Skin Effects of Antioxidants

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As other tissues, skin depends on an optimal supply with nutritive compounds. Dermal tissue benefits from dietary antioxidants capable of scavenging reactive intermediates generated under the condition of photooxidative stress. Micronutrients may also act as UV absorbers, or modulate signaling pathways elicited upon UV exposure. Based on their structural features, carotenoids, flavonoids, as well as vitamin E and vitamin C are suitable compounds for photo-protection in humans.

Intervention studies with carotenoid supplements or diets rich in carotenoids have shown that they contribute to systemic photoprotection ameliorating UV-induced erythema (sunburn). Following the ingestion of lycopene or tomato-derived products rich in lycopene, photo-protective effects have been demonstrated. After 10-12 wk of intervention a decrease in the sensitivity towards UV-induced erythema was observed in volunteers.

The consumption of a cocoa beverage high in flavanols over a period of 12 wk was also associated with a decreased sensitivity of skin against UV-induced erythema. No effects were measured with a cocoa drink low in flavanols. Photoprotection through individual dietary components in terms of sun protection factor is considerably lower than that achieved with topical sunscreens.

3,3'-Dihydroxyisorenieratene (DHIR) is an unusual carotenoid. The polyenic backbone is substituted with phenolic end groups which can be easily oxidized to the respective quinone. DHIR is found in the bacterium *Brevibacterium linens* used in the dairy industry for the production of red cheeses. The antioxidant activity of the compound exceeds that of other carotenoids like astaxanthin, cryptoxanthin, zeaxanthin or lutein. Mechanistically it reacts as a bifunctional radical scavenger because polyenic and phenolic substructures are part of the molecule. Its activity for singlet oxygen quenching is in the range of other polyenic carotenoids. In-vitro data suggest that it is an efficient photoprotective compound.

Little is yet known about the effects of micronutrients on skin texture, structure and microcirculation, parameters which are closely related to skin health and aging. Premature aging of the skin results in increased wrinkling and a loss of elasticity. Supplementation with dietary micronutrients may modulate skin structure and texture contributing to the resistance of skin to environmental stress and improving general parameters indicative for skin health.

Supplementation with an antioxidant mixture composed of carotenoids, vitamin E and selenium led to an increase of skin density and thickness. Also skin surface parameters regarding roughness and scaling were improved. Ingestion of high flavanol cocoa led to an increase in blood flow of cutaneous tissue, and to a significant increase in skin density and skin hydration. Skin thickness was elevated whereas transepidermal water loss was diminished. Evaluation of the skin surface showed a significant decrease of skin roughness and scaling in the high flavanol cocoa group.

Optimal supply of the skin with micronutrients increases basal defense of the skin against UV-irradiation, contributes to the maintenance of skin health and appearance and likely supports life-long protection against environmental damage.

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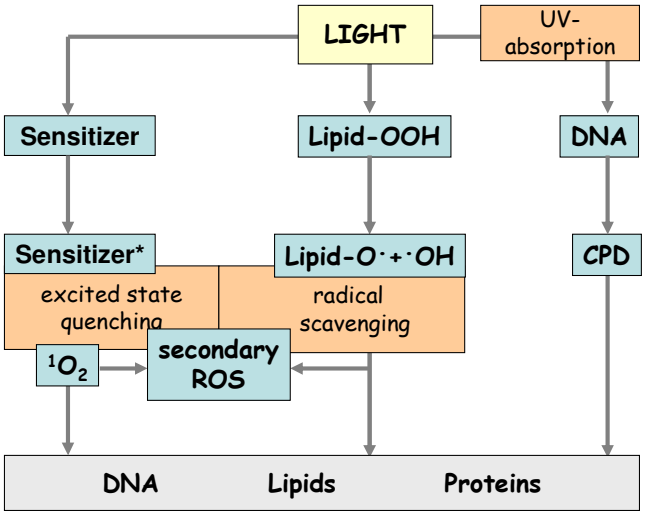
January 2012



Photooxidative stress and mechanisms of defence
Light interacts directly with the DNA and cyclobutane pyrimidine dimers (CPD) are formed. Upon interaction with light, lipid hydroperoxides are cleaved to yield radicals. After excitation of a sensitizer ROS are generated in either Type I (electron or hydrogen transfer) or Type II (energy transfer generating singlet oxygen $^1O_2$) photoreactions.
Photoprotection is provided by light absorption, scavenging of radicals, or quenching of excited states.