

## Immediate effects of UV radiation on the skin: modification by an antioxidant complex containing carotenoids

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**Background/Aims:** The ultraviolet (UV) portion of sunlight is involved in the induction and development of skin cancers against which a limited photoprotection may be provided by reduced time of exposure, clothing, and sunscreen applications. The concept of an effective, safe, systemic photoprotection will circumvent many of the shortcomings. The UV-induced oxidative stress is a cause of DNA damage and a few publications have shown, in humans, minimal benefits, if any, of the oral intake of antioxidant complex, contrasting with the large literature showing beneficial effects *in vitro* or in animal models.

**Methods:** We investigated, in 25 healthy individuals, the capacity of an antioxidant complex (AOC) – vitamins (lycopene,  $\beta$ -carotene,  $\alpha$ -tocopherol), selenium – to reduce UV-induced damages. The AOC was administered orally, daily during 7 weeks. Before and after irradiations, before and after the intake of the product, six parameters were studied: skin color by chromametry, minimal erythemal dose and, on skin

biopsies, sunburn cells (SBCs), p53 detected by immunohistochemistry, pigmentation index, and levels of lipoperoxides (thiobarbituric acid reaction).

**Results:** After the oral intake of AOC, we observed an elevation of the actinic erythema threshold (+20%,  $P = 0.01$ ) and a general reduction of the UV-induced erythemas, a reduction of the UV-induced p53 expression ( $P < 0.05$ ) and of SBCs ( $P < 0.01$ ), and a parallel reduction of the lipoperoxide levels ( $P < 0.01$ ). The pigmentation was increased ( $P < 0.01$ ).

**Conclusion:** After the oral intake of an antioxidant complex, many parameters of the epidermal defense against UV-induced damages are significantly improved. The oral intake of AOC could provide a safe, daylong and efficient complement to photo-protective measures provided by topical and physical agents and may contribute to reduce the DNA damages leading to skin aging and skin cancers.

**Key words:** antioxidant; carotenoids; clinical trial; melanin; photoprotection.

Ultraviolet radiation (UVR), and specifically UVB radiation, induces erythema, which may be followed by pigmentation and thickening of the epidermis (1). The first cutaneous events induced by UV exposure are the direct consequences of absorption of photons by cellular DNA, and of oxidative stress induced by a number of indirect reactions linked mostly to the absorption of UVA radiation by cellular chromophores (2). The oxidative stress is due to the production of free radicals and reactive oxygen species, leading to lipoperoxidation of membranes, and also to oxidative photoproducts within the DNA (3). Direct and indirect lesions to the DNA need to be repaired before cell division, in order to reduce or abolish mutations and carcinogenicity. It has been

shown that the sun-protected buttock skin of a normal subject, after exposure to sun-simulated UVR (SSR), expressed p53, p21<sup>waf1/Cip1</sup> and bax, ultimately generating apoptotic cells in dose–response amounts. Furthermore, the UV-induced stress was responsible for lipoperoxidation. The neomelanogenesis contributed to the hyperpigmentation as a later event (4).

Protective substances like direct antioxidants, membrane stabilizers, reactive oxygen species quenchers, or trace elements necessary for the enzymatic machinery to clear hydroperoxides, all act to limit UV-induced damages to the genome in the epidermis (5). Numerous studies, in experimental animals and in humans, have demonstrated, using artificial or natural