.

1. Introduction:

Efforts are under-processing to understand better skin health and focusing on mechanisms like melanogenesis, inflammation, and DNA damage that are influenced through visible light (VL) [11]. However, the VL-induced creation of free activists and responsive oxygen species (ROS) due to a crucial factor triggers a force of actions to alter skin well-being like the orientation of proinflammatory cytokines, matrix metalloproteinases, and melanogenesis [1]. Previously it was considered that UV radiation is the sole source of these reactive species although recent studies have shown that VL significantly contributes to their production by activating inflammatory cytokines and matrix metalloproteinases [2]. It was examined that approximately 50% of ROS generation is due to VL revelation by ex vivo skin explant studies and associated with 4% from UV-B and 46% from UV-A exposure [12]. Moreover, the skin barrier may be damaged through VL-induced ROS and reactive nitrogen species (RNS) that can lead to conditions like photoaging, hyperpigmentation, and melasma mostly in Fitzpatrick skin types [3]. Additionally, the bystander damages the healthy skin cells produced through ROS generation and alters endogenous antioxidant levels which are crucial for preventing further skin damage. VL-induced ROS and RNS can source radiation-independent pyrimidine dimer development by the melanin-containing cells [4]. However, UV radiation influences the wide amount of free radical formation and been explored that VL and infrared radiation (IR) can induce approximately 50% of free radicals. Excessive free radical generation and entrancing of the skin's value leads to DNA injury and increased melanogenesis [11].

This entrance of free radicals and reactive species elevates pro-inflammatory treats and tissue-destructive enzymes like atmosphere metalloproteinases which result in DNA and tissue harm linked with photoaging and melanogenesis. Recently, another source of free radicals induction is acknowledged as the Opsin-3 receptor [5]. VL-induced melanogenesis is the greatest definite in FSTs IV to VI depending upon the total dose with transient and long-lasting pigmentation in human skin [12]. The VL exposure is proposed to be photochemical due to immediate pigmentation and on the other side, the late skin color consequences after neo-melanogenesis. In FSTs IV to VI, initiating reactions that increase melanogenesis enzymes like tyrosinase and dopachrome tautomerase are activated through the OPN3 melanocyte sensor by VL exposure. However, the establishment of a protein compound amid tyrosinase also dopachrome tautomerase is induced by VL and maintains tyrosinase action leading to hyperpigmentation. Generally, VL-induced reactive species activate in many ways terminating in DNA harm via ROS and RNS [4].

2. The Impact of Antioxidants on Skin Protection

Oxidative stress initiates multiple pathways from both UV and VL that impact skin health. The skin from environmental stimuli is protected by natural endogenous antioxidants that safeguard the skin upgrading to defense. These antioxidants are glutathione, uric acid, α-tocopherol, squalene, and coenzyme. However, this protective system is overwhelmed by excessive UV and VL exposure which leads to DNA damage, hyperpigmentation, and melanogenesis [11]. Supplemental antioxidants and radical quenchers can influence the skin's endogenic arrangement. However, more than a few exogenic antioxidants and free radical searchers are recognized like vitamin E (α-tocopherol), vitamin C, licochalcone A, and diethylhexyl syringylidene malonate. Vitamin E inhibits ROS production during lipid oxidation and free radical propagation, protects membrane phospholipids and fatty acids, and inhibits UV-A–induced DNA damage in keratinocytes [13]. The skin contains vitamin C in large concentrations but is depleted by oxidative stress, making its antioxidant activity more effective when combined with vitamin E. Licochalcone A is a basis cutting of Glycyrrhiza inflata and is a strong antioxidant that inhibits UV-induced ROS cohort also activates Nrf2 pathway by regulating cytoprotective genes [12].

3. Function of Antioxidants in the Human Body

The mitochondrial activity offers an increase in Reactive oxygen species (ROS) as a by-product and contributes to offering oxidative stress within cells. ROS facilitates intracellular signaling at low, levels, and cell death may occur while at high levels. The accumulated ROS are managed by the robust antioxidant defense system. However, the NADPH is produced over the pentose phosphate trail and extra causes and serves by way of a substratum for either GSH renewal or ROS manufacture. The red blood cells are protected through glutathione-S-transferase and glucose-6-phosphate dehydrogenase are usual antioxidant enzymes that neutralize oxidative metabolites [8].

The enzymatic and non-enzymatic mechanisms regulate ROS in the human body and neutralize them over antioxidant action. Moreover, the enzymatic antioxidants are superoxide dismutase (SOD), catalase (CAT), and glutathione peroxidase and on the other side, non-enzymatic antioxidants include bilirubin and albumin. When the exogenous antioxidants from food, supplements, or pharmaceuticals that are necessary to protect against oxidative stress are exposed to high ROS levels. The vital exogenic antioxidants comprise phenolic compounds, carotenoids, vitamins C and E, and minerals like selenium and zinc. The effects of antioxidant compounds in plant extracts are evaluated through in vitro methods on the blood serum and other media [9].

Plants rich in phenols and flavonoids to supply antioxidants are crucial for the prevalence of chronic diseases. For example, beta-carotene is a fat-soluble antioxidant and is initiated in numerous orange-colored fruits and vegetables like apricots, pumpkins, and mangoes. This helps to secure free radicals and supports skin health. Furthermore, abundant green vegetables alike spinach and kale are also high in beta-carotene and contain lutein which is beneficial for eye health. Another potent antioxidant is lycopene originates in various vegetables and is a significant dietary antioxidant in the American diet. Vitamins are essential for normal bodily functions and have been extensively studied for their health benefits. Vitamin A derived from beta-carotene and exists in three arrangements are retinol (vitamin A1), vitamin A2 (3,4-didehydroretinol), and vitamin A3 (3-hydroxy-retinol) found in foods like sweet potatoes, carrots, milk, egg yolk, and mozzarella cheese. Vitamin E is mainly alpha-tocopherol and is present in almonds, wheat germ oil, safflower oil, corn oil, soybean oil, mango, jujube, and broccoli. It has been shown to reduce pneumonia incidence in the elderly, modulate IL-2 and IL-10 genes, and decrease respiratory infections. Vitamin C is mostly found in fruits, vegetables, cereals, beef, chicken, and fish, and scavenges superoxide and hydroxyl radicals and vitamin E prevents lipid peroxidation in cellular membranes [10].

4. Oxidative stress affects thyroid cancer

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Thyroid cancer (TC) accounts for approximately 1% of altogether cancer conditions and is categorized into three main histologic kinds. The first is Differentiated TC which originates as follicular cells, the second is papillary (PTC) and the third is follicular (FTC) type. Moreover, the incidence of DTC has increased in various people worldwide in the past. In many populations worldwide the incidence of DTC has been increased and is likely because of additional recurrent use of ultrasound investigations and fine-needle aspiration biopsies (FNAB) [6]. In 2020, about 586,000 people were affected globally by TC with 43,800 new cases stated in the United States in 2022. Despite this, DTC can happen at all ages and the average age of analysis is around 50 years old. Furthermore, it has occurred seven times more commonly in females than males. In 2021, a significant increase in TC-related results in mortality with an overall annual rate of 1.1%. There is an annual mortality rate was 2.9% in PTC at the advanced stage [7]. Recently, the genetic and metabolic mechanisms underlying progress in the danger issues and managing of TC like radioactive iodine therapy. Moreover, the management and prognosis of TC can be understood through the involvement of specific genetic mutations. However, therapeutic management guidelines are particularly for I-131 treatment and are efficient yearly. They contain uncertainties and need correction and explore the metabolic pathway disruptions that contribute to the development of DTC [6].

5. Conclusion:

In conclusion, the role of antioxidants is crucial in maintaining skin health and preventing disease. Furthermore, the oxidative stress induced by UV and visible light (VL) exposure. Recent studies showcase the VL contribution to free radicals and reactive oxygen species (ROS) production. The exacerbating skin conditions like photoaging, hyperpigmentation, and melanogenesis are mostly in darker skin types. However, these effects are mitigated through antioxidants, endogenous and exogenous, which play a vital role in mitigating these effects. Natural antioxidants in the skin are glutathione and α-tocopherol which protect against oxidative damage but can be overwhelmed by excessive environmental exposure. Supplementing with exogenous antioxidants like vitamins C and E, licochalcone A, and other plant-derived compounds has shown efficacy in neutralizing free radicals, reducing inflammation, and enhancing skin resilience.

References

[1] Godic A, Poljšak B, Adamic M, Dahmane R. The role of antioxidants in skin cancer prevention and treatment. Oxidative medicine and cellular longevity. 2014;2014(1):860479.
[2] Michalak M. Plant-derived antioxidants: Significance in skin health and the ageing process. International journal of molecular sciences. 2022 Jan 6;23(2):585.
[3] Evans JA, Johnson EJ. The role of phytonutrients in skin health. Nutrients. 2010 Aug 24;2(8):903-28.
[4] Pandel R, Poljšak B, Godic A, Dahmane R. Skin photoaging and the role of antioxidants in its prevention. International Scholarly Research Notices. 2013;2013(1):930164.
[5] Sen S, Chakraborty R. The role of antioxidants in human health. InOxidative stress: diagnostics, prevention, and therapy 2011 (pp. 1-37). American Chemical Society.
[6] Muzza M, Pogliaghi G, Colombo C, Carbone E, Cirello V, Palazzo S, Frattini F, Gentilini D, Gazzano G, Persani L, Fugazzola L. Oxidative stress correlates with more aggressive features in thyroid cancer. Cancers. 2022 Nov 28;14(23):5857.
[7] Buczyńska A, Sidorkiewicz I, Rogucki M, Siewko K, Adamska A, Kościuszko M, Maliszewska K, Kozłowska G, Szumowski P, Myśliwiec J, Dzięcioł J. Oxidative stress and radioiodine treatment of differentiated thyroid cancer. Scientific reports. 2021 Aug 24;11(1):17126.
[8] Yadav A, Kumari R, Yadav A, Mishra JP, Srivatva S, Prabha S. Antioxidants and its functions in human body-A Review. Res. Environ. Life Sci. 2016 Nov;9(11):1328-31.
[9] Khan I, Ahmad S. The impact of natural antioxidants on human health. Functional Food Products and Sustainable Health. 2020:11-24.
[10] Wu D, Meydani SN. Antioxidants and immune function. InAntioxidant Status, Diet, Nutrition, and Health 2019 Oct 16 (pp. 370-400). CRC Press.
[11] Lim HW, Kohli I, Ruvolo E, Kolbe L, Hamzavi IH. Impact of visible light on skin health: The role of antioxidants and free radical quenchers in skin protection. Journal of the American Academy of Dermatology. 2022 Mar 1;86(3):S27-37.
[12] Fernández-García E. Skin protection against UV light by dietary antioxidants. Food & function. 2014;5(9):1994-2003.
[13] Dunaway S, Odin R, Zhou L, Ji L, Zhang Y, Kadekaro AL. Natural antioxidants: multiple mechanisms to protect skin from solar radiation. Frontiers in pharmacology. 2018 Apr 24;9:392.