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Letter to the editor:

AN UPDATE ON THE POTENTIAL HEALTH BENEFITS OF CAROTENES

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Dear Editor,

Carotenes, which are yellow-orange pigments, are a class of related organic compounds classified as hydrocarbons, more specifically as terpenoids, with the molecular formula C40H56. Plants, fungi, and photosynthetic bacteria synthesize carotenes, while animals must obtain them as a dietary nutrient (Vrolijk et al., 2015). Plants are capable of synthesizing several isomers of carotene. Alpha-carotene (α-carotene) and beta-carotene (β-carotene) are the two primary isomers found in plants; other carotene isomers found in plants are gamma-, delta-, epsilon-, and zeta-carotene (γ, δ, ε, and ζ-carotene) (Hammond and Renzi, 2013). β-Carotene is the most common form of carotene in plants and can be found in yellow, orange, and green leafy vegetables and fruits. It is an important dietary resource and a precursor of vitamin A in humans (Haskell, 2012; Tang, 2012; Sommer and Vyas, 2012).

Carotenes show a range of biological activity and health benefits for animals, making it an interesting material for the pharmaceutical, food, and cosmetics industries. We have reviewed the most recent studies on carotenes and its biological and pharmacological activities (Table 1).

Table 1: Recent studies on carotene and its biological and pharmacological activities

Key message	Reference
A treatment strategy using vitamins E and C combined with β-carotene significantly improved cognitive function in elderly subjects, particularly with higher doses of β-carotene.	Li et al., 2015
The combination of antioxidants and UV filters in sunscreens was shown to reduce cutaneous penetration of UV light and improve sunscreen safety. β-Carotene alone, and a mixture of β-carotene and trans-resveratrol, was shown to reduce the delivery of light from four different UV filters to the stratum corneum and viable epidermis.	Freitas et al., 2015
Diets high in β-carotene and α-carotene were shown to be associated with a reduced occurrence of type 2 diabetes in generally healthy men and women.	Sluijs et al., 2015
Higher nonsupplemented serum β-carotene concentrations were shown to be negatively associated with all-cause mortality among asbestos-exposed individuals.	Hashim et al., 2015

Table 1 (cont.): Recent studies on carotene and its biological and pharmacological activities

Key message	Reference
β-Carotene showed an ameliorative effect against arsenic-induced toxicity in albino mice mediated by its antioxidant and antigenotoxic properties.	Das et al., 2015
A favorable effect of β-carotene on insulin sensitivity in obese individuals that could involve a positive regulation of adiponectin, either directly or via its provitamin A activity, was shown.	Ben Amara et al., 2015
β-Carotene was shown to be capable of exerting antioxidant activity in plasma without triggering pro-oxidant events in the brain, suggesting that it may be a safer nutritional supplement with provitamin A activity.	Schnorr et al., 2014
β-Carotene supraphysiological supplementation caused no toxic effects, showed a positive response in the modulation of blood pressure, and lowered serum malondialdehyde levels.	Fiorelli et al., 2014
Long-term supplemental α-tocopherol or β-carotene had no effect on liver cancer or chronic liver disease mortality over 24 years of follow-up.	Lai et al., 2014
The antioxidant action of β-carotene was shown to provide some beneficial effects in the treatment of lead poisoning.	Kasperczyk et al., 2014
β-Carotene was shown to be a potential chemotherapeutic reagent for the treatment of neuroblastoma, this effect being mediated by the regulation of the differentiation and stemness of cancer stem cells.	Lim et al., 2014
Resveratrol was suggested to regenerate β-carotene following its sacrificial protection of unsaturated lipids from oxidative stress, modeling the synergistic effects in cell membranes by combinations of dietary antioxidants.	Wang et al., 2014
β-Carotene was shown to represent an effective chemotherapeutic agent by regulating the invasion and metastasis of neuroblastoma via HIF-1α.	Kim et al., 2014
The radioprotective and antimutagenic activity of β-carotene was discussed, and its use by the population as a means of health protection was suggested.	Berti et al., 2014
The capacity of lycopene and β-carotene to inhibit cell proliferation, arrest the cell cycle in different phases, and increase apoptosis was shown, indicating them to be potential agents for biological interference with cancer. The effect was shown to be cell type-dependent.	Gloria et al., 2014
β-Carotene improved spermatogenesis defects in titanium oxide nanoparticle-treated mice. β-Carotene showed a potent protective effect against testicular toxicity, and was suggested to be clinically useful.	Orazizadeh et al., 2014
β-Carotene exerted antikeratopathy effects and ameliorated the corneal changes in diabetic rats via its hypoglycemic and antioxidant mechanisms.	Abdul-Hamid and Moustafa, 2014
β-Carotene supplementation in weanling mice was shown to be effective in enhancing mucosal IgA induction in the jejunum or ileum. The effects were shown to be mainly due to the rheumatoid arthritis-mediated immune response.	Nishida et al., 2014
A diet containing natural carotenoids, rich in 9-cis-β-carotene, was shown to have the potential to inhibit atherosclerosis progression, particularly in a high-fat diet regime.	Harari et al., 2013
β-Carotene and vitamin E in doses higher than the recommended daily allowance were shown to significantly increase mortality.	Bjelakovic et al., 2013
β-Carotene was shown to be a potential chemotherapeutic reagent for the treatment of neuroblastoma cancer stem-like cells. The results suggested that the targeting of cancer stem cells is a novel mechanism of β-carotene.	Lee et al., 2013
β-Carotene was shown to effectively protect against nicotine-induced teratogenesis in mouse embryos through its antioxidative, antiapoptotic, and anti-inflammatory activities.	Lin et al., 2013

Table 1 (cont.): Recent studies on carotene and its biological and pharmacological activities

Key message	Reference
Treatment with 9-cis-β-carotene significantly increased retinal function in patients with retinitis pigmentosa (RP) under the tested conditions, and may represent a new therapeutic approach for some patients with RP.	Rotenstreich et al., 2013
β-Carotene was shown to decrease cholesterol absorption in the intestine and increase cholesterol excretion into the feces without a direct effect on the expression of cholesterol metabolism genes.	Silva et al., 2013
β-Carotene was shown to affect the microenvironment of a tumor, thus providing further evidence for its anticancer effects.	Lim et al., 2013
β-Carotene supplementation was shown to prevent ethanol-induced liver damage by decreasing ethanol-induced oxidative stress and inhibiting apoptosis in the liver.	Peng et al., 2013

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