

Human Nutrition and Metabolism Research Communication

Supplementation with β -Carotene or a Similar Amount of Mixed Carotenoids Protects Humans from UV-Induced Erythema

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Ulrike Heinrich, Christine Gärtner,* Mathilde Wiebusch, Olaf Eichler,^{†1} Helmut Sies,^{†1} Hagen Tronnier and Wilhelm Stahl^{†2}

Institut für Experimentelle Dermatologie, Universität Witten-Herdecke, D-58455 Witten, Germany, *Cognis Deutschland GmbH & Co. KG, Nutrition and Health, D-40551 Düsseldorf, Germany and [†]Institut für Physiologische Chemie I and Biologisch-Medizinisches Forschungszentrum, Heinrich-Heine-Universität Düsseldorf, D-40001 Düsseldorf, Germany

ABSTRACT Carotenoids are useful oral sun protectants, and supplementation with high doses of β -carotene protects against UV-induced erythema formation. We compared the erythema-protective effect of β -carotene (24 mg/d from an algal source) to that of 24 mg/d of a carotenoid mix consisting of the three main dietary carotenoids, β -carotene, lutein and lycopene (8 mg/d each). In a placebo-controlled, parallel study design, volunteers with skin type II ($n = 12$ in each group) received β -carotene, the carotenoid mix or placebo for 12 wk. Carotenoid levels in serum and skin (palm of the hand), as well as erythema intensity before and 24 h after irradiation with a solar light simulator were measured at baseline and after 6 and 12 wk of treatment. Serum β -carotene concentration increased three- to fourfold ($P < 0.001$) in the β -carotene group, whereas in the mixed carotenoid group, the serum concentration of each of the three carotenoids increased one- to threefold ($P < 0.001$). No changes occurred in the control group. The intake of either β -carotene or a mixture of carotenoids similarly increased total carotenoids in skin from wk 0 to wk 12. No changes in total carotenoids in skin occurred in the control group. The intensity of erythema 24 h after irradiation was diminished in both groups that received carotenoids and was significantly lower than baseline after 12 wk of supplementation. Long-term supplementation for 12 wk with 24 mg/d of a carotenoid mix supplying similar amounts of β -carotene, lutein and lycopene ameliorates UV-induced erythema in humans; the effect is comparable to daily treatment with 24 mg of β -carotene alone. *J. Nutr.* 133: 98–101, 2003.

KEY WORDS: • sunburn • skin carotenoids • β -carotene • lycopene • lutein

Supplementation with β -carotene or the consumption of a carotenoid-rich diet provides moderate protection from UV-induced erythema (1–5). In all of the studies showing efficacy, supplementation was for periods longer than 10 wk and the doses ranged from 15 to 180 mg/d.

The protective effects of carotenoids from UV-induced lesions are ascribed to their antioxidant activities including scavenging reactive oxygen species generated in photooxidative processes. However, at higher levels, prooxidant reactions have been observed when carotenoids were applied in vitro (6–8). Irradiation of fibroblasts with UV light in the presence of high amounts of β -carotene increases lipid peroxidation (8) and stimulates the expression of heme oxygenase-1 and interleukin-6 (9,10).

Concerns about the safety of supplementation with higher dosages of β -carotene has been raised on the basis of the results of two intervention trials in individuals at high risk for lung cancer (11,12), in which β -carotene was applied (20 and 30 mg/d) alone or in combination with α -tocopherol or retinol for several years. In the α -tocopherol, β -carotene supplementation study (ATBC) (11) of Finnish long-term heavy smokers (>1 pack/d for 35 y), a slightly higher cumulative incidence of lung cancer was observed in the group that received β -carotene than in the placebo control. An increased risk for lung cancer was also found in the CARET (β -Carotene and Retinol Efficacy Trial) study (12), which included smokers and asbestos workers. No elevated risk was observed in three other intervention trials performed in populations less at risk for lung cancer, supplementing β -carotene at comparable doses (13–15).

β -Carotene is supplied by a diet rich in fruit and vegetables, which also contains a number of other carotenoids including lycopene, the major carotenoid in the tomato, or xanthophylls like lutein, which is found in green leafy vegetables and in fruit (16). These carotenoids are also suitable antioxidants, and it has been shown that the consumption of tomato products rich in lycopene protects against UV light-induced erythema (2). In the present study we investigated whether a high dose of β -carotene or a mixture of carotenoids provides comparable sun protection.

SUBJECTS AND METHODS

Study design. Thirty-six healthy adults, all of skin type II and between 22 and 55 y old (12 men, 24 women) were randomly assigned to three groups of 12. The “ β -carotene group” ingested 24 mg of β -carotene per day, the source of which was a natural carotenoid extract from the alga *Dunaliella salina* (Betatene[®], Cognis Australia Pty. Ltd., Melbourne, Australia), provided as a soft gel

¹ O.E. is a Stipendiat of the “Graduiertenkolleg Toxikologie und Umwelthygiene” of the Deutsche Forschungsgemeinschaft, Bonn. H.S. is a Fellow of the National Foundation of Cancer Research, Bethesda, MD.

² To whom correspondence should be addressed.
E-mail: wilhelm.stahl@uni-duesseldorf.de