

A review on nutrition and skin aging

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Background: Skin reflects the general health status and is not an exception in the process of aging. Intervention studies indicate that it is possible to delay skin aging and improve skin conditions through diet-based anti-aging strategies. The purpose of the current work was to review recent existing literature regarding the role of nutrition, for and against skin aging processes.

Method: This review provides updates on the effects of nutrition strategies on skin aging developed during 2008-2014. Databases such as the ISI web of science, PubMed, Scopus and Google Scholar were investigated.

Result: The most important role of nutrition on skin aging is by restricting the generation or activation of reactive oxygen species (ROS) which is considered as the main cause of extrinsic skin aging. Excess sugar in daily diet accelerates aging processes through the production of advanced glycation end products that inhibit proper repair of collagen fibers. Monounsaturated and omega-3 polyunsaturated fatty acids have inverse association with severe photoaging. Antioxidants such as vitamins C, A, E, carotenoids, flavonoids and botanical antioxidants such as resveratrol, curcumin and green tea polyphenols effectively decelerate this process. Zinc, selenium and copper are coenzymes of metallothioneins and glutathione that reduce intracellular oxidative stress and result in skin protection.

Conclusion: The link between nutritional issues and skin aging is an interesting but conflicting subject that requires many interventional studies. Intracellular antioxidant mechanisms are the most effective protection against skin aging.

Keywords: antioxidants, nutrition, reactive oxygen species, skin aging, vitamins

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INTRODUCTION

Aging is considered as the consequence of both genetic and environmental influences. The latter includes physical and psychological stress, ionizing and ultraviolet radiation besides inappropriate nutrient intake. Skin is not an exception in the process of aging and it results from genetic, environmental and endocrinologic factors as well ¹.

Skin aging has two clinically independent

processes: 1) Intrinsic skin aging which occurs as a result of chronological aging and clinically expresses as smooth, dry, and thinned skin which is inevitable and time dependent. 2) Extrinsic skin aging which occurs as a result of sun exposure, smoking, pollution, sleep deprivation and poor nutrition includes signs like photo-damage, wrinkles, pigmented lesions, actinic keratosis and patchy hypopigmentation ¹. Moreover, photo-damage, endocrinologic changes also have influences on the skin. Menopause is associated with cellular

repository of iron and increases iron in the skin which contributes to the manifestation of accelerated skin aging and photoaging. Previous studies have suggested that the use of estrogen prevents skin dryness and wrinkling. Therefore, hormone replacement therapy (HRT) in postmenopausal women protects the skin against age-associated dermatologic conditions ².

Skin reflects the general health status and aging. The best way to limit the extrinsic skin aging processes is by "prevention". The triple principles for skin aging prevention include sunscreen, balanced nutritional diet (including antioxidants) and total body care (including calorie restriction and exercise) ². Focusing on the role of nutrition, skin functions and healthy appearance depend on a sufficient supply of essential nutrients. Intervention studies indicate that it is in fact possible to manipulate and delay skin aging and to improve skin conditions through supplementation with selected nutritional supplements. It has also been shown that diet-based anti-aging strategies are most effective when directed against extrinsic skin aging ³.

The most important role of nutrition is through antioxidants such as vitamins E, C, A, carotenoids, tocopherols and flavonoids ^{4,5}. Reactive oxygen species (ROS) that are mainly the result of ultraviolet (UV) radiation, activate a signaling path in cells which induces the expression of anti-oxidative enzymes such as superoxide dismutase and catalase that have cell-protective and anti-aging effects and protect the cell against harmful levels of ROS in cells.

The objective of this review was to determine the relationship between nutrition and skin aging which has been investigated repeatedly based on the belief that diet can directly determine skin condition. The purpose of this study is to review recent existing literature regarding the role of nutrition-based anti-aging strategies against skin aging processes.

MATERIALS AND METHODS

This review provides literature focusing on the effects of nutrition strategies on skin aging developed during 2008-2014. Databases such as the ISI web of science, PubMed, Scopus and Google Scholar were investigated.

DISCUSSION

Carbohydrates

Excess amount of sugar in daily diet results in covalent cross-linking between two collagen fibers, which renders both of them incapable of easy repair. Glucose and fructose link the amino acids present in the collagen and elastin that support the dermis, produce advanced glycation end products which inhibit proper repair of collagen fibers ⁶.

Lipids

Previous researches have indicated that monounsaturated fatty acids (MUFAs) reduce oxidative stress, insulin resistance and inflammatory processes, thereby protecting the skin from extrinsic aging ⁷⁻⁹. The main sources of MUFA include olive, avocado and sesame. More recently, the role of polyunsaturated fatty acids (PUFAs) such as α -linoleic acid (ALA), eicosapentaenoic (EPA) and docosahexaenoic (DHA) acids have been investigated and an inverse association with severe photoaging have been reported ¹⁰. Honey bee royal jelly which mainly contains medium-chain aliphatic fatty acids, saturated and monounsaturated fatty acids besides sterols have been indicated to be useful in skin-aging protection and immune system modulation. These evidences suggest that the health protecting properties of royal jelly can be due to lipid actions ¹¹.

Fluid

The elderly have less elastic skin and more wrinkles. Drier skin shows more wrinkles and deeper furrows, with wider intervals ¹². Drinking fluids throughout the day ensures proper hydration of the body and helps in reducing skin dryness. Experts usually recommend the drinking of 6-8 glasses of water a day. Moreover, drinking too much fluid 2-3 h before going to bed is not recommended. This may cause puffiness and excessively stretchy skin ¹³.

Daily Energy Intake

Calorie restriction without malnutrition, delays the onset of aging in animal models ¹⁴. Increased values for collagen and elastic fibers, fibroblasts, and

capillaries and prevention of age-related increase in the depth of the epidermis, dermis, and fat layer were observed in skin samples from calorie restricted rats¹⁵. This might be a result of several causative processes such as oxidation status, DNA repair, apoptosis, alteration in hormone metabolism and signaling¹⁶.

Vitamin A

Vitamin A is critical for the normal life cycle of skin cells¹³. Vitamin A deficiency causes the skin to become dry, fragile and prone to wrinkles. Chemically stable ester derivatives of vitamins A, C and E have become a subject of interest due to their role in the satisfactory results obtained in skin aging treatments¹⁷. β -carotene is an endogenous photoprotector, and its efficacy in the prevention of UV-induced erythema formation, has been shown in various studies^{18,19}. β -carotene and lycopene are usually the dominating carotenoids in human blood and tissues and are known to modulate skin properties and protect the skin against sunburn (solar erythema) by increasing the basal defense against UV-mediated damage²⁰. The topical retinoid treatments inhibit the UV-induced breakdown of collagen and protect against UV-induced decreases in procollagen expression^{21,22}.

Vitamin B

Vitamin B₁ boosts circulation in the body and gives the skin a certain glow. Contraceptive pills induce vitamin B₁ deficiency. Egg yolks, nuts and raisins are great sources of vitamin B₁. Niacin from vitamin B₃ helps the skin to receive plenty of oxygen, which prevents the development of acne among other benefits. Niacin-rich foods include tomatoes, broccoli and carrots. The B-vitamins, niacinamide and panthenol, have been shown to reduce many signs of skin aging, including hyperpigmentation and redness¹⁷.

Vitamin C

Vitamin C is an essential part of skin health both as a small molecular weight antioxidant and as a critical factor for collagen synthesis²³. Vitamin C, iron and copper are usually discussed together because all three are important for the synthesis

of collagen, a key structural protein in the skin¹³. Most fruits are good sources of vitamin C. Fruits should become a staple addition to everyday diet. Vegetables like broccoli, cauliflower, tomato, Brussels sprouts and cucumber are also good sources of this vitamin²³.

Vitamin E

Vitamin E is a well known vitamin that is essential for healthy skin. This is because vitamin E is an effective antioxidant against free radicals. Appearance of age spots, wrinkles, stretch marks and lines are reduced by applying products rich in vitamin E. Vitamin E can also be found in foods like olives, sunflower seeds, peanuts, almonds, wheat germ and leafy greens²³. Products containing alpha-tocopherol (vitamin E), L-ascorbic acid (vitamin C), retinol (vitamin A), and niacinamide (vitamin B₃), are effective for the treatment of photoaging.

Iron

Similar to oxygen, iron can be toxic and it makes the aging process more progressive. Oxidative damage of iron might be the result of ROS generation such as hydroxyl radicals due to sun exposure. Excess iron in the skin, when combined with UV radiation, acts as oxidative product and plays a key role in photoaging²⁴. Since women in menopause age do not lose iron through menstruation, accelerated skin aging and photoaging after menopause results from increased cutaneous iron²⁵. This harmful effect of excess cutaneous iron raises the hypothesis that topical iron chelator treatments, prevent the toxic effects of UV radiation by scavenging free iron²⁶. Some studies have indicated the individual and social benefits of regular blood donation²⁴.

Zinc

Changes in appearance of the skin which mainly relate to hyperpigmentation and wrinkling caused by age, is a major problem. It has been previously confirmed that prevention of ROS generation improves hyperpigmentation and wrinkling. It is believed that zinc induces metallothioneins (MTs) and glutathione and leads to more clearance of intracellular ROS and reduced oxidative stress.

Various compounds of zinc and other biomolecules have been tested in several studies aiming to evaluate the efficacy of MT synthesis ²⁷.

Selenium

Intracellular anti-oxidative defense contains MTs such as glutathione peroxidase and superoxide dismutase that mainly include trace elements such as selenium, zinc and copper. A study in 1993 showed increased synthesis and activity of glutathione peroxidase by adding sodium-selenite to the culture of human fibroblasts, thereby increasing the survival of UV-irradiated cells ²⁸. Recent studies focused on different products containing selenium and one of them indicated significantly increased collagen type-I and decreased fibronectin synthesis in the presence of selenium ²⁹. Treatment with topical antioxidants such as selenium can prevent and even reverse skin photo-damage as well ³⁰.

Probiotics

Similar to the gut microflora, the skin's microbiota plays a beneficial role. The possibility to modulate the microbiota more selectively is highly interesting. Probiotics can help preserve skin homeostasis by modulating the skin immune system ^{31,32}.

Botanical Antioxidants

Resveratrol which is a natural polyphenol in the skin of grapes (but not in the flesh) has anti-inflammatory, antioxidative and anti-collagenase activities ^{33,34}. Curcumin induces cellular stress responses in skin fibroblasts and green tea polyphenols protect the human skin from cutaneous signs of photoaging ^{35,36}.

Topical Antiaging Nutrients

Four groups of topically applied substances are able to reverse the degenerative skin changes seen with aging by stimulating the synthesis of collagen and elastin fibers, they are as follows ³⁷:

1. Avocado and soybean oils
2. Vitamin A derivatives
3. Alpha-hydroxy acids (AHAs)
4. Extracts of Aloe vera

CONCLUSION

The effect of nutrition on the process of skin aging is an interesting topic among many researchers in the scientific fields of dermatology and nutrition. This topic is very important as well, because nutritional modification is one of the best practical solutions to prevent or limit the intrinsic and extrinsic skin aging processes. Daily intake of antioxidants mainly from fruits and vegetables is considered to have beneficial effects on the scavenging of reactive oxygen species, thereby preventing skin photo-damage and aging. Whether diet influences the way skin ages or how it works, still remains a question that needs to be answered through several intervention studies.

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